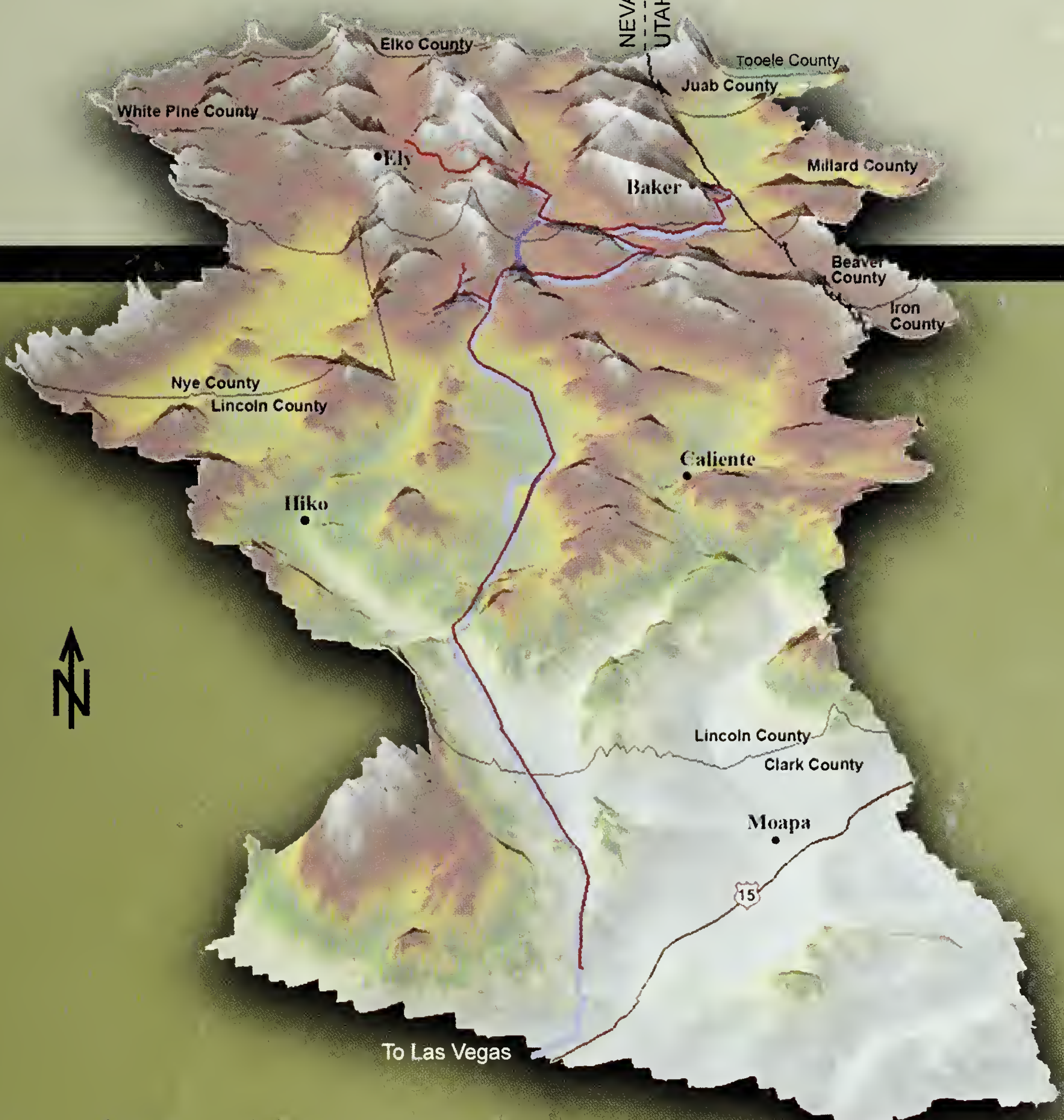
Clark, Lincoln, and White Pine Counties Groundwater Development Project Final Environmental Impact Statement

Book 1 of 2



Bureau of Land Management

August 2012
FES 12-33

Cooperating Agencies

Army Corps of Engineers
Bureau of Indian Affairs
Bureau of Reclamation
Central Nevada Regional Water Authority
Clark County, NV
Juab County, UT
Lincoln County, NV
Millard County, UT
National Park Service
Nellis Air Force Base
Nevada Department of Wildlife
State of Utah
Tooele County, UT
U.S. Fish and Wildlife Service
U.S. Forest Service
White Pine County

BLM
Nevada State Office

Mission Statement

The BLM's multiple-use mission is to sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations.

BLM/NV/NV/ES/11-17+1793

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Nevada State Office
1340 Financial Boulevard
Reno, Nevada 89502-7147
http://www.blm.gov/nv

In Reply Refer To:
2800 (NV910)
N-78803

August 2012

Dear Reader:

Enclosed is the *Clark, Lincoln, and White Pine Counties Groundwater Development Project Final Environmental Impact Statement* (Final EIS). The full text of the Final EIS including responses to comments on the Draft EIS is contained within the disk found inside the back cover of Book 2. You may also download the Final EIS from www.blm.gov/5w5c. The Bureau of Land Management (BLM) has prepared this Final EIS in response to a right-of-way (ROW) application submitted by the Southern Nevada Water Authority (SNWA) for construction and operation of a pipeline system and associated infrastructure to support the proposed future conveyance of groundwater to Las Vegas Valley from five hydrologic basins in east-central Nevada. Sixteen Cooperating Agencies have assisted the BLM in developing this Final EIS:

U.S. Forest Service	U.S. Fish and Wildlife Service	Clark County, NV
Nellis Air Force Base	National Park Service	Lincoln County, NV
Army Corps of Engineers	State Of Utah	White Pine County, NV
Bureau of Indian Affairs	Nevada Department of Wildlife	Juab County, UT
Bureau of Reclamation	Central Nevada Regional Water Authority	Millard County, UT
		Tooele County, UT

Some of the above Cooperating Agencies will be using the Final EIS in their decision-making process for other permits and licenses associated with the proposed project.

The BLM completed a Draft EIS that analyzed a conceptual plan of development submitted to BLM by SNWA, which included information about the proposed project. The Draft EIS was released to the public on June 10, 2011, with publication of a Notice of Availability (NOA) in the Federal Register. The NOA initiated a 90-day public comment period (extended for an additional 30 days) ending on October 11, 2011. Public meetings were held August 2, 2011 through August 18, 2011. The BLM received comments on the Draft EIS through more than 460 letters and emails (plus over 20,000 email action alert submissions). The BLM reviewed the comments and provided written responses in this Final EIS (included within Appendix H). Some comments resulted in modifications to text in the EIS. Substantive changes in the Final EIS are marked with a text bar in the margin. The Final EIS is a "full text" document that contains the entire EIS and supersedes the Draft EIS.

This Final EIS considers the expected environmental effects associated with granting the ROW across public land and subsequent construction and operation of SNWA's proposal. In addition to SNWA's proposal, seven alternatives including the No Action alternative also are presented and analyzed in the Final EIS. One additional alternative was prepared and analyzed specifically for this Final EIS. Specifics of associated future water development currently are unknown and, therefore, are treated programmatically and conceptually in the EIS. As part of the EIS process for this project, a comprehensive groundwater model was prepared. The model report was updated for the additional alternative and is included on a separate disk included with the Final EIS.

Although water rights, pumping rates, volume of water proposed for transport to the Las Vegas Valley, and the point of use of water proposed for transport across public land all are outside the jurisdiction of the BLM, these issues have been included in the analysis in this document. Water rights and pumping rates are under the purview of the Nevada State Engineer. Water distribution and use associated with the importation of water in the Las Vegas Valley have been addressed by local and regional planning agencies in accordance with Nevada Revised Statutes.

The purpose of this Final EIS is to document and disclose the expected environmental effects associated with the proposed project and seven alternatives. The BLM will use the Final EIS to render a decision on whether to grant a ROW or under what conditions the ROW should be granted. This Final EIS is not a decision document; however, BLM has selected a preferred alternative, which, at this time, would best accomplish the purpose and need of the proposed action while fulfilling BLM's statutory mission and responsibilities.

The *Clark, Lincoln, and White Pine Counties Groundwater Development Project Final Environmental Impact Statement* will be available for 30 days. A description of new or missed information within this Final EIS may be submitted within the thirty day availability period to:

Penny Woods, Project Manager
Bureau of Land Management
Nevada Groundwater Projects Office
Nevada State Office (NV-910.2)
1340 Financial Blvd
Reno, NV 89502
FAX: 775.861.6689
Email: nvgwprojects@blm.gov

The BLM will issue one or more records of decision (ROD) based on this Final EIS. The ROD(s) will not be issued until other agency permits and approvals have been finalized and their conditions of approval will be incorporated into the ROD(s). For more information, Please contact Penny Woods at 775.861.6466.

Environmental Impact Statement For the Clark, Lincoln and White Pine Counties Groundwater Development Project Right-of-Way

( ) Draft (X) Final

Lead Agency:	United States Department of the Interior Bureau of Land Management
Cooperating Agencies:	White Pine County, Nevada Lincoln County, Nevada Clark County, Nevada Juab County, Utah Tooele County, Utah Millard County, Utah Central Nevada Regional Water Authority Nevada Department of Wildlife State of Utah United States Air Force – Nellis Air Force Base United States Army Corps of Engineers United States Bureau of Indian Affairs United States Bureau of Reclamation United States Fish and Wildlife Service United State Forest Service National Park Service
Counties Directly Affected:	Clark, Lincoln and White Pine Counties, Nevada

Environmental Impact Statement Contact:

Penny Woods, Nevada Groundwater Projects Manager
Bureau of Land Management, Nevada State Office
1340 Financial Blvd
Reno NV 89502
775.861.6466

Date Filed with the Environmental Protection Agency: August 3, 2012

The Nevada State Office of the Bureau of Land Management (BLM) has prepared this Final Environmental Impact Statement (EIS) in response to a right-of-way (ROW) application filed by the Southern Nevada Water Authority (SNWA or applicant), a subdivision of the State of Nevada, to construct and operate the Clark, Lincoln, and White Pine Counties Groundwater Development Project (proposed action), a system of groundwater conveyance facilities including main and lateral pipelines, power lines, pumping stations, substation, pressure reduction stations, an underground water reservoir, a water treatment plant and associated ancillary facilities. The project would be located in northern Clark County, Lincoln County, and southeastern White Pine County, primarily within the 2,640-foot wide corridor established by the Lincoln County Conservation, Recreation, and Development Act (LCCRDA) under public law 108-424. Enacted on November 30, 2004, the LCCRDA designated utility corridors to be used for ROWs for roads, wells, pipelines, and other infrastructure needed for construction and operation of water conveyance systems in Lincoln and Clark Counties. The requested ROW extends beyond the northern boundary of the designated corridor into White Pine County in Spring and Snake valleys. For engineering feasibility reasons and/or to minimize environmental impacts, the requested ROW deviates from the corridor in a few locations in Clark and Lincoln Counties. The ROW would be processed in accordance with the Federal Land Policy and Management Act of 1976, which authorizes the Secretary of the Interior to grant ROWs across public lands administered by the BLM. In addition, the Southern Nevada Public Lands Management Act of 1998 also directs the Secretary of the Interior to issue ROWs in Clark County to units of local or regional government for pipelines and systems needed for the impoundment, storage, treatment, transportation, and distribution of water.

This Final EIS considers the expected environmental effects of granting of a ROW across public lands and subsequent construction and operation of the proposed action, no action, and six action alternatives. The BLM will use the EIS when rendering a decision on whether to grant the requested ROW. The BLM action is to either grant or deny the request for ROWs through public land administered by the BLM. This Final EIS satisfies the requirements of the National Environmental Policy Act, which mandates that federal agencies analyze the environmental consequences of major federal actions.

This Final EIS also includes a programmatic agreement (PA) prepared under the provisions of Section 106 of the National Historic Preservation Act of 1966. The PA has been executed by the BLM, the Advisory Council on Historic Preservation, the Nevada State Historic Preservation Officer, and the SNWA to guide roles of the involved agencies and provide procedures on inventorying for historic properties and mitigation of adversely-affected historic properties. The PA was developed with the involvement of Indian Tribes and other consulting parties as well as the public.

Official responsible for the environmental impact statement:

Amy Lueders, State Director

August 3, 2012
Date

Acronyms and Abbreviations

°C	Degrees Celsius
°F	Degrees Fahrenheit
$\mu g/m^3$	micrograms per cubic meter
µS/cm	microSiemens per centimeter
3M Plan	Monitoring, Mitigation, Management Plan
AADT	Annual Average Daily Traffic
AAQS	Ambient Air Quality Standard
AC	alternating current
ACEC	Area of Critical Environmental Concern
ACHP	Advisory Council on Historic Preservation
ACM	Applicant-committed Protection Measure
AFB	Air Force Base
afy	acre-feet per year
AGI	American Geological Institute
AIRFA	American Indian Religious Freedom Act
AML	appropriate management level
amsl	above mean sea level
APE	area of potential effects
APLIC	Avian Power Line Interaction Committee
ARPA	Archaeological Resources Protection Act
ASCE	American Society of Civil Engineers
BARCAS	Basin and Range Carbonate-Rock Aquifer System
BCS	Bird Conservation Strategy
BGEPA	Bald and Golden Eagle Protection Act
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BMP	Best Management Practices
BO	Biological Opinion
BRT	Biological Resource Team
CAA	Clean Air Act
CAP	Conservation Action Plan
CASTNet	Clean Air and Trends Network
CBER	Center for Business and Economic Research
CCRP	Central Carbonate-Rock Province

CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Register
cfs	cubic feet per second
CO	carbon monoxide
CO_2	carbon dioxide
COM Plan	Construction, Operation, Maintenance, Monitoring, Management, and Mitigation Plan
CRWC	Colorado River Water Consultants
CWA	Clean Water Act
dB	decibels
dBA	decibels A-weighted scale
DCNR	Department of Conservation and Natural Resources
DOI	Department of the Interior
DRI	Desert Research Institute
EA	Environmental Assessment
EIS	Environmental Impact Statement
EMS	Emergency Medical Services
ENWU	Eastern Nevada-Western Utah
EO	Executive Order
ESA	Endangered Species Act
ET	evapotranspiration
FBO	full build out
FEMA	Federal Emergency Management Agency
FLAG	Federal Land Managers Air Quality Related Values Workgroup
FLPMA	Federal Land Policy and Management Act of 1976
FONSI	Finding of No Significant Impact
FRCC	Fire Regime Condition Class
GBBO	Great Basin Bird Observatory
GBCAAS	Great Basin carbonate and alluvial aquifer system
GBNP	Great Basin National Park
GID	General Improvement District
GIS	Geographic Information System
GPCD	gallons per capita per day
gpm	gallons per minute
GPS	Global Positioning System
GWD Project	SNWA's Clark, Lincoln, and White Pine Counties Groundwater Development Project

HA	hydrogeologic area
HFB	hydraulic flow barrier
HGU	hydrogeologic units
HMA	herd management area
IM	Instruction Memorandum
IMPROVE	Iinteragency Monitoring of Protected Visual Environments
IPCC	Intergovernmental Panel on Climate Change
ISA	Instant Study Area
ITA	Indian Trust Assets
KEA	key reclamation potential
KOP	key observation points
kV	kilovolts
LCCRDA	Lincoln County Conservation, Recreation, and Development Act
LCWD	Lincoln County Water District
LDS	Church of Jesus Christ of Latter Day Saints
LMVW	Lower Meadow Valley Wash
LRP	low reclamation potential
LUTAQ	Land Use Transportation and Air Quality
LVCVA	Las Vegas Convention and Visitors Authority
LVVWD	Las Vegas Valley Water District
LWC	Lands with Wilderness Characteristics
MBTA	Migratory Bird Treaty Act
MCL	Maximum Contaminant Level
mg/m^3	milligrams per cubic meter
MLRA	Major Land Resource Areas
Mm^{-1}	inverse megameters
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
mph	mile per hour
MW	megawatt
NAC	Nevada Administrative Code
NAGPRA	Native American Grave Protection and Repatriation Act of 1990
NBMG	Nevada Bureau of Mines and Geology
NCAI	National Congress of American Indians
NDEP	Nevada Division of Environmental Protection
NDOT	Nevada Department of Transportation

NDOW	Nevada Department of Wildlife
NDWR	Nevada Department of Water Resources
NEPA	National Environmental Policy Act
NGO	Non-governmental Organization
NGSCT	Nevada Governor's Sage-Grouse Conservation Team
NHPA	National Historic Preservation Act
NI	none identified
NMD	no measureable discharge
NNHP	Nevada Natural Heritage Program
NO_2	nitrogen dioxide
NOA	Notice of Availability
NOAA	National Oceanographic and Atmospheric Administration
NOI	Notice of Intent
NO_X	nitrogen oxides
NPCA	National Parks Conservation Association
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRG	Natural Resources Group
NRHP	National Register of Historic Places
NRS	Nevada Revised Statute
NSE	Nevada State Engineer
NWR	National Wildlife Refuge
OHV	off-highway vehicle
ON	One Nevada
PA	Programmatic Agreement
PGH	Preliminary General Habitat
PHMSA	Pipeline and Hazardous Materials Safety Administration
PILT	Payment in Lieu of Taxes
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter of 10 microns or less
$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 microns or less
PMU	Population Management Unit
POD	Plan of Development
PPA	past and present actions
PPH	Preliminary Priority Habitat

ppm	parts per million
ppmw	parts per million weight
PRCS	Properties of Religious and Cultural Significance
PRISM	Parameter-elevation Regression on Independent Slopes Model
PWR	Public Water Resources
RASA	Regional Aquifer Systems Analysis
RFFA	reasonably foreseeable future actions
RFRA	Religious Freedom Restoration Act
RMIS	Recreation Management Information System
RMP	Resource Management Plan
RNA	Research Natural Area
ROD	Record of Decision
ROW	right-of-way
RV	recreational vehicle
SH	State Highway
SHPO	State Historic Preservation Officer
SIL	Significant Impact Levels
SLD	Salt Lake Desert (flow system as opposed to Spring [201])
SNPLMA	Southern Nevada Public Land Management Act
SNRPC	Southern Nevada Regional Planning Coalition
SNWA	Southern Nevada Water Authority
SO_2	sulfur dioxide
SR	State Route
SRMA	Special Recreational Management Areas
SRP	Special Recreation Permit
SSURGO	Soil Survey Geographic Database
STATSGO	U.S. General Soil Map
SWIP	Southwest Intertie Project Transmission Line
SWPP Plan	Storm Water Pollution Prevention Plan
SWReGAP	Southwest Regional Gap Analysis Project
TCP	Traditional Cultural Properties
TCWCP	Tri-County Weed Control Project
TDS	total dissolved solids
TIGER©	Topologically Integrated Geographic Encoding and Referencing
TM	Thematic Mapper
Tonnes	metric tons

TSP	total suspended particulate
TSS	total suspended solids
TWE	TransWest Express
U.S.	United States
UDAQ	Utah Division of Air Quality
UDWR	Utah Division of Wildlife Resources
UDWRi	Utah Division of Water Rights
UGS	Utah Geological Society
UNLV	University of Nevada, Las Vegas
UNR	University of Nevada, Reno
USACE	U.S. Army Corps of Engineers
USC	United States Code
USDA	U.S. Department of Agriculture
USDOE	United States Department of Energy
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGCRP	United States Global Change Research Program
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator
VOC	volatile organic compounds
VQO	Visual Quality Objectives
VRI	Visual Resource Inventory
VRM	Visual Resource Management
WEG	Wind Corrodibility Group
WMA	Wildlife Management Area
WRAP	Western Region Air Partnership
WRMP	Water resources monitoring plan
WSA	Wilderness Study Area
WWI	World War I

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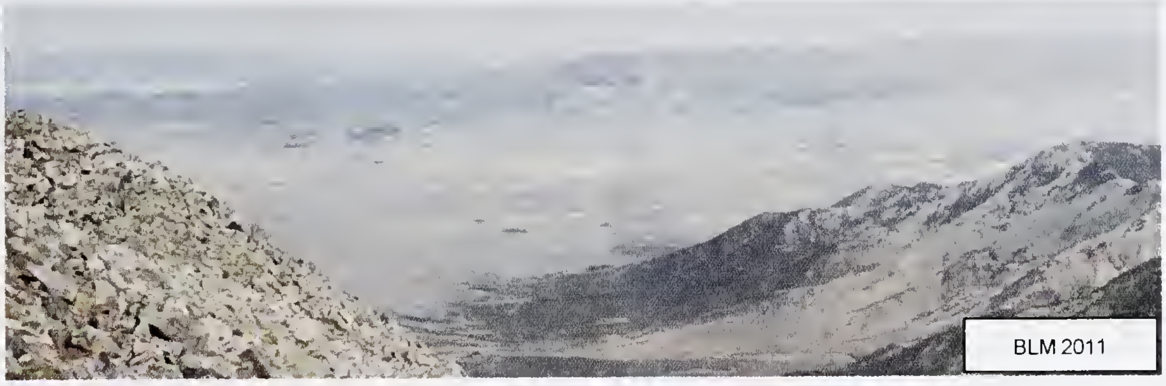


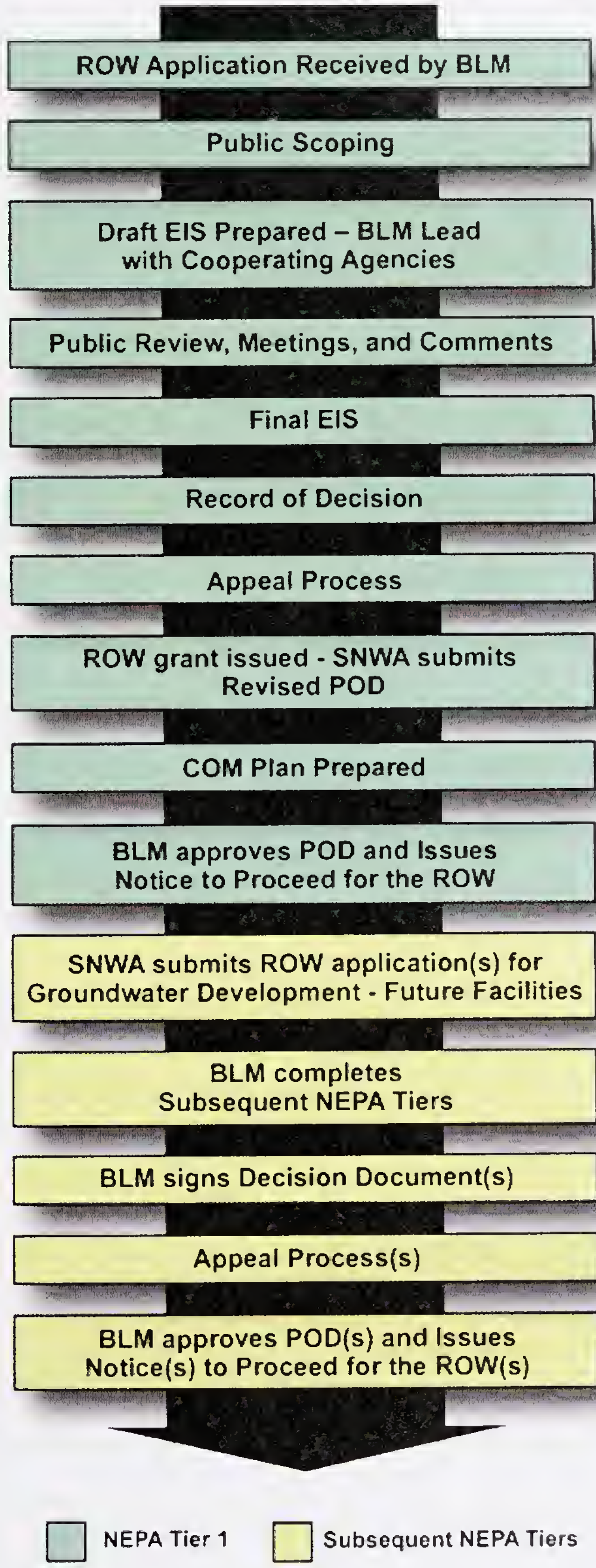
Executive Summary

The United States (U.S.) Bureau of Land Management (BLM) received an application from the Southern Nevada Water Authority (SNWA) for a right-of-way (ROW) grant to provide access to public lands for the purpose of constructing and operating pipelines, power lines, and ancillary facilities for groundwater conveyance. These facilities are associated with groundwater rights either awarded to SNWA or for which applications are pending with the Nevada State Engineer (NSE). Approved groundwater withdrawals would occur in central-eastern Nevada and transported via pipeline to the Las Vegas Valley.

The National Environmental Policy Act (NEPA) mandates federal agencies prepare a detailed study of potential effects of "major federal actions significantly affecting the quality of the human environment." BLM's grant of a ROW to SNWA for these facilities is considered a major federal action, and therefore, must undergo the NEPA review process; in this case by the preparation of an Environmental Impact Statement (EIS). The NEPA process requires a number of steps including public involvement, description of the affected environment, and disclosure of anticipated impacts from the Proposed Action and reasonable alternatives, including those that the BLM has no authority to implement. Decision-makers must consider environmental effects on social, cultural, economic, natural, and other resources.

The BLM, as the lead federal agency, developed this Final EIS with assistance from 16 cooperating agencies and additional Department of Interior staff. The document has been prepared to comply with applicable laws and regulations, consider the issues and concerns identified during scoping, provide a reasonable range of alternatives for analysis, and supply a robust analysis to support the Record of Decision (ROD) that will be issued by the BLM for this action.

The Executive Summary for the Clark, Lincoln, and White Pine Counties Groundwater Development Project (GWD Project) Final EIS is intended to supply information about the project, present BLM's decision regarding the Agency's Preferred Alternative, and help locate information in the Final EIS that may be of particular interest. The Executive Summary is presented in a "Question and Answer" format that generally parallels the presentation of the Final EIS main document.



1. What does the Executive Summary contain?

The Executive Summary provides an overview of the Final EIS prepared by the BLM for the SNWA (also referred to as the applicant) proposed GWD Project in Clark, Lincoln, and White Pine counties, Nevada. The report generally follows the order of presentation found in the Final EIS (**Figure ES-1**), beginning with essential background information about the NEPA process, continuing with a description of project facilities and the Final EIS alternatives, and concluding with summaries of project environmental impacts. **Figure ES-2** provides an overview of the project area and proposed facilities.

Final EIS: SNWA's Clark, Lincoln, and White Pine Counties Groundwater Development Project

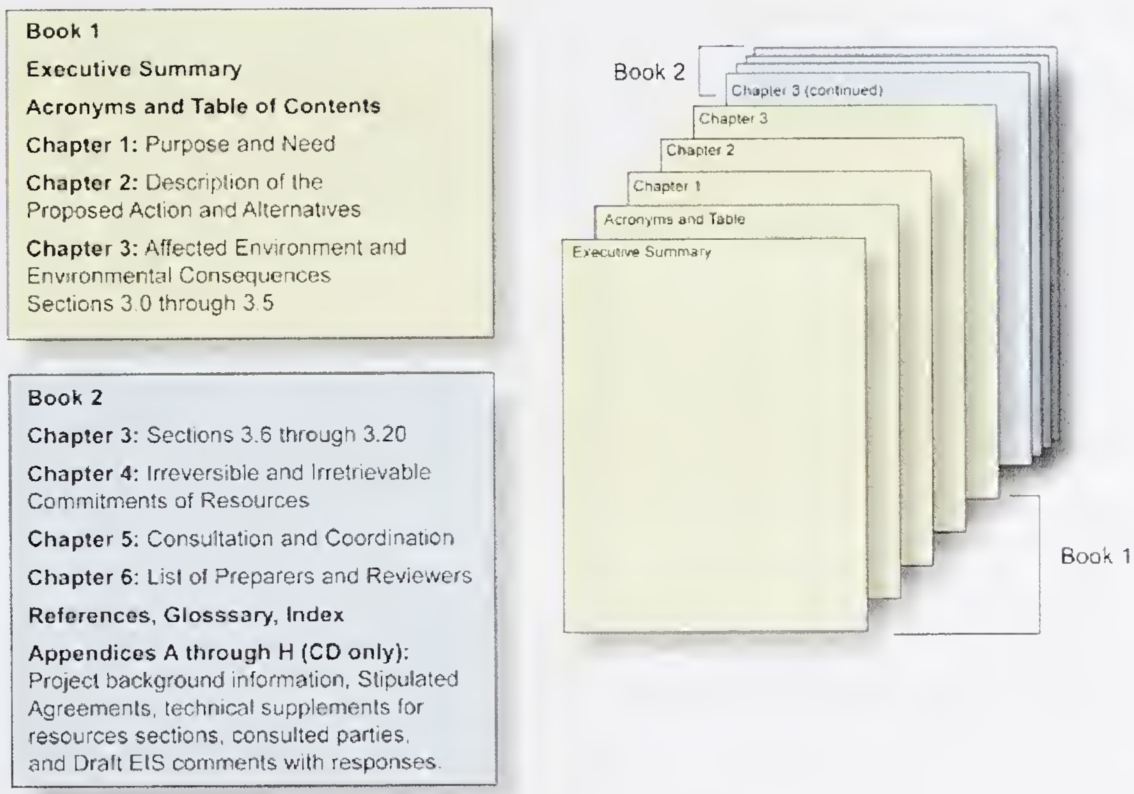


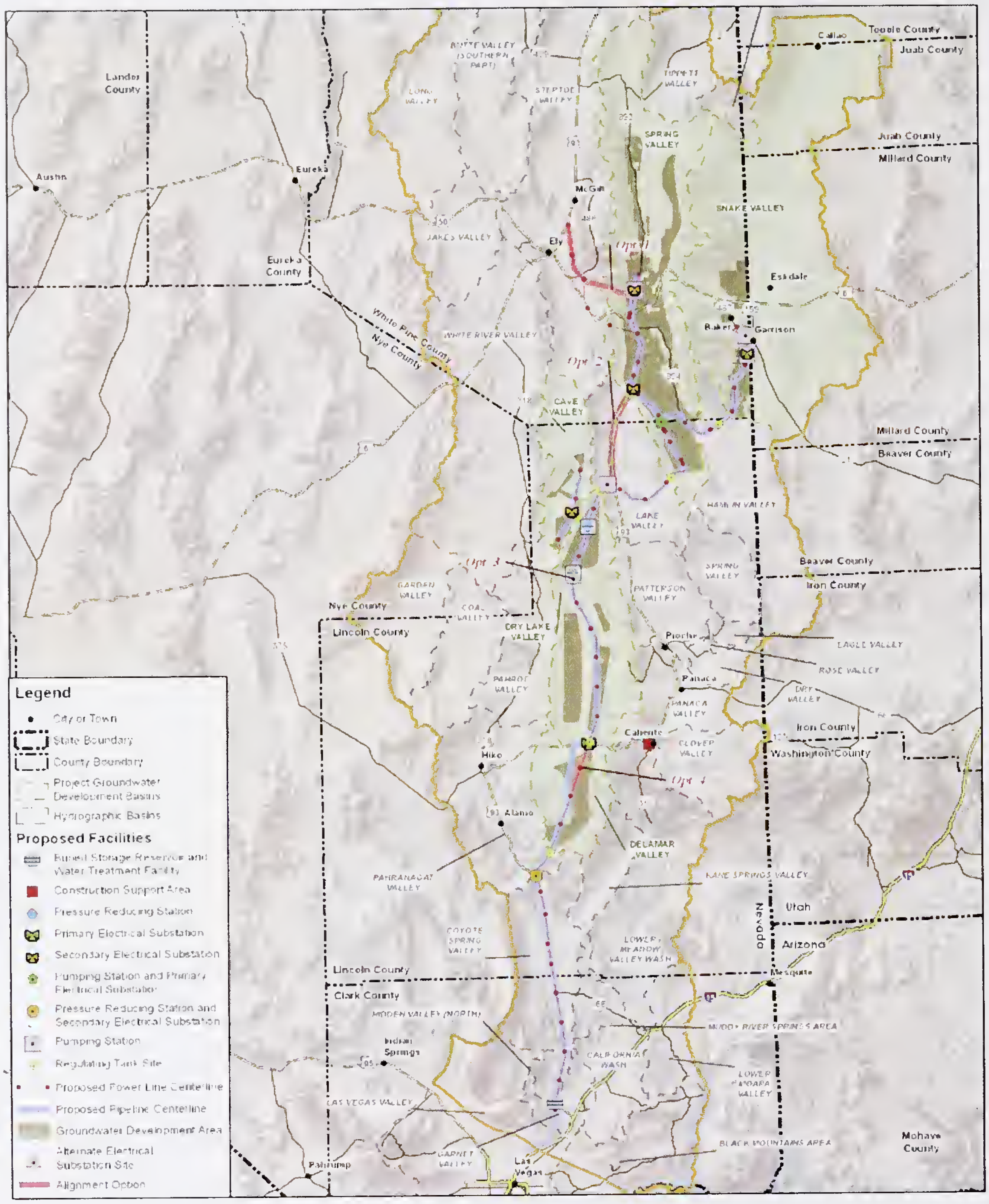
Figure ES-1 Organizational Overview of the Final EIS

The Executive Summary uses a "Question and Answer" presentation style to bring forward important questions surrounding this project. An electronic version of the full Final EIS, including all graphics, is contained on the CD enclosed with the printed Executive Summary. Availability of this Final EIS was published in the Federal Register by the BLM and U.S. Environmental Protection Agency (USEPA). Following a 30-day availability period, the BLM will complete a ROD concerning the GWD Project. The complete Final EIS can be accessed on the BLM's groundwater projects website at: http://www.blm.gov/5w5c.

For mail recipients, you have received a printed copy of the Executive Summary and an electronic version on the enclosed Final EIS CD. When you open the electronic version, clicking on the green boxes (see example) will open pertinent sections of the Final EIS.

Appendix A

Additional information is available from the BLM Groundwater Projects Website:
http://www.blm.gov/5w5c



KEY ACRONYMS	
afy	Acre-feet per year
BLM	Bureau of Land Management
COM Plan	Construction, Operation, Maintenance, Monitoring, Management, and Mitigation Plan
EIS	Environmental Impact Statement
FLPMA	Federal Land Policy and Management Act of 1976
GWD	Groundwater Development (as in reference to this project)
NEPA	National Environmental Policy Act
NSE	Office of the Nevada State Engineer
SNWA	The Southern Nevada Water Authority (the applicant for this project)
ROW	Right-of-way

Figure ES-2 **SNWA Proposed Groundwater Development Main Right-of-way and Future Groundwater Development Basins**

2. Why was this EIS prepared?

On August 19, 2004, the BLM received a ROW application from the SNWA to support construction and operation of a buried pipeline system to convey groundwater from central-eastern Nevada to the Las Vegas Valley (**Figure ES-2**). The requested ROWs would be located in Clark, Lincoln, and White Pine counties.

The SNWA proposes to construct and operate main and lateral pipelines, power lines, and ancillary facilities. This environmental study analyzes site-specific impacts of ROW construction and pipeline operation and provides a programmatic analysis of the potential impacts of future lateral lines, groundwater production facilities, including wells and collector lines, and drawdown from pumping groundwater on environmental resources. Additional environmental studies will be required before specific, local well fields can be defined and evaluated.

The FLPMA gives the Secretary of the Interior general authority to grant ROWs across public lands administered by the BLM, including ROWs for facilities and systems for the storage, transportation and distribution of water.

The BLM need for a federal action arises from its multiple-use mission which includes managing activities on federal land such as ROW authorizations, while conserving natural, historical, cultural, and other resources on the public lands. The BLM is required by the Federal Land Policy and Management Act of 1976 (FLPMA) and other legislation to consider and respond to the applicant's ROW requests.

Future groundwater development and production in Spring, Snake, Delamar, Dry Lake, and Cave valleys would be consistent with the approval of water rights by the NSE and associated future ROW grants from the BLM, neither of which are part of this Proposed Action.

As part of its review of ROW applications, BLM policy requires that an applicant demonstrate the technical and financial capability to construct, operate, maintain, and terminate its project; SNWA has demonstrated that capability. BLM is not required by NEPA, FLPMA, or other regulations, to independently validate an applicant's estimated costs or make a determination of overall project feasibility; neither is a benefit-cost analysis required.

2.1 Why is the Southern Nevada Water Authority seeking to develop this groundwater?

The SNWA depends on the Colorado River for 90 percent of its current water needs.

Appendix A

The SNWA is a political subdivision of the State of Nevada, established in 1991 by agreement among the seven municipal water providers serving the Las Vegas Valley. Its mission is to address the regional water needs of southern Nevada by acquiring and managing water resources, building and managing regional water facilities, and promoting responsible water use (SNWA 2009). The SNWA allocates and delivers water to meet the demands of its member agencies. Each member agency is individually responsible for and has sole authority over the allocation and delivery of retail water to customers within its respective service areas, which collectively include the Las Vegas Valley, Boulder City, and Laughlin.

As required by state law, (Nevada Revised Statute Section 704) the SNWA develops long-term water demand forecasts for its service area. The SNWA *Water Resource Plan 09* addressed forecasted water demand through 2060. The planning outcomes documented in that plan indicate that SNWA's long-term water demands, including allowances for further conservation, are greater than what could be served with existing resources. In addition, the *09 Water Plan* identified the benefits of having additional resources to respond to drought conditions in the Colorado River Basin that could affect SNWA's withdrawals from Lake Mead, its principal reservoir which stores its primary supply. Based on expected growth in demand at the time the *09 Water Plan* was produced, SNWA anticipated needing groundwater from this proposed project by 2020. The long-term demand outlined in the *09 Water Plan* is even greater than the quantity of water proposed for conveyance through the Proposed Action, which would eventually require yet further supply. The SNWA decided to move forward with the groundwater development.

Between 1991 and 2008, conservation efforts in Clark County have reduced average water use by 28 percent, to 248 gallons per capita per day.

In 2009, the SNWA adopted a conservation goal to reduce water use to 199 gallons per capita per day by 2035.

2.2 Why doesn't the SNWA withdraw more water from the Colorado River system?

The Colorado River is governed by a unique body of law, consisting of interstate compacts, statutes, Supreme Court decisions, contracts, treaties, regulations, and policies that together constitute the *Law of the River* and govern how Colorado River water is used. Many elements have been added to the *Law of the River* over the past 30 years, allowing river management to accommodate social and economic change. These changes have been integrated into the legal framework that respects the historic rights and obligations and conforms to statutory, treaty and decree requirements.

The *Law of the River* dates back to the signing of the Colorado River Compact ("Compact") in 1922; the Compact was negotiated by the seven Colorado River Basin States and the federal government. The Compact divided the Colorado River into Upper and Lower Basins at Lee's Ferry, a point just south of the Utah-Arizona border, and apportioned, in perpetuity, the exclusive consumptive beneficial use of 7.5 million acre-feet per year (afy) to each basin.

The 1928 Boulder Canyon Project Act gave Congressional approval to the Colorado River Compact and provided for comprehensive federal management of flood control, power generation, and use of Colorado River water resources within the Lower Basin (primarily through operation of Lake Mead). This act also appointed the Secretary of the Interior as the sole contracting authority for permanent water delivery contracts with users in the Lower Basin. The Boulder Canyon Project Act also apportioned the Lower Basin's 7.5 million afy among Arizona (2.8 million afy), California (4.4 million afy), and Nevada (0.3 million afy) and authorized the construction of Hoover Dam and related facilities, the completion of which created Lake Mead.

The Mexican Water Treaty of 1944 allotted 1.5 million afy of the Colorado River's annual flow to Mexico, increasing to 1.7 million afy in years of surplus and reduced in years of extraordinary drought.

The total annual allocation of Colorado River water is 16.5 million afy. Between 1906 and 2008, the annual average natural inflow was about 16.3 million afy. The Colorado River has experienced below average inflow for 10 of the past 13 years (2000-2012, inclusive).

In May 2005, in response to continuing drought in the Colorado River Basin and reduced storage levels in Lakes Powell and Mead, the Secretary of the Interior (Secretary) initiated a process to develop Lower Basin shortage guidelines and explore coordinated management operations for lakes Powell and Mead. In April 2007, the Basin States reached agreement on actions to improve management and augment the supply of water available for use in the Colorado River System. Under the Seven States' Agreement, the Basin States recommended the Secretary conjunctive management of Lakes Powell and Mead and agreed to diligently pursue development of interim water supplies, system augmentation, system efficiency and water enhancement projects within the Colorado River system. SNWA's Groundwater Development is an example of long-term augmentation project contemplated by the Basin States' Agreement.

The 2007 Interim Guidelines, adopted by the Secretary, define criteria for reductions in deliveries to the Lower Division states based on Lake Mead surface water elevations. When Lake Mead is at or below elevation 1,075 feet and at or above 1,050 feet, the shortage is 0.333 million afy; when Lake Mead is below elevation 1,050 feet and at or above 1,025 feet, the shortage is 0.417 million afy; when Lake Mead is below 1,025 feet, the shortage is 0.500 million afy. Of these shortage volumes listed, Nevada will take reductions in deliveries of 13,000 acre-feet, 17,000 acre-feet, and 20,000 acre-feet, respectively. In the event that Lake Mead's surface water elevation falls below 1,025 feet, the Secretary will consult with the Basin States in the development of further measures, consistent with applicable Federal law, to reduce the possibility of Lake Mead's surface water elevation falling below 1,000 feet.

In January 2010, the Bureau of Reclamation, in collaboration with the seven Colorado River Basin States initiated the "Colorado River Basin Water Supply and Demand Study". The study, anticipated to be completed in the fall of 2012, will define current and future imbalances in water supply and demand in the Colorado River Basin and adjacent areas over the next half-century, and develop and analyze adaptation and mitigation strategies to resolve those imbalances and assess risks to Basin resources. These resources include water allocations and deliveries consistent with apportionments under the Law of the River; hydroelectric power generation; recreation; fish, wildlife, and their habitats; water quality; flow and water dependent ecological systems; and flood control.

2.3 Who is responsible for preparing this EIS?

The BLM is the lead federal agency for the EIS process in compliance with the NEPA and the Council on Environmental Quality (CEQ) regulations implementing NEPA (40 Code of Federal Regulations [CFR] 1500-1508). This Final EIS conforms with policy guidance provided in BLM Handbook H-1790-1 and with land management plans currently in place for the affected lands.

As provided for by NEPA, 16 agencies with either jurisdiction by law, or special expertise, elected to enter into a Memorandum of Understanding with the BLM to assist as a cooperating agency in the EIS process. These agencies are listed below.

Cooperating Agencies for the SNWA Groundwater Project EIS

U.S. Army Corps of Engineers • U.S. Bureau of Indian Affairs • U.S. Bureau of Reclamation
Central Nevada Regional Water Authority • Clark County, NV • Juab County, UT • Lincoln County, NV
Millard County, UT • National Park Service • Nellis Air Force Base • Nevada Department of Wildlife
State of Utah • Tooele County, UT • U.S. Fish and Wildlife Service • U.S. Forest Service • White Pine County, NV

Federal law requires the Secretary to grant the ROWs requested by the SNWA in Clark and Lincoln counties in accordance with the FLPMA and other applicable regulations, subject to NEPA review.

In White Pine County, the BLM may grant the ROWs under its own FLPMA general authority.

Federal law also requires an agreement between Utah and Nevada on the division of water resources from those interstate flow systems from which water would be diverted, prior to any transbasin diversion.

2.4 Under what laws is the BLM acting?

The ROWs requested by the SNWA for this GWD Project must be processed in accordance with the FLPMA, and other laws, as well as the BLM ROW regulations. FLPMA requires that, each ROW shall contain such terms and conditions deemed necessary to: protect federal property and economic interest; protect life and property; protect the interest of individuals who rely on the fish, wildlife, and other biotic resources; and protect the public interest in lands (Sec 505 [43 United States Code (USC) 1765]). BLM is also generally obligated to avoid unnecessary or undue degradation of the public lands (43 USC §1732). In addition, Congress specifically directed the BLM to grant ROWs for water resource development and conveyance projects in Lincoln and Clark counties pursuant to the Lincoln County Conservation, Recreation, and Development Act of 2004. This law established "*...a 2,640 foot wide corridor for utilities in Lincoln County and Clark County, Nevada...*" The law requires the BLM to issue to the SNWA and the Lincoln County Water District "*...nonexclusive ROW to federal land in Lincoln County and Clark County, Nevada for any roads, wells, ... other facilities necessary for the construction and operation of a water* *conveyance system,... within that corridor.*" The law also directs the BLM to conduct environmental studies to identify and consider the potential impact to fish and wildlife resources and habitat. The law contains a provision that "*...the State of Nevada and the State of Utah shall reach an agreement regarding the division of water resources of those interstate groundwater flow system(s) from which water will be diverted and used by the project. The agreement should allow for the maximum sustainable beneficial use of the water resources and protect existing water use.*" Additionally, the Southern Nevada Public Lands Management Act of 1998 requires the BLM to issue ROW to units of local or regional government on federal lands. The Southern Nevada Water Authority is a qualified unit of regional government.

Simply put, federal law mandates the BLM to grant the ROWs requested by the SNWA in Clark and Lincoln counties. The ROW grant will contain appropriate conditions to ensure compliance with FLPMA and to avoid unnecessary or undue degradation of the public lands. The SNWA's requested ROWs in White Pine County may be granted pursuant to the BLM's authority under the FLPMA.

When issuing ROWs, the BLM may formulate monitoring and mitigation strategies including conditions to minimize environmental impacts resulting from the construction and operation of the GWD Project (see Final EIS Sections 2.4, Environmental Inspection, Compliance Monitoring, and Post Approval Variances, and 3.20, Monitoring and Mitigation Summary).

2.5 When was the Draft EIS available and what alternatives were considered?

On June 10, 2011, a Notice of Availability was published in the Federal Register (76[112]:34097-34099) announcing the availability of the Draft EIS. The Draft EIS assessed the impacts of SNWA's Proposed Action, a full range of reasonable action alternatives, and the No Action Alternative. Each groundwater development action alternative is defined by one of the three major ROW alignment options, an assumed well development pattern and level of SNWA groundwater production, and whether future groundwater production would occur full time or on an intermittent basis.

Although the BLM is mandated by law to grant certain ROWs, the No Action Alternative is used as a benchmark for the comparison of the Proposed Action and alternatives.

The SNWA ROW request for the main pipeline extends from Clark County to a point in northern Lincoln County near its boundary with White Pine County (common to all three alignments. Three major laterals also will be constructed; one in Lincoln County (Cave Valley), and two in White Pine County (Spring and Snake valleys).

The three alignment options considered for the main project conveyance system include:

1) The SNWA's full ROW request for the main pipeline, major lateral pipelines, power lines, and other ancillary facilities;
2) The ROW mandated by Congress in Lincoln and Clark counties only (Lincoln County Conservation, Recreation, and Development Act [LCCRDA]); and
3) The ROW mandated by Congress, with an extension into Spring Valley in White Pine County.

Four levels of assumed annual groundwater production were defined for the analysis:

- Pumping at the SNWA application volumes: up to 176,655 afy;
- Pumping of up to 114,755 afy, with production in all 5 basins;
- Pumping of up to 78,755 afy, assuming no groundwater development in Snake Valley; and
- Pumping of up to 114,129 afy, assuming no groundwater development in Snake Valley.

The groundwater production assumptions also reflect options regarding well placement, and assumed frequency and duration of groundwater production.

The ROW alignments relate to the current federal action and would result in a ROD that makes a decision regarding the ROW; the other factors relate to the programmatic analysis of future groundwater development facilities. **Table ES-1** summarizes the eight alternatives for analysis and **Figure ES-3** shows the three main pipeline ROW alternatives. The Proposed Action and Alternatives A, B, and C all use the full project footprint contained in the SNWA ROW application.

Table ES-1 Summary of the Eight Alternatives for EIS Analysis

Alternatives for Analysis	Conveyance System Alignment	SNWA Groundwater Production[2]	Basins in Which SNWA Production Would Occur	Well Placement[3]	Assumed Full Build out
Proposed Action	Full ROW request [1]	Up to 176,655 afy	Spring, Snake, Delamar, Dry Lake, Cave	Distributed	Year 38
A	Full ROW request [1]	Up to 114,755 afy	Spring, Snake, Delamar, Dry Lake, Cave	Distributed	Year 38
B	Full ROW request [1]	Up to 176,655 afy	Spring, Snake, Delamar, Dry Lake, Cave	Points of Diversion	Year 38
C	Full ROW request [1]	12,000 to 114,755 afy (varies in response to drought)	Spring, Snake, Delamar, Dry Lake, Cave	Distributed	Year 38
D	LCCRDA	Up to 78,755 afy	Spring (south), Delamar, Dry Lake, Cave	Distributed	Year 33
E	Spring / Delamar, Dry Lake, and Cave	Up to 78,755 afy	Spring, Delamar, Dry Lake, Cave (no Snake)	Distributed	Year 33
F	Spring / Delamar, Dry Lake, and Cave	Up to 114,129 afy	Spring, Delamar, Dry Lake, Cave (no Snake)	Distributed	Year 33
No Action	None	None	None	None	NA

[1] Full ROW request includes the ROW for the main pipeline, three lateral pipelines, transmission line, and other ancillary facilities.

[2] Includes 3,000 afy of water rights transferred by the SNWA to the Lincoln County Water District.

[3] "Distributed" refers to siting wells based on the results of monitoring, productivity, and hydrologic modeling to reduce long-term adverse environmental effects. "Points of diversion" refers to siting wells at specific locations identified and approved by the NSE.

Each ROW alignment provides for temporary and permanent ROWs to support construction of a pipeline, power line, and other ancillary facilities.

The differences in the northern terminus among the three alignments result in different ROW lengths and corresponding differences in surface disturbance. SNWA's full ROW request involves 306 miles of ROW for the pipeline and 12,288 acres of temporary disturbance, while the LCCRDA alignment has the smallest numbers, 225 miles of pipeline ROW and 8,828 acres of temporary disturbance. Additional information about the three alignments can be found in Sections 2.5 and 2.6 of the Final EIS.

Most of the surface area disturbed during construction would be revegetated in accordance with BLM's Resource Management Plan (RMP) management actions and best management practices (BMPs). The estimated net long-term disturbance following revegetation is 999 acres under the SNWA full ROW request; 808 acres with the LCCRDA alignment; and 945 acres for the Spring/Delamar, Dry Lake, and Cave alignment.

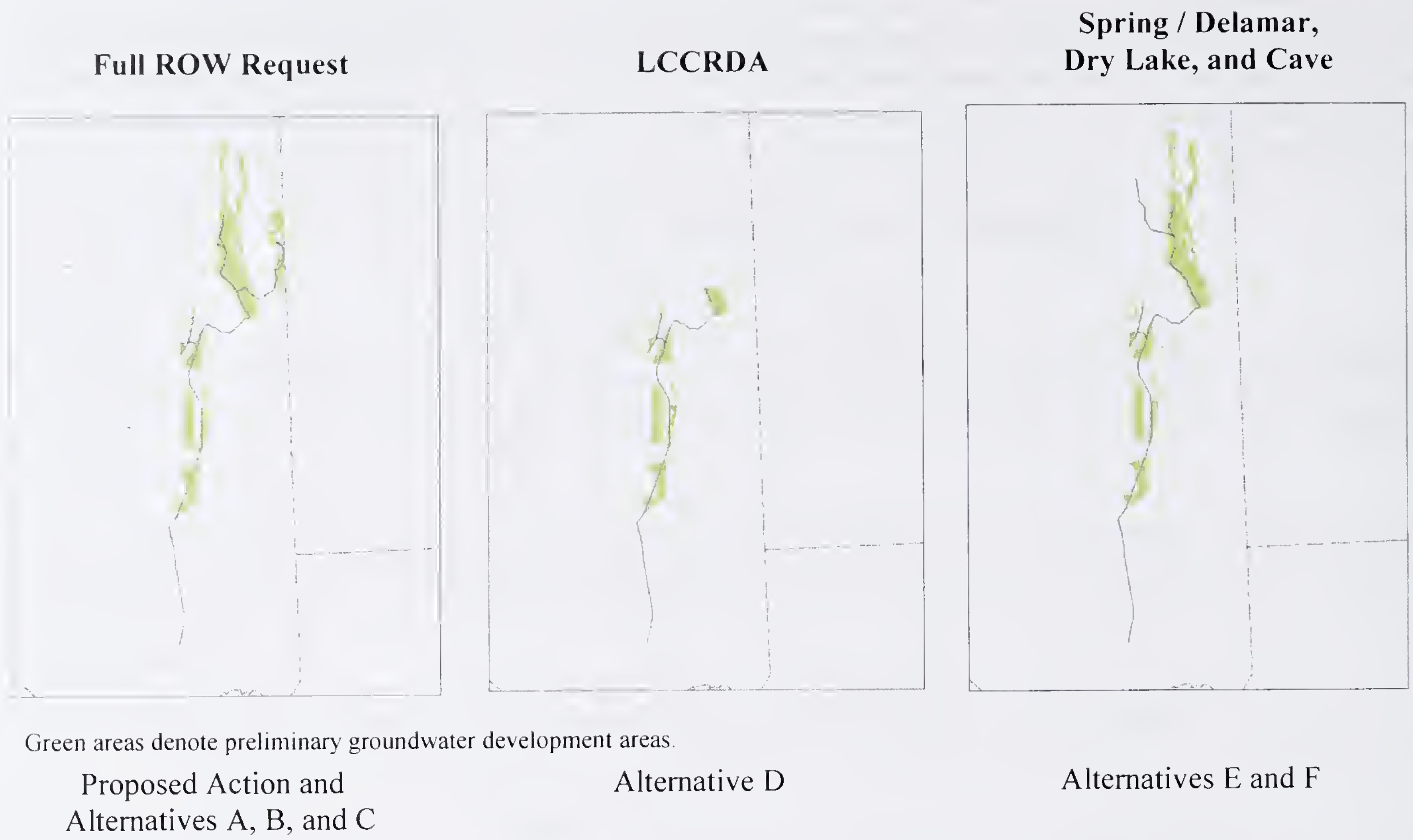


Figure ES-3 Groundwater Development Project Main Right-of-way Alignments

2.6 Alternative F was added for the Final EIS. Does CEQ allow the addition of an alternative at this point in the process?

The BLM developed and analyzed a new alternative, Alternative F, in this Final EIS. The proposed development of the main water conveyance pipeline and related facilities is consistent with that analyzed for Alternative E in the Draft EIS. The volume of groundwater developed would not exceed 114,129 afy. No water would be developed by the SNWA in Snake Valley.

The agency's decision to develop the new alternative was based upon input from the applicant, review of public comments, and the desire to analyze a broader range of alternatives in the Final EIS. The addition of this new alternative is consistent with CEQ guidance allowing an agency to develop new alternative(s) that are variations of alternatives analyzed in the Draft EIS. Alternative F is equivalent to Alternative E in regard to construction footprint and numbers and types of facilities and the assumed groundwater withdrawal volumes are within the range of those analyzed for the Proposed Action and Alternative E.

2.7 What comments were received on the Draft?

The Notice of Availability published in the Federal Register (76[112]:34097-34099) defined a 90-day public review and comment period running from June 10 through September 9, 2011. The comment period was extended by 30 days in response to public input; ending on October 11, 2011.

The BLM received more than 460 sets of written comments and oral statements made during public hearings on the Draft EIS. More than 20,000 form letters were also submitted, either in hardcopy or digital format. Comments were received on all sections and topics in the Draft EIS. The more common resource topics and concerns include the following:

General: duration of the comment period; the definition of alternatives, programmatic analysis of the future facilities; public policy issues associated with groundwater allocation; and water conservation.

Air Quality and Climate Change: potential dust-related effects on human health; visibility (especially related to Great Basin National Park [GBNP]); the potential contribution to National Ambient Air Quality Standard non-attainment areas; requests for additional Air Quality modeling; and, potential long-term effects of Climate Change on the area.

Geology: concerns related to long-term subsidence.

Water Resources: definition of the groundwater flow model area; predicted water use and drawdown under the No Action Alternative; use of the regional groundwater flow model and simulated 10-foot drawdown to define the drawdown area for the impact analysis; use of simulated changes to flow in selected springs and streams; and the development and pumping timeframes for the programmatic analysis.

Biological Resources: loss of vegetation; particularly wetlands/meadows and white sage; vegetation re-establishment and treatment/prevention of annual invasive weed species in areas of disturbance; new policies (e.g., greater sage-grouse, southwestern willow flycatcher revised proposed critical habitat); loss of hunting and fishing habitat; potential pumping effects on special status species in Utah hydrologic basins; the risks of relatively large predicted flow reductions in some springs in Spring and Snake valleys; and potential effects on special status aquatic species.

Human Resources: visual resources concerns related to project components and desertification (particularly the viewshed from GBNP); effects to recreation and tourism including visitation to the GBNP; loss or population decline of game species; inadequate tribal consultation and Native American concerns related to loss of historic lands, Traditional Cultural Properties, artifacts, plants and animals of cultural importance, and loss of water which many tribes hold sacred; project cost and the effects on ratepayers; SNWA's need for additional water given current economic conditions or projected growth in the Las Vegas Valley; potential adverse effects or benefits in Clark County if the project does/does not move forward; and the potential that the exportation of water facilitated by the project could foreclose economic development opportunities in White Pine County and the Utah portion of the Snake Valley.

Cumulative Impacts: concerns related to the projects that were included/excluded and the process for conducting the cumulative impact analysis.

Monitoring, Management, and Mitigation: requests for additional specificity in the mitigation, management, and monitoring plans; the effectiveness of proposed monitoring, management, and mitigation; assurances that long-term monitoring, management, and mitigation would occur; concerns that pumping would not be discontinued even if major adverse effects are identified; and the cost implications of monitoring, management, and mitigation.

Appendix H provides a listing of all comments and the specific responses to those comments. The Final EIS reflects many changes made in response to public input. In general, more of the comments and concerns focused on the potential long-term effects of pumping and groundwater drawdown than the effects related to the ROW grant and construction of the main pipeline.

Appendix H

2.8 What other changes were made between the Draft and this Final EIS?

In response to agency and public comments on the Draft EIS, the BLM has made numerous changes in the Final EIS. The most substantive changes are summarized below.

Chapters 1 and 2

- Added Alternative F.
- Identified the Agency Preferred Alternative.
- Summarized the NSE rulings on SNWA's water rights applications in Spring, Delamar, Dry Lake, and Cave valleys.
- Added a discussion of project capital costs.

Chapter 3

- All resource areas incorporated analysis of Alternative F.
- The Air and Atmospheric Values analysis was revised to include a regional-scale model that more clearly assesses potential project-related pumping and groundwater drawdown impacts to air quality.
- The Climate Change discussion was expanded and resource-specific Climate Change analyses incorporated into the cumulative analysis sections of each resource.
- The greater sage-grouse analysis was updated to reflect the newly implemented Instruction Memorandum No. 2012-044 which specifies increased buffer zones around leks and transmission lines.
- Additional analysis regarding potential long-term effects to the landscape as viewed from the GBNP was added for all alternatives.
- Additional information on past, present, and reasonably foreseeable future actions was incorporated into the cumulative effects section.
- The Native American Traditional Values, Section 3.17, was expanded; now including a comparison of alternatives highlighting the impacts to sites and places of tribal concern.
- Section 3.20, Monitoring and Mitigation Summary, was revised to include a new construction, operation, and monitoring (COM Plan) for the project area. Some mitigation measures have been added, removed, or modified based on agency and public comment.

Chapter 4

- The description of irreversible and irretrievable resource commitments associated with the GWD Project was revised.

Chapter 5

- A synopsis of the Public Meetings on the Draft EIS and a summary of overarching comments received on the Draft EIS was added.

Chapter 6

- The list of preparers and reviewers for the EIS was updated.

Appendices

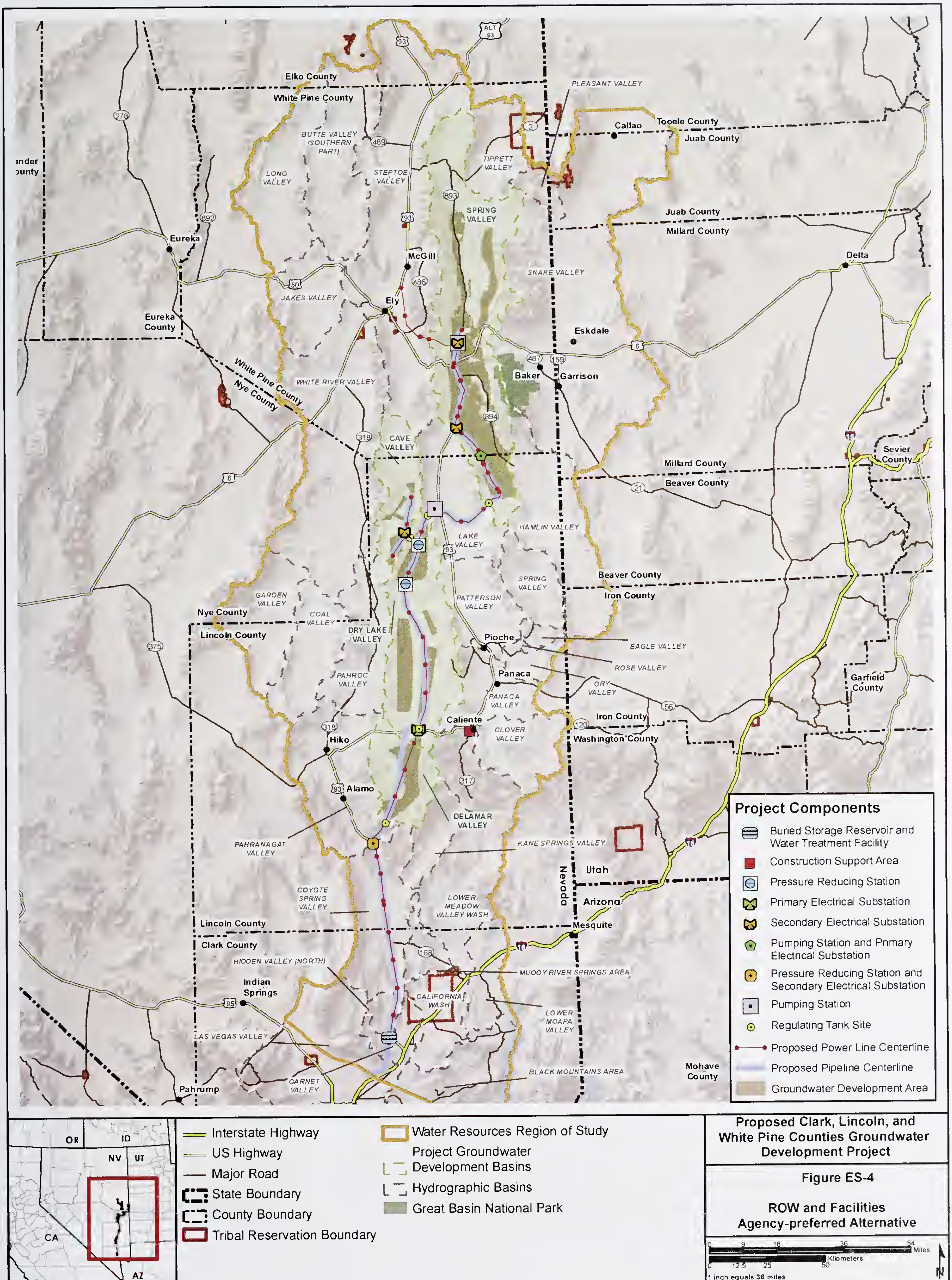
- SNWA's summary of Applicant-committed Measures (ACMs) in **Appendix E** was revised.
- Additions were made to the consultation record presented in **Appendix G**.
- Revisions to **Appendix F** sub-appendices related to individual resources have occurred as appropriate to support changes in the main document.
- **Appendix H** was added, presenting the comments on the Draft EIS and comment responses.

2.9 What is the Agency's Preferred Alternative?

Under the BLM's NEPA regulations (43 CFR § 46.420[d]), the BLM's "Preferred Alternative" is the alternative which the BLM believes would best accomplish the purpose and need of the proposed action while fulfilling the agency's statutory mission and responsibilities; giving consideration to environmental, technical, cultural, social, economic, and other factors. The Preferred Alternative is not a final agency decision; rather, it is an indication of the agency's current preference.

The BLM has identified the main conveyance pipeline alignment contained in Alternative F, with Alignment Option 1 - the Humboldt-Toiyabe Power Line Alignment as its Preferred Alternative.

The BLM has identified the main conveyance pipeline alignment contained in Alternative F as its Preferred Alternative (**Figure ES-4**). This alternative does not include ROW in Snake Valley. Alignment Option 1 – the Humboldt-Toiyabe Power Line Alignment would be included in the Preferred Alternative selection. The alignment option routes the power line in Steptoe Valley, east of Ely, across U.S. Forest Service lands through an existing utility corridor.



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure ES-4

ROW and Facilities Agency-preferred Alternative

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

In selecting the Preferred Alternative, the BLM considered all information received; consistent with its environmental review, ROW permitting responsibilities, and the NSE's jurisdiction over water rights. Therefore, BLM's preferred alternative would be limited to the amount of water stated in the NSE's March 2012 rulings. However, the agency Preferred Alternative is not, and should not be interpreted as a factual finding or opinion by the BLM on any past ruling, or current issue before the NSE.

Alternative F was not analyzed in the Draft EIS. However, the public will recognize similarities between Alternatives F and E; most notably that the pipeline alignments are identical and do not extend into Snake Valley. The ROW in Alternative E was analyzed in the Draft EIS. Based on the quantities of water approved for development by the NSE in the March 2012 ruling, as compared to the quantities analyzed in the EIS, the BLM acknowledges that Alternative E may understate the potential impacts, while Alternative F may overstate the expected impacts of the preferred alternative (**Table ES-2**). Alternatives E and F do differ in the quantity of water to be developed and conveyed. **Figure ES-5** presents a comparison of both alternatives model-simulated drawdown at the full build out plus 75 years timeframes. Since the NSE ruling groundwater amount is a reduction of roughly 26 percent over Alternative F (future facilities, the number of wells, miles of pipeline, etc.) would be reduced accordingly and impacts to federal resources would also be reduced. Since the BLM Preferred Alternative would limit the water developed by the project to that approved in the four valleys (Spring, Delamar, Dry Lake, and Cave) by the NSE (up to 83,988 afy), the two alternatives "bracket" the water quantities granted by the NSE.

Table ES-2 Comparison of Groundwater Withdrawal Volumes Pertaining to the Preferred Alternative

	Current NSE Rulings	Alternative E	Alternative F
Spring Valley	61,127	60,000	84,370
Delamar Valley	6,042	2,493	6,591
Dry Lake Valley	11,584	11,584	11,584
Cave Valley	5,235	4,678	11,584
Total Delamar, Dry Lake, and Cave Valleys	22,861	18,755	29,759
Total	**83,988**	**78,755**	**114,129**

2.10 What decisions will the BLM make based on this EIS?

The Final EIS assesses the short and long-term effects of construction and operation of the main water conveyance pipeline, water treatment and storage facilities, and the power transmission line and other facilities associated with system operations. Construction of these facilities would occur within temporary and permanent ROW grants issued by the BLM.

The analysis in this EIS will inform the decision makers whether they should:

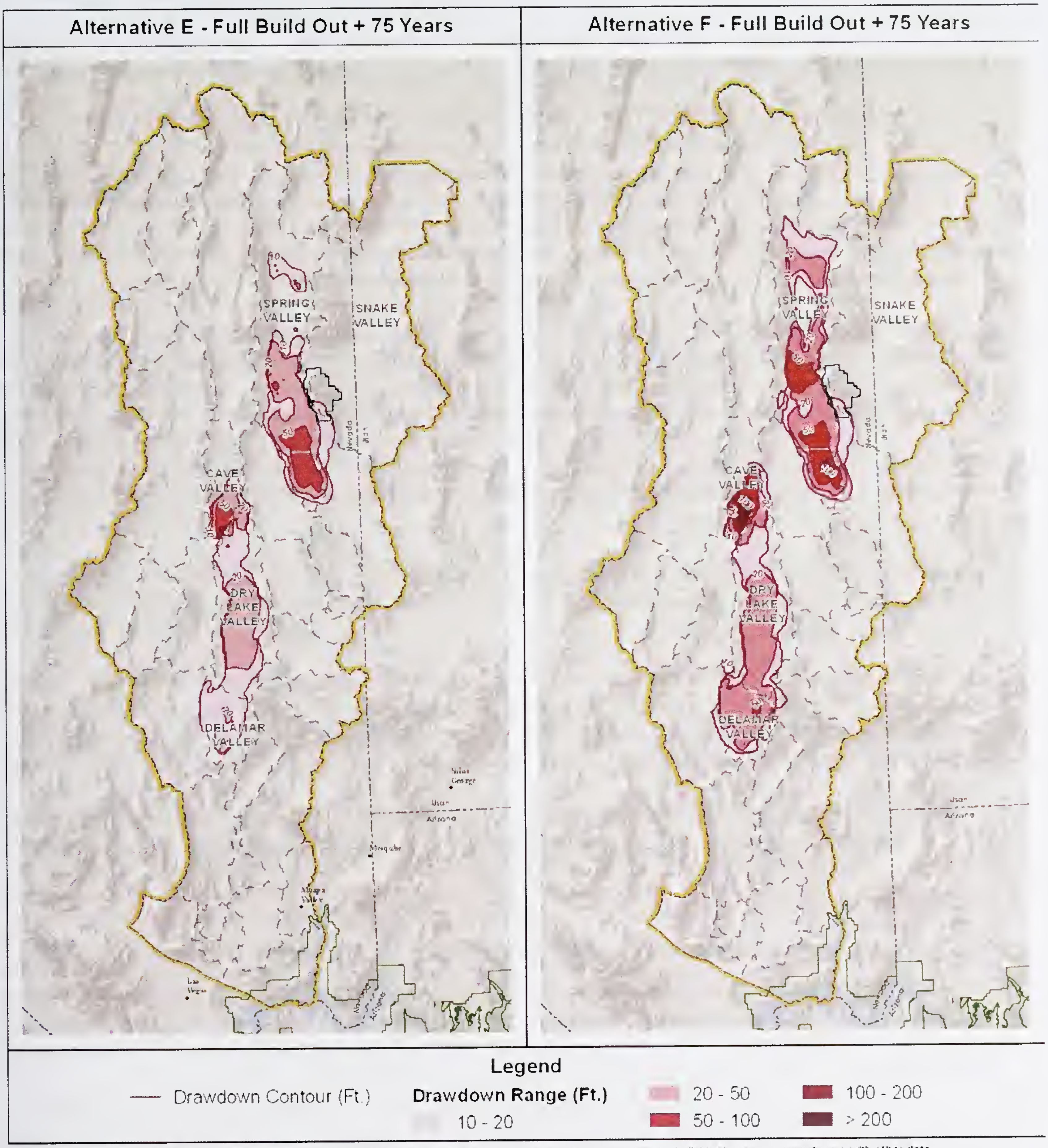
1) Approve, modify, or deny (only in White Pine County) the ROWs as applied for by the SNWA;
2) Apply all appropriate mitigation measures; and
3) Require the development and implementation of an integrated and comprehensive COM Plan that will direct decision-makers on appropriate action for ROW actions associated with the SNWA GWD Project. The objectives of the COM Plan are to protect federal resources and federal water rights that may be impacted by construction, operation, maintenance, and abandonment of the project. The COM Plan is designed to provide early warning of potentially adverse impacts, provide time and flexibility to implement management measures to mitigate impacts, gage their effectiveness, and recommend appropriate action.

BLM DECISIONS TIED TO THE NEPA ANALYSIS IN THIS EIS

Approve or deny ROW Grants for the main pipeline, transmission line, water storage and treatment facilities, and associated ancillary facilities.*

Develop appropriate monitoring and mitigation to address potential adverse impacts of the GWD Project.

* *ROW grants for future lateral lines and groundwater production wells and facilities would be subject to additional NEPA analysis.*



No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

Figure ES-5 Drawdown Comparison of Alternatives E and F

If ROW grants are approved, the ROD document would contain the requirement for the applicant to prepare detailed, site-specific construction and operation plans for each project phase or facility component. These plans require BLM approval prior to surface disturbance and issuance of a Notice to Proceed for construction.

2.11 What mitigation and monitoring requirements would the BLM impose as conditions of any ROW grants for the GWD Project?

Section 3.20

It is understood that the SNWA would implement the Applicant-committed Measures (ACMs) it has proposed as part of its project unless superseded by the Ely or Las Vegas RMP management actions, BMPs, U.S. Fish and Wildlife Service Biological Opinion Terms and Conditions, or unless specifically modified by other ROW conditions. Under the FLPMA, the BLM may impose conditions on any ROW grant it permits for the GWD Project. Additional requirements and mitigation measures may be included as specific conditions to the ROD issued by the BLM for this EIS.

For the GWD Project, the BLM will require the SNWA to implement a comprehensive COM Plan. The objectives of the COM Plan are to protect federal resources and federal water rights that may be impacted by project construction, operation, maintenance, and abandonment. The COM Plan is designed to provide early warning of potential adverse impacts, provide time and flexibility to implement management and mitigation measures.

The COM Plan includes a comprehensive monitoring, management, and mitigation program for the entire project to integrate the various required monitoring, management, and mitigation actions which are provided through the following regulations and other commitments:

- BLM Land and RMP management actions and BMPs
- U.S. Fish and Wildlife Service Biological Opinion
- Section 106 Programmatic Agreement
- Mitigation from Final EIS
- Stipulated Agreements
- Applicant Committed Measures
- Clean Water Act (CWA) Section 404 Mitigation

If ROW grants for the groundwater development areas are approved in the future, the decision documents, either RODs or Findings of No Significant Impact would contain requirements for the submission of Plans of Development (PODs) containing the site specific construction and operation plans comparable to those required for the main water conveyance pipeline system.

2.12 How are Native Americans engaging in the NEPA process?

In 2007, the BLM initiated government-to-government consultation under section 106 of the National Historic Preservation Act with 28 Indian tribes and bands that may have religious or cultural ties to the project area. The executed Programmatic Agreement has been included as part of this EIS (**Appendix F3.16**). The tribes have declined to concur with the PA and their reasons are noted in the letter contained in **Appendix F3.16**.

Chapter 5 lists the Tribes that have been identified as having involvement or a particular interest in the GWD Project or project area. The BLM, with Tribal input has developed an Ethnographic Assessment report and is addressing potential properties of religious and cultural significance identified through the Ethnographic Assessment. Several of these Tribes assert federally reserved water rights claims to water potentially affected by the GWD Project. Some of these claims were addressed by the NSE in his recent rulings on Spring, Dry Lake, Delamar, and Cave Valleys. The Rulings can be accessed at http://water.nv.gov. The particular water rights claims and related resources are covered in more detail in Chapter 3.

2.13 Are other agency approvals and consultation required before the Project would move forward?

No Notice to Proceed for construction associated with this project would be issued until the detailed POD is submitted by SNWA and approved by the BLM.

Section 1.5.5

Yes, a number of other federal and state agency reviews, permits, and consultations would be required for the SNWA to move ahead with construction of the GWD Project. Many review processes are concurrent with the EIS process, while construction approvals, wildlife handling permits, and other approvals will follow the BLM's decision on the ROW application.

Prior to issuing a Notice to Proceed, the BLM ROD and the subsequent ROW grant would require the applicant to prepare and submit for BLM approval a detailed revised POD for the main water conveyance pipeline and related facilities, including all of the stipulations, conditions, and other requirements specified in the ROD. Based on the POD, BLM would prepare the COM Plan.

ROW applications for the subsequent individual groundwater development areas will be subject to NEPA analysis (subsequent/tiered NEPA), including public input. If ROW grants for the groundwater development areas are approved in the future, the RODs or Finding of No Significant Impact will contain requirements for the submission of PODs containing the site-specific construction and operation plans prior to the ROW/Notice to Proceed.

No Notice to Proceed for construction associated with this project would be issued until the detailed POD is submitted by SNWA and approved by BLM.

When the BLM is satisfied that the SNWA has developed all required plans related to construction and operation for the ROW and ancillary facilities and the COM Plan is prepared, the BLM may issue construction Notices to Proceed on a segmented basis.

Although the ROD and associated decisions do not carry an expiration date, the data, analyses, and other information used to reach a decision may change over time. A delay in project implementation of even a few years could result in the need to supplement the NEPA (EIS) process and associated processes such as section 7 and section 106 consultation.

2.14 What does "tiering" mean in the National Environmental Policy Act process and how does it relate to the GWD Project?

Tiering for NEPA purposes refers to the process of sequential assessment of regional-scale or phased projects to be developed over time; first addressing the environmental effects and issues for those project elements that are developed and ready for analysis, while deferring detailed assessment of subsequent phases (tiers) until they are ready. For the GWD Project, this EIS addresses the site-specific effects of construction and operation of the main and lateral pipeline, pumping stations, regulating tanks, pressure-reducing stations, electrical power lines, electrical substations, electronic system operations facilities, communication facilities, access roads, a water treatment facility, an underground water storage reservoir, and ancillary facilities.

"Tiering"

Tiering is a staged approach to NEPA described in CEQ's regulations (40 CFR 1500-1508). Tiering allows an assessment of some site-specific actions for which adequate information is available, addressing effects of other future actions programmatically. The other actions are subject to additional future NEPA assessment.

Programmatic assessments provide a broad characterization of potential effects over a wide area and/or period of time, with the expectation that the assessment will be refined in subsequent NEPA studies. The programmatic analysis for the GWD Project studies potential effects based on assumptions about the location and amount of disturbance involved for production wells, collector pipelines, and distribution power lines. The analysis also assumes a range of groundwater withdrawal rates and volumes. When applications for additional ROWs are submitted in the future, the environmental effects of those ROWs will be studied using data and results from the initial NEPA assessment (Tier 1), as a starting point for additional analyses. The more detailed assessments are referred to as subsequent or tiered analysis. The tiering process is summarized in **Figure ES-6**. The SNWA has not yet applied for ROWs for groundwater production wells and collector pipelines because certain aspects of that future development are unknown. The environmental effects of that future development, including the long-term effects of groundwater production, are therefore the subject of programmatic analysis in this EIS.

In future tiered analyses, more detailed information regarding the location and type of development is used to prepare individual environmental assessments or environmental impact statements focused on a specific valley or other geographic area and the environmental issues associated with that location and development. The hydrologic model used for Tier 1 and baseline characterizations for all resources will be updated in future tiered analyses on site-specific components. The BLM will approve or deny any future proposed ROWs after environmental analysis with a decision document issued for each additional request.

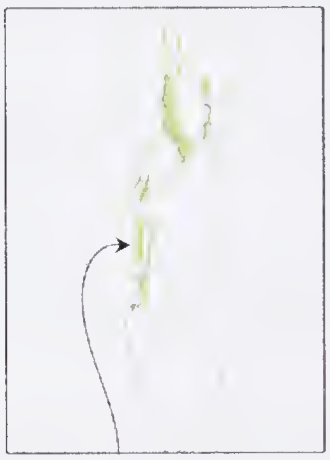
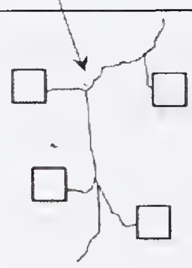
Tier 1 – this EIS **Detailed Assessment for ROWs for Main Facilities** **Programmatic Analysis of Future Facilities, Groundwater Pumping and Drawdown**			
Study Area	**NEPA Documents**	**Focus of the Analysis**	**BLM Decisions**
	*Clark, Lincoln, and White Pine Counties Environmental Impact Statement* (this EIS).	• Affected Environment described. • Detailed analysis of pipeline and power line infrastructure including construction and operation. • Programmatic analysis of groundwater pumping and conveyance. • Cumulative impacts analyzed.	• Location, alignment and extent of the ROW grant. • Notice to Proceed for construction (requires approved POD and implementation of the COM Plan). • Mitigation measures specified or proposed.
Subsequent Tiers: **Detailed Assessments for Future Facility Right-of-way and Updated Assessments for Groundwater Pumping and Drawdown**			
 Example of a cluster of 4 production wells, roads, power lines and collector lines.	Future Environmental Assessments or EISs.	• The Tier 1 EIS is incorporated by reference. • Other future NEPA preceding a specific analysis also is incorporated by reference. • Analysis focused to specific area, using more site-specific and updated information, including hydrology and monitoring. • Site-specific geographic setting and impacts.	• Location and size of ROW grants. • Notice to Proceed (requires POD and implementation of COM Plan). • Project-specific mitigation measures specified.

Figure ES-6 Overview of Tiered NEPA Analysis

2.15 Who is responsible for granting water rights?

In 1989, the Las Vegas Valley Water District applied to the Nevada Division of Water Resources (Office of the NSE) for groundwater rights in Snake, Spring, Delamar, Dry Lake and, Cave valleys. The applications were subsequently transferred to SNWA. The NSE held hearings on SNWA's applications on the latter four basins in 2011, permitting groundwater rights to SNWA in 2012. Hearings on SNWA's applications in Snake Valley have not been scheduled. The conditions of production associated with the permitted groundwater rights in the four designated basins are subject to conditions specified in Stipulated Agreements signed by appropriate Department of the Interior bureaus. The approved levels of groundwater pumping are not the BLM's decision to make but rather are the decision of the NSE. The water rights granted by the NSE do not obligate the BLM to grant additional licenses to the water rights holder to construct on, or cross, federal land.

Water rights in Nevada are administered by the Nevada State Engineer (NSE) under Nevada Revised Statute Title 48, Chapter 533. The NSE has jurisdiction to grant or deny SNWA's groundwater applications.

2.16 What are the Nevada State Engineer's responsibilities?

Nevada's first water statute was enacted in 1866 and has since been amended many times. The NSE is under the Nevada Division of Water Resources. The mission of the Nevada Division of Water Resources is to conserve, protect, manage, and enhance the State's water resources for Nevada's citizens through the appropriation and reallocation of the public waters. The NSE is responsible for gathering input and conducting a public process to evaluate the available data and testimony prior to responding to applications for water rights.

Nevada water law is based on two fundamental concepts: prior appropriation and beneficial use. Prior appropriation (also known as "first in time, first in right") allows for the orderly use of the state's water resources by granting priority to senior water rights. Nevada water law has the flexibility to accommodate new and growing uses of water in Nevada while protecting those who have used water in the past.

All water may be appropriated for beneficial use as provided in Nevada law. Irrigation, mining, recreation, commercial/industrial, and municipal uses are examples of beneficial uses, among others.

2.17 What is the Nevada water rights process?

The process to obtain a permit to develop un-appropriated groundwater or surface water begins with filing an application for a water permit with the NSE. In determining whether to grant an application, the NSE must consider if:

1) Unappropriated water exists at the proposed source of supply;
2) The proposed quantity and use of water would conflict with existing rights;
3) The proposed use of water would adversely affect domestic wells; and
4) The proposed use of the water would be detrimental to the public interest.

The BLM has no legal authority over water rights in Nevada.

The NSE has jurisdiction to grant or deny SNWA's groundwater applications in five groundwater development basins. See Nevada Revised Statute Title 48, Chapter 533 for additional factors to be considered prior to approving applications for inter-basin water transfers. More information regarding the Nevada water rights process can be found on the internet at http://water.nv.gov.

2.18 What is the relationship between the BLM environmental process and Nevada's water rights process?

There are functional interrelationships between the NEPA and NSE processes, in part because decisions and approvals made by one agency may influence the review and approval process of the other agency.

Future development proposed for locations on public lands and involving additional federal ROWs for groundwater production wells and collector pipelines would require additional environmental studies for future actions.

Figure ES-7 illustrates key points and general correspondence between the two processes.

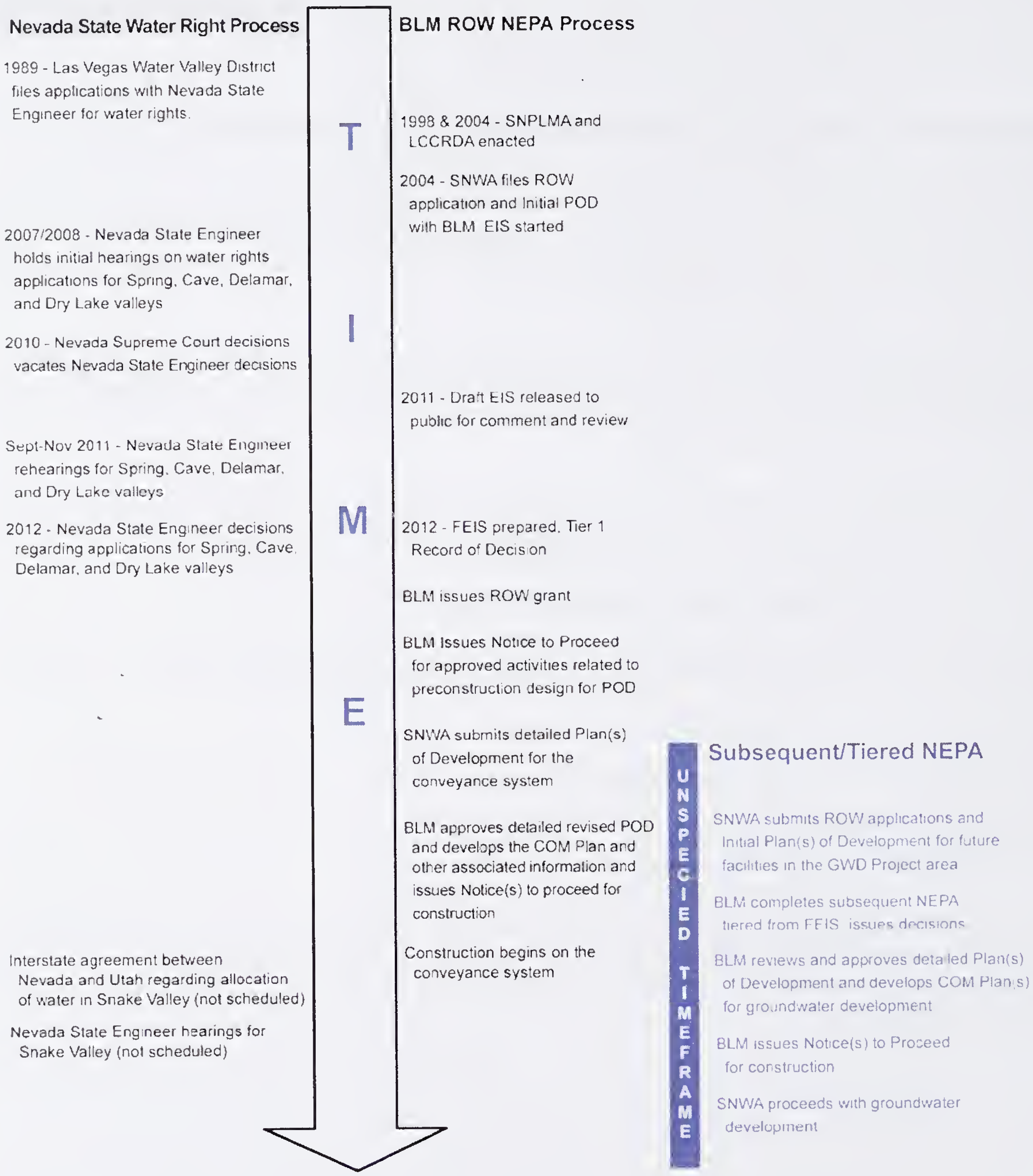


Figure ES-7 **General Timing Relationship Between the BLM NEPA and the NSE Water Rights Processes**

2.19 What were the Nevada State Engineer's rulings on the SNWA's water rights applications in Spring, Delamar, Dry Lake, and Cave valleys?

The NSE held a hearing on the Spring, Delamar, Dry Lake, and Cave valleys applications in the fall of 2011. On March 22, 2012, the NSE issued Rulings #6164, #6165, #6166, and #6167 permitting water rights to SNWA totaling up to 83,988 afy in Spring, Delamar, Dry Lake, and Cave valleys. In Spring Valley, SNWA was permitted up to 61,127 afy, in 3 stages of development (Ruling #6164). In Delamar, Dry Lake, and Cave valleys, SNWA was permitted 5,235 afy, 11,584 afy, and 6,042 afy, respectively (Rulings #6165, #6166, and #6167). All of the rulings require compliance with hydrologic and biological monitoring and mitigation plans, preparation of annual reports, completion of baseline studies, and periodic updating of a groundwater flow model.

State Water Rights Hearings

The NSE held hearings on SNWA's applications for water rights in the Spring, Delamar, Dry Lake, and Cave Valley basins in 2011, issuing decisions approving the applications in March 2012. Hearings for the Snake Valley application are not presently scheduled.

The NSE has not identified a schedule for the Snake Valley water rights proceedings.

2.20 What controversies are associated with this Project?

The BLM recognizes that there are differing opinions among experts and others on a variety of issues regarding SNWA's GWD Project. Conflicting ideas and areas of controversy related to this project include:

- Potential climate change effects on long-term water needs and availability;
- Water need and availability and the equity of water transfers;
- Groundwater modeling and results, including use of faults as barriers to flow;
- The timing and significance of possible future impacts in Snake Valley and vicinity of GBNP; and
- The relationship of groundwater to economic and population growth in the Las Vegas Valley.

While recognizing these controversies, it should be noted that many aspects of these issues are outside the jurisdiction of the BLM.

3. Environmental Consequences – Tier 1 Facilities

3.1 What project facilities and effects does this EIS address?

The SNWA current ROW request covers only the main conveyance pipeline, three lateral pipelines, power lines, and ancillary facilities. Details regarding future facilities for groundwater development, including the number and location of wells, presently are unknown. The Final EIS includes both the site-specific analysis for the mainline conveyance system and a programmatic analysis for future facilities, including the long-term effects of groundwater production (see Sections 4 and 5 of this Executive Summary).

3.2 How would the Project be constructed?

Standard pipeline, power line, and facility construction techniques would be used. Descriptions of construction methods and procedures, including manpower and equipment estimates, are provided in SNWA's POD in **Appendix E** of the Final EIS.

Appendix E
SNWA's POD

The ROW boundaries would first be surveyed and staked. Plant and topsoil salvage would occur and the ROW would be cleared as required for the type of construction. Access roads within the ROW would be constructed or improved at the beginning of construction. Portable sanitation and water storage facilities would be provided for construction personnel.

Pipeline construction would use a standard cut and cover technique, with an open trench, in most locations. **Figure ES-8** depicts a general layout of facilities and cut-and-cover construction within the ROW. Pipe sections would be placed and welded, and the trench backfilled and compacted. Blasting might be necessary if caliche (consolidated calcium carbonate layer) or large boulders are encountered during excavation. At stream crossings with flowing water, construction would either involve jack-and-bore under the channel or open-cut with temporary diversion of water flow, in accordance with applicable laws.

The SNWA Proposed Action calls for a main pipeline of up to 96 inches in diameter. The pipeline could be resized during final design. For this analysis, it is assumed that neither the ROW width or amount of temporary disturbance would be affected by the diameter of the main pipeline.

The regulating tanks and access roads would be constructed in conjunction with the pipelines.

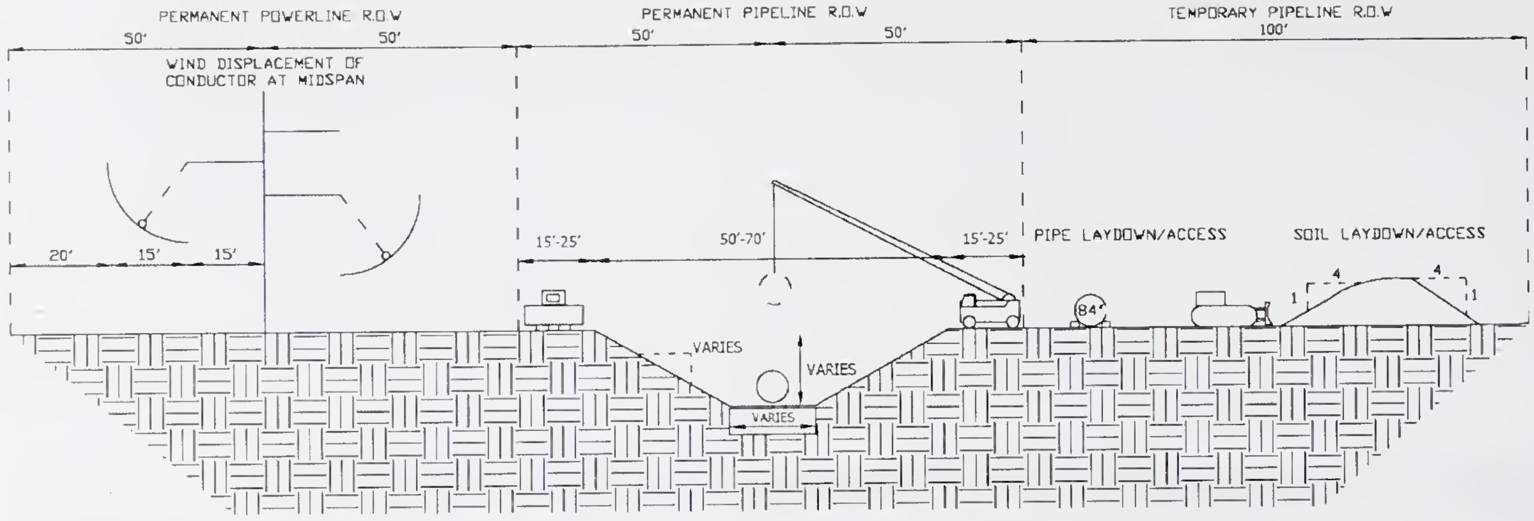


Figure ES-8 Preliminary Pipeline and Power Line ROW Cross Section

Water would be required for dust control, pipe bedding, trench backfill compaction, hydrostatic testing, and other purposes. The SNWA assumes that this water would be obtained from existing or exploratory wells drilled at the time of construction. A construction water supply well would be needed approximately every 10 miles along the pipeline alignment. If needed, additional temporary water wells would be drilled within construction staging areas. Hydrostatic testing would be conducted to pressure-test the pipeline when construction is completed; this testing might be done as individual segments are completed.

Figure ES-9 illustrates typical power line configurations. Power line construction would not require clearing and grading the entire ROW. Work sites of up to 0.5-acre would be cleared for each power pole location and an access road or road spur to the pole location would be rough-graded. A truck-mounted rotary auger would bore the pole locations, and then install the poles on site. Conductor lines would be strung using conventional tensioning equipment. Electrical equipment would be tested and the power lines energized after being connected to substations and facilities.

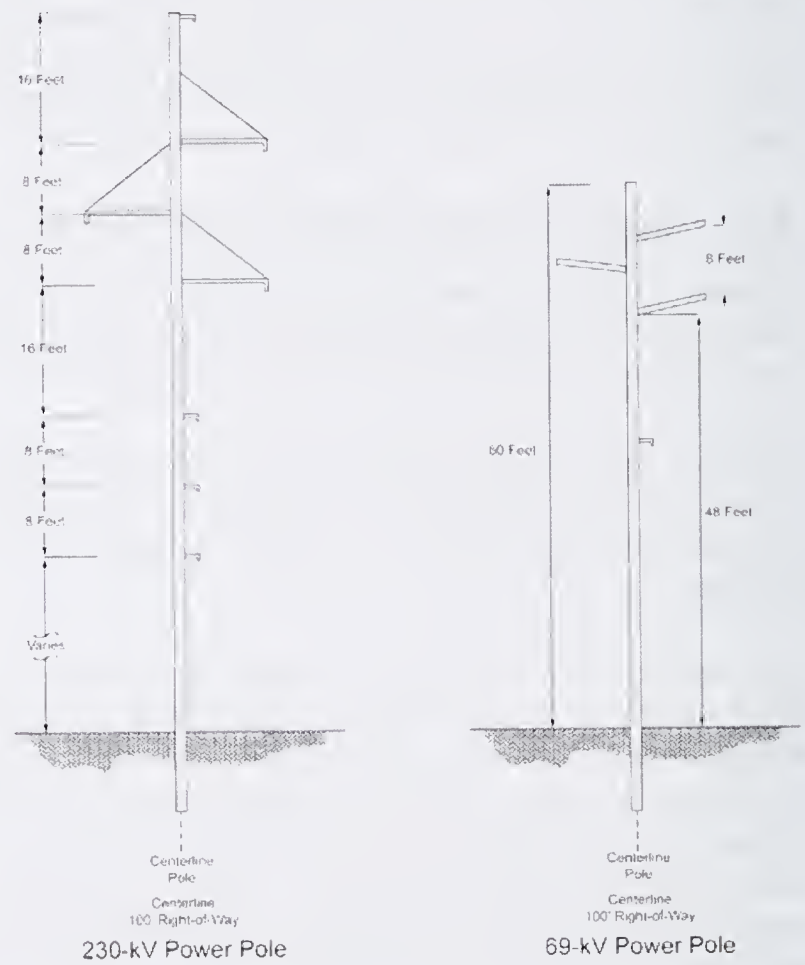


Figure ES-9 Typical Power Pole Designs

Ancillary facility sites would be staked and then plant and topsoil salvage would be conducted and the sites would be cleared, graded, and fenced. Excavation would be conducted as needed, and then the structures would be installed on site. Following the completion of construction, the temporary ROWs would be reclaimed.

The service life of water pipelines is estimated at 65 to 95 years. Future replacement of substantial portions of the pipeline would require additional approvals from the BLM and may be subject to additional NEPA. Future reclamation and abandonment of the ROW would be subject to approval by the BLM.

3.3 What is the schedule for Project construction?

During the time the Draft EIS was being prepared, SNWA had assumed that ROW grants and permits, and rulings by the NSE on SNWA's water applications would occur by early 2012, followed by the initiation of construction. Given the requirements to develop a final POD and implement the COM Plan, the need to obtain other permits, and other factors, SNWA has not identified a revised date for the anticipated beginning of project construction.

Actual construction of the project could be deferred for several years, accelerated, or be completed in phases depending on SNWA's needs for water, securing project financing, and other factors. The following is a conceptual construction sequence for the project.

For purposes of this EIS, a 12-year project construction schedule is assumed for the Proposed Action. That schedule is outlined in SNWA's POD (**Appendix E**), but is not tied to a specific start date.

The estimated annual number of direct construction jobs over the 12-year period, which provide an indication of the level of construction activity, is shown in **Figure ES-10**. Construction would likely be year-round, although seasonal wildlife stipulations may preclude activity in specific locations during certain periods.

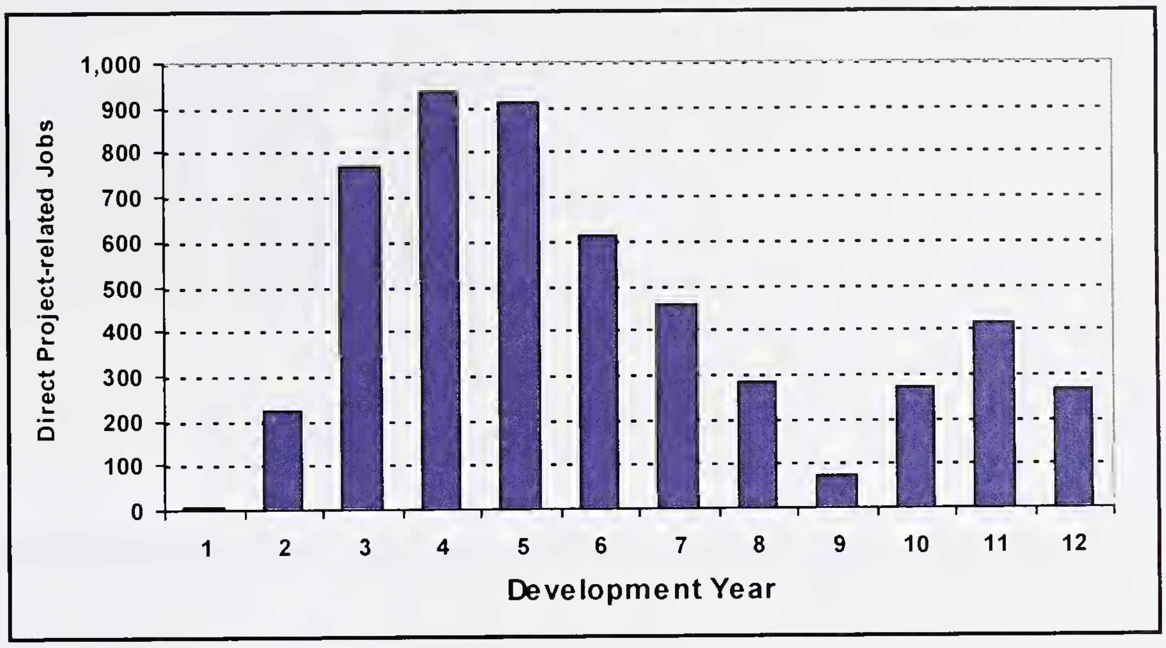


Figure ES-10 Projected Direct Construction Workforce – Proposed Action

Construction of the project would begin at the southern terminus, where the pipeline would connect to the SNWA's existing system, proceeding generally northward into Lincoln County. Construction of the main pipeline and transmission facilities to the juncture for the Spring and Snake Valley laterals would occur by year 8. An additional 2 years would then be required to complete the Spring Valley lateral and pump stations, followed by completion of the Snake Valley lateral and pump stations in year 12. The water treatment facility, buried water storage reservoir, and connections to SNWA's existing system would be completed within the first 4 or 5 years. Conveyance of water through the system is not contingent upon completion of the entire system, but could begin following completion of system and associated groundwater production facilities in the Delamar, Dry Lake, and Cave valleys.

Construction employment would increase over the first 3 years, peaking in year 4, when construction of the pipeline and water treatment, storage, and other facilities in Clark County would occur concurrently (**Figure ES-10**). Construction employment would decline for 5 or 6 years thereafter until increasing for completion of the Snake Valley lateral. Construction of the conveyance system associated with Alternatives D, E, and F could be accomplished in a shorter time period.

3.4 How much would the overall GWD Project cost to build and how would project activities be financed?

SNWA's project costs do not factor into BLM's decision on the ROW application. A cost summary for the Proposed Action and EIS alternatives is presented in the Final EIS in response to public comments to the Draft EIS.

Development of the proposed system would require major capital investment on the part of the SNWA. SNWA presented conceptual construction cost and financing information for the project at the NSE's hearing on the Authority's water rights applications in the Spring, Delamar, Dry Lake, and Cave valleys. That information outlined a conceptual construction cost estimate of $3.22 billion; expressed in terms of 2007 dollars (SNWA 2011). That sum did not include contingencies, long-term financing costs, or implementation of the COM Plan.

A more recent estimate for the Proposed Action, prepared by SNWA for the EIS, is $3.87 billion. Corresponding cost estimates for the EIS alternatives range between the $3.87 billion for the Proposed Action and a low of $2.42 billion for Alternative D (**Figure ES-11**); a 37 percent difference. However, because the two alternatives also vary in the amount of water conveyed, it should not be interpreted that the differences represent savings, or a lower cost option.

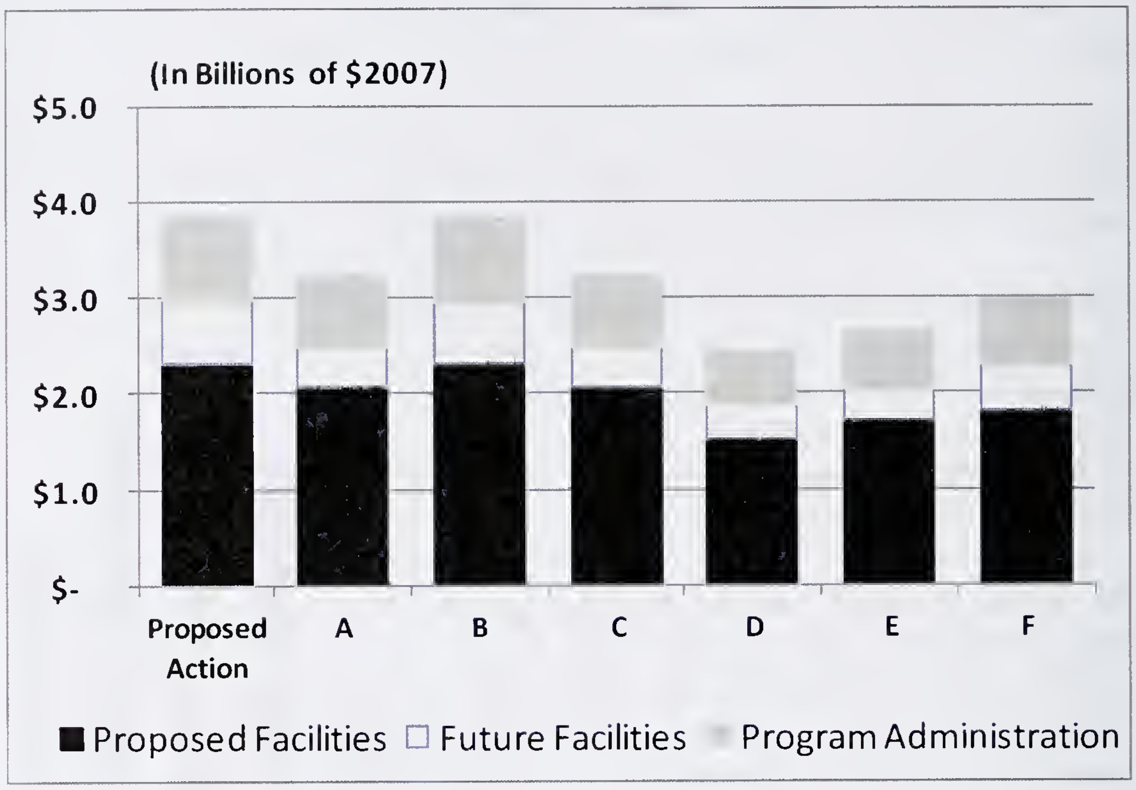


Figure ES-11 Conceptual Construction Costs for the EIS Alternatives

The SNWA recently adopted a 3-year infrastructure surcharge, effective April 2012, to help pay for large water system projects, such as the GWD Project. The financing plan indicates that water commodity charges would need to increase substantially over the life of the project to provide the necessary debt service.

3.5 What methods were used to assess potential environmental effects?

Environmental effects for construction and operation of the pipeline and other facilities were based on an understanding of the location, extent, and timing of development.

The first step in assessing the potential environmental impacts was to define the geographic area likely to be affected and to understand the current environmental and socioeconomic conditions within that area. For the GWD Project, this study area includes the ROW corridors and nearby areas because some potential effects may extend beyond the immediate facility construction area.

The ROW corridors and facility locations proposed by the SNWA were mapped using data from geographic information system and other sources. This information yielded estimates of the extent and location of temporary and long-term surface disturbance. These maps were then used to focus the collection, compilation, and analysis of data for resources that may be affected by the project.

Methods and assumptions for impact analysis were developed for each resource. Impacts to resources were then determined and interpreted in terms of magnitude, duration, context, and intensity (BLM NEPA Handbook 2008). The estimated impact levels were then reassessed considering the effects of application of the BLM RMP Management Actions, BMPs and ACMs. Additional mitigation measures were developed and applied to certain impact issues (See Section 3.6 of this Executive Summary).

Conclusions concerning residual impacts after application of protection measures and mitigation measures were prepared. Quantified impact results were displayed in figures and tables to allow a comparison of alternatives. Impact summaries are included at the end of Chapter 2 in the Final EIS.

3.6 How does the EIS address mitigation of potential short and long-term environmental effects?

The anticipated effects from project construction and maintenance on a particular resource were evaluated to determine how effects could be avoided or reduced through the application of monitoring, management, and mitigation measures. Four sources of protection or mitigation were considered; the BLM management direction established in management documents, RMP management actions, BMPs, ACMs, and additional mitigation.

BLM Best Management Practices

BMPs *are state-of-the-art mitigation measures applied to help ensure that facility development is conducted in an environmentally responsible manner. BMPs protect wildlife, air quality, and landscapes as we work to develop vitally needed minerals, energy, water, and other resources.*

BMPs have been identified for implementation as part of the GWD Project (see **Appendix D** of the Final EIS)

Air Resources • Water Resources • Soil Resources • Vegetation Resources • Fish and Wildlife
Special Status Species • Wild Horses • Cultural Resources • Paleontological Resources
Visual Resources • Travel Management and Off-Highway Vehicle Use • Recreation • Livestock Grazing
Fire Management • Noxious and Invasive Weed Management • Health and Safety

The BLM Ely District RMP (2008) and the BLM Las Vegas RMP (1998) provide management direction for all BLM-managed lands that would be occupied by the GWD Project facilities. The Ely District RMP management actions, BMPs, and U.S. Fish and Wildlife Service's Biological Opinion terms and conditions applicable to the GWD Project were identified. Las Vegas RMP management actions also will be identified.

In addition to implementing BLM RMP Management Actions and BMPs, SNWA has agreed to an extensive series of ACMs in conjunction with the GWD Project. The SNWA's ACMs address construction procedures and operational practices, and identify specific mitigation to address potential environmental resource impacts. The ACMs include measures to address future development, operations, and regional water-related effects. The resources and topics addressed by one or more ACMs are listed in the adjacent box.

APPLICANT-COMMITED MEASURES

A. **ROW Measures**
1. General Construction Measures
2. General Operation Practices
3. Geologic Hazards and Soils
4. Water Resources
5. Biological Resources
6. Paleontological Resources
7. Cultural Resources
8. Land Use and Range Management
9. Noise
10. Air Quality
11. Visual Resources
12. Socioeconomics

B. **Programmatic Measures – Future ROWs**
1. Planning and Design
2. General Construction Practices
3. General Operation Practices
4. Water Resources
5. Biological Resources

C. **Regional Water-Related Effects**

D. **Measures from SNWA Agreements and NSE Permit Conditions**

Two critical measures include:

- SNWA must complete a detailed POD, to be approved by the BLM, for the ROW noted in the ROD for the main pipeline and associated facilities. Additional PODs and specific plans will be required for subsequent NEPA tiers. The detailed construction, operation, and monitoring plans will incorporate all BLM RMP Management Actions, BMPs, ACMs, and other required mitigation contained in the ROD or other decision documents. The BLM will prepare the COM Plan before issuing a Notice to Proceed for any construction or surface disturbance activity. This COM Plan will include an interagency process for the setting of monitoring parameters and triggers with related measures to mitigate adverse effects.
- The general extent of regional water-related effects associated with the proposed groundwater withdrawal for the GWD Project is estimated using groundwater modeling. Because the precise nature, extent, timing, and location of

water-related effects cannot be determined, SNWA has identified ACMs that may be implemented, as needed, to avoid, minimize, or mitigate potential water-related effects associated with future withdrawals. ACMs include a series of monitoring, management, and mitigation plans, conservation agreements, and adaptive management plans to address adverse effects associated with groundwater production. These will be further analyzed during NEPA review processes in the future. A complete listing of SNWA ACMs for this project can be found in **Appendix E** in the Final EIS.

3.7 What are the environmental impacts of implementing the three main conveyance pipeline alignments?

There are relatively few major surface disturbance differences among the GWD Project alignments because all three main pipeline ROWs would be the same for most of their respective lengths.

The environmental impacts include the effects to natural and human resources from surface disturbance and the human and mechanical activities associated with creating that disturbance and reclamation. The extent of many of the environmental effects associated with pipeline and associated facilities construction depend on the length and width of the ROW and the temporary disturbance during construction, and later, the permanent disturbance after reclamation. In this case the three major ROW alignments are the same from Clark County to the White Pine County line. The differences in environmental effects among alignments are largely related to the Spring and Snake valley laterals. ROW requirements for roads and power lines among the three ROW alternatives also would factor into differences in impacts. **Figure ES-12** illustrates the pipeline ROW miles and acres of temporary disturbance for the three main ROW alignments.

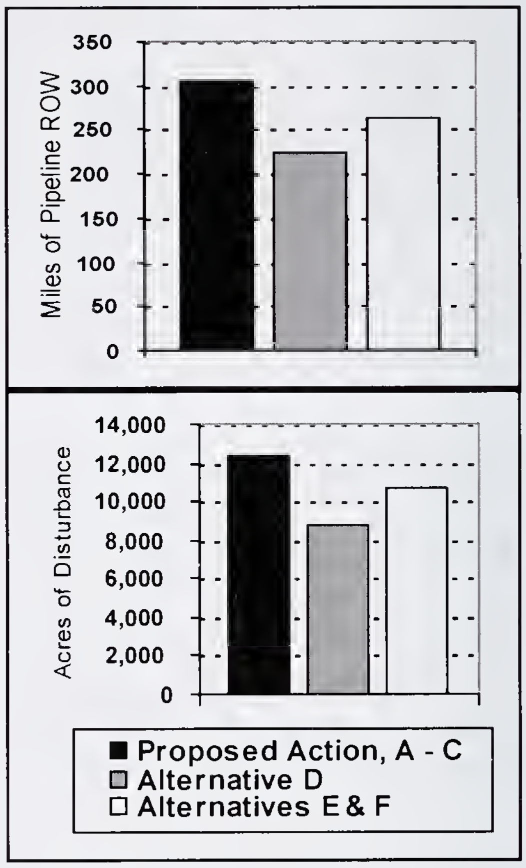


Figure ES-12 Pipeline ROW and Temporary Disturbance

Approximate differences between the Proposed Action alignment and the alternatives are:

- Alternatives A, B, and C are the same as the Proposed Action,
- Alternative D is 28 percent lower in terms of acres of surface disturbance and 26 percent lower in terms of the miles of pipeline ROW, and
- Alternatives E and F are 13 percent less in terms of both surface disturbance and miles of pipeline ROW.

A summary of the environmental impacts from construction related to the Proposed Action main pipeline and associated facilities follows. Generally, compared to the Proposed Action, impacts would be less and would occur over shorter periods of time for Alternatives D, E, and F. There would be few environmental impacts in White Pine County under Alternative D. Under Alternatives E and F, environmental effects would extend into northern Spring Valley, but not into Snake Valley.

The summary that follows includes the effects for the Proposed Action and Alternatives A through C. Unless differences are identified for Alternatives D, E, and F, the expected effects are similar for all alternatives.

Air Quality and Atmospheric Resources:

See Section 3.1

- Air pollutant emissions related to construction, disturbance and reclamation associated with activities on approximately 12,288 acres over an 11-year period. Emissions are expected to be less for Alternatives D, E, and F because of smaller surface disturbance areas, and fewer pipeline miles.
- Minor increase in air pollutant emissions, including greenhouse gas emissions, from operation and maintenance activities.

Geologic/Paleontological Resources

See Section 3.2

- Some scientifically valuable fossils may be disturbed and lost during excavation and ROW grading.

Water Resources:

See Section 3.3

- A temporary channel alteration resulting in temporary water quality effects would occur on one perennial stream crossed by the pipeline ROW. There would be no perennial stream crossings by the pipeline ROW under Alternatives D, E, and F.
- Water quality effects may occur on two perennial streams crossed by the power line ROW. No perennial streams would be crossed by the power line ROW under Alternatives D, E, and F.
- There is a potential for channel alteration and water quality effects on numerous intermittent and ephemeral streams by the pipeline and power line ROWs.

Soil Resources:

See Section 3.4

- Short-term disturbance would occur on the following number of acres of sensitive soils: highly wind erodible (1,474), highly water erodible (614), compaction prone (123), and vegetation growth limitations (10,568).
- Short-term disturbance of approximately 2,335 acres of land with prime farmland characteristics may occur. Under Alternative D, 2,295 acres of lands with prime farmland characteristics may occur, compared to 2,350 acres under Alternatives E and F.

Surface Disturbance

Up to 12,288 acres of surface disturbance would occur (Proposed Action or Alternatives A through C).

Disturbed areas that do not support aboveground facilities would be reclaimed as soon as construction segments are completed.

Permanent disturbance would be less than 1,000 acres for all alternatives.

Vegetation:

Section 3.5

- Clearing of approximately 12,288 acres would be required during construction, with 11,289 acres to be reclaimed. Alternative D would require clearing of 8,828 acres during construction with 8,020 acres reclaimed. Alternatives E and F would require clearing 10,681 acres during construction with 9,736 acres to be reclaimed.
- Temporary clearing would increase the potential for spread of noxious weeds by construction traffic, particularly in and near cleared areas.
- Construction activities would result in increased risk of wild land fires.
- The areas of temporary disturbance include some suitable habitat for six BLM sensitive plant species.
- There would be some loss of yucca and cacti during salvage, interim storage, and subsequent replanting.

Wildlife Resources:

See Section 3.6

ROW vegetation clearing would affect important big game range in the project area. The majority of the affected areas would be located in northern portions of the study area. The estimated affected areas include:

- antelope (7,952 acres),
- elk (4,019 acres),
- mule deer (3,917 acres), and
- desert bighorn sheep (259 acres).

Less big-game range would be affected under Alternatives D, E, and F. The affected areas for those alternatives are as follows:

- Alternative D: antelope (4,571 acres), elk (2,704 acres), mule deer (2,949 acres), and desert bighorn sheep (260 acres).
- Alternatives E and F: antelope (6,345 acres); elk (4,019 acres); mule deer (3,547 acres), and desert big horn sheep (260 acres).

- ROW vegetation clearing would alter habitats for special status wildlife species, including desert tortoise, sage-grouse, pygmy rabbit, western burrowing owl, bald eagle, golden eagle, ferruginous hawk, bats, dark kangaroo mouse, Gila monster, and Mojave Poppy Bee. Habitat alterations for Mojave Poppy Bee would be the same, but habitat alterations for the other special status wildlife species would be reduced for Alternatives D, E, and F.
- Potential effects associated with the electrical power lines include bird collisions, electrocution, and increased predation on desert tortoise, pygmy rabbit, and other wildlife species by raptors.

Aquatic Biology:

See Section 3.7

- Habitat alteration and potential water quality effects would occur on one perennial stream containing game fish species crossed by the pipeline ROW under the Proposed Action. There would be no perennial stream crossings by the pipeline ROW under Alternatives D, E, and F.
- No springs with aquatic biological resources are located in ROWs for any of the alternatives.
- Temporary water quality effects could occur in two perennial streams containing game fish species crossed by the power line ROW. No perennial streams would be crossed by the power line ROW under Alternatives D, E, and F.
- Potential habitat alteration and water quality effects on numerous intermittent streams potentially containing macroinvertebrates crossed by the pipeline and power line ROWs.
- Potential amphibian mortalities could occur near waterbodies crossed by vehicles.

Land Use:

See Section 3.8

- ROW vegetation clearing would affect surface uses (grazing and recreation) on 12,288 acres of land, 97 percent of which is managed by the BLM. Up to 999 acres would be converted for aboveground facility uses which would preclude existing uses. ROW clearing would be less for Alternatives D, E , and F (see Section 3.5, Vegetation Resources).
- Short-term disturbance would occur over several years, with reclamation occurring once all construction in a segment is completed.
- BLM lands for disposal would not be limited by ROW construction or operation.
- Approximately 25 percent of the estimated short-term disturbance would be located outside of designated utility corridors. Approximately 10 percent of the Alternative D disturbance would be located outside of designated utility corridors. For Alternatives E and F, approximately 15 percent would be located outside of disignated utility corridors.
- ROWs and ancillary facilities would cross two ROW avoidance areas – Coyote Springs and Kane Springs Areas of Critical Environmental Concern (ACEC) – where additional stipulations may be imposed.

Recreation:

See Section 3.9

- Construction activities in some locations may result in short-term conflicts with off-highway vehicle race routes.
- ROW vegetation clearing would affect some lands within the Caliente Special Recreational Permit, Chief Mountain Special Recreational Management Area, Las Vegas Valley Special Recreational Management Area, Loneliest Highway Special Recreational Management Areas, Pioche Special Recreational Permits, and Steptoe Valley Wildlife Management Area A. The Loneliest Highway and Steptoe Valley Special Recreational Management Areas would not be crossed under Alternative D.
- Short-term interference with hunting access and other dispersed recreation use on public lands, with the location of such interference shifting over time as construction moves along the ROW.
- Long-term effects on recreation would result from alteration of the recreational setting with above-ground structures and vegetation alteration.
- Project road improvements would result in an increased potential for off-highway vehicle route proliferation and unauthorized public use of project ROWs that could degrade the recreation setting.

Transportation:

- Construction would result in short-term increases in vehicular traffic on roads and highways in the area, resulting in increased risk for vehicular accidents, vehicle/animal collisions, and traffic delays. Long-term effects would be limited due to relatively low maintenance and operation-related traffic numbers.

See Section 3.10

Minerals:

- Potential short-term access restrictions to ongoing mineral extraction sites until roadways are restored after construction is completed.

See Section 3.11

Rangeland:

- ROWs for the Proposed Action and Alternatives A through C would cross 23 grazing allotments; resulting in surface disturbance to 10,544 acres during construction. Alternative D would cross 14 grazing allotments and Alternatives E and F would cross 20 allotments. The total area of surface disturbance would be 7,083 acres for Alternative D and 8,937 acres for Alternatives E and F.
- Following reclamation, there would be permanent commitment of 708 acres in 18 allotments associated with aboveground facilities for the Proposed Action and Alternatives A through C. Permanent land commitments for Alternative D would affect a total of 564 acres in 11 allotments, while 562 acres in 16 allotments would be the permanent disturbance for Alternatives E and F.

See Section 3.12

Wild Horses:

- ROW vegetation clearing would affect 3,015 acres in 2 wild horse management areas, and long-term aboveground facility commitments of 164 acres within 2 herd management areas. Short term construction activities could affect movement and forage use by wild horse herds within herd management areas. Due to the location of the herd management areas, the same effects would occur under Alternatives D, E, and F.

See Section 3.13

Special Designations:

- ROW vegetation clearing would affect two special designation areas: Coyote Spring ACEC and Kane Springs ACEC. Due to the locations of these special designation areas, the same effects would occur under Alternatives D, E, and F.

See Section 3.14

Visual Resources:

- Given climatic constraints on successful re-vegetation, potential visual impacts resulting from changes in woody vegetation in disturbed areas would be visible in the long term until woody vegetation becomes re-established, especially in the linear pipeline/power line ROW.
- While texture and color contrasts might be partially mitigated by using appropriate earth-toned building materials and colors, in general, new buildings, structures, and their shadows would be prominent in the landscape foreground.
- The scale of linear aboveground and surface-disturbing activities (across more than 300 miles), high visibility from scenic byways and special designation areas, and long duration within view from Highway 93 would result in long-term visual impacts from sensitive viewpoints.
- Although outside the GBNP boundary, the surface disturbance associated with the Proposed Action, and Alternatives A, B, C, E, and F facilities would not meet the intent of National Park Service scenery management objectives for GBNP. Alternative D facilities would be located entirely within Lincoln County, and 15 or more miles from the nearest GBNP boundary.

See Section 3.15

Cultural Resources:

- Potential adverse effects to sites listed in the National Register of Historic Places would be mitigated prior to construction.
- Some unanticipated discoveries and potential loss of cultural resources would occur during construction.
- Accidental disturbance, vandalism, and illegal collecting most likely would occur where the proposed GWD Project may result in increased public areas.

Section 3.16

Native American Traditional Values:

- Potential short- and long-term effects to traditional cultural properties, sacred sites, and areas of cultural or religious importance could occur during the construction period.

Section 3.17

Socioeconomics:

- Temporary gains in employment, income, population, and related effects would occur, with the focus of activity shifting over time, from south (Clark County) to north (southern White Pine County).
- Short-term demand for temporary housing may exceed availability especially in Lincoln County.
- Short-term demands on local law enforcement and emergency services may strain capacity in rural communities.
- Fiscal pressures on budgets could result in White Pine and Lincoln counties due to temporary demand on county services. Project construction would generate substantial sales and use taxes, some of which would accrue to these affected local governments.
- The existing agreement between SNWA and White Pine County provides payments in lieu of taxes to cover reductions in tax revenues associated with SNWA purchases of private ranches.
- SNWA facilities would be exempt from local property taxes.
- Limited direct long-term employment, population, or population related effects would occur during operations.
- Onset of construction of the project would be a "signal" event, with potentially widespread and long-term social concerns related to quality of life and outlook for the future, both from opponents and proponents of the project. In the rural areas, the effects are likely to be perceived as negative; in the Las Vegas Valley perceptions would be more favorable. The perception of long-term social effects in the rural areas would be lower in White Pine County under Alternatives D, E, and F.

Section 3.18

Socioeconomic Effects

Short-term: increases in jobs, income, demand for temporary housing, demand on law enforcement and emergency medical services, effects on individual and community social conditions.

Alternatives D, E, and F would result in fewer social and economic effects in White Pine County, particularly Snake Valley.

Long-term: Social and economic effects directly related to system operations would be limited.

Public Health and Safety:

- There would be a short-term potential for spills or leaks from use of hazardous materials mostly consisting of fuels and lubricants during construction and operation.

Section 3.19

3.8 Four localized alignment options are analyzed. What are they and how would the environmental effects differ with these options?

The EIS assesses the potential environmental effects of four localized alignment options. Each option involves a selected segment of the main pipeline or power line alignments. Each of these options involves potential trade-offs in terms of environmental effects; some also depend on factors beyond SNWA's or the BLM's control, e.g., completion of another transmission line. **Table ES-3** below describes the options, the rationale for each option, and the compatibility of a specific option with each of the 3 major ROW alignments. **Figure ES-13** shows the locations of these localized alignment options.

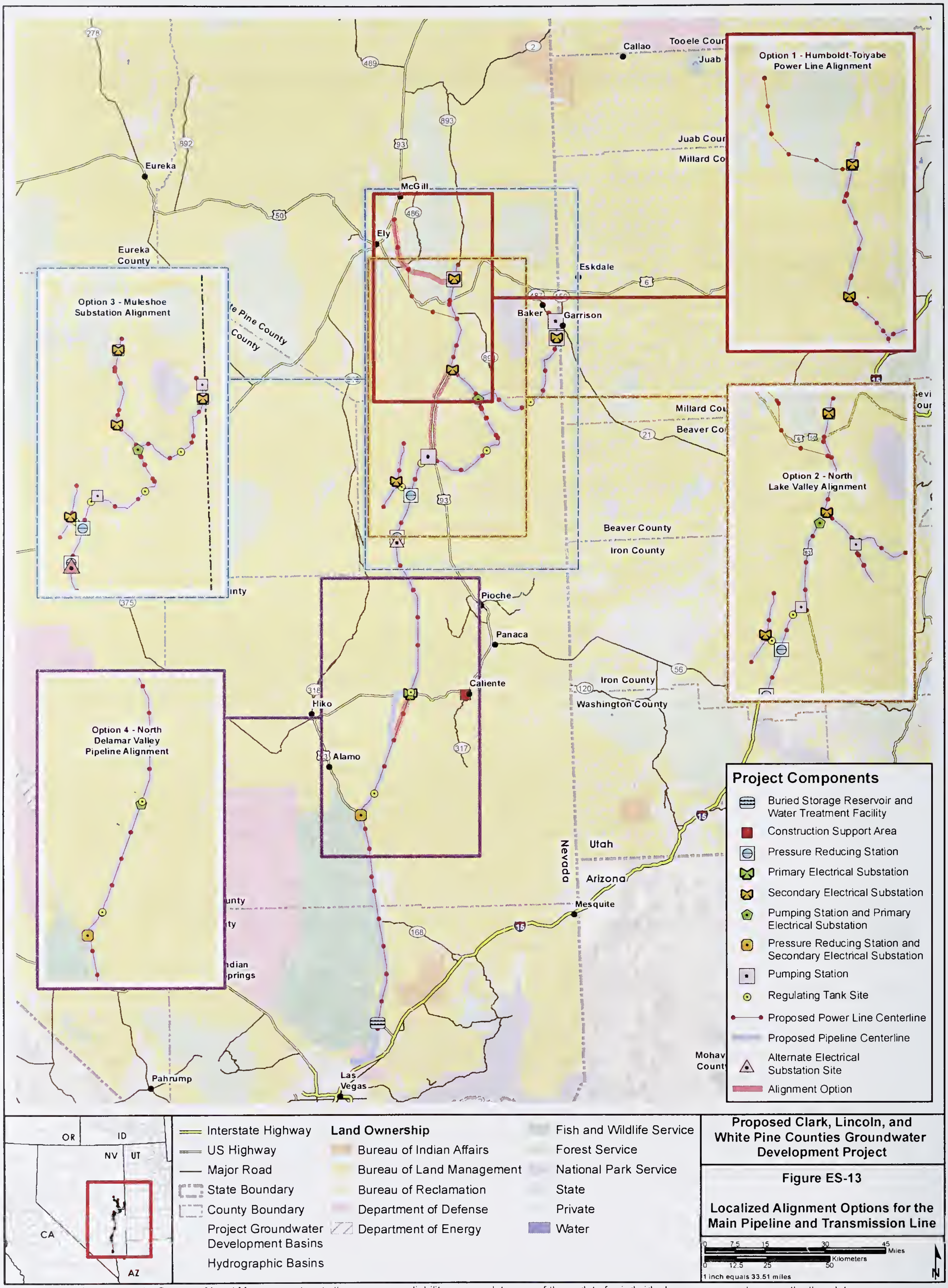
Table ES-3 Local Alignment Options

Alignment Option	Option Description/Rationale	Would the Option Be Compatible with the Following ROW Alignment Alternatives?		
		Proposed Action and Alternatives A through C	Lincoln County Conservation, Recreation, and Development Act (Alternative D)	Spring / Delamar, Dry Lake, and Cave (Alternatives E and F)
1	**Humboldt-Toiyabe Electrical Power Line Alignment:** Locate the Gonder to Spring Valley segment of the electrical power line in an existing corridor across U.S. Forest Service land to reduce new disturbance. It would also limit disturbance in sagebrush habitat and the species dependent on that habitat.	Yes	No	Yes
2	**North Lake Valley Pipeline and Electrical Power Line Alignment:** Locate a segment of the main pipeline and power line within an existing transportation utility corridor (U.S. 93).	Yes	No	Yes
3	**Muleshoe Substation and Power Line Alignment Option:** Utilize an alternative electrical power supply from a new regional transmission line, thereby avoiding construction of the Gonder to Spring Valley power line.	Yes	No	Yes
4	**North Delamar Valley Pipeline Alignment:** Locate segments of both the pipeline and power line within the Lincoln County Conservation, Recreation, and Development Act corridor to reduce new disturbance.	Yes	Yes	Yes

Note: Alignment Options 1 and 3 are mutually exclusive.

Because of the localized nature of these alignment options, the differences in environmental consequences also are localized. Although these options result in minor net changes in the overall surface disturbance, the location changes also affect a variety of resources. After consideration of the potential resource effects of implementing each option, the following are brief conclusions concerning the tradeoffs as compared to the Proposed Action, and other applicable alternatives:

- Alignment Option 1 - Humboldt-Toiyabe Power line. This option provides an opportunity to reduce both surface disturbance area and visual resource effects to scenic byways by locating the transmission line in an existing U.S. Forest Service transmission line corridor. By routing along an existing utility corridor, this option would also reduce disturbance in new sage brush habitat and to the species (e.g., sage grouse) dependent on that habitat. The options also would avoid passing within 4 miles of 3 active sage grouse leks.
- Alignment Option 2 - North Lake Valley Pipeline. This option allows reduction in transmission line voltage, but increases the number of aboveground facilities near and adjacent to Highway 93, thereby increasing the overall project visibility from a scenic byway. This alignment would result in additional impacts to one perennial stream and three springs compared to the Proposed Action.
- Alignment Option 3 - Muleshoe Substation. This option would eliminate the need for constructing a 230-kilovolt transmission line from Gonder Substation to Spring Valley, with a consequent reduction in long term visible surface disturbance in the vicinity of a scenic byway, and an overall reduction of wildlife habitat disturbance. The feasibility of this option is substantially improved by the current construction of the ON Line Transmission Project where the Muleshoe Substation would interconnect, however, it is dependent on whether SNWA could obtain power supply contracts with ON Line.
- Alignment Option 4 - North Delamar Valley Pipeline. This option would reduce the overall surface disturbance effects to Mojave Desert shrublands (including mature Joshua trees) by using an existing utility ROW. However, this option would require construction of a new pumping station which would be located very close to Highway 93, adding a new aboveground structure that would be visible to highway travelers.



No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

3.9 What cumulative surface disturbance impacts are anticipated in conjunction with the Tier 1 aspects of the GWD Project?

Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7).

Interrelated projects and actions defined for this EIS are those past, present, and reasonably foreseeable future actions that could interact with the Proposed Action. The cumulative effects analysis for the EIS is separated into two parts; those with potential to interact with the Tier 1 facilities in terms of surface disturbance (this section) and those with potential to interact with groundwater development (pumping [see Section 5]). The primary unit of geographic analysis is the hydrographic basin, specifically those basins where surface disturbance from project-related activities would be anticipated.

Tier 1 Project Facilities

This analysis focuses primarily on the interactions of:

1) GWD Project facilities; mainline pipeline, ancillary facilities, and future facilities;
2) Past and present actions: existing energy and transportation infrastructure, areas burned by large wildfires, current land uses (mining, grazing, and recreation); and
3) Surface disturbing projects and activities that meet the reasonably foreseeable criteria for inclusion.

Section 2.9

Past and Present Actions for the Cumulative Analysis
(see Section 2.9 of the Final EIS for more information)

Roads and Railroads • Populated Places • Agricultural Lands • Wildland and Forest Fires
Vegetation treatment areas • Mining districts • Section 386 Energy Corridors Zones • ROWs

Reasonably foreseeable future actions were compiled to determine overlapping relationships with the GWD Project. An initial screening of reasonably foreseeable future actions used a variety of resources:

- The BLM Ely District and Las Vegas District pending project lists;
- The Nevada Division of Environmental Protection list of mining projects;
- The Nevada Wind Energy Projects list;
- Projects that are addressed in the cumulative impact sections of other water project NEPA analysis (e.g., Kane Springs Groundwater Development EIS [BLM 2008]) in the area of interest;
- Internet and literature searches; and
- Pending Utah projects gathered from the BLM Fillmore and Cedar City web sites.

The project lists and descriptions were then reviewed and compared to the following three criteria to determine the projects to be included in the cumulative analysis.

1. If a project is subject to an existing proposal, such as the filing with BLM of a ROW application or plan of development, the cumulative impact analysis should describe the types of facilities, land requirements, and other infrastructure needed (roads, electrical service, water). In general, evidence of project viability, funding and progress show that the project is highly probable.
2. If a proposed project has been approved and may already be underway, those facts could also be included in the cumulative impacts analysis.

3. Development on private land that shows evidence of project viability, funding and progress, based on filings with local governments, evidence of construction from aerial photo reviews, or other documented information should also be included in the cumulative impacts analysis.

Based on these criteria the following reasonably foreseeable projects and associated development areas (hydrologic basins) were identified.

Wilson Creek Wind Project: Located between southern Spring and northern Lake Valley within an overall proposed development area of approximately 31,000 acres.

Spring Valley Wind Project: Located north of the intersection of Highways 93 and 6&50 in Spring Valley within an overall development area of 7,653 acres.

ON Line Transmission Project: Located in a 200-foot-wide ROW within an approved BLM utility corridor between a substation west of Ely and a terminus at the Harry Allen Power Plant in Clark County.

Kane Springs Valley Groundwater Development Project: This groundwater development and pipeline system is located in Kane Springs and Coyote Spring valleys northeast of the Lincoln/Clark County line, Nevada. Other residential, commercial, industrial, and recreational development also will occur in the Coyote Springs Investments development.

Coyote Springs Development: Located east of U.S. Highway 93 near the Lincoln-Clark County line, the development consists of 21,454 acres of residential land (mostly undeveloped) and 13,767 acres of conservation land.

Silver State Energy Association Eastern Nevada Transmission Project: This project is proposed in two separate alignments in Clark County, Nevada. One alignment extends 21 miles from the Gemmill substation near the U.S. Highway 93 and Nevada Highway 168 intersection (south of the Coyote Spring private land block) to the Tortoise Substation near Moapa. The second alignment extends 33 miles from the Silverhawk power plant to a Newport Substation south of Henderson. The temporary surface disturbance associated with the two alignments is estimated at 252 and 396 acres, respectively, with permanent commitments of 25 and 40 acres, respectively.

TransWest Express Transmission Project: One of the alternatives proposed for this proposed high voltage transmission line overlaps with the LCCRDA corridor from Las Vegas north to a point where it heads east towards Caliente.

Zephyr Transmission Project: Located in a 200-foot wide ROW, one alternative routing of which overlaps with the LCCRDA corridor from a point near Highway 93 in the Delamar Valley to a point near the Harry Allen Power Plant in Clark County.

Geographic Information System mapping was used to estimate the surface disturbance for the past, present, and reasonably foreseeable future projects within the 14 hydrographic basins where groundwater development facilities would be constructed and operated. These basins encompass 8.6 million acres. Estimated past and present cumulative disturbance in the area is approximately 917,100 acres (10.6 percent) (**Figure ES-14**).

The GWD Project Proposed Action surface disturbance for Tier 1 facilities is estimated to be 12,288 acres, less than 0.2 of 1 percent of the total area of hydrographic basins where groundwater development facilities would be located; the foreseeable projects also would contribute less than 1 percent.

The cumulative effects of the Proposed Action, and Alternatives A through C would be similar, and are discussed below. The cumulative surface disturbance effects of Alternatives D, E, and F would be less than the other alternatives because no groundwater development would occur in Snake Valley.

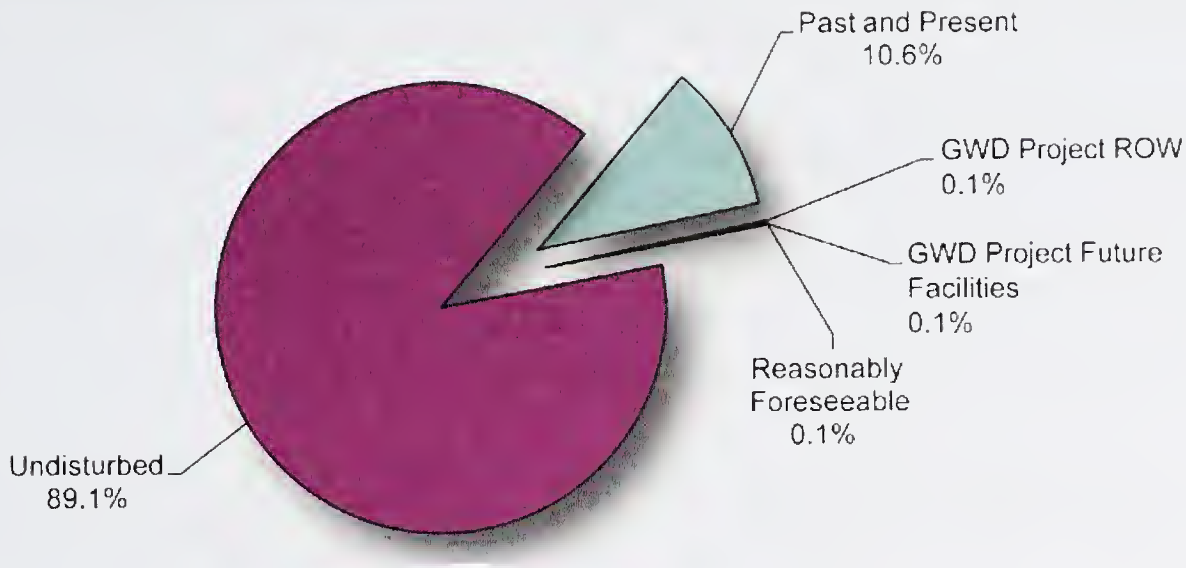


Figure ES-14 Summary of Surface Disturbing Actions for Past, Present, and Reasonably Foreseeable Future Actions in 14 Hydrographic Basins Crossed by the GWD Project Facilities

Summary of GWD Project Tier 1 Cumulative Surface Disturbance Effects

The cumulative effects of the Proposed Action, and Alternatives A through C would be similar, and are discussed below. The cumulative surface disturbance effects of Alternatives D, E, and F would be less than the other alternatives because no groundwater development would occur in Snake Valley.

Note that for some resources, the potential for cumulative short-term effects is higher during periods of concurrent construction activity in close proximity to one or more other projects. Uncertainty regarding the development schedules of several of the RFFAs (e.g., the Zephyr and TransWest Express Transmission Projects) that may share portions of the same utility corridor generally limits the risks for short-term adverse cumulative effects associated with the GWD Project. Furthermore, the risks for cumulative effects in conjunction with these projects also are limited by the fact they also are linear projects, where the locations of construction activity move along the corridor, thereby reducing the duration of concurrent activity in an area.

Air and Atmospheric Values
Groundwater development facilities would be constructed several years after some of the RFFA projects (ON Line Transmission Project, Wilson Creek Wind, and Spring Valley Wind) that would share portions of the same utility corridor. Therefore the individual project construction periods would not overlap and the GWD Project would not contribute to cumulative increases in construction equipment emissions and fugitive dust. Potential cumulative effects could occur with other projects, but these effects would be localized.

Geologic Resources
Geologic hazards (e.g. fissures, faults, karst voids, caves) generally are not cumulative in their effects. A hazard encountered by one project typically decreases the damage risks for subsequent projects in the same corridor because the hazards become better known and engineering solutions improve.

Surface disturbance of paleontological resources by the GWD Project could result in cumulative losses of valuable fossil material as the result of excavations by all projects sharing the same utility corridor. The BLM would implement paleontological monitoring and appropriate fossil material recovery to limit losses.

Water Resources
The GWD Project and other actions would contribute small, localized cumulative increases in soil erosion and sediment yield to ephemeral and intermittent stream channels crossed by ROWs, and in new areas of surface disturbance caused by foreseeable projects. The majority of these cumulative sediment increases would occur in the

existing utility corridors and in the Spring Valley Wind Development area where new road and construction disturbance would occur.

Soils
The GWD Project would temporarily disturb approximately 12,288 acres of native rangeland soils; less than 0.2 of 1 percent of the total area of these hydrographic basins.

The GWD Project and other projects located in the same utility corridor (ON Line, TransWest Express and Zephyr Transmission Projects, Wilson Creek Wind, and Spring Valley Wind) would contribute to cumulative increases in soil erosion from disturbed surfaces, however, the GWD Project and each foreseeable project would be required by BLM BMPs to control soil erosion, and to revegetate disturbed surfaces.

Vegetation
The GWD Project would remove approximately 12,288 acres of vegetation from ROWs in the hydrographic basins where the GWD Project facilities would be located. This vegetation removal increase represents less than 0.2 of 1 percent of the total area of these hydrographic basins. The primary vegetation communities affected by cumulative surface disturbance sources include sagebrush shrubland, greasewood/salt desert shrubland, and Mojave mixed desert shrubland.

The GWD Project and other projects constructed in the same utility corridors would incrementally contribute to reduced plant community productivity and diversity because of long vegetation recovery times, losses of individuals of sensitive species populations, an increased risk for non-native invasive species invasion, and small reductions in populations of plants used traditionally by Native Americans. GWD Project facilities would be constructed several years after other foreseeable projects that would share the same utility corridor (ON Line Transmission Project, Eastern Nevada Transmission Line, Wilson Creek Wind, and Spring Valley Wind).

Terrestrial Wildlife
The GWD Project would remove approximately 12,288 acres of wildlife habitats from ROWs in the hydrographic basins where GWD Project facilities would be located. This habitat removal represents less than 0.2 of 1 percent of the total area of these hydrographic basins.

GWD Project facilities would be constructed several years after other foreseeable projects that would share the same utility corridor. However, the long vegetation recovery times would result in increases in habitat fragmentation as new project surface disturbance is added to utility corridors over time. These disturbed corridors would contain vegetation at varying levels of recovery.

The primary surface disturbance cumulative effects on wildlife habitats and populations would be:

- Overall wildlife habitat fragmentation where new and existing ROWs overlap, or intersect, resulting in changes in wildlife population habitat occupation and movement.
- Habitat fragmentation and increased human activity in pronghorn and mule deer winter ranges in Spring Valley.
- Fragmentation and loss of desert tortoise and Gila monster habitat in the Mojave Desert region (Delamar, Coyote Springs, Hidden, and Garnet valleys), and increased predator perching sites provided by electrical distribution lines. Fragmentation of greater sage grouse habitat in valleys dominated by big sagebrush vegetation (Spring, Snake, Cave, and Lake valleys). Of specific fragmentation concern are the shared utility ROWs in these valleys, as well as the overlap with the Spring Valley Wind development.
- Fragmentation of pygmy rabbit habitat in sagebrush and desert shrubland habitats in Dry Lake, Cave, Lake, and Spring valleys, and an increase in predator perching sites provided by electrical distribution lines.

Aquatic Biological Resources
The GWD Project would expand the network of roads and pipelines throughout the primary groundwater development basins. It is not expected that the cumulative development would substantially increase the surface disturbance to aquatic biological resources, because only three perennial streams (Snake Creek and Big Wash in Snake Valley, and Steptoe Creek in Steptoe Valley) would be crossed by the GWD Project facilities. Based on the use of avoidance criteria, the GWD Project would not contribute incremental sedimentation effects on Bonneville cutthroat trout

streams. Increased traffic on roadways could locally affect northern leopard frog populations in Spring Valley where the GWD Project would overlap with the Spring Valley Wind Project.

Land Use
The GWD Project would convert approximately 1,000 acres of land used for a combination of livestock grazing and wildlife habitat to long-term (life of project) industrial uses (permanent ancillary facilities). This conversion represents less than one percent of the total area of the hydrographic basins where GWD Project facilities would be constructed.

Recreation
The GWD Project would contribute to cumulative short and long-term effects on recreation resources, including access and recreation setting, where other RFFAs are share the same utility corridor or are in close proximity to one another (e.g., GWD and the ON Line, Zephyr and Trans West Express Transmission Projects west of Caliente). Effects would be greater near popular use areas in the southern portions of the project area. Projects that occur concurrently or sequentially would have greater and more noticeable effects on recreation uses.

Transportation
Construction of the GWD Project is not expected to contribute to cumulative traffic congestion and increased accident risks on state and federal highways, and county roads because GWD Project facilities would be constructed several years after other foreseeable projects that would share the same utility corridor (ON Line Transmission Project, Wilson Creek Wind, and Spring Valley Wind).

Mineral Resources
The GWD Project is not expected to contribute to a cumulative reduction in access to mineral resources, because none of the GWD Project alternatives are expected to interfere, or preclude the extraction of minerals.

Rangelands and Grazing
Construction of the GWD Project would remove approximately 12,288 acres of vegetation from ROWs in the hydrographic basins where GWD Project facilities would be located. The incremental vegetation removal affects less than 1 percent of the total area of all cumulative surface disturbance in these basins. No changes in livestock stocking rates in BLM allotments are anticipated.

The GWD Project would not contribute to cumulative livestock movements across grazing allotments, or access to water sources because GWD Project facilities would be constructed several years after other foreseeable projects (ON Line Transmission Project, Wilson Creek Wind, and Spring Valley Wind) that would share the same utility corridors.

Wild Horses
Construction of the GWD Project would remove approximately 3,015 acres of wild horse forage in the Silver King and Eagle Horse Management Areas. Combined with other cumulative surface disturbance, the net effect represents less than 1 percent of the area of these two wild horse management areas. These cumulative forage reductions are not expected to affect wild horse herd sizes established by the BLM appropriate management levels for these areas.

Construction of the GWD Project would not contribute to cumulative changes in herd movement across herd management areas and to water sources because GWD Project facilities would be constructed several years after other foreseeable projects (TransWest Express, Zephyr, and ON Line Transmission Projects, Wilson Creek Wind, and Spring Valley Wind) that would share the same utility corridor.

Special Designations
Construction of the GWD Project may result in surface disturbance in five BLM ACECs. ACECs are managed as avoidance areas, but BLM may grant ROWs if minimal conflicts exist with identified resource values, and if impacts can be mitigated.

The GWD Project and the TransWest Express, Zephyr, and ON Line Transmission Projects would construct on ROWs through the Coyote Spring Areas of Critical Environmental Concern. This portion of the Areas of Critical Environmental Concern overlaps with the Lincoln County Conservation, Recreation, and Development Act utility corridor, which allows utility project construction and operation. The GWD Project would cross portions of the Kane

Springs Areas of Critical Environmental Concern, and the ON Line Transmission Project would disturb an area adjacent to the Areas of Critical Environmental Concern boundary. The GWD Project would be located within the LCCRDA corridor. The cumulative surface disturbance of these two projects, combined with existing ROWS in the same corridor (including Highway 93) would cumulatively reduce the natural values for which the Areas of Critical Environmental Concern was designated (desert tortoise habitat protection).

Visual Resources

The GWD Project ROWs and facilities would result in cumulative visual resource changes where project ROWs parallel or cross existing roads and utility. The addition of wind energy projects on valley floors (Spring Valley Wind) and on ridge lines (Wilson Creek Wind) where GWD Project facilities would be located, and the co-location of the GWD Project facilities with the ON Line Transmission Project, and the Eastern Nevada Transmission Line in a common utility corridor would incrementally change the natural character of the hydrographic basins where these projects would be constructed. The following are visual resource cumulative effect conclusions by hydrographic basin:

- Dry Lake Valley, Delamar Valley, Coyote Springs Valley – strong contrasts and cumulative effects from the GWD Project main pipeline and groundwater development areas, combined with existing utility ROWs, new high voltage power lines, surface water developments, and roads. These projects and actions would be visible from the Silver State Trail Backcountry Byway and Highway 93.
- Lake Valley – strong contrasts and cumulative effects from the GWD Project main pipeline, combined with the Wilson Creek Wind Project, high voltage power lines, surface water developments, and roads. These projects and actions would be visible from the U.S. 93 scenic byway and the Silver State Trail Backcountry Byway.
- Spring Valley – strong contrasts and cumulative effects from the GWD Project main pipeline and groundwater development areas, the Spring Valley Wind Project, roads, surface water development, and fiber optic lines. These projects and actions would be visible from the U.S. 6/50/93 scenic byway, the Loneliest Highway special recreation management area, developed recreation and bird watching sites, Humboldt National Forest, and GBNP. Alternative D facilities would not overlap with the Spring Valley Wind Project.
- Steptoe Valley – strong contrasts and cumulative effects resulting from the GWD Project power line combined with roads, surface water developments, and existing power lines. These projects and actions would be visible from the U.S. 6/50/93 scenic byway, designated fishing and bird watching areas, and the Loneliest Highway and Egan Crest special recreation management areas.

The GWD Project's contribution to landscape changes may potentially conflict with BLM Visual Resource Management Classes II and III when considered with existing and foreseeable projects and actions where these projects and actions share viewsheds. The GWD Project, when considered with past, present, and foreseeable actions, would conform with the U.S. Forest Service and GBNP for lands these agencies directly administer, but would not meet the intent of GBNP viewshed preservation objectives outside the National Park boundaries.

Cultural Resources and Native American Traditional Values

The GWD Project would temporarily disturb approximately 12,288 acres of land in the hydrographic basins where GWD Project facilities would be located. This surface disturbance could result in cumulative losses of archaeological resources or traditional or religious sites as the result of grading and excavations by the foreseeable projects (ON Line Transmission Project, Eastern Nevada Transmission Line, Wilson Creek Wind, and Spring Valley Wind) sharing the same utility corridors. The BLM would implement pre-construction surveys to identify and avoid archeological sites where possible for all projects. The BLM would implement construction monitoring and unanticipated discovery plans to comply with its responsibilities under the federal cultural heritage regulations, and under its obligations to consult with affected Tribes. Consultation also would identify traditional, cultural, or religious areas of importance through government-to-government consultation or tribal monitoring.

Socioeconomics and Environmental Justice

The GWD Project would require temporary construction workers, demands for temporary housing, and demands on local law enforcement and emergency services. Based on the preliminary construction schedules of the foreseeable projects ON Line Transmission Project, Eastern Nevada Transmission Line, Wilson Creek Wind, Spring Valley Wind, and Kane Springs Valley Water Development Project), it appears that the GWD Project peak construction period would occur after these projects are completed.

Public Health and Safety

Because health and safety issues are specific to the GWD Project pipelines and water development construction and operation locations, GWD Project facility construction and operations are not expected to contribute to cumulative effects with the identified past and present actions, or foreseeable projects.

3.10 How is climate change addressed in the EIS?

In accordance with Secretarial Orders 3289 and 3226, the Final EIS considers and analyzes the potential effects of climate change. Secretarial Order No. 3289 establishes a Department-wide approach for applying scientific tools to increase understanding of climate change and to coordinate an effective response to its impacts on tribes and the land, surface and subsurface waters, fish and wildlife, and cultural heritage resources that the Department manages. Secretarial Order No. 3289 also reestablished the requirements set forth in Secretarial Order No. 3226 that each bureau and office of the Department must consider and analyze potential climate change impacts when undertaking long-range planning exercises, setting priorities for scientific research and investigations, developing multi-year management plans, and making major decisions regarding potential use of resources under the Department's purview. Secretarial Order No. 3289 did not alter or affect any existing duty or authority of individual bureaus. Consistent with Secretarial Order No. 3289 and Secretarial Order No. 3226, and to the extent reasonably possible, the BLM considers and analyzes potential climate change impacts in the EIS. Climate change effects are addressed for all affected resources as part of the cumulative effects assessment. In addition, the findings of the Final EIS associated with the project's contribution to climate change were considered when making decisions regarding the selection of the preferred alternative for this project. Finally, the information in the Final EIS will be considered when setting priorities for developing appropriate project monitoring and mitigation plans.

4. Environmental Consequences - Programmatic Assessment of Long-Term Pumping Effects

4.1 What Future Facilities would be required for groundwater development?

Completion of the future groundwater production facilities, including wells, power lines, access roads, collector pipelines, and ancillary facilities, would result in additional temporary and long-term disturbance. The exact number and locations of wells is presently unknown. Consequently, a series of assumptions were developed to allow programmatic analysis of the environmental effects of the future development. Additional ROW requests and subsequent NEPA compliance would be conducted for specific sites after the SNWA establishes their locations. The programmatic level of development, including a range of temporary and permanent ROW associated with the future facilities for each alternative is summarized below in **Table ES-4**.

Table ES-4 Future Facilities Summary of the Alternatives for Analysis in this EIS

ROW and Facility Requirements	Proposed Action	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E	Alternative F
Groundwater Production Wells (number)	144 to 174	97 to 117	136	97 to 117	69 to 83	69 to 83	96 to 117
Collector Pipelines (miles)	177 to 434	100 to 246	236	100 to 246	127 to 206	86 to 210	134 to 344
Staging Areas (number of 1-acre sites)	59 to 145	33 to 82	79	33 to 82	42 to 69	29 to 70	45 to 115
Electric Power Lines (miles)	177 to 434	100 to 246	236	100 to 246	127 to 206	86 to 210	134 to 344
Permanent ROW (acres)	2,374 to 5,536	1,370 to 3,171	3,077	1,370 to 3,171	1,655 to 2,635	1,158 to 2,683	1,782 to 4,359
Temporary ROW (acres)	1,216 to 2,874	699 to 1,643	1,587	699 to 1,643	858 to 1,370	595 to 1,396	916 to 2,270

4.2 When and how will additional NEPA compliance be completed for these Future Facilities?

The SNWA does not anticipate filing ROW applications for groundwater production wells and collector pipelines until after the ROD on this EIS and submittal of a detailed POD for the main pipeline. Consequently, the level of detail regarding future facilities development, including the number and location of wells, lengths and routes of collector pipeline and distribution power lines, and road access, currently is inadequate to support site-specific NEPA analysis in this EIS process.

After the SNWA identifies specific groundwater development component details, it will submit additional ROW applications to the BLM. Based on these applications, the BLM will address the site-specific effects in subsequent NEPA documents (see 2.14 above regarding "tiering").

4.3 What would be the relative environmental effects of implementing these future facilities?

The environmental effects of future development, including the long-term effects of groundwater production, have been the subject of conceptual analysis in this EIS. The conceptual analysis encompasses the groundwater development areas where production wells, collector pipelines, and distribution power lines might be located and assumptions regarding the type and range of facilities to be developed. The range of facilities reflects the assumed level of groundwater pumping associated with each alternative. (See **Table ES-5** and Chapter 2 and **Appendix E** in the Final EIS, for more information regarding future facilities development.)

Appendix E

Like the pipeline, future facility development and pumping would be phased, beginning in the southern basins (Delamar, Dry Lake, and Cave), moving northward into Spring and Snake valleys in later years. SNWA's proposed development schedule for future facilities extends over nearly 35 years, beginning in Delamar Valley in year 5 (**Table ES-5**). The proposed schedule provides for complete system build out and achieving full pumping volume by year 38 for the Proposed Action and Alternatives A through C. The time frame for build out of Alternatives D, E, and F is year 33 as no facilities would be constructed in Snake Valley, resulting in an earlier project completion date. The actual timing of future facility development would depend on water availability from SNWA's other sources, water demand, and drought status.

Table ES-5 Timing of Future Facility Development, By Basin and Alternative

Groundwater Basin	Production Well Development Period [1]	Basin Included In Alternative					
		Proposed Action	A	B	C	D	E and F
Delamar, Dry Lake and Cave	Years 5 thru 8	Yes	Yes	Yes	Yes	Yes	Yes
Spring Valley – south (Lincoln County)	Years 9 thru 11	Yes	Yes	Yes	Yes	Yes	Yes
Spring Valley – north (White Pine County)	Years 27 and 28	Yes	Yes	Yes	Yes	No	Yes
Snake Valley	Years 36 thru 38	Yes	Yes	Yes	Yes	No	No

[1] Exploratory development would occur in each basin prior to the production well development. Specific development plans would be submitted to the BLM based on exploratory drilling and Tier II NEPA completed for the specific plans.

Environmental effects associated with the future facility development would be similar to those described for ROW facilities, but smaller in scale. Unlike the relatively wide, linear corridor associated with the pipeline ROW, the disturbance area for each groundwater production well would be a rectangular parcel, accessed via an improved road that would be co-located with the collector pipelines in a 50-foot permanent ROW. **Table ES-6** summarizes the environmental impacts for the future facilities.

Table ES-6 **Summary of Future Groundwater Development Impacts Associated with Surface Disturbance for the Proposed GWD Project Alternatives**

Disturbance/Impacts	Proposed Action	Alternatives A and C	Alternative B	Alternative D	Alternative E	Alternative F
Disturbance (Acres)[1]						
Spring Valley	1,206-2,853	826-1,905	2,504	1,586-1,832	826-1,905	1,136-2,605
Snake Valley	450-985	316-735	1,183	0	0	0
Cave Valley	575-1,652	230-751	312	230-751	230-751	577-1,651
Dry Lake Valley	402-849	402-849	323	402-849	402-849	405-864
Delamar Valley	957-2,071	296-573	342	296-573	296-573	580-1,509
Total	3,590-8,410	2,069-4,814	4,664	2,513-4,005	1,754-4,079	2,698-6,629
Pumping Stations	2	2	2	2	2	2
Substations	2	2	2	2	2	2
Air Resources, Geology, Soils, Vegetation, Terrestrial Wildlife, Land Use, Transportation, Minerals, Rangeland, Wild Horses, Cultural Resources, Native American Traditional Values, Public Health and Safety	Construction and operation-related disturbance impacts could occur in all five groundwater development basins with relative effects related to the range in acres listed above. The types of impacts would be the same as those discussed for ROWs.			Construction and operation-related disturbance impacts could occur in four groundwater development basins (Snake Valley eliminated) with relative effects related to the range in acres listed above. The types of impacts would be the same as those discussed for ROWs.		
Water Resources (Stream reaches and springs potentially affected by disturbance)	• 28 perennial stream reaches in Spring and Snake valleys. • 60 springs in the 5 valleys.	• Same as the Proposed Action.	• 3 perennial stream reaches in Snake Valley. • 7 springs in Snake Valley.	• No disturbance to perennial stream reaches. • 13 springs in Spring, Cave, Dry Lake, and Delamar valleys.	• 23 perennial stream reaches in Spring Valley. • 49 springs in Spring, Cave, Dry Lake, and Delamar valleys.	• Same as Alternative E.
Aquatic Biological Resources Disturbance effects to aquatic habitat and species (game fish, special species or native species)	Number of waterbodies with game fish or special status amphibian species: • 17 perennial streams in Spring and Snake valleys. • 3 springs. • Potential mortalities to amphibians during movement periods from vehicle traffic.	• Same as the Proposed Action.	Number of waterbodies with non-game and non-special status species: • 1 perennial stream in Snake Valley and 1 spring in Snake Valley. • Potential mortalities to amphibians during movement periods from vehicle traffic.	• No disturbance to perennial streams or springs with game fish or special status species. • Potential mortalities to amphibians during movement periods from vehicle traffic.	Number of waterbodies with game fish or special status species: • 13 perennial streams in Spring valley. • 3 springs in Spring Valley. • Potential mortalities to amphibians during movement periods from vehicle traffic.	• Same as Alternative E.

Table ES-6 Summary of Future Groundwater Development Impacts Associated with Surface Disturbance for the Proposed GWD Project Alternatives (Continued)

Disturbance/Impacts	Proposed Action	Alternatives A and C	Alternative B	Alternative D	Alternative E	Alternative F
Recreation	• Potential disturbance to 6 recreation areas.	• Same as Proposed Action.	• Same as Proposed Action	• Potential disturbance to 4 recreation areas.	• Same as Proposed Action	• Samc as Proposed Action.
Special Designations	• Potential disturbance to 3 special designation areas in Spring and Snake valleys.	• Same as Proposed Action.	• Same as Proposed Action.	• No special designations would fall within the groundwater development areas.	• Potential disturbance to 2 special designation areas in Spring Valley.	• Same as Alternative E.
Socioeconomics	Temporary employment and population gains. Limited scale and duration for each well. Multiple rigs could operate simultaneously in different locations. Increased intensity of social effects, both for those opposed and supporting the project.			Same as the Proposed Action but less intense in White Pine County.	Same as the Proposed Action but less intense in White Pine County.	Same as the Proposed Action but less intense in White Pine County.
Visual	• 23,409 acres of disturbance in VRM Class II. • Meets intent of GBNP Visual Objectives.			• 12,822 acres of disturbance in VRM Class II. • Meets intent of GBNP Visual Objectives.	• 22,938 acres of disturbance in VRM Class II. • Does not meet intent of GBNP Visual Objectives.	• 22,938 acres of disturbance in VRM Class II. • Does not meet intent of GBNP Visual Objectives.

[1] Disturbance was estimated based on the addition of temporary and permanent ROWs (pipeline and power line), wells, and other ancillary facilities.

4.4 How were the effects of long-term pumping on water resources determined?

A groundwater flow model was developed for this Final EIS to evaluate the probable long-term effects of groundwater withdrawal on a regional scale. The study area for water resources encompasses all or part of 35 hydrographic basins shown in **Figure ES-15** and covers over 20,000 square miles. **Figure ES-15** also indicates the locations of inventoried springs and identified perennial stream reaches located within the region. Generally speaking, the analysis of pumping effects on environmental resources followed a series of steps that links the results of groundwater flow modeling to those resources with dependence on surface water and/or groundwater as a source of water or habitat.

The computerized model was calibrated to water levels and flow measurements in the field. The groundwater model represents a generalized understanding of the surface and underground water and hydrogeologic conditions over this large region. The model was used to simulate groundwater withdrawal for the eight alternatives for analysis (i.e., the Proposed Action, six action alternatives, and the No Action Alternative). The assumed time frame for full build out under the Proposed Action is 38 years from BLM issuance of a Notice to Proceed. The modeling results were evaluated at three future time frames: full build out, full build out plus 75 years, and full build out plus 200 years.

The BLM established a technical review team to assist it by reviewing the model documentation reports and provide recommendations for improving the model. The team included hydrology specialists from the BLM Nevada and Utah State Offices, and National Operations Center in Denver; the U.S. Geological Survey; and AECOM (BLM EIS Contractor).

An electronic copy of the modeling report is included with this EIS.

Despite inherent uncertainty associated with hydrogeologic conditions over this broad region, the calibrated model is a reasonable tool for estimating probable regional-scale drawdown patterns and trends over time resulting from the various pumping alternatives. Impacts were evaluated in terms of the potential impacts to flows of seeps, springs and streams, potential impacts on water rights, and drawdown effects on subsurface water.

The potential for impacts to individual seeps, springs, or stream reaches depends on:

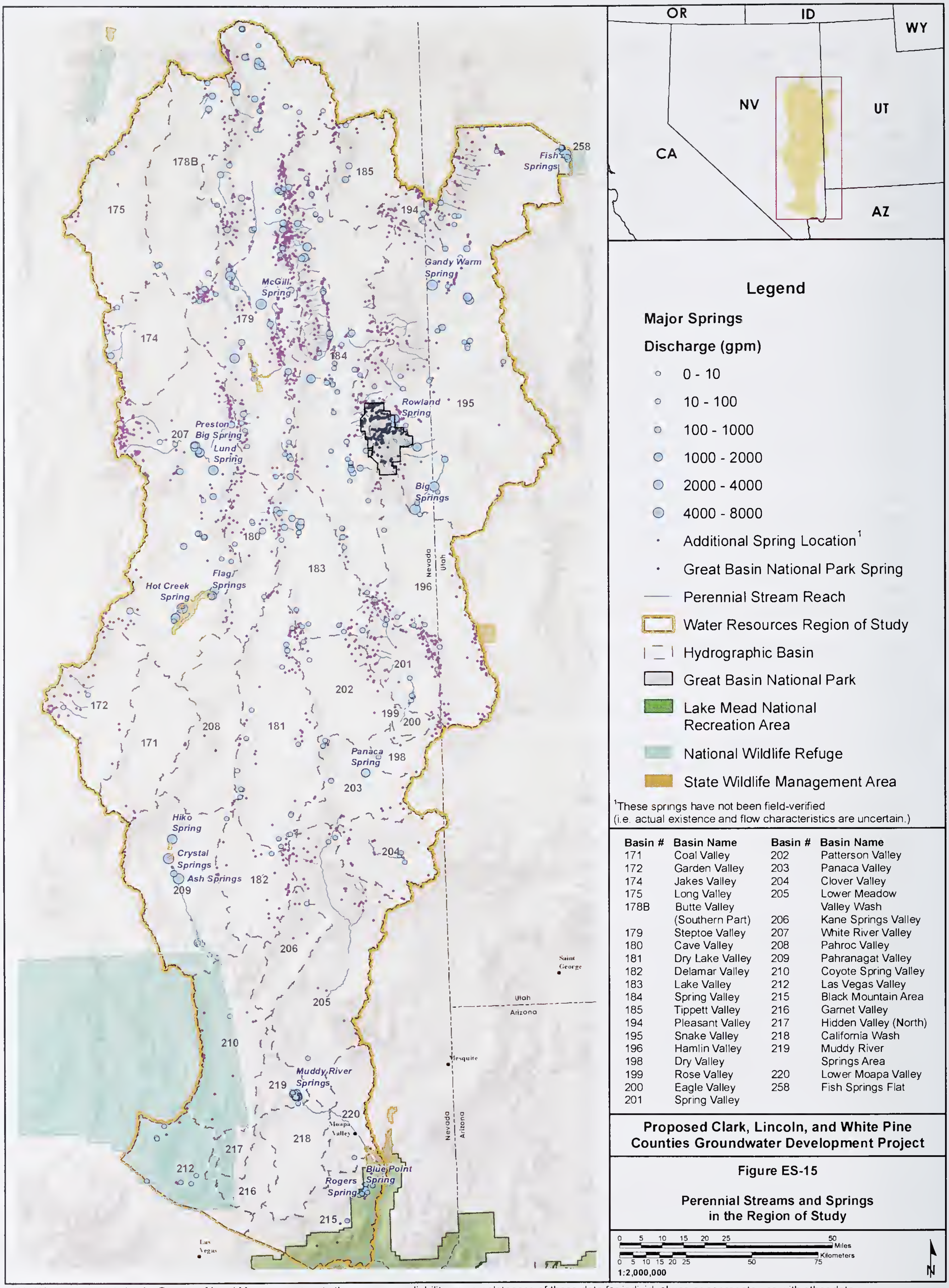
1) the source of groundwater that sustains the perennial flow;
2) the interconnection (or lack of interconnection) between the perennial surface waters and the groundwater aquifers; and
3) the drawdown that results from the groundwater development.

Results of the regional groundwater flow model were used to evaluate the effects on water resources at three time frames that correspond to full build out of the system (approximately 38 years after Notice to Proceed), and at full build out plus 75 and full build out plus 200 years after full build out.

This evaluation identifies areas where there is likely to be a high or moderate risk of impacts to perennial surface water sources from groundwater development.

The water rights impact evaluation discloses potential effects to existing surface and groundwater rights resulting from the various proposed pumping alternatives. The assessment was conducted by overlaying maps of the predicted drawdown on the maps of existing water rights. For surface water rights, it was assumed that water rights located within the projected 10-foot drawdown area and located within the identified high and moderate risk areas previously described for perennial water could be affected. It was also assumed that groundwater rights located within the same defined drawdown area could be affected.

The impact evaluation identifies perennial water resources located in areas where there is a high or moderate risk of impacts.



Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure ES-15

Perennial Streams and Springs in the Region of Study

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

4.5 Where and how large are the areas that would likely experience long-term drawdown effects?

Table ES-7 summarizes the groundwater production rates assumed for the various groundwater development alternatives. Groundwater modeling for the Proposed Action and Alternatives A through F, all show drawdown expanding progressively as pumping continues over time. The alternatives with the highest groundwater withdrawal volumes (Proposed Action and Alternative B) show the greatest drawdown effects; and the alternatives with the lower groundwater withdrawal volume (Alternatives C, D, E, and F) show the least drawdown effects.

Table ES-7 Summary of Pumping Assumptions for the Alternatives for Analysis

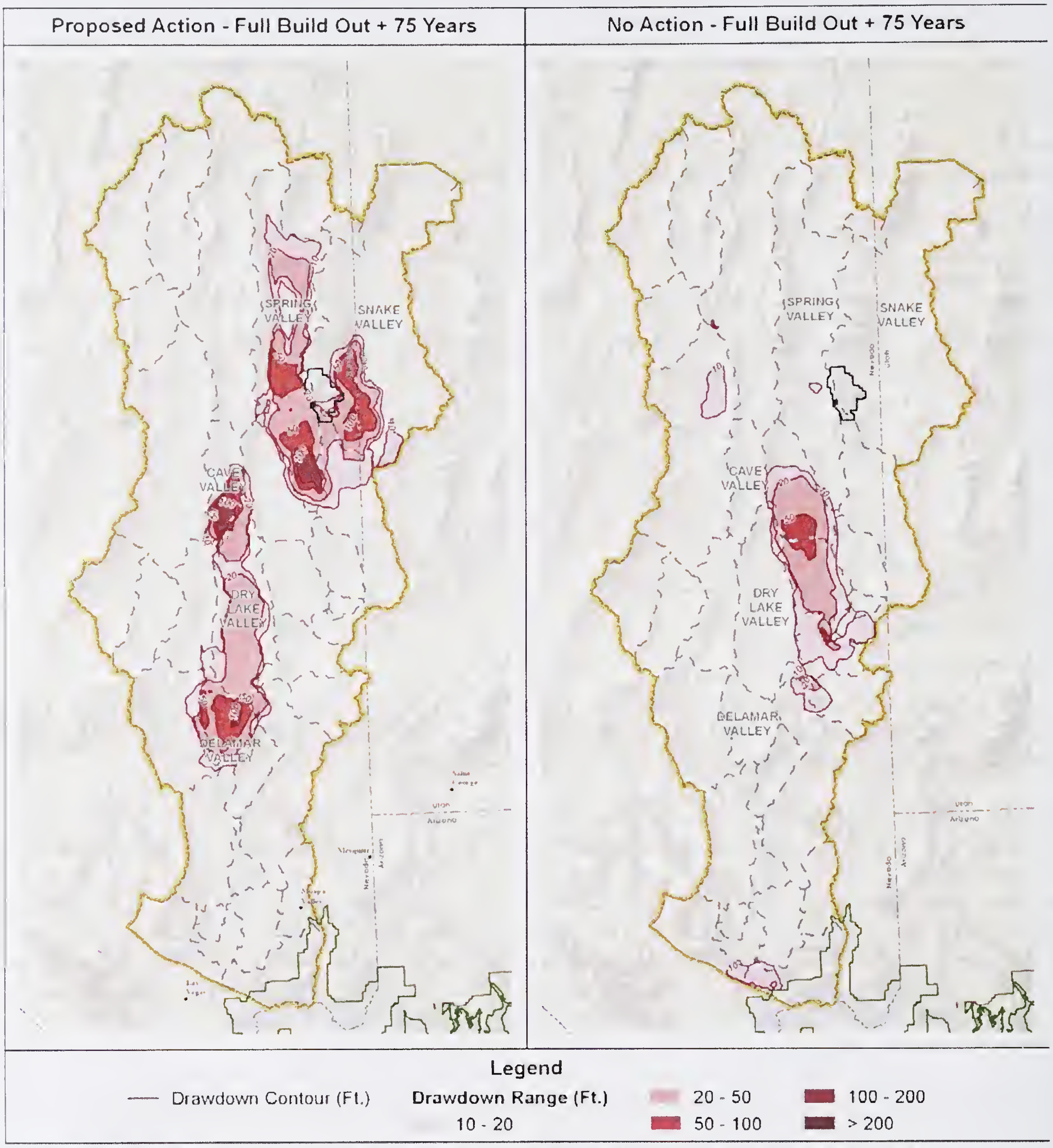
Alternatives for Analysis	SNWA Groundwater Production	Basins in Which SNWA Production Would Occur
Proposed Action	Up to 176,655 afy	Spring, Snake, Cave, Delamar, Dry Lake
A	Up to 114,755 afy	Spring, Snake, Cave, Delamar, Dry Lake
B	Up to 176,655 afy	Spring, Snake, Cave, Delamar, Dry Lake
C	12,000 to 114,755 afy (varies in response to drought)	Spring, Snake, Cave, Delamar, Dry Lake
D	Up to 78,755 afy	Spring (southern portion), Cave, Delamar, Dry Lake (no Snake)
E	Up to 78,755 afy	Spring, Cave, Dry Lake, Delamar (no Snake)
F	Up to 114,129 afy	Spring, Cave, Dry Lake, Delamar (no Snake)
No Action	None	None

Section 3.3 – Water Resources and **Appendix F3.3** present extensive discussion and graphical results of the water modeling and effects analyses prepared for this EIS. Example outputs from the analysis are presented in a series of side-by-side figures on the following pages.

Section 3.3

Figure ES-16 shows the projected groundwater drawdown effects under the Proposed Action and No Action at full build out plus 75 years. For the No Action Alternative, the groundwater pumping analysis shows the potential future effects from continuing current water use by agricultural, municipal, mining and milling, industrial, and power plant users. This includes pumping SNWA's existing water rights from its agricultural property in Spring Valley. The No Action pumping scenario does not include any groundwater pumping associated with the water rights applications included in the Proposed Action. As shown, drawdown effects occur in northern Lincoln County under the No Action, with some drawdown in excess of 50 feet. The groundwater pumping scenario for the Proposed Action assumes pumping at the full development quantities (approximately 177,000 afy) for the 5 proposed pumping basins.

For the Proposed Action, at the full build out plus 75 year time frame, there are 2 distinct drawdown areas, with the affected areas separate from those affected under the No Action alternative (**Figure ES-16**). The northern drawdown area encompasses most of the valley floors in Spring Valley, southern Snake Valley, and northern Hamlin Valley. The southern drawdown area extends north-south across the Delamar, Dry Lake, and Cave valleys and into the eastern edge of Pahranagat Valley and northwestern edge of Lower Meadow Valley Wash.



No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

Figure ES-16 Model Simulated Drawdown for the Proposed Action and No Action at the Full Build Out Plus 75 Years Time Frame

Figure ES-17 shows the areal extent and magnitude of the projected groundwater drawdown effects under the Proposed Action and Alternative A at full build out plus 75 years. Alternative A assumes groundwater pumping at reduced quantities (approximately 115,000 afy) in the 5 proposed production basins. As shown, the reduced quantity pumping under Alternative A, as compared to the Proposed Action, would reduce the drawdown area particularly in northern Spring Valley, northern Lake Valley, and along the southern edge of the drawdown area.

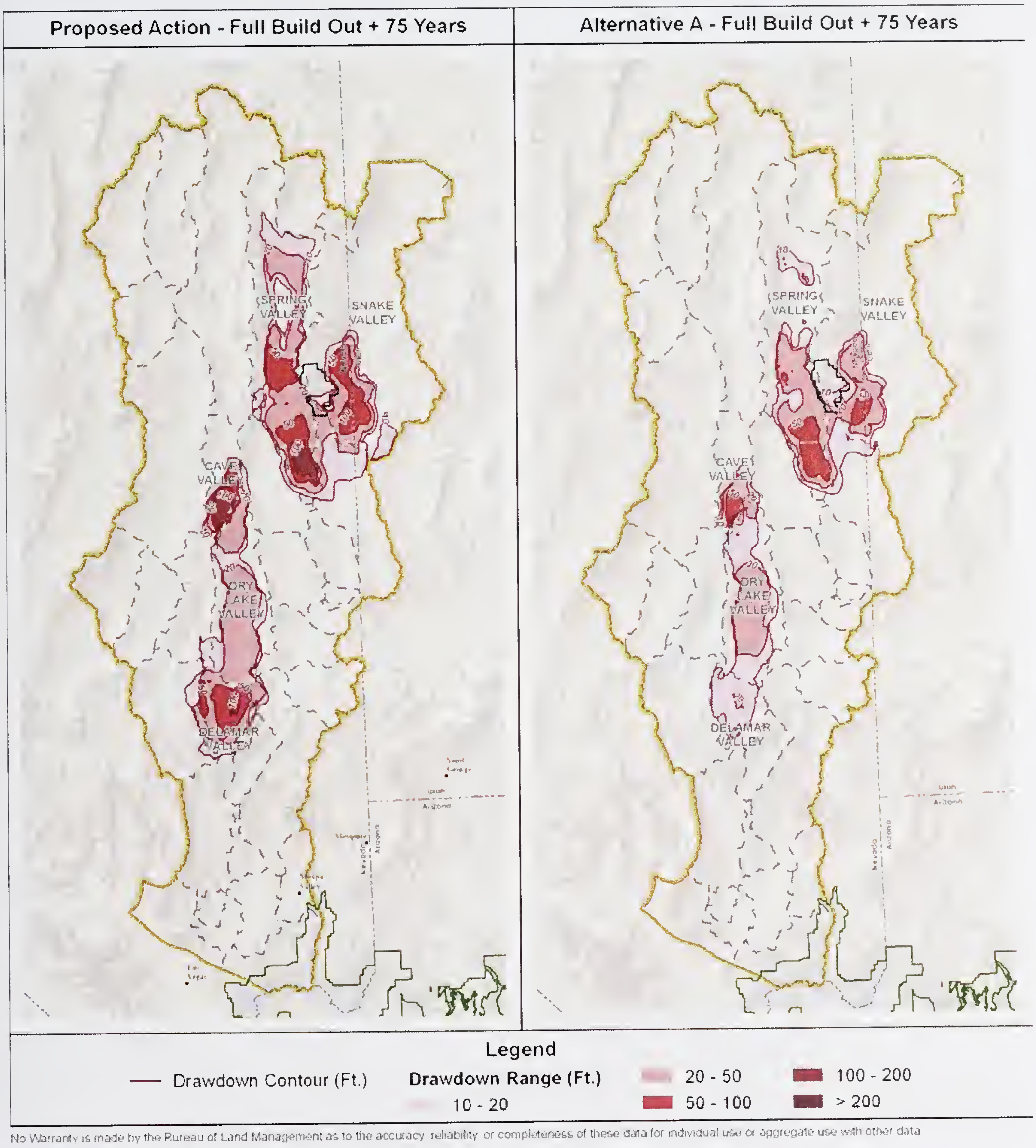
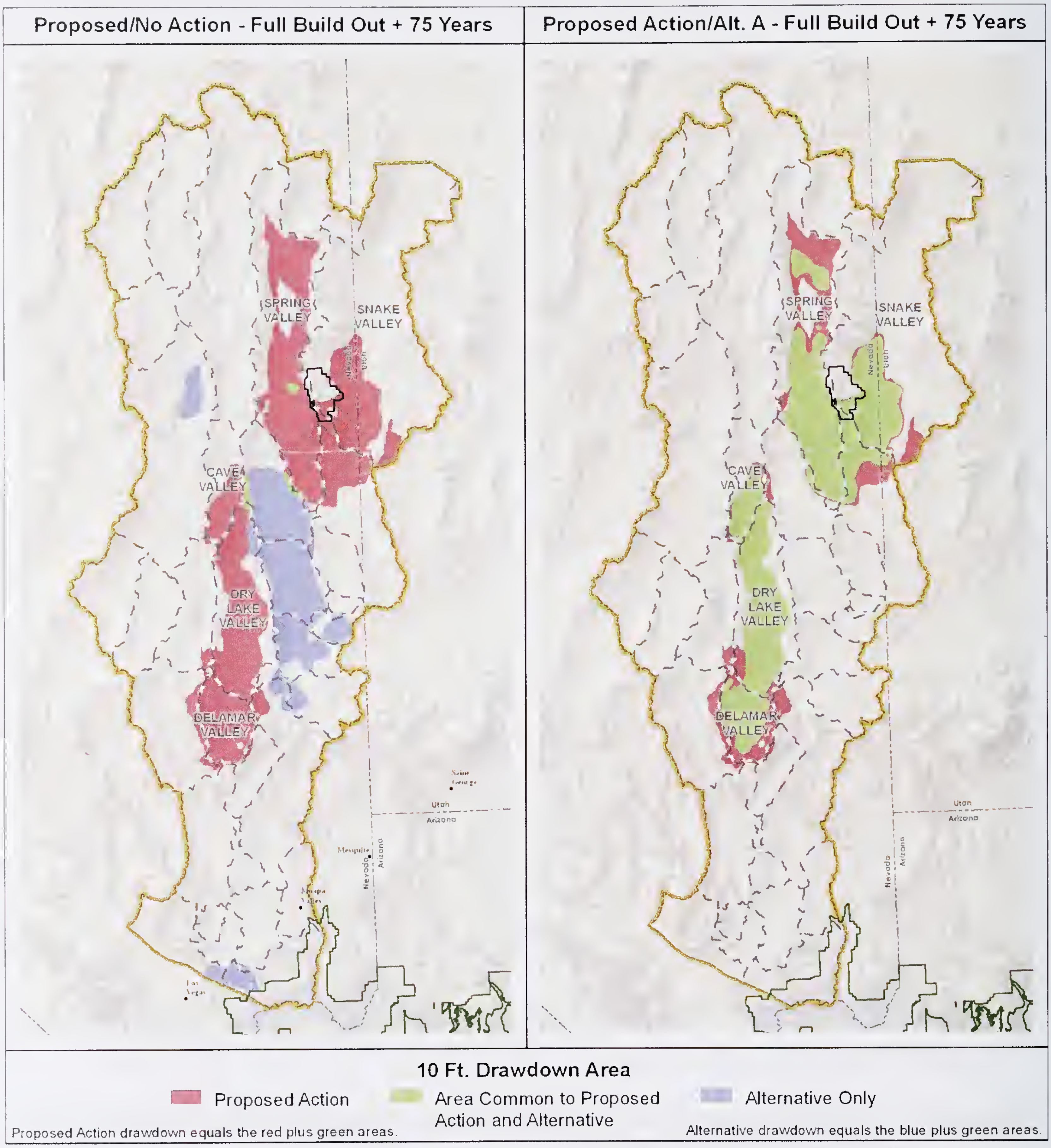


Figure ES-17 Model Simulated Drawdown for the Proposed Action and Alternative A at the Full Build Out Plus 75 Years Time Frame

Figure ES-18 presents a different perspective on the projected drawdown area at full build out plus 75 years, showing the overall area projected to be affected by 10-foot or greater drawdown under the Proposed Action and No Action (left panel) and the Proposed Action and Alternative A (right panel). In these figures, the area shaded green represents the affected area under either of the two alternatives, the reddish/brown area is the incremental area affected by the Proposed Action, and the blue area is the area affected by the alternative but not the Proposed Action.



No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

Figure ES-18 Comparative Drawdown Areas, Proposed Action and No Action (Left) and Proposed Action and Alternative A (Right) at the Full Build Out Plus 75 Years Time Frame

Figure ES-19 shows the areal extent and magnitude of the projected groundwater drawdown effects under Alternatives B and C at full build out plus 75 years. Alternative B assumes groundwater pumping at the full quantities (i.e., approximately 177,000 afy) listed on the SNWA pending water rights application from the 5 proposed project pumping basins, assuming that wells would be developed at the actual points of diversion listed on the applications. The Alternative C pumping scenario assumes the same groundwater production wells defined for Alternative A but instead of pumping at a sustained rate (as in Alternative A) pumping rates would cycle from minimum to maximum pumping rates every 5 years, as a way of simulating increased reliance on groundwater during periods of drought.

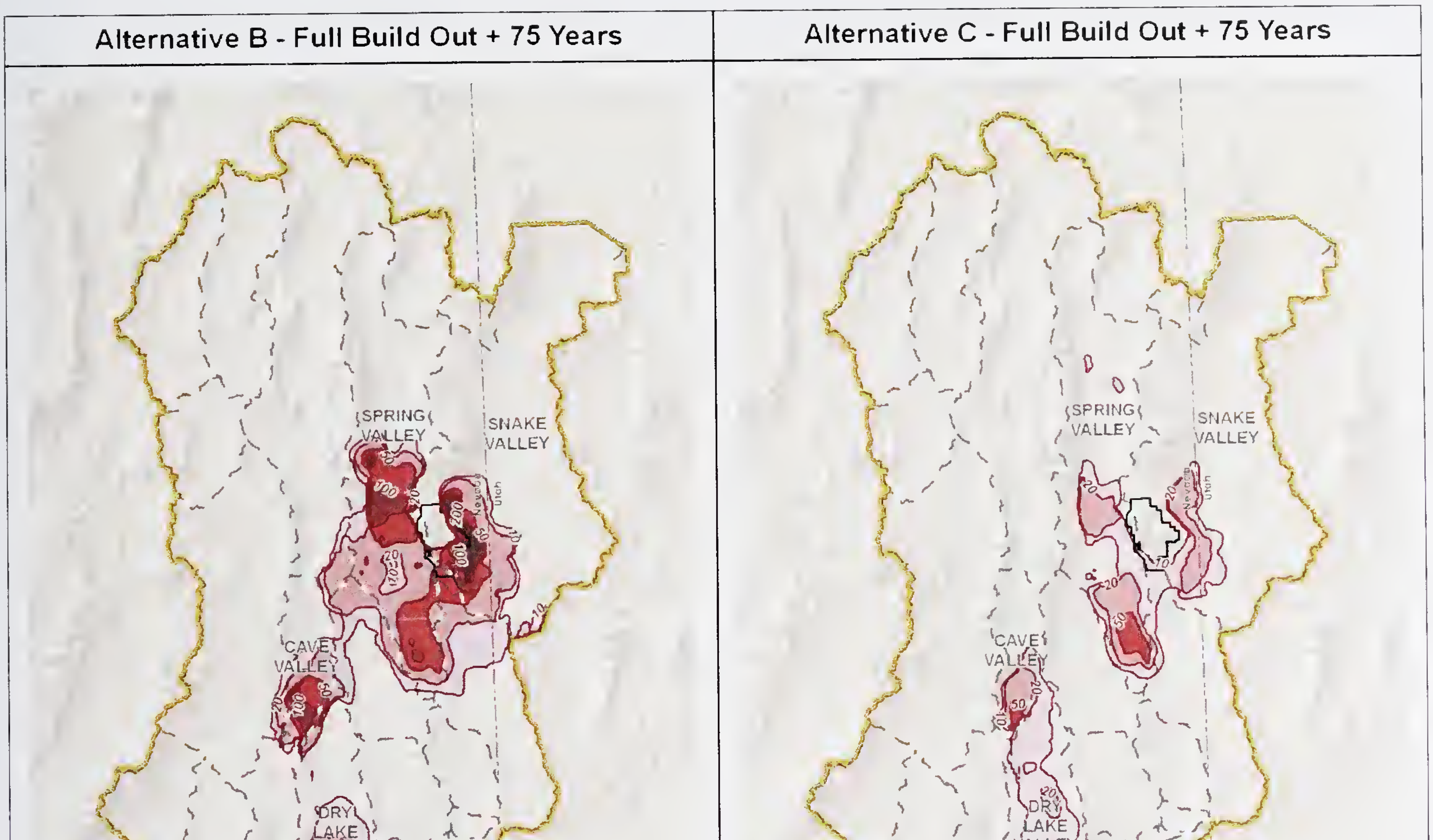


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Figure ES-19 Model Simulated Drawdown for Alternative B and Alternative C at the Full Build Out Plus 75 Years Time Frame

Figure ES-20 shows the incremental differences in the projected drawdown area to be affected by 10-foot or greater drawdown at full build out plus 75 years under the Proposed Action and Alternative B (left panel) and the Proposed Action and Alternative C pumping scenarios (right panel).

Compared to the Proposed Action, the Alternative B pumping scenario would expand the area of drawdown along the southern edge of Steptoe Valley, in the southern Snake Range between Spring and Snake Valley, and in southern Lake Valley. The drawdown area for Alternative B does not extend into northern Spring Valley or Tippett Valley (**Figure ES-20**). The model results indicate that the reduction in groundwater withdrawal under Alternative C would further reduce the magnitude of drawdown area compared to the Proposed Action and Alternatives A and B.

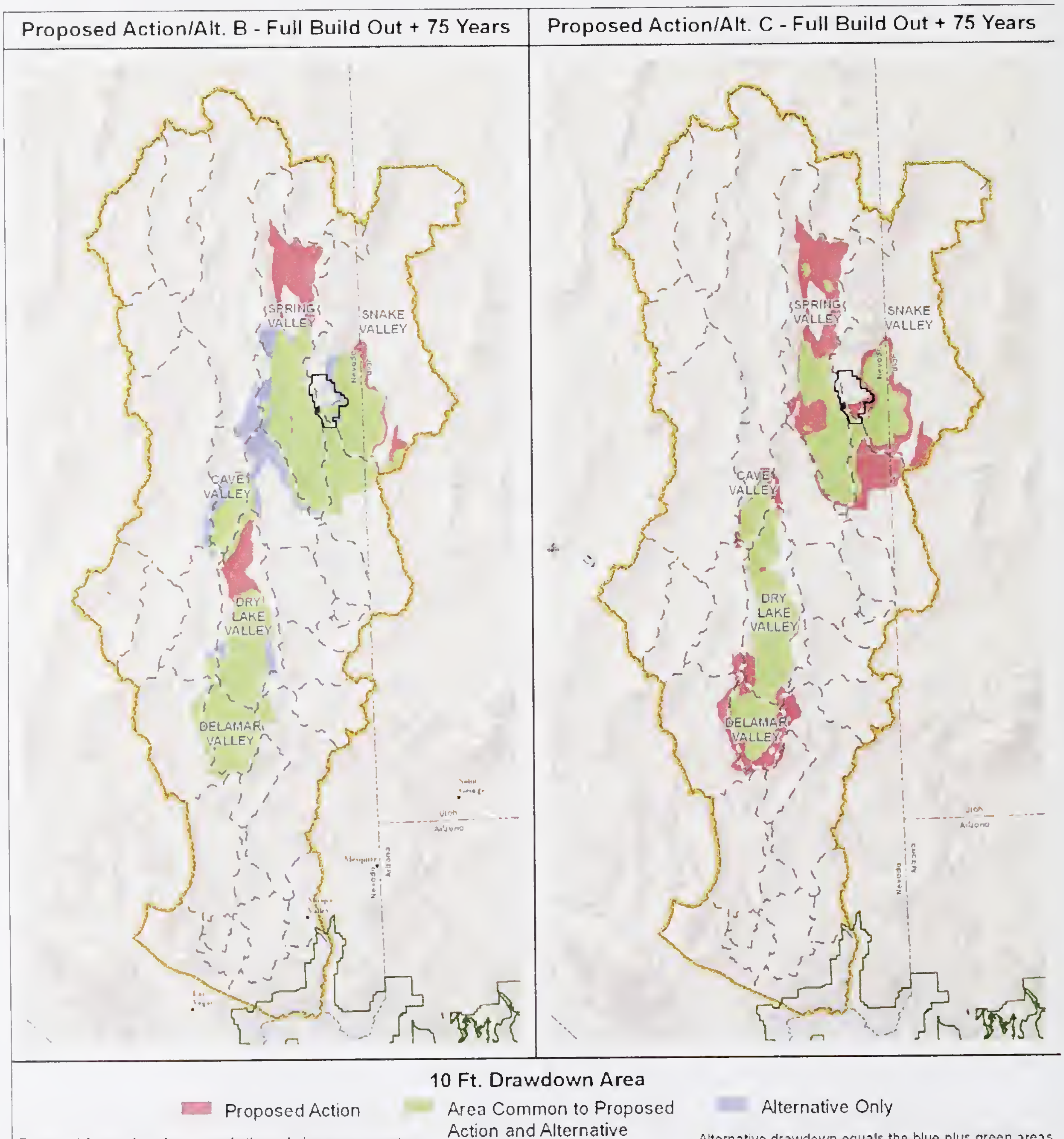

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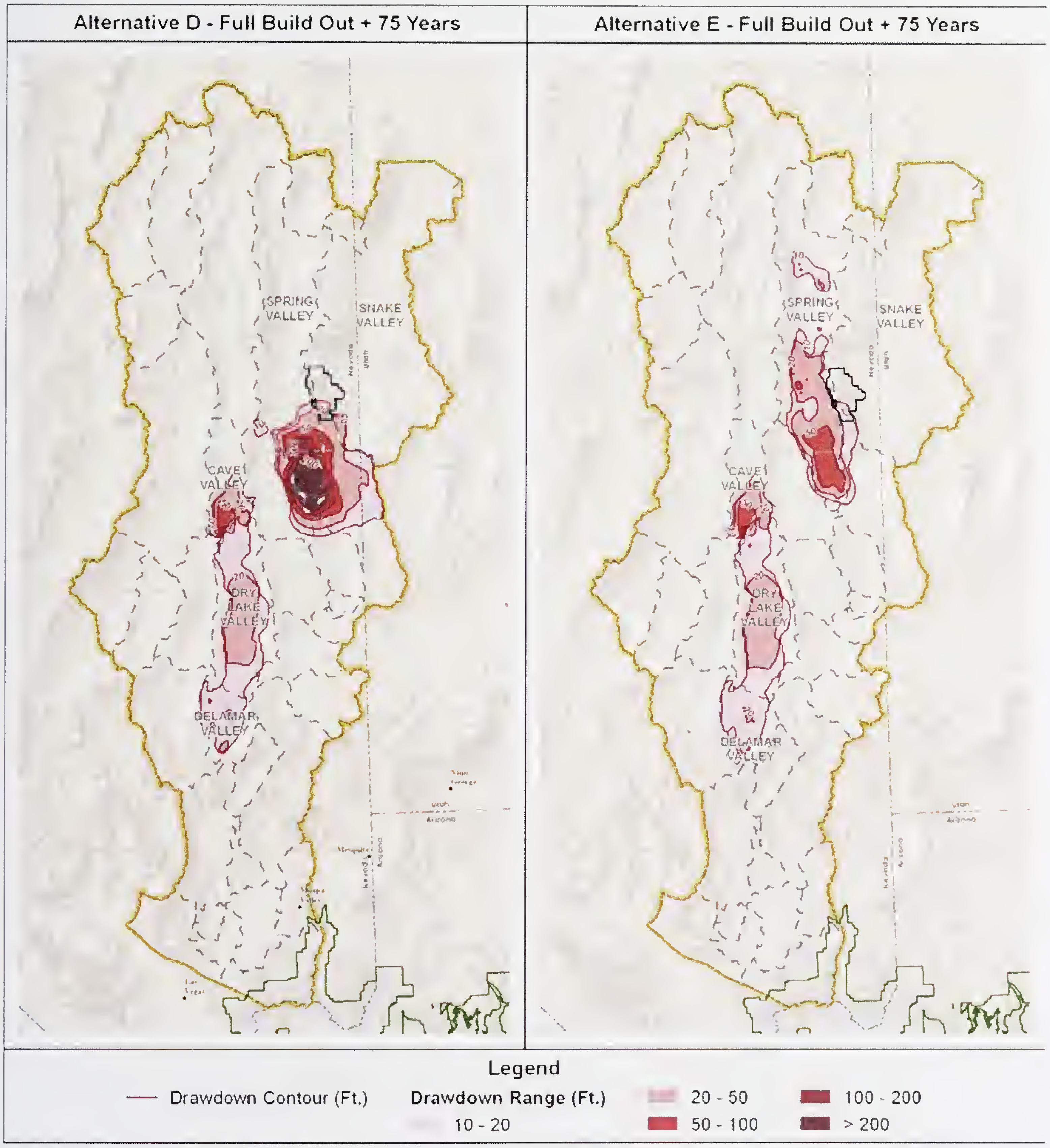
Figure ES-20 **Comparative Drawdown Areas, Proposed Action and Alternative B (Left) and Proposed Action and Alternative C (Right) at the Full Build Out Plus 75 Years Time Frame**

Figure ES-21 shows the areal extent and magnitude of the projected groundwater drawdown effects under the Alternatives D and E at full build out plus 75 years. Alternative D assumes no groundwater pumping in Snake Valley, and pumping in Spring Valley would be restricted to the southern portion of the valley that is in Lincoln County. The maximum groundwater production rate for this alternative is approximately 79,000 afy from the four pumping basins (Spring and Delamar, Dry Lake, and Cave valleys), the same maximum pumping rate assumed for these basins under Alternatives A, C, and E. The Alternative E pumping scenario includes the same spatial distribution of wells included in Alternative A for Spring, Delamar, Dry Lake, and Cave valleys but assumes no pumping in Snake Valley.



No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

Figure ES-21 Model Simulated Drawdown for Alternative D and Alternative E at the Full Build Out Plus 75 Years Time Frame

Figure ES-22 shows the incremental differences in the projected drawdown area at full build out plus 75 years, showing the overall area projected to be affected by 10-foot or greater drawdown under the Proposed Action and Alternative D (left panel) and the Proposed Action and Alternative E (right panel).

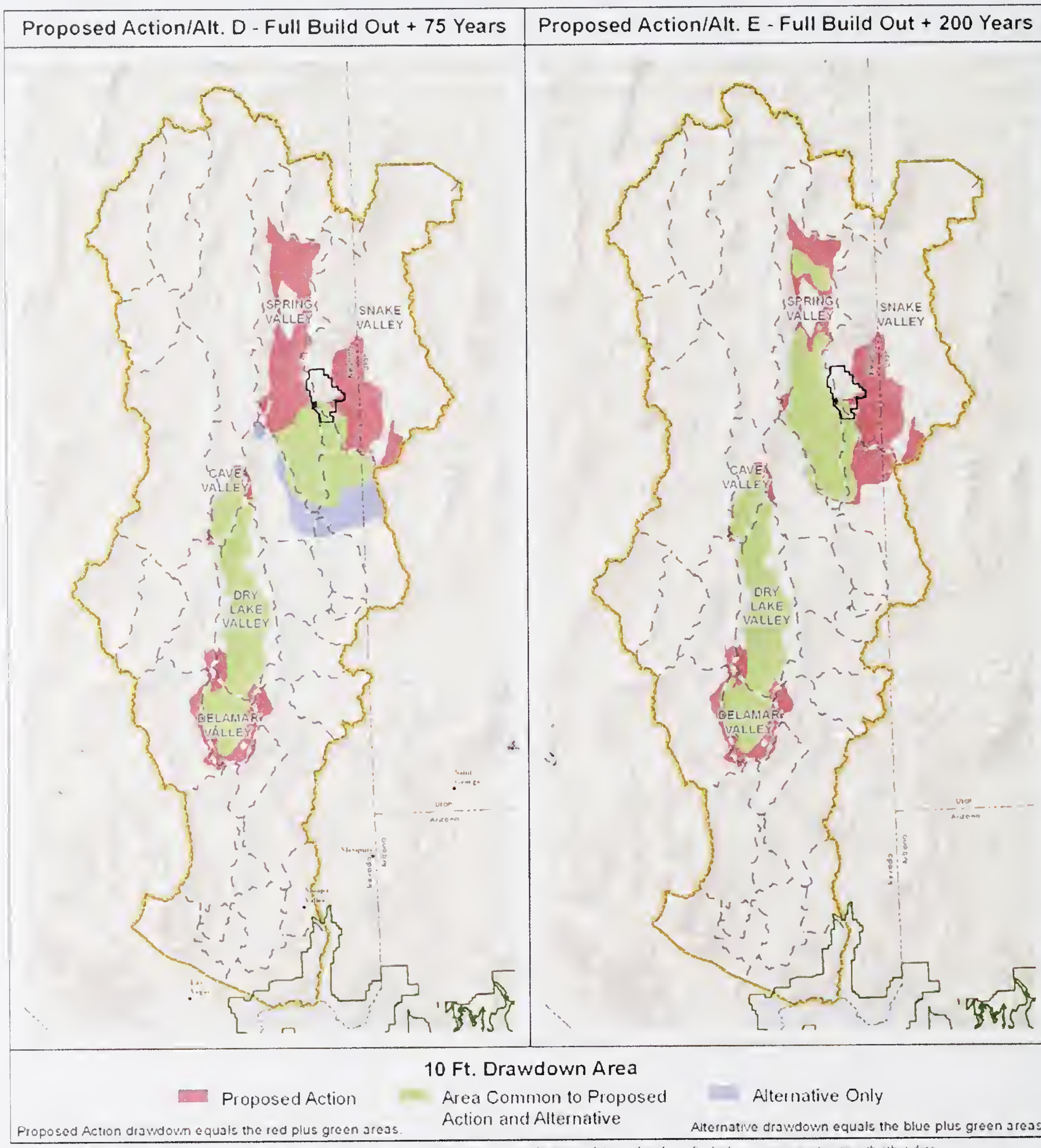


Figure ES-22 Comparative Drawdown Areas, Proposed Action and Alternative D (Left) and Proposed Action and Alternative E (Right) at the Full Build Out Plus 75 Years Time Frame

Compared to the Proposed Action, Alternative D limits drawdown in the central and northern portion of Spring Valley (Hydrographic Area [HA] 184) in White Pine County and southern portion of Snake Valley; but expands drawdown in Lake Valley, Hamlin Valley, and northern Spring Valley (HA 201) in east-central Lincoln County (the hydrographic areas are identified in **Figure 3.3.1-1** of the Final EIS). The concentration of pumping in southern Spring Valley (HA 184) under Alternative D results in projected drawdown of greater than 200 feet across the entire southern portion of the valley (**Figure ES-20**).

Because the pumping schedules for Alternatives E and A are identical for Spring, Delamar, Dry Lake, and Cave valleys, so too are the predicted drawdowns in those valleys (**Figure ES-16**). Alternative E would substantially reduce the drawdown area in Snake Valley compared with the Proposed Action and Alternative A.

Figure ES-23 shows the areal extent and magnitude of projected groundwater drawdown effects under Alternative F at full build out plus 75 years (left panel) and the incremental difference in the projected area affected by 10-foot or greater drawdown under the Proposed Action and Alternative F (right panel) at full build out plus 75 years.

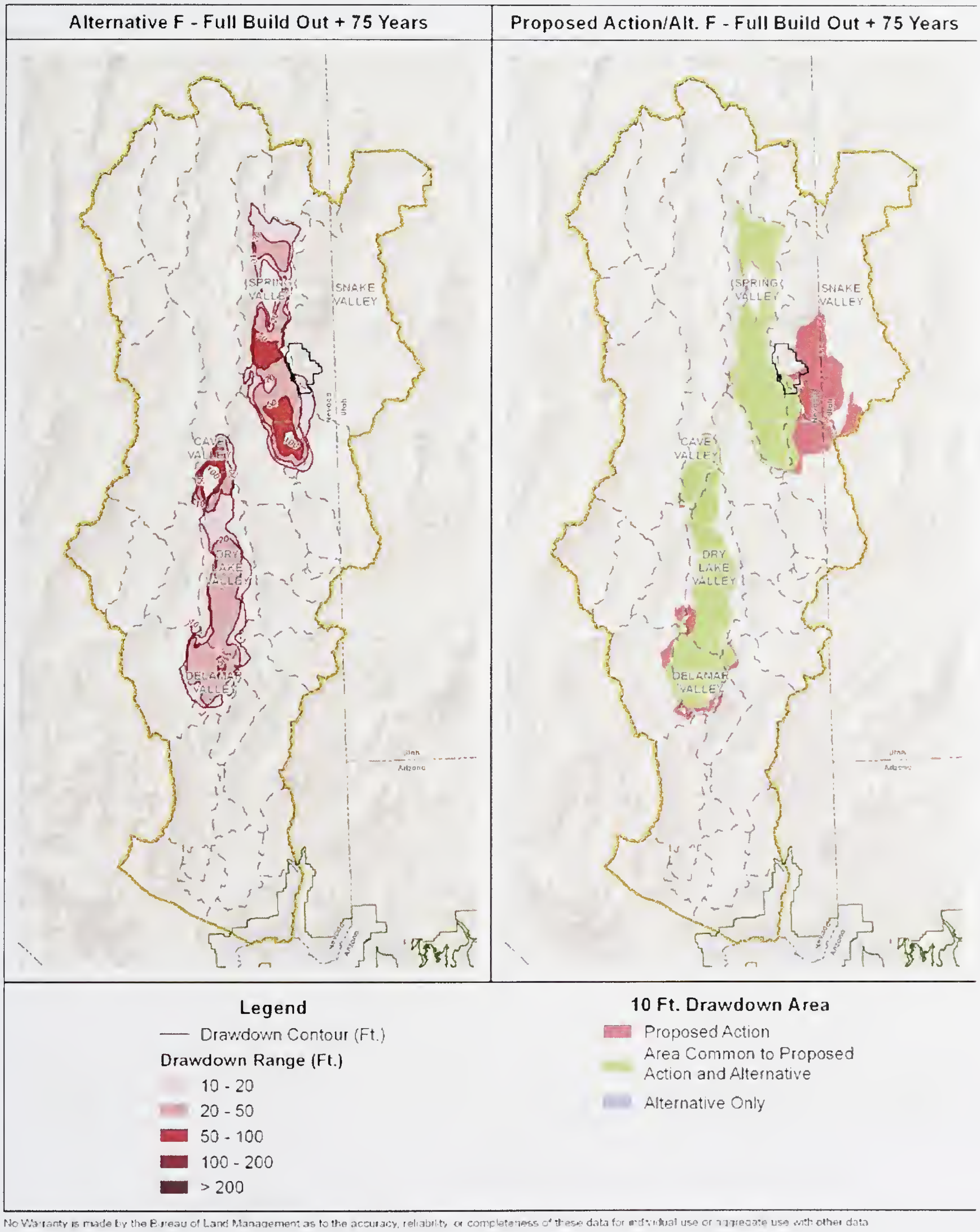


Figure ES-23 **Model Simulated Drawdown for Alternative F at the Full Build Out Plus 75 Years Time Frame (Left) and Comparative Drawdown Areas for the Proposed Action and Alternative F (Right) at the Full Build Out Plus 75 Years Time Frame**

The maximum groundwater production rate for Alternative F is approximately 114,129 afy for the 4 pumping basins (Spring and Delamar, Dry Lake, and Cave valleys). Under Alternative F, the same number of wells would be developed in Cave and Dry Lake valleys as for the Proposed Action. Spring and Delamar valleys would have fewer wells, with no wells or pumping in Snake Valley. Alternative F would substantially reduce the drawdown area in Snake Valley compared with the Proposed Action.

4.6 Does the area affected by 10-feet or more of drawdown continue to expand beyond the full build out plus 75 years time frame?

Yes. The groundwater modeling shows continued expansion of the groundwater drawdown area, for all alternatives, including No Action, assuming continued pumping beyond full build out plus 75 years. For example, **Figure ES-24** shows the expansion of the model simulated drawdown for the Proposed Action Alternative between the full build out plus 75 years and full build out plus 200 years time frames.

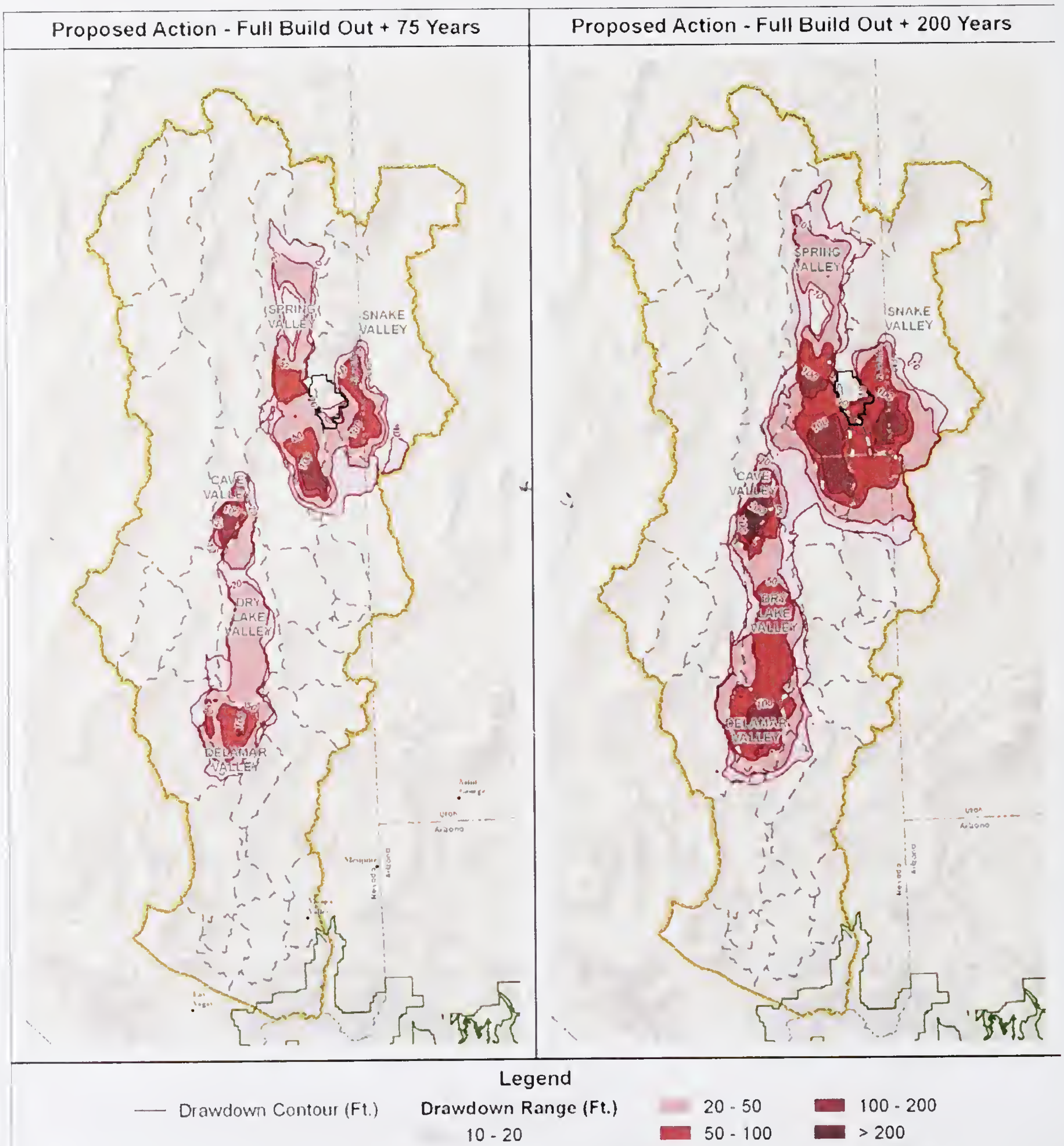


Figure ES-24 Model Simulated Drawdown for the Proposed Action at the Full Build Out Plus 75 years and Full Build Out Plus 200 Years Time Frames

4.7 How would long-term pumping affect water resources in the study area?

Table ES-8 provides a comparison of the potential impacts to water resources in the region of study associated with the various alternative pumping scenarios.

Table ES-8 Potential Incremental Effects to Water Resources at the Full Build Out Plus 75 Years and Full Build Out Plus 200 Years Time Frame Resulting from the Alternative Pumping Scenarios[1]

Water Resource Issue	Proposed Action	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	No Action
Full Build Out Plus 75 Years								
Drawdown effects on perennial springs: • Number of inventoried springs located in areas where impacts to flow could occur[2]	44	29	54	19	13	19	30	12
Drawdown effects on perennial streams: • Miles of perennial stream located in areas where impacts to flow could occur[2]	80	58	91	37	4	7	21	19
Drawdown effects on surface water rights: • Number of surface water rights located in areas where impacts to flow could occur[2]	145	109	141	78	23	60	88	105
Drawdown effects on groundwater rights: • Total groundwater rights in areas with >10 feet of drawdown • Number of groundwater rights in areas with >100 feet of drawdown	199 2	174 0	184 8	133 0	27 2	70 0	84 1	372 0
Percent reduction in groundwater discharge to evapotranspiration: • Spring Valley • Snake Valley • Great Salt Lake Desert Flow System	77% 28% 48%	51% 23% 34%	66% 18% 37%	37% 15% 24%	18% 4% 10%	52% 0% 21%	73% 1% 30%	7% 3% 5%
Full Build Out Plus 200 Years								
Drawdown effects on perennial springs: • Number of inventoried springs located in areas where impacts to flow could occur[2]	59	46	78	26	31	30	41	20
Drawdown effects on perennial streams: • Miles of perennial stream located in areas where impacts to flow could occur[2]	112	81	120	59	48	23	46	52
Drawdown effects on surface water rights: • Number of surface water rights located in areas where impacts to flow could occur[2]	212	151	186	98	56	94	132	164
Drawdown effects on groundwater rights: • Total groundwater rights in areas with >10 feet of drawdown • Number of groundwater rights in areas with >100 feet of drawdown	264 34	223 2	301 45	171 0	213 6	110 2	131 5	409 0
Percent reduction in groundwater discharge to evapotranspiration: • Spring Valley • Snake Valley • Great Salt Lake Desert Flow System[1]	84% 33% 54%	57% 27% 39%	73% 24% 44%	37% 17% 25%	28% 8% 16%	56% 3% 24%	80% 3% 34%	7% 3% 5%

[1] Supporting information used to develop these estimated effects are provided in **Appendices F3.3.6** through **F3.3.16**.
[2] Total located in high or moderate risk areas.

Potential Impacts to Springs and Streams

Springs and streams that are controlled by discharge from (or interconnected with) the regional groundwater system and located where a reduction in groundwater levels would occur, would likely experience a reduction in flow. The number of inventoried springs and miles of perennial streams located within the modeled drawdown area and located within areas at moderate to high risk of impacts are shown in **Figures ES-25** and **ES-26**.

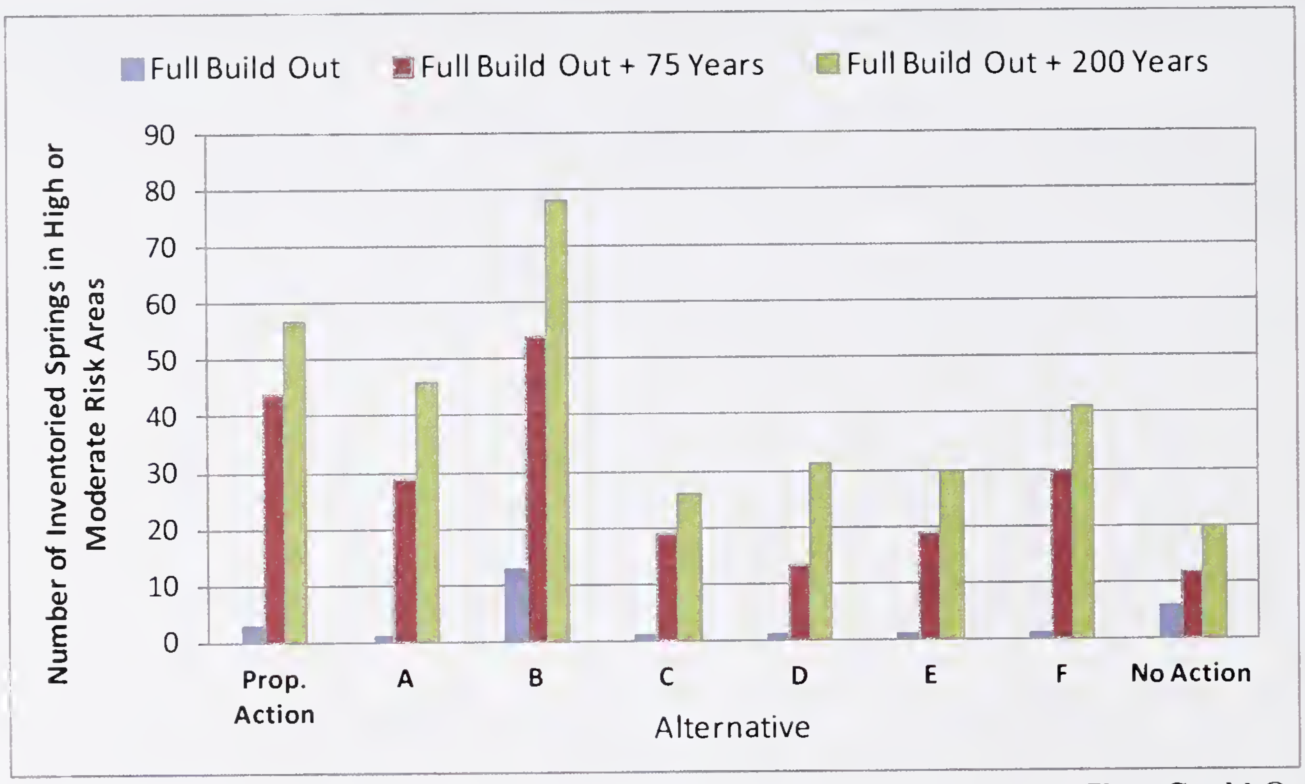


Figure ES-25 **Number of Inventoried Springs Located in Areas Where Impacts to Flow Could Occur (High or Moderate Risk Areas)**

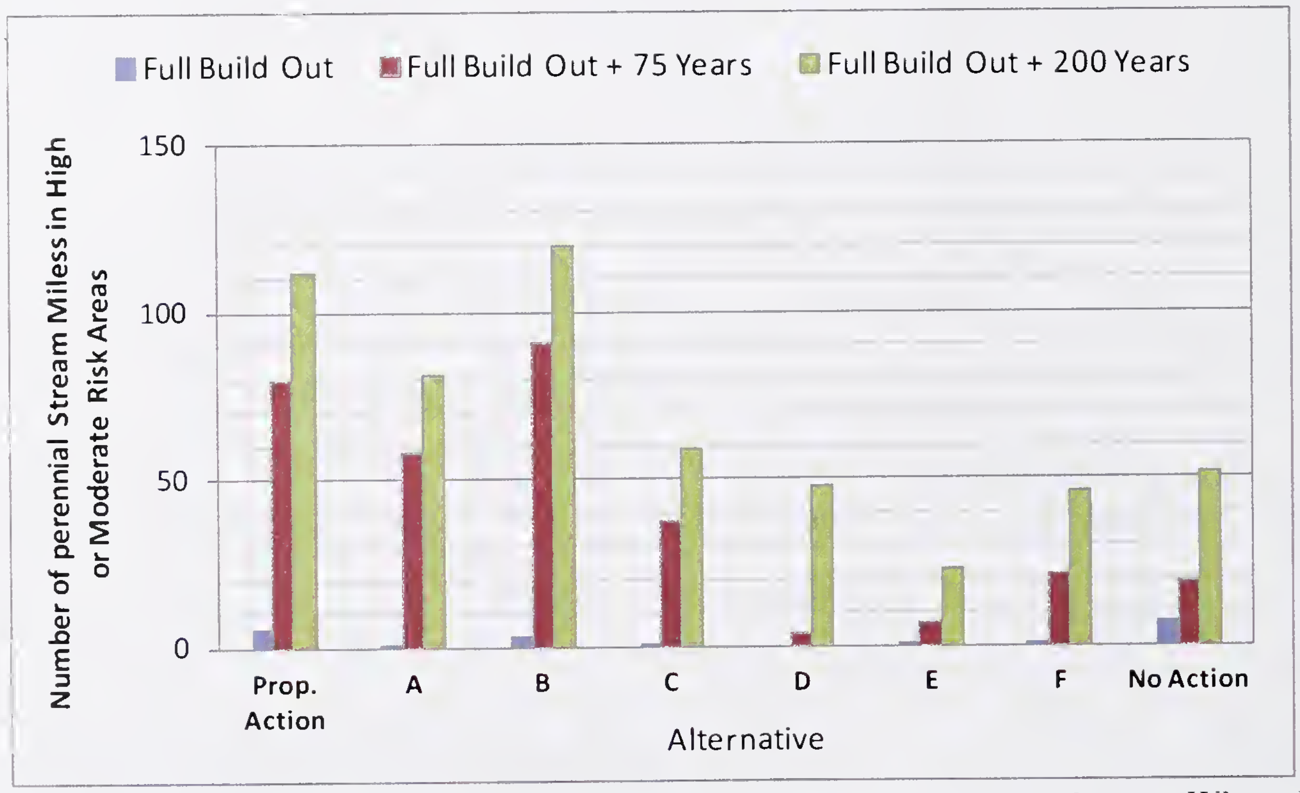


Figure ES-26 **Miles of Perennial Streams Located within the Drawdown Area and Areas Where Impacts to Flow Could Occur (High or Moderate Risk Areas)**

Construction of current pumping under the No Action Alternative pumping scenario would put 12 inventoried springs at high to moderate risk of being affected at the full build out plus 75 years time frame. The number of springs increases to 20 at the full build out plus 200 year time frame in areas where there is a high to moderate risk of drawdown impacts. The total estimated lengths of perennial streams at high to moderate risk of impacts from the model simulated drawdown increases from about 19 miles at full build out plus 75 years time frame to 52 miles at full build out plus 200 years time frame.

The springs and perennial stream reaches that are at high to moderate risk are identified in:

Section 3.3

The model indicates that continuing the existing pumping under the No Action Alternative would not result in a measurable flow reduction (i.e. >5 percent) in discharge at regional springs in Pahranagat Valley. However, existing pumping in the Muddy River Springs Area, Lower Meadow Valley Wash, and Lower Moapa Valley Hydrologic basins is predicted to cause a progressive reduction of flow over time in the Muddy River.

The simulated drawdown under the Proposed Action and Alternative B, the two alternatives with the largest groundwater withdrawal rate, potentially could impact flows in the largest number of springs and greatest number of miles of perennial stream reach. Compared to the Proposed Action, the reduced drawdown areas resulting from the Alternative A pumping scenario would reduce the number of springs and miles of streams potentially impacted. The Alternatives C, D, E, and F pumping scenarios would further reduce the drawdown area compared to Alternative A, and would potentially impact the fewest number of inventoried springs and fewer miles of perennial stream reach in the region.

Impacts to individual springs and streams would depend on the actual drawdown in these areas and the hydraulic connection between the impacted groundwater systems and the perennial water source. Perennial water sources that are hydraulically connected to the impacted groundwater system in the drawdown area would likely experience a reduction in baseflow that, depending on the severity, could result in springs drying up or a reduction in the length of the perennial stream reaches and their associated riparian areas.

Potential Impacts to Water Rights

The number of surface water rights located in areas where impacts to surface water resources could occur, and the number of groundwater rights located within the areas where the model simulations predict a drawdown of 10 feet or more are listed in **Table ES-8**. There are a large number of existing surface water rights located in areas where impacts from drawdown could occur under both the No Action Alternative and various pumping scenarios. The model indicates that drawdown for the two alternatives with the highest groundwater withdrawal rate (Proposed Action and Alternative B) could impact the largest number of water rights. The reduced drawdown areas under Alternatives A through F would decrease the number of water rights impacted.

The actual impacts to individual surface water rights would depend on the site-specific hydrologic conditions that control surface water discharge. Only the waters that depend on discharge from (or interconnected with) the regional groundwater system that would be affected by pumping would be potentially impacted.

For this evaluation, it is assumed that wells located within the areas affected by drawdown of 10 feet or more could be impacted. Effects on individual wells would depend on the: 1) well construction, including pump setting, depth, yield, predevelopment static, and groundwater pumping levels; 2) interconnection between the aquifer where the well is located and the aquifer targeted by the GWD Project; and 3) the magnitude and timing of the drawdown at each location. Impacts to wells could include a reduction in yield, increased pumping cost, or if the water level were lowered below the pump setting or the bottom of the well, the well could be rendered unusable.

Potential Reduction in Groundwater Discharge to Evapotranspiration Areas

Groundwater pumping is anticipated to result in a reduction in the amount of groundwater that discharges to evapotranspiration areas. These evapotranspiration areas are surface areas where water is lost to the atmosphere through evaporation (including evaporation from surface water, soil, or from the capillary fringe of the water table) and through plant transpiration. Reductions in groundwater discharge to evapotranspiration areas would likely affect vegetation resources within these areas.

Potential changes in the water balance for the groundwater system within the region of study were estimated using the groundwater flow model. The estimated reductions in groundwater discharge to evapotranspiration areas for selected basins and flow systems are summarized in **Table ES-8** and illustrated in **Figure ES-27**.

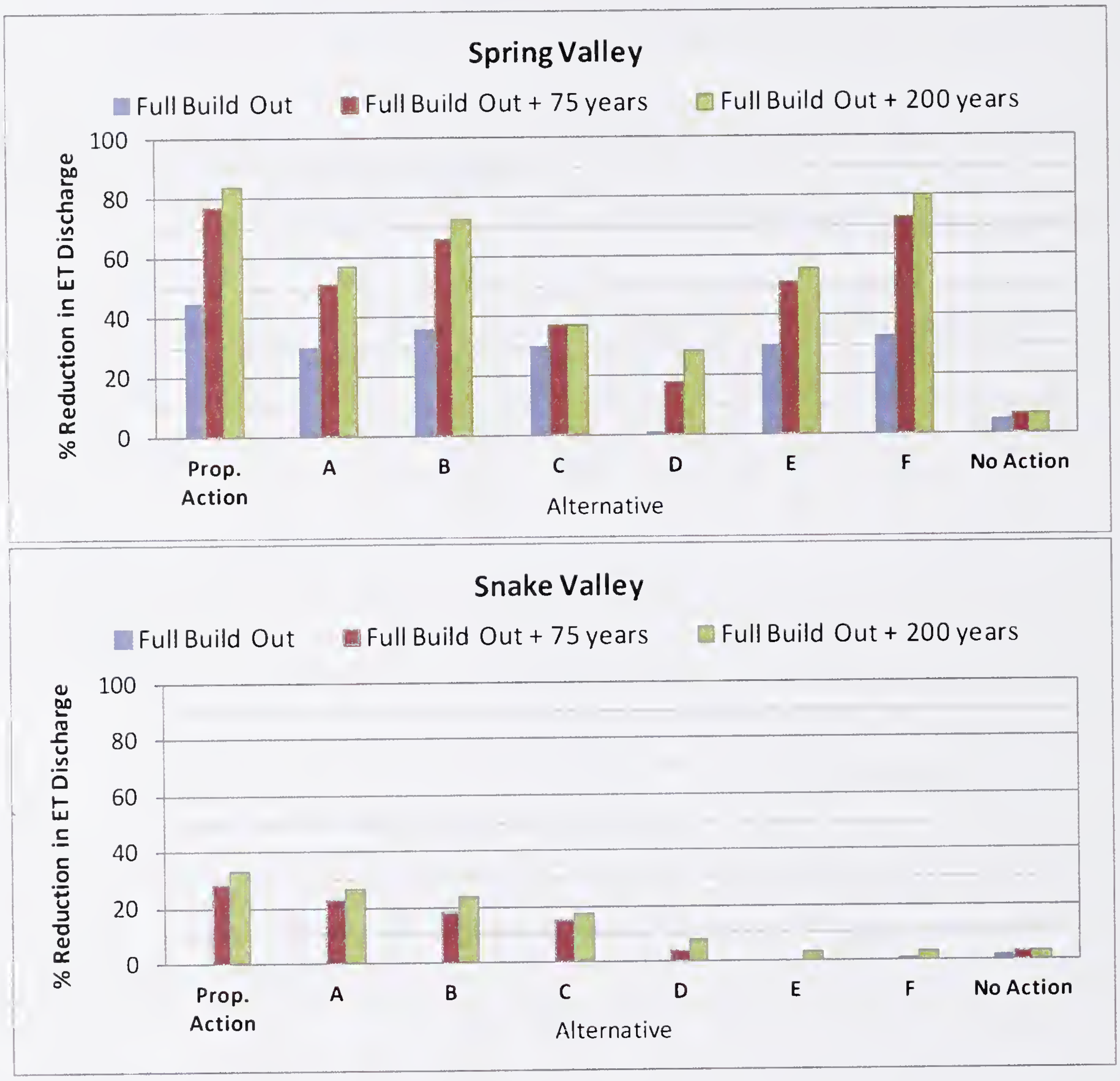


Figure ES-27 Model Simulated Reductions in Groundwater Discharge to Evapotranspiration Areas in Spring and Snake Valleys

The Proposed Action would result in the largest reductions in groundwater discharge to evapotranspiration areas within Spring and Snake valleys, with estimated reductions of up to 84 percent in such discharge in Spring Valley, and up to 34 percent in Snake Valley. For Snake valley, most of the reductions of discharge to areas would occur in the southern portion of the valley. The model results indicate that Alternative D would have the least impact to evapotranspiration areas in Spring Valley because the pumping is concentrated in the southern end of the valley away from much of the evapotranspiration areas. However, the concentrated pumping under Alternative D results in the deepest drawdown cone indicating that a higher percentage of the groundwater withdrawn under this scenario is from groundwater storage compared to the other groundwater development alternatives. Alternative E would result in the smallest impacts to evapotranspiration area in Snake Valley. These predicted reductions in evapotranspiration discharge rates indicate that spring discharge within and associated with these evapotranspiration areas would be reduced. Estimates of the potential impacts to vegetation within evapotranspiration areas are summarized under Vegetation Resources.

4.8 How would long-term pumping affect other resources in the study area?

The groundwater flow model was used to simulate reductions in groundwater elevation (i.e., drawdown) occurring over time from pumping under the Proposed Action or other action alternatives. In addition to the groundwater drawdown, the groundwater flow model was used to simulate potential flow changes in selected springs, streams, and rivers. The model results were used to define the area of projected drawdown of 10 feet or more, relative to current groundwater elevations. An expected drawdown of 10 feet or more is used to identify the area of potential environmental effects, including those on surface water and associated habitat (springs, ponds, wetlands, meadows, perennial streams, playas, and swamp cedar woodlands), and phreatophytic shrubland vegetation. For phreatophytic shrubland vegetation, a 10-foot or greater drawdown was also used to identify areas where loss of vegetation may occur.

For other environmental resources, functional connections to surface water, vegetation and habitat, or groundwater were used to evaluate potential effects. Examples of resource effects due to drawdown include:

- Air and Climate – dust generation risk from soil surface drying.
- Geology – pumping induced ground surface subsidence.
- Soils – potential structural and functional changes in hydric soils.
- Wild Horses – changes in water availability and forage quality and quantity resulting in a possible decrease of the appropriate management levels of horses.
- Rangeland and Livestock Grazing – changes in water sources and forage resulting in possible changes to the carrying capacity of a grazing allotment.
- Special Designations – potential changes in the natural and cultural values for which areas were designated.
- Native American Concerns – changes in water quantity and quality that could affect resources, places of traditional value and sacred sites.

The connections between pumping effects on surface waters and other resources are illustrated in **Figure ES-28**.

The effects of groundwater pumping for the Proposed Action, Alternatives A through F, and the No Action for several other key resources are summarized below. For some resources, impact parameter information is used to show the magnitude of effects on the resource. Except for transportation and public safety, the resource effects are directly related to surface water sources such as springs and perennial streams or indirectly linked to water for moisture, plant growth, or habitat (**Figure ES-28**). A comparison of potential effects among alternatives for air resources, geology, soils, vegetation, aquatic biological resources, and land use is provided in **Figures ES-29** through **ES-39**. As shown previously for water resources, these figures illustrate that for all resources, the two alternatives with the largest groundwater withdrawal rate (Proposed Action and Alternative B), would potentially have the largest effect on these resources. The reduced pumping assumed for Alternative A is estimated to result in a reduction in potential impacts (compared to the Proposed Action and Alternative B) for most of the resources. Groundwater pumping under Alternatives C, D, and E would further reduce potential effects compared to Alternative A. However, the magnitude of the potential reduction in effects for Alternatives C, D, E, and F varies by resource.

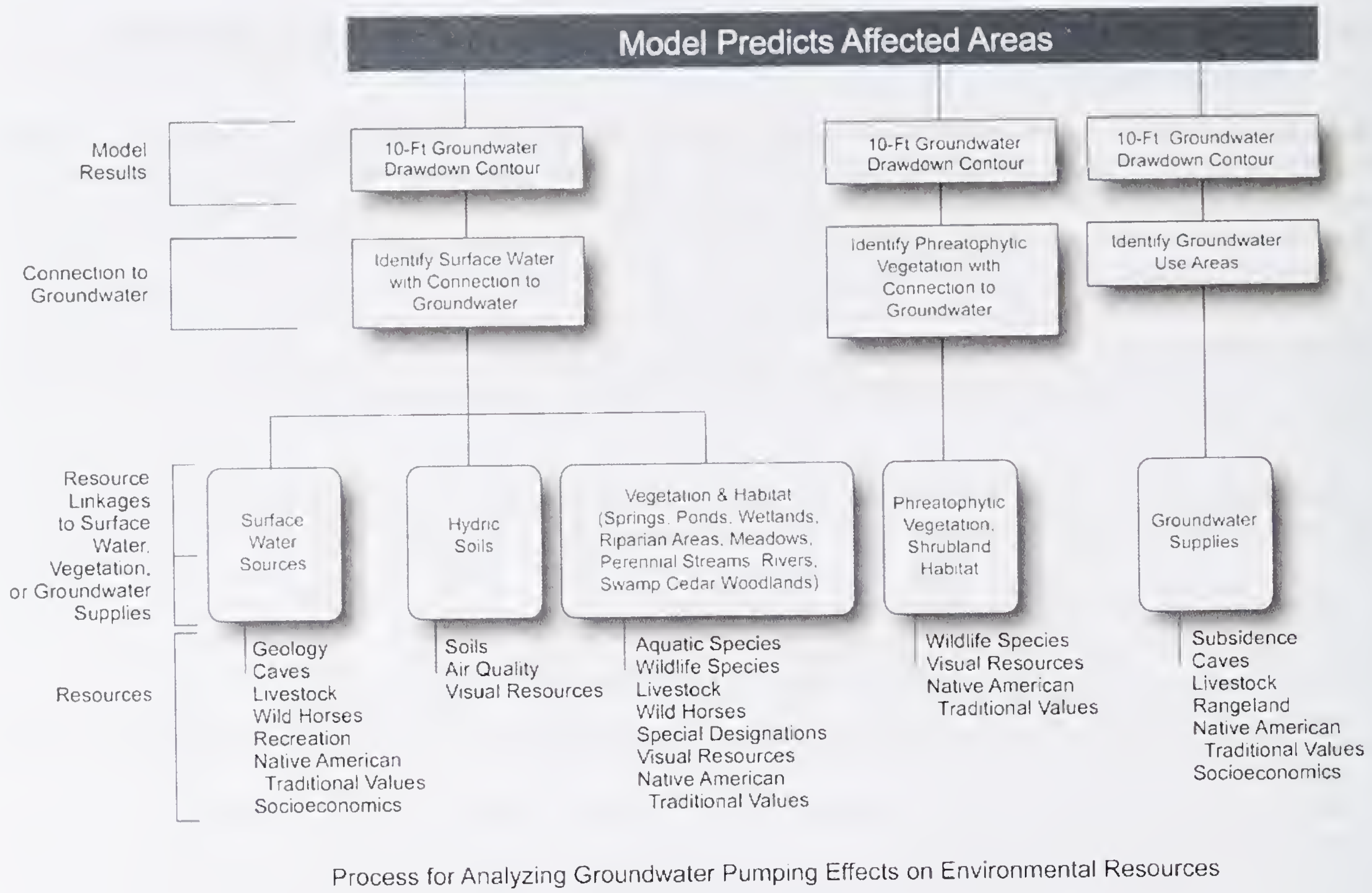


Figure ES-28 Process for Analyzing Groundwater Pumping Effects on Environmental Resources

Air Resources

- Groundwater drawdown would likely result in windblown dust emissions due to drying of hydric soils and loss or reduction of basin shrubland vegetation. The estimated particulate matter for a size of 10-micrometer emissions by alternative are shown on **Figure ES-29.** The particulate matter emissions for a size of 2.5 micrometers would show the same pattern of drawdown effects by alternative, although the magnitude would be less than the 10-micrometer size.
- The level and extent of these predicted dust emissions are highly uncertain due to the assumptions involving dust increases from changes in vegetation.
- Based on predicted power requirements, indirect emissions of greenhouse gases associated with electricity generation would range from approximately 182,000 (Alternative D) to 327,000 tonnes (U.S. metric ton) per year (Proposed Action).

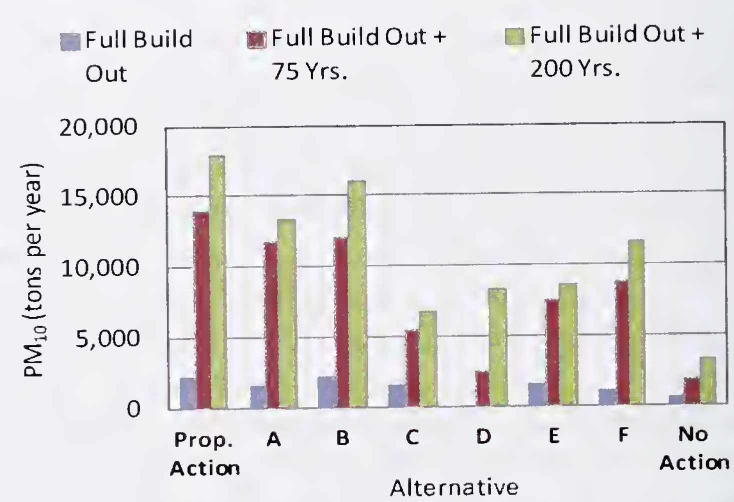


Figure ES-29 Comparison by Alternative of Particulate Matter Emissions Estimated from Groundwater Pumping

Geology

- The major geologic hazard associated with groundwater pumping would be the risk of subsidence of the ground surface as a result of withdrawal of groundwater. A measure of potential subsidence was estimated based on model-simulated drawdowns and the assumption that every 20 feet of long-term drawdown could result in 1 foot of surface subsidence. **Figure ES-30** illustrates the estimated area that could potentially experience subsidence of 5 feet or greater for each alternative. Predictions for subsidence for Alternative B are especially high because pumping would occur at a small number of points of diversion, resulting in deep aquifer drawdowns in Spring and Snake valleys, with consequent risks of subsidence.
- There is a lack of data on water resources and hydrological linkages of cave systems to groundwater to make conclusions regarding cave susceptibility to groundwater pumping.

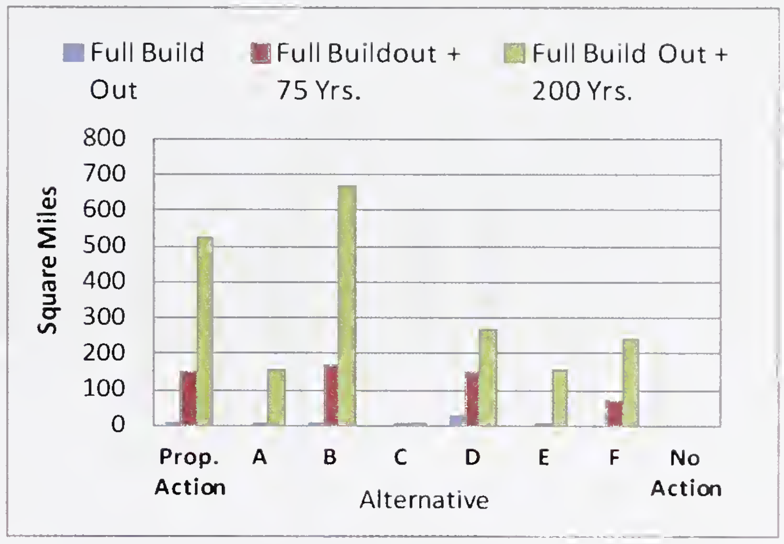


Figure ES-30 Comparison by Alternative of Areas at Risk of Subsidence > 5 Feet from Drawdown

Soils

- Reductions in groundwater levels and input from surface flows could reduce the area and functionality of hydric soils to support wetland and other water-dependent vegetation for all pumping alternatives. The magnitude of effects on acres of hydric soils are shown in **Figure ES-31**.

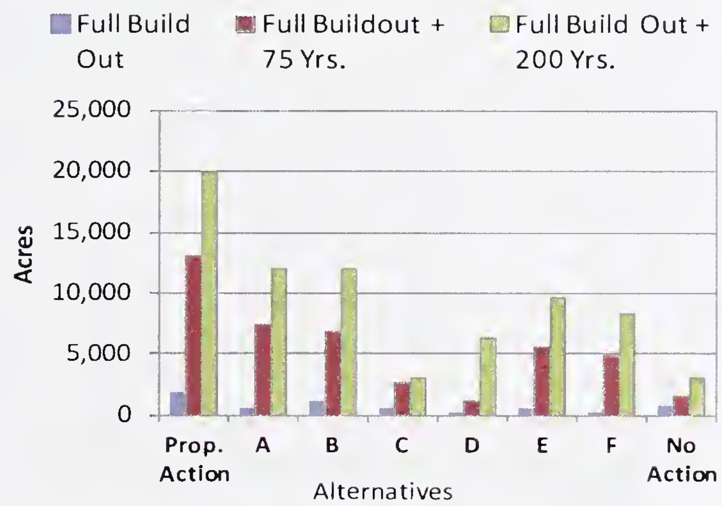


Figure ES-31 Hydric Soil Acres at Risk from Drawdown (≥ 10 feet)

Vegetation

- Groundwater pumping would potentially reduce available moisture in the root zones of vegetation communities that transpire (evaporate) large quantities of soil water through plant leaves. The Wetland/Meadow and Basin Shrubland vegetation are the primary sources of transpiration water from the hydrographic basins to be developed by the GWD Project.
- The Wetland/Meadow cover type depends on shallow groundwater (generally 10 feet or less) and surface flows, and are often supported from surface and subsurface flows from springs, and other areas of shallow groundwater. This cover type occupies relatively small areas in Spring, Snake, and Lake valleys.
- The Basin Shrubland cover type consists of a variety of shrub species, with greasewood (*Sarcobatus vermiculatus*) the most abundant. Greasewood and some other species of shrubs can extend their root systems to depths of 50 feet to take advantage of both shallow and deep groundwater. The Basin Shrubland cover type occupies very large areas across basin floors in Spring, Snake, Lake, and Hamlin valleys.
- Based on drawdown effect studies in other desert basins, it is anticipated that groundwater drawdown of 10 feet or more would result in the drying out, and then conversion of Wetland/Meadow cover types to upland shrub-dominated areas. It is anticipated that the greatest risk of compositional change to these communities would occur under the Proposed Action, and Alternatives A and B in Spring and Snake valleys (**Figure ES-32**).
- Groundwater drawdown may affect spring and stream flows, which in turn may affect water availability to riparian shrubs, grasses, and herbs. These vegetation communities may become less vigorous or extensive under decreased spring and stream flow over time (**Figure ES-33**). The relative drawdown effects of various alternatives to spring and stream dependent vegetation are indicated by the Aquatic Biological Resource figures in the next section.

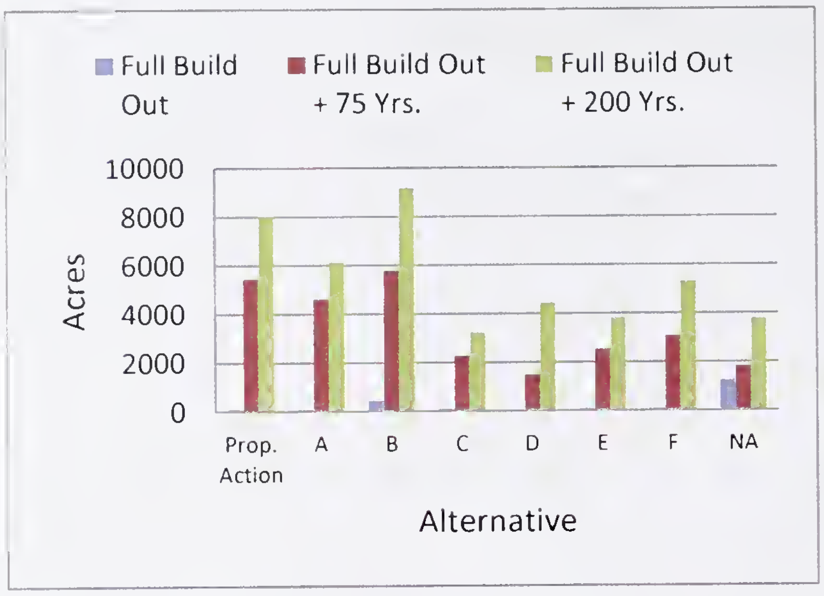


Figure ES-32 **Wetland/Meadow Acres at Risk from Drawdown (≥ 10 feet)**

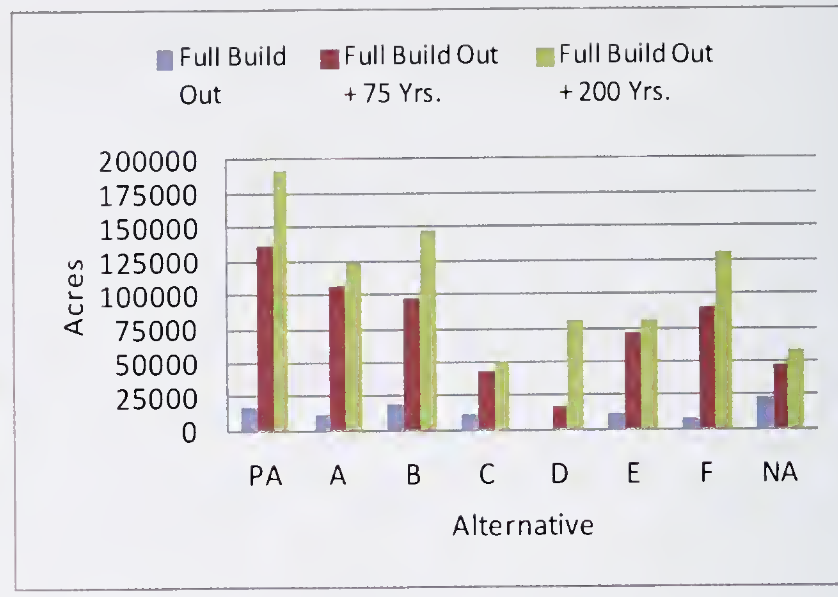


Figure ES-33 **Basin Shrub Acres At Risk from Drawdown (≥ 10 feet)**

- It is anticipated that the Basin Shrubland cover type would retain its dominant shrubs, but shrub densities may decline, and there is a risk of invasion by invasive annual species (**Figure ES-33**). The overall risk of wildland fires would increase in areas dominated by annual species. The alternatives and valleys where there would be a risk of compositional change would be the same as for the Wetland/Meadow cover type.
- The vegetation community compositional changes identified above may affect the availability and extent of tribal traditional use plants in the hydrographic basins affected by the GWD Project.
- Plant species in vegetation communities that are directly dependent on perennial spring and stream flows would experience the greatest potential change in plant species composition. Under drawdown conditions, wetland communities consisting of sedges, rushes, and cattails would progressively change toward a community dominated by deep-rooted grasses. The overall surface area occupied by wetland species would decrease, with persistence only in areas that continue to receive sufficient surface and groundwater for long-term survival. Dominant phreatophytic shrubs likely would persist over the long term, but potentially at lower densities and vigor as the result of reduced availability of soil moisture at greater depths, and lower suitability for shrub seedling re-establishment and growth.

Aquatic Biological Resources

- Spring, pond, lake, and perennial stream habitats located within the 10-foot drawdown contour and characterized as having moderate or high risks of flow reductions could be adversely affected by pumping from all alternatives. The number of affected waterbodies would vary by alternative, as indicated below in the spring and stream figures. Game fish, native fish, special status species, and other aquatic species would be adversely affected by flow reductions.
- Flow reductions would modify habitat by decreasing depths, water velocities, and wetted area in spring/pond/lake and stream habitats. A complete loss of habitat and species could occur in small springs and larger springs where all or most of the flow input is affected. Flow reductions could adversely affect aquatic species by reducing abundance and diversity, altering composition, reducing food sources, limiting spawning or early life stage development, and decreasing overall health condition.

Impact differences among the alternatives at the three model time frames are shown in **Figures ES-34** through **ES-37** for some of the key impact parameters.

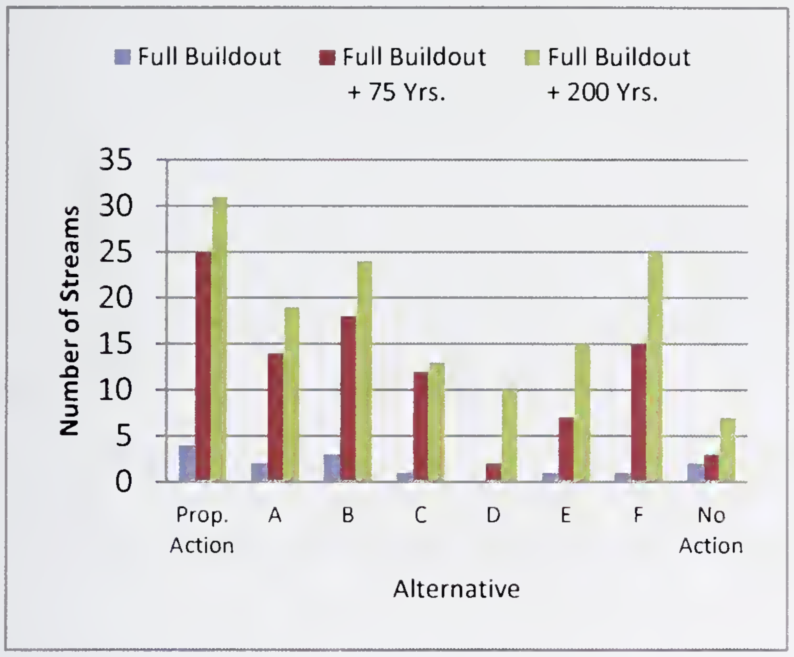


Figure ES-34 Streams with Aquatic Biology Resources with Potential Flow Reductions

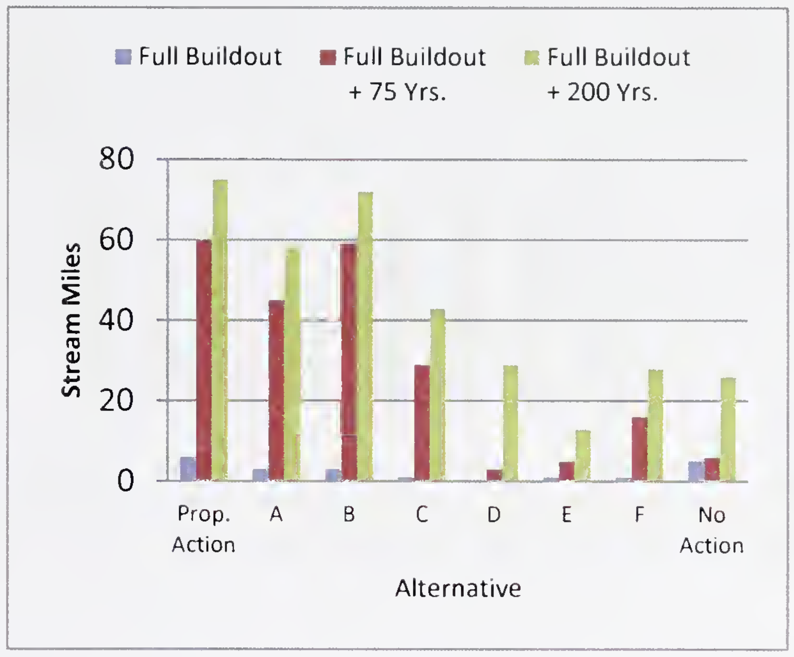


Figure ES-35 Miles of Game Fish and Special Status Species Streams with Potential Flow Reductions

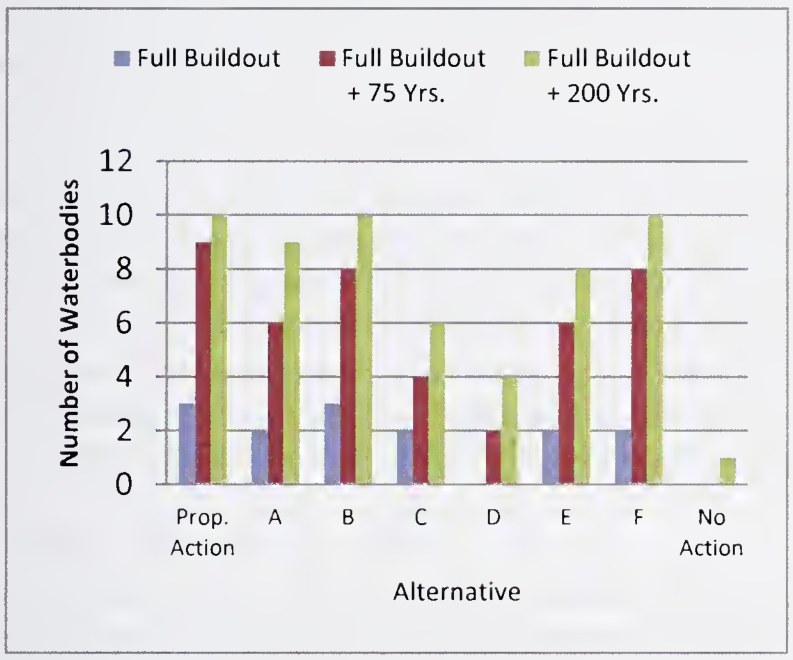


Figure ES-36 Springs/Ponds/Lakes Containing Special Status Amphibian Species with Potential Flow Reductions

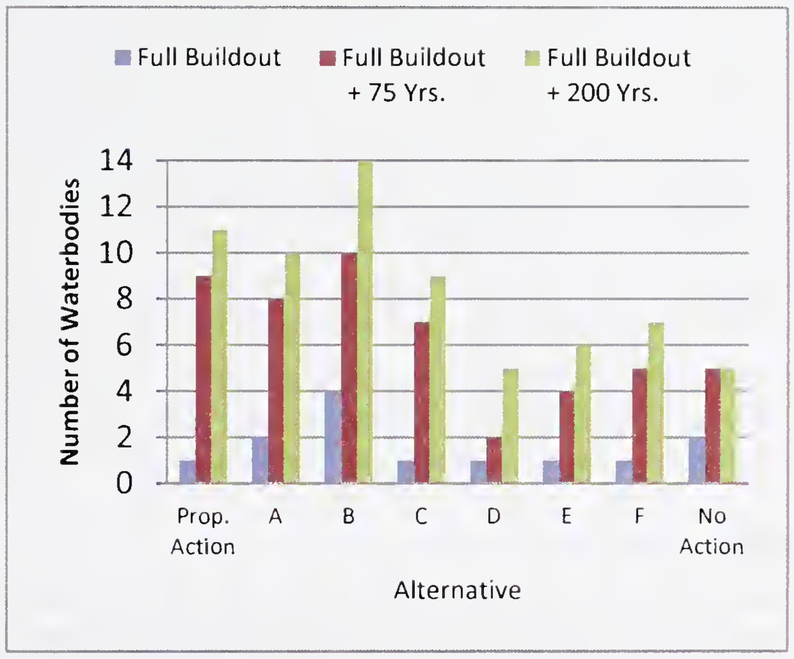


Figure ES-37 Springs/Ponds/Lakes Containing Game Fish and Special Status Species with Potential Flow Reductions

- Pumping by all alternatives could adversely affect two federally listed fish (Pahrump poolfish and White River spinedace), northern leopard frog, and special status fish and invertebrate species (springsnails, freshwater mussel, and California floater). Pumping by all alternatives would conflict with recovery or conservation management objectives for the two federally listed species: northern leopard frog, and Bonneville cutthroat trout.
- Fish species considered to be traditional values to regional Tribes could be affected in Snake, Spring, and Lake valleys to varying degrees by the pumping alternatives.

Land Use

- Groundwater pumping would result in the drawdown of groundwater levels on public lands that are available for disposal and private agricultural lands. The magnitude of effects on these two land use parameters are shown below (**Figures ES-38** and **ES-39**).

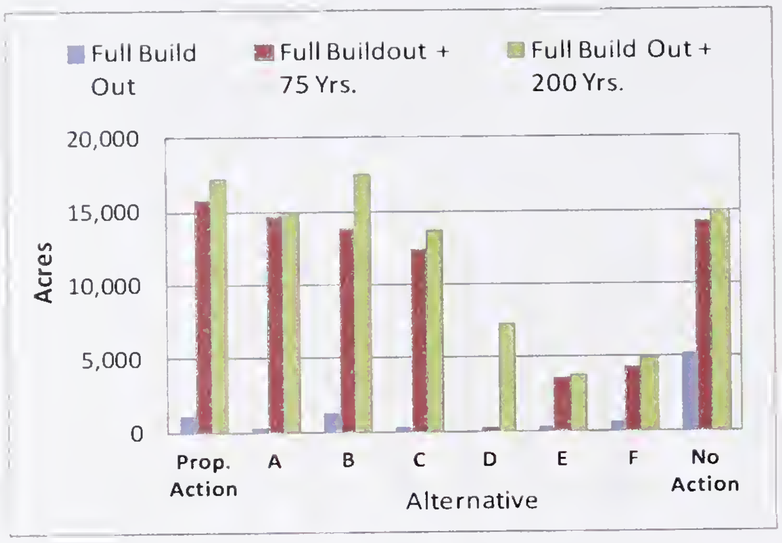


Figure ES-38 Private Agricultural Lands (Acres) at risk from Drawdown

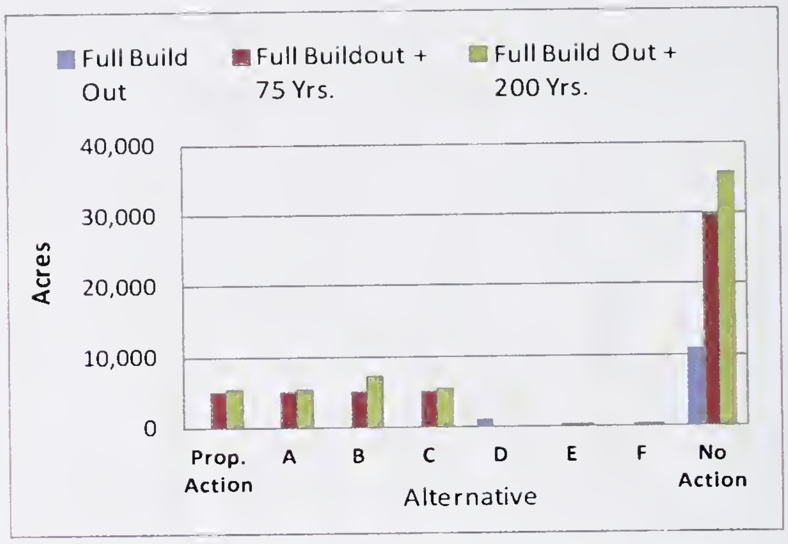


Figure ES-39 Public Lands Available for Disposal (Acres) at Risk for Drawdown

Wildlife

- Reductions in groundwater levels and input to surface flows would affect wildlife habitats such as springs, perennial streams, wetland/meadow, and basin shrublands. The potential reduction or loss of these habitats would result in reduction or loss of cover, breeding sites, foraging areas, and changes in both plant and animal community structure. The degree of impacts to wildlife resources would depend on a number of variables such as the existing habitat values and level of use, species' sensitivity to the water-dependent habitats, and the magnitude of the habitat reduction. Species groups with potential adverse effects would include big game, small and large mammals, upland game birds, waterfowl, nongame birds, bats, reptiles, and invertebrates.
- Pumping by all alternatives could adversely affect two federally listed birds (southwestern willow flycatcher and Yuma clapper rail), one federal candidate bird species (yellow-billed cuckoo), greater sage-grouse (federal candidate), other special status bird and bat species, pygmy rabbit, and invertebrates. Pumping by all alternatives could conflict with recovery or conservation management objectives for the federally listed species.
- The pattern of effects by pumping alternatives on wildlife habitat are assumed to be similar to the effects shown in **Figures ES-25** and **ES-26** for springs and streams and **Figures ES-32** and **ES-33** for wetland/meadow and shrubland evapotranspiration values, which serve as indicators of potential adverse effects to wildlife habitat.

Recreation

- Groundwater pumping could result in flow reductions in perennial streams, springs, and ponds and alter wetland meadow and basin shrubland vegetation, which could change the recreation setting, wildlife use patterns, fish abundance, and recreation use of these resources.
- Surface and/or groundwater sources in the GBNP and the Loneliest Highway and North Delamar Special Recreation Management Area, Cave Lake State Park, and Pioche Special Recreation Permit Area could be indirectly affected by drawdown from groundwater pumping under one or more of the alternative. The number of areas potentially affected areas for each alternative are: 4 for the Proposed Action; 3 for Alternative F; 2 for Alternatives A, C, D, and E; and 5 for Alternative B.

Rangelands and Grazing

- Reductions in groundwater levels and input to surface flows would affect water sources (springs and perennial streams) and alter forage vegetation (wetland meadow and basin shrubland) within grazing allotments. The pattern of effects by alternatives would be the same as shown in figures for water resources and vegetation.
- The capacity of habitat within grazing allotments to sustain livestock includes consideration of adequate forage, water, space, and cover. Reduced stream and spring flows could adversely affect forage production on a given allotment and cause overgrazing near existing water sources.

Wild Horses

- The capacity of habitat within wild horse herd areas includes consideration of adequate forage, water, space, and cover. Water is a limiting factor in some herd management areas. Reduced stream and spring flows could adversely affect forage production on a given Herd Management Area and cause overgrazing near existing water sources.
- The pattern of effects by pumping alternatives on wildlife habitat are assumed to be similar to the effects shown in **Figures ES-25** and **ES-26** for springs and streams and **Figures ES-32** and **ES-33** for wetland/meadow and shrubland evapotranspiration values, which serve as indicators of potential adverse effects to wild horse habitat.

Visual Resources

- Groundwater pumping potentially could reduce soil moisture and stress wetland meadow and basin shrubland vegetation. These changes in vegetation communities could gradually change the scenic views in terms of color, texture, density, and vegetation patterns. The pattern of effects for each of the alternatives is shown in the vegetation figures.

Special Designations

- Water level changes in springs and streams in the Baking Powder Flat, Shoshone Ponds, and Swamp Cedar ACECs, under all action alternatives, could affect those resources protected by the ACEC designation, compromising the objective of the designation. In addition, the Proposed Action and Alternative B could affect water levels in springs and streams in the Lower Meadow Valley ACEC.
- Drawdown effects in the Pahranagat National Wildlife Refuge under the Proposed Action and Alternatives B and F could affect migratory bird habitat, but would not be anticipated to compromise the objectives of the National Wildlife Refuge designation.
- Drawdown effects on springs and streams in the High Schells (Proposed Action and Alternatives B and F) and Mount Grafton (all but Alternative C) Wilderness Areas could affect some primitive recreation dependent on water sources, but would not be anticipated to compromise the objectives of the wilderness designation. Alternative D could have similar effects on the Parsnip Peak and White Rock Range Wilderness Areas.
- Groundwater pumping could result in flow reductions in springs, ponds, and perennial streams and alter vegetation (stream riparian areas and associated wetlands) within GBNP (Proposed Action and Alternatives A through C). The pattern of effects by alternatives would be the same as shown in figures for vegetation.

Cultural Resources

- Groundwater pumping by all alternatives could result in impacts to subsurface archaeological sites. The extent and significance of these potential impacts are difficult to define and quantify given the lack of specific location information for buried sites.
- Potential subsidence effects associated with drawdown could contribute to the integrity of standing structures.

Native American Traditional Values

- The location and availability of plants used for food and traditional uses, fishery quality, and flows of streams and springs may be modified by groundwater pumping.
- The location and availability of plants used for food and traditional uses, fishery quality, and flows of streams and springs may be modified by groundwater pumping. The pattern of effects by pumping alternatives would be similar to the effects shown in **Figures ES-25** and **ES-26** for springs and streams, **Figures ES-32** and **ES-33** for wetland/meadow and shrubland evapotranspiration values, and **Figures ES-34** and **ES-35** for aquatic resources, which serve as indicators of potential effects to Native American Traditional Values within the study area.

Socioeconomics

- Potential social and economic effects related to the groundwater pumping and drawdown are inherently long-term, materializing over time as pumping and groundwater drawdown continue, and tend to be directly correlated with the volume of pumping and drawdown.
- The likelihood that some effects of drawdown may be irreversible are themselves dimensions of project-related impacts to social and economic conditions in the rural areas of the region.

- Drawdown poses long-term risks to the agricultural sector in the rural areas through potential effects on grazing, irrigation and well development costs, and streams and seeps that serve as livestock water supplies.
- Groundwater production and conveyance would generate interbasin water transfer fees in White Pine and Lincoln counties which must be used for economic development, health care, and education.
- Residents of the rural area express concern about potential long-term indirect socioeconomic effects could result from impacts on wildlife, rangeland, air quality and visibility, and long-term economic development.
- The onset of groundwater pumping would cause increasing distress for many residents of the rural area; stemming from their perceived risks to the local environment and concern for detrimental long-term effects on their health, quality of life and livelihoods, and those of successive generations. For some residents, particularly in Snake and Spring valleys, personal distress would stem from the risk of loss of a valued rural way of life.
- The potential for adverse social and economic effects in the Snake Valley would be avoided under Alternatives D, E, and F. Alternative D also would reduce such effects in northern Spring Valley.
- The availability of groundwater in Clark and Lincoln counties, conveyed by the pipeline and facilities associated with the Proposed Action and other action alternatives could, in combination with other factors, enable a portion of the growth anticipated by those two counties, but only if other necessary underlying economic and environmental factors to stimulate growth are in place. Water availability would not be a driving force for growth.
- For some Las Vegas Valley residents, organizations, community and political leaders, and development interests, initiation of groundwater pumping may provide a measure of assurance that additional water will be available to enable growth in the Las Vegas Valley and provide a buffer against future water shortages due to episodic drought or climate change.

4.9 What are the residual effects (impacts) of the Groundwater Development Project?

Tier 1 Activities

The BLM National Environmental Policy Act Handbook (BLM 2008) defines residual effects as "those effects remaining after mitigation has been applied to the proposed action or an alternative". Residual effects of Tier 1 GWD Project components (mainline pipeline and ancillary facilities) and activities (including reclamation) are presented because these project facilities are proposed for specific surface locations at specific time frames, enabling detailed analysis of environmental consequences. The residual effects (impacts) related to Tier 1 activities are presented at the end of each resource issue topic in the Final EIS Chapter 3 Resource Sections 3.1 through 3.19, and summarized in Chapter 2 (**Table 2.10-1**).

Subsequent Tier Activities

As discussed in the Water Resources section (Section 3.3) of the Final EIS, groundwater drawdown effects, as predicted by the groundwater model, would extend for at least the time frame corresponding to pumping, full build out plus 200 years, and the time required for recovery following the cessation of pumping. Although it is not possible to identify residual impacts for subsequent tiers, each resource section of the Final EIS contains a summary statement of potential impacts after mitigation is applied. The residual effects of subsequent NEPA analyses for groundwater well field development and groundwater pumping could occur during the time frame of this analysis or beyond. As the knowledge of groundwater regimes in the pumping basins improves with additional study and groundwater development plans are more clearly defined in the future, a better analysis can be made of the residual impacts of groundwater well field development and operation, and groundwater pumping on water-dependent and other resources. Implementation of the COM Plan, ACMs, monitoring and mitigation recommendations, and adaptive management likely would reduce adverse effects at some locations. In particular, objectives of the COM Plan are to avoid or minimize impacts to groundwater-dependent ecosystems and biological communities and provide a process for mitigating impacts to ensure compliance with appropriate laws, policies, and regulations. However, the BLM lacks the site specific information to assess the level of impacts or impact mitigation at this time. Thus, while some residual impacts on resources could occur at some locations, the long-term residual effects of subsequent tier activities are uncertain but will be developed in subsequent NEPA tiers.

5. Cumulative Groundwater Drawdown Effects

The hydrologic study area for cumulative impacts from groundwater withdrawal encompasses the 35 hydrographic basin regions included in the model that was developed to evaluate the potential effects of the GWD Project. The groundwater model also was used to evaluate the potential cumulative effects assuming continuation of existing pumping; project-related pumping; and reasonably foreseeable future pumping in the region over the same time period as the project-related pumping, that is, full build out plus 200 years.

5.1 What level of cumulative groundwater pumping is assumed for this EIS?

The cumulative analysis of groundwater drawdown effects is based on the results of groundwater model simulations. The past and present actions reflect the best available information on consumptive uses in the groundwater basins included in the model. The reasonably foreseeable projects were those that were known at the time the modeling simulations were conducted.

The pumping scenarios were developed to simulate the combined effects associated with: 1) the continuation of existing pumping in the region included under the No Action pumping scenario; 2) additional pumping associated with the proposed groundwater development project, or alternative groundwater development scenarios (i.e., Alternatives A through F); and 3) additional reasonably foreseeable groundwater developments that have been identified within the cumulative study area.

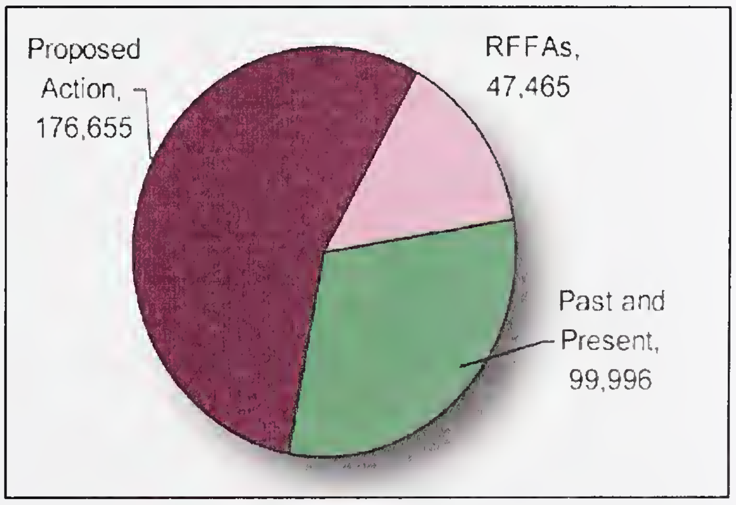


Figure ES-40 **Cumulative Groundwater Development (afy)**

Figure ES-40 summarizes the total cumulative groundwater consumptive use for the hydrologic basins within the overall hydrologic region of study included under the Proposed Action cumulative effects analysis. The Proposed Action represents the GWD Project alternative with the maximum potential groundwater withdrawal from the five project basins. No past or current pumping is occurring in Cave, Delamar, and Dry Lake valleys. Little or no incremental change in pumping is foreseeable in the five project basins. Based on these estimates, the GWD Project would be the primary groundwater user in all five groundwater development proposed pumping basins.

As discussed earlier, site-specific NEPA analysis would be conducted for the various groundwater development basins. Therefore, the cumulative analysis would be reviewed and updated as necessary during subsequent NEPA analyses.

5.2 What are the potential cumulative drawdown effects to water resources?

The potential cumulative drawdown effects were evaluated using results of the groundwater modeling over the same time frame as the project-related pumping, that is, full build out plus 75 years and full build out plus 200 years. The effects are summarized below.

No Action Alternative Cumulative Pumping. The predicted changes in groundwater levels attributable to the No Action Alternative cumulative pumping results in the development of new or expanded drawdowns in the Steptoe, Clover, Kane Springs, and Coyote Springs valleys. The model indicates that existing and reasonably foreseeable future pumping under the No Action Alternative cumulative scenario does not substantially contribute to drawdowns in Spring and Snake valleys.

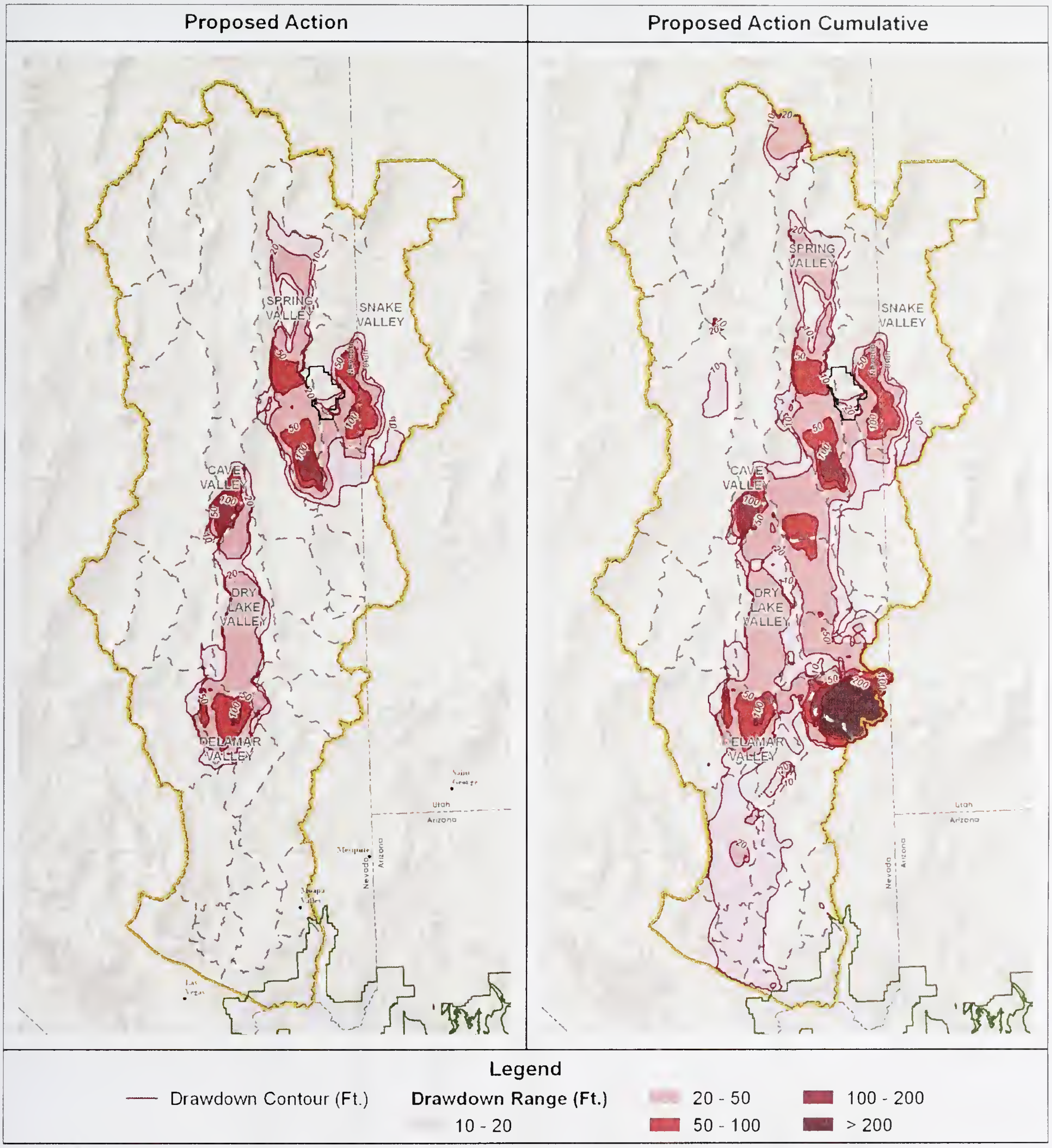
Groundwater Development Pumping Scenarios. The cumulative drawdown predicted for each of the seven groundwater development pumping alternatives (Proposed Action and Alternatives A through F) reflect the combined effects associated with the No Action Alternative cumulative drawdown and the incremental effects attributable to the GWD Project pumping under the specific alternative described previously.

The Proposed Action provides an example of the maximum cumulative drawdown predicted for the seven groundwater development scenarios (**Figure ES-41**. Comparison of the No Action Alternative scenario with the seven project alternative scenarios results in the following observations.

- Spring and Snake Valleys: The continuation of existing pumping and reasonably foreseeable pumping is not expected to substantially increase drawdown effects over those for the project specific effects.
- White River, Cave, Dry Lake, and Lake Valleys: Predicted drawdown from project pumping would overlap with the drawdown for the No Action Alternative in Lake Valley and adjacent areas. The overlapping drawdown effects from the proposed project pumping and existing pumping in Lake Valley would increase drawdown in Lake Valley and in Cave and Dry Lake valleys. The proposed groundwater development is predicted to contribute to a reduction in flow to springs located near the eastern margin of the valley floor in the southern portion of White River Valley.
- Delamar Valley, Lower Meadow Valley Wash, and Clover Valley: The proposed groundwater development is not anticipated to contribute to additional drawdown in Clover Valley. However, the overlapping drawdown from pumping in Clover and Delamar valleys is predicted to increase drawdown in the northern portion of the Lower Meadow Valley Wash.
- Coyote Spring, Muddy River Springs, Hidden Valley North, Garnet Valley, Black Mountain Area, and Las Vegas Valley: The drawdown effects in these basins are essentially the same under both the No Action Alternative cumulative and the project related cumulative scenarios. The incremental drawdown attributable to project pumping is not anticipated to substantially contribute to drawdowns beyond those simulated for the No Action Alternative in Coyote Spring, Muddy River Springs, Hidden Valley North, Garnet Valley, Black Mountain Area, and Las Vegas Valley.

These observations generally apply to all seven alternative cumulative pumping scenarios unless otherwise noted. However, the alternatives with the highest groundwater withdrawal volumes (Proposed Action and Alternative B) show the largest overlapping drawdown effects; and the alternative with the lowest groundwater withdrawal volume (Alternative C) show the smallest amount of overlapping drawdown effects.

Potential effects to water resources resulting from the cumulative pumping scenario at the full build out plus 75 years and full build out plus 200 years time frame are summarized in **Table ES-9**. The following discussion provides a summary of potential major effects and compares the results for the alternative pumping scenarios.



No Warranty is made by the Bureau of Land Management as to the accuracy, reliability or completeness of these data for individual use or aggregate use with other data

Figure ES-41 Drawdown Area Proposed Action at Full Build Out Plus 75 years and Proposed Action Cumulative at Full Build Out Plus 75 years

Table ES-9 Comparison of Potential Cumulative Effects to Water Resources at the Time Frames Associated with Full Build Out Plus 75 and Full Build Out Plus 200 Years[1]

Water Resource Issue	Proposed Action	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	No Action
Full Build Out Plus 75 Years								
Drawdown effects on perennial springs: • Number of inventoried springs located in areas where impacts to flow could occur[2]	65	53	77	42	34	42	51	19
Drawdown effects on perennial streams: • Miles of perennial stream located in areas where impacts to flow could occur[2]	131	110	137	98	53	56	69	42
Drawdown effects on surface water rights: • Number of surface water rights located in areas where impacts to flow could occur[2]	305	274	299	257	198	224	245	159
Drawdown effects on groundwater rights: • Total groundwater rights in areas with >10 feet of drawdown • Number of groundwater rights in areas with >100 feet of drawdown	683 21	667 19	679 27	635 19	541 21	558 19	567 21	500 19
Percent reduction in evapotranspiration and spring discharge: • Spring Valley • Snake Valley • Great Salt Lake Desert Flow System[1]	78% 30% 50%	55% 25% 38%	69% 21% 41%	43% 17% 28%	24% 7% 14%	55% 4% 25%	76% 4% 33%	6% 2% 4%
Full Build Out Plus 200 Years								
Drawdown effects on perennial springs: • Number of inventoried springs located in areas where impacts to flow could occur[2]	82	74	102	63	53	62	70	28
Drawdown effects on perennial streams: • Miles of perennial stream located in areas where impacts to flow could occur[2]	193	166	201	151	119	120	140	79
Drawdown effects on surface water rights: • Number of surface water rights located in areas where impacts to flow could occur[2]	422	372	393	341	302	315	352	228
Drawdown effects on groundwater rights: • Total groundwater rights in areas with >10 feet of drawdown • Number of groundwater rights in areas with >100 feet of drawdown	783 181	752 76	754 171	730 66	672 139	642 76	650 97	555 66
Percent reduction in groundwater discharge to evapotranspiration: • Spring Valley • Snake Valley • Great Salt Lake Desert Flow System[1]	86% 35% 56%	61% 29% 42%	76% 27% 47%	42% 20% 29%	35% 11% 21%	60% 6% 28%	82% 6% 37%	9% 3% 5%

[1]Supporting information used to develop these estimated effects are provided in **Appendices F3.3.6** through **F3.3.16**.

[2]Total located in high or moderate risk areas.

Potential Impacts to Springs and Streams

As described previously, springs that are controlled by discharge from (or hydraulically connected to) the regional groundwater system and located in areas that experience a reduction in groundwater levels would likely experience a reduction in flow.

The number of inventoried springs and miles of perennial stream located within the modeled cumulative drawdown area and located in areas at high or moderate risk are presented in **Figures ES-42** and **ES-43**. These charts show that the number of springs and miles of streams at risk increases over time for all of the cumulative pumping scenarios. For the No Action Alternative at the full build out for both full build out plus 75 years and full build out plus 200 years timeframes, there are 19 and 28 inventoried springs located in areas where impacts to perennial water could occur. Because the No Action Alternative cumulative pumping scenario is a component of the other alternative pumping scenarios, the total number of springs and miles of perennial stream identified for the No Action Alternative is included in the other seven alternatives (i.e. Proposed Action and Alternatives A through F).

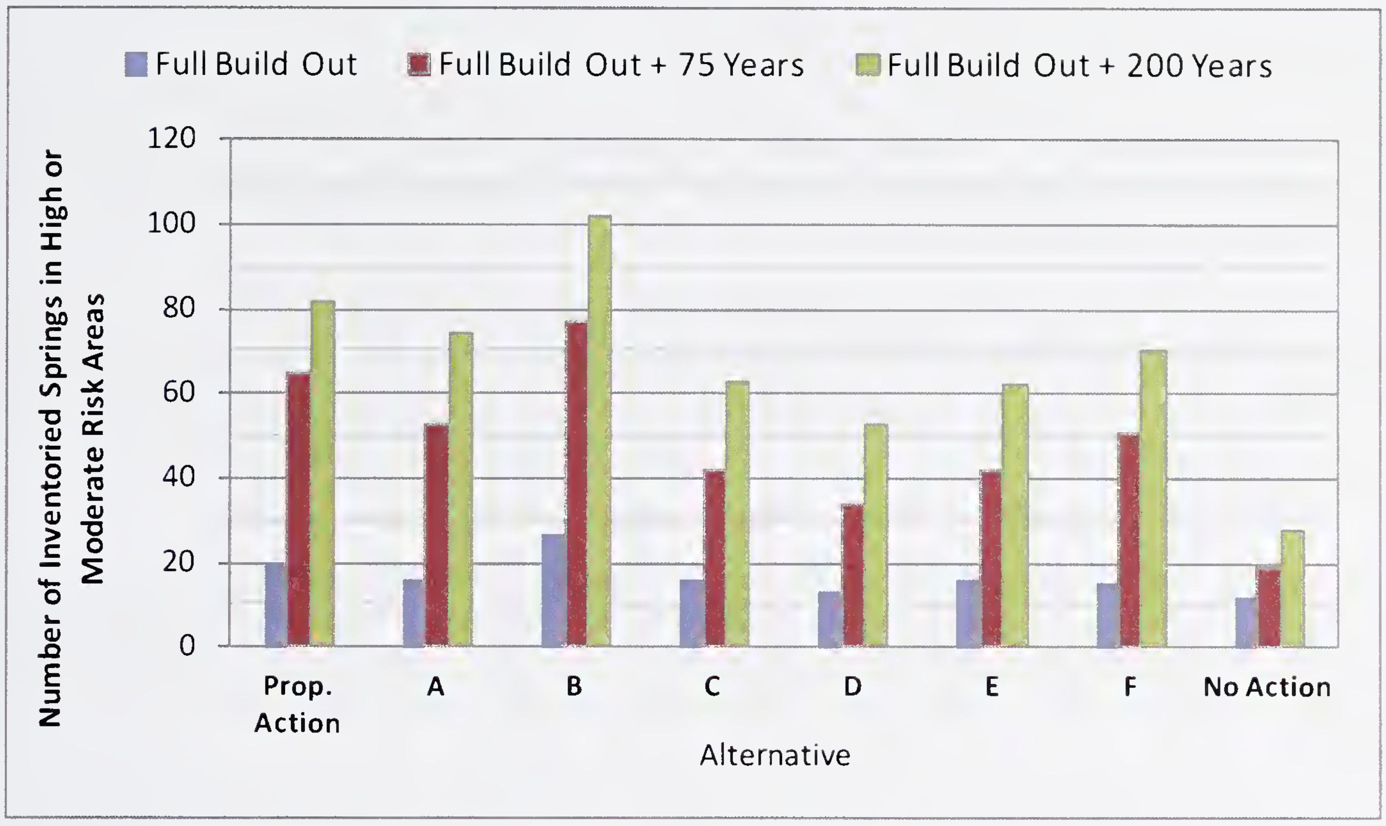


Figure ES-42 **Number of Inventoried Springs Located within the Cumulative Drawdown Area and Areas Where Impacts to Flow Could Occur**

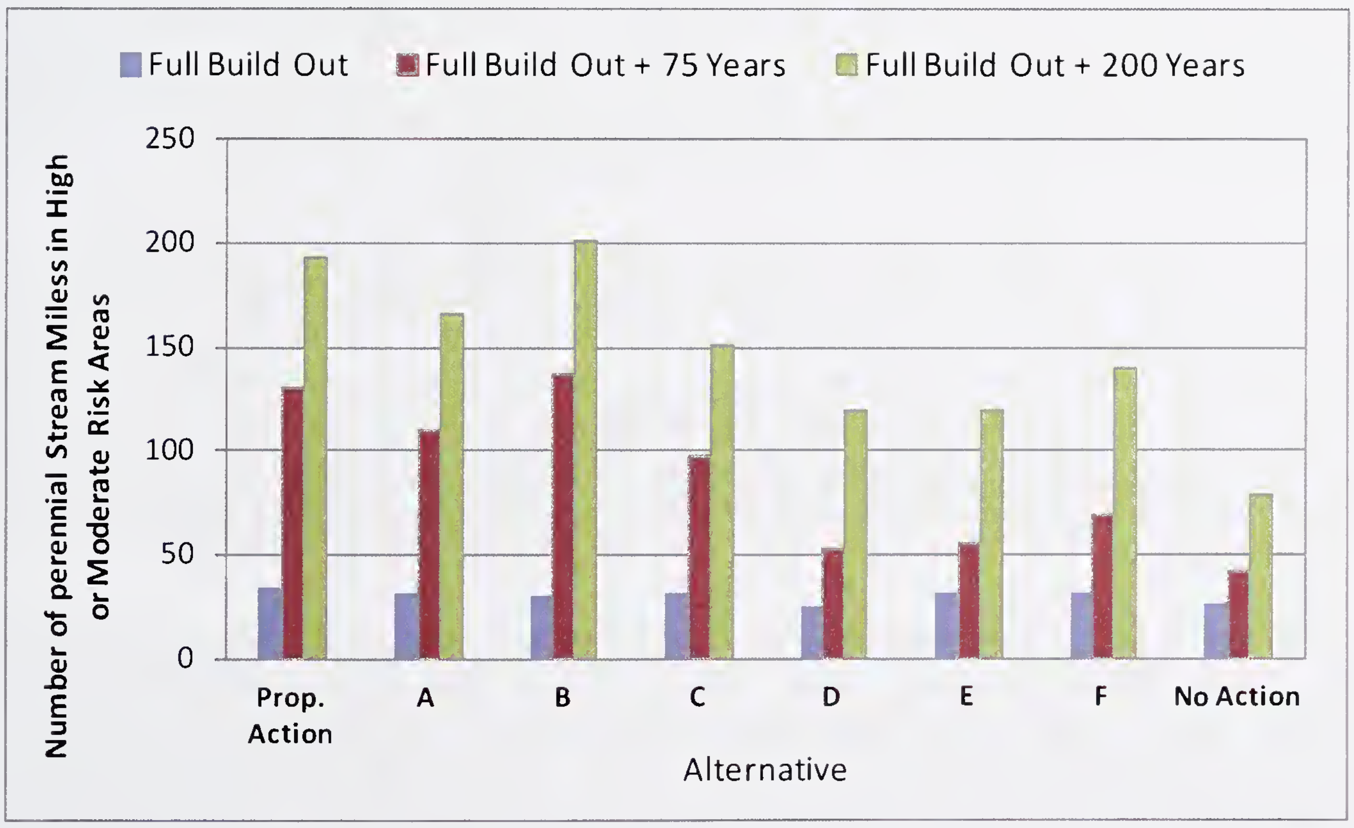


Figure ES-43 **Miles of Perennial Stream Located within the Cumulative Drawdown Area and Areas Where Impacts to Flow Could Occur**

The simulated drawdown for the two alternatives with the largest groundwater withdrawal rate (Proposed Action and Alternative B) could impact flows in the largest number of springs and greatest number of miles of perennial stream reach. The reduced drawdown areas resulting from the Alternative A cumulative pumping scenario could reduce the number of springs and miles of streams impacted. The Alternatives C, D, E, and F cumulative alternatives would further reduce the drawdown area compared to Alternative A, and would potentially impact the fewest number of inventoried springs and fewer miles of perennial stream reach.

Model-simulated Spring and Stream Discharge Estimates

The groundwater flow model was used to simulate changes in flow for selected springs and streams for each of the cumulative pumping scenarios. The selected springs and streams simulated with the model included major groundwater discharge areas located within the White River Valley, Pahranagat Valley, Muddy River Springs Area, Panaca Valley, and Snake Valley discussed below.

The White River Valley is located in the upper portion of the White River Flow System and is characterized by numerous perennial surface-water features, which include approximately 13 major spring discharge areas. Example results for two major spring discharge areas located in White River Valley are presented in **Figure ES-44**. Preston Big Springs is located in the northern portion of White River Valley, and Butterfield Springs is located near the eastern edge of the valley floor.

The model simulations indicate that the flow at Preston Big Springs would be reduced by up to 7 percent from groundwater withdrawals included in the No Action Alternative cumulative pumping scenario. Additional reductions in flow resulting from the pumping included in the groundwater development alternatives would be negligible. The model-simulated flow changes at Cold Spring and Nicolas Spring, located in the same general area, show essentially the same results.

Butterfield Springs is located near the eastern edge of the valley floor in the southern portion of White River Valley. The model results indicate that the No Action cumulative pumping scenario would result in a small reduction in flow (up to 3 percent) over the model-simulation period (**Figure ES-44**). The model simulations indicate that all of the groundwater development alternatives would result in reduced flow at these springs. These potential flow reductions result from pumping in Cave Valley. The maximum pumping rate in Cave Valley would occur under the Proposed Action and`Alternative B, and the greatest flow reduction at these springs would occur under Alternative B. The model simulations indicate that distributed pumping from the Proposed Action would substantially reduce the potential flow reduction in these springs compared to Alternative B. The reduced pumping in Cave Valley under Alternatives A, C, D, E, and F pumping scenarios is anticipated to also lessen the effects to flows at these springs.

Pahranagat Valley is located near the middle of the White River flow system. Major surface-water resources in Pahranagat Valley include groundwater discharge at Hiko, Crystal, and Ash springs, along with Brownie Spring and other smaller springs and seeps in the southern portion of the discharge area. Discharge from the springs supports perennial flows and riparian vegetation along Pahranagat Wash in the Pahranagat hydrographic basin. The regional springs that discharge in Pahranagat Valley (i.e. Hiko, Crystal and Ash Springs) are predicted to experience small flow reductions (up to 4 percent) under the No Action Alternative scenario. These simulated flow changes are essentially the same for all of the scenarios indicating that additional reductions in flow resulting from the GWD Project would be negligible for all alternatives.

Muddy River Springs near Moapa is the headwaters for Muddy River and represents the largest groundwater discharge at the lower end of the White River flow system. The model simulations indicate that groundwater withdrawal included in the No Action cumulative pumping scenario would eventually result in up to a 61 percent reduction in flow at the Muddy River Springs (**Figure ES-45**). Note that the numerical model simulations do not account for the existing Muddy River Memorandum of Agreement regarding groundwater withdrawal in Coyote Spring Valley and California Wash basins, among the SNWA, Moapa Valley Water District, Coyote Springs Investment, Moapa Band of Paiutes, and the U.S. Fish and Wildlife Service, which includes minimum in-stream flow levels. Most of the reduction in flow can be attributed to the pumping included under reasonably foreseeable future actions in the region. These flow changes are essentially the same for all of the groundwater development cumulative pumping scenarios, indicating negligible further reductions in flow from the project for all alternatives.

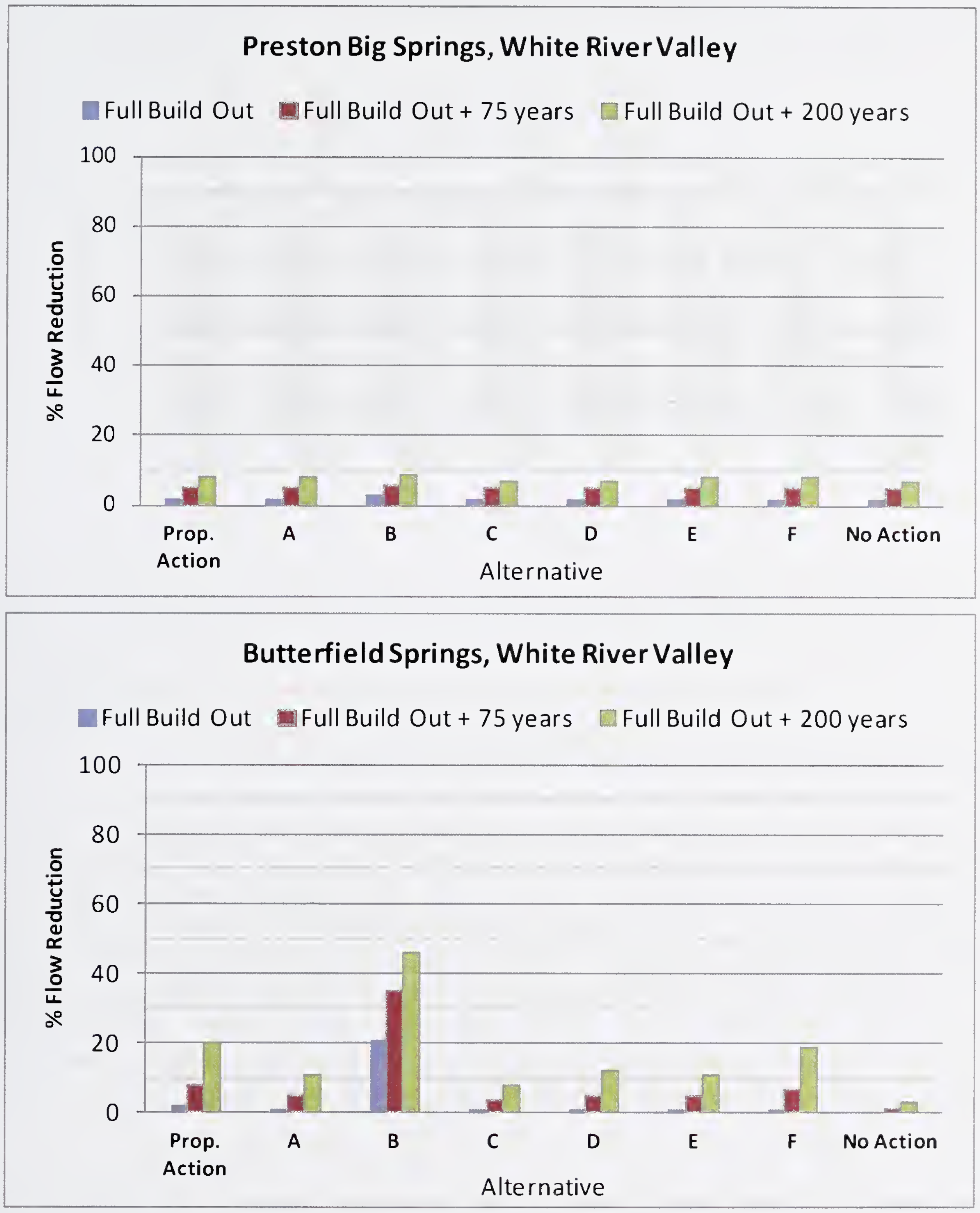


Figure ES-44 Model Simulated Cumulative Reduction in Flows at Preston Big Spring and Butterfield Springs, White River Valley

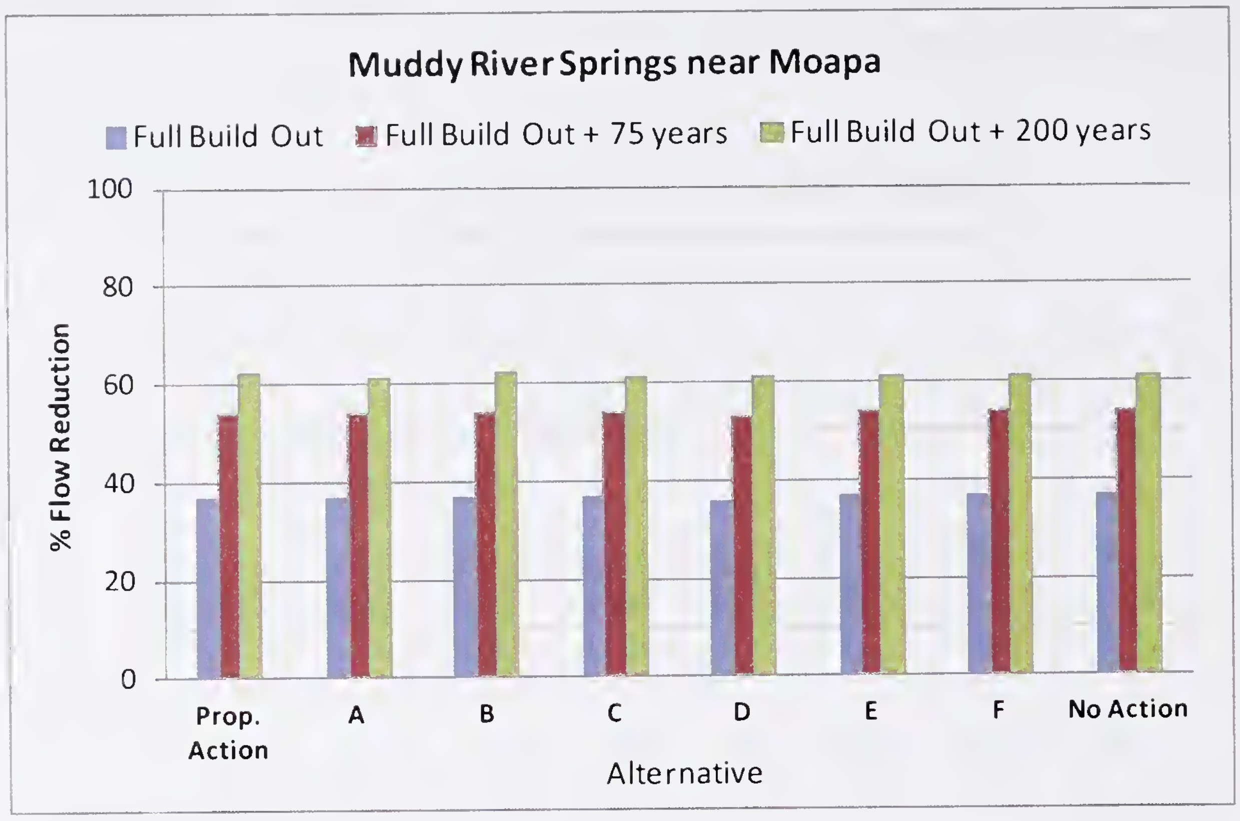


Figure ES-45 **Model Simulated Cumulative Reduction in Flows at Muddy River Springs near Moapa**

Panaca Spring is a major spring located in Panaca Valley in the Meadow Valley Flow System. The model simulations results indicate that flow at Panaca Spring located in Panaca Valley would experience flow reductions from pumping under the No Action Alternative cumulative pumping scenario, but the groundwater development pumping (under the Proposed Action and Alternatives A through F) would not contribute to these reductions.

Big Springs is the largest spring located in southern Snake Valley and is located relatively close to the groundwater development area within Snake Valley. For Big Springs, the model simulations indicate that flow reductions for the No Action Alternative cumulative scenario are similar to those in the No Action Alternative scenario. All of the groundwater development alternatives are expected to result in substantial reduction in flow (or potentially eliminate discharge) at Big Springs (**Figure ES-46**). Reductions of flow at Big Springs would reduce flows in Big Springs Creek, and reduce flows to Lake Creek and into Pruess Lake. These results suggest that the springs located on the valley floor in the southern portion of the valley likely would experience a reduction in flow. The simulations indicate that none of the cumulative pumping scenarios would reduce flows in the three other springs located in the central portion of Snake Valley (Foote Reservoir Spring, Kell Spring, and Warm Creek near Gandy).

Potential Impacts to Water Rights

The number of surface water rights located in areas where cumulative impacts to surface water resources could occur and the number of groundwater rights in the areas where the simulations predict drawdown of 10 feet or more are listed in **Table ES-9**. There are a large number of existing surface water rights located in areas where impacts from drawdown could occur under both the No Action Alternative and groundwater development cumulative pumping scenarios. The model indicates that drawdown for the two alternatives with the greatest groundwater withdrawal rate (Proposed Action and Alternative B) could potentially impact the highest number of water rights. The reduced drawdown areas resulting from the other alternatives (Alternatives A, C, D, E, and F) would decrease the number of water rights impacted. Potential impacts to individual water rights are the same as previously summarized.

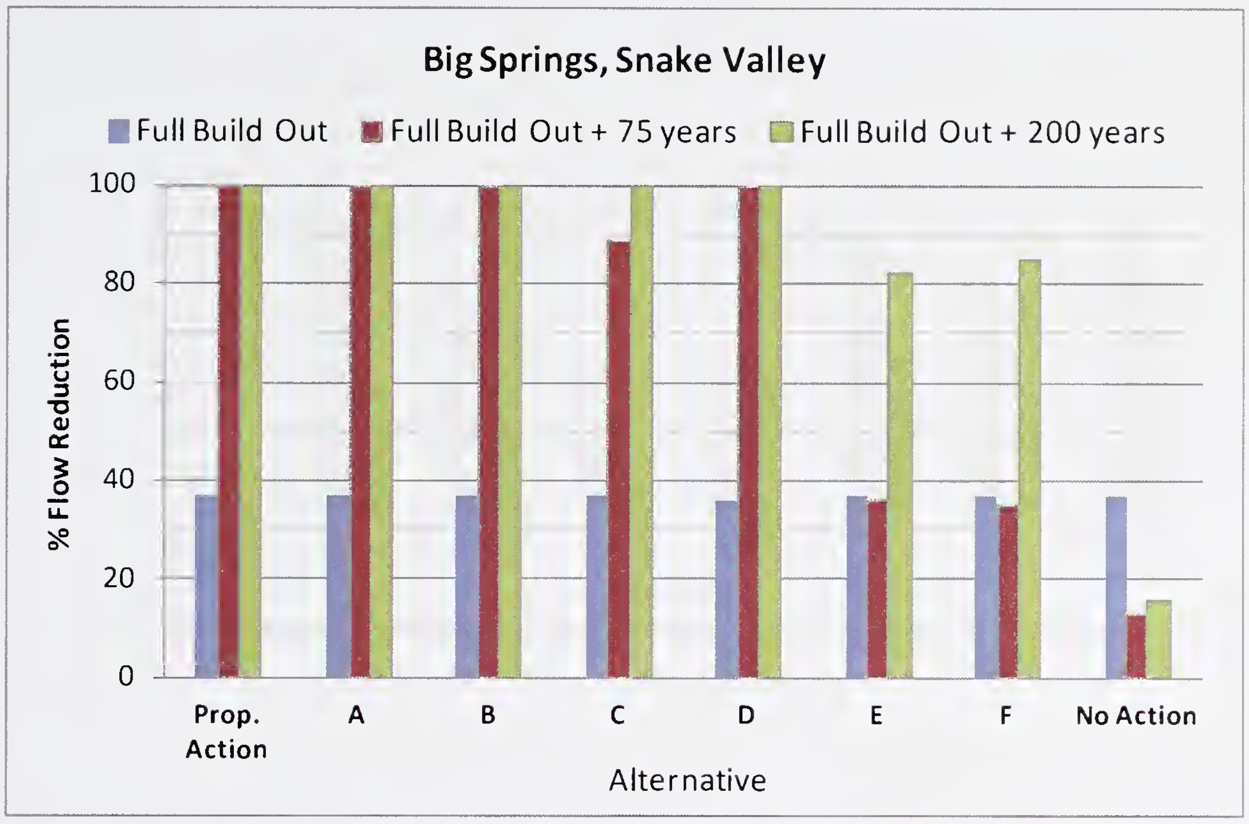


Figure ES-46 Model Simulated Cumulative Reduction in Flows at Big Springs, Snake Valley

Potential Reduction in Groundwater Discharge to Evapotranspiration Areas

Potential changes in the water balance for the groundwater system in the study area were estimated using the groundwater flow model (SNWA 2010b). The estimated cumulative reductions in groundwater discharge to evapotranspiration areas for selected basins and flow systems are summarized in **Table ES-9** and illustrated in **Figure ES-47**. The model indicates that groundwater withdrawal included in the No Action Alternative cumulative pumping scenario would have a small effect on the groundwater discharge to evapotranspiration areas in the Great Salt Lake Desert Flow System. For Spring Valley, the No Action Alternative pumping is estimated to result in a 6 and 9 percent reduction of groundwater discharge for evapotranspiration at the full build out plus 75 years, and full build out plus 200 years time frames, respectively. In Snake Valley, pumping is expected to result in minimal reductions (<4 percent) of groundwater discharge to support evapotranspiration.

The Proposed Action would result in the largest reductions in groundwater discharge to evapotranspiration areas within Spring and Snake valleys; with estimated reductions of up to 86 percent in Spring Valley, and up to 35 percent in Snake Valley. The model indicates that Alternative D would have the least impact to evapotranspiration areas in Spring Valley because pumping is concentrated in the south end of the valley away from much of the evapotranspiration areas. The concentrated pumping under Alternative D results in the deepest drawdown cone indicating that a higher percentage of the groundwater withdrawn under this scenario is from storage compared to the other groundwater development alternatives. For Snake Valley, most of the reductions would occur in the south portion of the valley. Alternative E would result in the least impacts to evapotranspiration areas in Snake Valley.

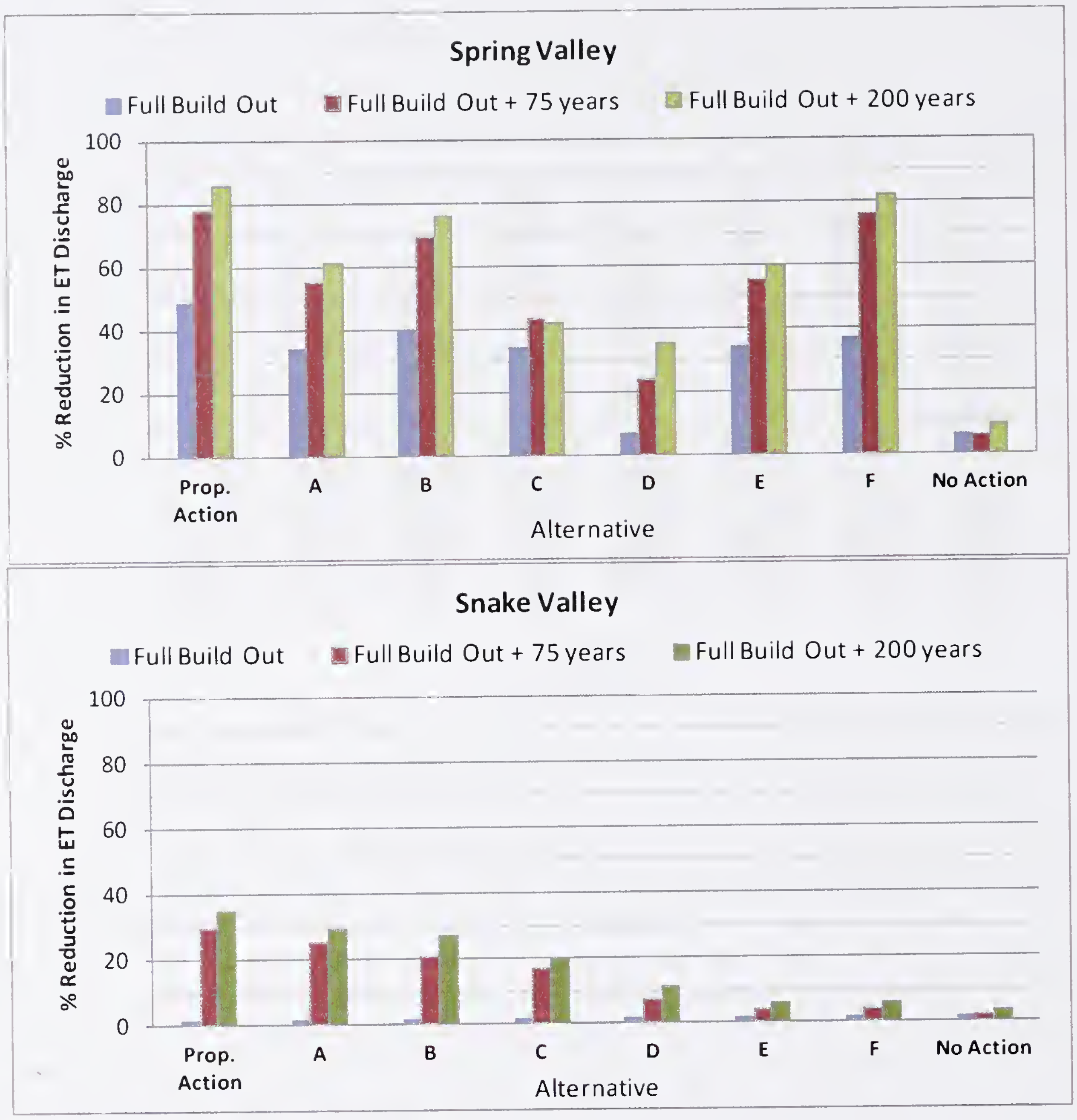


Figure ES-47 **Model Simulated Cumulative Reductions in Groundwater Discharge to Evapotranspiration Areas in Spring and Snake Valleys**

Other Resources

The cumulative effects of groundwater pumping on other resources are summarized in **Table ES-10.** Cumulative effects on resources from the action alternatives and No Action are presented using key impact indicators. The table provides the following information:

- Results are presented for the full build out plus 75 years time frame. The main body of the EIS provides additional results for 2 additional time frames (i.e., full build out and full build out plus 200 years).
- For comparison, the table provides the estimated incremental and cumulative effects associated with each specific pumping alternative. The estimated incremental effects represent those effects that are directly attributable to the specific pumping alternative. The cumulative effects include the combined effects resulting from the total pumping included in:
  1) The No Action pumping scenario (i.e., continuation of existing pumping into the future);
  2) Reasonably foreseeable future pumping (i.e., estimated additional pumping that may occur in the future from other projects in the region); and
  3) Pumping attributable to the specific pumping alternatives.

- The incremental contribution of each alternative to the cumulative effects can be estimated by comparing the impact indicator information for the incremental and cumulative effects under each alternative. The difference between the incremental effects and the overall cumulative effects for a specific alternative is assumed to be the result of the additional pumping included under No Action and reasonably foreseeable groundwater development projects included in the cumulative pumping scenarios.
- The cumulative impact patterns for water dependent resources closely follow the patterns and interactions identified for water resources. In general, the GWD Project would be the dominant contributor of cumulative effects in the hydrographic basins where project well development would occur.

Table ES-10 Summary of Resource Impact Parameters for Individual Alternatives and Cumulative Pumping - Full Build Out Plus 75 Years

Resource	Impact Parameter	Proposed Action	Cumulative with Proposed Action	Alternative A	Cumulative with Alternative A	Alternative B	Cumulative with Alternative B	Alternative C	Cumulative with Alternative C	Alternative D	Cumulative with Alternative D	Alternative E	Cumulative with Alternative E	Alternative F	Cumulative with Alternative F	No Action	Cumulative with No Action
Air	PM_{10} emissions (tons per year) from windblown dust	14,046	18,173	11,826	15,784	12,104	25,537	5,416	10,185	2,474	7,150	7,464	11,588	8,747	12,754	1,869	3,827
	PM_{10} emissions ($\mu g/m^3$) from windblown dust	• Air quality impacts are not anticipated to contribute to nearby nonattainment areas such as Clark County or the Wasatch Front. • Model-predicted impacts indicate that air quality standards at GBNP would be met. However, windblown dust emissions from groundwater drawdown could possibly impair visibility conditions at GBNP.														Some increase in fugitive dust generation would occur due to continued ground-water pumping.	
Geology	Square miles of area with potential ground surface subsidence of > 5 feet	147	283	5	131	172	323	<1	126	152	281	5	131	71	208	0	126
Water	Number of inventoried springs with moderate or high risk of flow reductions	44	65	29	53	54	77	19	42	13	34	19	42	30	51	12	19
	Miles of perennial streams with moderate or high risk of flow reductions	80	131	58	110	91	137	37	98	4	53	7	56	21	69	19	42
	Number of surface water rights in drawdown area with moderate or high risks of flow reductions	145	305	109	274	141	299	78	257	23	198	60	224	88	245	105	159
Soils	Acres of hydric soils within high or moderate risk zones within drawdown areas	13,143	26,936	7,374	19,839	6,817	18,022	2,626	16,110	1,143	12,712	5,586	17,854	4,949	14,727	1,571	8,798

Table ES-10 Summary of Resource Impact Parameters for Individual Alternatives and Cumulative Pumping - Full Build Out Plus 75 Years (Continued)

Resource	Impact Parameter	Proposed Action	Cumulative with Proposed Action	Alternative A	Cumulative with Alternative A	Alternative B	Cumulative with Alternative B	Alternative C	Cumulative with Alternative C	Alternative D	Cumulative with Alternative D	Alternative E	Cumulative with Alternative E	Alternative F	Cumulative with Alternative F	No Action	Cumulative with No Action
Vegetation	Wetland/meadows with composition/growth effects (acres)	5,460	7,789	4,624	6,881	5,794	9,008	2,287	4,718	1,507	4,067	2,548	4,805	3,096	3,655	261	1,840
	Basin shrublands with composition/growth effects (acres)	136,990	187,887	106,414	158,531	97,174	152,528	42,703	96,911	16,747	71,537	71,429	122,805	89,049	133,132	32,229	47,358
Wildlife	Pumping effects on spring, stream, wetland, and basin shrubland habitats	Wildlife habitats may be modified by changes in composition of groundwater dependent vegetation, and seasonal availability of surface water. For this alternative, see: • Water – risks to springs and streams; and • Vegetation – risks to Wetland/ Meadows and Basin Shrublands.														No additional changes in wildlife habitats would occur because no groundwater pumping would occur in project hydrographic basins.	
Aquatic Biological Resources	Miles of perennial streams with game fish and special status species with moderate or high risks of flow reductions	60	92	45	77	59	89	29	87	3	34	5	37	16	48	6	26
	Number of springs with game and special status fish species with moderate or high risk of flow reductions	9	31	8	31	10	26	7	16	2	14	4	13	5	15	5	6
Land Use	Acres of private agricultural land in the drawdown area	15,792	32,183	14,605	31,220	13,865	30,449	12,359	29,891	299	19,228	3,635	20,178	4,400	20,978	14,204	17,921

Table ES-10 Summary of Resource Impact Parameters for Individual Alternatives and Cumulative Pumping - Full Build Out Plus 75 Years (Continued)

Resource	Impact Parameter	Proposed Action	Cumulative with Proposed Action	Alternative A	Cumulative with Alternative A	Alternative B	Cumulative with Alternative B	Alternative C	Cumulative with Alternative C	Alternative D	Cumulative with Alternative D	Alternative E	Cumulative with Alternative E	Alternative F	Cumulative with Alternative F	No Action	Cumulative with No Action
Rangeland	Number of perennial springs in grazing allotments with risk of flow reductions	210	297	118	227	156	243	63	168	41	127	55	167	131	217	46	78
	Perennial stream miles within grazing allotments with risk of flow reductions	73	119	52	99	78	119	37	89	5	48	6	51	21	65	19	37
Wild Horses	Number of perennial springs in herd management areas with risk of flow reductions	2	28	2	28	2	28	2	28	7	31	2	28	2	28	19	26
	Acres of basin shrublands and wetlands/meadows in herd management areas and drawdown areas	0	2,664	0	2,664	0	2,664	0	2,664	0	2,664	0	2,664	0	2,664	2,511	2,664
Recreation	Number of springs in recreation areas with risks of flow reductions	20	44	13	39	40	64	3	35	0	23	5	30	9	35	14	24
	Miles of game fish streams in recreation areas with risks of flow reductions	8	25	7	21	17	32	1	19	0	12	0	14	0	14	<1	12
Special Designations	Acres of wetland/meadow and basin shrubland vegetation in special designations and drawdown area	13,730	14,296	11,223	11,744	13,534	14,142	4,911	5,743	11,223	9,377	11,222	11,744	13,334	13,900	0	488

Table ES-10 Summary of Resource Impact Parameters for Individual Alternatives and Cumulative Pumping - Full Build Out Plus 75 Years (Continued)

Resource	Impact Parameter	Proposed Action	Cumulative with Proposed Action	Alternative A	Cumulative with Alternative A	Alternative B	Cumulative with Alternative B	Alternative C	Cumulative with Alternative C	Alternative D	Cumulative with Alternative D	Alternative E	Cumulative with Alternative E	Alternative F	Cumulative with Alternative F	No Action	Cumulative with No Action
Visual Resources	Acres of disturbance in Visual Resource Management Class I	402	7,789	402	6,881	402	9,008	402	4,718	402	4,067	402	4,805	402		402	1,840
	Acres of disturbance in Visual Resource Management Class II	23,412	187,887	23,412	158,531	23,412	152,528	23,412	96,911	12,822	71,537	22,938	122,805	22,938		23,412	47,358
	Changes in appearance of wetland/meadows and shrublands from draw-down effects	Changes in the appearance of the landscape from groundwater drawdown may result from broadscale vegetation changes. See also: • Water – risks to springs and streams; and • Vegetation – risks to wetlands/meadows and basin shrublands.														No changes in visual resources would occur because no groundwater pumping would occur in project hydrographic basins.	
Native Americans Traditional Values	Drawdown effects on water and vegetation aquatic biological and wildlife resources	The location and availability of plants used for food and traditional uses, fishery quality, and flows of streams and springs may be modified by groundwater pumping. For all action alternatives, see: • Water – risks to springs and streams; • Aquatic Biology – risks to game fish and special status species. • Vegetation – risks to Wetland/ Meadows and Basin Shrublands														No additional changes in the availability of plants used for food and traditional uses, and flows in springs and streams because no groundwater pumping would occur in project hydrographic basins.	

Table ES-10 **Summary of Resource Impact Parameters for Individual Alternatives and Cumulative Pumping - Full Build Out Plus 75 Years (Continued)**

Resource	Impact Parameter	Proposed Action	Cumulative with Proposed Action	Alternative A	Cumulative with Alternative A	Alternative B	Cumulative with Alternative B	Alternative C	Cumulative with Alternative C	Alternative D	Cumulative with Alternative D	Alternative E	Cumulative with Alternative E	Alternative F	Cumulative with Alternative F	No Action	Cumulative with No Action
Socioeconomics	Acres of agricultural land potentially affected by drawdown of ≥10 feet in Snake and Spring valleys	15,792	15,978	14,605	14,943	13,865	14,172	12,359	1,3613	299	3,024	3,635	39,014	3,383	3,618	1,654	1,654
	Acres of public lands identified for potential disposal with drawdown risks ≥10 feet	4,918	47,666	4,918	47,666	4,918	47,666	4,918	47,666	107	42,197	107	42,847	107	42,847	29,612	42,493

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1. Purpose and Need for this Federal Action

1.1 Introduction

On August 19, 2004, the Bureau of Land Management (BLM) received a right-of-way (ROW) application from the Southern Nevada Water Authority (SNWA) for construction and operation of a pipeline system to convey groundwater in southeastern Nevada (**Figure 1.1-1**). The overall proposal, termed the Groundwater Development Project (GWD Project), would convey water produced from existing and new water rights for which the SNWA has applied to the Nevada Division of Water Resources (Office of the Nevada State Engineer [NSE]). The GWD Project would develop and convey groundwater resources that the NSE has permitted to SNWA in Spring, Delamar, Dry Lake, and Cave valleys and may permit in Snake Valley for use in Clark County.

The GWD Project is one component of the SNWA's long-term plan (**Appendix A**) to meet future demand pursuant to Nevada Revised Statutes (NRS) § 704.661. Additional information regarding the SNWA's water resource plan and the role of the GWD Project in meeting community needs is provided in Section 1.6, Southern Nevada Water Authority Responsibilities, Current Water Supply, and Future Needs. The BLM has no administrative or approval authority over the appropriation of water rights in Nevada or the SNWA's water resource plan.

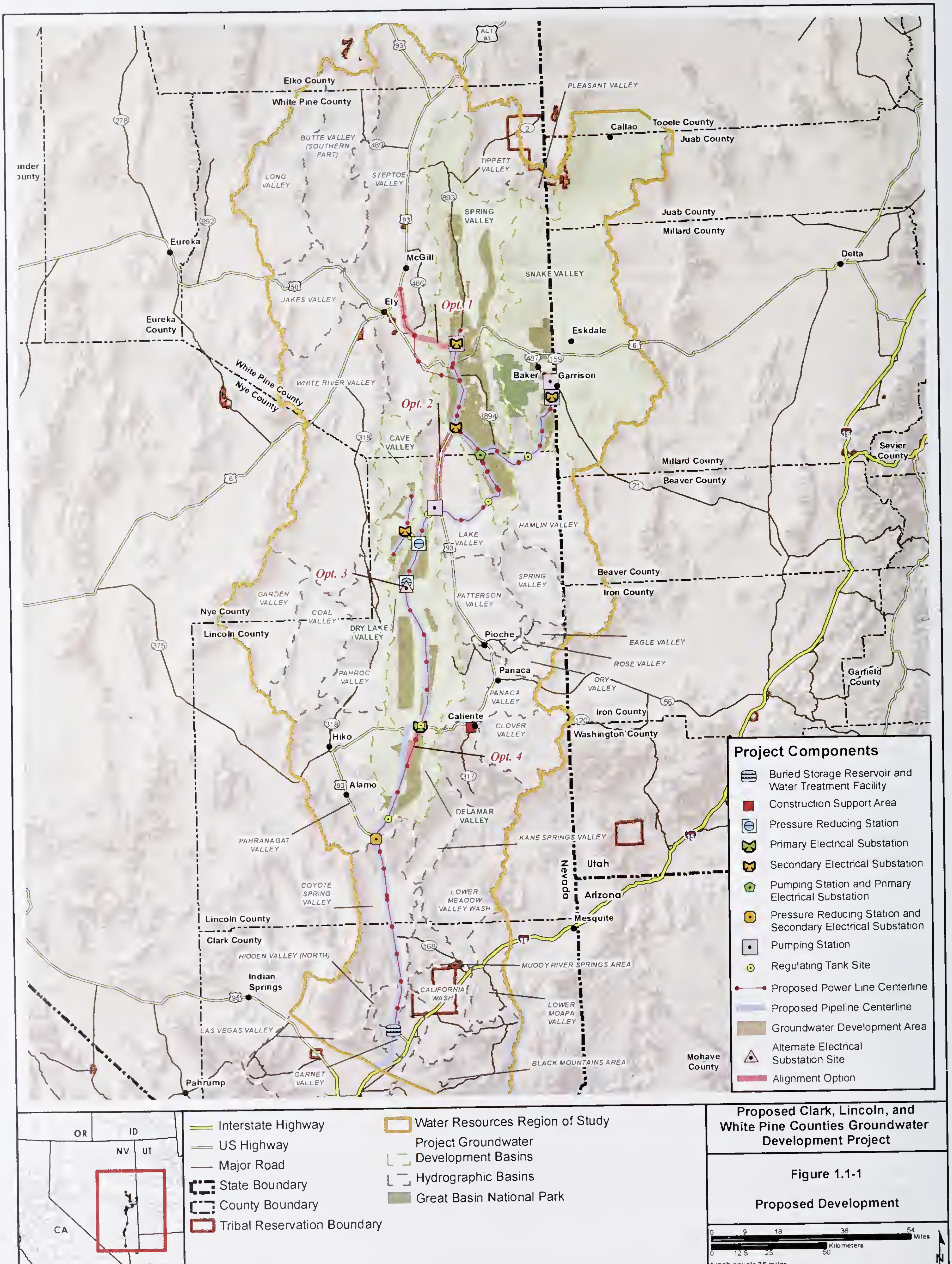
The BLM's role as a Federal Lands Manager considering SNWA's ROW applications is separate from the NSE water rights process.

The BLM is the lead federal agency for preparing this Environmental Impact Statement (EIS) in compliance with National Environmental Policy Act (NEPA) and the Council on Environmental Quality (CEQ) regulations implementing NEPA (40 Code of Federal Regulations [CFR] 1500-1508). This EIS also is being prepared in conformance with the policy guidance provided in the Department of the Interior (DOI) Regulations at 43 CFR 46, DOI Environmental Statement Memoranda and the BLM's NEPA Handbook (BLM Handbook H-1790-1).

The **GWD Project** Conveyance System includes buried pipelines, pumping stations, regulating tanks, pressure reducing stations, electrical power lines, electrical substations, electronic system operations facilities, a water treatment facility, communication facilities, access roads, and an underground water storage reservoir. The majority of these facilities would be located on public lands managed by the BLM.

The BLM manages surface and mineral resources for federal lands it administers under the Federal Land Policy and Management Act of 1976 (FLPMA) and applicable regulations and in conformance with Resource Management Plans (RMPs) prepared pursuant to the FLPMA for the BLM, Southern Nevada, and Ely Districts. The BLM lands that would be dedicated for ROW for the proposed GWD Project are managed by the Schell and Caliente field offices of the Ely District and the Las Vegas Field Office of the Southern Nevada District.

This EIS evaluates the environmental impacts associated with the GWD Project's proposed conveyance system consisting of buried pipelines, pumping stations, regulating tanks, pressure-reducing stations, electrical power lines, electrical substations, electronic system operations facilities, communication facilities, access roads, a water treatment facility, an underground water storage reservoir, and ancillary facilities. The majority of these facilities would be located on public lands managed by the BLM.



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 1.1-1

Proposed Development

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

This EIS also includes a programmatic analysis of environmental effects associated with the SNWA's prospective future groundwater development actions. Such future development, much of which likely would also occur on public lands and entail additional federal ROWs for specific groundwater production wells and collector pipeline locations, will require additional NEPA analysis (see Section 1.3.6, National Environmental Policy Act Tiering). Site-specific NEPA analysis, as provided in 40 CFR Part 1500 and the BLM NEPA Handbook, will be conducted for future proposed GWD Project facilities involving public lands in conjunction with water to be conveyed by the pipeline.

Programmatic Analysis. A NEPA analysis suited to broader scale temporal and spatial effects or activities that affect large areas. A programmatic analysis typically is associated with activities which occur in two or more phases, where subsequent phases are subject to additional, site-specific assessment.

1.2 Purpose and Need

Pursuant to 40 CFR 1502.13 and Section 6.2 of the BLM's NEPA Handbook, the purpose and need statement should state why the BLM is taking action (i.e., deciding whether or how to grant a ROW). This BLM purpose and need for action dictates the range of alternatives and provides the rationale for selection of an alternative in the decision. The proponent's information regarding its purpose and need is helpful background that the BLM may use in its development of the alternatives.

1.2.1 Purpose

The BLM's purpose for this ROW action is to consider the applicant's request for use of federal land managed by the BLM for construction and operation of the proposed groundwater conveyance system. The applicant has requested the proposed ROWs to develop the main conveyance system and convey groundwater rights permitted by the NSE in Spring, Cave, Dry Lake, and Delamar valleys and applied for in Snake Valley to the Las Vegas Valley. Future groundwater development is contingent upon approval of associated future ROW grants by the BLM.

1.2.2 Need

The BLM's need for federal action arises from its responsibility under the FLPMA and other legislation to respond to the applicant's ROW request. The BLM's multiple-use mission includes managing activities on federal land such as ROW authorizations, while conserving natural, historical, cultural, and other resources on the public lands. The FLPMA gives the Secretary of the Interior general authority to grant ROWs across public lands administered by the BLM, including ROWs for reservoirs, canals, ditches, flumes, laterals, pipes, pipelines, tunnels, and other facilities and systems for the impoundment, storage, transportation, or distribution of water (43 United States Code [USC] § 1761).

The **FLPMA** gives the Secretary general authority to grant ROWs across public lands administered by BLM, including ROWs for facilities and systems for the storage, transportation, and distribution of water.

Congress specifically directed the BLM to grant ROWs to the SNWA for water resource development and conveyance projects in Lincoln and Clark Counties pursuant to the Southern Nevada Public Lands Management Act (SNPLMA) and the Lincoln County Conservation, Recreation and Development Act of 2004 (LCCRDA). The applicant's proposal to construct, operate, and maintain a groundwater development and conveyance system on public lands is consistent with this objective. The BLM is required by the FLPMA and other legislation to consider and respond to the applicant's ROW requests.

Applicant's Rationale

SNWA's basis for the GWD Project is multi-faceted; to diversify its water resource portfolio to protect the community from drought and shortages from the Colorado River system, to fulfill its contractual obligation to provide conveyance capacity in Lincoln County to the Lincoln County Water District, and to help supply future projected water demands. SNWA has identified groundwater in these five basins as a resource that would be used in the short term to offset drought impacts and in the long-term to meet projected water demands.

1.3 Regulatory Framework

1.3.1 Federal Land Policy and Management Act and Right-of-way Authorities

The FLPMA authorizes the Secretary of the Interior to grant ROWs across public lands administered by the BLM. FLPMA requires that: Each ROW shall contain such terms and conditions deemed necessary to: protect federal property and economic interests; protect lives and property; protect the interest of individuals who rely on the fish, wildlife, and other biotic resources; and protect the public interest in the lands (Sec. 505 [43 USC 1765]). The BLM is also generally obligated to avoid unnecessary or undue degradation of the public land (43 USC 1732). All ROWs requested by the SNWA for the GWD Project would be processed in accordance with the FLPMA and the BLM ROW regulations in 43 CFR Part 2800.

In addition to the FLPMA, Congress specifically directed the BLM to grant ROWs to the SNWA for water resource development and conveyance projects in Lincoln and Clark counties pursuant to the SNPLMA and the LCCRDA. The SNPLMA requires the Secretary of the Interior, upon application and in accordance with the FLPMA and other applicable provisions of law, to issue ROW grants on federal lands in Clark County, Nevada, to a unit of local government or regional governmental entity for reservoirs, canals, channels, ditches, pipes, pipelines, tunnels, and other facilities and systems needed for the impoundment, storage, treatment, transportation, or distribution of water.

The **LCCRDA** requires the Secretary of the Interior to grant the ROWs requested in Clark and Lincoln counties, subject to NEPA review.

In White Pine County, the BLM may grant ROWs under the FLPMA general authority.

In 2004, Congress enacted the LCCRDA, which established "…a 2,640-foot wide corridor for utilities in Lincoln County and Clark County, Nevada, as generally depicted on the map entitled 'Lincoln County Conservation, Recreation, and Development Act' and dated October 1, 2004" (Public Law No. 108-424, 118 Stat. 2403 § 301). The LCCRDA states that the Secretary of the Interior will grant to the SNWA and the Lincoln County Water District "nonexclusive ROW to federal land in Lincoln County and Clark County, Nevada for any roads, wells, well fields, pipes, pipelines, pump stations, storage facilities, or other facilities necessary for the construction and operation of a water conveyance system, as depicted on the map." This act also states, "Before granting a ROW under paragraph (1), the Secretary of the Interior shall comply with the NEPA (42 USC 4321 et seq.) including the identification and consideration of potential impact to fish and wildlife resources and habitat." The LCCRDA also contains a provision that the State of Nevada and the State of Utah shall reach an agreement regarding the division of water resources of those interstate groundwater flow system(s) from which water will be diverted and used by the project prior to any transbasin diversion from groundwater basins located within both states. The agreement shall allow for the maximum sustainable beneficial use of the water resources and protect existing water.

The **LCCRDA** also requires an agreement between Nevada and Utah on the division of water resources from interstate groundwater flow systems.

The utility corridors established by the LCCRDA were incorporated into the Ely District Record of Decision (ROD) and Approved RMP (BLM 2008a) and added to the previously identified corridors in the 1998 Las Vegas RMP (BLM 1998).

In summary, the SNPLMA mandates the BLM grant the ROWs requested by the SNWA in Clark County in accordance with the FLPMA and the BLM's ROW regulations. The ROW grant will contain appropriate conditions to ensure compliance with FLPMA and to avoid unnecessary or undue degradation of the public lands. The BLM is required by the LCCRDA to grant ROWs requested in Clark and Lincoln counties. The SNWA's requested ROWs in White Pine County may be granted pursuant to the BLM's general authority under the FLPMA.

The **SNPLMA** requires the Secretary of the Interior to grant the ROWs requested by the SNWA in Clark County in accordance with FLPMA and other applicable regulations.

1.3.2 Determination of Technical and Financial Capability

As part of its review of ROW applications, it is the BLM's policy that an applicant demonstrate it has the technical and financial capability to construct, operate, maintain, and terminate its project. SNWA's status as an existing unit of local/regional government, current service provider in a major metropolitan market with an ongoing enterprise operation, a multi-million dollar budget, and established presence in the capital markets, is evidence of such capacity.

BLM is not required by NEPA, FLPMA or other regulations, to independently validate SNWA's projected project construction costs, make determinations regarding the marketability of the proposed financing in the capital markets, or overall project economic feasibility. Neither is a benefit-cost analysis required for the project.

1.3.3 Programmatic Agreement Review – Section 106 under National Historic Preservation Act

As part of this environmental review, a Programmatic Agreement (PA) (**Appendix F3.16**) under the provisions of Section 106 of the National Historic Preservation Act of 1966 (NHPA) was completed. The agreement parties include the BLM, the Advisory Council on Historic Preservation (ACHP), the Nevada State Historic Preservation Officer (SHPO), and the SNWA. The United States Army Corps of Engineers (USACE) designated the BLM as the lead federal agency to act on the behalf of the USACE for purposes of compliance with Section 106. Indian Tribes and other consulting parties were invited to sign as concurring parties. The PA explains the proposed project and describes each agency's role in complying with Section 106. It also addresses the area of potential effects, the processes and methods the BLM would use when inventorying historic properties, the consultation process to be used during inventories, how eligibility for inclusion on the *National Register of Historic Places* would be determined, and mitigation of adversely-affected resources. In addition, procedures to be used when inadvertent discoveries of human remains or historic properties during project construction, should the ROW be granted, are addressed.

1.3.4 Endangered Species Act

The Endangered Species Act (ESA), Section 7(a)(2), requires all federal agencies to consult with the U.S. Fish and Wildlife Service (USFWS) on any actions they authorize, fund, or carry out to ensure that the action is not likely to jeopardize the continued existence of listed species, or result in the destruction or adverse modification of habitat of listed species. For this project, both the BLM and USACE must complete Section 7 consultation. The USACE has designated the BLM as the lead federal agency to act on their behalf for purposes of this consultation.

The BLM has prepared a Biological Assessment that contains an analysis of the potential effects on federally listed species and critical habitat. The USFWS will use the information provided in the Biological Assessment to complete their own analysis and a Biological Opinion (BO) in a programmatic consultation. Terms and conditions of the BO will be included into the ROD and will become requirements of the BLM ROW grant. Similar to the EIS, the Biological Assessment provides a tiered analysis (see Section 1.3.6 for description of tiering) on the main water conveyance pipeline and associated facilities, as well as a programmatic analysis for future groundwater development. Each subsequent tier of the project will be subject to additional Section 7 consultations, which will be tiered to the overall programmatic consultation.

1.3.5 Clean Water Act

The USACE has jurisdiction related to this project under the authority of Section 404 of the Clean Water Act for the discharge of dredged or fill material into waters of the U.S. Waters of the U.S. include, but are not limited to, rivers, perennial or intermittent streams, lakes, ponds, wetlands, vernal pools, marshes, wet meadows, and seeps. Project features that result in the discharge of dredged or fill material into waters of the U.S. will require an USACE authorization prior to starting work.

In May 2009, SNWA prepared the "Waters of the United States Preliminary Jurisdictional Determination Report for the Southern Nevada Water Authority Clark, Lincoln, and White Pine Counties Groundwater Development Project", which was verified by the USACE in August 2009 for a period of 5 years. The report found that 4.5 acres of ephemeral drainages (0.02 permanent acres) would be impacted by the project. The report also stated that no impacts to wetlands would occur. This report was based on the proposed action and included Tier 1 of the project (construction of the main pipeline and related infrastructure facilities) only.

Nationwide Permit #12 applies to activities required for the construction, maintenance, repair, and removal of utility lines and associated facilities in waters of the U.S., provided the activity does not result in the loss of greater than 1/2 acres of water of the U.S. However, the USACE may exert discretionary authority and require an alternate permitting mechanism in cases where activities will result in more than minimal individual and cumulative impacts. The USACE will require a pre-construction notification for this project because of the adverse cumulative impacts to waters of the U.S., especially those impacts associated with the long-term effects of drawdown on wetland habitat. The USACE is required to analyze alternatives for the "least environmentally damaging alternative". This is in accordance with the Clean Water Act Section 404(b)(1) guidelines. Therefore, the USACE may not adopt the agency preferred alternative (Section 2.8).

1.3.6 National Environmental Policy Act Tiering

Tiering is a staged approach to NEPA described in CEQ's Regulations (40 CFR 1500-1508). Tiering allows the agency to broadly address known actions to determine specific impacts while addressing related actions programmatically in initial (Tier 1) analyses. Programmatic analysis is any type of analysis and documentation from which subsequent NEPA documents are tiered (CEQ 2003).

The BLM is using a "tiered" approach to implement the NEPA for the GWD Project. Tiering allows an assessment of a combination of site-specific actions and broader programs and issues in an initial (Tier 1) analysis, evaluating the effects of additional site-specific proposals more comprehensively in subsequent or "tiered" NEPA analyses. Tiering expands upon the foundation provided in the Tier 1 analysis, focusing the subsequent analysis on actions, alternatives and issues not already addressed (BLM 2008b). Tiering is appropriate when it helps the lead agency focus on those issues ready for decision; deferring detailed consideration of those issues not yet ready for analysis due to uncertainty or lack of sufficiently detailed description of the proposed development. Due to the size of the area of potential effects and inability to perform analyses at the appropriate level to determine specific impacts, a programmatic analysis followed by subsequent tiered NEPA is appropriate for this project stage.

Tier 1 Analysis

The major conveyance system components specifically addressed in Tier 1 includes up to 306 miles of pipelines, 5 pumping stations, 6 regulating tanks, 3 pressure reducing stations, a water treatment facility, a 40-million gallon buried storage reservoir, approximately 323 miles of electrical power lines, 7 electrical substations, and access roads.

Programmatic Analysis

The programmatic portion of this EIS generally assesses the effects of the future production wells, collector pipelines, additional pumping stations, distribution power lines, additional secondary substations, pressure reduction valves, and maintenance roads.

Tier 1 – This Environmental Impact Statement

This Tier 1 EIS is the vehicle for fact-based analyses that support informed decision-making on ROW-related (surface disturbance) impacts and programmatic analysis of groundwater-related pumping. This tier includes a Draft EIS, a Final EIS, and a ROD. The ROD will present the BLM's decision for, and will include specific direction on future decisions related to this project. The tiered process provides decision-making on issues that are ripe for decision and provides a means to communicate the intent of the decision maker for the Tier 1 document, preserve those decisions, and provide future goals and direction to future decision makers.

For this project, some project and site-specific details of the Proposed Action, primarily the proposed alignment of the main water conveyance pipeline and associated operational facilities (power transmission lines, pump stations, etc.) are known. Consequently, this Tier 1 document addresses the environmental effects of these known components.

Information used for Tier 1 analysis (e.g., groundwater modeling) will be performed at a more site-specific and detailed level for subsequent tiers to focus the specificity of the analysis. Future NEPA will provide analysis for decisions on specific, related future actions that could include the construction of the following facilities:

The SNWA's current ROW request covers only the main pipeline, power line, and primary lateral facilities.

This EIS includes both site-specific analysis for the mainline and primary lateral facilities and programmatic conceptual analyses for future facilities.

- Groundwater Production wells;
- Collector Pipelines;
- Access roads;
- Pumping Stations; and
- Power Facilities including overhead power lines, electrical substations, and hydro-turbine energy recovery facilities.

The environmental effects of the future groundwater development, including the long-term effects of groundwater production, are the subject of programmatic analysis in this EIS. For future facilities not yet fully defined, the SNWA has identified groundwater development areas within which it anticipates accessing its permitted and applied for water rights and the number of production wells to be developed (**Figure 1.1-1**). The analysis relies on assumptions that encompass the SNWA identified areas where water production wells, collector pipelines, and distribution power line routes might be located. The BLM made programmatic assumptions about future facilities for the impact analysis, including assumptions on the lengths of the collector pipelines and power lines in each groundwater basin, and groundwater withdrawal rates and volumes. This conceptual or development scenario approach is typical of NEPA analyses when specific locations of future facilities cannot be defined based on current knowledge.

Subsequent Tiers

After the SNWA identifies specific details of the groundwater development components involved in the programmatic analysis, it will submit additional ROW applications to the BLM. Based upon these applications, the BLM will address these future site-specific components in subsequent tiered NEPA documents. The hydrologic model used for this EIS (Tier 1) and baseline assessments for all resources will be updated in subsequent tiered analyses on site-specific groundwater development components. These subsequent documents will conform to NEPA with full public involvement, including public scoping and document review.

1.3.7 Bureau of Land Management Decisions

1.3.7.1 Tier 1

The analysis in this EIS will inform the decision makers whether they should:

1) Approve, modify, or deny (only in White Pine County) the ROWs as applied for by the SNWA;
2) Apply all appropriate mitigation measures; and
3) Require the development and implementation of an integrated and comprehensive Construction, Operation, and Monitoring (COM Plan) that will direct decision-makers on appropriate action for ROW actions associated with the SNWA GWD Project. The objectives of the COM Plan are to protect federal resources and federal water rights that may be impacted by construction, operation, maintenance, and abandonment of the project. The COM Plan is designed to provide early warning of potentially adverse impacts, provide time and flexibility to implement management measures to mitigate impacts, gage their effectiveness, and recommend appropriate action.

The BLM ROD and the subsequent ROW grant would require the applicant to prepare and submit for BLM approval a detailed revised POD for the main water conveyance pipeline and related facilities. The final Plan of Development (POD) should incorporate all of the mitigation for the main conveyance pipeline and associated facilities specified by the BLM in the ROD. SNWA has revised its applicant-committed environmental protection measures (ACMs) (see

Appendix E) and has committed to the preparation of site-specific construction and operation plans for each project phase or facility component. The POD must contain sufficient information for the BLM and other agencies to evaluate specific construction activities and planned application of monitoring and mitigation.

Prior to development of the revised POD, SNWA must collect and develop detailed information such as engineering designs, soil and terrain profiles, and maps showing the exact siting of all facilities associated with the project as well as any construction sites. Much of this information cannot be developed until further field research is completed. For example, the soil and terrain profiles and the specific construction maps cannot be developed until geo-technical studies are completed and the precise location of the pipeline and other facilities would be established based on on-the-ground cultural surveys and perhaps additional biological surveys. Therefore, before SNWA develops a detailed POD, it may request a Notice to Proceed specifically to conduct these necessary studies and/or inventories. No Notice to Proceed for construction associated with this project would be issued until the detailed POD is submitted by SNWA and approved by BLM.

The ROD will document the BLM's decision on which alternative (or a subset or compilation of alternatives/options) the applicant may implement plus associated mitigation and COM Plan that will be required in the implementation of the BLM decision. Once the ROD is completed, the SNWA will prepare and submit for BLM approval a detailed revised POD for the main water conveyance pipeline and related facilities and is expected to include all of the stipulations, conditions and other requirements contained in the ROD/ROW grant by BLM. The BLM, working in conjunction with other federal, state, local, and tribal agencies/governments, will develop a COM Plan. When the BLM is satisfied that the SNWA has developed all required plans related to construction and operation for the ROW and ancillary facilities, the BLM may issue construction Notices to Proceed on a segmented basis. The Notice to Proceed will specify how the applicant must continue to move forward with the project, including defining additional requirements that were not specified in the ROD and/or ROW. In the ROW, the BLM will require that progress on implementation of the project must begin within a reasonable period of time.

Although the ROD and associated decisions do not carry an expiration date, the data, analyses, and other information used to reach a decision may change over time. A delay in project implementation of even a few years could result in the need to supplement the NEPA process and associated processes such as Section 7 and Section 106 consultation if there are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts.

The COM plan (see Section 3.20, Monitoring and Mitigation Summary) includes a comprehensive monitoring and mitigation program for the entire project to integrate the various required monitoring and mitigation actions, which are provided through the following policies and other commitments:

- **BLM Land and Resource Management Plans and BMPs** – All actions approved or authorized by the BLM must conform to the existing land use plans (43 CFR 1610.5-3, 43 CFR 2920.2-5).
- **Biological Opinion** – The USFWS will issue a BO that will include conservation recommendations and/or terms and conditions to maintain and protect threatened and endangered species as required under Section 7 of the ESA.
- **Applicant Committed Measures** – The proponent, SNWA, has committed to environmental protection measures that will be implemented as part of the construction and operation of the GWD Project.
- **Section 106 Programmatic Agreement** – A PA was completed under the provisions of Section 106 of the NHPA. The agreement was executed by the BLM, the ACHP, the Nevada SHPO, and the SNWA.
- **Stipulated Agreements** – SNWA has entered into several stipulated agreements with Department of Interior Bureaus (i.e., Bureau of Indian Affairs [BIA], BLM, USFWS, and National Park Service [NPS]). The agreements apply to the SNWA's water rights in Spring, Delamar, Dry Lake, and Cave valleys (see Section 2.3.2, Stipulation Agreements).
- **Clean Water Act (CWA) Section 404 Mitigation** – The USACE has jurisdiction related to the project under the authority of Section 404 of the CWA for the discharge of dredged or fill material into waters of the U.S.

1.3.7.2 Subsequent NEPA Tiers

Decisions related to the ROWs associated with future groundwater development areas will focus on the following types of actions:

1. Determining the placement of water production wells, collector pipelines, roads, power lines, substations, etc., associated with that development;
2. Appropriate monitoring and mitigation measures; and
3. Development and implementation of comprehensive COM Plans specific to the ROW application and associated groundwater development area.

As SNWA submits future ROW applications and BLM completes related NEPA analysis, they will submit initial PODs and COM Plans specific to the area and facilities specified in the application. The COM Plan will identify monitoring, management, and mitigation requirements relating to the construction, operation, and maintenance of the planned development. Future groundwater development may require a new COM Plan or amendments of the existing COM Plan. At the conclusion of the NEPA process, the decision document [ROD or Finding of No Significant Impact (FONSI)] will contain requirements for the submission of a final POD to the BLM. The BLM must approve the final POD and the ROW grant prior to issuing a Notice to Proceed. The BLM-approved POD will be tiered to the POD for the main pipeline; a summary of which is presented in Section 3.20, Monitoring and Mitigation Summary, of this Final EIS.

In addition, the BLM will be involved in SNWA's conversion of pressure-reducing stations to hydroelectric power generation sites. This action likely will be lead by a Federal agency other than the BLM such as the FERC.

1.4 Relationship of the Bureau of Land Management Decisions to the Nevada Water Rights Process

The NSE has jurisdiction to grant or deny the SNWA's groundwater applications in the five groundwater development basins associated with the GWD Project (NRS § 533.370). The process for obtaining a permit to develop unappropriated groundwater or surface water begins with an application for a water permit with the NSE. In determining whether to grant an application, the NSE must consider: 1) whether there is unappropriated water at the proposed source of supply; 2) whether the proposed use of water would conflict with existing rights; 3) whether the proposed use of the water would threaten to prove detrimental to the public interest; and 4) whether the proposed use of the water would adversely impact domestic wells. NRS § 533 stipulates additional factors for the NSE to consider prior to approving applications for interbasin transfers of water.

Water rights in Nevada are administered by the NSE under NRS § 533. The NSE has jurisdiction to grant or deny SNWA's groundwater applications.

Acre-foot. A unit measuring the volume of water -- the quantity of water required to cover a 1-acre area to a depth of 1 foot, which is equal to 43,560 cubic feet or 325,851 gallons.

Southern Nevada Water Authority Groundwater Applications

In 1989, the Las Vegas Valley Water District (LVVWD) filed applications for groundwater rights in Spring, Snake, Delamar, Dry Lake, and Cave valleys (the five groundwater production basins included in the GWD Project). The BLM and other DOI agencies filed protests to the applications in all five basins. In 2002, the SNWA assumed full interest in the applications from the LVVWD. The NSE approved the SNWA's applications in Spring Valley in April 2007 for development and production of up to 40,000 acre-feet per year (afy) of groundwater, with potential future approval of up to 20,000 afy additional if, following the first 10 years of groundwater production, the NSE determined that additional water can be produced subject to the criteria outlined above (NSE Ruling 5726). DOI agency protests relating to the Spring Valley applications were resolved by a joint stipulation between the SNWA and the DOI agencies.

In 2007 and 2008, the NSE reviewed the SNWA's groundwater applications in Delamar, Dry Lake, and Cave valleys. In July 2008, the SNWA was permitted 18,755 afy in these 3 valleys (4,678 afy in Cave Valley; 11,584 afy in Dry Lake Valley; and 2,493 afy in Delamar Valley) (NSE Ruling 5875). Similar to Spring Valley, the BLM and other DOI agencies protests relating to Delamar, Dry Lake, and Cave valleys were resolved by a joint stipulation between the SNWA and the DOI agencies.

On October 19, 2009, the Seventh Judicial District Court of Nevada issued an Order vacating and remanding the NSE Ruling 5875 (July 9, 2008) on Delamar, Dry Lake, and Cave valleys in response to a request for a judicial review. This decision was appealed to the Nevada Supreme Court by both the NSE and the SNWA.

On June 17, 2010, the Nevada Supreme Court issued an opinion on the matter of Great Basin Water Network, et al. v. State Engineer and Southern Nevada Water Authority (Nevada Supreme Court 2010). That decision voided prior NSE rulings on the 1989 water appropriation applications and directed the NSE to reopen the water rights proceedings for the SNWA water appropriation applications including reopening the protest period.

The NSE reissued public notice on the SNWA applications in Spring, Delamar, Dry Lake, and Cave valleys in January and February, 2011. The protest period ended in March, 2011. An initial evidence exchange occurred July 1, 2011, with a second rebuttal evidence exchange on August 26, 2011. The NSE held a hearing on the Spring, Delamar, Dry Lake, and Cave valleys applications between September 26, 2011, and November 18, 2011. Oral public comment occurred on October 7, 2011, and written public comments were accepted through December 2, 2011.

On March 22, 2012, the NSE issued Rulings #6164, #6165, #6166, and #6167 permitting water rights to SNWA in Spring, Delamar, Dry Lake, and Cave valleys (NSE 2012a, 2012b, 2012c, and 2012d). In Spring Valley, SNWA was permitted up to 61,127 afy, in three stages of development. In Delamar, Dry Lake, and Cave valleys, SNWA was permitted 5,235 afy, 11,584 afy, and 6,042 afy, respectively. All of the rulings required compliance with hydrologic and biological monitoring and mitigation plans, preparation of annual reports, completion of baseline studies, and periodic updating of a groundwater flow model. A more detailed description of the procedural history associated with the SNWA applications, NSE findings of fact, and conclusions of law can be found in the Rulings. The Rulings can be accessed at http://water.nv.gov. The rulings were recently appealed to the County District court. These appeals are pending.

The NSE has not identified a schedule for the Snake Valley water rights proceedings.

The water rights granted by the NSE does not grant the water rights owner additional license to construct on or cross federal land.

Other Water Rights and Applications

The SNWA holds other water rights and applications in the region that are not planned for development in conjunction with the GWD Project. These applications include 27,500 afy in Coyote Spring Valley. The NSE concluded in March 2002 (Order 1169) that there was insufficient information on pumping effects to existing water rights and has required the SNWA to conduct aquifer testing prior to ruling on these applications. The SNWA has completed construction of facilities to conduct the required testing, which began in November 2010. Because aquifer testing has not been completed to provide the NSE with sufficient information, water rights and applications for Coyote Spring Valley are not included in the GWD Project.

1.5 Other Governmental Agencies Involved in the National Environmental Policy Act Analysis

1.5.1 Cooperating Agencies

Under the CEQ regulations, federal agencies responsible for preparing NEPA analyses and documentation may do so in cooperation with federal, state, local, and/or tribal governments and agencies with jurisdiction by law or special expertise (40 CFR 1501.6). The BLM contacted potential cooperating agencies having a jurisdictional authority or special expertise on the project or whose jurisdictional authority or special expertise overlies the project area or one of the hydrographic basins from which water is proposed to be withdrawn (i.e., Spring, Snake, Delamar, Dry Lake, and Cave valleys). A total of 16 agencies elected to serve as cooperating agencies for this project. The BLM and each cooperating agency signed a Memorandum of Understanding (MOU) outlining the role of the cooperating agency.

The following cooperating agencies have signed an MOU with the BLM:

Federal Agencies

- Department of Agriculture, Forest Service (USFS)
- Department of Defense, USACE
- Department of Defense, Nellis Air Force Base (AFB)
- DOI, BIA
- DOI, Bureau of Reclamation
- DOI, USFWS
- DOI, NPS

State Agencies

- State of Utah
- Nevada Department of Wildlife (NDOW)

Local Agencies

- Central Nevada Regional Water Authority
- Nevada Counties: Clark, Lincoln, White Pine
- Utah Counties: Juab, Millard, Tooele

1.5.2 United States Geological Survey

The United States Geological Survey (USGS) "is a science organization that provides impartial information on the health of our ecosystems and environment, the natural hazards that threaten us, the natural resources we rely on, the impacts of climate and land-use change, and the core science systems that help us provide timely, relevant, and useable information" (USGS 2011). For water resources, the USGS collects information necessary to understand the Nation's water resources, and provides access to water data, publications, and maps, as well as to recent water projects and events. The USGS is contributing to the EIS process as a Technical Advisor to the BLM.

1.5.3 Tribal Governments

In 2007, the BLM initiated government-to-government consultation under Section 106 of the NHPA with 28 Indian tribes and bands that may have religious or cultural ties to the project area. The executed PA has been included as part of this EIS (**Appendix F3.16**). The tribes have declined to concur with the PA and their reasons are noted in the letter contained in **Appendix F3.16**.

Chapter 5 lists the Tribes that have been identified as having involvement or a particular interest in the GWD Project or project area. The BLM, with Tribal input has developed an Ethnographic Assessment report and is addressing potential properties of religious and cultural significance (PRCS) identified through the Ethnographic Assessment. Several of these Tribes assert federally reserved water rights claims to water potentially affected by the GWD Project. Some of these claims were addressed by the NSE in his recent rulings on Spring, Dry Lake, Delamar, and Cave

Valleys. The Rulings can be accessed at http://water.nv.gov. The particular water rights claims and related resources are covered in more detail in Chapter 3.

1.5.4 Nevada Office of the State Engineer

The Nevada Department of Water Resources (NDWR), headed by the State Engineer, is responsible for the administration and enforcement of Nevada's water law. The State Engineer's authority and responsibility includes overseeing the appropriation, distribution, and management of the state's surface and groundwater. In March 2012, the State Engineer issued a series of rulings on Spring, Dry Lake, Delamar, and Cave Valleys as discussed in Section 1.4.

The NSE served as a technical observer in the hydrologic modeling process.

1.5.5 Federal and State Agency Permitting, Approvals, and Consultations

In addition to the SNWA's requests for ROWs addressed in the EIS, the GWD Project involves a number of other federal and state agency reviews, permits, and consultations. One of the important state processes for the GWD Project is the groundwater application process before the NSE, described above. Other permitting and consultation requirements are summarized in **Table 1.5-1**. Many of these review processes are concurrent with the EIS process, while others, such as state construction approvals and wildlife handling permits, will follow the BLM's decision on the ROW application. See Section 1.3.4 for a description of the role of the USACE.

Table 1.5-1 Agency Permits, Approvals, and Consultations for the Clark, Lincoln, and White Pine Counties Groundwater Development Project

Agency	Permit/Approval/Consultations	Agency Action
Federal		
BLM	NEPA – Lead Federal Agency	Preparation of the EIS.
	ROWs for the pipeline and all related facilities located on federal land	Consider issuance of a ROW grant for the portion of the project on federal land.
	ROWs for temporary workspace areas and access roads during construction	Consider the issuance of temporary ROWs for the portion of the project on federal land.
	Conformance Review of RMPs	Determine conformance of the Proposed Action and Alternatives with Ely RMP and Las Vegas RMP.
BLM and BIA	Native American Graves Protection & Repatriation Act (NAGPRA)	Coordination with affected Tribes; Ensure that adequate compliance plans are in place to address NAGPRA before construction is authorized.
	Indian Trust Responsibilities	Coordination with affected Tribes.
	American Indian Religious Freedom Act (AIRFA) and Religious Freedom Restoration Act (RFRA)	Coordination with affected Tribes.
	NHPA	Section 106 Consultation.
USFWS	Section 7 Consultation under the ESA Fish and Wildlife Act Coordination Migratory Bird Treaty Act (MBTA) Consultation Bald and Golden Eagle Protection Act Consultation	Review/evaluate lead agency Biological Assessment and prepare a BO with conditions. USFWS responsibilities in the BO include: determine if the agency-preferred alternative will jeopardize a listed species or adversely modify its critical habitat; provide reasonable and prudent measures in the event of a non-jeopardy determination; and provide reasonable and prudent alternatives (if any exist) in the event of a jeopardy determination.

Table 1.5-1 Agency Permits, Approvals, and Consultations for the Clark, Lincoln, and White Pine Counties Groundwater Development Project (Continued)

Agency	Permit/Approval/Consultations	Agency Action
Federal Highway Administration	Permit for pipeline and transmission line crossings of federal highways	Consider approval of permits to cross federal highways.
USACE	Section 404 CWA Permit	Consider issuance of Section 404 nationwide or individual permits for wetland and waters of the U.S. crossings.
U.S. Environmental Protection Agency (USEPA)	Section 309 of the Clean Air Act (CAA), EIS review and comment	Provide comments to lead federal agency; review Section 404 permits (veto power).
USFS, Humboldt-Toiyabe National Forest	Humboldt-Toiyabe Forest Plan[1]	Verify conformance with Forest Plan utility corridors. Consider approval of use permit applications for ROWs and other uses.
	Special Use Permits[1]	Consider issuance of temporary use permits for temporary construction activities on National Forest System lands. Issue the transmission line special use permit across National Forest System Lands. Consider issuance of Notices to Proceed for National Forest System lands.
State - Nevada		
Nevada Division of Environmental Protection (NDEP), Bureau of Water Pollution Control	401 Water Quality Certification (CWA permit requirement for Section 404 permit) General Stormwater Permit Temporary Discharge Permit Temporary Groundwater Discharge Permit Working in Waterways Permit Underground Injection Control Permit	Consider issuance of water quality related permits in Nevada.
NDEP, Bureau of Safe Drinking Water	Letter of Approval to Construct	Ensure protection of drinking water.
Nevada Department of Transportation (NDOT)	Encroachment into State Highway ROWs ROW Occupancy Permit	Consider approval of project facilities within Nevada state highway ROWs.
Nevada Division or State Lands (National Guard Lands)	Permanent and temporary construction easements	Consider approval of easements across state lands.
NDEP, Bureau of Air Pollution Control	Dust Control Permit for Surface Area Disturbance (Lincoln and White Pine counties)	Consider issuance of air quality related permits in Nevada.
	Permit for emergency (standby) generators at pumping stations	Consider issuance of permit for stationary emission source (backup generators).
NDWR	Water rights permits Drilling permit Recharge, storage, and recovery of underground water permit Dam Safety Permit	Consider issuance of water rights and related permits.
NDOW	Nevada Revised Statute 503.597	Authorization to handle any fish and wildlife resources.
Nevada Division of Forestry	Collection permit for state-listed plants	Consider issuance of permit to collect state-listed plants during construction.
Nevada Department of Cultural Affairs, SHPO	Section 106 Consultation, NHPA	Opportunity to comment on the undertaking. Concurrence on eligibility determination and adverse effects to historic properties.
Nevada State Fire Marshal	Permit to store hazardous materials, such as combustibles, flammables, and explosives	Consider issuance of permit under Nevada Administrative Code (NAC) 477.323.

Table 1.5-1 **Agency Permits, Approvals, and Consultations for the Clark, Lincoln, and White Pine Counties Groundwater Development Project (Continued)**

Agency	Permit/Approval/Consultations	Agency Action
Local Agencies		
Clark County, Nevada	Special Use Permit, Encroachment Permit, Grading Permit, Building Permit, Sand and Gravel Processing Permit, Blasting Permit, and Fuel Storage Permit	Consider issuance of permits.
	Non-attainment conformance review; dust control permits	Review documentation that project particulate and criteria pollutant emissions would not exceed non-attainment thresholds. Consider issuance of permits.
Lincoln County, Nevada	Special Use Permit, Encroachment Permit, Building Permit, and Blasting Permit	Consider issuance of permits and a Development Agreement.
White Pine County, Nevada	Encroachment Permit, Building Permit, and Excavation Permit	Consider issuance of permits.
Nevada Counties (Clark, Lincoln, White Pine)	Road use and crossing permits, other permits	Consider approval of various construction and facility permit application.

[1] If the Option 1 transmission line route were selected by the BLM in the EIS ROD.

1.6 Southern Nevada Water Authority Responsibilities, Current Water Supply, and Future Needs

The SNWA is a political subdivision of the State of Nevada, established in 1991 to address the regional water needs of southern Nevada. The SNWA was formed by cooperative agreement among the Big Bend Water District, City of Boulder City, City of Henderson, City of Las Vegas, City of North Las Vegas, Clark County Water Reclamation District, and LVVWD. The SNWA's Board of Directors is comprised of elected officials representing each of those agencies. The SNWA was formed by these seven entities for the purpose of acquiring and managing water resources for southern Nevada, constructing and managing regional water facilities, and promoting responsible water use (**Appendix A**).

The SNWA allocates and delivers available water supplies to meet the demands of its member agencies. Each member agency is individually responsible for and has sole authority over the allocation and delivery of retail water to customers within its respective service areas, the latter of which collectively encompass the Las Vegas Valley, Boulder City, and Laughlin. A description of the SNWA water delivery system, water rights, and recent history of water planning and water development is contained in **Appendix A**.

1.6.1 Water Demand and Conservation

In accordance with the requirements of public utilities (Chapter 704, NRS 704.661), the SNWA develops water demand forecasts for its service area across a long-term planning horizon. This forecasting is based on both population projections and expected conservation. The current Water Resource Plan (**Appendix A**) forecasts water demands through 2060 based on the June 2008 Clark County Population Forecast prepared by the University of Nevada Las Vegas Center for Business and Economic Research (CBER) (2008). The BLM has no administrative or regulatory authority over the SNWA's demand projections, the timing or quantity of water required, potential alternative sources of water, or priorities established with respect to procuring additional sources. CBER's 2008 forecast called for Clark County's population growing from a population of approximately 2 million to approximately 3.65 million in 2035. The SNWA's water demand forecast is based on CBER's population forecast, with a short-term adjustment to reflect the recent economic conditions and an adjustment to reflect that the SNWA service area does not encompass the entirety of Clark County. Recent adjustments to this long-term population growth forecast in light of the recent economic downturn in the Las Vegas region are discussed in **Appendix A**, SNWA Water Resource Plan.

Water demand generally is a function of both population and individual water use. A commonly used measure of individual water use is average gallons per capita per day (GPCD), which in this instance equals the total community water use, divided by the total resident population, divided by 365 days per year. The GPCD parameter is not particularly useful for comparison between different communities, due to inconsistent water use accounting practices, varying climate conditions, different community demographics factors and economic factors. However, it is a good tool to measure and compare an individual community's water usage and conservation progress over time.

Total annual community water use (gallons) ÷ Community population ÷ 365 days per year = GPCD.

Another component of determining projected water demand is factoring in current and future water conservation efforts that can slow the rate of increase or conceivably even reduce overall water demand. Since the SNWA's inception in 1991, through implementation of water conservation efforts, the SNWA has reduced community water use from 344 to 248 GPCD in 2008 (**Appendix A**, SNWA Water Resource Plan). To promote water efficiency and extend the availability of limited resources, the SNWA adopted a more aggressive conservation goal in early 2009 to reduce water use to 199 GPCD by 2035. The SNWA anticipates that achieving that conservation goal will save the community approximately 276,000 afy by the year 2035 (**Appendix A**).

Ongoing conservation programs have reduced average community water use 28 percent, from 344 to 248 GPCD between 1991 and 2008.

Allocation is a process that allows a limited resource (e.g., water) to be shared.

As shown on the SNWA Water Plan (**Appendix A**), even with the incorporation of the more aggressive conservation goal of 199 GPCD, the SNWA's long-term water demands are projected to increase over 30 percent between 2008 and 2035, to approximately 739,000 afy. Under normal Colorado River conditions, the SNWA anticipates GWD Project water would not be needed until 2020. However, if severe drought in the Colorado River Basin persists and a portion of the SNWA's Colorado River resources becomes unavailable, the SNWA may need to begin using GWD Project water before 2020.

1.6.2 Colorado River Water Supplies

The SNWA depends on the Colorado River for 90 percent of its water resource needs. These Colorado River resources include a basic apportionment for the State of Nevada, return-flow credits, developed resources conveyed to the river for credit (including conserved tributary water, imported groundwater, and system efficiency projects, collectively known as an Intentionally Created Surplus [Bureau of Reclamation 2007]), and water banked in Arizona and California. A detailed description of the SNWA's current and future water resources is provided in its Water Resource Plan (**Appendix A**).

The SNWA depends on the Colorado River for 90 percent of its present water resource needs.

The SNWA deems development of in-state groundwater resources critical to ensure adequate resource availability for essential southern Nevada municipal water supplies in times of drought.

Due to extended drought in the Colorado River Basin, the combined storage of Lake Mead and Lake Powell (the primary SNWA storage reservoirs) stood at about 64 percent of capacity as of February 2012.

In 1999, the Colorado River Basin began to experience drought conditions that became the worst 5-year drought in the recorded history of the basin. These conditions contributed to extremely dry soil conditions, which further reduced total runoff. As a result, water levels in the two primary storage reservoirs on the Colorado River (Lake Mead and Lake Powell) declined to levels not observed since Lake Powell began filling in the early 1960s. Except for 2005 and 2008, when the Colorado River Basin received slightly above-normal runoff, drought conditions in the basin persisted. As of February 2012, the combined storage of Lake Mead and Lake Powell was about 64 percent of capacity. Lake Mead storage was at approximately 57 percent of capacity with a water level of about 80 feet lower than experienced in the late 1990s.

Prior to this recent drought, the SNWA had projected that it could utilize surplus water on the Colorado River (domestic surplus), along with conservation and use of banked water to meet projected demands and would not need additional water resources until 2016 or later (2002 SNWA Water Plan). Due to the severity of the drought, surplus Colorado River water is no longer projected to be available (Bureau of Reclamation 2007). The SNWA would utilize surplus water if it becomes available; however, the SNWA's 2009 Water Resource Plan does not assume availability or use of surplus during the 50-year planning horizon.

Construction of a third intake structure in Lake Mead is an action independent from the GWD Project analyzed in this EIS.

For the SNWA, the prospect of continued declines in Lake Mead water levels raised concerns of reductions of available Colorado River supplies and operating challenges associated with water intake facilities in Lake Mead. The SNWA currently has two intake structures in Lake Mead. Had drought conditions continued and Lake Mead water levels continue to drop, the first intake (shallowest depth) might have become unusable as early as 2012 (**Appendix A**). To preserve supply capacity and provide access to better water quality as lake levels decline, the SNWA currently is constructing a third intake, anticipated to be completed in 2014. The SNWA also would face a reduction in supply if water levels in Lake Mead decline to specified levels and the Secretary of the Interior declares shortage conditions (Bureau of Reclamation 2007). Under shortage conditions, the SNWA would continue to utilize those Colorado River resources that are available, along with temporary resources such as banked water supplies, and implement additional demand management measures.

The SNWA Water Resource Plan states current and possible future conditions in the Colorado River necessitate development of in-state groundwater resources to protect the community from drought and shortage impacts to preserve essential municipal water supplies and meet future demands.

1.7 Consultation and Coordination

1.7.1 Scoping

Project scoping began in April 2005, with a final scoping summary report issued in February 2007. The BLM conducted extensive public outreach, and received oral and written comments from thousands of individuals, organizations and agencies.

On April 8, 2005, the BLM published a Notice of Intent (NOI) and initiated the NEPA process. Concurrent with publication of the NOI, the BLM sent a public scoping package to the mailing list maintained in the Ely Field Office and issued press releases. The public, governmental agencies, and non-governmental organizations were invited to provide oral and written comments at scoping meetings, as well as written comments by mail.

The scoping period extended from April 8 through August 1, 2005, and included nine public scoping meetings in Nevada and Utah where interested parties were invited to submit oral and written comments. A total of 657 members of the public signed in as meeting participants; 210 participants provided oral comments.

A second NOI was published on July 19, 2006, to reopen scoping for the proposed GWD Project. Concurrent with publication of the second NOI, the BLM sent a scoping package to an updated mailing list. The BLM also issued press releases to local and regional radio stations and newspapers.

A final scoping summary report was issued in February 2007. A summary of comments received, and a list of governmental and non-governmental organizations that submitted comments are presented in the scoping report, which is available on the BLM Nevada website under the Nevada Groundwater Projects Office: http://www.blm.gov/nv/st/en/prog/planning/groundwater_projects/snwa_ groundwater_project/public_scoping. Most of the issues identified by the public and agencies during scoping are addressed in this EIS. Some, however, were outside the scope of the EIS, as described in Section 1.7.2, Colorado River Water Supplies. The following issues related to EIS components were raised and are addressed in this EIS.

- Purpose and Need – the BLM's administrative responsibilities in processing SNWA's ROW application and SNWA's projected water supply requirements that drive the proposed project.
- Project Description – A comprehensive description of the project construction and surface disturbance; surface disturbance reclamation; disclosure of the volumes and rates of groundwater withdrawal; disclosure of costs of construction; project abandonment.
- Project Alternatives – Alternative water conveyance proposals.
- Cumulative Impacts – Impacts to the human environment in conjunction with existing and reasonably foreseeable projects.
- Air Quality and Climate Change – Potential increases in fugitive dust from project construction and operation; local and regional climate changes resulting from project operation. Impacts related to climate change.
- Geology (Minerals, Geologic Hazards, Caves, Paleontology) – Loss of access to underlying minerals; potential modification of groundwater regime that forms and maintains caves; potential seismic activity damage to project facilities; potential surface subsidence caused by groundwater drawdown; and loss or damage of paleontological resources from surface disturbance.
- Soils – Potential increases in soil erosion and compaction from surface disturbance; potential risk of soil contamination and biotic soil crust damage during construction; disturbed soil protection and mitigation after construction; and potential changes in shallow groundwater flow from pipeline installation.
- Water Resources (Groundwater, Surface Water) – Appropriate groundwater and surface water study areas; surface drainage and hydrogeologic characterization using best available information; hydrogeologic modeling that is sufficiently sensitive to estimate effects over long time frames; aquifer drawdown effects on sustainable yield, water-dependent surface resources, and water quality; potential groundwater and surface water availability impacts on various water rights (private, Tribal, Lake Mead); and groundwater drawdown monitoring to detect and prevent impacts.
- Biological Resources (Vegetation, Aquatic Biota, Terrestrial Biota, Special Status Species) – Characterization of vegetation communities, wildlife species and habitat and aquatic systems (springs, streams) within appropriate study areas; potential groundwater drawdown effects on vegetation, wildlife, and aquatic systems; and implementation of biological resource monitoring and mitigation programs.
- Land Use and Management including Protected Lands, Utility Uses and Corridors, Agriculture (Livestock Grazing, Irrigated Cropland), Recreation, Wild Horses, Traffic, Public and Private Land Access – Project compatibility with protected lands, utility uses and corridors, designated wilderness and wilderness study areas (WSAs), construction surface disturbance effects to livestock grazing and irrigated lands; potential groundwater drawdown effects on agricultural uses; and implementation of groundwater monitoring and mitigation systems.
- Aesthetics (Visual Resources, Noise, Artificial Lighting) – Landscape modification effects from construction and operation of project transmission lines and pumping stations.
- Cultural Resources (Tribal Consultation, Archaeology, and Ethnography) – Tribal consultation process for the NHPA Section 106 compliance process and ethnographic documentation; and potential project construction and operation effects on pre-historic and cultural resources.
- Native American Traditional Values – Effects of project construction and operation on tribal lifestyles.
- Socioeconomics (Economic and Social Impacts, Environmental Justice) – Effects of project construction and operation on rural lifestyles, attitudes, population, age distribution, and social structure; county and community fiscal costs and benefits; and environmental justice. Potential for induced growth in Clark County.
- Public Health and Safety – Health and public safety effects from construction and post-construction dust; potential exposure to radioactive dust as the result of historic aboveground nuclear tests; and potential for crossing soils contaminated by industrial wastes.

1.7.2 Issues Outside the Scope of the Environmental Impact Statement

Several issues raised during scoping are outside the scope of this EIS because they are related to in-state water rights administration by the NSE. As such, this federal EIS is not the proper venue to address the following issues.

The BLM has no administrative or regulatory authority over SNWA's demand projections, the timing or quantity of indicated need, alternative sources of water, or priorities established with respect to procuring such sources.

- Requirement for a compensation program for potential injury (reduction in quantity or quality) to existing water rights for Native American and other water claims.
- Project financing and financial feasibility.
- Requirement of a project bond for potential injury to water rights.
- The SNWA's projected requirement for in-state groundwater water resources, the timing of that requirement, alternative sources of water, priorities for expanding its water resource portfolio, conservation targets, water pricing by the SNWA's member water purveyors, or, the allocation of these water resources to serve growth or bolster supplies in times of drought.

1.7.3 Topics of Controversy

The BLM acknowledges that areas of controversy exist regarding the Proposed Action and the analyses in this EIS. Many of these issues are not easily resolved because they reflect differing points of view or irreducible uncertainties in predicting the future. Throughout this EIS, the BLM has carefully evaluated the effects of the Proposed Action and alternatives on environmental resources.

The proposed GWD Project extends over a very large geographic area characterized by complex geology and terrain. The BLM has developed this EIS using high quality information and professional scientific analysis, and has made reasonable assessments of impacts to natural and human resources based on this information. The BLM has developed and used data from a variety of sources. These data have been reviewed for their completeness and estimated accuracy, and to ensure that they are as current as possible. The BLM has instituted an inclusive input process for identifying appropriate data sources, developing the groundwater modeling methodologies, and sharing preliminary modeling and impact results to improve the final result. The BLM recognizes that there are differing opinions among experts on a variety of issues. The BLM has documented the range of opinions that has emerged throughout the modeling and impact assessment process. The BLM acknowledges that there is incomplete and unavailable information for this EIS. Specific areas of these types of information for this EIS are discussed in the Chapter 3, Introduction to the Affected Environment and Environmental Consequences.

The BLM and other federal and state agencies recognize that additional monitoring information must be gathered in the future to document predicted ecosystem changes; help guide future management actions; contribute to improvements in the understanding of the groundwater system; and document how surface resources are responding to groundwater pumping. These monitoring results also will be used as a baseline for future site-specific groundwater development evaluations.

There are a variety of views on the timing and significance of possible future impacts in the Snake Valley and vicinity of the Great Basin National Park (GBNP). This includes the potential effectiveness of the proposed monitoring and mitigation plans proposed in this EIS.

Some specific examples of areas of controversy are listed below. A synopsis of these issue areas, which generally apply to all alternatives, is provided in Chapter 3, Introduction to the Affected Environment and Environmental Consequences. Further detail is then provided in the individual resource sections.

- Differences in the region of study across/between resources. A definition of the region of study used for each resource is presented in the introduction material for each resource section.
- Potential climate change effects. See Section 3.1, Air and Atmospheric Values.

- Groundwater modeling methods and study areas, and modeling input and output decisions. See Section 3.3, Water Resources.
- Criteria for evaluating groundwater drawdown effects on surface natural resources. See Sections 3.3, Water Resources; 3.5, Vegetation Resources; 3.6, Terrestrial Wildlife Resources; and 3.7, Aquatic Biology Resources.
- The relationship of groundwater to economic and population growth in the Las Vegas Valley. See Section 3.18, Socioeconomics and Environmental Justice.
- Uncertainty of the current science as to whether some geologic faults in the project area act as barriers to flow, and if so, to what extent. Further information is needed to more accurately characterize these fault properties. See Section 3.3, Water Resources.
- Water need and availability and the equity of water allocation between Nevada and Utah. See Section 3.18, Socioeconomics and Environmental Justice.

1.7.4 Draft EIS

A Notice of Availability (NOA) was published in the Federal Register on June 10, 2011 announcing the availability of the Draft EIS. The NOA specified a 90-day comment period with an end date of September 9, 2011. The 90-day time period specified by the BLM was twice that required by the NEPA - mainly due to the volume and complexity of the information presented in the Draft EIS. In response to requests from the public, an additional 30 days was added to the comment period, resulting in a total comment period of 120 days.

The Draft EIS was made available to the public on the BLM website; those entities on the mailing list for the project received a hard copy of the Executive Summary accompanied by a CD containing the entire Draft EIS and Appendices, and a CD containing background information related to the groundwater model. The Draft EIS also was produced as a two-volume hard copy set that included the previously mentioned CDs. The BLM supplied the hard copy set to those who submitted a request.

During the public comment period, the BLM held meetings for the public and for area tribes in numerous locations in Nevada and Utah. Please see Tables 5.3.1 and 5.3.2 in Chapter 5 for a summary of public and tribal meetings, respectively. Additional information on the public involvement process is presented in Chapter 5.

1.7.5 Major Document Changes between the Draft and Final EIS

In response to the agency and public comments on the Draft EIS, the BLM has made numerous changes to the Final EIS. The most substantive changes are summarized below. Non-editorial changes are marked with a text bar in the margin throughout the Final EIS.

Chapters 1 and 2

- Revisions to clarify the purpose and need for the project.
- The introduction of Alternative F (an alternative that includes only Spring, Delamar, Dry Lake, and Cave valleys) and information related to the alternative definition. This additional alternative reflects the same ROWs but higher pumping volumes when compared to Alternative E.
- Identification of the Agency Preferred Alternative.
- A summary of the Rulings by the Nevada State Engineer on SNWA water right applications in Spring, Delamar, Dry Lake, and Cave valleys.
- The addition of a discussion of project capital costs.

Chapter 3

- All resource areas incorporated and analyzed the new Alternative F. In addition, the Air and Atmospheric Values analysis was strengthened by including a regional-scale model to more clearly assess potential project-related pumping and groundwater drawdown impacts to air quality.
- The Climate Change discussion was expanded and resource-specific Climate Change analyses were moved into the cumulative analysis sections of each resource.
- Updated species lists were obtained and changes were addressed for plants, wildlife, and aquatic species. The greater sage-grouse analysis now reflects the newly implemented Instruction Memorandum (IM) No. 2012-044 which specifies increased buffer zones around leks and transmission lines.
- Additional analysis regarding changes in the landscape as viewed from the Great Basin National Park was added for all alternatives. The revised analysis evaluated impacts related to surface facilities in the ROWs and groundwater development. As, effects to vegetation from groundwater drawdown, and potential increases in sky glow in the night-time sky.
- The Cultural Resources impact discussion was expanded to include totals of cultural sites and historic properties potentially impacted for each alternative. Additional information on past and present actions and reasonably foreseeable future actions (RFFAs) was incorporated into the cumulative effects section to strengthen the analysis.
- The Section 3.17, Native American Traditional Values, was expanded to include a comparison of alternatives table which provides a more useful tool to highlight the impacts to sites and places of tribal concern for each alternative. Additional information on past and present actions and RFFAs was incorporated into the cumulative effects section based on public comment.
- The Socioeconomics, Section 3.18, Socioeconomics and Environmental Justice, was updated to reflect more current data where those data were relevant to the analysis.
- The list of cumulative actions has been reviewed and revised, and the revisions factored into the cumulative effects analysis for the various resources.
- The monitoring and mitigation, Section 3.20, Monitoring and Mitigation Summary, was revised to include a new COM Plan for the project area and new mitigation measures that have been identified based on agency and public comment have been added.

Chapter 4

- Updated Irreversible and Irretrievable information was added as appropriate. Updates were based on changes to analyses in response to comments or new information.

Chapter 5

- A synopsis of the Public Meetings on the Draft EIS was added along with a summary of overarching comments received on the Draft EIS during the public comment period. The Public Outreach section has been updated, as has the section titled "Agencies, Organizations, and Individuals to Whom Copies of the Statement are Sent."

Chapter 6

- Updates to the preparers and reviewers list have occurred to reflect staff/project role changes between the Draft and Final EIS.

Appendices

Substantive changes to appendices include:

- The addition of revised applicant-committed measures to the SNWA POD in **Appendix E**.
- Additions to the consultation record presented in **Appendix G**.
- Revisions to **Appendix F** sub-appendices related to individual resources have occurred as appropriate to support changes in the main document. These changes include the addition of information related to Alternative F.
- **Appendix H** was added to present the comments and comment responses on the Draft EIS.

1.7.6 Final EIS and Future Involvement

BLM received approximately 4,500 written comments on the Draft EIS. These comments are included, with agency responses, as **Appendix H** of this Final EIS. Availability of the Final EIS will be published in the *Federal Register* by the BLM and USEPA. After a 30-day availability period, the BLM will complete a ROD concerning the GWD Project's proposed conveyance system consisting of buried pipelines, pumping stations, regulating tanks, pressure-reducing stations, electrical power lines, electrical substations, electronic system operations facilities, communication facilities, access roads, a water treatment facility, an underground water storage reservoir, and ancillary facilities.

The Notice of Availability for the ROD will be published in the Federal Register and will be made available to parties on the mailing list and others who commented on this EIS during the NEPA process.


SWReGAP 2011

2. Description of the Proposed Action and Alternatives

2.1 Introduction

This chapter describes the range of alternatives considered in this EIS. These alternatives were developed by the BLM with input from the SNWA, public issues and concerns, and from collaboration with cooperating agencies.

This EIS contains specific environmental impact analyses for a main groundwater conveyance pipeline of up to 96 inches in diameter and related support facilities that require a ROW grant, and programmatic information for future groundwater development and supporting facilities.

Alternatives that address the SNWA's request for the BLM ROW grant and respond to the NEPA requirements include the following:

- No Action (no groundwater conveyance or groundwater development facilities would be constructed or operated);
- Proposed Action (the SNWA's proposed groundwater conveyance facilities and future groundwater sources); and
- Six groundwater conveyance and development alternatives (A through F).

As described in Chapter 1, Section 1.3.6, a tiered NEPA process can be used for multi-phased projects when specific locations and design elements have not been defined for all phases. See Section 2.1.2 for additional NEPA tiering information as it relates to the BLM's decision-making authority.

Project schedules including workforce timing, and other topics related to project construction and other project activities were carefully projected at project inception and have been updated periodically as the EIS process has continued. This information was a necessary component of the conceptual framework for the analysis of the proposed action and alternatives. Unknowns related to the timing of the project going forward have made projecting specific dates difficult. For the Final EIS, specific dates have been removed from the document as project timing would vary depending on a variety of future decisions.

QUICK REFERENCES

ACM – Applicant-committed Protection Measures
afy – acre feet per year
BLM – Bureau of Land Management
CEQ – Council on Environmental Quality
CFR – Code of Federal Regulations
FLPMA – Federal Land Policy and Management Act
GBNP – Great Basin National Park
GWD – Groundwater Development
LCCRDA – Lincoln County Conservation, Recreation, and Development Act of 2004
MOU – Memorandum of Understanding
NAGPRA - Native American Graves Protection & Repatriation Act
NDEP – Nevada Division of Environmental Protection
NDOT – Nevada Department of Transportation
NDOW – Nevada Department of Wildlife
NDWR – Nevada Department of Water Resources
NEPA – National Environmental Policy Act
NHPA – National Historic Preservation Act
NOI – Notice of Intent
NPS – National Park Service
NSE – Nevada Office of the State Engineer
RMP – Resource Management Plan
ROD – Record of Decision
ROW – Right-of-way
SHPO – State Historic Preservation Office
SNPLMA – Southern Nevada Public Lands Management Act
SNWA – Southern Nevada Water Authority
USACE – U.S. Army Corps of Engineers
USEPA – U.S. Environmental Protection Agency
USFWS – U.S. Fish and Wildlife Service
USGS – U.S. Geological Survey

2.1.1 Alternatives Overview

An overview of the ROW alternatives and their associated facilities are summarized in **Table 2.1-1**.

Table 2.1-1 Summary of Project Main Pipeline Right-of-way Alternatives and Groundwater Development Scenarios (see text for detailed descriptions)

Alternative	Main Pipeline ROW Description	Groundwater Development Scenario
Proposed Action Distributed Pumping at Application Quantities	All requested ROWs for a main pipeline of up to 96 inches in diameter, lateral pipelines, and associated ancillary facilities, required for this alternative.	Facilities to pump up to 176,655 afy of new applications from 5 basins at distributed locations.
A Distributed Pumping at Reduced Quantities	All requested ROWs for a main pipeline of up to 84 inches in diameter, lateral pipelines, and associated ancillary facilities required for this alternative.	Facilities to pump up to 114,755 afy of new applications from 5 basins at distributed locations.
B Point of Diversion Pumping at Application Quantities	All requested ROWs for a main pipeline of up to 96 inches in diameter and lateral pipelines, and associated ancillary facilities, required for this alternative.	Facilities to pump up to 176,655 afy of new applications from 5 basins at or near Points of Diversion.
C Intermittent Pumping at Reduced Quantities	All requested ROWs for a main pipeline of up to 84 inches in diameter and lateral pipelines, and associated ancillary facilities required for this alternative.	Facilities to pump a potential range of volumes from 12,000 afy to 114,755 afy of new applications from 5 basins at distributed locations; groundwater pumping over intermittent periods, based upon drought conditions and availability of Colorado River water.
D Distributed Pumping at Reduced Quantities in Lincoln County Only	ROWs for a main pipeline of up to 78 inches in diameter, lateral pipelines, and associated ancillary facilities required for this alternative within Clark and Lincoln counties only, as authorized under the LCCRDA.	Facilities to pump up to 78,755 afy of new applications from 4 basins at distributed locations (Delamar, Dry Lake, and Cave valleys and a portion of Spring Valley) in Lincoln County only.
E Distributed Pumping at Reduced Quantities in Spring, Cave, Dry Lake, and Delamar valleys	ROWs for a main pipeline of up to 78 inches in diameter and lateral pipelines, associated ancillary facilities required for this alternative from within Spring, Cave, Dry Lake, and Delamar valleys.	Facilities to pump up to 78,755 afy of new applications from 4 basins at distributed locations within Spring, Delamar, Dry Lake, and Cave valleys.
F Distributed Pumping in Spring, Delamar, Dry Lake, and Cave valleys	ROWs for a main pipeline of up to 84 inches in diameter and lateral pipelines and associated ancillary facilities required for this alternative from within Spring, Delamar, Dry Lake, and Cave valleys.	Facilities to pump up to 114,129 afy of new applications from 4 basins at distributed locations within Spring, Delamar, Dry Lake, and Cave valleys.

The following section provides the basis for the range of ROW and groundwater development alternatives fully analyzed in this EIS. The volumes of water proposed for development are summarized in **Table 2.1-2** by alternative.

Table 2.1-2 SNWA Groundwater Development Volumes for the Groundwater Development Project Alternatives

Water Volume (afy)	Alternatives							
	Proposed Action	A	B	C Low	C High	D	E	F
New Groundwater Development								
Spring Valley	91,224	60,000	91,224	3,000	60,000	60,000	60,000	84,370
Snake Valley	50,679	36,000	50,679	2,000	36,000	0	0	0
Delamar, Dry Lake, and Cave valleys	34,752	18,755	34,752	7,000	18,755	18,755	18,755	29,759
Total SNWA Groundwater Development Volume (afy)	**176,655**	**114,755**	**176,655**	**12,000**	**114,755**	**78,755**	**78,755**	**114,129**

Totals exclude agricultural water rights granted to SWNA (8,000 afy) and Tuffy Ranch Properties, LLC (11,300 afy) and also do not include the potential conveyance of water for Lincoln County Water District. See "Pipeline Conveyance Volumes" following the alternative descriptions.

- **Proposed Action – Distributed Pumping at 1989 Application Quantities**. This alternative requires ROWs for a main pipeline of up to 96 inches in diameter, lateral pipelines, and associated ancillary facilities. As discussed in Chapter 1, Section 1.4.1.1, the SNWA holds groundwater applications originally filed in 1989. In 2007 and 2008, the NSE ruled on the SNWA's groundwater applications in Spring, Delamar, Dry Lake, and Cave valleys and allotted the SNWA a reduced volume of 78,755 afy of new groundwater rights, instead of the requested 125,976 afy. However, the NSE decisions granting these water rights were vacated on appeal to the Nevada Supreme Court. Due to the Nevada Supreme Court decision and the re-initiation of the NSE water appropriation process, the SNWA revised its conceptual POD in 2011 to consider conveyance of the full quantity of its previous applications in Spring, Snake, Delamar, Dry Lake, and Cave valleys. Under this alternative, groundwater wells would be distributed across five hydrologic basins with the objective of minimizing effects on senior water rights or areas containing water-dependent sensitive or listed species and their habitats. Based on the Nevada Supreme Court's decision, the applications for Spring, Delamar, Dry Lake, and Cave valleys have been re-noticed and the NSE submitted its ruling on these applications in March 2012. Even though the rulings granted less than the application quantities, the Proposed Action alternative has been carried forward for comparative analysis purposes.
- **Alternative A – Distributed Pumping at Reduced Quantities**. This alternative requires ROWs for a main pipeline of up to 84 inches in diameter, lateral pipelines, and associated ancillary facilities. In 2007 and 2008, the NSE ruled on the SNWA's groundwater applications in Spring, Delamar, Dry Lake, and Cave valleys and allotted the SNWA a reduced volume of 78,755 afy of new groundwater rights, instead of the requested 125,976 afy. However, the NSE decisions granting these water rights were vacated on appeal to the Nevada Supreme Court. Based on the Nevada Supreme Court's decision, the Spring, Delamar, Dry Lake, and Cave valleys' applications have been re-noticed and the NSE submitted its ruling on these applications in March 2012. Even though the rulings grated less than the application quantities, this alternative has been carried forward for comparative analysis purposes. The NSE has not allotted the same amount of water to the SNWA as was allotted in the previous ruling, however, this alternative provides a comparative benchmark to indicate a full-basin pumping scenario similar to that which the NSE may have approved based on the previous ruling. This alternative also assumes that the SNWA may be permitted 36,000 afy of new groundwater rights in Snake Valley, instead of the requested 50,679 afy, as described in a draft Snake Valley Agreement between the states of Nevada and Utah. Under this alternative, groundwater wells would be distributed across the hydrologic basins with the objective of

Points of Diversion: Within the 5 basins, 34 specific locations—called Points of Diversion—for groundwater development have been identified in the groundwater applications. Under Alternative B, groundwater development would occur at or close to the Points of Diversion.

minimizing effects on senior water rights or areas containing water-dependent sensitive or listed species and their habitats.

- **Alternative B – Points of Diversion Pumping at 1989 Application Quantities.** This alternative requires ROWs for a main pipeline of up to 96 inches in diameter, lateral pipelines, and associated ancillary facilities. Alternative B would develop and convey the same groundwater volume as the Proposed Action (see the previous discussion for that alternative). In this alternative, groundwater would be developed within a 1-mile radius of the 34 application Points of Diversion locations. The expected effects of such a development plan would be to intensify the local drawdown effects in the vicinity of the points of diversion, and potentially avoid drawdown effects to other areas.

- **Alternative C – Intermittent Pumping at Reduced Quantities.** This alternative requires ROWs for a main pipeline of up to 84 inches in diameter, lateral pipelines, and associated ancillary facilities. The development pattern for this alternative would be the same as Alternative A – Distributed Pumping at Reduced Quantities. However, a lower overall volume of groundwater would be pumped over time as compared to any of the other alternatives. In this scenario, the volumes of water conveyed by the project would be related to the SNWA's Colorado River water supply. For the purposes of the EIS, it is assumed that drought conditions affecting the Colorado River water supply would trigger increased pumping and would occur at an average interval of 10 years, necessitating a 5-year period of minimal conveyance, with full conveyance during the other 5 years.

Intermittent Groundwater Pumping: The amount of groundwater pumped would be dependent upon the availability of SNWA's other Colorado River water resources.

- **Alternative D – Distributed Pumping at Reduced Quantities in Lincoln County Only.** The pipeline and groundwater development for this alternative is limited to Clark and Lincoln counties; no facilities would be constructed in White Pine County. This alternative requires ROWs for a main pipeline of up to 78 inches in diameter, lateral pipelines, and associated ancillary facilities. This alternative was developed to examine effects of constructing a project that would allow the SNWA to utilize the LCCRDA utility corridor already designated by Congress, and to develop all granted water rights within Lincoln County. This alternative would not allow development of groundwater within Snake Valley, and would result in lower groundwater development volumes compared to the Proposed Action, and Alternatives A, B, C, and F.

- **Alternative E – Distributed Pumping at Reduced Quantities – Spring, Delamar, Dry Lake, and Cave Valleys.** The pipeline and groundwater development for this alternative is limited to four groundwater development basins (Spring, Delamar, Dry Lake, and Cave valleys), with no facilities extending into Snake Valley, and no groundwater development occurring there. This alternative requires ROWs for a main pipeline of up to 78 inches in diameter, lateral pipelines, and associated ancillary facilities. This alternative was developed to address concerns regarding potential effects from groundwater development in Snake Valley. The volume of water would be the same as Alternative D because no water would be developed in Snake Valley.

- **Alternative F – Distributed Pumping – Spring, Delamar, Dry Lake, and Cave Valleys.** The pipeline and groundwater development for this alternative is limited to four groundwater development basins (Spring, Delamar, Dry Lake, and Cave valleys), with no facilities extending into Snake Valley, and no groundwater development occurring there. This alternative requires ROWs for a main pipeline of up to 84 inches in diameter, lateral pipelines, and associated ancillary facilities. This alternative was developed to create an upper boundary for groundwater withdrawal, while addressing concerns regarding potential effects from groundwater development in Snake Valley.

Pipeline Conveyance Volumes

In addition to the application groundwater volumes described for each alternative (**Table 2.1-2**), the SNWA would potentially convey its existing water rights in Spring Valley, as well as those to be developed by Lincoln County Water District (LCWD) in the future. The SNWA's main line pipeline design would accommodate these additional water quantities for all alternatives. The construction and permanent main line pipeline ROW widths would be the same for all alternatives; therefore, the maximum dimensions of the ROWs that may be granted by the BLM in the ROD for this Tier 1 analysis would accommodate differences in the various action alternatives. The ultimate pipeline dimensions and water conveyance volumes depend upon the volumes granted by the NSE, as well as the groundwater volumes developed in the future by Lincoln County. The following groundwater (in addition to that described in **Table 2.1-2**) may be conveyed in the SNWA pipeline system in the future, based on currently available information:

- The SNWA existing agricultural water rights in Spring Valley consisting of 8,000 afy. The SNWA would first obtain approval from the NSE to convert these agricultural rights to municipal uses, then would develop the gathering pipeline infrastructure necessary to connect to the GWD Project mainline pipeline system. Specific plans have not been provided to the BLM to convey this water, and therefore all ROWS would be approved under subsequent NEPA tiers. SNWA proposes to convey these water rights for all alternatives. However, the SNWA would not convey these volumes under Alternative C (intermittent pumping) when groundwater pumping for the entire project would be minimized. These agricultural rights have been included in the No Action groundwater modeling in this EIS because they represent existing uses, and their general location is known.
- Tuffy Ranch Properties, LLC agricultural water rights in Lake Valley consisting of 11,300 afy. Similar to the description of the SNWA's agricultural rights in Spring Valley, Tuffy Ranch Properties, LLC would obtain approval from the NSE to convert existing agricultural water rights to municipal uses, and then develop the infrastructure necessary to interconnect with the SNWA main line pipeline system in Lake Valley. Specific plans have not been provided to the BLM to convey this water, and therefore all ROWS would be approved under subsequent NEPA. These agricultural rights have been included in the No Action groundwater modeling in this EIS because they represent existing uses, and their general location is known.
- LCWD pipeline conveyance request consisting of 21,700 afy. A conveyance agreement has been reached between the SNWA and Lincoln County for transportation of this water in the future. For the purpose of this EIS these are undefined sources of water (there are no specific project plans and no water right applications) resulting in insufficient information to adequately characterize and analyze the Lincoln County water under this NEPA action. Independent NEPA analysis in the form of a separate Environmental Assessment (EA) or EIS would be required if, and when, the Lincoln County project plan is defined and specific plans submitted to the BLM for the requested ROW. There is no ROW application before the BLM for development and conveyance of this Lincoln County water; therefore, there is no basis for cumulative NEPA analysis in this Tier 1 EIS.

2.1.2 Bureau of Land Management Authority and Limitations

National Environmental Policy Act Tier 1

Rights-of-way and Ancillary Facilities

For this project, some project and site-specific details of the Proposed Action, primarily the proposed alignment of the main pipeline and associated operational facilities (power transmission lines, pump stations, etc.) are known. Consequently, this Tier 1 document addresses the environmental effects of these known components.

As discussed in Chapter 1, Section 1.3.1, subject to the requirements of the SNPLMA and the LCCRDA, the BLM generally has authority under the FLPMA to approve or deny ROWs on federal lands and to develop mitigation procedures to minimize impacts to natural and human resources in accordance with monitoring, management, and published land management plans. The effects of the BLM's ROW decisions on the SNWA's ability to develop its pending groundwater rights are summarized as follows:

- If the Proposed Action, or Alternatives A, B, or C were approved in the ROD, additional ROWs may be granted (after further NEPA analysis [subsequent tiers] is completed) for facilities to allow future groundwater development in all five hydrologic basins (Spring, Snake, Delamar, Dry Lake, and Cave).

Programmatic Analysis

The programmatic portion of this Tier 1 document includes the future production wells, collector pipelines, additional pumping stations, distribution power lines, additional secondary substations, pressure reduction valves, and maintenance roads.

- If Alternative D were approved in the ROD, additional ROWs may be granted (after further NEPA analysis [subsequent tiers] are completed) to allow future groundwater development only in hydrologic basins within Lincoln County (Southern Spring, Delamar, Dry Lake, and Cave valleys).
- If Alternative E or F were approved in the ROD, additional ROWs may be granted (after further NEPA analysis [subsequent tiers] are completed) to allow future groundwater development in four hydrologic basins (Spring, Delamar, Dry Lake, and Cave valleys).

Future Facilities

Details regarding future facilities for groundwater development, including the number and locations of wells, and the specific lengths and routes of collector pipeline and distribution power lines, are presently unknown. Thus, the environmental effects of future groundwater development, including the long-term effects of groundwater production, are the subject of programmatic analysis in this EIS.

Subsequent National Environmental Policy Act Tiers

The analysis in this EIS provides the basis for subsequent NEPA tiering when plans for future ROWs and associated facilities are finalized and submitted to the BLM by the SNWA. At that time, the BLM would conduct NEPA reviews of the specific ROWs and facilities required to implement groundwater development (wells, collector pipelines, electrical power lines, access roads). The BLM would approve or deny these proposed ROWs in a Decision Document (ROD/FONSI) written for each additional phase of the groundwater development project.

For groundwater pumping, the NSE has ruled on the SNWA water rights applications in Spring, Delamar, Dry Lake, and Cave valleys. See the rulings on the NSE website at www.ndep.State.nv.us/hearings/past/springetal/documents.cfm. Under the FLPMA, the BLM has the authority to "protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values" (Section 102 [43 U.S.C 1701] [a], paragraph 8). As a signatory to the stipulated agreements for Spring, Delamar, Dry Lake, and Cave valleys, the BLM may negotiate monitoring programs that would identify changes in the quantity and quality of natural resources on the BLM-administered public lands. The BLM, as the Federal Land Manager, enforces the ROW grant through terms and conditions. The BLM's intent is to protect federal resources and federal water rights that may be impacted by construction, operation, maintenance, and abandonment of the project.

2.2 No Action

The No Action Alternative describes the baseline conditions, or the status quo, before any approval of the Proposed Action or other action alternative. The No Action Alternative assumes that the project ROW would not be granted by the BLM. Even when Congress mandates that an action take place, the impacts of the No Action Alternative are evaluated, although the evaluating agency might have limited or no authority to deny project authorization. The project water model included approximately 104,000 afy of groundwater that currently is permitted by the NSE in the project area. The water volume for the No Action Alternative includes 8,000 afy of groundwater associated with SNWA agricultural properties and 11,300 afy for which permits are held by Tuffy Ranch Properties, LLC. Because this water is currently being used, it is included in the No Action total.

Key Points—No Action

Maintain the status quo. The SNWA would not receive the approval necessary to construct and develop the GWD Project. The current total amount of regional groundwater use is approximately 104,000 afy, including 11,300 afy of Lincoln County and 8,000 afy of the SNWA's existing agricultural water rights. The total No Action volume represents the entire hydrologic model area (**Figure 2.2-1**) including the project development basins.

Although certain ROWs are required to be granted by the LCCRDA, the No Action Alternative in this EIS describes baseline conditions without construction of the GWD Project, as a benchmark for the comparison of the Proposed Action and action alternatives.

2.2.1 Rights-of-way for the No Action Alternative

Pursuant to the SNPLMA and the LCCRDA, the BLM must grant the SNWA's ROW requests in Clark County and Lincoln County. However, the No Action Alternative in this EIS describes baseline conditions without construction of the GWD Project, as a benchmark for the comparison of the Proposed Action and alternatives.

The SNPLMA requires the BLM to grant ROWs in Clark County for "all reservoirs, canals, channels, ditches, pipes, pipelines, tunnels, and other facilities and systems needed for (i) the impoundment, storage, treatment, transportation, or distribution of water…" (Public Law 105-263, as amended).

The LCCRDA requires that ROWs be granted in Lincoln and Clark counties for any "roads, wells, well fields, pipes, pipelines, pumping stations, storage facilities, or other facilities and systems that are necessary for the construction and operation of a water conveyance system…" (H.R. 4593, Title III-Utility Corridors, Section 301. Utility Corridors and Rights-of-Way. Paragraph [b][1]).

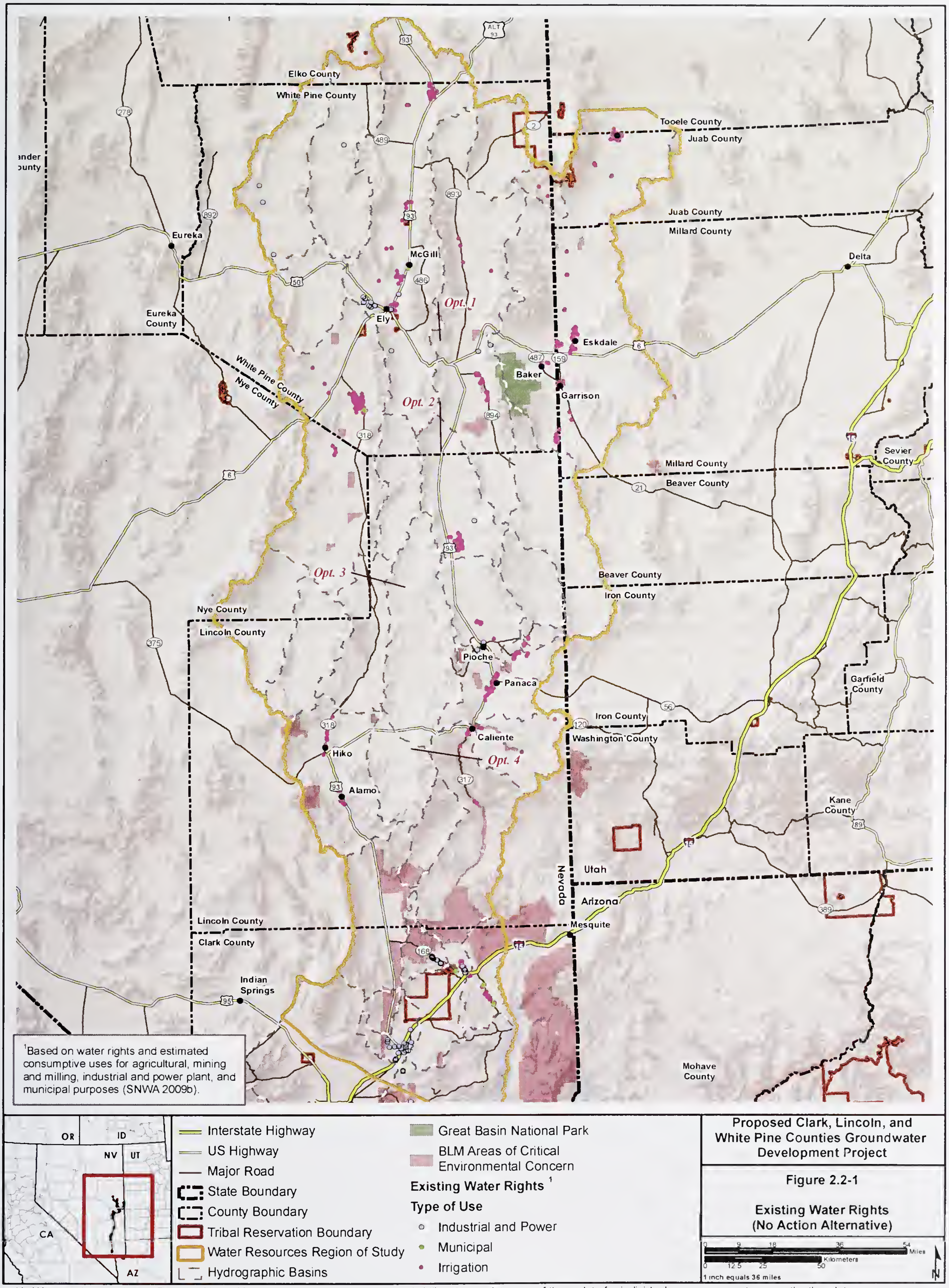
Under the analysis presented in the No Action Alternative, the lack of a federal ROW would effectively preclude the SNWA from developing and conveying via pipeline, its existing and pending groundwater rights from the five groundwater basins (Spring, Snake, Delamar, Dry Lake, and Cave valleys) across public lands as proposed by the SNWA and analyzed in the Proposed Action and Alternatives A through C. Limited private lands exist in these basins, and the SNWA would be limited to constructing a water conveyance system without crossing BLM-administered land.

Selection of the No Action Alternative would not address the SNWA's needs to augment its existing water resources and to diversify available water supplies, as discussed in the SNWA's supporting rationale (**Appendix A**). Nor would the No Action Alternative meet Congress' LCCRDA purpose in mandating that BLM grant SNWA a ROW for the Project. Under the analysis presented in the No Action Alternative, the lack of a federal ROW would effectively preclude SNWA from developing and conveying its existing and pending groundwater rights across public lands.

2.2.2 Groundwater Development for No Action

Groundwater development under the No Action Alternative would consist of a continuation of historical and permitted uses, including the continued development of Lincoln and White Pine counties' agricultural water rights. Land sales specified in the Ely RMP/EIS could change the current water use or increase slightly the amount of water being used. However, changes in water use would require NSE approval, and would not occur automatically with a land sale. **Figure 2.2-1** illustrates the locations of water supply wells for agricultural, municipal, and industrial/power purposes that were included in the No Action Alternative for the groundwater modeling simulation. These sources represent a total volume of approximately 104,000 afy of existing and other planned future groundwater use and consumption and include the 11,300 afy of Tuffy Ranch Properties, LLC's existing agricultural water rights in Lake Valley and 8,000 afy of existing SNWA agricultural groundwater rights associated with the SNWA properties in Spring Valley. Because these agricultural water rights are associated with private property and currently are being developed regardless of the Proposed Action, they are included in the No Action Alternative.

Because these agricultural water rights are associated with private property and currently are being developed regardless of the Proposed Action, they are included in the No Action Alternative.



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 2.2-1

Existing Water Rights (No Action Alternative)

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

2.3 Management Common to All Alternatives

This section summarizes the BLM management decisions, actions, and other guidance that must be addressed for the GWD Project, regardless of the action alternative.

2.3.1 Bureau of Land Management Resource Management Plans

All actions approved or authorized by the BLM must conform to the existing land use plan where one exists (43 CFR 1610.5-3, 43 CFR 2920.2-5). The BLM's planning regulations state that the term "conformity" or "conformance" means that "...a resource management action shall be specifically provided for in the plan, or if not specifically mentioned, shall be clearly consistent with the terms, conditions, and decisions of the approved plan or amendment" (43 CFR 1601.0-5[b]). According to the BLM Handbook (BLM 2008a), if the proposed action does not conform to the existing land use plan, either the proposal should be modified to conform, or a land use plan amendment that allows the action should be considered. Additionally, if the existing land use plan is silent about an activity, the plan direction, including the broad and programmatic goals and objectives, should be reviewed.

As stated in Chapter 1, Section 1.4.1, the BLM Ely District RMP (BLM 2008b) and the BLM Las Vegas District RMP (BLM 1998) provide management direction for all BLM-managed lands that would be occupied by the GWD Project facilities. Conformance of the proposed and alternative ROWs with the applicable RMPs was evaluated in accordance with the following process:

- The Ely District RMP management actions, best management practices (BMPs), and USFWS BO terms and conditions that would apply to the GWD Project were identified. These same measures also would be applied in the Southern Nevada District as their land management direction is consistent with the Ely RMP. A list of the BMPs are in **Table 2.3-1**. A complete list of BLM BMPs also is contained in **Appendix D**. Ely District also is completing watershed restoration plans that may guide future assessment related to the project.
- The locations of proposed groundwater development facilities were evaluated for their conformance with approved BLM utility corridors, and with the management prescriptions for special use areas, such as Areas of Critical Environmental Concern (ACECs).
- The ACMs included in the SNWA POD were evaluated for their conformance with the RMP management actions and BMPs.
- The RMP management actions, BMPs, and ACMs were then evaluated for their effectiveness to avoid or reduce the environmental consequences identified for each resource discussed in the Affected Environment portion of Chapter 3.
- For some resources, additional mitigation measures were developed to further reduce or avoid resource impacts after the BLM RMP management actions, BMPs, and ACMs are fully implemented. These additional measures conform to the resource management direction contained in the RMPs.

Table 2.3-1 Bureau of Land Management Ely District – Best Management Practices[1]

Air Resources	
1.	Use dust abatement techniques on unpaved, unvegetated surfaces to minimize airborne dust.
2.	Post and enforce speed limits (e.g., 25 miles per hour [mph]) to reduce airborne fugitive dust.
3.	Cover construction materials and stockpiled soils if they are a source of fugitive dust.
4.	Use dust abatement techniques before and during surface clearing, excavation, or blasting activities.
Water Resources	
3.	Construct a containment barrier around all pumps and fuel containers utilized within 100 feet (30.5 meters [m]) of a stream channel. The containment barrier would be of sufficient size to contain all fuel being stored or used on site.
12.	Limit stream crossings on travel routes and trails to the minimal number necessary to minimize sedimentation and compaction. The BLM Authorized Officer will determine if any impacts need to be rehabilitated by the permittee.

Table 2.3-1 Bureau of Land Management Ely District – Best Management Practices[1] (Continued)

13. Conduct mixing of herbicides and rinsing of herbicide containers and spray equipment only in areas that are a safe distance from environmentally sensitive areas and points of entry to bodies of water (storm drains, irrigation ditches, streams, lakes, or wells).
Soil Resources
2. During periods of adverse soil moisture conditions caused by climatic factors such as thawing, heavy rains, snow, flooding, or drought, suspend activities on existing roads that could create excessive surface rutting. When adverse conditions exist, the operator would contact the BLM Authorized Officer for an evaluation and decision based on soil types, soil moisture, slope, vegetation, and cover.
3. When preparing the site for reclamation, include contour furrowing, terracing, reduction of steep cut and fill slopes, and the installation of water bars, as determined appropriate for site-specific conditions.
5. Restoration requirements include reshaping, re-contouring, and/or resurfacing with topsoil, installation of water bars, and seeding on the contour. Removal of structures such as culverts, concrete pads, cattle guards, and signs would usually be required. Fertilization and/or fencing of the disturbance may be required. Additional erosion control measures (e.g., fiber matting and barriers) to discourage road travel may be required.
Vegetation Resources
1. Where seeding is required, use appropriate seed mixture and seeding techniques approved by the BLM Authorized Officer.
2. The BLM Authorized Officer will specify required special handling and recovery techniques for Joshua trees, yucca, and some cactus in the southern part of the planning area on a site-specific basis.
3. Keep removal and disturbance of vegetation to a minimum through construction site management (e.g., using previously disturbed areas and existing easements, limiting equipment/materials storage and staging area sites, etc.).
4. Generally, conduct reclamation with native seeds that are representative of the indigenous species present in the adjacent habitat. Document rationale for potential seeding with selected nonnative species. Possible exceptions would include use of nonnative species for a temporary cover crop to out-complete weeds. In all cases, ensure seed mixes are approved by the BLM Authorized Officer prior to planting.
5. Certify that all interim and final seed mixes, hay, straw, and hay/straw products are free of plant species listed on the Nevada noxious weed list.
6. An area is considered to be satisfactorily reclaimed when all disturbed areas have been recontoured to blend with the natural topography, erosion has been stabilized, and an acceptable vegetative cover has been established. Use the Nevada Guidelines for Successful Revegetation prepared by the NDEP, the BLM, and the U.S. Department of Agriculture Forest Service (USDA) (or most current revision or replacement of this document) to determine if revegetation is successful.
7. The perennial plant cover of the reclaimed area would equal or exceed perennial cover of selected comparison areas (normally adjacent habitat). If the adjacent habitat is severely disturbed, an ecological site description may be used as a cover standard. Cover is normally crown cover as estimated by the point intercept method. Selected cover can be determined using a method as described in Sampling Vegetation Attributes, Interagency Technical Reference, 1996, BLM/RS/ST-96/002+1730. The reclamation plan for the area project would identify the site-specific release criteria and associated statistical methods in the reclamation plan or permit.
8. Utility companies will manage vegetation in their ROWs for safe and reliable operation while maintaining vegetation and wildlife habitat.
9. Respread weed-free vegetation removed from the ROWs to provide protection, nutrient recycling, and seed source.
Fish and Wildlife
1. Install wildlife escape ramps in all watering troughs, including temporary water haul facilities, and open storage tanks. Pipe the overflow away from the last water trough on an open system to provide water at ground level.
2. As appropriate, mark certain trees on BLM-administered lands for protection as wildlife trees.

Table 2.3-1 Bureau of Land Management Ely District – Best Management Practices[1] (Continued)

3. Consider seasonal distribution of large wildlife species when determining methods used to accomplish weed and insect control objectives.
4. Protect active raptor nests in undisturbed areas within 0.25 mile of areas proposed for vegetation conversion using species-specific protection measures. Inventory areas containing suitable nesting habitat for active raptor nests prior to the initiation of any project.
5. When used to pump water from any pond or stream, screen the intake end of the draft hose to prevent fish from being ingested. Screen opening size would be a maximum of 3/16 inch (4.7 millimeters).
Special Status Species
1. Avoid line-of-sight views between the power poles along power lines and sage grouse leks, whenever feasible.
2. Use current science, guidelines, and methodologies (Avian Power Line Interaction Committee [APLIC] 2006, 1994; APLIC and USFWS 2005) for all new and existing power lines to minimize raptor and other bird electrocution and collision potential.
3. When managing weeds in areas of special status species, carefully consider the impacts of the treatment on such species. Wherever possible, hand spraying of herbicides is preferred over other methods.
4. Do not conduct noxious and invasive weed control within 0.5 mile of nesting and brood rearing areas for special status species during the nesting and brood rearing season.
7. For streams currently occupied by any special status species, do not allow extraction of water from ponds or pools if stream inflow is minimal (i.e., during drought situations) and extraction of water would lower the existing pond or pool level.
Wild Horses
1. To protect wild horses and wildlife flag all new fences every 16 feet with white flagging that is at least 1 inch wide and has at least 12 inches hanging free from the top wire of the fence.
2. If a project involves heavy or sustained traffic, require road signs for safety and protection of wild horses and wildlife.
Cultural Resources
1. Ensure that all activities associated with the undertaking, within 325 feet of the discovery, are halted and the discovery is appropriately protected, until the BLM issues a Notice to Proceed. A Notice to Proceed may be issued by the BLM under any of the following conditions:
• Evaluation of potentially eligible resource(s) results in a determination that the resource(s) are not eligible;
• The fieldwork phase of the treatment option has been completed; and
• The BLM has accepted a summary description of the fieldwork performed and a reporting schedule for that work.
2. The operator will inform all persons associated with the project that knowingly disturbing cultural resources (historic or archaeological) or collecting artifacts is illegal.
Paleontological Resources
1. When paleontological resources of potential scientific interest are encountered (including all vertebrate fossils and deposits of petrified wood), leave them intact and immediately bring them to the attention of the BLM Authorized Officer.
Visual Resources
1. On industrial facilities authorized by the Ely District Office, utilize anti-glare light fixtures to limit light pollution.
3. When feasible, bury utility lines on public land when in the viewshed of residential or community development.

Table 2.3-1 Bureau of Land Management Ely District – Best Management Practices[1] (Continued)

Travel Management and Off-highway Vehicle Use	
1.	Design access roads requiring construction with cut and fill to minimize surface disturbance and take into account the character of the landform, natural contours, cut material, depth of cut, where the fill material would be deposited, resource concerns, and visual contrast. Avoid construction of access roads on steep hillsides and near watercourses where alternate routes provide adequate access.
2.	Where adverse impacts or safety considerations warrant, limit or prohibit public access when authorizing specific routes to areas or sites under permit or lease.
Recreation	
1.	Do not allow surface or underground disturbance to occur within 100 yards (horizontally or vertically) of known cave resources.
Livestock Grazing	
1.	Water troughs
	• Place troughs connected with spring developments outside of riparian and wetland habitats to reduce livestock trampling damage to wet areas; and
	• Control trough overflow at springs with float valves or deliver the overflow back into the native channel.
Fire Management	
3.	Within the area of operation, every effort will be made to prevent, control, or suppress any fire. Fire-fighting equipment may be required to be on site while operations are in progress, depending on hazards inherent in the type of operation and fire hazard levels. Report uncontrolled fires immediately to the BLM Ely District Office Manager or Authorized Officer. The BLM Fire Dispatch telephone number is (775) 289-1925 or 1-800-633-6092. After working hours, call 911 or the White Pine County Sheriff's Office at (775) 289-8801, the Lincoln County Sheriff's Office at (775) 962-5151, or the Nye County Sheriff's Office at (775) 482-8101.
Noxious and Invasive Weed Management	
2.	When maintaining unpaved roads on BLM-administered lands, avoid the unnecessary disturbance of adjacent native vegetation and the spread of weeds. Grade road shoulders or barrow ditches only when necessary to provide for adequate drainage. Minimize the width of grading operations. The BLM Authorized Officer will meet with equipment operators to ensure that they understand this objective.
Health and Safety	
1.	Consider nozzle type, nozzle size, boom pressure, and adjuvant use and take appropriate measures for each herbicide application project to reduce the chance of chemical drift.
2.	All applications of approved pesticides will be conducted only by certified pesticide applicators or by personnel under the direct supervision of a certified applicator.
3.	Prior to commencing any chemical control program, and on a daily basis for the duration of the project, the certified applicator will provide a suitable safety briefing to all personnel working with or in the vicinity of the herbicide application. This briefing will include safe handling, spill prevention, cleanup, and first aid procedures.
4.	Store all pesticides in areas where access can be controlled to prevent unauthorized/untrained people from gaining access to the chemicals.
5.	Do not apply pesticides within 440 yards (0.25 mile) of residences without prior notification of the resident.
6.	Areas treated with pesticides will be adequately posted to notify the public of the activity and of safe re-entry dates, if a public notification requirement is specified on the label of the product applied. The public notice signs will be at least 8 1/2" x 11" in size and will contain the date of application and the date of safe re-entry.
9.	Properly dispose of all tailings, dumps, and deleterious materials or substances. Take measures to isolate, control, and properly dispose of toxic and hazardous materials.

Table 2.3-1 Bureau of Land Management Ely District – Best Management Practices[1] (Continued)

10. Remove and properly dispose of all trash, garbage, debris, and foreign matter. Maintain the disposal site and leave it in a clean and safe condition. Do not allow burning at the site.
11. Do not drain oil or lubricants onto the ground surface. Immediately clean up any spills under 25 gallons; clean up spills over 25 gallons as soon as possible and report the incident to the BLM Authorized Officer and NDEP.
12. The operator will work with the BLM Authorized Officer on the containment of drilling fluids and drill hole cuttings. Adequately fence, post, or cover mud and separation pits, and hazardous material storage areas.
14. Containerize petroleum products such as gasoline, diesel fuel, helicopter fuel, and lubricants in approved containers. Properly store hazardous materials in separate containers to prevent mixing, drainage, or accidents.

[1] Numbered measures are selected from the RMP BMPs list.

The following GWD Project ROW location conformance issues were identified:

- The proposed buried water reservoir would be located in the Coyote Springs ACEC in the BLM Southern Nevada District (see Section 3.14, Special Designations). This ACEC is a ROW avoidance area. The proposed facilities would be located within the LCCRDA corridor, which was approved by Congress. The provisions of the LCCRDA supersede the BLM ACEC management prescriptions.
- An approximately 10-mile segment of the proposed mainline pipeline in the Delamar Valley is proposed for location outside the LCCRDA corridor under the Proposed Action, and Alternatives A through F. This segment would be located outside the LCCRDA corridor to avoid the need for an additional pumping station and to avoid an area of dense Joshua trees. Alignment Option 4 is a route option that would locate the pipeline within the LCCRDA corridor in Delamar Valley. Implementation of Alignment Option 4 would provide an opportunity to ensure that project facilities would be located within approved utility corridors.
- The proposed action 230 kV power line in Steptoe Valley may not be compatible with VRM Class II management objectives. Alignment Option 1 Humboldt-Toiyabe alignment for the 230-kV would have less impact on the visual landscape.

For groundwater development facilities, the BLM would make determinations on RMP conformance in future NEPA analyses (subsequent tiers). The following are examples of potential future effects on resources that may not conform to management actions contained in the Ely District RMP:

Aquatic resources in Shoshone Ponds and vegetation resources in the Swamp Cedars and Baking Powder Flat ACECs may be affected by construction of groundwater development facilities, and aquifer drawdowns from pumping in the future. These areas are classified as avoidance areas, on which facilities may be located on a case-by-case basis. Management direction for the effects of aquifer drawdown from groundwater pumping on these ACECs is not included in the Ely District ROD management prescriptions for the ACECs (BLM 2008b), and groundwater pumping may not comply with the management prescriptions to protect the identified sensitive vegetation and other biotic communities.

Potential riparian vegetation changes related to aquifer drawdown may occur within some wilderness areas (e.g., Fortification Range, Highland Ridge, and Mount Grafton) based on estimated aquifer drawdown contours. Groundwater pumping and the related impacts may raise concerns regarding the Wilderness Act. Potential effect to vegetation and biotic communities may occur as a result of groundwater pumping but would be assessed in greater detail in future tiered analyses.

The visual impacts of the future project construction may not comply with Visual Resource Management (VRM) guidelines in the RMP; a final determination of compliance would be made when site-specific facility locations are proposed and evaluated.

2.3.2 Stipulated Agreements

The SNWA has entered into several stipulated agreements (stipulations) with DOI Bureaus (i.e., BIA, BLM, USFWS, and NPS). The agreements apply to the SNWA's water rights applications with the NSE and are not related specifically to the water volume requests contained in the applications. The terms of these stipulated agreements currently are in full force among the parties, and were amended so that the terms apply to the SNWA's 1989 applications as well as the SNWA applications refiled in 2010. This does not include future applications. These agreements are intended to manage the development of groundwater by the SNWA in various hydrologic basins. This management will occur through the implementation of monitoring, management, and mitigation plans, to monitor and manage development properly without causing injury to federal water rights or unreasonable adverse effects to federal resources and special status species within a defined area of interest. A synopsis and full text of the Spring Valley and Delamar, Dry Lake, and Cave valley agreements are included in **Appendix C**. The following sections provide an overall summary.

2.3.2.1 Spring Valley Stipulated Agreement

The stipulated agreement describes actions that various parties would take to initiate monitoring programs, as well as establish the administrative structure to oversee these programs (**Appendix C**). In summary, the stipulated agreement would:

- Establish a system of early warning monitoring wells within the Spring Valley and Hamlin Valley hydrologic basins, in both the alluvial and carbonate aquifers;
- Conduct constant-rate aquifer tests, groundwater chemistry sampling, and spring and stream discharge measurements;
- Establish biological resource monitoring programs;
- Prepare annual monitoring reports; and
- SNWA groundwater withdrawals would not affect federal resources within the boundaries of GBNP.

2.3.2.2 Delamar, Dry Lake, and Cave Valley Stipulated Agreement

The stipulated agreement describes actions that various parties would take to initiate monitoring programs, as well as establish the administrative structure to oversee these programs (**Appendix C**). The following is a summary of activities to be undertaken:

- Establish a system of early warning monitoring wells within the Cave, Dry Lake, and Delamar hydrologic basins in both the alluvial and carbonate aquifers. Establish monitoring wells in adjacent hydrologic basins (e.g., White River, Pahranagat, Pahroc);
- Conduct constant-rate aquifer tests, groundwater chemistry sampling, and spring and stream discharge measurements;
- Prepare annual monitoring reports; and
- Prepare a written Hydrologic Management and Mitigation Operation Plan that identifies and defines early warning indicators for adverse impacts.

Amendments to the Spring and Delamar, Dry Lake, and Cave valleys stipulated agreements were signed in April 2010. These amendments extend the terms and conditions of the 2006 and 2008 Spring and Delamar, Dry Lake, and Cave valleys stipulations to the SNWA applications refilled in 2010 in the stipulated agreement valleys. This does not include future applications.

2.3.3 Draft Agreement Between Nevada and Utah

In 1989 the SNWA submitted water rights applications in five hydrographic basins (Spring, Snake, Delamar, Dry Lake, and Cave valleys) as part of a proposed project to develop a water conveyance system through Clark, Lincoln, and White Pine counties. In 2004 the Lincoln County Conservation, Recreation, and Development Act (P.L. 108-424) was signed into law. A portion of the Act required the states of Nevada and Utah to reach an agreement regarding the division of water resources for any groundwater basins located within both states, prior to any transbasin diversion. In response to this requirement, the two states negotiated a Draft Agreement, which was released for public review on August 13, 2009. One component of this draft agreement was the division of the water identified as available for appropriation and use on an annual basis. This water quantity, based on best available data, was estimated to be 132,000 afy; of which Nevada was allocated 36,000 afy. The SNWA had previously applied for 50,697 afy of water in Snake Valley.

The NSE originally scheduled the SNWA Snake Valley water applications hearing for September or October 2009. In subsequent actions, the draft UT/NV Snake Valley Agreement specified that the NSE will not schedule a hearing for SNWA's Snake Valley applications until after September 1, 2019. This 10-year period will be used to conduct additional studies and collect data on the Snake Valley aquifer and groundwater availability. Subsequent to publication of the draft agreement and receipt of public comments, Utah and Nevada published a revised draft with minor changes. Due to circumstances outlined in Section 1.4, The Relationship of the Bureau of Land Management Decisions to the Nevada Water Rights Process, the draft agreement has been tabled. Since Snake Valley does not currently have a monitoring/mitigation plan in place, the Utah BLM drafted a Monitoring, Mitigation, and Management Plan (commonly referred to as the "Snake Valley 3M Plan") to provide management direction for resources in the valley. This plan has been included in this Final EIS as **Appendix B**.

2.4 Environmental Inspection, Compliance Monitoring, and Post-Approval Variances

Under the FLPMA, the BLM may impose conditions on any ROW grant that it permits for the GWD Project. These conditions could include additional requirements and mitigation measures recommended in this EIS to minimize environmental impacts resulting from the construction and operation of the GWD Project (see Chapter 3). Additional requirements and mitigation measures may be included as specific conditions to the ROD issued by the BLM. It is understood that the SNWA would implement the ACMs it has proposed as part of its project unless superseded by the Ely or Las Vegas RMPs' management actions, BMPs, or USFWS BO Terms and Conditions, or unless specifically modified by other ROW conditions.

BLM would require the SNWA to develop and implement a comprehensive construction, operation, maintenance, monitoring, mitigation, and management (COM Plan) encompassing future hydrographic development areas and facilities associated with the SNWA groundwater development project (see Section 3.20, Monitoring and Mitigation Summary). The objectives of the COM Plan are to protect federal resources and federal water rights that may be impacted by project construction, operation, maintenance, and abandonment. The COM Plan is designed to provide early warning of potential adverse impacts, provide time and flexibility to implement management and mitigation measures, and gage effectiveness of those measures to determine if additional action is needed to protect resources.

The COM Plan includes a comprehensive monitoring, management, and mitigation program for the entire project to integrate the various required monitoring, management, and mitigation actions which are provided through the following:

- **BLM Land, Resource Management Plans, and BMPs** – All actions approved or authorized by the BLM must conform to the existing land use plans (43 CFR 1610.5-3, 43 CFR 2920.2-5).
- **Biological Opinion** – The USFWS will issue a BO that will include terms and conditions to maintain and protect threatened and endangered species as required under Section 7 of the ESA.
- **Applicant-committed Environmental Protection Measures** – The proponent, SNWA, has identified environmental protection measures that will be implemented as part of the construction and operation of the GWD Project.
- **Section 106 Programmatic Agreement** – A PA was completed under the provisions of Section 106 of the NHPA. The agreement was executed by the BLM, ACHP, Nevada SHPO, and SNWA (see Section 1.3.3).
- **Stipulated Agreements** – SNWA has entered into several stipulated agreements with DOI Bureaus (i.e., BIA, BLM, USFWS, and the NPS). The agreements apply to the SNWA's water rights applications with the NSE in Spring, Delamar, Dry Lake, and Cave valleys (see Section 2.3.2, Stipulated Agreements).
- **CWA Section 404 Mitigation** – The USACE has jurisdiction related to this project under the authority of Section 404 of the CWA for the discharge of dredged or fill materials into waters of the U.S (see Section 1.3.5).

The BLM ROD would require the applicant to prepare and submit for BLM approval a detailed revised POD for the main water conveyance pipeline and related facilities. The plan is expected to include all of the stipulations, conditions, and other requirements contained in the Final EIS/ROD. The POD must contain sufficient information for the BLM and other agencies to evaluate specific construction activities and planned application of monitoring, management, and mitigation.

Following issuance of the ROD and the ROW grant and approval of the Final POD, a COM Plan would be developed. The COM Plan would identify monitoring, mitigation, and management requirements relating to the construction, operation, and maintenance of the main conveyance pipeline and related facilities considered under the Tier I NEPA process.

If ROW grants for the groundwater development areas are approved in the future, the decision documents, either RODs or FONSIs would contain requirements for the submission of PODs containing the site-specific construction and operation plans comparable to those required for the main water conveyance pipeline system. As SNWA submits ROW applications in the future for the individual groundwater development plans and related NEPA, SNWA would submit groundwater development specific PODs and COM Plans for related development and areas expected to be impacted by the development. These groundwater development specific COM Plans would be incorporated into the project wide COM Plan. The groundwater development-specific COM plan would be subject to NEPA analysis and related public input process.

A separate monitoring, management, and mitigation plan for Snake Valley was drafted by the Utah BLM. This plan (commonly referred to as the "Snake Valley 3M Plan") was drafted in coordination with SNWA. The plan would be developed if project impacts determine the need for the plan or SNWA proposes development in Snake Valley. This draft plan is included in **Appendix B** of this EIS.

As part of the detailed environmental protection plan, environmental inspectors would be on site during all facets of project construction. These inspectors' responsibilities are to ensure that the environmental conditions attached to the BLM ROW grant and other permits and authorizations are met. During the construction phase, environmental inspectors would inspect and report to the BLM all construction and mitigation activities to ensure compliance with the requirements of environmental plans, permits, and conditions. Environmental inspectors also may oversee cultural resource and/or biological monitors that may be required to monitor and evaluate construction impacts on resources as specified in this EIS.

After construction is completed, the BLM would continue to conduct oversight inspection and monitoring. If it is determined that any of the proposed monitoring time frames are not adequate to assess the success of restoration, the SNWA would be required to extend its post-construction monitoring programs.

Surface disturbance locations and acreages identified in this EIS represent reasonable estimates for the construction, operation, and maintenance of the project up to, but not including, future groundwater development activities. However, route and other project refinements often continue past the project review phase and into the construction phase. As a result, work location and disturbed acres documented in the EIS may change after project approval. These changes frequently involve minor route realignments or moving approved temporary workspaces, adding new temporary workspaces, adjusting workspaces based on site-specific conditions and adding access routes to work areas.

When work areas different from those evaluated in this EIS are needed, additional inventory and evaluation would be required to ensure that impacts on biological, cultural, and other resources are avoided or minimized to the extent practicable. New workspace location and survey results would be documented and forwarded to the BLM in the form of a "variance request." The request would be reviewed by the BLM, consultations would be conducted, and other approvals would be obtained before the BLM would approve the variance. At the conclusion of the project, as-built drawings would be provided to the BLM. In addition, the SNWA, when working with specific requirements of the ROW (e.g., a 0.5-mile buffer from a raptor nest), could make a "variance request" if circumstances warranted (e.g., the nest is not within line of sight of the construction). The BLM would address these requests on a case-by-case basis.

2.5 Proposed Action—Distributed Pumping at Application Quantities

2.5.1 Rights-of-way

2.5.1.1 Overview

The SNWA has developed a preliminary POD (SNWA 2011, included in **Appendix E**), that provides a description of the proposed project facilities as well as the construction methods, construction schedules, and ACMs to be used. For this alternative, the following project components would be identified for construction.

- **Pipelines:** Approximately 306 miles of buried water pipelines, between 30 and 96 inches in diameter, and temporary construction areas including staging areas, construction support area, plant nursery sites, construction camps, and borrow pits.
- **Power facilities:** Approximately 323 miles of 230-kilovolt (kV), 69-kV, and 25-kV overhead power lines, as well as 2 primary and 5 secondary electrical substations.
- **Ancillary facilities:** Five pumping stations, six regulating tanks, three pressure-reducing stations, a water treatment facility and buried storage reservoir, access roads, and communications facilities.

Key Points—Proposed Action

Under this alternative, the SNWA proposes to construct and operate a pipeline capable of conveying the full quantity of SNWA's groundwater rights and NSE applications identified in SNWA's application with the BLM.

The Proposed Action would consist of 306 miles of buried water pipelines, 323 miles of overhead power lines, 7 electrical substations, and ancillary facilities.

In the future, pumping would occur at distributed locations in 5 basins.

ROWs would be required across federal lands managed by the BLM, state lands (Nevada National Guard in east-central Las Vegas Valley and Steptoe Valley Wildlife Management Area [WMA]), and private lands (Apex area in east-central Las Vegas Valley, land in central Coyote Spring Valley, and land in west Caliente). **Table 2.5-1** summarizes land ownership of the requested ROWs.

Table 2.5-1 Land Ownership Percentage for the Proposed Action

Ownership	Percent of Total Acres
Bureau of Land Management	97
Department of Defense	<1
State of Nevada	1
Private	2
Total	**100**

Note: Only those components that require a separate ROW are listed.

ROWs can be permanent or temporary. If the BLM decides to approve ROWs in the ROD, then permanent ROW locations and dimensions on BLM lands will be specified in the ROW grant to the SNWA. On private lands, the SNWA would either obtain easement agreements or purchase the land from private landowners.

A temporary ROW is defined as an area of land that is required for project construction purposes but then would revert to its previous use. On BLM lands, the BLM would issue temporary ROWs that contain conditions for restoring any surface disturbance. On private lands, the SNWA would either obtain temporary ROWs under easement agreements or purchase the land from private landowners.

A **permanent ROW** is an area of land on which a permanent ROW is maintained. This may include areas where permanent project facilities are installed.

A **temporary ROW** is an area of land that is required for project construction purposes but then would revert to its previous use.

It is estimated that total construction surface disturbance for all ROWs (pipeline and ancillary facilities) would be 11,289 acres; it is expected that 11,289 acres of temporary disturbance would be revegetated after the construction period, and that 999 acres would represent permanent disturbance (land committed to industrial uses over the project life).

2.5.1.2 Pipeline System

To transport the volumes of water identified by the SNWA, a total of approximately 306 miles of pipelines would be required. The pipeline system would consist of buried main and lateral pipelines (**Figure 2.5-1**). **Table 2.5-2** lists anticipated pipeline lengths (by valley) and anticipated pipe diameter. The final sizes of the pipelines would be determined during facility design.

Table 2.5-2 Pipeline Characteristics for the Proposed Action

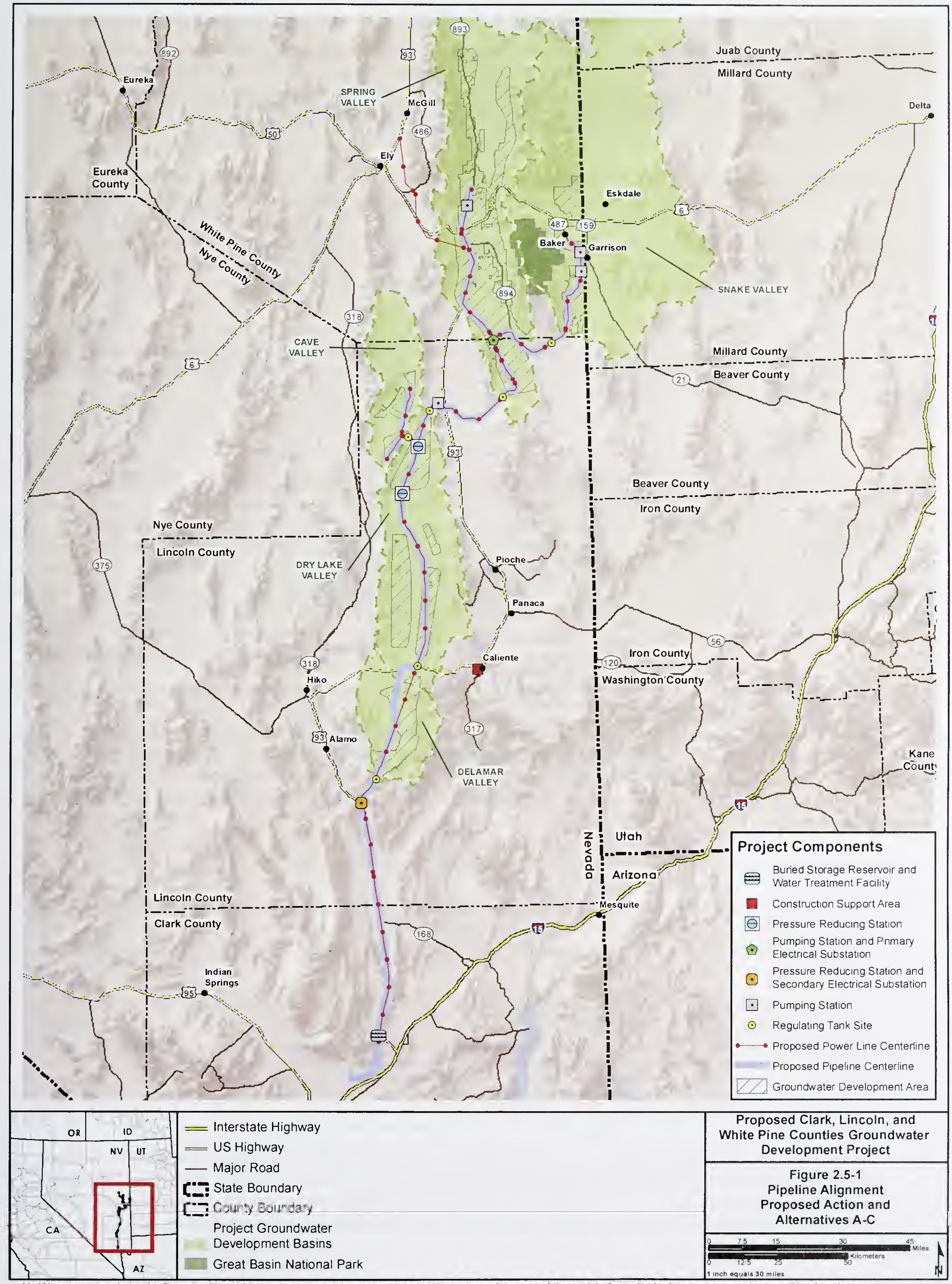
Pipeline	Valley	Pipe Diameter (inches in diameter)	Pipe Length (miles)[1]
Main Pipeline	Spring	78	17
	Lake	78	21
	Dry Lake	84	66
	Delamar	90	23
	Pahranagat	66-78	7
	Coyote Spring	96	41
	Hidden	96	12
	Garnet	90-96	7
	Las Vegas	90	9
Spring Lateral	Spring	60	38
Snake Lateral	Snake	54	24
	Hamlin	54	10
	Spring	54	9
Cave Lateral	Cave	30	19
	Dry Lake	30	3
Total			**306**

[1] Pipe lengths are rounded to the nearest mile.

The main pipeline would be between 66 and 96 inches in diameter and the route would extend between southern Spring Valley and Las Vegas Valley. Lateral pipelines could be between 30 and 60 inches in diameter, and would extend into northern Spring, Snake, and Cave valleys. All pipelines would be buried, with the exception of structures for air/vacuum valves, isolation valves, and drain valves, which might be partially buried or be installed with vents extending aboveground.

Air/vacuum valves are used to release air within the pipeline and would be located at or near all high points, grade breaks on steep slopes, and long downward-sloping pipe segments. The valves would be housed in belowground or partially buried structures, with 12- to 24-inch gooseneck pipe extending approximately 2 to 3 feet above ground.

Isolation valves would be placed along the pipeline and would stop the flow of water when in the closed position. These valves would be constructed belowground or would be partially buried, and would be remotely monitored and controlled (Section 2.5.1.8).



No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

Drain valves, used to drain the pipeline, would be located at the lowest pipeline elevations in any segment. These valves would extend to a discharge location, such as a dry-wash channel lined with riprap if necessary to reduce or avoid erosion. Valve locations would be dependent upon elevation, and final locations would be determined during pipeline design after detailed topographic surveys are completed. All valves would be located within the pipeline ROWs.

There would be no permanent security fencing or other permanent access restrictions on the pipeline ROWs. Temporary security and environmental exclusion fencing might be used on pipeline segments during construction.

A permanent 100-foot ROW plus an adjacent 100-foot temporary construction ROW would be required for the main and lateral pipelines. The preliminary ROW cross section, shown in **Figure 2.5-2**, is representative of contiguous pipeline and power line ROWs; anticipated to occur throughout the majority of the alignment.

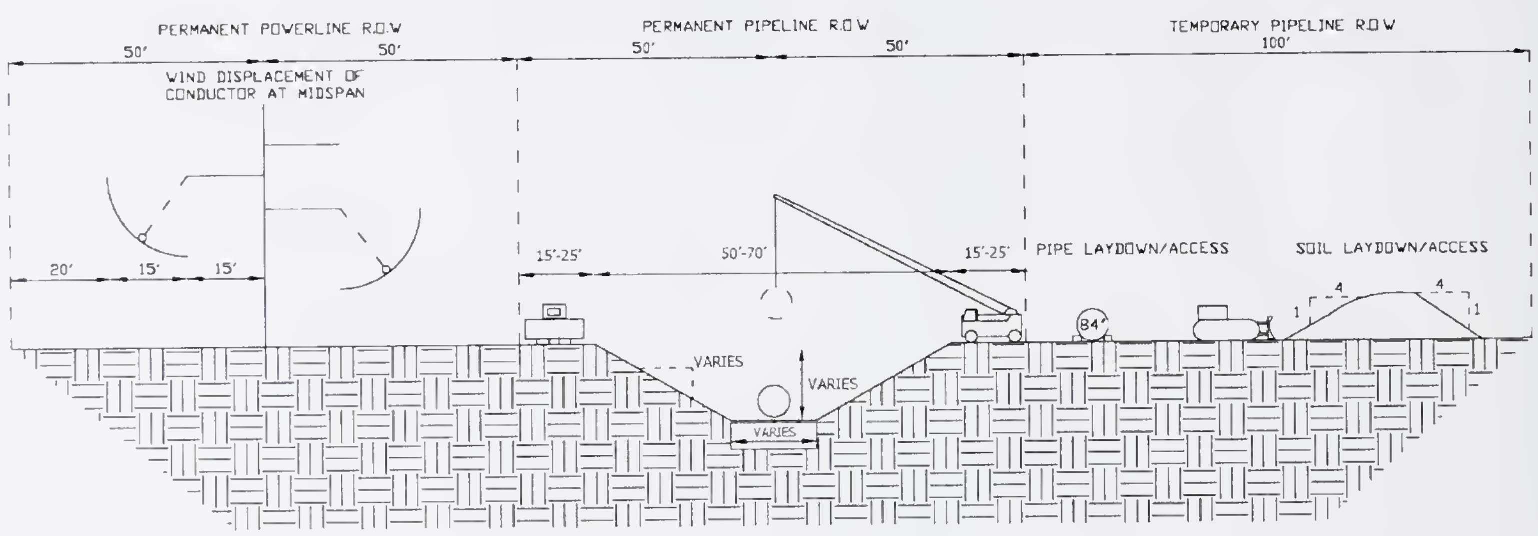


Figure 2.5-2 Preliminary Pipeline and Power Line Right-of-way Cross Section for a 96-inch Pipe

The 100-foot permanent ROW for the main pipeline would accommodate a 50- to 70-foot-wide trench at the ground surface, with a slope of up to 2:1 and a depth equal to the pipe diameter from the ground surface to the top of the pipe. For a 96-inch pipe, this would result in a trench at least 16 feet deep. The remaining permanent and temporary ROWs would be used for excavated material storage, pipe storage before installation, movement of heavy equipment, and safe personnel workspace.

Pipeline construction also would require the following temporary construction areas:

- **Staging Areas**: These areas would be used for equipment and materials storage, construction office trailers, fuel storage, equipment maintenance, and temporary stockpiling. Temporary security fencing might be used to enclose staging areas during construction. Staging areas of 3 acres would be placed approximately every 3 miles along the pipeline ROW.
- **Caliente Construction Support Area**: This area would be used for pipe and equipment storage, temporary construction management offices, and other support activities. Some or all of the pipe required for construction would be fabricated at one or more existing manufacturing plants in the western U.S. and delivered by rail or truck.
- **Temporary Plant Nursery Sites**: These sites would be used for storing cactus, yuccas, and other plants that might be salvaged from within the ROW for use in post-construction restoration.
- **Temporary Construction Camps**: These areas would be used for temporary housing of construction workers and would be located on private lands in and near existing communities. The size, number, location, and amenities of the temporary camps cannot be determined until facilities are designed and a detailed construction schedule is determined. The need for temporary camps also would vary depending upon the availability of lodging and

support services in nearby communities. Temporary camps may require permits for sanitary facilities, water, and other requirements.

- **Borrow Pits**: These sites would provide soil materials for bedding and backfilling of pipeline where existing soils are unsuitable. Eight potentially suitable sites have been identified, each of which could be partially excavated to a depth of approximately 15 feet. The borrow pits would be refilled with excess soils from excavated pipe trenches that are unsuitable for pipeline backfill.

2.5.1.3 Power Facilities

No existing electrical power distribution lines are sufficient to meet the needs of the GWD Project. Therefore, construction of a power line is identified as part of the GWD Project. The power line would begin in the south, at the Silverhawk Generating Station near Apex, and would tie into the Gonder Substation near Ely (**Figure 2.5-3**).

The anticipated power supply of approximately 97 megawatts (MW) necessary to operate project facilities would be obtained from the Silverhawk Generating Station. The SNWA owns 25 percent of that facility, which can produce in excess of 500 MW. Construction of new power generation facilities would not be required. A substation connection at the northern end of the power line provides improved reliability for system operations. The Gonder Substation is owned by Mount Wheeler Power.

Power Lines

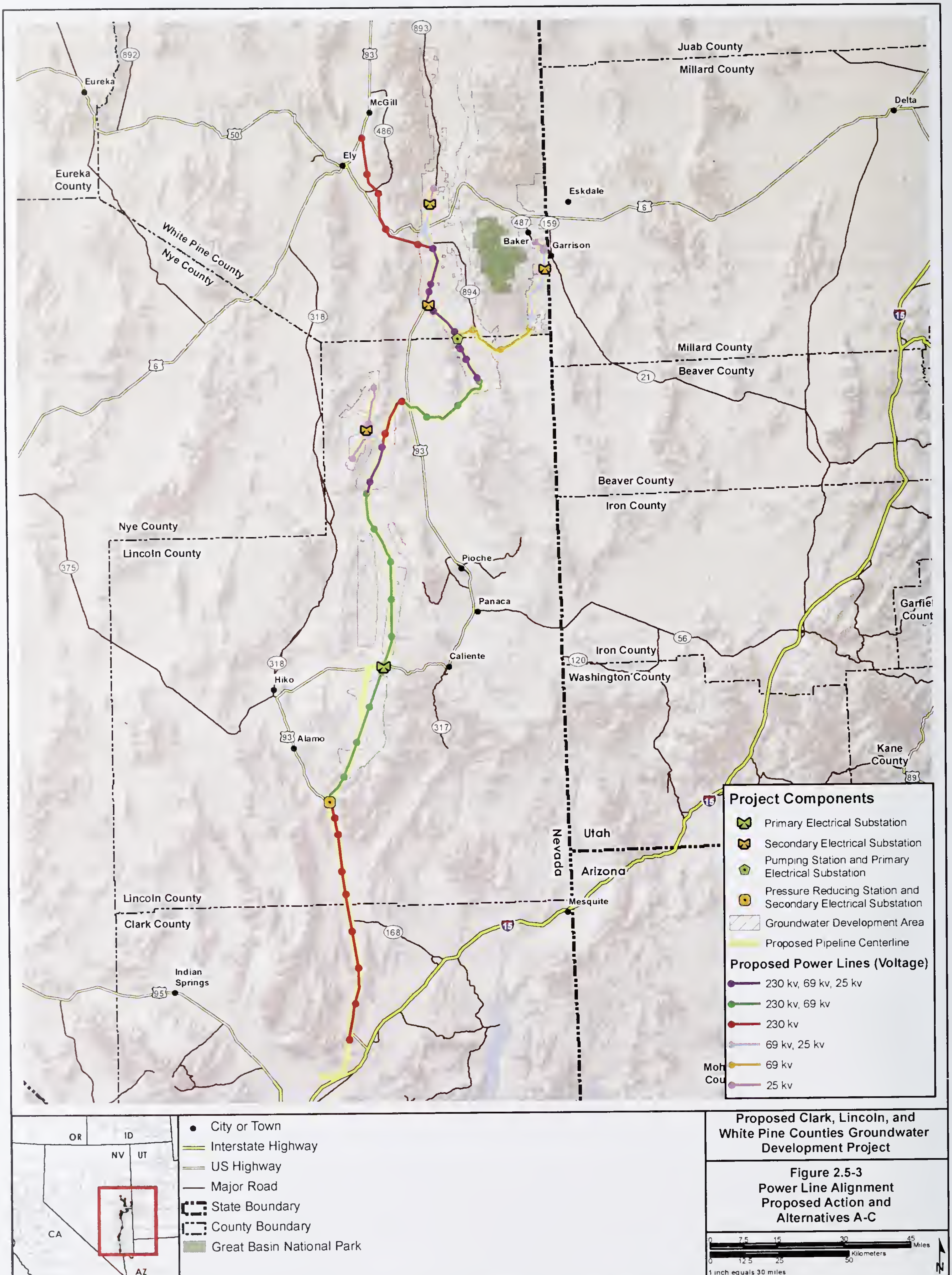
Power lines would include 230-kV, 69-kV, and 25-kV conductors (electrical wires). Example 230-kV and 69-kV power pole configurations are shown in **Figure 2.5-4**. Wherever possible, multiple conductors would be strung on the same power pole. **Figure 2.5-3** depicts the power line alignments, including places where multiple conductor voltages would be hung on the same pole. **Table 2.5-3** summarizes anticipated power line lengths. The 230-kV power poles would be single, steel power poles. These poles would be approximately 100 feet in height and spaced approximately 800 feet apart, depending on the terrain. The 69-kV power poles would be single, steel poles. These poles would be approximately 60 feet in height and spaced approximately 600 feet apart, depending on the terrain. The 25-kV power poles would be single, wooden poles. These poles would be approximately 50 feet in height and spaced approximately 500 feet apart, depending on terrain.

Table 2.5-3 GWD Project Power Lines for the Proposed Action

Power Line Conductor Voltages	Total Miles	Power Line ROW Width
230-kV Power Line	100	100
69-kV Power Line	21	100
25-kV Power Line	24	50
230-kV Power Line with 69-kV and 25-kV Underhang	46	100
230-kV Power Line with 69-kV Underhang	97	100
69-kV Power Line with 25-kV Underhang	36	100
Total[1]	323	N/A

[1] Due to rounding, the total is less than the sum of the individual miles.

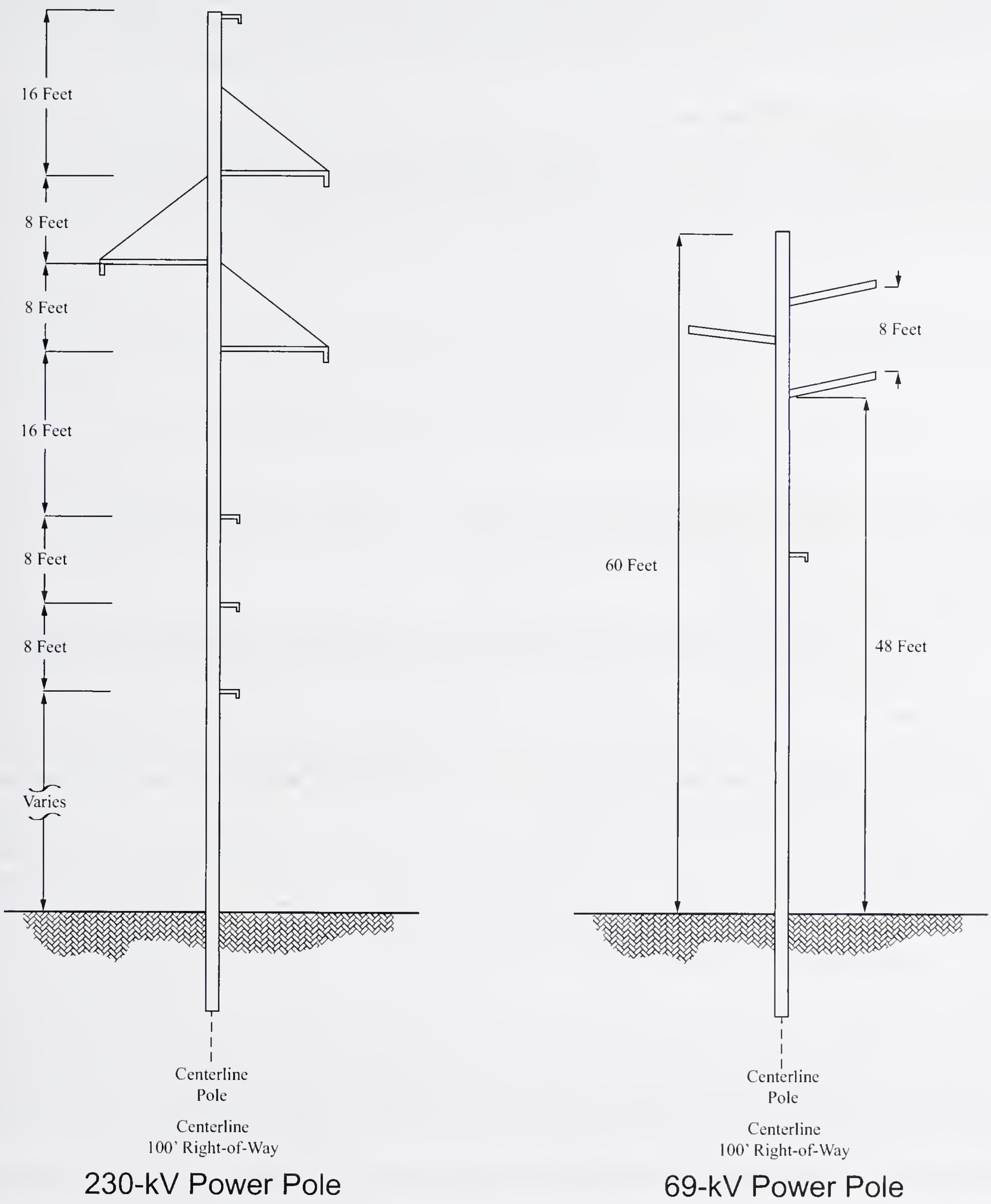
The permanent ROWs needed for the 230-kV or 69-kV power poles are 100 feet wide (**Figure 2.5-2**). This width is required for safe installation of the conductors. Only a portion of the permanent ROWs would be disturbed for installation of power poles and access spur roads, where needed. The permanent ROWs needed for 25-kV power poles are 50 feet wide. Temporary ROWs for the power lines are not required because the permanent ROWs are sufficient for construction needs.



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 2.5-3
Power Line Alignment
Proposed Action and Alternatives A-C

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data



Source: SNWA 2011

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 2.5-4

Power Line Configurations

Electrical Substations

Two new primary electrical substations and five secondary electrical substations (**Table 2.5-4**) are required to reduce electrical voltage from the higher levels for long-distance conveyance down to the lower levels appropriate for operational needs. A primary substation would reduce power from 230 kV to 69 kV, and a secondary substation would further reduce power to 25 kV. Additional facility substations beyond those identified below could be located within facility sites (e.g., pumping stations, water treatment facility) to reduce power to operational levels.

Table 2.5-4 Electrical Substations

Primary Electrical Substations	Spring Valley South (within Spring Valley South Pumping Station site)
	Southern Dry Lake Valley
Secondary Electrical Substations	Spring Valley North
	Spring Valley South
	Snake Valley
	Cave Valley
	Coyote Spring Valley (within Coyote Spring Valley Pressure Reducing Station site)

The primary electrical substation requires 10 acres of land, and the secondary substations require 1 acre. Temporary ROWs would not be required for construction of the substations.

2.5.1.4 Other Ancillary Facilities

Ancillary facilities required to operate the GWD Project include pumping stations, regulating tanks, pressure reduction stations, a water treatment facility and buried storage reservoir, access roads, and communications facilities.

Pumping Stations

Five pumping stations would be required to move water across elevation grade changes: Spring Valley North, Spring Valley South, Snake Valley North, Snake Valley South, and Lake Valley. All pumping stations would be located adjacent to a main or lateral pipeline and would include:

- Utility building;
- Pumps and motors;
- Forebay (surge facility or water storage tank);
- Surge-control system;
- Instrumentation and control systems;
- Electrical facilities, including switchgear, transformers, motor-control centers, local control panels, lighting, and standby diesel generators with fuel storage tanks;
- Mechanical systems, including heating, ventilation, air conditioning, plumbing, hoists, cranes, and compressors;
- Chemical addition facilities, where needed;
- Facility electrical substation;
- Break room and restroom, with associated septic tank and leach field; and
- Site fencing and security provisions.

Pumping stations would be contained in a concrete or concrete-block building. The approximate heights of the buildings would vary between 24 and 40 feet above grade, depending on conditions such as terrain, pump size, and other environmental and equipment requirements. The sites would be partially paved, and non-paved areas would be covered with crushed gravel. Security fencing with a locked gate would enclose each site.

Each pumping station would include a diesel-powered standby generator large enough to operate one of the pumps for periods of up to 72 hours to maintain pressures in the event of a power outage. A diesel fuel storage tank for generator operation would be located aboveground at each site. The tank would meet current regulatory requirements for containment and would be equipped with monitoring equipment for leak detection.

The Spring Valley South Pumping Station would require a 60-acre permanent ROW (encompassing a primary electrical substation); the Snake Valley South Pumping Station would require a 10-acre permanent ROW (encompassing an outdoor storage yard). Temporary ROWs would not be required because sufficient on-site space exists for construction. The Spring Valley North, Snake Valley North, and Lake Valley pumping stations would each require 5 acres of permanent and 5 acres of temporary ROWs.

Regulating Tanks

Six regulating tanks would be constructed to regulate water flow through the pipeline in the Spring, Hamlin, Lake, Delamar, Dry Lake, and Cave valleys. The main features at each site would be a tank, rate-of-flow control structure, and retention basin.

- The steel or concrete tanks typically are cylindrical and could be between 130 and 200 feet in diameter and 30 to 40 feet in height.
- The rate-of-flow control structure automatically would regulate flow into the tank and keep it from overflowing.
- The control structure would consist of water flow meter and valves that automatically reduce pressure and control flow.
- The valves and piping would be housed in a buried or partially buried concrete structure.
- The retention basin would be sized to contain emergency overflow in case of equipment malfunction.
- Inlet and outlet piping would connect to the pipelines and regulating tank features.
- Sites would be covered by crushed gravel for dust control, and security fencing with a locked gate would enclose each site.

The regulating tank sites in the Spring, Hamlin, Lake, and Cave valleys each would require 2 acres of permanent ROW and 3 acres of temporary ROW. The sites in the Dry Lake and Delamar valleys would require 5 acres of permanent ROW because larger tanks and retention basins might be required for surge control in those areas. Additional temporary ROWs should not be required at the Dry Lake Valley and Delamar Valley sites.

Pressure-Reducing Stations

Three pressure-reducing stations would be required to reduce pressures and control flow within the pipeline, as water moves from higher to lower elevations. Two stations would be located in Dry Lake Valley, and one would be located in northern Coyote Spring Valley. These facilities would maintain water pressures to the design limits within the pipelines and facilities and would mitigate the potential for pipeline rupture caused by excessive water pressure.

- These facilities would include isolation valves, pressure-reducing valves, storage tanks, and overflow basins.
- The valves would be located in a below-ground vault.
- The storage tanks would provide a discharge point for the valves to dissipate high pressures, regulation for valve opening and closing, and surge protection.
- The Coyote Spring Valley site would be occupied by three water storage tanks, as well as a secondary electrical substation and maintenance building.

- Each Dry Lake Valley pressure-reducing station would require a 2-acre permanent ROW and 5-acre temporary ROW.
- The Coyote Spring Valley pressure reducing station, which has additional tanks and other facilities, would require a 7-acre permanent ROW and a 6-acre temporary ROW.

Water Treatment Facility/Buried Storage Reservoir

A water treatment facility and buried storage reservoir would be constructed in Garnet Valley. This location would allow treatment of the water to drinking water standards before the water enters the SNWA's potable (drinking) water system via gravity flow. On-site facilities would include:

- Chemical building;
- Operations building;
- Energy dissipater;
- Rate-of-flow control structure;
- Buried storage reservoir;
- Warehouse; and
- Outdoor storage yard.

The maximum building height is anticipated to be approximately 20 to 30 feet to allow for chemical storage and overhead cranes. The sites would be partially paved, and non-paved area would be covered with crushed gravel. The sites would be surrounded by security fencing with locked gates.

Treatment processes are anticipated to include the addition of a disinfectant, corrosion inhibitor, and fluoride. These treatments would be accomplished by direct injection into the main pipeline. If necessary, other treatment (e.g., arsenic removal) may be added at the water treatment facility. Until the production wells are drilled and their water quality determined, the specific treatment processes cannot be determined. Chemicals required for water treatment would be stored in isolated tanks, either above or below ground level, in designated areas inside the chemical building. Spill containment would be provided as required by federal, state, and local regulations. The capacity of the water treatment facility could be as much as 165 million gallons per day.

Until the production wells are drilled and their water quality determined, the specific treatment processes cannot be determined.

The buried storage reservoir would be a 40-million-gallon, belowground, covered concrete tank. This tank would be used to manage flow and delivery of the treated water before it enters the SNWA's existing water system.

A permanent ROW of 75 acres would be required for the water treatment facility and buried storage reservoir. Additional temporary ROWs for construction would not be required.

Access Roads—Proposed Action

- Paved existing road: 14 miles
- Paved new road: 5 miles
- Improved existing road: 85 miles
- Improved new road: 200 miles
- Unimproved existing road: 27 miles
- Unimproved new road: 20 miles

Access Roads

Access to facilities would be required for both construction and operation. The majority of the pipeline and power line alignments are sited along or adjacent to existing roads, including paved highways and improved and unimproved dirt roads. Existing roads within the pipeline ROW would be used or improved, as necessary. **Figure 2.5-5** shows the access roads required for construction and operation.

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 2.5-5 Access Roads Proposed Action and Alternatives A-C

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

Short segments of unimproved spur roads from the primary access roads also would be required to access power pole sites. These spur road segments would be identified during design, when individual poles sites were selected. These power pole spur roads are not included in reported unimproved spur road lengths.

The primary access roads would be constructed within the pipeline ROW and used for transport of equipment, materials, and personnel during construction. Access roads would be prepared at the beginning of construction, by grading, installing culverts and graveling (for improved roads). At the completion of construction, the access roads would remain for facility inspections and operations access. At the completion of construction, asphalt paving would be installed on three road segments to allow for operational access between Highway 93 and the Spring Valley South Pumping Station, Lake Valley Pumping Station, and the water treatment facility/buried storage reservoir. The width of the paved and improved roads would be approximately 20 to 26 feet, to allow for 2 lanes of traffic. Unimproved roads would be used only for power line construction and would be graded dirt roads approximately 12 feet wide.

Because the access roads would be within the pipeline and power line ROWs, additional ROWs for access roads are not required, with two exceptions. For approximately 14 miles in southern Dry Lake and northern Delamar Valley, where the pipeline and power line are not contiguous, access to the power line ROW would use North and South Poleline Road. For approximately 14 miles from the Gonder Substation, the power line would use an existing adjacent power line access road. For both of these road segments, the SNWA has requested a 20-foot ROW to allow for leveling of deep ruts and minor grading, if needed.

Where the ROW parallels but would not encompass other existing access roads, the SNWA would coordinate with the BLM prior to construction to determine which roads should be reclaimed. Permanent access would be required along the entire ROW, but this access could be accomplished by using the improved access roads developed for construction within the ROW or other adjacent access roads, if available. In addition to using the ROW access roads (both new and upgraded), construction access for personnel and material deliveries would use existing roads and highways. These include Interstate 15; U.S. Highways 93, 6, and 50; and Nevada State Highways 168, 317, 318, 319, 320, 893, 894, and 487. Several unpaved roads currently maintained by Lincoln and White Pine counties also might be used:

- Cave Valley Road (from Ely into Cave Valley);
- Atlanta Road (from U.S. 93 to the pipeline alignment in Spring Valley);
- Stampède Road (from Pioche to the pipeline alignment in Dry Lake Valley);
- Pan American/Ely Springs Road (from Pioche to the pipeline alignment in Dry Lake Valley); and
- Turtle Walk (from Alamo to the pipeline alignment in Delamar Valley).

Beyond normal county maintenance activities, upgrades to these roads are not anticipated, so additional ROWs would not be required.

Communications Facilities

Communications facilities would be installed concurrently with project facilities for system operation and control, data collection, communication, and security surveillance. Communication requirements would be met through the use of fiber optics, radio systems, and possibly cellular communications equipment installed at facility sites.

Conduits for fiber-optic cables would be installed along with the pipelines. The fiber-optic cables would be installed underground, in either the pipeline trench or an adjacent access road, and would be contained within the requested ROW. No additional ROW would be required.

Facility sites also may encompass radio communication facilities. Radio communication facilities include non-licensed, broad-spectrum radio to communicate between the facility and nearby wells. A radio antenna as high as 20 feet may be mounted on top of buildings or tanks on facility sites for relay of operation information from the well sites, if fiber optics is not available. No additional permanent or temporary ROW would be required.

2.5.1.5 Construction Procedures

Standard pipeline, power line, and facility construction would be used. Detailed descriptions of construction methods and procedures, including workforce and equipment estimates, are provided in **Appendix E**. The following is a general summary of the construction methods, anticipated schedule, and workforce requirements.

Prior to ground disturbance, the ROW boundaries would be surveyed and staked. Areas that require avoidance would be staked and fenced, as necessary. Temporary fencing (security, tortoise exclusion, or wildlife fencing) would be installed as needed, and clearing, grading, and plant and topsoil salvage would occur. Access roads within the ROW would be constructed or improved at the beginning of construction, and portable sanitation and water storage facilities would be provided for construction personnel.

Pipeline construction would use a standard cut-and-cover technique, with an open trench. After trench excavation, engineered bedding would be laid, pipe sections would be placed and welded, and then the trench would be backfilled and compacted. The only exceptions would be a short segment of tunnel in the Apex area (because of rugged terrain) and highway and utility crossings (which would use jack-and-bore construction). Other short areas of tunnels or jack-and-bore construction might be necessary where the pipe depth exceeds 40 feet because of topography and the need to maintain an adequate hydraulic profile. Blasting might be necessary if caliche (a hardened deposit of calcium carbonate) or large boulders are encountered during excavation. For stream crossings with flowing water, the pipeline construction technique could be jack-and-bore beneath the water or open-cut with temporary diversion of water flow, in accordance with applicable USACE and State of Nevada permit requirements. These methods would be applied to Snake Creek (a perennial stream), and to Big Wash, and Lexington Creek if they contain water at the crossing location as can occur during high-flow years; all are in Snake Valley.

Cut-and-cover technique is a simple method of construction for shallow pipeline depths where a trench is excavated and backfilled after the pipe is laid.

Jack-and-bore is a method of tunnel construction where hydraulic jacks are used to push specially made pipes through the ground behind a tunnel boring machine or shield.

Snake Creek is a perennial stream, and Big Wash and Lexington Creek might contain water during high-flow years; all are in Snake Valley.

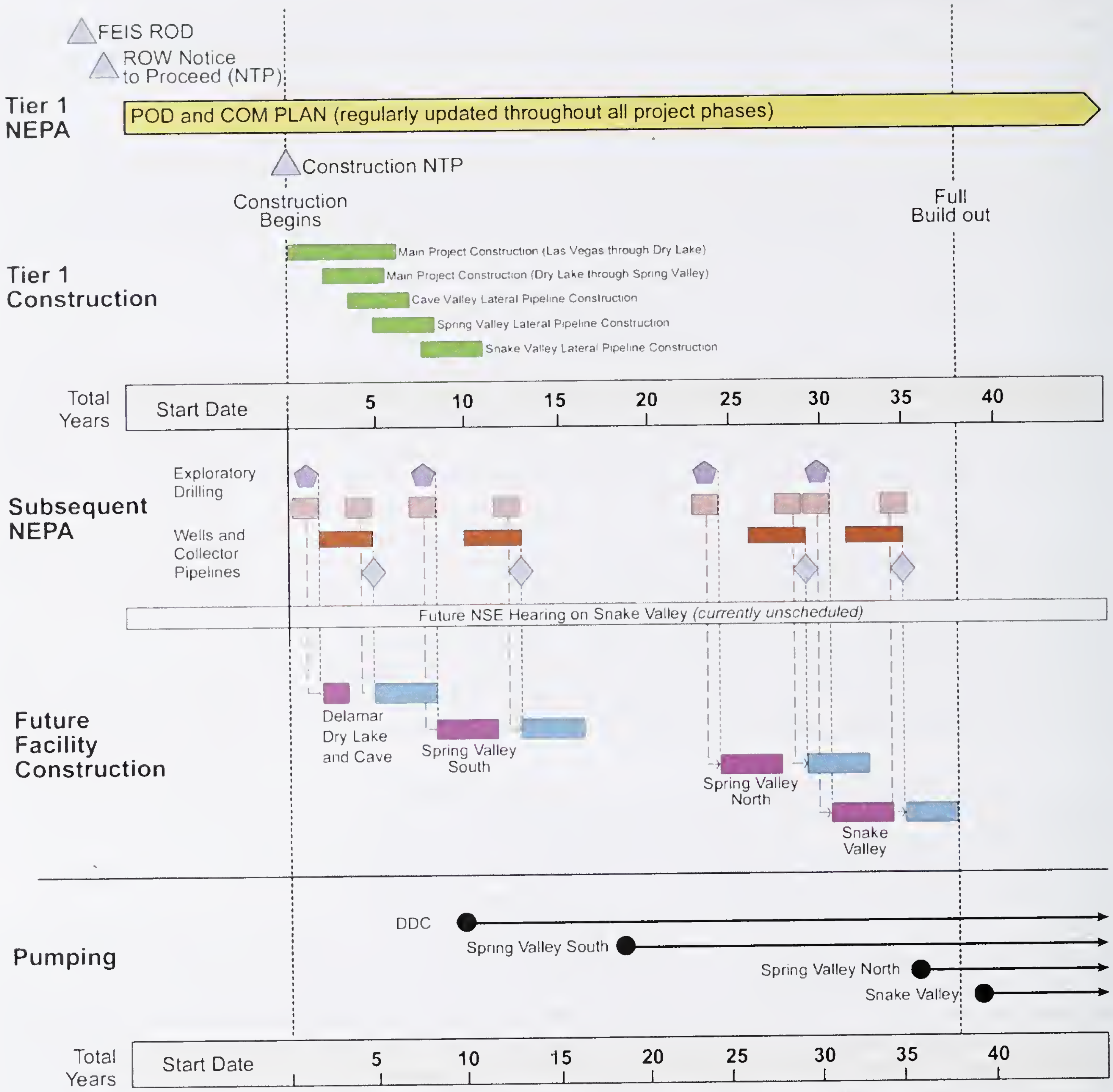
Water would be required for construction activities, including dust control, pipe bedding, trench backfill compaction, and hydrostatic testing. The SNWA has assumed that this water would be obtained from existing wells or exploratory wells that are available at the time of construction. A construction water supply well would be needed approximately every 10 miles along the pipeline alignment, and would need to be capable of a peak rate of 800 gallons per minute (gpm). It is estimated that between 5.5 and 8.7 million gallons of construction water would be needed for every mile of pipeline, with less water needed for dust control in wet winter conditions. The SNWA anticipates that existing and future exploratory wells capable of that peak rate would likely be available. If needed, additional temporary construction water wells would be drilled within the construction staging areas. Additional ROWs or other water supplies for construction water would not be needed. Hydrostatic testing would be conducted to pressure-test the pipeline at the completion of construction; this testing might be done in segments as individual construction contracts are completed.

Power line construction would not require clearing and grading of the entire ROW. Work areas as large as 0.5 acre would be cleared around each power pole location, and an access road or road spur to the pole location would be rough-graded. A truck-mounted rotary auger would be used to bore pole locations, and poles would be erected on site. Conductor lines would be strung using tensioning equipment. Electrical equipment would be tested and the power lines would be energized after being connected to substations and facilities.

Ancillary facility sites would be fenced, cleared, and graded, and plant and topsoil salvage would be conducted for temporary ROW areas. Excavation would be conducted as needed, and then structures would be constructed and erected on site.

2.5.1.6 Pipeline and Ancillary Facility Construction Schedule

The anticipated construction schedule is provided in **Figure 2.5-6** and **Table 2.5-5**.



* The NEPA ROW process, which includes any additional surveys and groundwater modeling specified by the BLM, will require an EA (resulting in a FONSI) or EIS (resulting in a ROD). Prior to the BLM issuing a notice to proceed (NTP), the SNWA must complete a detailed Plan of Development and a detailed COM Plan.

Legend

- Completed FEIS ROW, ROW NTP, and Construction NTP
- NEPA Compliance
- Future Facility Preliminary POD and COM Plan
- Construction of Tier 1 Facilities
- NEPA Compliance
- Exploratory Drilling
- Construction of the pipeline, laterals, wells, and collector pipelines
- Onset and continuation of pumping

Figure 2.5-6 SNWA's Preliminary Construction Schedule for the Proposed Action

Table 2.5-5 Construction Milestones for the Proposed Action

Facility		Anticipated Duration (years)
Main Pipeline	South Terminus to Reservoir/Water Treatment Facility	4.0
	Reservoir/Water Treatment Facility to Delamar Valley Regulating Tank	2.0
	Delamar Valley Regulating Tank to Dry Lake Valley Regulating Tank	1.75
	Dry Lake Valley Regulating Tank to Muleshoe Regulating Tank	1.75
	Muleshoe Regulating Tank to Spring Valley Regulating Tank	1.75
	Spring Valley Regulating Tank to Spring South Pumping Station	1.5
Lateral Pipelines	Cave Valley Lateral	1.0
	Spring Valley South	2.0
	Spring Valley North	0.5
	Snake Valley South Lateral	2.0
	Snake Valley North Lateral	1.0
Pumping Stations	Lake Valley Pumping Station	1.5
	Spring Valley South Pumping Station	2.0
	Spring Valley North Pumping Station	1.5
	Snake Valley South Pumping Station	1.5
	Snake Valley North Pumping Station	1.0
Pressure Reducing Stations	Coyote Spring Valley Pressure-reducing Station	0.5
	Dry Lake Valley South Pressure-reducing Station	0.5
	Dry Lake Valley North Pressure-reducing Station	0.75
Water Treatment Facility/ Buried Storage Reservoir Site	Buried Storage Reservoir	2.25
	Water Treatment Facility	1.5
Power Facilities	Transmission, Distribution, and Substations	3.5

In August 2009, the SNWA's Board of Directors authorized staff to complete all necessary state and federal permitting to move forward with the project in case of this eventuality. Currently the project schedule does not project the receipt of necessary ROW grants, permits, and applications. If drought conditions improve and do not impact the SNWA's water supplies on the Colorado River, construction may be deferred for several years. The regulating tanks and access roads would be constructed in conjunction with the pipelines and are not listed separately on the figure.

2.5.1.7 Construction Workforce

Figure 2.5-7 illustrates the construction workforce estimates, by year, for both ROW construction activities (i.e., pipeline, power lines, and ancillary facilities) over the entire project development period.

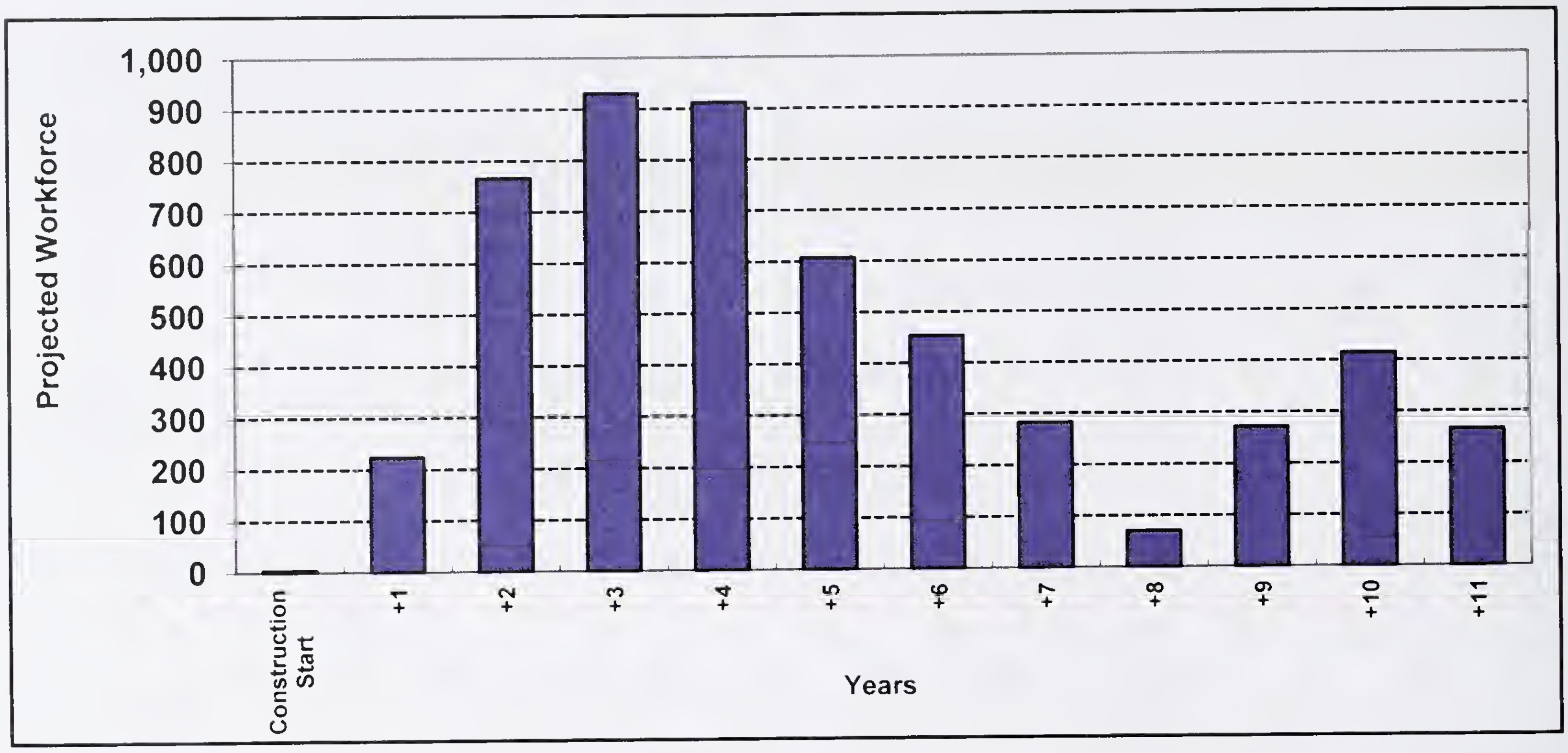


Figure 2.5-7 Construction Workforce Estimates – Proposed Action

2.5.1.8 Operation and Maintenance

The SNWA would use a remote monitoring system to continuously monitor operation of the GWD Project. This system would use fiber-optic cables installed along the pipelines to monitor overall performance, including water pressures, flow rates, power demands, and other factors. Staff would be dispatched as needed if any concerns are noted.

See the SNWA POD in **Appendix E** for estimated personnel, frequency of routine operations and maintenance activities, and consumable resource requirements.

Overall operation would be coordinated with the existing the SNWA water system. On-site personnel and the SNWA's remote monitoring and control system would track and manage facility functions.

In addition to routine operation of facilities, activities would include remote and on-site monitoring of system functions, inspection of the pipelines and facilities, regular maintenance of equipment, repairs conducted as needed, and responses to emergency conditions (should they occur). All operation and maintenance activities would be confined to the permanent ROW. The estimated personnel and frequency of routine operations and maintenance activities, plus consumable resource requirements (e.g., chemicals for the water treatment facility and power for project facilities) are detailed in the SNWA POD in **Appendix E**.

The service life of drinking water pipelines is estimated to range between 65 to 95 years (USEPA 2002). Future replacement of substantial portions of the pipeline may be subject to the NEPA and may require new approvals. The termination and abandonment would be subject to approvals by the BLM.

Pipelines

Operational activity on the pipeline would include maintenance of the ROWs and inspection, repair, and cleaning of the pipeline and valves. Aerial and ground inspections by pipeline personnel would identify areas of exposed pipeline, erosion, nearby excavation by third-party entities, encroachment on the ROW by permanent structures, vandalism, or any other conditions that could present a safety hazard or require preventive maintenance or reporting.

In the unlikely event of a system rupture or malfunction resulting in the discharge of water, pressure sensors installed on the system would detect the pressure loss, and the groundwater pumps and wells would begin an automatic, sequenced shut-down.

In the unlikely event of a system rupture or malfunction resulting in the discharge of water, pressure sensors installed on the system would detect the pressure loss, and the groundwater pumps and wells would begin an automatic, sequenced shutdown. Shutdown would be sequenced to avoid buildup of dangerous pressures in the pipelines and other facilities. Valve closing times would vary between valves but valve closure is anticipated to take approximately 15 to 25 minutes to avoid over-pressurizing the pipeline (i.e., water hammer). Alarms would sound at manned facilities along the pipeline alignment and at the SNWA operations centers, triggering a plan of action to investigate the source of the problem. Depending upon location of the incident, a manned response to reach remote areas could take up to 3 hours.

The quantity of water that might be released in the unlikely event of a pipeline rupture or valve failure cannot be precisely quantified because it would depend upon the type and extent of a break, along with the location of the break within a pipeline segment and the closest isolation valves. The SNWA has assumed, for a conservative analysis, that pipeline isolation valves may be located up to 10 miles apart. Assuming an extremely unlikely, but worst possible scenario of catastrophic failure with complete severing of the largest diameter pipeline over a 10 mile stretch, the maximum quantity of water that could be discharged would be 24.6 million gallons. This assumption uses a 35 minute response time (10 minutes for the system to identify the location and 25 minutes to close the nearest upstream isolation valve), and does not consider the effect of decreasing flow rate during the valve closure time period on the total discharge volume (**Appendix E**).

Power Facilities

Table 2.5-6 lists the anticipated power requirements necessary to operate project facilities.

Table 2.5-6 Anticipated Operational Power Requirements for the Proposed Action

Proposed Facilities	Power (MW)
Spring Valley North Pumping Station	5
Spring Valley South Pumping Station	17
Snake Valley North Pumping Station	3
Snake Valley South Pumping Station	5
Lake Valley Pumping Station	14
Buried Storage Reservoir	<1
Water Treatment Facility	2
Anticipated Future Groundwater Wells and Associated Facilities	52 (estimated)
Total	**97 (estimated)**

The power facilities would be monitored remotely to ensure proper operation and adequate power availability. The structures, insulators, conductors, and related hardware would be visually inspected at least annually. Substations would be inspected monthly. Additional (unscheduled) visual inspections might be carried out following severe weather or other events that could damage the facilities. Maintenance would be performed on an as-needed basis.

Other Ancillary Facilities

Pumping stations, regulating tanks, and pressure reducing stations would be remotely monitored to ensure proper operation, including controlling the valves to maintain water flow through the system. Visual inspections of facilities would vary depending upon size, location, and amount of use. Pumping stations would likely be visually inspected daily, regulating tanks weekly, and pressure reducing stations 2 to 3 times per week. Routine inspections would use existing access roads and designated access roads within the ROW. No off-road or overland travel would occur for routine inspections.

Proposed Future Facilities Key Points—Proposed Action

In the future, as many as 174 groundwater wells would be located within development areas in the 5 hydrologic basins.

Conveyance of the groundwater produced from these future wells would require new facilities, consisting of as many as 434 miles of collector pipelines, 434 miles of electrical power lines, two electrical substations, and additional ancillary facilities.

Future facilities would require additional ROWs, including as many as 5,536 acres of permanent ROW and 2,874 acres of temporary ROW.

An integrated control system would be developed for operation of the water treatment facility, which would be coordinated with the SNWA's other water supply facilities. Shifts of 3 to 6 operational personnel are anticipated to be present at the facility daily.

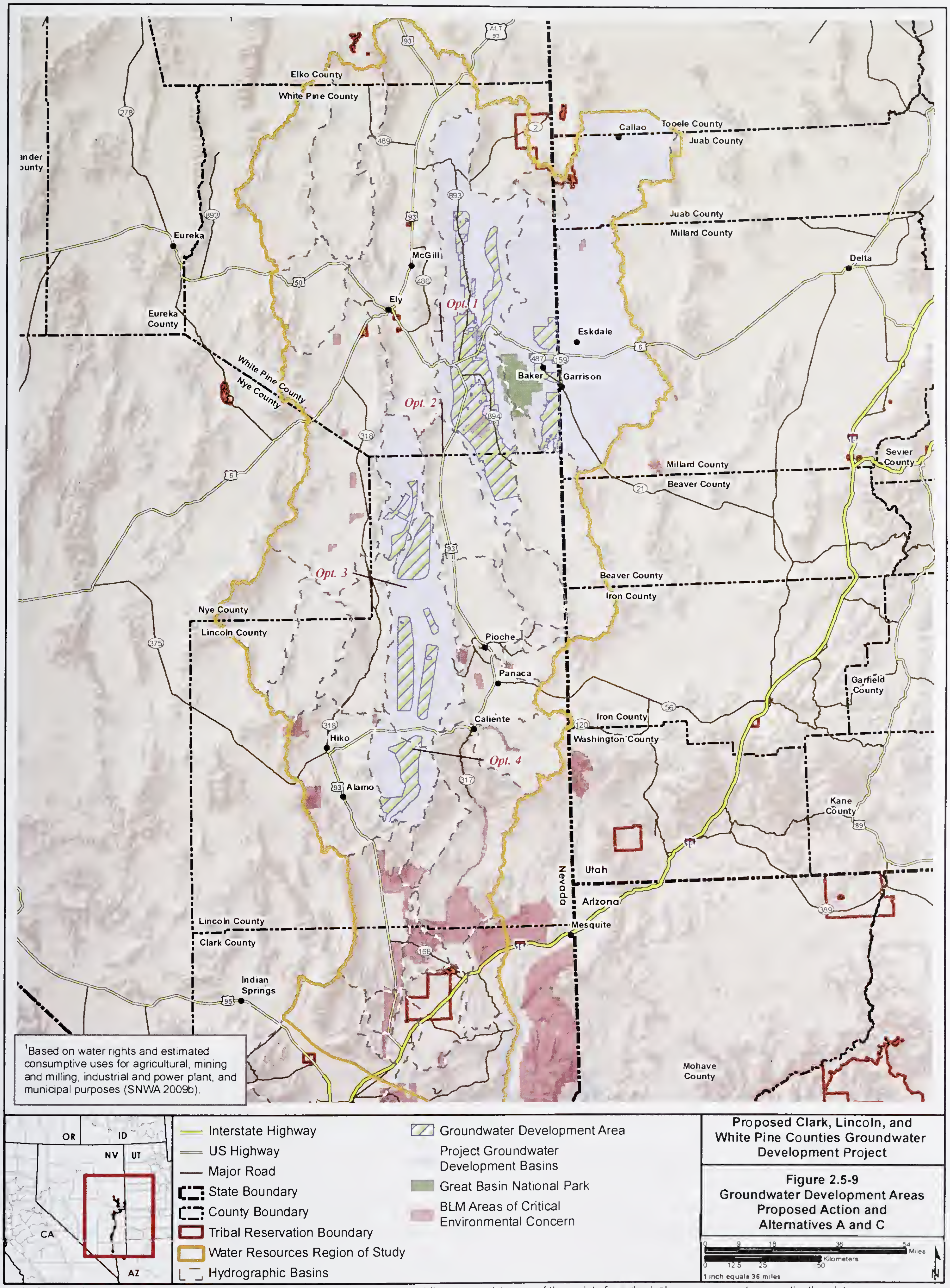
2.5.2 Future Facilities - Proposed Action

The programmatic portion of this Tier 1 document includes the future production wells, collector pipelines, additional pumping stations, distribution power lines, additional secondary substations, pressure reduction valves, and maintenance roads. The analysis in this EIS provides the basis for subsequent NEPA tiering when plans for future ROWs and associated facilities are finalized and submitted to the BLM by the SNWA. At that time, the BLM would conduct NEPA reviews of the specific ROWs and facilities required to implement groundwater development (wells, collector pipelines, electrical power lines, access roads). The BLM would approve or deny these proposed ROWs in decision documents (ROD/FONSI) written for each additional phase of the groundwater development project.

As illustrated in **Figure 2.5-8**, a total volume of 176,655 afy is analyzed for development under the Proposed Action. The development time period is shown as 10-year increments. These water right volumes have been included in the groundwater modeling and subsequent EIS analysis for this alternative.

Figure 2.5-8 Groundwater Development Volumes for the Proposed Action

Groundwater pumping would be spatially distributed within the project development basins. This distribution could help minimize the pumping effects on senior water rights and on areas that contain sensitive or listed species and their groundwater-related habitat. The groundwater pumping locations would be selected by using groundwater modeling and other tools. **Figure 2.5-9** displays the groundwater development areas within which groundwater pumping would be anticipated.



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 2.5-9
Groundwater Development Areas
Proposed Action and Alternatives A and C

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

Future facilities (identified in **Table 2.5-7**) are analyzed at a programmatic level in this EIS so that the BLM can consider the effects of the Proposed Action. It is assumed that these future facilities would be located on federal lands that are managed by the BLM, and would be the subject of future ROW applications and associated subsequent NEPA analysis.

Table 2.5-7 Future Facilities for the Proposed Action

Facilities
Future Groundwater Production Wells (144 to 174 wells)
Spring Valley – 75-93 wells
Snake Valley – 39-48 wells
Cave Valley – 10-11 wells
Dry Lake Valley– 10-11 wells
Delamar Valley – 10-11 wells
Future Collector Pipelines (177 to 434 miles)
Spring Valley – 57-144 miles
Snake Valley – 20-48 miles
Cave Valley – 30-88 miles
Dry Lake Valley – 20-44 miles
Delamar Valley – 50-110 miles
Future Staging Areas
Staging Areas – 59-145 1-acre sites
Future Power Facilities
25-kV Power Line[1] (50 feet wide)
Dry Lake Valley 69/25-kV Substation
Delamar Valley 69/25-kV Substation
Hydroturbine Energy Recovery Facilities (3)[2]
Future Pumping Stations (2)
Delamar
Dry Lake
Future Access Roads
Located within ROWs

[1] The distances by valley are the same as for the collector pipelines in this table.
[2] Hydroturbines would be located on pressure reducing station sites, therefore no additional ROWs are required.

Full development of the GWD Project would require groundwater production wells, collector pipelines, and associated facilities, for which specific locations cannot yet be identified. The production well locations would be based on several factors, including but not limited to, geology, hydrology, well interference studies, environmental issues, existing senior water rights, and proximity to main and lateral pipelines. Production well locations also are subject to approval by the NSE. Because the specific locations of these facilities cannot currently be identified, the SNWA has not yet requested ROWs for them from the BLM.

For purposes of analysis, it was assumed that construction surface disturbance for all ROWS would be within a range of 3,590 to 8,410 acres; it is expected that 1,216 to 2,874 acres of temporary disturbance would be revegetated after the construction period; and that 2,374 to 5,536 acres would represent permanent disturbance (land converted to industrial uses for the project life).

2.5.2.1 Future Groundwater Production Wells

Future groundwater production wells would be located within development areas in the five hydrologic basins, as shown in **Figure 2.5-9**. As many as 174 groundwater production wells could be required (**Table 2.5-7**).

These estimates of future production wells were based on the assumption that each well would have an average well yield of approximately 800 to 1,000 gpm. A contingency of approximately 20 percent also was considered in the estimated number of wells because production capacity would not be known until after the wells are drilled, and it could be different than estimated. Wells also were assumed to be located at least 1 mile apart, and could be clustered in well fields, in grids of up to 4 wells.

The groundwater production wells would be drilled to depths between 1,000 and 2,000 feet in basin-fill and bedrock. The production well pumping equipment would be housed within a concrete block or pre-cast concrete structure for protection from vandalism and the elements. Electrical facilities, heating, ventilation, air-conditioning equipment, and control facilities would be located in each structure as required.

Depending upon the water quality at each well site, groundwater treatment facilities might be required on site, in or adjacent to the well building. Any treatment facilities would be equipped with secondary containment in accordance with Occupational Safety and Health Administration standards. Any sludge generated from the filtration would be disposed of in a permitted landfill.

Each well site is anticipated to require a permanent ROW of 1.5 acres, with an additional temporary 0.5-acre ROW for construction.

2.5.2.2 Future Collector Pipelines

Future collector pipelines would convey water from the future groundwater production wells to the main and lateral pipelines. The size of these future collector pipelines would depend upon the number of wells connected to them (**Table 2.5-8**). Currently, the collector pipelines are anticipated to range from 10 inches in diameter (where connected to a single well) to 30 inches in diameter (where connected to more than 3 wells).

Table 2.5-8 Future Collector Pipelines

Hydrologic Basin	Pipeline Length	Assumptions
Spring Valley	57 to 144 miles	Assumes wells might be clustered in groups of 4 wells, with each cluster located 3 to 6 miles from the main or lateral pipeline
Snake Valley	20 to 48 miles	Assumes wells might be clustered in groups of 4 wells, with each cluster located 2 to 4 miles from the lateral pipeline
Cave Valley	30 to 88 miles	Assumes individual wells might be located 3 to 8 miles from the lateral pipeline
Dry Lake Valley	20 to 44 miles	Assumes individual wells might be located 2 to 4 miles from the main pipeline
Delamar Valley	50 to 110 miles	Assumes individual wells might be located 5 to 10 miles from the main pipeline

Because the future groundwater production well sites cannot yet be identified, the sizes, routing, and distances of future collector pipelines also cannot yet be determined. However, assumptions as to the potential distances of future collector pipelines can be made based on the assumed number of future groundwater production wells. **Table 2.5-8** lists the estimated miles of collector pipeline per valley and the associated assumptions.

The collector pipelines would require a 50-foot permanent ROW and an adjacent 50-foot temporary ROW. A temporary construction staging area also might be required every 3 miles along the collector pipelines.

2.5.2.3 Future Power Facilities

Additional distribution power lines and substations would convey power to the future groundwater production wells and future pumping stations. The future power lines would be overhead 25-kV power lines, routed along the future collector pipeline alignments. Thus, the length of new overhead 25-kV power lines is assumed to be the same as the collector pipeline lengths. Additional 25-kV conductors might need to be hung on the power poles that are constructed as part of the GWD Project primary power supply system. The ROW width requirements for future distribution power lines (25 kV) would be 50 feet of permanent ROW.

Additional secondary substations might be required to reduce power from 69 to 25 kV and to provide operational power to future groundwater production wells and pumping station. Their locations would depend on the specific locations of the groundwater production wells and pumping stations. However, an additional 69/25-kV substation probably would be required in both Dry Lake and Delamar valleys. Each of the future substations would require a site of about 1 acre.

2.5.2.4 Future Ancillary Facilities

Pumping Stations

Two future pumping stations would be required to convey water from some of the future groundwater production well areas into the main and lateral pipelines. Based on known topography, a pumping station in Dry Lake Valley and one in Delamar Valley might be required. These facilities would be similar to the Lake Valley pumping station (Section 2.5.1.4). Five acres of permanent and 5 acres of temporary ROW would be required for each pumping station.

Access Roads

Access roads to future facilities would be located within the collector pipeline ROW. These might be either new roads or improvements to existing roads within the ROW. The road improvements could include grading, widening, and installing culverts, where needed. Gravel might be applied in some areas, if necessary, to maintain road conditions. Improved dirt roads would be 20 feet wide. No additional permanent or temporary access road ROWs would be required because the roads would be located within the collector pipeline ROW.

Communications Facilities

Communications facilities would be installed along with groundwater production wells, collector pipelines, and other facilities for system operation and control, data collection, communication, and security surveillance. Conduits for fiber-optic cables could be installed along with the collector pipelines. The fiber-optic cables would be installed underground in either the pipeline trench or adjacent access road, and would be contained within the requested ROW. No additional ROW would be required.

Hydroturbines

Hydroturbines may be installed in the future to generate electrical power as the water flows from higher to lower elevations. These facilities would be built belowground, with turbines placed within pipeline bypass piping. Electrical power generated by the hydroturbines would be used by the GWD Project or added to the utility grid. For operation of future facilities, it is estimated that future hydroturbines installed at the pressure reducing station sites could generate approximately 62 MW of power. The hydroturbines would be located within other sites and additional ROW is not anticipated to be required. These facilities would require permitting through the Federal Energy Regulatory Commission.

Future Right-of-way Requirements

Future distribution power lines (25 kV) would require a 50-foot-wide permanent ROW. Each of the future substations may require a 1-acre site.

2.5.2.5 Future Construction and Operations

Future construction methods would be similar to those described in Section 2.5.1.5 and would be in compliance with applicable federal and state regulations and the BLM and industry standards at the time of construction. Estimated future workforce requirements are identified in **Figure 2.5-7**.

Future operations would be similar to those described in Section 2.5.1.8 and would be in compliance with applicable federal and state regulations and the BLM and industry standards at the time of operation.

2.5.2.6 Abandonment

The ROW would be granted in accordance with the FLPMA, the SNPLMA, and the LCCRDA. In accordance with the LCCRDA and the SNPLMA, the ROW is granted in perpetuity. Termination and abandonment are not anticipated, unless exceptional circumstances should arise. In such a case, the termination and abandonment would be subject to approvals by the BLM. Termination and abandonment plans would be written in accordance with current management procedures and would be submitted to the BLM in advance of any associated actions. If the GWD Project were to be abandoned in part or in whole, the ROW would revert to the land managing agencies.

If upgrade or replacement of facilities is required, the SNWA would coordinate with the BLM prior to initiating major construction, in accordance with applicable stipulations of the final ROW grant.

2.5.3 Applicant-committed Environmental Protection Measures

The following section describes ACMs to which the SNWA has committed for the Project. Because of the large number of individual measures that are presented in the POD for the GWD Project, the protection measures are presented here in summary form. In response to comments on the Draft EIS, some updates/changes to the SNWA ACMs have occurred. A complete listing of all SNWA ACMs for this project can be found in **Appendix E**. The ACMs proposed by the SNWA will need to be approved in the final POD by the BLM after the ROD.

SNWA's ACMs address construction procedures and operational practices, and identify specific measures to address environmental resources. Additionally, the ACMs include programmatic measures to address future development, operations, and regional water-related effects.

2.5.3.1 Applicant-committed Environmental Protection Measures

A. ROW Measures

1. General Construction Measures

    - SNWA will obtain necessary permits and approvals prior to commencing construction.
    - (ACM—A.1.1) The SNWA will complete a detailed POD for the final project approved by the BLM. More than one POD may be developed if the project is constructed in phases. The detailed POD(s) will incorporate mitigation contained in the ROD and provide detailed project design and construction specifics, including but not limited to construction contract timing and phasing, construction access roads and ROW entry points, locations of refueling and equipment maintenance, hydrostatic discharge locations, areas of fencing for special status species, and other details. The POD(s) shall contain detailed plans, including, but not limited to, those listed below. The BLM will review and approve the POD(s) prior to notice to proceed for any surface disturbance activity.

        - Agency Coordination Plan
        - (ACM—A.5.62) Bird Conservation Strategy
        - (ACM—A.1.50) Blasting Plan
        - (ACM—A.1.1) Construction Plan
        - (ACM—A.1.28 to 37) Construction Traffic Management Plan
        - (ACM—A.10.1) Dust Control Plan
        - Emergency Response Plan
        - (ACM—A.1.47) Fire Prevention Plan
        - (ACM—A.1.51, 62, 64) Hydrostatic Discharge Plan
        - (ACM—A.1.26, 35, 58, 81 to 89, A.2.12, 13) Integrated Weed Management Plan

- Mitigation Plan
- (ACM—A.1.6) Public Information Plan
- (ACM—A.1.25, 27, 66 to 89) Restoration Plan
- (ACM—A.1.43 to 46, 55) Spill Prevention, Control, and Countermeasure Plan
- (ACM—A.1.53 to 68) Stormwater Pollution Prevention Plan

- (ACM—A.1.2) The SNWA will provide a Compliance Inspection Contractor for the project. The Compliance Inspection Contractor will provide environmental oversight and compliance/regulatory activities on behalf of the BLM during construction activities of the project. The Compliance Inspection Contractor will be responsible for ensuring that the ROW holder complies with all terms, conditions, stipulations and other measures required for the project, and will have the authority to halt activities that are in non-compliance.
- (ACM—A.1.9,10) The SNWA will survey and clearly delineate construction areas with stakes or fencing to ensure that work activities occur within the permitted area and to identify and protect sensitive resources.
- (ACM—A.1.12 to 18) As necessary, temporary fencing may be erected to enclose certain work areas and used to exclude wildlife from construction areas. Permanent fencing will be used at facility sites.
- (ACM—A.1.20, 23) Clearing procedures will crush vegetation to avoid topsoil stripping in areas to be disturbed only by vehicle traffic. In areas where topsoil stripping is required, topsoil handling procedures are identified to avoid mixing of topsoil with subsoils, minimize loss of topsoil to erosion, and avoid the spread of noxious weeds.
- (ACM—A.1.28) The Construction Traffic Management Plan addresses operating procedures and coordination approaches with the BLM and other agencies to minimize traffic congestion and provide safety measures during construction.
- (ACM—A.1.30 to 37) These measures involve maintaining public access routes within the ROWs or identifying detour routes during construction activities (A.1.30), signing and traffic controls during construction (A.1.31), use of signs and persons with flags to direct construction traffic (A.1.32), designated construction entry locations into the ROWs and measures to stabilize or prevent sediment trackout (A.1.33 to 35), maintenance of unpaved roads during construction (A.1.36), and access road restoration at completion of construction (A.1.37).
- (ACM—A.1.51, 53 to 65) The POD will identify procedures that will be used during construction to control storm water runoff and to reduce erosion. Examples of these procedures include minimum setbacks for refueling and soil storage at jurisdictional waterways, the installation of temporary and permanent erosion and sediment control measures (e.g., berms, silt fencing), and energy dissipating devices for non-storm water discharges.
- (ACM—A.1.22, 66 to 68) During restoration, terrain will be regraded to match surrounding topography to the extent practical. Stabilizing measures, such as riprap, will be used at certain drainages and washes to protect facilities and reduce erosion.
- (ACM—A.1.68 to 81) The Restoration Plan will identify reclamation objectives and methods; seeding mixes and application rates; cactus and yucca salvage, maintenance, and replanting procedures within Mohave Desert habitat; enhanced restoration efforts for ACECs; restoration success standards; and follow-up monitoring and reporting.
- (ACM—A.1.26, 82 to 89) Implementation of procedures identified within the Integrated Weed Management Plan will minimize the spread of noxious weeds. Procedures will include pre-treatment of areas currently infested by noxious weeds; use of materials (e.g., borrow or fill material, hay, straw, seed mixes) that are certified free of noxious weeds; use of vehicle cleaning stations; and use of herbicides as necessary.

2. Operational Practices

- (ACM—A.1.29, A.2.1) During operations, access will occur only along established access roads. Vehicle speed limit will be set at 25 mph along dirt roads to minimize dust and to reduce the chance of striking wildlife.
- (ACM—A.1.40, 41, 43 to 46; A.2.2, A.2.5, 3) The POD will address operational procedures to minimize environmental impacts during operations, including handling and disposal of waste (hazardous and non-hazardous materials) and maintenance of permanent erosion control structures.
- (ACM—A.2.4) The pipeline and its facilities will be equipped with pressure and flow sensors to indicate a major release or rupture of the pipe. Valves will be placed at locations to minimize the potential volume of water released in the event of a rupture. If a release occurs, personnel will be dispatched immediately to evaluate and repair any failure.
- (ACM—A.2.1, 6, 7, 8) Routine maintenance will occur within the ROW. If additional temporary workspace outside the ROW is required for facility repairs, replacements, or improvements, BLM approval will be required prior to activities outside the ROW.
- (ACM—A.2.9, 10) On the BLM lands, vegetation restoration success, and noxious weed conditions will be monitored for 7 years post-construction. Results will be reported annually to the BLM. If monitoring indicates that vegetation success will not meet restoration success standards, restoration activities may be revised and remedial measures implemented, subject to the BLM approval.
- (ACM—A.2.9) Vegetation restoration success on private lands will be coordinated with the landowner.
- (ACM—A.2.11) In the unlikely event of a system rupture, the SNWA will coordinate with the BLM to implement appropriate restoration measures.

3. Geologic Hazards and Soils

- (ACM—A.3.1 and 2) In areas where active geological faults have been identified, or in the "fissures" area of Dry Lake, additional design features will be implemented to increase pipeline integrity, reducing the chance of pipeline failure in the event of earth movement.

4. Water Resources

- (ACM—A.4.1) Construction across Snake Creek and Big Wash will use industry-accepted best management practices and be conducted in accordance with the CWA permitting requirements to minimize impacts.

5. Biological Resources

- (ACM—A.5.1) For applicable portions of the project, the SNWA will comply with the Clark County Multiple Species Habitat Conservation Plan to minimize overall impacts to species in the area.
- (ACM—A.5.2, 7) The BLM-approved qualified biologists will monitor construction and ensure compliance with mitigation measures, regulations, and other agreements. Monitoring and compliance updates will be provided to the BLM throughout construction.
- (ACM—A.5.5) Wildlife will not be harassed or intentionally harmed. Wildlife that become entrapped in trenches and that cannot escape on their own will be removed by qualified monitors.
- (ACM—A.5.3) All necessary federal and state permits for handling special status species will be obtained.
- (ACM—A.5.6) Prior to discharge of hydrostatic water, drainage locations will be surveyed for special status species and nesting migratory birds. If these species are found, then the BLM will be notified and additional mitigation measures implemented, if necessary.
- (ACM—A.5.8) Perch deterrents will be used on power lines to limit hunting perches for raptors and corvids, reducing depredation on sage-grouse, pygmy rabbit, and desert tortoise.

- (ACM—A.5.9) In areas where sensitive plant species were identified in previous surveys, either within or adjacent to the ROW, pre-construction surveys will be conducted during appropriate periods to determine the presence of special status plant species.
- (ACM—A.5.9 and 11) For special status plants located within the construction area, locations will be recorded for subsequent salvage or seed collection in the event that relocation of construction area is not possible.
- (ACM—A.5.10, 15) The SNWA will adjust construction activities to the extent practical to avoid construction within special status plant species locations. Exclusion fencing will be used and compliance monitors will ensure the area is protected from construction impacts.
- (ACM—A.5.12, 13) The SNWA will consult with the BLM regarding discoveries of special status species located within the ROW. The on-site biological monitor will have the authority to temporarily halt construction activities to protect special status species.
- (ACM—A.5.14) The SNWA will avoid using herbicides within or around exclusion areas created for special status plant species.
- (ACM—A.5.16 to 36) For desert tortoises and desert tortoise eggs, specific procedures are identified for handling and relocation to avoid harm and to maximize the likelihood for continued survival. USFWS-approved survey protocols will be followed for desert tortoise, unless determined to be unnecessary by the USFWS. Other measures include examination and excavation of burrows, exclusion fencing, biological monitoring, and reporting.
- (ACM—A.5.37 to 39) For banded Gila monster and chuckwalla, specific protection measures by qualified biologists include pre-construction surveys in suitable habitat following NDOW Gila monster protocol, examination and excavation of burrows, handling and relocation procedures, and reporting.
- (ACM—A.5.40 to 48) For burrowing owls and kit fox, specific procedures are identified for pre-construction surveys in suitable habitat during nesting season, examination of burrows, creation of avoidance areas using construction fencing, excavation and intentional destruction of burrows in ROW, mitigation for burrows destroyed during construction, relocation, and biological monitoring. If burrows are occupied by nesting burrowing owls or dening kit foxes, the area will be avoided until the young have left the area or have been relocated by qualified biologists, in coordination with and approval of the BLM and NDOW.
- (ACM—A.5.49 to 56) For greater sage-grouse, specific protection measures include facility siting criteria, biological monitoring, limitations on nighttime lighting, construction timing restrictions, enhanced restoration measures, and habitat enhancement.
- (ACM—A.5.57 to 60) For pygmy rabbit, specific protection measures include surveys, habitat improvement, livestock management, and enhanced restoration measures.
- (ACM—A.5.61) For the desert valley kangaroo mouse, qualified biologists will trap and relocate individuals within documented habitat within Dry Lake Valley.
- (ACM—A.5.62 to 69) For migratory birds (including raptors), specific protection measures include use of predictive models to identify critical nesting periods and locations, potential use of pre-construction ground clearing or tree removal, surveys, use of exclusion areas, adherence to recommendations to avoid electrocution or collisions with power lines and poles, construction monitoring, and compliance reporting.
- (ACM—A.5.70 to 76) For big game and wild horses, specific protection measures include provisions to allow seasonal movements across the ROW, ensuring water sources are available during construction and operations, consultation with the BLM and the NDOW to identify potential big game mitigation, and prioritization of restoration in important habitat areas.
- (ACM—A.5.77 to 78) For game fish, BMPs, including habitat compensation, will be implemented in Snake Creek and, if a high water year, in Big Wash.

6. Paleontological Resources

- (ACM—A.6.1 to 3) A field survey will occur in areas of high potential for paleontological resources. Areas of high potential will be monitored during construction and any fossils discovered will be recovered and curated.

7. Cultural Resources

- (ACM—A.7.1 to 8) The SNWA will enter into a PA with appropriate entities that will identify survey methodologies, mitigation measures, treatments (including avoidance), protection and proper handling of cultural resources and human remains discovered during construction and operations, and reporting requirements.

8. Land Use and Range Management

- (ACM—A.8.1) In advance of construction, the SNWA will coordinate with the BLM and grazing permit holders regarding access and grazing practices.
- (ACM—A.8.2) Range improvements and livestock watering sources that are affected by construction will be restored to the BLM standards and be functional by the completion of construction.
- (ACM—A.8.3) The SNWA will compensate owners for livestock struck by vehicles during construction.
- (ACM—A.8.4) Alternative water sources will be provided to livestock if access is temporarily restricted by construction.

9. Noise

- (ACM—A.9.1 to 4) Construction equipment and facilities will be operated in a manner to avoid unreasonable noise disturbances.

10. Air Quality

- (ACM—A.10.1 and 2) Fugitive dust control permits will contain a Dust Control Plan describing mitigation measures specific to the area and type of construction activities that will occur.
- (ACM—A.10.3) Tackifiers will be used for dust control.
- (ACM—A.10.4 and 5) Air quality permits for stationary sources (e.g., rock crushers, internal combustion engines at facilities) will include operating requirements, reporting requirements, and pollution emission limits.

11. Visual Resources

- (ACM—A.11.1) Facilities will be designed and painted or constructed of colored block to minimize visual impacts.
- (ACM—A.11.2 and 3) During construction and operation, use of nighttime lighting will be minimized, with lights shielded and directed downwards.
- (ACM—A.11.4) Artificial varnish will be used to minimize impacts on disturbed rock faces in the Pahranagat Canyon area.

12. Socioeconomics

- (ACM—A.12.1, 3, and 4) The SNWA will use local workers and resources as available. A Project Labor Agreement will cover the construction of the pipeline. The SNWA will work with labor unions and local governments to develop local trade resources.
- (ACM—A.12.2) The SNWA will pay White Pine County for property taxes and lost revenue associated with the purchase of private property in Spring Valley.

B. Programmatic Measures – Future ROWs

1. Planning and Design

- (ACM—B.1.1 and 3) Siting of future facilities will consider collocation opportunities and avoidance of sensitive environmental areas (e.g., wetlands, cultural resource sites).
- (ACM—B.1.2) Monitoring wells will utilize solar panels for power to the extent practical.
- (ACM—B.1.4) Groundwater production well sites will be housed with security fencing and lighting and designed to minimize visual impacts.

2. General Construction Practices

- (ACM—B.2.1) All necessary notices, permits, and waivers for drilling wells will be submitted or obtained from the NSE. Well abandonment and plugging will be in accordance with NDWR requirements.
- (ACM—B.2.2 and 3) Water generated during drilling or from hydrostatic testing will be discharged into dry washes, as feasible, and will follow practices designed to control flow of water and minimize erosion.
- (ACM—B.2.4) Use of nighttime lighting will be minimized, with lights shielded and directed downwards.

3. General Operation Practices

- (ACM—B.3.1) Water levels and discharges of all production wells will be recorded as required by applicable permits and agreements.

4. Water Resources

- (ACM—B.4.1) Exploratory wells unsuitable as production wells will be converted to groundwater monitoring wells.

5. Biological Resources

- (ACM—B.5.1) Groundwater development facilities will be sited as much as possible to avoid priority sage-grouse habitat, be within designated utility corridors, and co-located along existing ROWs including power lines and roads.
- (ACM—B.5.2) Exploratory drilling surface-disturbing activities will be restricted during the nesting and early brood-rearing season (generally April through June) in priority sage-grouse habitat.

C. Regional Water-Related Effects

- The general extent of regional water-related effects associated with the SNWA's groundwater withdrawal for the GWD Project is being estimated using groundwater modeling. Since the precise nature, extent, or location of water-related effects cannot yet be determined, the SNWA has identified a suite of potential ACMs that may be implemented, as needed, to avoid, minimize or mitigate potential water-related effects associated with the SNWA's groundwater withdrawals. Measures in this section are identified in two categories: 1) measures from the SNWA agreements and NSE water right permit conditions, and 2) adaptive management measures.
- SNWA has committed to a number of monitoring, management, and mitigation requirements under pre-existing agreements and NSE conditions, including:
  - Stipulation with DOI agencies on Spring Valley water rights (Spring Valley Stipulation);
  - Stipulation with DOI agencies on Delamar, Dry Lake, and Cave valleys (Delamar, Dry Lake, and Cave valleys Stipulation);
  - Spring Valley Hydrologic Monitoring and Mitigation Plan as determined by the NSE after the applications are reconsidered;

- State of Utah Conservation Agreement for Least Chub; and
- State of Utah Conservation Agreement for Columbia Spotted Frog.

- The SNWA is working on development of a Candidate Conservation Agreement with assurances to provide benefit to specific species (greater sage-grouse, northern leopard frog, and pygmy rabbit) that occur on the SNWA private properties in Spring Valley and associated grazing allotments. When those agreements are completed, other pertinent measures will be added.
- The SNWA has developed an Adaptive Management Plan to outline a process that would collect baseline data, identify environmental indicators and establish adaptive management thresholds, conduct monitoring of environmental indicators and the SNWA's groundwater pumping, determine whether the SNWA's groundwater pumping has likely caused or contributed to adverse environmental impacts, and if so, then to determine the appropriate adaptive management strategy to avoid future adverse environmental impacts and minimize or mitigate those that have already occurred.

D. Measures from the SNWA Agreements are summarized in Section 2.3.2, and full text is contained in **Appendix C**.

2.6 Comparison of Alternatives to the Proposed Action

The following sections compare the Proposed Action to the other alternatives being analyzed in this Final EIS. An overview of the ROW alternatives and their associated facilities are summarized in **Table 2.6-1**. See **Table 2.6-2** for a tabular comparison summary of the alternatives.

Table 2.6-1 Comparison of Project Main Pipeline Right-of-way Alternatives and Groundwater Development Scenarios (see text for detailed descriptions)

Alternative	Main Pipeline ROW Description	Groundwater Development Scenario
No Action No Project Pumping	No ROW granted.	Existing water development would continue.
Proposed Action Distributed Pumping at Application Quantities	All requested ROWs for a main pipeline of up to 96 inches in diameter, lateral pipelines, and associated ancillary facilities, required for this alternative.	Facilities to pump up to 176,655 afy of new applications from 5 basins at distributed locations.
A Distributed Pumping at Reduced Quantities	All requested ROWs for a main pipeline of up to 84 inches in diameter, lateral pipelines, and associated ancillary facilities required for this alternative.	Facilities to pump up to 114,755 afy of new applications from 5 basins at distributed locations.
B Point of Diversion Pumping at Application Quantities	All requested ROWs for a main pipeline of up to 96 inches in diameter and lateral pipelines, and associated ancillary facilities, required for this alternative.	Facilities to pump up to 176,655 afy of new applications from 5 basins at or near Points of Diversion.
C Intermittent Pumping at Reduced Quantities	All requested ROWs for a main pipeline of up to 84 inches in diameter and lateral pipelines, and associated ancillary facilities required for this alternative.	Facilities to pump a potential range of volumes from 12,000 afy to 114,755 afy of new applications from 5 basins at distributed locations; groundwater pumping over intermittent periods, based upon drought conditions and availability of Colorado River water.
D Distributed Pumping at Reduced Quantities in Lincoln County Only	ROWs for a main pipeline of up to 78 inches in diameter, lateral pipelines, and associated ancillary facilities required for this alternative within Clark and Lincoln counties only, as authorized under the LCCRDA.	Facilities to pump up to 78,755 afy of new applications from 4 basins at distributed locations (Delamar, Dry Lake, and Cave valleys and a portion of Spring Valley) in Lincoln County only.
E Distributed Pumping at Reduced Water Quantities in Spring, Delamar, Dry Lake, and Cave valleys	ROWs for a main pipeline of up to 78 inches in diameter and lateral pipelines, associated ancillary facilities required for this alternative from within Spring, Delamar, Dry Lake, and Cave valleys.	Facilities to pump up to 78,755 afy of new applications from 4 basins at distributed locations within Spring, Delamar, Dry Lake, and Cave valleys.
F Distributed Pumping in Spring, Delamar, Dry Lake, and Cave valleys	ROWs for a main pipeline of up to 84 inches in diameter and lateral pipelines, associated ancillary facilities required for this alternative from within Spring, Delamar, Dry Lake, and Cave valleys.	Facilities to pump up to 114,129 afy of new applications from 4 basins at distributed locations within Spring, Delamar, Dry Lake, and Cave valleys.

Table 2.6-2 Characteristics of Alternatives

	No Action	Proposed Action	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E	Alternative F
ROW and Facility Requirements								
Pipeline (miles)	0	306	306	306	306	225	263	263
Electric Power Lines (miles)	0	323	323	323	323	208	280	280
Electrical Substations (number)	0	7	7	7	7	4	6	6
Pumping Stations (number)	0	5	5	5	5	2	3	3
Regulating Tanks (number)	0	6	6	6	6	5	5	5
Pressure-reducing Stations (number)	0	3	3	3	3	3	3	3
Water Treatment Facility/Buried Storage Reservoir (number, location)	0	1 (Garnet Valley)	1 (Garnet Valley)	1 (Garnet Valley)	1 (Garnet Valley)	1 (Garnet Valley)	1 (Garnet Valley)	1 (Garnet Valley)
Access Roads (total miles)	0	351	351	351	351	315	388	388
Power Requirements (MW)	0	97	74	97	74	54	55	55
Estimated Construction Surface Disturbance[1]	0	12,288	12,288	12,288	12,288	8,828	10,681	10,681
Temporary Disturbance Area to be Revegetated[1]	0	11,289	11,289	11,289	11,289	8,020	9,736	9,736
Permanent Disturbance[1]	0	999	999	999	999	808	945	945
Conceptual Analysis – Groundwater Development Plan								
Current Groundwater Production (afy)[2]	105,700	0	0	0	0	0	0	0
Volume of Developed Groundwater (afy)	0	176,655	114,755	176,655	12,000[3] to 114,755[4]	78,755	78,755	114,129
Full Development Duration	NA	38 years	38 years	38 years	38 years	31 years	31 years	31 years
Well Locations	NA	5 basins; dispersed well sites	5 basins; dispersed well sites	5 basins; well sites within 1 mile of 34 Points of Diversion	5 basins; dispersed well sites	4 basins; dispersed well sites	4 basins; dispersed well sites	4 basins; dispersed well sites
Intermittent Pumping	No	No	No	No	Yes	No	No	No

Table 2.6-2 Characteristics of Alternatives (Continued)

	No Action	Proposed Action	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E	Alternative F
Programmatic Analysis – Future Facilities								
Groundwater Production Wells (number, distribution)	0	144 to 174 within 5 basins; dispersed within the groundwater development area	97 to 117 within 5 basins; dispersed within the groundwater development area	136 within 5 basins; within 1-mile radius of 34 Points of Diversion	97 to 117 within 5 basins; dispersed within the groundwater development area	69 to 83 within 4 basins; dispersed within the groundwater development area	69 to 83 within 4 basins; dispersed within the groundwater development area	96 to 117 within 4 basins; dispersed within the groundwater development area
Collector Pipelines (miles)	0	177 to 434	100 to 246	236	100 to 246	127 to 206	86 to 210	134 to 344
Staging Areas (number of 1-acre sites)	0	59 to 145	33 to 82	79	33 to 82	42 to 69	29 to 70	45 to 115
Electric Power Lines (miles)	0	177 to 434	100 to 246	236	100 to 246	127 to 206	86 to 210	134 to 344
Total Construction Disturbance	0	3,590 to 8,410	2,069 to 4,814	4,664	2,069 to 4,814	2,513 to 4,005	1,754 to 4,079	2,698 to 6,629
Temporary Disturbance Area to be Revegetated	0	1,216 to 2,874	699 to 1,643	1,587	699 to 1,643	858 to 1,370	595 to 1,396	916 to 2,270
Permanent Disturbance	0	2,374 to 5,536	1,370 to 3,171	3,077	1,370 to 3,171	1,655 to 2,635	1,158 to 2,683	1,782 to 4,359
Ancillary Facilities								
Pumping Stations	0	2	2	2	2	2	2	2
Substations	0	2	2	2	2	2	2	2

[1] Construction and permanent acreage numbers in the table include a minimal acreage of facilities that currently exist. Therefore the reported acreages conservatively overestimate the amount of disturbance anticipated by the proposed project by approximately 1 percent across all alternatives.

[2] The groundwater production estimate is the current use volume (total of the No Action sources evaluated in the groundwater modeling analysis).

[3] Includes 3,000 afy of the SNWA water rights that will be transferred to Lincoln County Water District.

[4] Range of values is based on minimum and maximum conveyance volumes during intermittent pumping.

2.6.1 Alternative A, Distributed Pumping at Reduced Quantities

All requested ROWs for a main pipeline of up to 84 inches in diameter, lateral pipelines, and associated ancillary facilities would be required for this alternative. Alternative A is based on a reduced volume of groundwater development based on previously granted groundwater rights in Spring, Delamar, Dry Lake, and Cave valleys totaling 78,755 afy. These rights were subsequently vacated on appeal to the Nevada Supreme Court. The NSE ruled in March 2012 for water rights in all valleys except Snake. See Section 1.4.1.1 for details and the NSE decisions. The NSE has not allotted the same amount of water as allotted in the previous ruling. Based upon previous ruling, this alternative has been carried forward for comparative analysis purpose. In addition, 36,000 afy are assumed for Snake Valley; the amount of groundwater rights described in the Draft Snake Valley Stipulated Agreement between the states of Nevada and Utah. This alternative provides a benchmark to indicate the factors the NSE considered in granting SNWA its water rights in the Spring and Delamar, Dry Lake, and Cave valleys and incorporates the Draft Snake Valley Stipulated Agreement between the states of Nevada and Utah when considering the proposed development volume in Snake Valley. Under this alternative, groundwater wells would be distributed across the hydrologic basins with the objective of minimizing effects on senior water rights or areas containing water-dependent sensitive or listed species and their habitats. Alternative A ROWs would be the same as the Proposed Action for the following project components:

- Construction schedule for mainline pipeline and associated facilities (**Figure 2.5-6**);
- Land Ownership (**Table 2.5-1**);
- Overall land requirements (**Table 2.6-2**);
- Mainline pipeline and ancillary facilities, and construction and operation procedures (Sections 2.5.1.5 through 2.5.1.8);
- Construction schedule and workforce requirements (**Figures 2.5-6** and **2.5-7**); and
- ACMs (Section 2.5.3).

Alternative A differs from the Proposed Action as follows:

- The volume of groundwater developed would not exceed 114,755 afy (**Figure 2.6-1**), which is 61,900 afy less than the Proposed Action. This alternative would involve a reduced volume of water, the amount of which reflects the water rights previously approved by the NSE in Spring, Delamar, Dry Lake, and Cave valleys and the water rights recommended in the Draft Snake Valley Stipulated Agreement between the states of Nevada and Utah in Snake Valley.
- Main pipeline and lateral lengths are the same, but diameters are smaller (**Table 2.6-3**);
- Power lines sizes and configuration are different (**Table 2.6-4**), and operational power requirements are less (**Table 2.6-5**); and
- Facilities or other parameters that differ from the Proposed Action are shown in **Table 2.6-6**.
- ROW requirements and groundwater development facilities would differ slightly from the Proposed Action, Facilities or other parameters that differ from the Proposed Action are shown in **Table 2.6-6**.

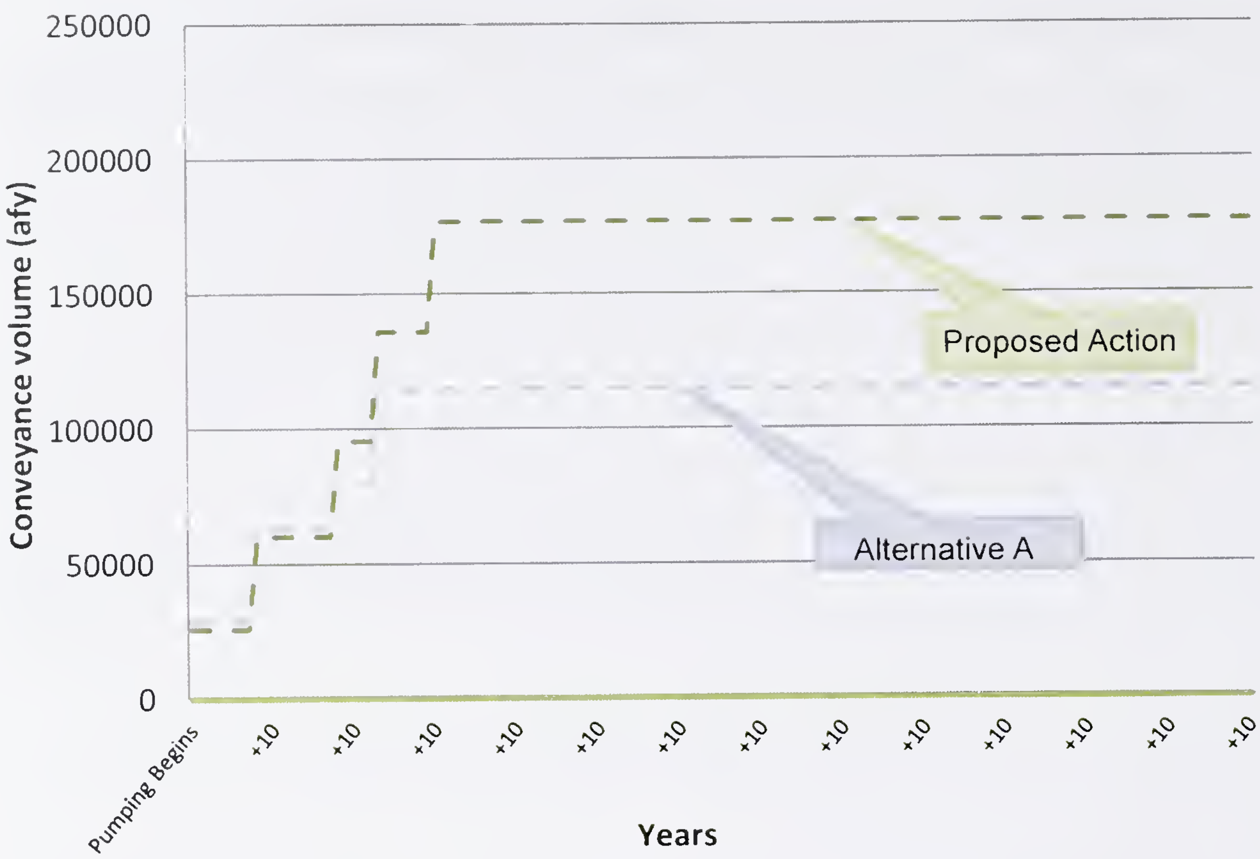


Figure 2.6-1 Groundwater Development Volume for Alternative A (and the Proposed Action)

Table 2.6-3 Pipeline Lengths, Alternative A

Pipeline	Valley	Pipe Diameter (inches in diameter)	Pipe Length (miles)[1]
Main Pipeline	Spring	66–72	17
	Lake	66–72	21
	Dry Lake	66–84	66
	Delamar	72–84	23
	Pahranagat	52–72	7
	Coyote Spring	52–84	41
	Hidden	72–84	12
	Garnet	72–84	7
	Las Vegas	72–78	9
Spring Lateral	Spring	42–54	38
Snake Lateral	Snake	42–54	24
	Hamlin	42–54	10
	Spring	42–54	9
Cave Lateral	Cave	16–30	19
	Dry Lake	16–30	3
Total			**306**

[1] Pipe lengths are rounded to the nearest mile.

Table 2.6-4 GWD Project Power Lines for Alternative A

Power Line Conductor Voltages	Total Miles	Power Line ROW Widths
230-kV Power Line	80	100
69-kV Power Line	10	100
25-kV Power Line	26	50
230-kV Power Line with 69-kV and 25-kV Underhang	135	100
230-kV Power Line with 69-kV Underhang	49	100
69-kV Power Line with 25-kV Underhang	22	100
Total	**322**	**N/A**

Table 2.6-5 Anticipated Operational Power Requirements for Alternative A

Proposed Facilities	Power (MW)
Pump Station:	
Spring Valley North	3
Spring Valley South	11
Snake Valley North	3
Snake Valley South	5
Lake Valley	12
Dry Lake	0
Delamar	0
Cave Valley	0
Buried Storage Reservoir	<1
Water Treatment Facility	2
Future Wells	40
Total[1]	**74**

[1] The total is less than the sum of the individual power requirements due to the effects of rounding.

Table 2.6-6 Alternative A, Comparison to the Proposed Action

	Proposed Action	Alternative A
ROW and Facility Requirements		
Power Requirements (MW)	97	74
Conceptual Analysis – Groundwater Development Plan		
Volume of Developed Groundwater (afy)	176,655	114,755
Programmatic Analysis – Future Facilities		
Groundwater Production Wells (number, distribution)	144 to 174 within 5 basins; dispersed within groundwater development areas	97 to 117 within 5 basins; dispersed within groundwater development areas
Collector Pipelines (miles)	177 to 434	100 to 246
Staging Areas (number of 1-acre sites)	59 to 145	33 to 82
Electric Power Lines (miles)	177 to 434	100 to 246
Estimated Construction Disturbance (acres)	3,590 to 8,410	2,069 to 4,814
Temporary Disturbed Area (acres)	1,216 to 2,874	699 to 1,643
Permanent Disturbance (acres)	2,374 to 5,536	1,370 to 3,171

2.6.2 Alternative B, Points of Diversion Pumping at Application Quantities

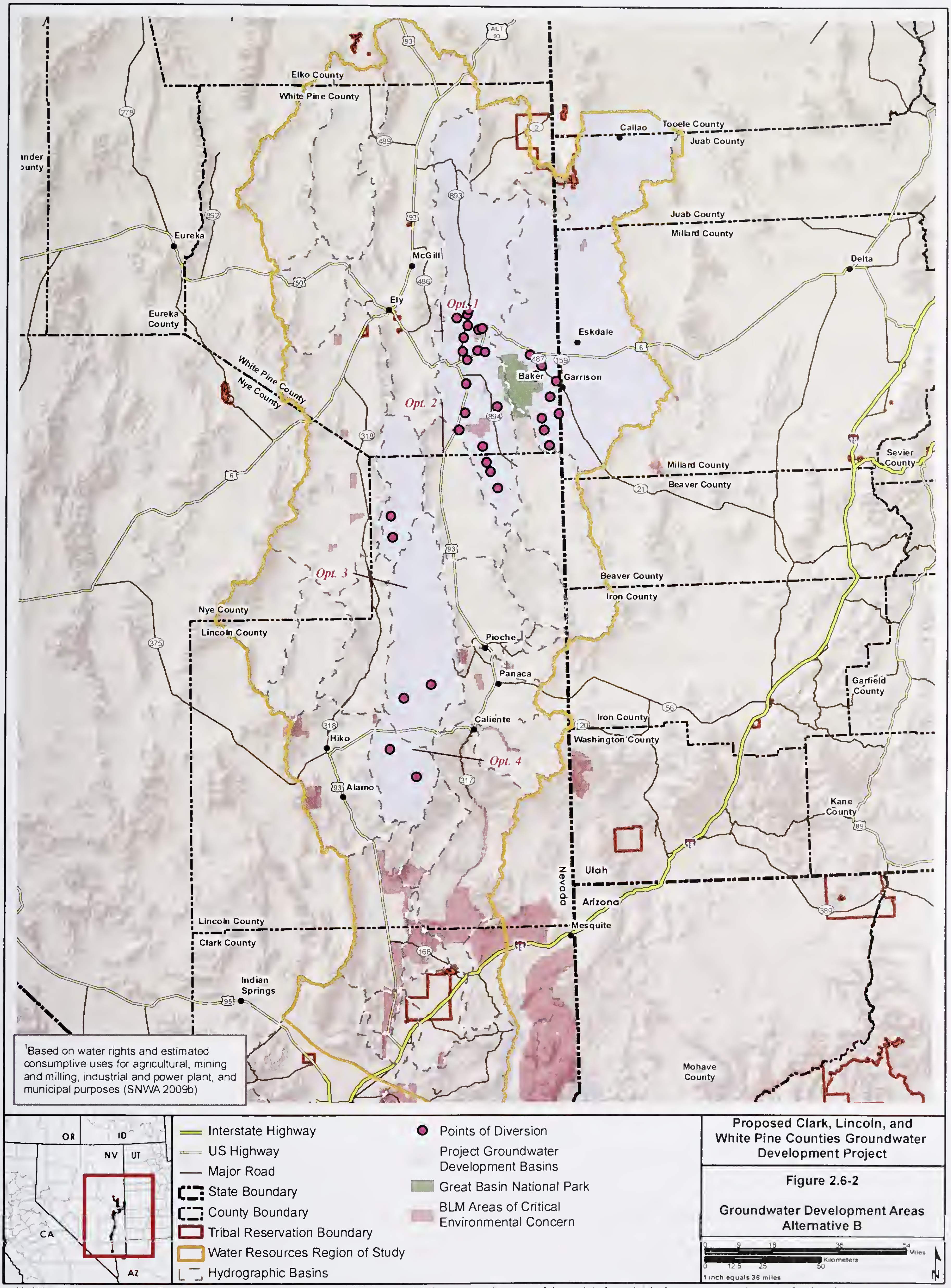
This alternative requires ROWs for a main pipeline of up to 96 inches in diameter, lateral pipelines, and associated facilities. Alternative B would develop and convey the same groundwater volume as the Proposed Action (see previous discussion). Future groundwater pumping for Alternative B would occur at or within a 1-mile radius of 34 Points of Diversion in the 5 project basins (**Figure 2.6-2**). The Points of Diversion include all locations of the current SNWA groundwater applications in Spring (19 locations), Snake (9 locations), Cave (2 locations), Dry Lake (2 locations), and Delamar (2 locations) valleys. Future groundwater production wells would be capable of developing the full quantity of groundwater rights from within 1 mile of these Points of Diversion.

Key Points—Alternative B

- The main and lateral pipelines and associated facilities for Alternative B (e.g., miles of main and lateral pipelines and power lines; number of electrical substations; ancillary facilities; ROW requirements; and conceptual pumping volume and schedule) would be identical to those described for the Proposed Action.
- In contrast to the Proposed Action, future groundwater pumping associated with Alternative B would be limited to a 1-mile radius around 34 Points of Diversion in the 5 project basins.

For Alternative B, an average of 4 wells would be located at or near the Points of Diversion, roughly spaced in a circular pattern at a radius of approximately 1 mile from each Point of Diversion. Thus, the numbers of wells identified in **Table 2.6-2** are presented as a total number per valley instead of as a range (as for other alternatives). This alternative assumes that sufficient well yield could be achieved to reach full development of all the groundwater applications at the Points of Diversion.

The length of future collector pipeline for Alternative B is estimated as: 1) the distance between the main or lateral pipeline and each Point of Diversion, and 2) the 1-mile radius for wells around each Point of Diversion (average of 4 miles per Point of Diversion). For future production wells for this alternative, this assumption results in a single total of pipeline distance per valley, instead of a range (as for other alternatives).



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 2.6-2

Groundwater Development Areas Alternative B

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

Alternative B would be the same as the Proposed Action for the following project components:

- Potential volumes of water developed (**Figure 2.6-3**);
- Land Ownership (**Table 2.5-1**);
- Operational Power Requirements (**Table 2.5-6**);
- Construction and workforce schedule (**Figure 2.5-6** and **2.5-7**);
- Mainline pipeline and ancillary facilities, and construction and operation procedures (Sections 2.5.1.5 through 2.5.1.8); and
- ACMs (Section 2.5.3).

Alternative B differs from the Proposed Action in the manner that future groundwater development would occur. These differences include:

- Future groundwater development would be centralized around 34 Points of Diversion; and
- ROW requirements and groundwater development facilities would differ slightly from the Proposed Action, Facilities or other parameters that differ from the Proposed Action are shown in **Table 2.6-7**.

Table 2.6-7 Alternative B, Comparison to the Proposed Action

	Proposed Action	**Alternative B**
Programmatic Analysis – Groundwater Development Plan		
Well Locations	5 basins; dispersed well sites	5 basins; well sites within 1 mile of 34 Points of Diversion
Programmatic Analysis – Future Facilities		
Groundwater Production Wells (number, distribution)	144 to 174 within 5 basins; dispersed within the groundwater development area	136 within 5 basins; well sites within 1 mile of 34 Points of Diversion
Collector Pipelines (miles)	177 to 434	236
Staging Areas (number of 1-acre sites)	59 to 145	79
Electric Power Lines (miles)	177 to 434	236
Estimated Construction Disturbance (acres)	3,590 to 8,410	4,664
Temporary Disturbed Area (acres)	1,216 to 2,874	1,587
Permanent Disturbance (acres)	2,374 to 5,536	3,077

Figure 2.6-3 shows the groundwater development volume and schedule for Alternative B compared to the Proposed Action.

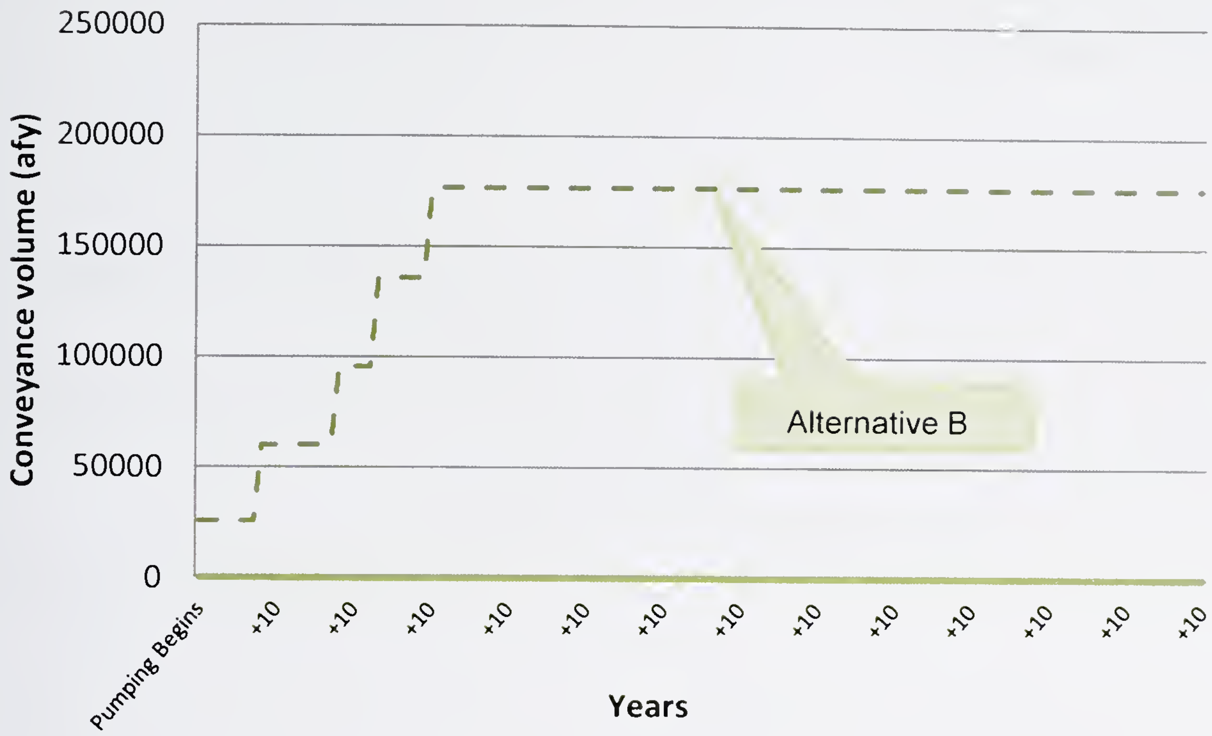


Figure 2.6-3 Groundwater Development Volume for Alternative B (and the Proposed Action)

2.6.3 Alternative C, Intermittent Pumping at Reduced Quantities

This alternative requires ROWs for a main pipeline of up to 84 inches in diameter, lateral pipelines, and associated ancillary facilities. The differences between the pumping schedule for the Proposed Action and Alternative C are due to assumptions made regarding potential availability of surplus Colorado River water to the SNWA. Projecting occurrences of drought and surplus on the Colorado River are inherently uncertain due to variability in climatic conditions affecting surface water runoff to the Colorado River. For the purposes of EIS analysis, the schedule for groundwater pumping assumes 5-year intermittent periods, cycling between full development and a minimum operational pumping volume. A minimum annual volume of groundwater pumping is necessary to maintain functionality of pumps, pipelines, and other facilities; to avoid sediment buildup; and to allow for conveyance of Lincoln County's water. This schedule also would allow wells to be pumped rotationally to avoid sediment plugging of the well screens. During periods of minimal development, the total volume of water conveyed would be approximately 45,000 afy. The quantity would consist of continued system conveyance of 33,000 afy for Lincoln County, and 12,000 afy minimal development volumes for SNWA production. As with Alternative A, the maximum volume of water analyzed for periods of full development is approximately 114,755 afy (**Table 2.1-2**). Groundwater development would proceed as described for the Proposed Action and Alternative A, reaching full capacity in approximately 38 years. For the purpose of analysis, groundwater withdrawal under Alternative C is assumed to cycle in 5-year intervals between full and minimal development, beginning at full build out.

Key Point—Alternative C Conceptual Future Facilities

- All future facilities that are associated with Alternative C (e.g., number of future wells, miles of pipelines and electrical power lines, number of electrical substations, ancillary facilities, ROW requirements) would be identical to those described for Alternative A.
- Development volumes would not exceed those described for Alternative A. However, annual development volumes may vary depending upon whether drought conditions on the Colorado River affect SNWA's other water supplies.

Alternative C would be the same as the Proposed Action for the following project components:

- Land Ownership (**Table 2.5-1**);
- Overall land requirements (**Table 2.6-2**);
- Mainline pipeline and ancillary facilities, and construction and operation procedures (Sections 2.5.1.5 through 2.5.1.8);

- Construction schedule and workforce requirements (**Figures 2.5-6** and **2.5-7**);
- General operation and maintenance practices; and
- ACMs (Section 2.5.3).

Alternative C differs from the Proposed Action in the following manner:

- Main pipeline and lateral lengths are the same, but diameters are smaller (same as Alternative A) (**Table 2.6-3**);
- Power line sizes and configurations are different (same as Alternative A) (**Table 2.6-4**);
- Annual development volumes are reduced and also may fluctuate depending upon whether drought conditions on the Colorado River affect the SNWA's other water supplies (**Figure 2.6-4**);
- Operational power requirements reflect intermittent pumping (**Table 2.6-8**); and
- ROW requirements and groundwater development facilities that differ from the Proposed Action are shown in **Table 2.6-9**.

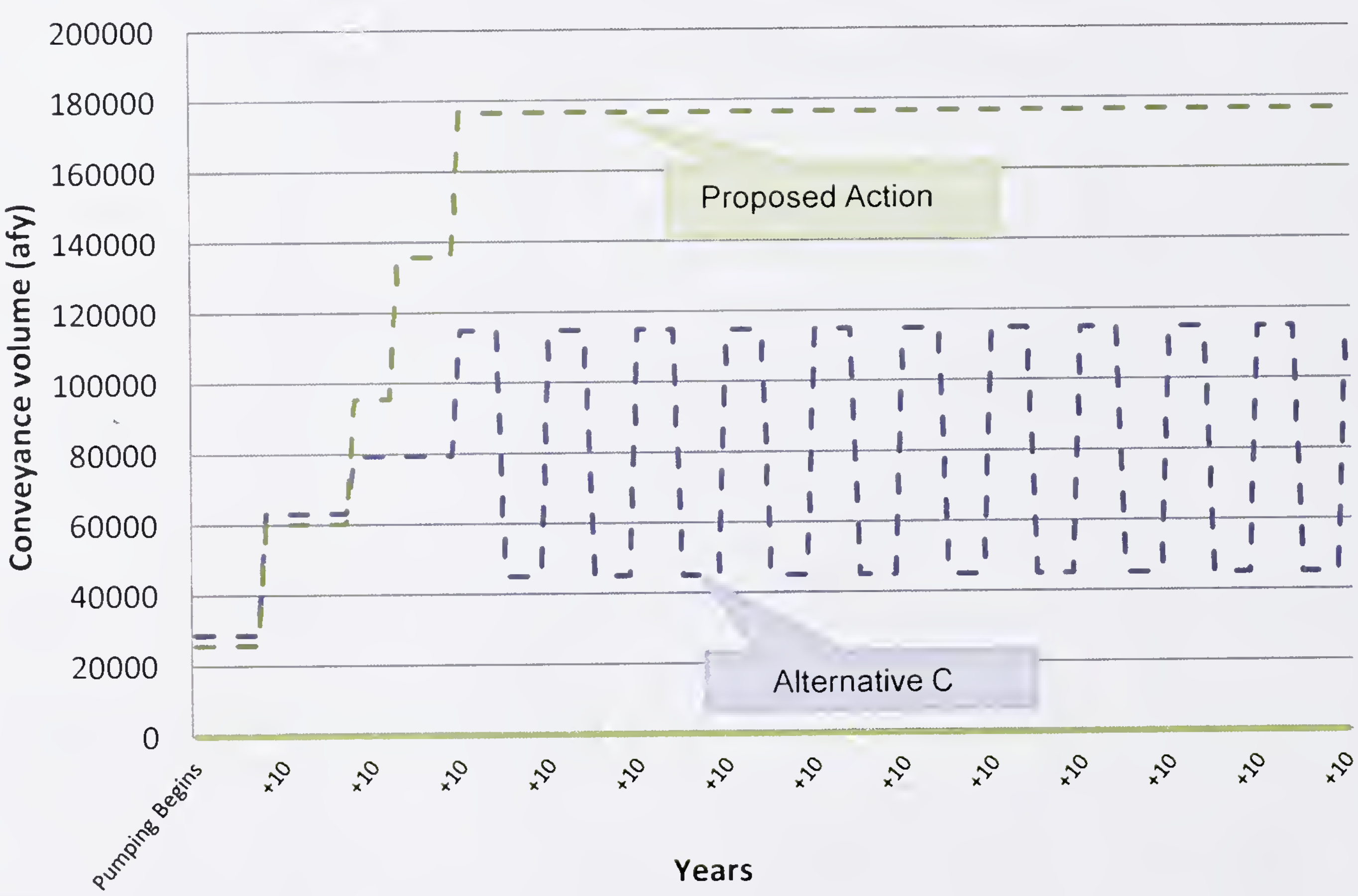


Figure 2.6-4 Groundwater Development Volume for Alternative C (and the Proposed Action)

Table 2.6-8 Anticipated Operational Power Requirements for Alternative C

Proposed Facilities	Power (MW)
Pump Station:	
Spring Valley North	<1 - 3
Spring Valley South	<1 - 11
Snake Valley North	<1 - 3
Snake Valley South	<1 - 5
Lake Valley	3 - 12
Dry Lake	0
Delamar	0
Cave Valley	0
Buried Storage Reservoir	<1
Water Treatment Facility	2
Future Wells	11 - 40
Total (maximum)	**74**

[1] The total is less than the sum of the individual power requirements due to the effects of rounding.

Table 2.6-9 Alternative C, Comparison to the Proposed Action

	Proposed Action	Alternative C
ROW and Facility Requirements		
Power Requirements (MW)	97	16 - 74
Conceptual Analysis – Groundwater Development Plan		
Volume of Developed Groundwater (afy)	176,655	12,000 to 114,755
Intermittent Pumping	No	Yes
Programmatic Analysis – Future Facilities		
Groundwater Production Wells (number, distribution)	144 to 174 within 5 basins; dispersed within the groundwater development area	97 to 117 within 5 basins; dispersed within the groundwater development area
Collector Pipelines (miles)	177 to 434	100 to 246
Staging Areas (number of 1-acre sites)	59 to 145	33 to 82
Electric Power Lines (miles)	177 to 434	100 to 246
Estimated Construction Disturbance (acres)	3,590 to 8,410	2,069 to 4,814
Temporary Disturbed Area to be Revegetated (acres)	1,216 to 2,874	699 to 1,643
Permanent Disturbance (acres)	2,374 to 5,536	1,370 to 3,171

2.6.4 Alternative D, Distributed Pumping at Reduced Quantities in Lincoln County Only

Alternative D was developed to examine effects of constructing a project that would allow the SNWA to utilize the LCCRDA utility corridor already designated by Congress, and to develop all granted water rights within Lincoln County. This alternative would not allow development of groundwater within Snake Valley, resulting in lower groundwater development volumes compared to the Proposed Action, and alternatives A, B, and C.

Unlike the Proposed Action, ROWs for Alternative D would be granted only within Lincoln and Clark Counties. Consequently, Alternative D differs from the Proposed Action in the following manner:

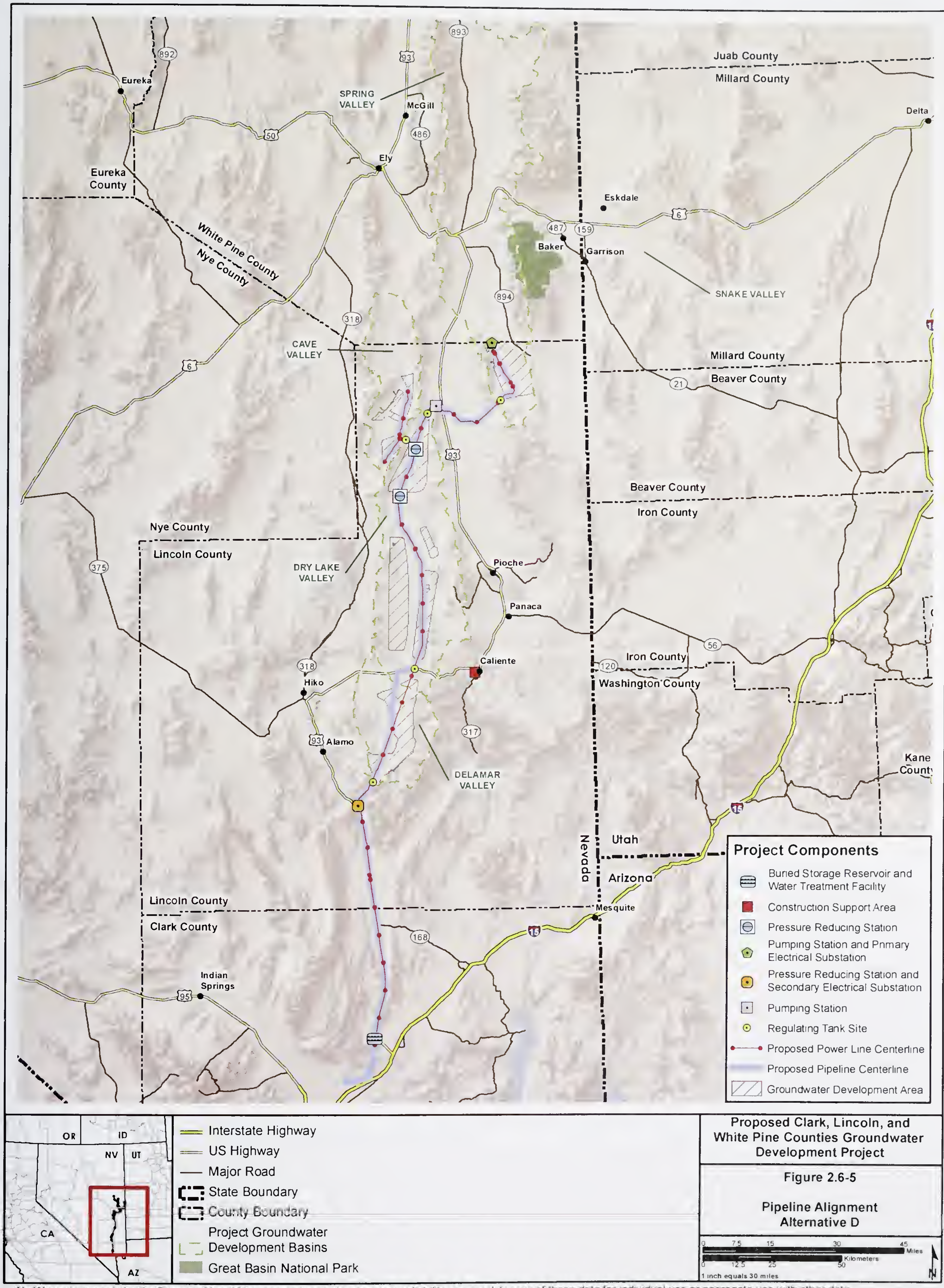
- Volumes of groundwater developed would not exceed 78,755 afy;
- No groundwater development by the SNWA in Snake Valley (i.e., the SNWA would not be able to access any groundwater that may be permitted by the NSE in that basin);
- Mainline pipeline would differ in diameter, length, and location;
- The number and size of ancillary facilities, including pumping stations, regulating tanks, and access roads, would be reduced;
- The length of power line would be reduced, and there would be no connection to the Gonder Substation;
- Proposed pumping would reach full volumes in approximately 31 years;
- Workforce requirements would be lower;
- The overall construction schedule would be shorter with the elimination of the Spring Valley and Snake Valley laterals;
- Land ownership of the requested ROWs (only those components that require a separate ROW are listed); and
  - BLM – 98 percent;
  - Private – 2 percent; and
  - State of Nevada – less than 1 percent.
- Estimated land requirements and ROW restoration.
  - Estimated Construction Disturbance – 8,828 acres;
  - Temporary Disturbed Area – 8,020 acres; and
  - Permanent Disturbance – 808 acres.

Main Points—Alternative D—ROWs

- For Alternative D, the BLM would grant LCCRDA-mandated ROWs for facilities only in Clark and Lincoln counties.
- Alternative D would disturb fewer acres of land and would require fewer ancillary facilities, compared to the Proposed Action. Pipeline diameters, alignments, and distances would be less than the Proposed Action.
- Electrical power facilities and requirements would be less and would not extend into White Pine County, and would not connect to the Gonder Substation.
- Groundwater development by SNWA of up to 78,755 afy would occur in four basins at distributed locations, rather than the five basins in the Proposed Action.
- Pumping would reach full capacity in about 31 years, 7 years earlier than for the Proposed Action.

2.6.4.1 Pipeline System

To transport the volumes of water identified under Alternative D, a total of approximately 225 miles of pipelines would be required. The pipeline system would consist of a buried main pipeline and one lateral pipeline (Cave Valley) (**Figure 2.6-5**). The final sizes of the main and lateral pipelines would be determined during facility design. **Table 2.6-10** lists pipeline lengths and anticipated pipe diameter by valley. Because a reduced quantity of water would be developed under this alternative, pipeline diameters are as much as 18 inches smaller than those under the Proposed Action. Because facilities are sized for hydraulic efficiencies, facility size reductions are not directly proportional to decreased water volume.



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 2.6-5

Pipeline Alignment Alternative D

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

Table 2.6-10 Pipeline Length, Alternative D

Pipeline	Valley	Pipe Diameter (inches in diameter)	Pipe Length (miles)[1]
Main Pipeline	Spring	60–66	17
	Lake	54–66	21
	Dry Lake	54–78	66
	Delamar	60–72	23
	Pahranagat	42–66	7
	Coyote Spring	42–78	41
	Hidden	66–78	12
	Garnet	60–72	7
	Las Vegas	60–72	9
Cave Lateral	Cave	16–30	19
	Dry Lake	16–30	3
Total			**225**

[1] Pipe lengths are rounded to the nearest mile.

The main pipeline between southern Spring Valley and Las Vegas Valley would be up to 78 inches in diameter. The lateral pipeline would be 16 to 30 inches in diameter and would extend into Cave Valley. The pipeline and work area requirements would be the same as those described for the Proposed Action (Section 2.5) and Alternatives A, B, and C.

Because most of the pipeline ROW requirements are associated with space that is needed for construction (**Figure 2.5-2**), reductions in pipe diameters would not change the widths of the permanent and temporary construction ROWs. The pipeline temporary construction areas would be the same as those described for the Proposed Action (Section 2.5.1.5), and Alternatives A, B, and C except that the areas in Northern Spring Valley and Snake Valley would be eliminated.

2.6.4.2 Power Facilities

As described for the Proposed Action (Section 2.5.1.3) and Alternatives A, B, and C, construction of a new power line is needed to provide power supply to project facilities. Under Alternative D, a new power line would be constructed between the Silverhawk Generating Station (near Apex) and the Spring Valley South pumping station (**Figure 2.6-6**). The power line would not tie into the Gonder Substation.

The anticipated power supply to operate project facilities for Alternative D would be approximately 54 MW (**Table 2.6-11**). This power supply would be obtained from the Silverhawk Generating Station and would be operated as described for Alternatives A, B, and C. Construction of new power generation facilities would not be required.

Power Lines

Power lines would include 230-kV, 69-kV, and 25-kV conductors, as described for the Proposed Action (Section 2.5.1.4). The locations of the power lines, including where multiple conductor voltages would be hung on the same pole, would be the same as displayed in **Figure 2.6-6,** except no power lines would extend into White Pine County. **Table 2.6-12** summarizes the power line lengths for Alternative D.

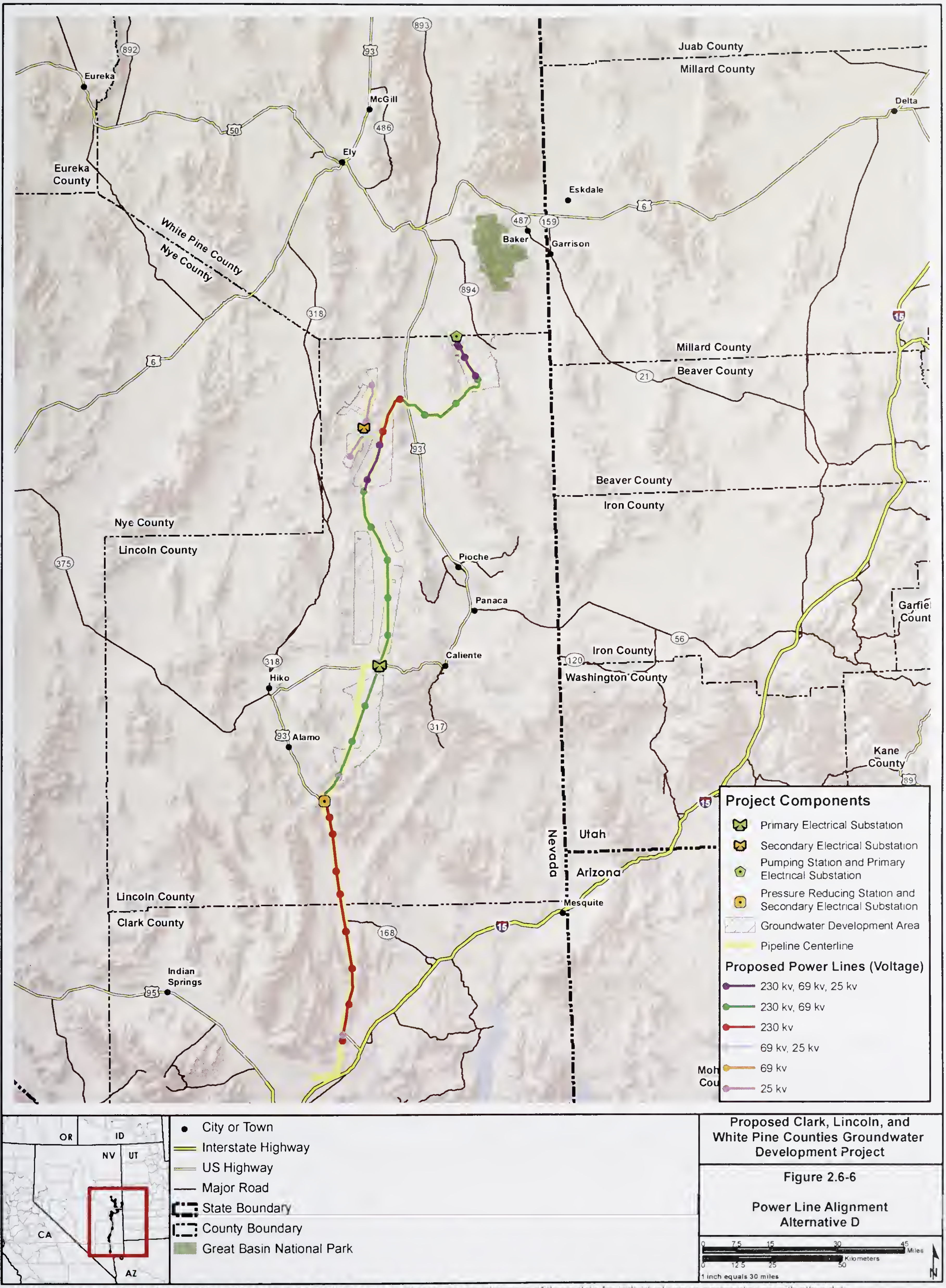


Figure 2.6-6

Power Line Alignment Alternative D

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

Table 2.6-11 **Anticipated Operational Power Requirements for Alternative D**

Proposed Facilities	Power (MW)
Spring Valley South Pumping Station	14
Lake Valley Pumping Station	12
Buried Storage Reservoir	<1
Water Treatment Facility	2
Anticipated Future Groundwater Wells and Associated Facilities	27 (estimated)
Total[1]	**54**

[1] The total is less than the sum of the individual power requirements due to the effects of rounding.

Table 2.6-12 **GWD Project Power Lines for Alternative D**

Power Line Conductor Voltages	Total Miles
230-kV Power Line	66
69-kV Power Line	0[1]
25-kV Power Line	17
230-kV Power Line with 69-kV and 25-kV Underhang	22
230-kV Power Line with 69-kV Underhang	97
69-kV Power Line with 25-kV Underhang	6
Total	**208**

[1] Length of 69-kV power line would be approximately 0.3 mile and is included in the total estimated length of power lines for Alternative D.

The ROW widths that would be required for power lines under Alternative D would be the same as those described for the Proposed Action, and Alternatives A, B, and C. The total length of power line would be 208 miles, of which approximately 191 miles would require a 100-foot-wide ROW and 17 miles would require a 50-foot-wide ROW.

Electrical Substations

Under Alternative D, there would be two primary and two secondary electrical substations. The primary electrical substations would be the same as described for the Proposed Action (Section 2.5.1.3) and Alternatives A, B, and C. The secondary electrical substations would be the same as the Cave and Coyote Spring Valley facilities described for the Proposed Action and Alternatives A, B, and C.

2.6.4.3 Ancillary Facilities

The ancillary facilities that would be required under Alternative D include pumping stations, regulating tanks, pressure-reducing stations, water treatment facility and buried storage reservoir, access roads, and communications facilities. Regulating tanks and pumping stations could be downsized by approximately 20 percent of their capacity with the reduced quantity of water under this alternative.

Pumping Stations

Under Alternative D, two pumping stations would be required: Spring Valley South and Lake Valley. The pumping station descriptions and ROW requirements for these facilities would be the same as described for the Proposed Action (Section 2.5.1.4) and Alternatives A, B, and C. Although the capacity of these facilities under Alternative D might be slightly smaller than under the Proposed Action or Alternatives A, B, or C, these reductions would not be enough to reduce the amount of permanent and temporary ROWs required for construction.

Regulating Tanks

Five regulating tanks would be required to regulate water flow through the pipeline in Spring, Lake, Delamar, Dry Lake, and Cave valleys. The facility descriptions and ROW requirements would be the same as described for the Proposed Action (Section 2.5.1.4) and Alternatives A, B, and C. Although the capacity of these facilities under Alternative D might be slightly smaller than under the Proposed Action and Alternatives A, B, and C, these reductions would not be enough to reduce the amount of permanent and temporary ROWs required for construction.

Pressure-reducing Stations

Because of elevation grade changes, three pressure-reducing stations would be required to reduce pressure and control flow within the pipeline. Two stations would be in Dry Lake Valley, and one would be in northern Coyote Spring Valley. These facilities would be the same as described for the Proposed Action (Section 2.5.1.4) and Alternatives A, B, and C.

Water Treatment Facility/Buried Storage Reservoir

The water treatment facility and buried storage reservoir site and structures would be the same as described for the Proposed Action (Section 2.5.1.4) and Alternatives A, B, and C. The water treatment facility would be sized for an approximate flow of 107 million gallons per day, based on the anticipated maximum flow. The buried storage reservoir would remain the same size (40 million gallons), to meet downstream daily flow requirements.

Access Roads

Access roads for construction and operation also would be required under Alternative D (**Figure 2.6-7**). These roads generally would be as described for the Proposed Action and Alternatives A, B, and C (Section 2.5.1.4), with the following differences:

Access Roads—Alternative D
Access roads for this alternative total 315 miles.

- Paved existing road: 3 miles
- Improved existing road: 70 miles
- Improved new road: 228 miles
- Unimproved existing road: 14 miles

2.6.4.4 Construction Procedures

Construction procedures would be the same as described for the Proposed Action.

2.6.4.5 Construction Schedule

The anticipated construction schedule and projected workforce is illustrated in **Figure 2.6-8**. The construction workforce for the pipeline and ancillary facilities would be employed approximately 7 years.

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2.6.4.6 Construction Workforce

The construction workforce for the pipeline and ancillary facilities would be employed approximately 7 years (**Figure 2.6-8**).

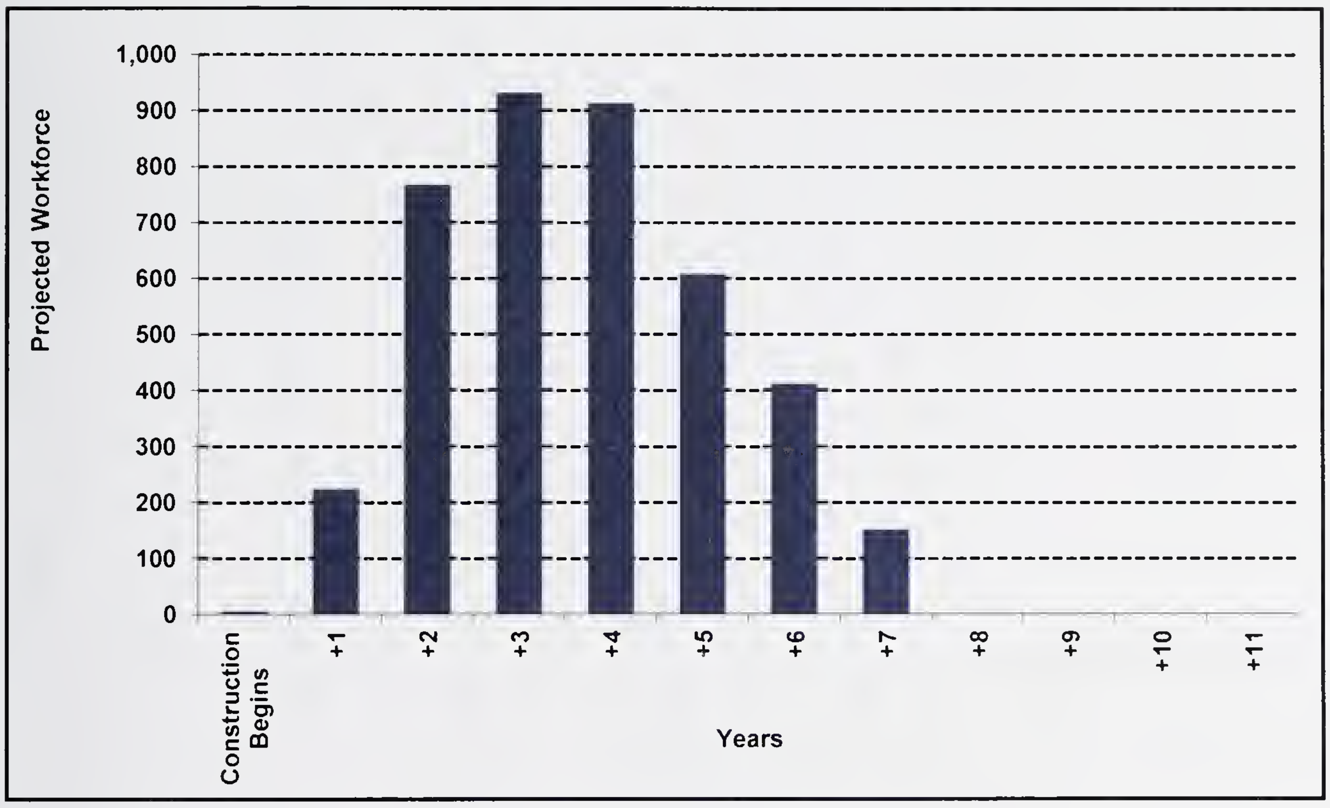


Figure 2.6-8 Construction Workforce Estimate—Alternative D

Table 2.6-13 provides a list of project construction milestones for the main line pipeline and ancillary facilities. It is anticipated that groundwater well development, and ancillary facility construction would proceed northward by valley (Spring, Delamar, Dry Lake valleys).

Table 2.6-13 Construction Milestones for Alternative D

Facility		Duration (years)
Main Pipeline	South Terminus to Reservoir/Water Treatment Facility	4.0
	Reservoir/Water Treatment Facility to Delamar Valley Regulating Tank	2.0
	Delamar Valley Regulating Tank to Dry Lake Valley Regulating Tank	1.75
	Dry Lake Valley Regulating Tank to Muleshoe Regulating Tank	1.75
	Muleshoe Regulating Tank to Spring Valley Regulating Tank	1.75
	Spring Valley Regulating Tank to Spring South Pumping Station	1.5
Lateral Pipelines	Cave Valley Lateral	1.0
Pumping Stations	Lake Valley Pumping Station	1.5
	Spring Valley South Pumping Station	2.0
Pressure Reducing Stations	Coyote Spring Valley Pressure-reducing Station	0.5
	Dry Lake Valley South Pressure-reducing Station	0.5
	Dry Lake Valley North Pressure-reducing Station	0.75
Water Treatment Facility/ Buried Storage Reservoir Site	Buried Storage Reservoir	2.25
	Water Treatment Facility	1.5
Power Facilities	Transmission, Distribution, and Substations	3.5

2.6.4.7 Operation and Maintenance

Operation and maintenance procedures, including staffing and monitoring frequency, would be the same as described for the Proposed Action (Section 2.5.1.8) and Alternatives A, B, and C.

2.6.4.8 Future Facilities

Conceptual Groundwater Development Volumes and Schedule

Alternative D would include development of a reduced quantity of the SNWA existing water rights and application volumes in Spring, Delamar, Dry Lake, and Cave valleys. The total volume of groundwater analyzed for development under this alternative would be up to 78,755 afy. The development schedule for Alternative D would be shorter than for the Proposed Action; full development would be completed in 31 years (**Figure 2.6-9**). The future groundwater production and ancillary facilities would be reduced, since there would be no groundwater development by the SNWA in Snake Valley.

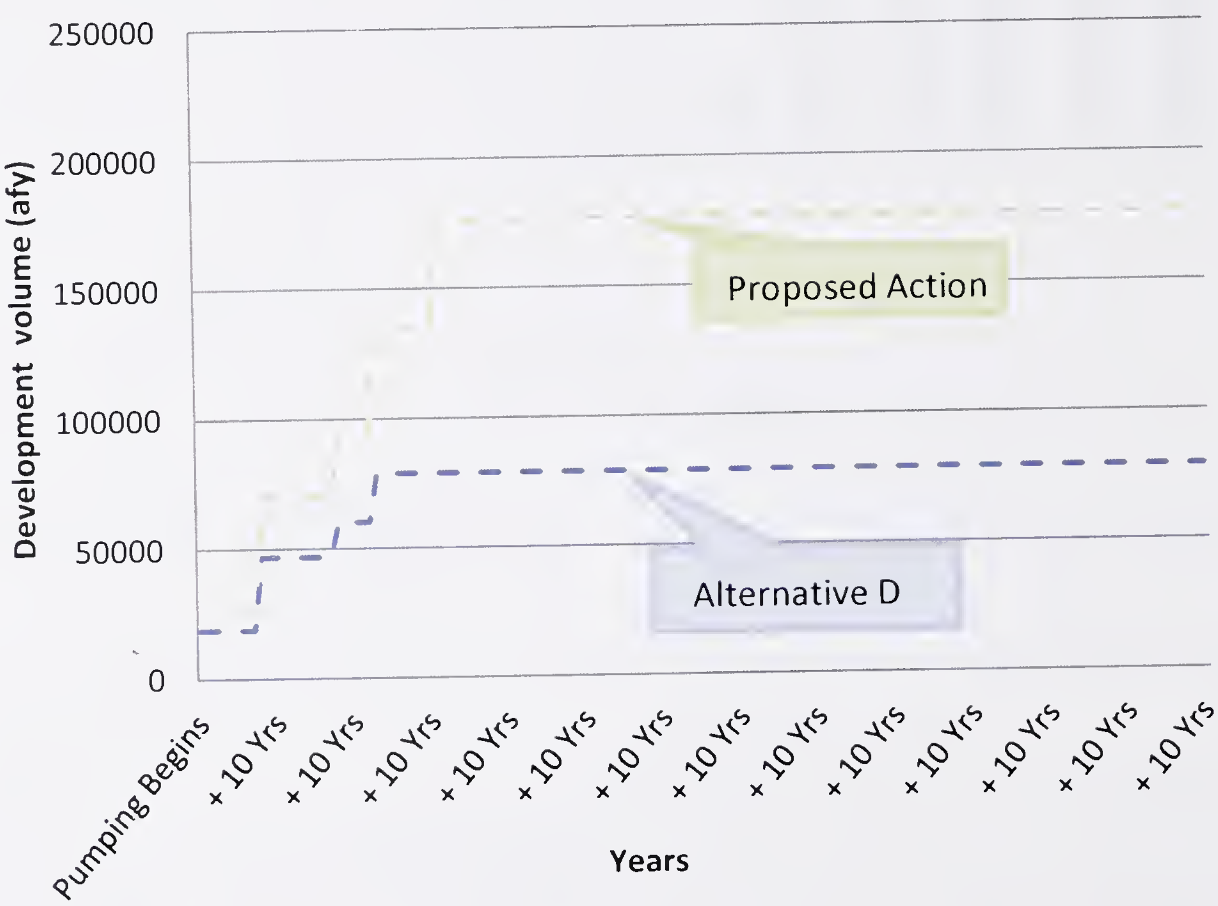


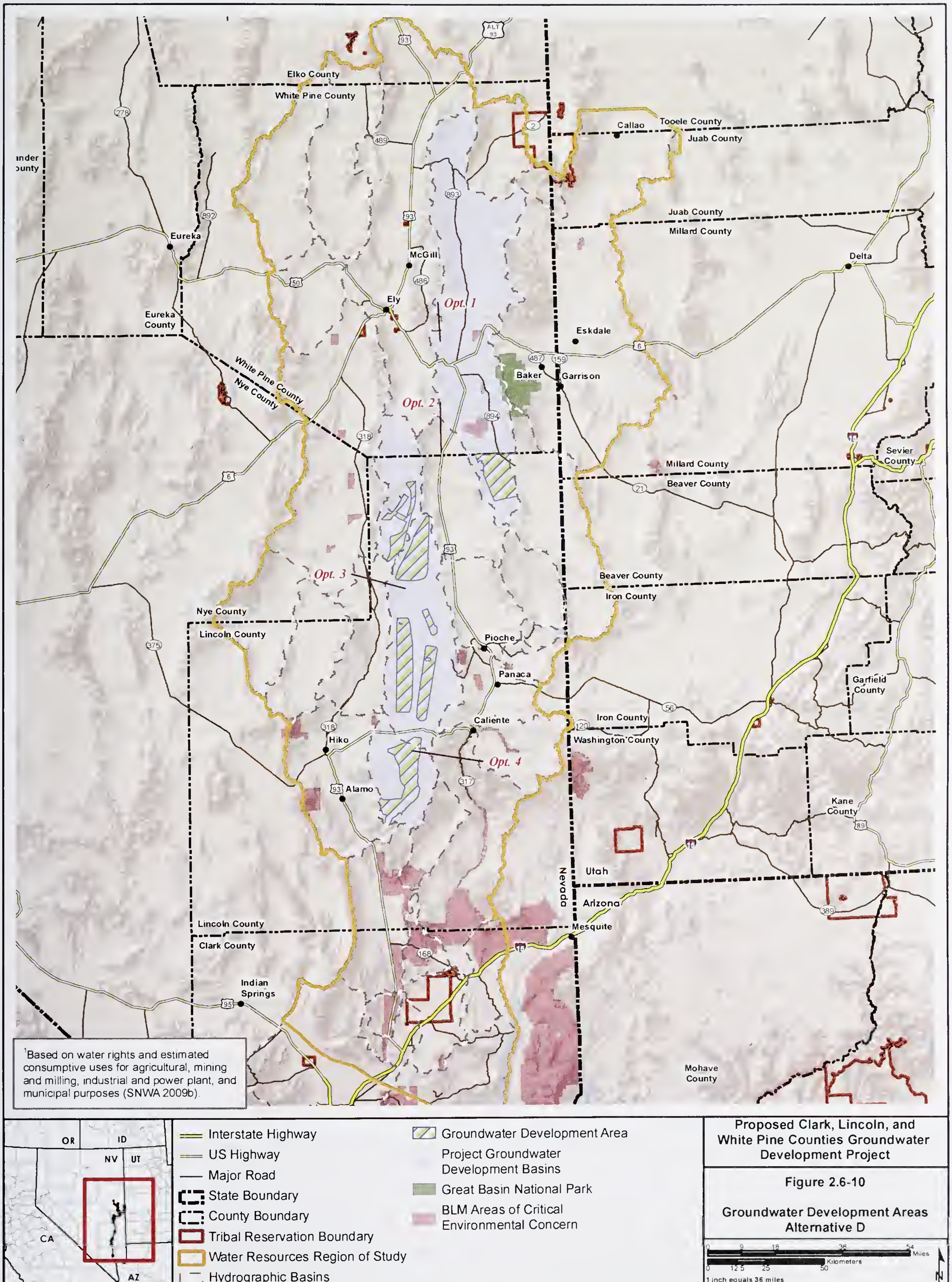
Figure 2.6-9 Groundwater Development Volumes for Alternative D (and the Proposed Action)

Conceptual Groundwater Development Plan

For Alternative D, the BLM would grant only those ROWs mandated under the LCCRDA for facilities in Clark and Lincoln counties. Thus, groundwater development would occur in Delamar, Dry Lake, and Cave valleys and the southern portion of Spring Valley. All of these development areas are located within Lincoln County. Groundwater development under this alternative does not include Snake Valley because only a very small portion of Snake Valley (approximately 0.5 square mile) is within Lincoln County, and extending facilities to develop groundwater from such a small area is considered to be unreasonable (**Figure 2.6-10**). See **Table 2.6-14** for land requirements.

Table 2.6-14 Land Requirements

Surface Disturbance Estimate	Acres
Estimated Construction Disturbance	2,513 to 4,005
Temporary Disturbed Area	858 to 1,370
Permanent Disturbance	1,655 to 2,635



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 2.6-10

Groundwater Development Areas Alternative D

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

The groundwater pumping for Alternative D would be spatially distributed within Delamar, Dry Lake, and Cave valleys, as described for the Proposed Action. It is assumed that all of the SNWA's water rights in Spring Valley could be developed from the southern portion of this valley within Lincoln County. Because this is a smaller geographic area, the groundwater pumping in southern Spring Valley would be more concentrated than under the Proposed Action or other alternatives. As shown in **Figure 2.6-10**, groundwater development in southern Spring Valley would be located within an area where the entire portion of the hydrologic basin is within Lincoln County, excluding private lands, wilderness area, and areas that have slopes greater than 20 degrees.

Groundwater development under Alternative D would occur only within Lincoln County. This alternative assumes that the NSE would approve moving the points of diversion for existing permitted rights, including the SNWA's existing agricultural water rights in central and northern Spring Valley (in White Pine County), into southern Spring Valley (in Lincoln County).

Future Groundwater Production Wells

Under Alternative D, individual well yields in Delamar, Dry Lake, and Cave valleys would be the same as described for the Proposed Action, and Alternatives A and C, so those valleys would contain the same number of production wells as under the Proposed Action, and Alternatives A and C.

In Spring Valley, the wells would be distributed in the southern portion of the valley within Lincoln County in the groundwater development area displayed in **Figure 2.6-10**. Because this geographic area is smaller than the entire valley, the wells likely would be more closely spaced in southern Spring Valley than under other alternatives. The wells would be evenly distributed throughout the entire development area.

For Delamar, Dry Lake, and Cave valleys, the wells would be distributed as described for the Proposed Action and Alternatives A and C (Section 2.5.2.1). Well construction, equipment, treatment, and ROW site requirements for individual wells under Alternative D would be the same as described for the Proposed Action and Alternatives A and C.

Future Collector Pipelines

The future collector pipelines in Spring Valley would convey water from production wells distributed across southern Spring Valley within Lincoln County, as mandated under the LCCRDA. For the purposes of analysis, it is assumed that collector pipelines would form a grid across the southern portion of the valley, with the following characteristics:

- Six primary collector pipelines extending from the main pipeline across the valley:
  - Three each at 6 miles in length;
  - One at 4 miles; and
  - Two at 3 miles.
- Individual wells spaced approximately 1 mile apart and as far as 1 mile from the primary collector lines.

Thus, the estimated length of collector pipelines for Spring Valley under Alternative D would be between 127 and 206 miles.

Assumptions of the potential lengths, sizes, ROW width requirements, and staging area dimensions of future collector pipelines for Delamar, Dry Lake, and Cave valleys would be the same as described under the Proposed Action (Section 2.5.2.2) and Alternatives A and C.

Comparison to Proposed Action

ROW requirements and groundwater development facilities that differ from the Proposed Action are shown in **Table 2.6-15**.

Table 2.6-15 Alternative D, Comparison to the Proposed Action

	Proposed Action	Alternative D
ROW and Facility Requirements		
Power Requirements (MW)	97	54
Conceptual Analysis – Groundwater Development Plan		
Volume of Developed Groundwater (afy)	176,655	78,755
Intermittent Pumping	No	No
Programmatic Analysis – Future Facilities		
Groundwater Production Wells (number, distribution)	144 to 174 within 5 basins; dispersed within the groundwater development area	69 to 83 within 4 basins; dispersed within the groundwater development area
Collector Pipelines (miles)	177 to 434	127 to 206
Staging Areas (number of 1-acre sites)	59 to 145	42 to 69
Electric Power Lines (miles)	177 to 434	127 to 206
Estimated Construction Disturbance (acres)	3,590 to 8,410	2,513 to 4,005
Temporary Disturbed Area to be Revegetated (acres)	1,216 to 2,874	858 to 1,370
Permanent Disturbance (acres)	2,374 to 5,536	1,655 to 2,635

2.6.5 Alternative E, Distributed Pumping at Reduced Quantities - Spring, Delamar, Dry Lake, and Cave Valleys

Alternative E was designed to address concerns regarding potential effects from groundwater development in Snake Valley. The volume of groundwater developed under Alternative E would be the same as Alternative D, because no water would be developed in Snake Valley.

Key Points – Alternative E

- Alternative E represents Alternative A, minus development in Snake Valley.
- Alternative E would consist of 263 miles of buried pipelines, 280 miles of overhead power lines, 6 electrical substations, and ancillary facilities.
- Up to 2,683 acres of permanent ROW and 1,396 acres of temporary ROW would be required.
- Alternative E would develop up to 78,755 afy of groundwater from 4 basins (Snake Valley not included).

Unlike the Proposed Action, ROWs for Alternative E would be granted only within Spring, Delamar, Dry Lake, and Cave valleys. Consequently, Alternative E differs from the Proposed Action in the following manner:

- Mainline pipeline segments would differ in diameter, length, and location (**Table 2.6-16**);
- Like Alternative D, the volumes of groundwater developed would not exceed 78,755 afy (**Table 2.1-2**). No water would be developed by the SNWA in Snake Valley;
- No pipeline laterals, power line laterals, or groundwater development by the SNWA would be constructed in Snake Valley (i.e., the SNWA would not be able to access any groundwater that may be permitted by the NSE in that basin);
- The number and size of ancillary facilities, including pumping stations, regulating tanks, and access roads, would be reduced;
- Power facilities would be similar, excluding power facilities for Snake Valley;
- Land requirements would be less;
- Proposed pumping would reach full volumes in approximately 31 years;
- Workforce requirements would be less;
- The overall construction schedule would be shorter, with the elimination of the Snake Valley lateral;
- Future ancillary facilities would be fewer;
- Land ownership for the requested ROWs; and
  - BLM – 98 percent
  - Private – 2 percent
  - State of Nevada – less than 1 percent
- Estimated land requirements and ROW restoration.
  - Estimated Construction Disturbance – 10,681 acres
  - Temporary Disturbed Area – 9,736 acres
  - Permanent Disturbance – 945 acres

ROWs would be required across federal lands that are managed by the BLM, state lands (Nevada National Guard in east-central Las Vegas Valley and Steptoe Valley Wildlife Management Area), and private lands (Apex area in east-central Las Vegas Valley, land in central Coyote Spring Valley, and land in west Caliente).

2.6.5.1 Pipeline System

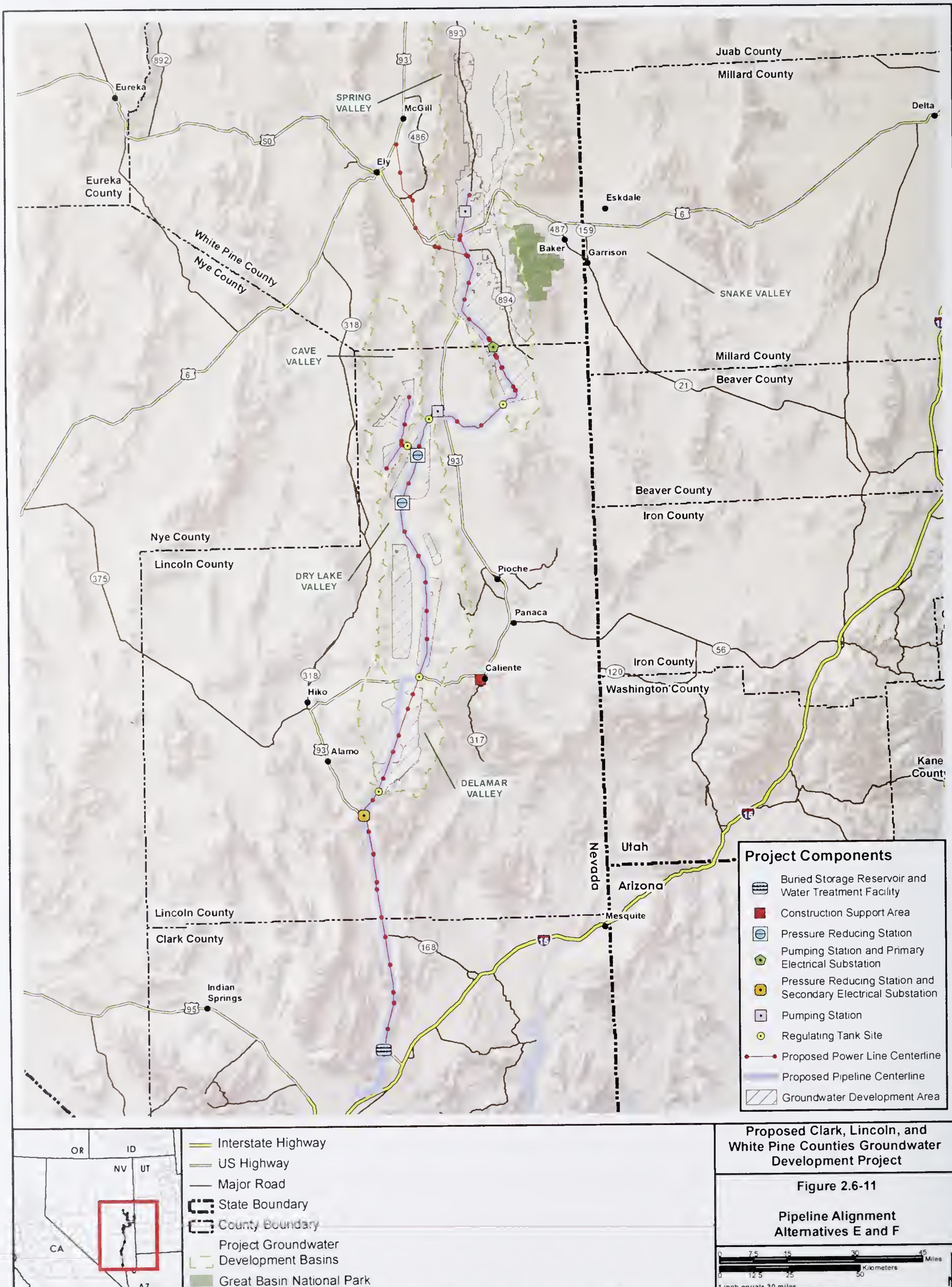
To convey the volumes of water identified under this alternative, a total of approximately 263 miles of pipelines would be required under Alternative E (**Figure 2.6-11**). The pipeline system would consist of a buried main pipeline and two lateral pipelines (Spring and Cave valleys). **Table 2.6-16** lists Alternative E pipeline lengths and anticipated pipe diameters by valley.

Table 2.6-16 Pipeline Lengths, Alternative E

Pipeline	Valley	Pipe Diameter (inches in diameter)	Pipe Length (miles)
Main Pipeline	Spring	60-66	17
	Lake	54-66	21
	Dry Lake	54-78	66
	Delamar	60-72	23
	Pahranagat	42-66	7
	Coyote Spring	42-78	41
	Hidden	66-78	12
	Garnet	60-72	7
	Las Vegas	60-72	9
Spring Lateral	Spring	42-54	38
Cave Lateral	Cave	16-30	19
	Dry Lake	16-30	3
Total			**263**

The final sizes of the main and lateral pipelines would be determined during facility design. Because of the reduced quantity of water that would be developed under this alternative, pipeline diameters are as much as 18 inches smaller than those under the Proposed Action. Because facilities are sized for hydraulic efficiencies, facility size reductions are not directly proportional to decreased water volume.

The pipeline work area requirements would be the same as described for the Proposed Action. Because most of the pipeline ROW width requirements are associated with the space required for construction (**Figure 2.5-2**), reductions in pipe diameters would not affect the widths of the required permanent and temporary construction ROWs.



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 2.6-11

Pipeline Alignment Alternatives E and F

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

2.6.5.2 Power Facilities

The power facilities for Alternative E would be the same as described for the Proposed Action, excluding the power facilities associated with the Snake Valley Lateral.

The anticipated power supply to operate project facilities for Alternative E would be approximately 55 MW (**Table 2.6-17**) and would be obtained from the Silverhawk Generating Station as described for the Alternative D.

Table 2.6-17 Anticipated Operational Power Requirements for Alternative E

Proposed Facilities	Power (MW)
Spring Valley North Pumping Station	3
Spring Valley South Pumping Station	11
Lake Valley Pumping Station	12
Buried Storage Reservoir	<1
Water Treatment Facility	2
Anticipated Future Groundwater Wells and Associated Facilities	28 (estimated)
Total[1]	**55**

[1] The total is less than the sum of the individual power requirements due to the effects of rounding.

Power Lines

Power lines would include 230-kV, 69-kV, and 25-kV conductors, as described for the Proposed Action. The locations of the power lines, including where multiple conductor voltages would be hung on the same pole, as illustrated on **Figure 2.6-12**. **Table 2.6-18** summarizes the power line lengths for Alternative E.

Table 2.6-18 GWD Project Power Lines for Alternative E

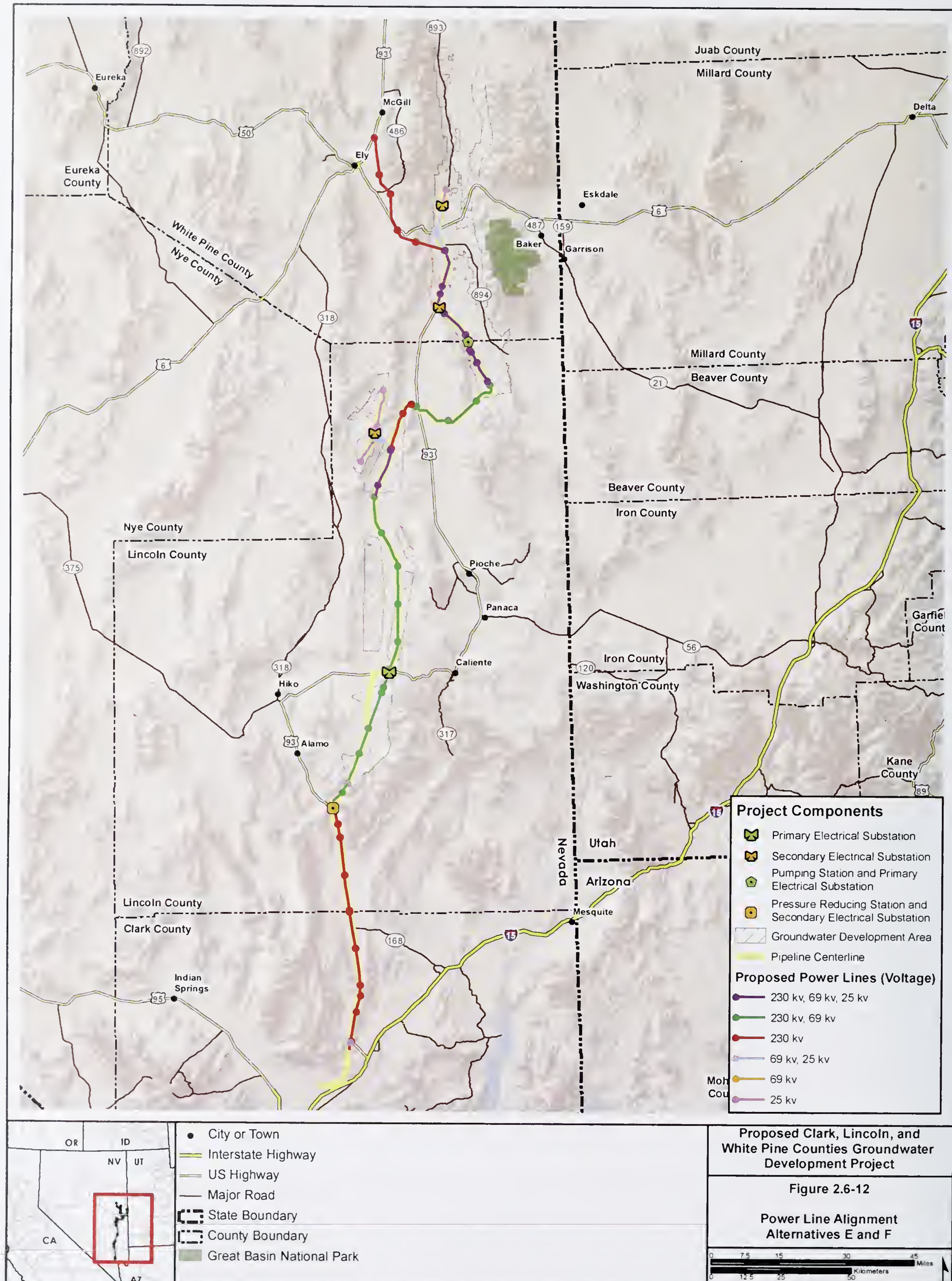
Power Line Conductor Voltages[1]	Total Miles
230-kV power line	100
25-kV power line	21
230-kV power line with 69-kV and 25-kV underhang	46
230-kV power line with 69-kV underhang	97
69-kV power line with 25-kV underhang	16
Total	**280**

[1] The only GWD Project 69-kV power line without an underhang was proposed for the Snake Lateral, which is not part of this alternative, thus, there is no listing for 69-kV (no underhang) on this table.

The ROW widths that would be required for power lines under Alternative E would be the same as those described for the Proposed Action. The total length of power line for Alternative E would be 280 miles, of which approximately 259 miles would require a 100-foot-wide ROW and 21 miles would require a 50-foot-wide ROW.

Electrical Substations

Under Alternative E, there would be two primary and four secondary electrical substations. The electrical substations would be the same as described for the Proposed Action, excluding the Snake Valley secondary substation.



No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

2.6.5.3 Ancillary Facilities

Ancillary facilities required are the same as described for the Proposed Action, with the exception of the two Snake Valley pumping stations. As described for Alternative D, regulating tank and pumping station capacities could be downsized approximately 20 percent from the Proposed Action with the reduced quantity of water conveyed under this alternative. However, these reductions would not be enough to reduce the amount of permanent and temporary ROWs required for construction.

Pumping Stations

Under Alternative E, three pumping stations would be required: Spring Valley North and South, and Lake Valley. The pumping station descriptions and ROW requirements for these facilities would be the same as described for the Proposed Action. Although the capacity of these facilities under this alternative might be slightly smaller than capacity under the Proposed Action, these reductions would not be large enough to reduce the amounts of permanent and temporary ROWs required for construction.

Regulating Tanks

The five regulating tanks would be the same as described for the Proposed Action, and would be sized as described for Alternative D.

Pressure-reducing Stations

The three pressure-reducing stations would be the same as described for the Proposed Action.

Water Treatment Facility/Buried Storage Reservoir

The water treatment facility and buried storage reservoir would be the same as described for the Proposed Action and would be sized as described for Alternative D.

Access Roads

Access roads needed for construction and operation under Alternative E would generally be the same as described for the Proposed Action, but would be reduced to a total of 388 miles due to the elimination of the Snake Valley Lateral and associated facilities (**Figure 2.6-13**).

- Paved existing road: 14 miles
- Improved existing road: 70 miles
- Improved new road: 258 miles
- Unimproved existing road: 28 miles
- Unimproved new road: 20 miles

Communications Facilities

Communications facilities would be the same as described for the Proposed Action.

2.6.5.4 Construction Procedures

Construction procedures would be the same as described for the Proposed Action.

2.6.5.5 Construction Workforce

The construction workforce for the pipeline and ancillary facilities would be employed for approximately 7 years (**Figure 2.6-14**).

2.6.5.6 Construction Schedule

The anticipated construction schedule would be the same as described for the Proposed Action, excluding the Snake Valley Lateral and associated facilities (**Table 2.6-19**).

Figure 2.6-13

Access Roads Alternatives E and F

Table 2.6-19 Construction Milestones for Alternatives E and F

Facility		Duration (years)
Main Pipeline	South Terminus to Reservoir/Water Treatment Facility	4.0
	Reservoir/Water Treatment Facility to Delamar Valley Regulating Tank	2.0
	Delamar Valley Regulating Tank to Dry Lake Valley Regulating Tank	1.75
	Dry Lake Valley Regulating Tank to Muleshoe Regulating Tank	1.75
	Muleshoe Regulating Tank to Spring Valley Regulating Tank	1.75
	Spring Valley Regulating Tank to Spring South Pumping Station	1.5
Lateral Pipelines	Cave Valley Lateral	1.0
	Spring Valley South	2.0
	Spring Valley North	0.5
Pumping Stations	Lake Valley Pumping Station	1.5
	Spring Valley South Pumping Station	2.0
	Spring Valley North Pumping Station	1.5
Pressure Reducing Stations	Coyote Spring Valley Pressure-reducing Station	0.5
	Dry Lake Valley South Pressure-reducing Station	0.5
	Dry Lake Valley North Pressure-reducing Station	0.75
Water Treatment Facility/ Buried Storage Reservoir Site	Buried Storage Reservoir	2.25
	Water Treatment Facility	1.5
Power Facilities	Transmission, Distribution, and Substations	3.5

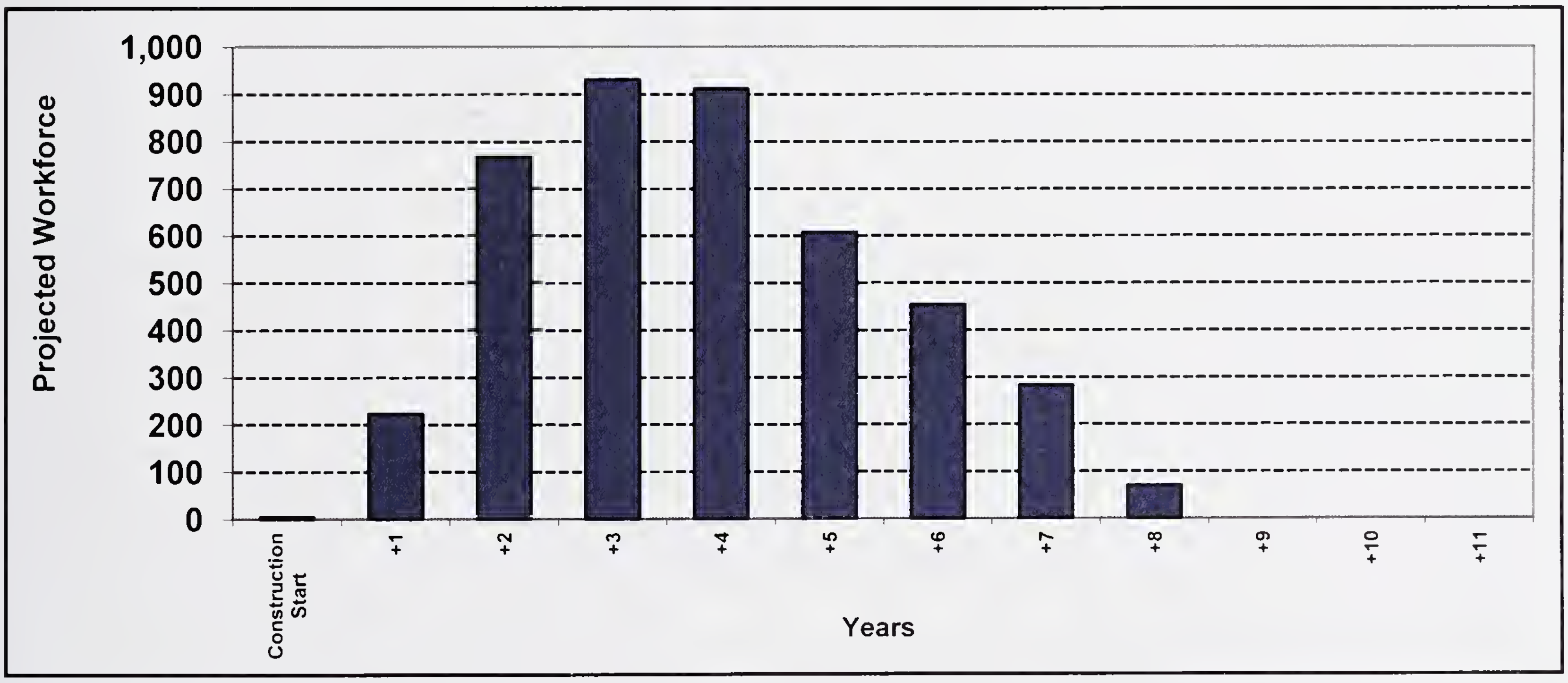


Figure 2.6-14 Construction Workforce Estimate – Alternatives E and F

2.6.5.7 Operation and Maintenance

Operation and maintenance procedures, including staffing and monitoring frequency, would be the same as described for the Proposed Action.

2.6.5.8 Future Facilities

Conceptual Groundwater Development Schedule and Volumes

Alternative E would include development of a reduced quantity of the SNWA existing water rights and application volumes in Spring, Delamar, Dry Lake, and Cave valleys. The total volume of water that is analyzed for conveyance under Alternative E (78,755 afy) would be the same as described under Alternative D, which is reduced quantity in four development basins (Section 2.1.1). A summary of groundwater development facilities is provided in **Table 2.6-2** and the groundwater development volume and schedule is shown in **Figure 2.6-15**.

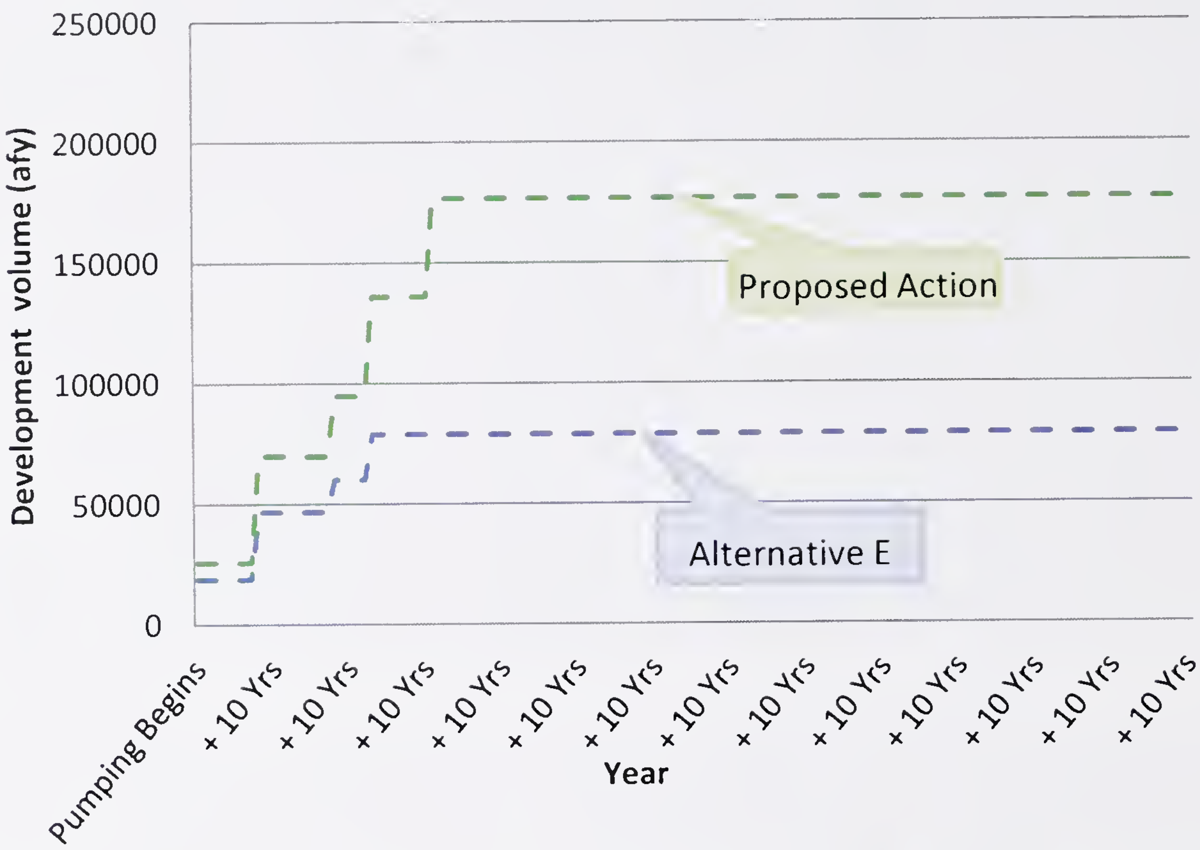


Figure 2.6-15 Groundwater Development Volume for Alternative E (and the Proposed Action)

Conceptual Groundwater Development Plan

Alternative E would exclude groundwater development from Snake Valley. Alternative E (**Figure 2.6-16**) is similar to Alternative D, except that groundwater development in all the remaining project basins, including Spring Valley, would be spatially distributed as described for Alternative A. Under Alternative E, the BLM would not grant ROWs for the Snake Lateral and its facilities in Spring, Hamlin, and Snake valleys. ROWs in the other project basins would be as described for Alternative A. **Table 2.6-20** summarizes the estimated land and ROW restoration requirements for the groundwater development facilities.

Main Points – Alternative E Conceptual Future Facilities

Future facilities associated with Alternative E are identical to those for Alternative D, except pumping locations could be more dispersed in Spring Valley than allowed in Alternative D.

Table 2.6-20 Land Requirements

Surface Disturbance Estimate	Acres
Estimated Construction Disturbance	1,754 to 4,079
Temporary Disturbed Area	595 to 1,396
Permanent Disturbance	1,158 to 2,683

The total volume of water that is analyzed for development under Alternative E (78,755 afy) would be the same as described under Alternative D. This volume assumes the development of a portion of the pending SNWA water rights in Spring, Delamar, Dry Lake, and Cave valleys, (**Table 2.1-2**). The groundwater development schedule for Alternative E would be the same as described for Alternative D. Construction of future facilities may extend approximately 28 years.

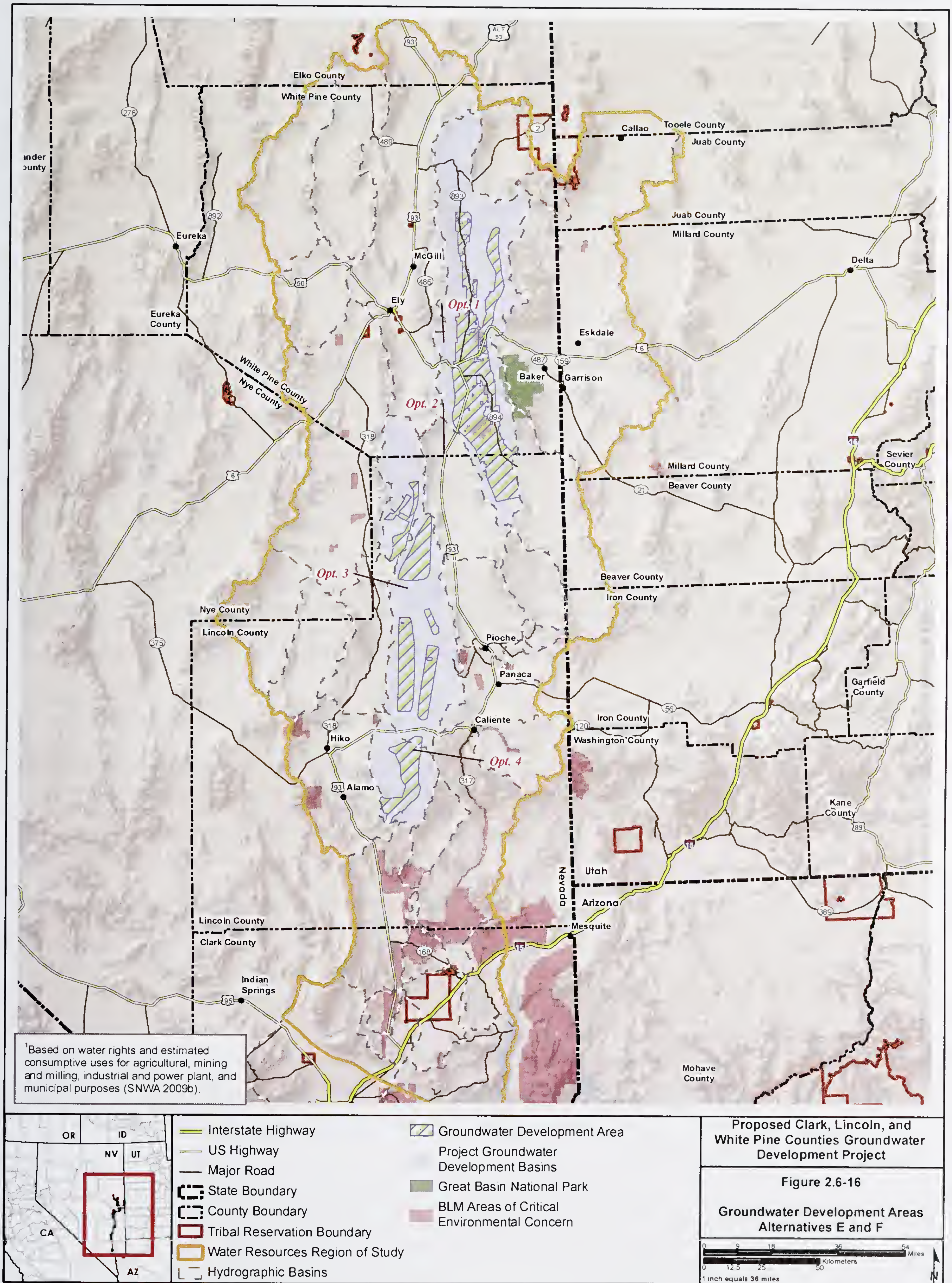


Figure 2.6-16

Groundwater Development Areas Alternatives E and F

Future Groundwater Production Wells

Under Alternative E, individual well yields in Spring, Delamar, Dry Lake, and Cave valleys would be the same as described for Alternative A, so those valleys would contain the same number of production wells as under Alternative A. However, under Alternative E, no production wells or associated facilities would be developed in Snake Valley.

For Spring, Delamar, Dry Lake, and Cave valleys, the wells would be distributed as described for Alternative A (Section 2.5.2.1). Well construction, equipment, treatment, and ROW site requirements for individual wells under Alternative E in these valleys would be the same as described for Alternative A. No development would occur in Snake Valley under Alternative E.

Future Collector Pipelines

Assumptions of the potential lengths, sizes, ROW width requirements, and staging area dimensions of future collector pipelines for Spring, Delamar, Dry Lake, and Cave valleys would be the same as described under Alternative A (Section 2.5.2.2). No pipelines would be developed in Snake Valley under Alternative E.

2.6.5.9 Future Power Facilities

Additional distribution power lines and substations would convey power to the future groundwater production wells and future pumping stations. The future power lines would be overhead 25-kV power lines, routed along the future collector pipeline alignments. Thus, the length of new overhead 25-kV power lines is assumed to be the same as the collector pipeline lengths. Additional 25-kV conductors might need to be hung on the power poles that are constructed as part of the GWD Project primary power supply system. The ROW width requirements for future distribution power lines (25 kV) would be 50 feet of permanent ROW.

Additional secondary substations might be required to reduce power from 69 to 25 kV and to provide operational power to future groundwater production wells and pumping station. Their locations would depend on the specific locations of the groundwater production wells and pumping stations. However, an additional 69/25-kV substation probably would be required in both Dry Lake and Delamar valleys. Each of the future substations would require a site of about 1 acre.

2.6.5.10 Future Ancillary Facilities

Pumping Stations

Two future pumping stations would be required to convey water from some of the future groundwater production well areas into the main and lateral pipelines. Based on known topography, a pumping station in Dry Lake Valley and one in Delamar Valley might be required. These facilities would be similar to the Lake Valley pumping station (Section 2.5.1.4). Five acres of permanent and 5 acres of temporary ROW would be required for each pumping station.

Access Roads

Access roads to future facilities would be located within the collector pipeline ROW. These might be either new roads or improvements to existing roads within the ROW. The road improvements could include grading, widening, and installing culverts, where needed. Gravel might be applied in some areas, if necessary, to maintain road conditions. Improved dirt roads would be 20 feet wide. No additional permanent or temporary access road ROWs would be required because the roads would be located within the collector pipeline ROW.

Communications Facilities

Communications facilities would be installed along with groundwater production wells, collector pipelines, and other facilities for system operation and control, data collection, communication, and security surveillance. Conduits for fiber-optic cables could be installed along with the collector pipelines. The fiber-optic cables would be installed underground in either the pipeline trench or adjacent access road, and would be contained within the requested ROW. No additional ROW would be required.

Hydroturbines

Hydroturbines may be installed in the future to generate electrical power as the water flows from higher to lower elevations. These facilities would be built belowground, with turbines placed within pipeline bypass piping. Electrical power generated by the hydroturbines would be used by the GWD Project or added to the utility grid. For operation of future facilities, it is estimated that future hydroturbines installed at the pressure reducing station sites could generate approximately 62 MW of power. The hydroturbines would be located within other sites and additional ROW is not anticipated to be required These facilities would require permitting through the Federal Energy Regulatory Commission.

Future Right-of-way Requirements

Future distribution power lines (25 kV) would require a 50-foot-wide permanent ROW. Each of the future substations may require a 1-acre site.

2.6.5.11 Future Construction and Operations

Future construction methods would be similar to those described in Section 2.5.1.5 and would be in compliance with applicable federal and state regulations and the BLM and industry standards at the time of construction. Estimated future workforce requirements are identified in **Figure 2.5-7**.

Future operations would be similar to those described in Section 2.5.1.8 and would be in compliance with applicable federal and state regulations and the BLM and industry standards at the time of operation.

2.6.5.12 Abandonment

The ROW would be granted in accordance with the FLPMA, the SNPLMA, and the LCCRDA. In accordance with the LCCRDA and the SNPLMA, the ROW is granted in perpetuity. Termination and abandonment are not anticipated, unless exceptional circumstances should arise. In such a case, the termination and abandonment would be subject to approvals by the BLM. Termination and abandonment plans would be written in accordance with current management procedures and would be submitted to the BLM in advance of any associated actions. If the GWD Project were to be abandoned in part or in whole, the ROW would revert to the land managing agencies.

If upgrade or replacement of facilities is required, the SNWA would coordinate with the BLM prior to initiating major construction, in accordance with applicable stipulations of the final ROW grant.

Comparison to Proposed Action

ROW requirements and groundwater development facilities that differ from the Proposed Action are shown in **Table 2.6-21**.

Table 2.6-21 Alternative E, Comparison to the Proposed Action

	Proposed Action	Alternative E
ROW and Facility Requirements		
Power Requirements (MW)	97	55
Conceptual Analysis – Groundwater Development Plan		
Volume of Developed Groundwater (afy)	176,655	78,755
Intermittent Pumping	No	No
Programmatic Analysis – Future Facilities		
Groundwater Production Wells (number, distribution)	144 to 174 within 5 basins; dispersed within the groundwater development area	69 to 83 within 4 basins; dispersed within the groundwater development area
Collector Pipelines (miles)	177 to 434	86 to 210
Staging Areas (number of 1-acre sites)	59 to 145	29 to 70
Electric Power Lines (miles)	177 to 434	86 to 210
Estimated Construction Disturbance (acres)	3,590 to 8,410	1,754 to 4,079
Temporary Disturbed Area to be Revegetated (acres)	1,216 to 2,874	595 to 1,396
Permanent Disturbance (acres)	2,374 to 5,536	1,158 to 2,683

2.6.6 Alternative F, Distributed Pumping at Reduced Quantities - Spring, Delamar, Dry Lake, and Cave Valleys

The CEQ guidance titled: *Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations"* was created to assist Agencies to efficiently and consistently respond to public inquiries on common topics related to implementation of the NEPA. Question 29 in the guidance addresses the options available to the agencies for analysis of new alternatives between the Draft EIS and Final EIS. CEQ specifically allows an agency to develop new alternative(s) that are variations of alternatives analyzed in the Draft EIS. The CEQ states that the new alternative should be qualitatively within the spectrum of alternatives analyzed in the Draft EIS. In such a case, the agency is allowed to develop and evaluate one or more additional alternatives, if reasonable, in the Final EIS.

Based upon this guidance, the BLM has developed and analyzed Alternative F in this Final EIS. Alternative F proposed groundwater withdrawal volumes are within (bracketed by) the qualitative spectrum of the Proposed Action and Alternative E and the alternative is equivalent to Alternative E in regard to construction footprint and numbers and types of facilities.

Key Points – Alternative F

- Alternative F represents Alternative A, minus development in Snake Valley.
- Alternative F would develop up to 114,129 afy of groundwater from four basins (Snake Valley not included).

The agency's decision to develop the new alternative was based upon input from the applicant, review of public comments, and the desire to analyze a greater range of alternatives in the Final EIS. The proposed development of the main water conveyance pipeline and related facilities is consistent with that analyzed for Alternative E in the Draft EIS. The larger groundwater development volumes and pumping-related impacts presented and analyzed for Alternative F provide additional information for consideration by the public and decision makers.

This alternative requires ROWs for a main pipeline of up to 84 inches in diameter, lateral pipelines, and associated facilities. Similar to Alternative E, Alternative F was designed to address concerns regarding potential effects from groundwater development in Snake Valley.

Unlike the Proposed Action, ROWs for Alternative F would be granted only in Spring, Delamar, Dry Lake, and Cave valleys. Consequently, Alternative F differs from the Proposed Action in the following manner:

- Mainline pipeline segments would differ in diameter, length, and location (**Table 2.6-22**);
- The volume of groundwater developed would not exceed 114,129 afy (**Table 2.1-2**). No water would be developed by the SNWA in Snake Valley;
- No pipeline laterals, power line laterals, or groundwater development by the SNWA would be constructed in Snake Valley (i.e., the SNWA would not be able to access any groundwater that may be permitted by the NSE in that basin);
- The number and size of ancillary facilities, including pumping stations, regulating tanks, and access roads would be reduced;
- Power facilities would be similar, excluding power facilities for Snake Valley;
- Land requirements would be less;
- Proposed pumping would reach full volumes in approximately 23 years;
- Workforce requirements would be less;
- The overall construction schedule would be shorter, with the elimination of the Snake Valley lateral;
- Future ancillary facilities would be fewer;

- Land ownership for the requested ROWs; and
  - BLM – 98 percent
  - Private – 2 percent
  - State of Nevada – <1 percent
- Estimated land requirements and ROW restoration.
  - Estimated Construction Disturbance – 10,681 acres
  - Temporary Disturbed Area – 9,736 acres
  - Permanent Disturbance – 945 acres

ROWs would be required across federal lands that are managed by the BLM, state lands (Nevada National Guard in east-central Las Vegas Valley and Steptoe Valley Wildlife Management Area), and private lands (Apex area in east-central Las Vegas Valley, land in central Coyote Spring Valley, and land in west Caliente).

2.6.6.1 Pipeline System

To convey the volumes of water identified under this alternative, a total of approximately 263 miles of pipelines would be required under Alternative F (**Figure 2.6-11**). The pipeline system would consist of a buried main pipeline and two lateral pipelines (Spring and Cave valleys). **Table 2.6-22** lists Alternative F pipeline lengths and anticipated pipe diameters by valley. The final sizes of the main and lateral pipelines would be determined during facility design. Because of the reduced quantity of water that would be developed under this alternative, pipeline diameters could be as much as 12 inches smaller than those under the Proposed Action. Because facilities are sized for hydraulic efficiencies, facility size reductions are not directly proportional to decreased water volume.

Table 2.6-22 Pipeline Lengths, Alternative F

Pipeline	Valley	Pipe Diameter (inches in diameter)	Pipe Length (miles)
Main Pipeline	Spring	60-66	17
	Lake	60-66	21
	Dry Lake	66-72	66
	Delamar	72-78	23
	Pahranagat	54-72	7
	Coyote Spring	78-84	41
	Hidden	72-78	12
	Garnet	72-78	7
	Las Vegas	72-78	9
Spring Lateral	Spring	60-66	38
Cave Lateral	Cave	24-30	19
	Dry Lake	24-30	3
Total			**263**

The pipeline work area requirements would be the same as described for Alternative E. Because most of the pipeline ROW width requirements are associated with the space required for construction (**Figure 2.5-2**), reductions in pipe diameters would not affect the widths of the required permanent and temporary construction ROWs. Similarly, because facilities are sized for hydraulic efficiencies, reductions in facilities' sizes are not directly proportional to decreased water volume.

2.6.6.2 Power Facilities

The power facilities for Alternative F would be the same as described for the Proposed Action, excluding the power facilities associated with the Snake Valley Lateral.

The anticipated power supply to operate project facilities for Alternative F would be approximately 55 MW (**Table 2.6-23**) and would be obtained from the Silverhawk Generating Station as described for Alternatives D and E.

Table 2.6-23 Anticipated Operational Power Requirements for Alternative F

Proposed Facilities	Power (MW)
Spring Valley North Pumping Station	3
Spring Valley South Pumping Station	9
Lake Valley Pumping Station	10
Buried Storage Reservoir	<1
Water Treatment Facility	2
Anticipated Future Groundwater Wells and Associated Facilities	31 (estimated)
Total[1]	**55**

[1] The total is less than the sum of the individual power requirements due to the effects of rounding.

Power Lines

Power lines would include 230-kV, 69-kV, and 25-kV conductors, as described for the Proposed Action. The locations of the power lines, including where multiple conductor voltages would be hung on the same pole, as illustrated on **Figure 2.6-12**. **Table 2.6-24** summarizes the power line lengths for Alternative F.

Table 2.6-24 GWD Project Power Lines for Alternative F

Power Line Conductor Voltages[1]	Total Miles
230-kV power line	100
25-kV power line	21
230-kV power line with 69-kV and 25-kV underhang	46
230-kV power line with 69-kV underhang	97
69-kV power line with 25-kV underhang	16
Total	**280**

[1] The only GWD Project 69-kV power line without an underhang was proposed for the Snake Lateral, which is not part of this alternative, thus, there is no listing for 69-kV (no underhang) on this table.

The ROW widths that would be required for power lines under Alternative F would be the same as those described for the Proposed Action. The total length of power line for Alternative F would be 280 miles, of which approximately 259 miles would require a 100-foot-wide ROW and 21 miles would require a 50-foot-wide ROW.

Electrical Substations

Under Alternative F, there would be two primary and four secondary electrical substations. The electrical substations would be the same as described for the Proposed Action, excluding the Snake Valley secondary substation.

2.6.6.3 Other Ancillary Facilities

Ancillary facilities required are the same as described for the Proposed Action, with the exception of the two Snake Valley pumping stations. As described for Alternatives D and E, regulating tank and pumping station capacities could be downsized approximately 20 percent from the Proposed Action with the reduced quantity of water conveyed under this alternative. However, these reductions would not be enough to reduce the amount of permanent and temporary ROWs required for construction.

Pumping Stations

Under Alternative F, two pumping stations would be required: Delamar and Dry Lake valleys. The pumping station descriptions and ROW requirements for these facilities would be the same as described for the Proposed Action. Although the capacity of these facilities under this alternative might be slightly smaller than capacity under the Proposed Action, these reductions would not be large enough to reduce the amounts of permanent and temporary ROWs required for construction.

Regulating Tanks

The five regulating tanks would be the same as described for the Proposed Action, and would be sized as described for Alternatives D and E.

Pressure-reducing Stations

The three pressure-reducing stations would be the same as described for the Proposed Action.

Water Treatment Facility/Buried Storage Reservoir

The water treatment facility and buried storage reservoir would be the same as described for the Proposed Action.

Access Roads

Access roads needed for construction and operation under Alternative F generally would be the same as described for the Proposed Action, but would be reduced to a total of 388 miles due to the elimination of the Snake Valley Lateral and associated facilities (**Figure 2.6-13**).

Access roads for this alternative total 388 miles.

Communications Facilities

Communications facilities would be the same as described for the Proposed Action.

2.6.6.4 Construction Procedures

Construction procedures would be the same as described for the Proposed Action.

2.6.6.5 Construction Workforce

The construction workforce for the pipeline and ancillary facilities would be employed approximately 7 years (**Figure 2.6-14**).

2.6.6.6 Pipeline and Ancillary Facility Construction Schedule

The anticipated construction schedule would be the same as described for the Proposed Action, excluding the Snake Valley Lateral and associated facilities (**Table 2.6-19**).

2.6.6.7 Operation and Maintenance

Operation and maintenance procedures, including staffing and monitoring frequency, would be the same as described for the Proposed Action.

2.6.6.8 Future Facilities

Conceptual Groundwater Development Schedule and Volumes

Alternative F would include development of SNWA existing water rights plus water volumes up to the application amounts in Spring, Delamar, Dry Lake, and Cave valleys. The total volume of water analyzed for conveyance under Alternative F is 114,129 afy. A summary of groundwater development facilities is provided in **Table 2.6-2** and the groundwater development volume and schedule is shown in **Figure 2.6-17**.

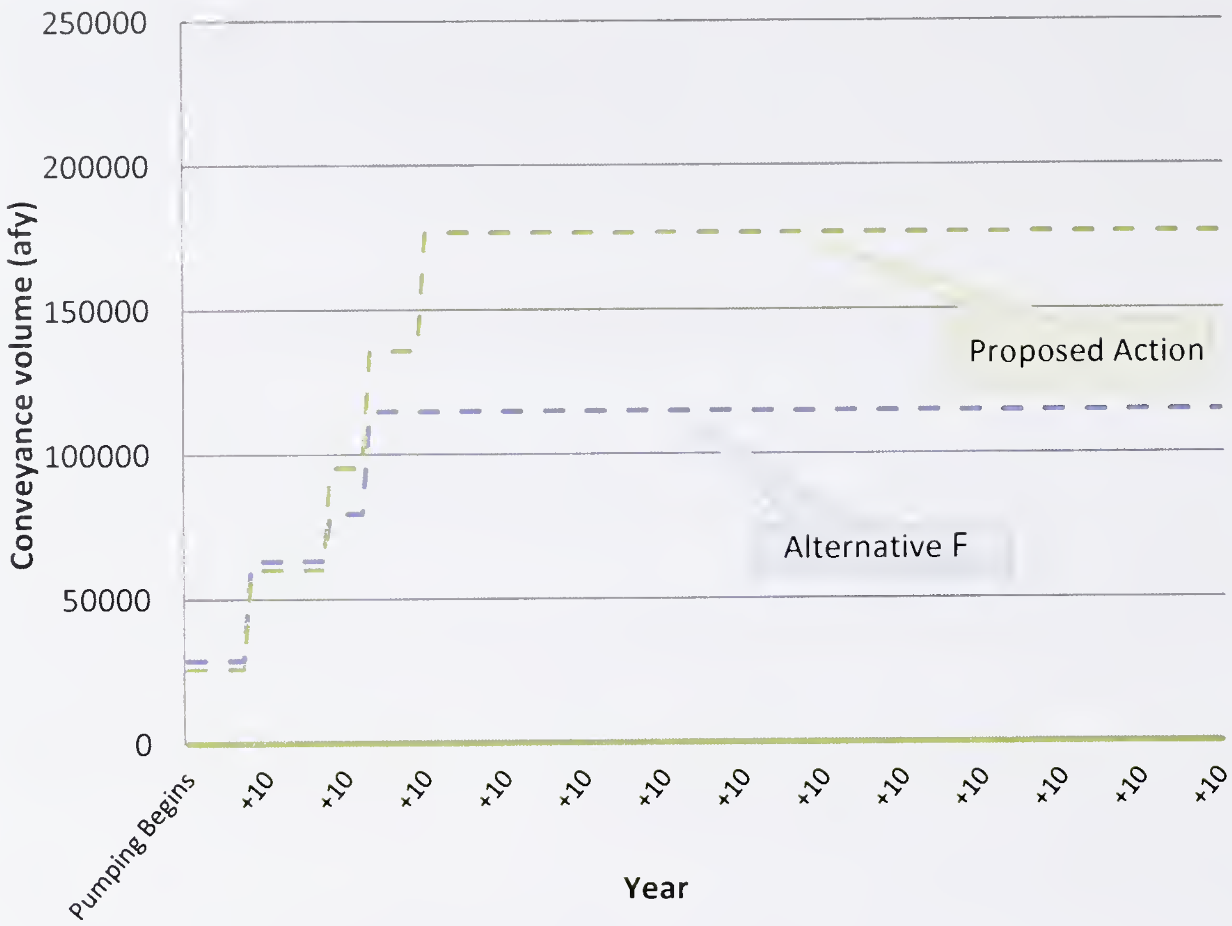


Figure 2.6-17 Groundwater Development Volume for Alternative F (and the Proposed Action)

Conceptual Groundwater Development Plan

Alternative F would exclude groundwater development from Snake Valley. Alternative F (**Figure 2.6-17**) is similar to Alternatives D and E, although groundwater development in all the remaining project basins, including Spring Valley, would be spatially distributed as described for the Proposed Action. Under Alternative F, the BLM would not grant ROWs for the Snake Lateral and its facilities in Spring, Hamlin, and Snake valleys. ROWs in the other project basins would be as described for the Proposed Action. **Table 2.6-25** summarizes the estimated land and ROW restoration requirements for the groundwater development facilities.

Table 2.6-25 Land Requirements

Surface Disturbance Estimate	Acres
Estimated Construction Disturbance	2,698 to 6,629
Temporary Disturbed Area	916 to 2,270
Permanent Disturbance	1,782 to 4,359

The total volume of water analyzed for development under Alternative F is 114,129 afy. This volume assumes the development of a portion of pending the SNWA water rights applications in Spring, Delamar, Dry Lake, and Cave valleys, (**Table 2.1-2**). The groundwater development schedule for Alternative F would be the same as described for Alternatives D and E. Construction of future facilities may extend approximately 28 years.

Future Groundwater Production Wells

Under Alternative F, there would be the same number of wells developed in Cave and Dry Lake valley as for the Proposed Action. Spring and Delamar valleys would have fewer wells compared to the Proposed Action. Throughout the four affected valleys there would be a total of 96 to 117 wells developed. Well construction, equipment, treatment, and the required temporary and permanent ROWs for well sites would be the same as for the Proposed Action. No development would occur in Snake Valley under Alternative F.

Future Collector Pipelines

The estimated total length of collector pipelines under Alternative F would be 134 to 344 miles. Additionally, there may be temporary construction staging areas every three miles along the collector line routes resulting in 45 to 115 total areas.

2.6.6.9 Future Power Facilities

Additional distribution power lines and substations would convey power to the future groundwater production wells and future pumping stations. The future power lines would be overhead 25-kV power lines, routed along the future collector pipeline alignments. Thus, the length of new overhead 25-kV power lines is assumed to be the same as the collector pipeline lengths. Additional 25-kV conductors might need to be hung on the power poles that are constructed as part of the GWD Project primary power supply system. The ROW width requirements for future distribution power lines (25 kV) would be 50 feet of permanent ROW.

Additional secondary substations might be required to reduce power from 69 to 25 kV and to provide operational power to future groundwater production wells and pumping station. Their locations would depend on the specific locations of the groundwater production wells and pumping stations. However, an additional 69/25-kV substation probably would be required in both Dry Lake and Delamar valleys. Each of the future substations would require a site of about 1 acre.

2.6.6.10 Future Ancillary Facilities

Pumping Stations

Two future pumping stations would be required to convey water from some of the future groundwater production well areas into the main and lateral pipelines. Based on known topography, a pumping station in Dry Lake Valley and one in Delamar Valley might be required. These facilities would be similar to the Lake Valley pumping station (Section 2.5.1.4). Five acres of permanent and 5 acres of temporary ROW would be required for each pumping station.

Access Roads

Access roads to future facilities would be located within the collector pipeline ROW. These might be either new roads or improvements to existing roads within the ROW. The road improvements could include grading, widening, and installing culverts, where needed. Gravel might be applied in some areas, if necessary, to maintain road conditions. Improved dirt roads would be 20 feet wide. No additional permanent or temporary access road ROWs would be required because the roads would be located within the collector pipeline ROW.

Communications Facilities

Communications facilities would be installed along with groundwater production wells, collector pipelines, and other facilities for system operation and control, data collection, communication, and security surveillance. Conduits for fiber-optic cables could be installed along with the collector pipelines. The fiber-optic cables would be installed underground in either the pipeline trench or adjacent access road, and would be contained within the requested ROW. No additional ROW would be required.

Hydroturbines

Hydroturbines may be installed in the future to generate electrical power as the water flows from higher to lower elevations. These facilities would be built belowground, with turbines placed within pipeline bypass piping. Electrical power generated by the hydroturbines would be used by the GWD Project or added to the utility grid. For operation of future facilities, it is estimated that future hydroturbines installed at the pressure reducing station sites could generate approximately 62 MW of power. The hydroturbines would be located within other sites and additional ROW is not anticipated to be required These facilities would require permitting through the Federal Energy Regulatory Commission.

Future Right-of-way Requirements

Future distribution power lines (25 kV) would require a 50-foot-wide permanent ROW. Each of the future substations may require a 1-acre site.

2.6.6.11 Future Construction and Operations

Future construction methods would be similar to those described in Section 2.5.1.5 and would be in compliance with applicable federal and state regulations and the BLM and industry standards at the time of construction. Estimated future workforce requirements are identified in **Figure 2.6-14**.

Future operations would be similar to those described in Section 2.5.1.8 and would be in compliance with applicable federal and state regulations and the BLM and industry standards at the time of operation.

2.6.6.12 Abandonment

The ROW would be granted in accordance with the FLPMA, the SNPLMA, and the LCCRDA. In accordance with the LCCRDA and the SNPLMA, the ROW is granted in perpetuity. Termination and abandonment are not anticipated, unless exceptional circumstances should arise. In such a case, the termination and abandonment would be subject to approvals by the BLM. Termination and abandonment plans would be written in accordance with current management procedures and would be submitted to the BLM in advance of any associated actions. If the GWD Project were to be abandoned in part or in whole, the ROW would revert to the land managing agencies.

If upgrade or replacement of facilities is required, the SNWA would coordinate with the BLM prior to initiating major construction, in accordance with applicable stipulations of the final ROW grant.

Comparison to Proposed Action

ROW requirements and groundwater development facilities that differ from the Proposed Action are shown in **Table 2.6-26**.

Table 2.6-26 Alternative F, Comparison to the Proposed Action

	Proposed Action	Alternative F
ROW and Facility Requirements		
Power Requirements (MW)	97	55
Conceptual Analysis – Groundwater Development Plan		
Volume of Developed Groundwater (afy)	176,655	114,129
Intermittent Pumping	No	No
Programmatic Analysis – Future Facilities		
Groundwater Production Wells (number, distribution)	144 to 174 within 5 basins; dispersed within the groundwater development area	96 to 117 within 4 basins; dispersed within the groundwater development area
Collector Pipelines (miles)	177 to 434	134 to 344
Staging Areas (number of 1-acre sites)	59 to 145	45 to 115
Electric Power Lines (miles)	177 to 434	134 to 344
Estimated Construction Disturbance (acres)	3,590 to 8,410	2,698 to 6,629
Temporary Disturbed Area to be Revegetated (acres)	1,216 to 2,874	916 to 2,270
Permanent Disturbance (acres)	2,374 to 5,536	1,782 to 4,359

2.6.7 Alignment Options 1 through 4

Local-scale option locations for certain facilities (pipelines, power lines) also were evaluated. **Table 2.6-27** provides a description and rationale for these options, and identifies the alternatives where they could be applied.

Alignment Options 1 through 4 address potential changes in facility locations or alignments from the Proposed Action. Each of these options assumes conceptual development of the full quantity of groundwater associated with the SNWA rights and applications, as identified for the Proposed Action (Section 2.5). Thus, the descriptions provided in this section focus on the changes in ROWs that would be granted under Alignment Options 1 through 4. **Figure 2.6-18** shows the relative location of the alignment options.

Table 2.6-27 Local-scale Facility Location Options

Option	Description/Rationale	Alternative						
		Proposed Action	A	B	C	D	E	F
1	Humboldt-Toiyabe Electrical Power Line Alignment • Opportunity to locate the Gonder to Spring Valley electrical power line within an existing transmission line corridor across USFS land.	X	X	X	X	X	X	X
2	North Lake Valley Pipeline and Electrical Power Line Alignment • Opportunity to locate the main pipeline and power line within an existing transportation utility corridor (U.S. 93).	X	X	X	X		X	X
3	Muleshoe Substation and Power Line Alignment • Opportunity to tie into a different regional substation, if regional power lines are constructed by other entities as planned, and avoid construction of the Gonder to Spring Valley power line segment.	X	X	X	X		X	X
4	North Delamar Valley Pipeline Alignment • Opportunity to locate both the pipeline and power line within the LCCRDA corridor. One additional pumping station would be required.	X	X	X	X	X	X	X

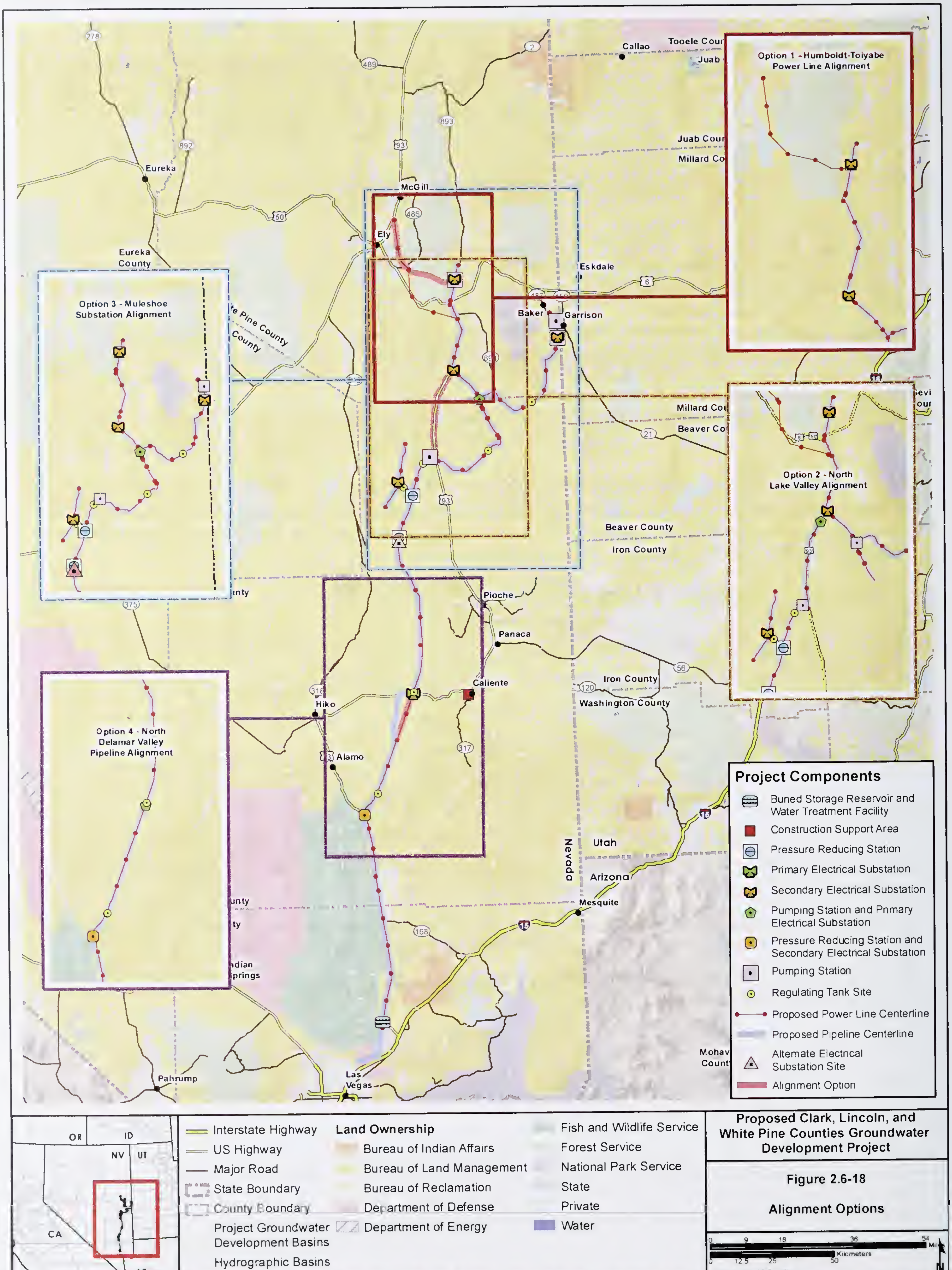
2.6.7.1 Alignment Option 1—Humboldt-Toiyabe Power Line Alignment

In this option, the Humboldt-Toiyabe 230-kV power line would parallel an existing transmission line over the Schell Creek Range between the Gonder Substation and Spring Valley. **Table 2.6-28** shows the major differences of this option when compared to the segment replaced in the Proposed Action.

Table 2.6-28 Comparison of Alignment Option 1 to the Proposed Action

	Alignment Option 1	Proposed Action
Length of ROW (miles)	Transmission Line: 12.4 miles	Transmission Line: 20.3 miles
Disturbance (acres)	150 acres	245 acres
Land Ownership	BLM: 27 % USFS: 70 % Private: 3 %	BLM: 100 %
Land Cover	Pinyon Juniper Woodland: 46 % Greasewood/Salt Desert Shrubland: 1 % Sagebrush Shrubland: 53 %	Pinyon Juniper Woodland: 28 % Greasewood/Salt Desert Shrubland: 8 % Sagebrush Shrubland: 63 % Perennial Grassland: 1 %

- The Humboldt-Toiyabe alignment option would represent an incremental expansion in the width of an existing cleared transmission line ROW.
- The corresponding segment of the Proposed Action power line would be constructed in a new ROW, which would require tree and shrub clearing of power pole sites and construction of a new access road.
- This alternative power line segment is shorter (8 miles) than the 230-kV power line for the Proposed Action in this area, but it crosses steeper terrain.

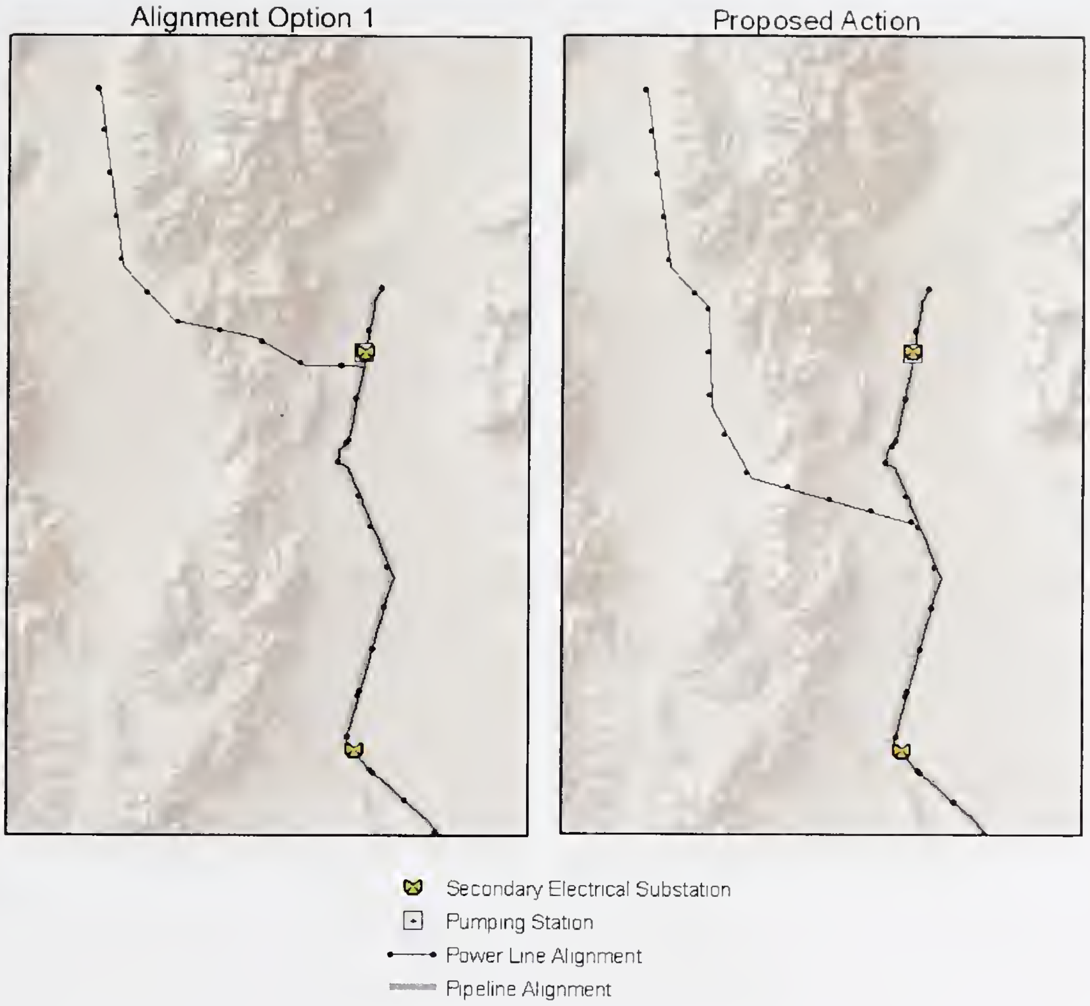


Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 2.6-18

Alignment Options

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data



2.6.7.2 Alignment Option 2—North Lake Valley Pipeline and Power Line Alignments

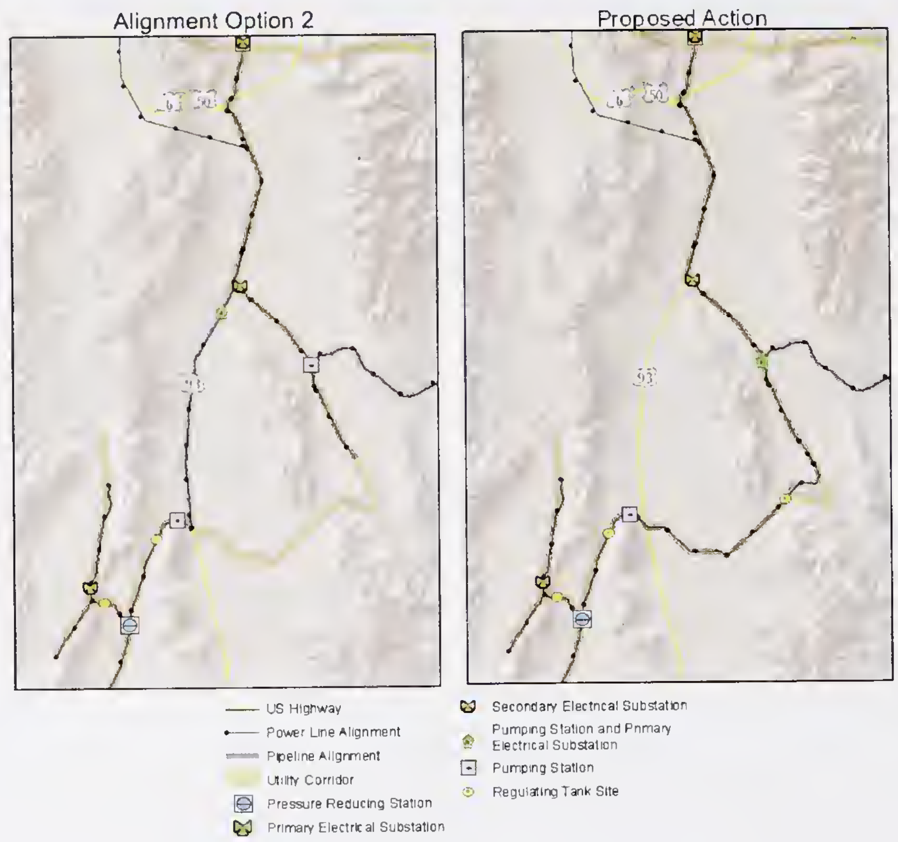
This option would change the location of the mainline pipeline and associated power line in North Lake Valley. The primary environmental consequence of this option would be the collocation of more of the project facilities within the Highway 93 transportation corridor, as compared to the Proposed Action. **Table 2.6-29** shows the major differences of this alignment option compared to the segment replaced in the Proposed Action.

Table 2.6-29 Comparison of Alignment Option 2 to the Proposed Action

	Alignment Option 2	Proposed Action
Length of ROW (miles)	Pipeline ROW: 24.3 miles Transmission Line: 24.3 miles	Pipeline ROW: 23.0 miles Transmission Line: 22.9 miles
Disturbance (acres)	975 acres	915 acres
Land Ownership	BLM: 94 % Private: 6 %	BLM: 100 %
Land Cover	Pinyon Juniper Woodland: < 1 % Greasewood/Salt Desert Shrubland: 8 % Sagebrush Shrubland: 68 % Perennial Grassland: 23 % Annual Invasive Grassland: < 1 %	Pinyon Juniper Woodland: 6 % Greasewood/Salt Desert Shrubland: 4 % Sagebrush Shrubland: 89 % Perennial Grassland: < 1 %

- The mainline pipeline and power line would be located parallel to Highway 93, over a distance of about 8 miles.
- An additional Pumping Station would be required along Highway 93, 3 miles south of the intersection with Atlanta Road (a 60-acre site).

- The proposed Pumping Station in southern Spring Valley would be reduced in size (to a 5-acre permanent site); a regulating tank would not be required.
- The power line that is parallel to the Spring Valley lateral pipeline would be reduced from 230 to 69 kV.



This option would be longer than the Proposed Action and would require an additional Pumping Station. The overall length of the alignment would be approximately 25 miles, replacing approximately 20 miles of the Proposed Action alignment through central Lake Valley.

2.6.7.3 Alignment Option 3—Muleshoe Substation and Power Line Alignment

This option depends on the implementation of at least one major regional power line project in the GWD Project area. Great Basin Transmission and NV Energy are planning and developing the One Nevada (ON) Transmission Line (formerly Southwest Intertie [SWIP]) Project, a 500-kV power line that is being constructed from a substation west of Ely in White Pine County to the Harry Allen Power Plant in Clark County. NV Energy and others also have proposed additional high voltage power lines through this region. The ON Transmission Line project would cross into the GWD Project area in northern Dry Lake Valley (also known as Muleshoe Valley). This option assumes that this project would be completed, would have available capacity, and an agreement could be reached for the SNWA to tie into that line. A new regional substation would be required. A tie-in to a regional transmission line project would eliminate the need for the proposed 34-mile groundwater development 230-kV transmission line from Gonder to Spring Valley. For this option, the following facilities would be constructed:

- The Muleshoe Substation, on a 43-acre site, would convert power from the 500-kV power line to 138 kV, for conveyance to project facilities. This site is adjacent to the boundaries but outside of BLM-designated utility corridors. An approximately 1,000-foot-long segment of permanent ROW for an additional 138-kV power line segment would be constructed between the main line and the Muleshoe Substation.
- 138-kV power lines would be used to convey power along the main alignment. The 138-kV power poles would be single, steel power poles, approximately 70 feet tall and spaced at approximately 700-foot intervals, depending on the terrain. The routing and ROW width requirements of the 138-kV power line would be the same as those described for the Proposed Action.
- The primary and secondary electrical substations identified for the Proposed Action would be needed, to further convert power for conveyance to project facilities. The primary electrical substations would convert project facility power from 138 kV instead of 230 kV. There would be no change in the ROW requirements for these substation sites.

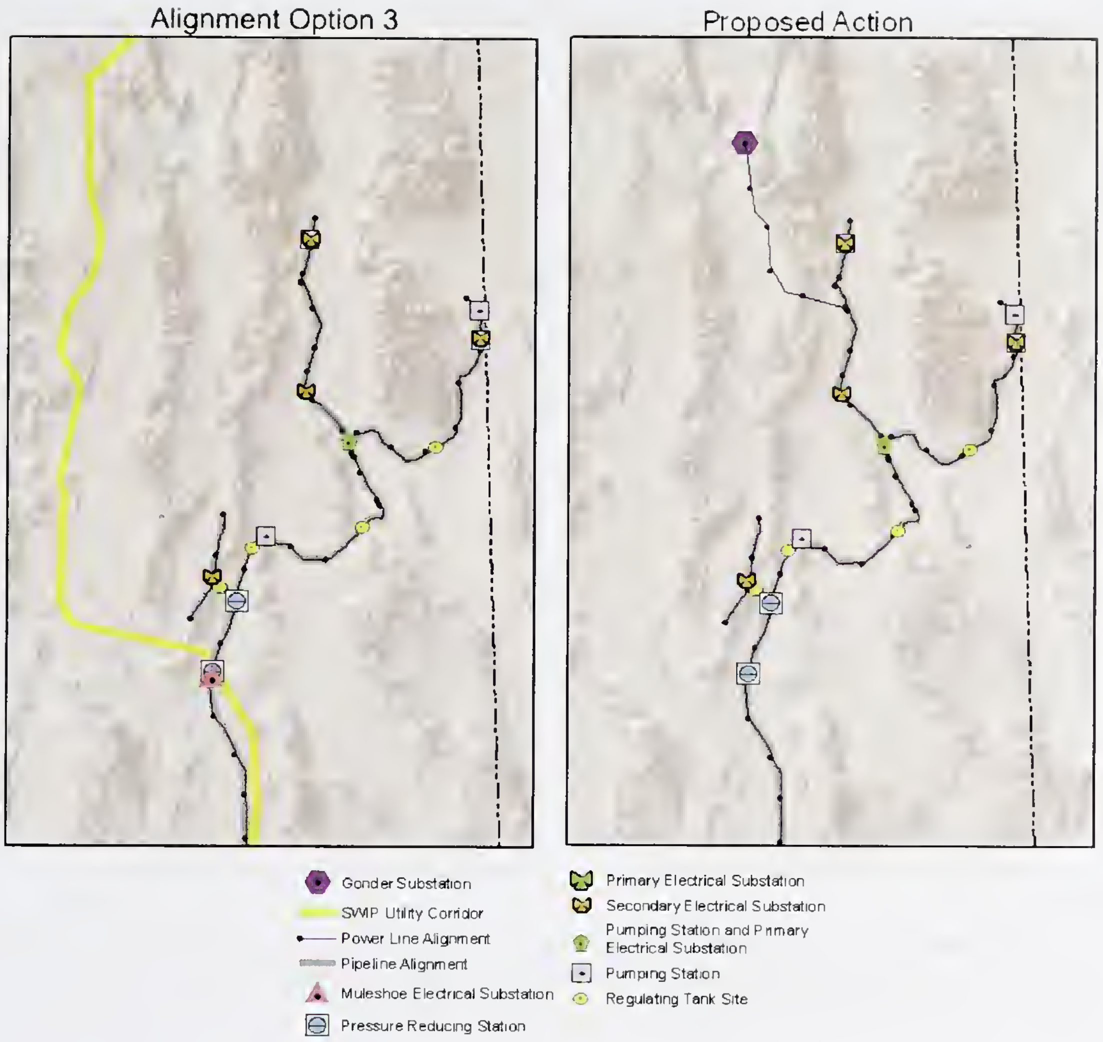


Table 2.6-30 shows the major differences of this option compared to the segment replaced in the Proposed Action.

Table 2.6-30 Comparison of Alternative Option 3 to the Proposed Action

	Alternative Option 3	Proposed Action
Length of ROW (miles)	Transmission Line: 0 mile	Transmission Line: 34 miles
Disturbance (acres)	44.7 acres	409 acres
Land Ownership	BLM: 100 %	BLM: 88 % State: 10 % Private: 2 %
Land Cover	Greasewood/Salt Desert Shrubland: 39 % Sagebrush Shrubland: 61 %	Pinyon Juniper Woodland: 77 % Greasewood/Salt Desert Shrubland: 5 % Sagebrush Shrubland: 38 % Perennial Grassland: < 1 %

2.6.7.4 Alignment Option 4—North Delamar Valley Pipeline Alignment

Alignment Option 4 would be the same as the Proposed Action, except that the pipeline and power line in northern Delamar Valley would follow the same alignment along Poleline Road. Under the Proposed Action, the pipeline and power line would diverge in this area because of an elevation increase along the road. Under Alignment Option 4, both the pipeline and power line would parallel each other and would be within the LCCRDA corridor. For this option, the following facilities would be constructed:

- An additional Pumping Station would be built to move water across the higher elevation along Poleline Road. This new Pumping Station would be located on BLM land at U.S. 93 and North Poleline Road. The Pumping Station would be similar to the Lake Valley Pumping Station described under the Proposed Action, and would require a 5-acre permanent ROW and a 5-acre temporary ROW.

- The length of pipeline under Alignment Option 4 would be slightly shorter; approximately 14 miles, compared to 16 miles under the Proposed Action.

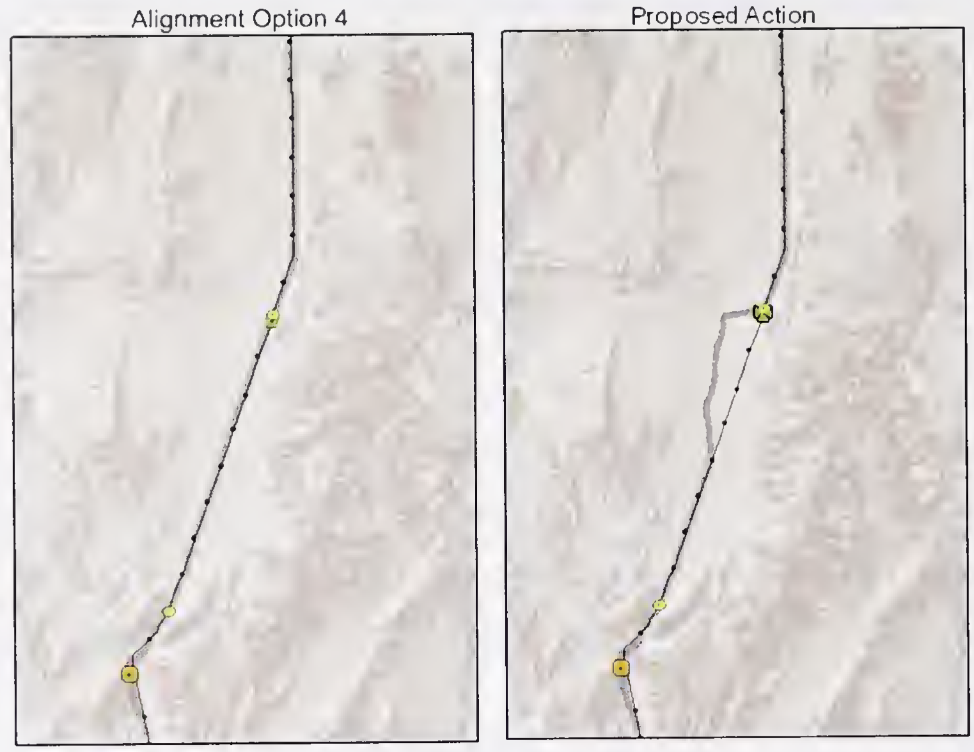


Table 2.6-31 shows the major differences of this option compared to the Proposed Action.

Table 2.6-31 Comparison of Alignment Option 4 to the Proposed Action

	Alignment Option 4	Proposed Action
Length of ROW (miles)	Pipeline: 13.4 miles	Pipeline: 16.1 miles
Disturbance (acres)	352 acres	403 acres
Land Ownership	BLM: 100 %	BLM: 100 %
Land Cover	Greasewood/Salt Desert Shrubland: 7 % Sagebrush Shrubland: 81 % Mojave Mixed Desert Scrub: 12 % Perennial Grassland: < 1 %	Greasewood/Salt Desert Shrubland: 15 % Sagebrush Shrubland: 80 % Mojave Mixed Desert Scrub: 4 % Annual Invasive Grassland: 1 % Barren: < 1 %

2.6.8 SNWA's Estimated Project Development and Financing Costs

As described in Sections 2.5.1, 2.5.2, and SNWA's conceptual POD (**Appendix E**), the overall GWD Project would consist of the main pipeline conveyance system and groundwater production wells and collector pipeline network. SNWA envisions construction of these facilities over nearly 40 years, based on its internal forecasts of water needs and available resources, although the schedule could be modified in response to changes affecting Colorado River supply, future demand, or other factors affecting SNWA's project planning. Development of the proposed system would require major capital investment on the part of the SNWA.

Considerable interest and concern regarding project costs was expressed in the public comments to the DEIS.

SNWA presented conceptual construction cost and financing information for the project at the NSE's hearing in the fall of 2011 on the SNWA water right applications in the Spring, Delamar, Dry Lake, and Cave valleys. Although SNWA's project implementation costs do not factor into BLM's decision on the ROW application, that information, along with a comparison of construction cost estimates for the EIS alternatives, is summarized below in response to public interest.

2.6.8.1 Conceptual Project Development Costs Including Financing

SNWA anticipated funding most of the GWD construction costs via the issuance and retirement of long-term debt, similar in many respects to homebuyers taking on mortgages, to be repaid over time.

Information presented by SNWA at the NSE's hearing in the fall of 2011 on the SNWA water rights applications in the Spring, Delamar, Dry Lake, and Cave valleys, outlined a conceptual construction cost estimate of $3.224 billion; $2.011 billion for the main conveyance system, $ 0.469 billion for future facilities, and $0.744 billion for design and construction management. These monetary values were expressed in terms of 2007 dollars (SNWA 2011).[1] In other words, $3.224 billion represented the estimated lump-sum construction costs of the entire project, had it been built and completed in 2007. That estimate included allowances for final engineering and design (10 percent of construction costs), construction management services (20 percent of construction costs), and the acquisition and installation for all pipelines and laterals, power lines, access roads, production wells, and ancillary facilities. The $3.224 billion sum does not represent the total project costs as it did not reflect allowances for contingencies or long-term financing associated with actual project development.

A conceptual project financing approach, developed for SNWA by Hobbs, Ong & Associates and Public Financial Management, Inc., and detailed in the *Ability to Finance Report to the Southern Nevada Water Authority,* also was presented at the NSE hearings (Hobbs, Ong & Associates 2011).[2] The financing plan uses short-term borrowing during the first 3 years of construction, followed by issuance of long-term bonds to complete the main conveyance system and future facilities.

The timing of bond issues would coincide with the anticipated funding needs associated with the overall project development schedule, as shown in **Figure 2.5-6**.

As outlined in the *Ability to Finance Report*, the monetary outlay associated with construction of the proposed groundwater development system totals $15.46 billion over 66 years, in nominal terms including assumed inflation. Base construction costs, including allowances for contingencies and environmental protection/mitigation, would account for approximately 23 percent of the total; allowances for inflation over time accounts for 18 percent of the total; various bond issuance costs and capitalized interest equals 5 percent; and interest paid on the bonds the remainder (**Figure 2.6-19**).

The *Ability to Finance Report* examines the potential effects of the conceptual funding approach on consumer water rates. Historically, four major revenues sources have been available to SNWA to repay its debt obligations:

- Regional connection charges – commonly called "hook-up fees" for new connections;
- Sales tax revenues – the proceeds of a one-quarter of one cent per dollar of taxable sales in Clark County;
- A share of proceeds from land sales under the Southern Nevada Public Land Management Act – 10 percent of the sales prices of certain public lands in Clark County; and

[1] The reference to 2007 dollars means that SNWA used material and equipment pricing and labor cost data from 2007 to develop these estimates. The use of a base year is common in engineering, economic, and financial analyses, as it provides a starting point reflecting reasonably current pricing information. Adjustments and allowances for other related activities, e.g., construction contingencies and future price changes, are then added.

[2] Additional information regarding project costs, including testimony from parties not aligned with SNWA can be found at: http://water.nv.gov/hearings/past/springetal/.

- Commodity and reliability charges – a charge for each 1,000 gallons of potable water delivered and metered in Henderson, North Las Vegas, and the Las Vegas Valley Water District, and an excise tax of 0.25 percent for residential customers and 2.5 percent for other customers in the same service areas.

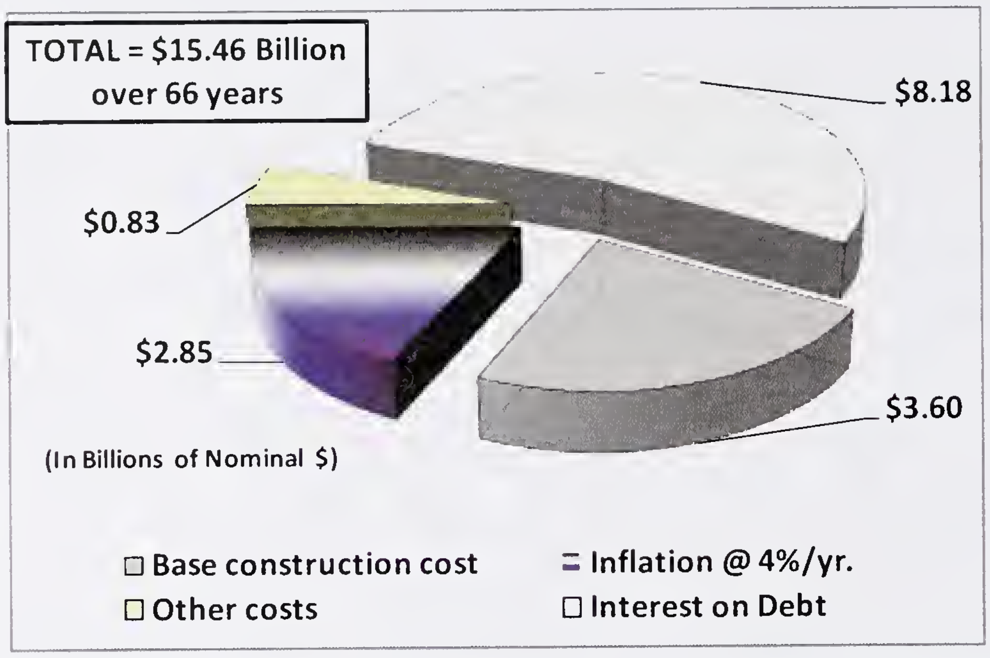


Figure 2.6-19 **Conceptual GWD Project Development Costs, Assuming Long-Term Debt Financing**

To examine the potential impacts on rates, the annual debt service payments associated with the overall outstanding debt in any given year were calculated, and the commodity and reliability charges necessary to generate sufficient revenue to satisfy the requirements then derived. Results of the analysis indicate a likely need to raise the commodity charges to address debt service, not only to fund the groundwater development, but also to accommodate existing debt and other major planned projects. The magnitude of the potential increase solely attributable to the groundwater development would be to increase the per 1,000 gallon commodity charge to $4.67 per 1,000 gallons with the groundwater development (as compared to $2.15 without—all other things remaining equal). This increase would not be required until the year 2026. As reported by the study's authors, those results represent a "worst case" assessment that reflects two important assumptions:

> The SWNA's ability to finance, construct and operate the project will be ultimately determined by the capital markets and regional economic conditions.

- The revenue projections are based on more conservative population projections than those used in the 2009 Water Resource Plan: a service area population of 2,219,599 in 2030, rising to 2,603,066 by 2050; and
- The analysis does not include allowances for substantial revenues to reduce the impacts on commodity charges from either regional connection charges or sales tax receipts.

The SNWA recently adopted a 3-year infrastructure surcharge to help pay for its Third Intake Project. The monthly charge, effective April 2012, is based on a customer's meter size, with the base rate of $5.00 per month for normal residential meters, and as high as $1,659.59 for the largest industrial and commercial customers. Revenues generated by the surcharge are intended to help offset the dramatic decline in connection charges in recent years (SNWA 2012a).

2.6.8.2 Incremental Effects of the GWD Project on SNWA's Operating Costs

To fund its operating costs and other factors unrelated to capital improvements, the SNWA assesses a wholesale delivery charge for each acre-foot of water delivered to its member utilities and to Nellis Air Force Base. In 2011, the wholesale delivery charge was $283.00 per acre-foot (Hobbs, Ong & Associates 2011). The *Ability to Finance Report* does not address the incremental effects of the groundwater development production and system operations on SNWA operating costs, or the potential impacts of those costs on wholesale delivery charges.

Neither the *Ability to Finance Report* nor the SNWA POD explicitly address the potential cost of mitigation, although SNWA suggests that the construction management allowance was increased from the standard 25 percent of construction costs to 30 percent, in part to address to environmental protection/mitigation. Those funds would be available during and after project construction. With respect to ongoing costs, SNWA has acknowledged the uncertainty associated with implementation of the monitoring, management, and mitigation framework developed for this project. Consequently, although long-term provisions to fund monitoring and mitigation are unknown at this time, "...SNWA has the flexibility and capability to fund construction and operation of the GWD Project, including any costs associated with monitoring, management and mitigation of groundwater development." (Hobbs 2011)

2.6.8.3 Comparison of Construction Costs for the EIS Alternatives

SNWA prepared conceptual construction cost estimates for the EIS alternatives using an approach consistent with that used to prepare the $3.224 billion "lump sum" estimate presented at the NSE hearings, including revisions to the estimated costs for the Proposed Action. The comparative estimates range from $3.874 billion for the Proposed Action to $2.428 billion for Alternative D (see **Table 2.6-32** and **Figure 2.6-20)**. The range between the high and the low cost is $1.446 billion or 37 percent, although the two alternatives also vary substantially in the amount of water conveyed. Consequently, an interpretation that the differences represent savings, or a lower cost option, would be inappropriate.

Table 2.6-32 Engineering Construction Costs Estimates (Millions of $2007)

	EIS ALTERNATIVE						
	Proposed Action	**Alternative A**	**Alternative B**	**Alternative C**	**Alternative D**	**Alternative E**	**Alternative F**
Main Conveyance System – Construction	$ 2,328	$ 2,064	$ 2,328	$ 2,064	$ 1,510	$ 1,709	$ 1,827
Production wells & future facilities – Construction	$ 652	$ 418	$ 621	$ 418	$ 358	$ 323	$ 470
Program Administration (30% of construction)	$ 894	$ 745	$ 885	$ 745	$ 560	$ 610	$ 689
Total Capital Cost	**$ 3,874**	**$ 3,227**	**$ 3,834**	**$ 3,227**	**$ 2,428**	**$ 2,642**	**$ 2,986**
Difference Compared to the Proposed Action							
Absolute	NA	$ (647)	$ (40)	$ (647)	$(1,446)	$(1,232)	$ (888)
Percent	NA	-17%	-1%	-17%	-37%	-32%	-23%

Notes:
1) Capital costs are in $2007 dollars.
2) Actual costs, when adjusted to reflect price changes in materials, labor, fuel, adjustments to address site specific construction conditions, will be higher.
3) The quantities of water delivered vary by alternative. These differences are not reflected in this table.

Allowances for contingencies, bond issuance costs, allowances for inflation and the long-term debt service/interest expense are not included in the conceptual cost estimates presented above for the EIS alternatives. Although the prospective construction and financing costs associated with all alternatives would likely yield a comparable conclusion with respect to commodity charges as that in the *Ability to Finance Report*, it is unclear that the potential increases in commodity charges would be lower for the less costly alternatives. The uncertainty arises due to the differences in water quantity conveyed by the various alternatives.

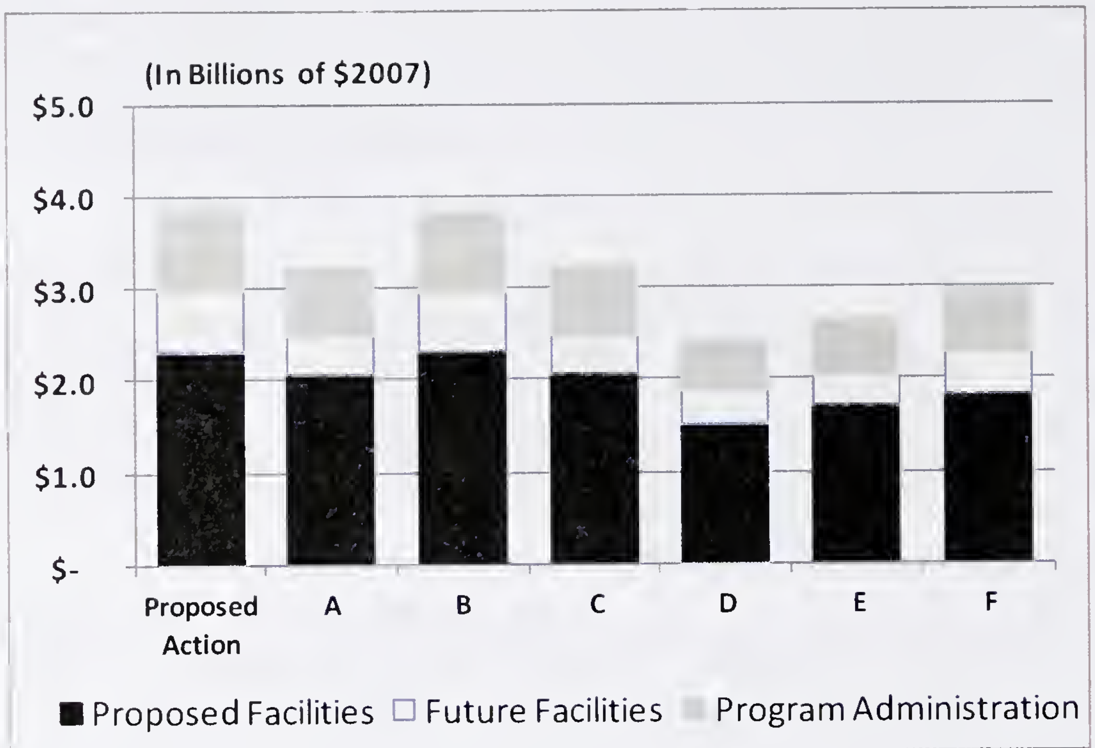


Figure 2.6-20 Conceptual GWD Project Construction Costs

2.7 Alternatives Considered But Not Carried Forward for Detailed Analysis

The BLM is required to explore and evaluate reasonable alternatives to the Proposed Action, and to briefly discuss the reasons for eliminating potential alternatives from detailed study (40 CFR § 1502.14[a]). The goal of the alternative selection process is to provide a reasonable range of alternatives to the Proposed Action, and to foster informed decision making and informed public participation.

Main Points—Alternatives Considered But Eliminated

- The BLM considered but eliminated 5 conveyance alternatives for environmental and economic reasons.
- Other water supply alternatives were eliminated because they did not meet the purpose and need of the Proposed Action.

The purpose and need of a project dictates the range of reasonable alternatives. The BLM's *NEPA Handbook*, H 1790-1, V-5 (BLM 2008a), provides that, except for the No Action Alternative, alternatives that are selected for the EIS should "respond to the purpose and need for the action." Project alternatives are potential substitutes for the Proposed Action and might accomplish the general goal of the project in another manner, or they may provide other means of carrying out the Proposed Action.

As described in Section 1.2, the purpose of the action addressed in this EIS is for the BLM to respond to the SNWA's request for legal access across federal land managed by the BLM for construction and operation of a groundwater development and conveyance system. Groundwater would be developed within hydrologic basins in Lincoln and White Pine counties, Nevada. Groundwater would be delivered to interconnections with municipal systems in Lincoln County, and the Las Vegas Valley. The need for the action arises from the BLM's responsibilities under the FLPMA and other legislation to respond to the SNWA's ROW request. Possible alternatives were screened against this purpose and need criterion.

Further, an agency is not required to consider alternatives that are infeasible, ineffective, or inconsistent with the basic policy objectives for federal management of an area. Alternatives that are remote, speculative, or impractical need not be considered in detail. A reasonable alternative should "avoid or minimize adverse effects of these actions upon the quality of the human environment" (40 CFR 1500.2[c]). Although legal issues or conflicts might represent an obstacle to implement an alternative, the CEQ has indicated that legal factors cannot be used as the sole basis to eliminate an otherwise reasonable alternative (CEQ 1981).

2.7.1 Groundwater Conveyance and Water Management Alternatives

The BLM examined the feasibility of transporting groundwater from groundwater development areas to Lincoln County and the Las Vegas Valley via trains, trucking, and aqueducts, and implementing different configurations of the proposed water development and conveyance system. None of these alternatives would result in a reduction in environmental impacts, or be more economical to develop than the Proposed Action.

Trucking: Based on the need to transport approximately 218,000 afy of water, the number of tanker trucks, each capable of transporting 8,400 gallons, would be 8,365,654 tanker trucks on an annual basis, equivalent to 22,919 trucks daily. The actual fleet needed would be approximately twice this size (46,000 tanker trucks), since the trucks would need to return to the groundwater area empty to be refilled. The trucks would need to travel hundreds of miles, obtaining water from various regions of Nevada and hauling the water to Clark and Lincoln counties. Trucking poses a greater safety risk to the public than pipelines (Pipeline and Hazardous Materials Safety Administration [PHMSA] 2010). The substantial number of trucks required to haul this volume of water would likely cause a substantial increase in vehicular accidents with associated injuries and fatalities. Further, the emissions from the transport trucks would decrease air quality due to an increase in mobile emissions.

Railroads: Transportation by train would require a substantial number of rail cars transporting water on a daily basis. New rail lines would need to be constructed, causing temporary and permanent surface disturbances and a significant economic investment in land acquisition since the rail ROW would not be reclaimed to previous use, like a pipeline. Like trucking, transportation by rail also would increase public safety risks compared to pipelines. Rail cars can transport 84,000 gallons. Based on approximately 218,000 afy of water to be conveyed, this would require an annual total of 636,654 rail cars, equivalent to 2,292 rail cars per day. The rail cars would need to travel hundreds of miles, obtaining water from various regions of Nevada and hauling the water to Clark and Lincoln counties. Rail transport poses a greater safety risk to the public than pipelines (PHMSA 2010). The substantial number of rail cars required to haul this volume of water would likely cause a substantial increase in accidents with associated injuries and fatalities. Further, the emissions from the train traffic would decrease air quality due to an increase in mobile emissions.

Aqueducts: Because of numerous changes in elevation between the groundwater source areas and the delivery points, construction of an aqueduct would likely have to be combined with a pipeline system in areas of steep topography. Pumping stations and pipelines would still be required to move water over drainage divides. Construction of aqueducts would create temporary and permanent surface disturbance. Like railroads, construction of aqueducts would require a significant investment in land acquisition, since the land would not be restored to previous uses, like a pipeline. Also like railroads, existing land uses would be impacted by the permanent aboveground aqueduct that would reduce amount of land available for grazing and would fragment habitat and create potential hazards for livestock and wildlife. In addition, there would be evaporative loss of water associated with aqueducts as a water source.

Phased Development of the GWD Project: This alternative would consist of constructing two smaller pipelines to achieve a similar conveyance capacity of the Proposed Action. The rationale for a phased approach is to address potential uncertainties in available groundwater for transport, and to reduce the initial facilities capital investment. A phased development of the project would result in construction of smaller, but duplicate parts of the conveyance system. This approach would result in greater overall surface disturbance impacts to environmental resources. The project completion time frame would spread out over a longer period than the Proposed Action. Construction costs would be substantially higher than the Proposed Action due to added design, mobilization, and additional material compared to the Proposed Action.

Return of Groundwater to Original Hydrographic Basins: This alternative would modify the Proposed Action by constructing a second pipeline system to return treated wastewater to the hydrographic basins from which the groundwater was originally withdrawn, and then reinjecting the water into the aquifer through wells or infiltration basins. Although this alternative potentially would increase aquifer recharge, it would not increase the amount of water conveyed to Lincoln and Clark counties. Since the SNWA accounts for return waters in its planning calculations, this scenario would actually decrease the amount of water available for the SNWA member users. This alternative would require substantial pumping capacity and electrical power because of the elevation gain between Las Vegas and the individual hydrologic basins. Components would include additional treated water pipelines in the Las Vegas Valley, a secondary pipeline of similar size as the water supply pipeline; pumping stations and injection wells or infiltration basins. Project surface disturbance would be at least twice as great as the Proposed Action due to the duplication of systems. In addition, returning water to the basins of origin is not economically feasible. Capital and infrastructure to build return pipelines would likely be more than twice the cost of the Proposed Action.

2.7.2 Water Supply and Management Alternatives Suggested by the Public

Water supply and management alternatives different in type and location from the SNWA proposal were offered during public scoping. None of these water supply alternatives would fulfill the project purpose (which is for the BLM to provide the SNWA with legal access for a water conveyance system across federal land managed by the BLM) or the need (BLM's responsibilities to comply with the FLPMA and other legislation). In determining whether to carry forward water supply alternatives for detailed environmental review, BLM also considered whether proposed alternatives would be technically and legally feasible in the timeframe of the proposed GWD Project, whether they would be more effective in minimizing environmental impacts, and whether they would meet SNWA's goals and objectives in proposing the GWD Project and requesting a BLM right-of-way. A number of the water supply alternatives considered by BLM in the EIS, some of which are already included in SNWA's water resource portfolio, rely on Colorado River supplies. SNWA's water resource plan (**Appendix A**) indicates that while it intends to pursue these resources, including desalination, over the long-term (if technical, political, and legal obstacles can be overcome), these possible future resources do not currently provide reasonable alternatives to developing SNWA's instate groundwater resources.

Table 2.7-1 provides a summary of other water supply and water conservation alternatives that were brought forward by the public. Implementation considerations for future water supply acquisition and delivery are provided for each alternative. Several of these future water supply alternatives were recently evaluated as a means of augmenting long-term water supplies (Colorado River Water Consultants 2008). For example, the feasibility of increased cloud seeding is currently being studied within the Colorado River drainage, and desalination projects and agricultural water conservation projects are being implemented in California at various scales to increase regional municipal water availability. Please see **Appendix A-2** for a discussion related to desalination.

Table 2.7-1 **Summary of Water Supply and Conservation Alternatives Provided by the Public**

Water Supply and Conservation Alternatives	Implementation Considerations
Water Conservation / Demand Management in Las Vegas Valley: Water conservation, broadly defined, includes reducing consumption relative to established use patterns and increasing the efficiency of use of the presently available water supply. By definition, this alternative affects long-term demand rather than supply. Technologies to reduce water use/increase efficiency are being adopted and implemented in Las Vegas, both in conjunction with retrofits/upgrades and as part of new construction.	• SNWA does not have the legal authority to implement progressive water rate structures (which can decrease demand). The adoption of progressive rate structures is primarily under the auspices of the member utilities and/or local governments. • Conservation actions and incentives would assist in reducing demand, but are insufficient by themselves to accommodate the need for additional water supplies associated with predicted population growth rates. Conservation actions also would not help diversify resources in the event of drought.
Diversion or Conveyance of Conserved Water from Nevada Irrigated Farmland: Fallow irrigated farm land in Nevada or other off-system agricultural users in Nevada would be acquired to fallow currently irrigated lands. Credit would be obtained to divert the resulting reductions in water consumption, factoring in adjustments to account for groundwater recharge requirements, to the Las Vegas Valley to help meet future demand. This alternative would require construction of facilities to convey conserved water from central Nevada to the Las Vegas Valley, similar to the Proposed Action.	• Opportunities for diverting water from existing irrigated lands within the hydrologic basins proposed for groundwater pumping are very limited, and far less than the groundwater rights that SNWA holds, or for which the SNWA has applied in the project basins. • New or modified facilities would be required for diversion, treatment, and transport of water from fallowed lands to the SNWA system. The widely-spaced distribution of irrigated lands in Nevada would require an extensive system of pipelines to collect and convey the water to Las Vegas Valley. • Trans-basin diversion of water within Nevada would require approval from the NSE. Water rights would have to be converted from irrigation to municipal and industrial use; again through proceedings with the NSE. There are regulatory restrictions/constraints which limit the segregation of less than 100 percent share of an existing water right. • Potential quality of life and socioeconomic effects on affected local communities, as well as on the state economy, associated with fallowing currently irrigated lands are expected to result in a regional scale expansion of potential socioeconomic effects.
Modifications of the Colorado River Compact: This modification would require approval from the seven basin states and Congress to change the apportionment under the Compact to increase Nevada's share of water.	• Reallocation of more than 200,000 afy would require an act of Congress, approval of the Secretary of the Interior, and substantial negotiation between basin states. A reallocation is unlikely at best and could take decades to accomplish.
Freshwater Harvested from Icebergs: Icebergs would be located and towed from the Arctic or Antarctic to a location off the coast of California.	• The legal rights and technology to tow icebergs are untested and cost basis has not been established.
Water Banking from Underground Storage: Surface or groundwater would be pumped into aquifers and storage formations and then withdrawn for future use.	• Water banking provides flexibility in water storage, but does not result in a net increase in water available for municipal uses.

Table 2.7-1 Summary of Water Supply and Conservation Alternatives Provided by the Public (Continued)

Water Supply and Conservation Alternatives	Implementation Considerations
Water Purchase from Large Water Supply: Surface water would be diverted from a regional water supply in the western U.S. with delivery to Las Vegas via existing canal systems and new pipelines. Project components would include existing or new canal systems, existing or new pipeline systems, pumping stations, power supplies, and a possible impoundment near Las Vegas to store water.	• Capital and operational costs to implement interstate diversions are unquantifiable, but are expected to be very large to pay for the construction and operation of a long interstate pipeline and associated pumping system. • The likelihood of reaching inter-basin and interstate agreements would be very low, particularly because these transfers could affect downstream water rights holders. The time frame to obtain regulatory approvals and complete construction of a new interstate water transport system would likely require decades.
Riparian Vegetation Management: Phreatophyte vegetation would be removed along stream banks in the Colorado River system to potentially increase the amount of available water.	• Successful eradication methods are labor intensive, would require long-term ongoing vegetation management, • Water saved by phreatophyte control would be very difficult to measure and apportion among the Colorado Compact states. • Quantity of water potentially available would be substantially less than the groundwater rights the SNWA has applied for in the project basins.
Desalination: This alternative would require the construction and operation of an ocean desalination plant along the Pacific coastline and a water exchange with the Colorado River system (e.g., Lake Mead). See **Appendix A-2**.	• Project feasibility is dependent on modifying agreements between Compact states, and potentially the U.S. and Mexico, for Colorado River deliveries. Regulatory compliance would be required for International Boundary and Water Commission, Mexico's environmental laws, California Environmental Quality Act, California Coastal Act, and other state and local permits. The time frames for modifying these agreements and regulatory approvals could be lengthy. • Operation and maintenance costs of desalination facilities are high. • Desalination brine disposal through an ocean outfall presents environmental and regulatory issues due to the concentration of residuals in the effluent. • Desalination would not help diversify southern Nevada's water resources in the event of Colorado River system drought.
Weather Modification: Cloud seeding would be used to increase precipitation and snow pack in the Colorado River drainage.	• Cloud seeding is sensitive to location and weather, limiting the areas that can be effectively seeded. • Weather modification to increase precipitation can be considered an opportunity to supplement available supplies, but cannot be considered a stable or reliable supply because of year-to-year variability in precipitation. • Given the yield uncertainty and the difficulty of statistically demonstrating and predicting precise amounts of increased snowpack from a certain level of effort, this alternative is an unlikely solution for reliably increasing the quantity of water managed by the SNWA.

2.8 Agency Preferred Alternative

2.8.1 Selection of the Preferred Alternative

Under the BLM's NEPA regulations (43 C.F.R. § 46.420(d)), the BLM's "Preferred Alternative" is the alternative which the BLM believes would best accomplish the purpose and need of the proposed project while fulfilling the agency's statutory mission and responsibilities; giving consideration to social, cultural, environmental, technical, economic, and other factors. The Preferred Alternative is not a final agency decision; rather, it is an indication of the agency's preliminary preference. The Preferred Alternative presented at this Final EIS stage in the environmental review process could be changed based on new information or comments received on this Final EIS. The agency Preferred Alternative is not, and should not be interpreted as a factual finding or opinion by the BLM on any past ruling or current issue before the NSE.

In selecting the Preferred Alternative, the BLM considered all information received; consistent with its environmental review, ROW permitting responsibilities, and the NSE's jurisdiction over the SNWA's groundwater applications. The BLM has identified the main conveyance pipeline alignment contained in Alternative F as its Preferred Alternative. This alternative does not include development in Snake Valley. In addition to Alternative F, Alignment Option 1 – Humboldt-Toiyabe Power Line Alignment would be included in the Preferred Alternative selection. Alignment Option 1 would lessen impacts to visual resources and to sagebrush habitat and the species dependent upon that habitat (i.e. sage grouse, pygmy rabbits, migratory birds). The Humboldt-Toiyabe option also would maintain the proposed power line within an existing utility corridor.

As noted in Chapters 1 and 2, the BLM does not grant the rights to the water to be conveyed in the pipeline. That responsibility is held by the NSE (NRS § 533.370). In March 2012, the NSE presented its rulings on the SNWA water right applications (originally filed in 1989) in four of the five basins analyzed in this EIS. These basins; Spring, Delamar, Dry Lake, and Cave valleys; are all included in Alternative F. Water rights hearings for Snake Valley have not been scheduled. Water developed under the Preferred Alternative would be limited to that approved in the four valleys (Spring, Delamar, Dry Lake, and Cave) by the NSE up to 83,988 afy.

Alternative F was not included for analysis in the Draft EIS but was based upon input from the applicant, review of public comments and the agency's desire to provide a more comprehensive range of alternatives. The BLM anticipates that the public will recognize the similarities between Alternative F and Alternative E; most notably that both alternatives specify there would be no development in Snake Valley and the pipeline alignment is identical. Alternative E was analyzed in the Draft EIS and the BLM received numerous public and agency comments noting the probable reduction in impacts related to that alternative compared to the alternatives that included Snake Valley. In addition, many commenters expressed their concerns with pumping in Snake Valley due to its close proximity to GBNP.

Additional environmental benefits of the Preferred Alternative include: the construction of conveyance facilities within a designated BLM utility corridor and/or adjacent to existing BLM-granted ROWs (limiting the fragmentation of habitat and natural features); and following the most direct route would streamline the operation and maintenance of the system and the delivery of the water.

Both Alternatives E and F analyze the same main conveyance pipeline alignment and differ only in the analysis of the quantity of water to be developed. To understand the impacts of the Preferred Alternative, the reader should consider the impacts of Alternatives E and F and understand that the Preferred Alternative's impacts would be between the two. It is important to note that the amounts of groundwater analyzed for development in Alternative F exceed the expected cumulative impacts due to the large quantity of water proposed for development within this alternative. This is an

Comparison of Groundwater Withdrawal Volumes Pertaining to the Preferred Alternative

	Current NSE Rulings	Alternative E	Alternative F
Spring Valley	61,127	60,000	84,370
Delamar Valley	6,042	2,493	6,591
Dry Lake Valley	11,584	11,584	11,584
Cave Valley	5,235	4,678	11,584
Total Delamar, Dry Lake, and Cave Valleys	22.861	18,755	29.759
Total	**83,988**	**78,755**	**114,129**

amount that is greater than that allocated by the NSE in the March 2012 ruling. The amount of groundwater analyzed for development in Alternative E is closer to that allocated by the NSE in the March 2012 ruling. Since the NSE ruling groundwater amount is a reduction of approximately 26 percent of Alternative F, future facilities (the number of wells, miles of pipeline, etc.) would be reduced accordingly and impacts to federal resources would also be reduced. The BLM acknowledges that Alternative E presents an impact analysis based on a lower water development figure than the Preferred Alternative while Alternative F presents a larger water development figure. The two alternatives provide a "bracketing" of the water quantities, but do not include the water right quantities granted by the NSE.

2.9 Past, Present, and Reasonably Foreseeable Future Actions

A *cumulative impact* is defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and RFFAs regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7). BLM IM NV-90-435 specifies that impacts first must be identified for the Proposed Action before cumulative impacts with interrelated actions occur.

The geographic area for evaluating cumulative effects varies by the type of resource that could be affected. In some instances, impacts for certain resources are restricted to the actual area of surface disturbance. Other resources, such as livestock and wildlife, might range over a wide area, and cumulative impacts might involve more than surface disturbance to forage or habitat (such as surface water sources that are required for drinking). Socioeconomic effects might be bounded by political jurisdictions such as towns, counties, and states. Resource-specific cumulative effects study areas were developed for each resource and are discussed in Chapter 3.

The cumulative effects analysis for this EIS has been separated into two parts, as described below.

Tier 1 Project Facilities. This analysis addresses the combined effects of the project facilities, past and present actions, and the reasonably foreseeable projects know at the time of completion of this EIS (expected in 2012). The primary unit of geographic analysis is the hydrologic basin, consisting specifically of the basins included within the GWD Project groundwater model region of study. This analysis is focused primarily on the interactions of:

1) GWD Project facilities (mainline pipeline and ancillary facilities; groundwater development areas) by alternative;

2) Past and present actions. These actions include existing energy and transportation infrastructure, and current land uses (mining, grazing, recreation). The sources used to define these actions are further described in Section 2.1.1.

3) Surface disturbance projects and activities that meet the reasonably foreseeable criteria for inclusion in the cumulative analysis. A variety of renewable energy generation and transmission projects have been proposed within the cumulative study areas of various resources in the past 5 years. Many of these projects have subsequently been withdrawn, or have become dormant for economic or other reasons. The criteria for inclusion of reasonably foreseeable projects in the cumulative analysis are described in Section 2.9.1.2.

As discussed in Chapter 1, it is anticipated that site-specific NEPA analysis will be conducted in the various groundwater development basins over the next 30 to 40 years. Because of this long time frame, it is anticipated that the cumulative analysis will be updated in each successive NEPA tier to accurately characterize cumulative effects.

This analysis does not attempt to specifically address future projects that may be implemented beyond the time frame of this EIS because it would be speculative to include them. The economic viability of many renewable energy projects, particularly wind and solar projects, are predicated on access to states with renewable energy portfolio standards. These portfolio standards may either be augmented (which would encourage new project proposals), or may be eliminated (which would likely result in the abandonment of new proposals). Proposals for power generation and large transmission projects represent large, long-term permitting efforts. The viability of these projects depend on many factors, and there may be a sufficient market for only one or two of the numerous projects proposed within a region.

Groundwater Development. The cumulative analysis of groundwater drawdown effects is based on a regional groundwater modeling exercise that was initiated in 2006. The past and present actions reflect the best available information on consumptive uses in the groundwater basins included in the model. The reasonably foreseeable projects were those that were known at the time the modeling effort was initiated. For example, the reasonably foreseeable projects include industrial consumptive uses for a power plant project in Steptoe Valley that is currently on hold; the timing of groundwater development in hydrologic basins that would serve residential developments in Lincoln County are not known because of current housing overdevelopment and the economic downturn in southern Nevada.

As described for the Tier 1 Project Facilities, it is anticipated that the regional model would be adjusted to include new sources of groundwater use as they become better defined. These new sources would be included in future NEPA analyses for the SNWA groundwater development in individual hydrologic basins.

2.9.1 Tier 1 Facilities

2.9.1.1 Past and Present Actions

Past and present actions (PPAs) within the GWD Project region are illustrated on **Figure 2.9-1**. Also included in this category are large-scale wildfires. The portion of the GWD Project in White Pine and Lincoln counties is sparsely populated. The project would be located almost entirely on federal lands that are administered by the BLM, and more than 90 percent of the land surface in these two counties is under federal ownership.

The primary land uses in these two counties are livestock grazing and limited irrigated agriculture (primarily in the White River, Spring, and Snake valleys). Existing towns and unincorporated communities are small (less than 500 residents, with the exception of Ely) and serve as regional commercial centers that support the agricultural, mining, and recreation industries. Mining is an important industry in eastern Nevada but no existing mining districts would be crossed by GWD Project facilities. Dispersed recreation—including hunting, off-highway vehicle use, hiking, and visitation to GBNP—provides an important economic element within these two counties.

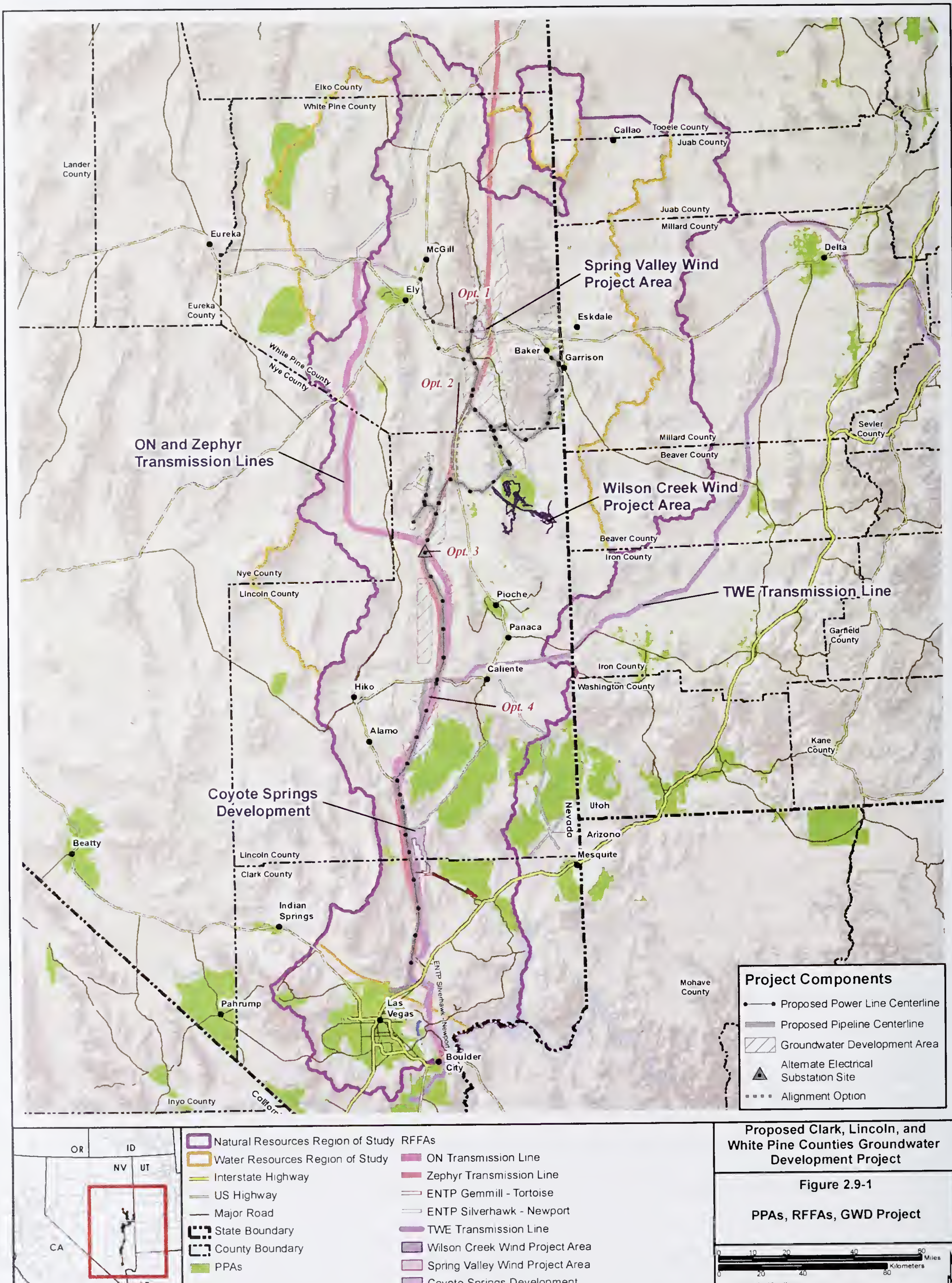
Two major U.S. highways (U.S. 93 running north and south, and the collocated U.S. 6 and U.S. 50 running east and west) serve the GWD Project area in these counties. A system of unpaved county and private roads extends across the large valley floors. A railroad segment that carries a high volume of rail traffic between Salt Lake City and Las Vegas extends across southern Lincoln County.

The land uses in the project area of northern Clark County are influenced by the proximity to the Las Vegas urban area. Land uses also are influenced by multi-state pipeline and electrical utility corridors, which extend from energy source regions in Wyoming and Utah to high energy demand areas in Las Vegas, and in California and Arizona.

The past and present actions and their overlap with the GWD Project were analyzed. Data from the following past and present actions were compiled using Geographic Information System (GIS) shapefile layers for the following components:

- Roads and Railroads (assumed a 100-foot width to account for potentially collocated electrical power lines);
- Populated Places (places from the National Atlas in U.S. Populated Places 2005);
- Agricultural lands (Southwest Regional Gap Analysis Project [SWreGAP] vegetation, with additional agricultural lands from Basin and Range Carbonate Aquifer Study [BARCAS] and the SNWA evapotranspiraton [ET] studies);
- Fires (BLM, Ely District 2005);
- Vegetation treatment areas (BLM, Ely District 2010);
- Mining districts (BLM Ely Field Office);
- Section 368 Energy Corridor Zones; and
- ROWs (Power, Communication Sites, Telephone, Pipelines, Railroads, Roads, Water, General, and Other).

Surface disturbance or land use components not included in the analysis are: 1) Nellis AFB, since it falls outside of the main ROW cumulative effects study area and 2) Patriot missile sites, whose aboveground temporary communication tower sites are used only periodically. Also not included are the specific locations of a small number of the SNWA exploration and monitoring groundwater wells that were developed under separate EAs approved by the BLM.



No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

Approved surface uses on BLM lands (e.g. livestock grazing, recreational uses, transportation corridors) were considered in the cumulative impact analysis where there was a likelihood that the surface use might be affected by cumulative project interactions.

2.9.1.2 Reasonably Foreseeable Future Actions

The RFFAs were compiled to determine overlap relationships with the GWD Project. An initial screening of RFFAs used a variety of resources:

- The BLM Ely District and Las Vegas District pending project lists;
- The NDEP list of mining projects;
- The Nevada Wind Energy Projects list;
- Projects that are addressed in the cumulative impact sections of other water project NEPA analysis (BLM 2008c) in the area of interest;
- Internet and literature searches; and
- Pending Utah projects gathered from the BLM Fillmore and Cedar City web sites.

To develop a footprint for the RFFA GIS map overlay, the following shapefiles and documents were used and assumptions made.

- BLM LR2000 System;
- Wind and Solar Energy (Plans of Development, EAs, and Pending and Authorized ROWs);
- The private land parcel near Coyote Springs (for residential and solar development); and
- The Nevada BLM land ownership data.

The project lists and descriptions were then reviewed to determine the projects to be included in the cumulative analysis. The following criteria were applied:

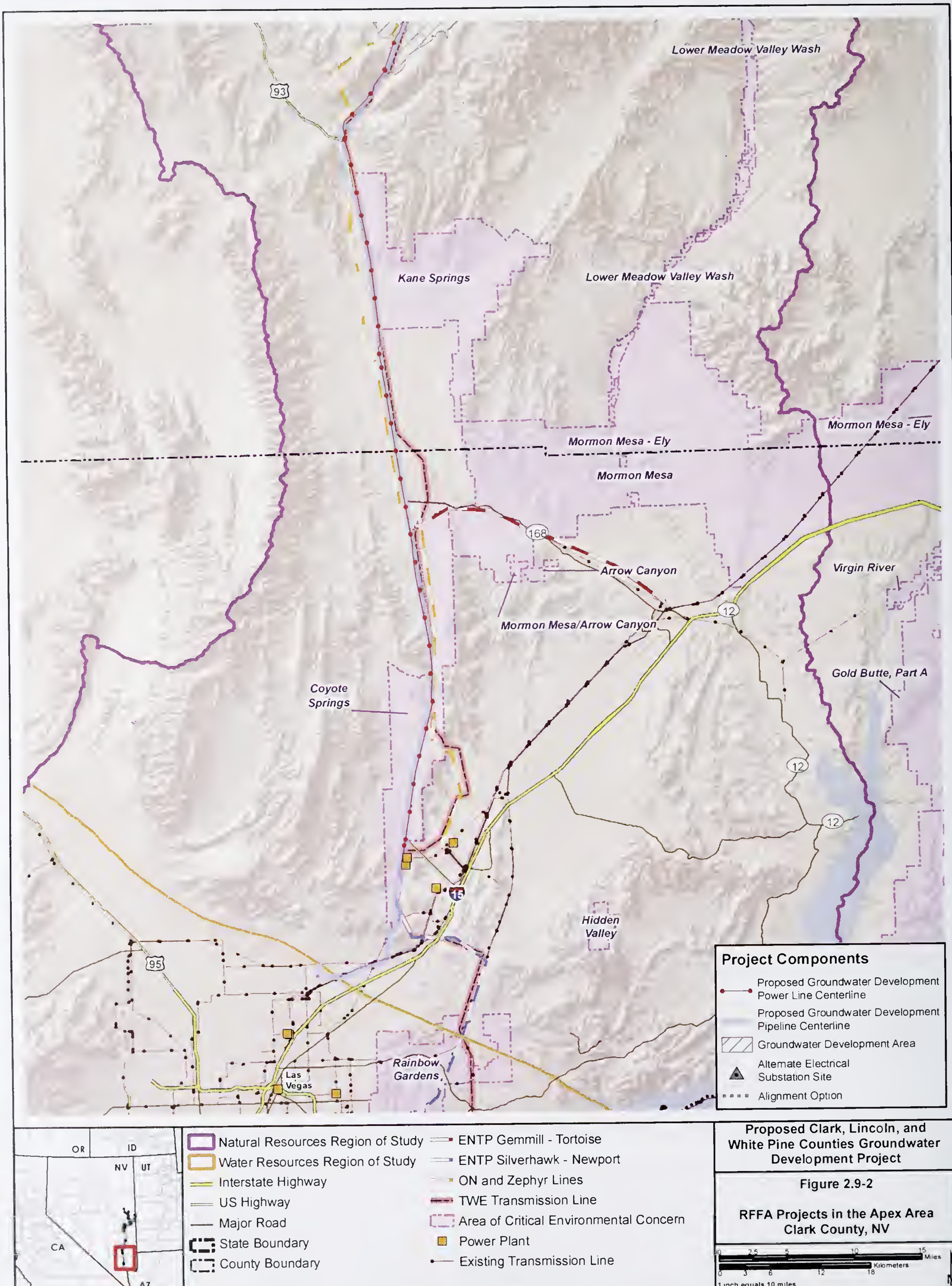
1. If a project is subject to an existing proposal, such as the filing with BLM of a ROW application or plan of development, the cumulative impact analysis should describe the types of facilities, land requirements, and other infrastructure needed (roads, electrical service, water). In general, evidence of project viability, funding and progress show that the project is highly probable.

2. If a proposed project has been approved and may already be underway, those facts could also be included in the cumulative impacts analysis.

3. Development on private land that shows evidence of project viability, funding and progress, based on filings with local governments, evidence of construction from aerial photo reviews, or other documented information should also be included in the cumulative impacts analysis.

Based on these criteria the reasonably foreseeable projects, and associated development areas (hydrologic basins) are summarized on **Figures 2.9-1** and **2.9-2**. The following section provides a description of each of the reasonably foreseeable projects, and the anticipated interactions with GWD Project.

The consideration of RFFAs for Cumulative Impact Assessment varies by resource and is influenced by the geographic extent of the potential direct and indirect impacts of the No Action and other alternatives on the resource.



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 2.9-2

RFFA Projects in the Apex Area Clark County, NV

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

Wilson Creek Wind Project

- Location. This project is being developed in three phases along the summits of the Wilson Peak Range, located between southern Spring and northern Lake Valley (**Figure 2.9-1**) within an overall lease area of approximately 31,000 acres.
- Permitting/Development Status. The Wilson Creek/Table Mountain area represents the first project phase. The Atlanta Summit and White Rock areas would be developed at a later time, depending on the quality of the wind resource. This project is currently undergoing an EIS review process under the lead of the BLM Schell Field Office. The Wilson Creek/Table Mountain area is being analyzed on a site-specific level; the other two areas are being evaluated at a programmatic level. Public scoping was completed during July 2011. In late 2011, Wilson Creek Wind informed the BLM that the company wished to maintain its active ROW application, but would evaluate different wind energy sites within the same region. As a consequence of this decision, preparation of the Draft EIS has been placed on hold.
- Project Description. The following is a summary of facilities, and an estimate of land requirements for the Phase 1 facilities, based on the POD (Wilson Creek Power Partners 2010).
  - Turbines. The first phase is planned for 195 turbines of various sizes.
  - Roads. It is estimated that a total of 178 miles of roads would be required to support the first phase of the project. Of this mileage, approximately 50 percent represents existing roads requiring improvement.
  - Transmission line. The project transmission line would extend from the project area to the LCCRDA corridor boundary on the divide between Spring and Lake valleys. The transmission line would then be located within the LCCRDA corridor across Lake and Dry Lake valleys to an interconnection with the 500 kV ON Transmission Line in Dry Lake Valley.
  - Project surface disturbance. It is assumed that approximately 750 acres of temporary surface disturbance would be required for new and upgraded surface roads, and turbine pads for Phase 1. It is assumed that the 50 mile transmission line would require a construction ROW 100 feet wide, and temporary surface disturbance of approximately 600 acres. Permanent land commitments to roads and turbine sites is estimated to be about 500 acres.
- Relationship to the GWD Project.
  - Transmission lines for both projects would be located within the LCCRDA corridor within the Lake and Dry Lake valleys, and ROWs could be adjacent.

Spring Valley Wind Project

- Location. The project is being constructed north of the intersection of Highways 93 and 6&50 in Spring Valley within an overall development area of 7,653 acres (**Figure 2.9-1**).
- Permitting/Development Status. The ROD and FONSI were issued by the BLM in October 2010. It was assumed in the EA that the project would be in service by the end of 2011. The project ROD and FONSI were appealed, but the BLM decision to grant the required ROWs was upheld. Project construction activities were initiated in late 2011, with the expectation that facility construction will be completed in 2012.
- Project Description (based on the EA):
  - Turbines. 75 wind turbines would be installed (subsequently reduced to 66 turbines).
  - Roads. Approximately 28 miles.
  - Transmission Lines. Direct interconnection via substation with an existing NV Energy 230 kV line in Spring Valley.
  - Project Surface disturbance. Temporary surface of approximately of 337 acres; permanent land commitments to access roads and turbines of 111 acres.
- Relationship to the GWD Project. Overlaps with a GWD Project groundwater development area in Spring Valley.

ON Line Transmission Project

- Location. The 500-kV transmission line project is being constructed in a 200-foot-wide permanent ROW within an approved BLM utility corridor between a substation west of Ely in White Pine County and a terminus at the Harry Allen Power Plant in Clark County (**Figures 2.9-1** and **2.9-2**).
- Permitting/Development Status. ROW grants and partial Notices to Proceed received. Facility construction was initiated in 2011, with completion of the entire system anticipated in 2013.
- Project Description. 500 kV alternating current (AC) transmission line, with an associated access road. Based on information contained in the project description chapter of the supplemental Final EIS (BLM 2010), it is assumed that temporary surface disturbance required for roads, pulling stations, and other temporary work areas would require 12 acres per mile; permanent road and transmission structures would require 3 acres per mile. Assuming an overlap with the GWD Project facilities in the same utility corridor for 136 miles, temporary surface disturbance would be 1,632 acres; permanent land commitments to access roads and transmission line structures would be 408 acres.
- Relationship to the GWD Project. Groundwater development facilities (pipeline and transmission line) would share the same utility corridor with the ON Transmission Line in Cave, Dry Lake, Delamar, Pahranagat, Coyote Springs, Hidden, and Garnet Valleys over a distance of approximately 136 miles. ROWS of the two projects could be adjacent.

Kane Springs Valley Groundwater Development Project

- Location. This groundwater development and pipeline system is located in Kane Springs and Coyote Springs Valley northeast of the Lincoln/Clark County line, Nevada.
- Permitting/Development Status. The ROD was signed in November 2008. Project is currently undergoing engineering analysis and construction design.
- Project Description. The project consists of groundwater wells in Kane Springs Valley, a 9 mile water conveyance pipeline, a 4 mile transmission line, and water storage tanks. Total land requirements would be 191 acres.
- Relationship to the GWD Project. The utility ROWs would not overlap, but would be located within the same hydrologic basin. The groundwater pumping for this project is a foreseeable project under groundwater development.

Coyote Springs Residential Development

- Location. This development is located on a block of land east of U.S. Highway 93 near the Lincoln-Clark County line.
- Permitting Development Status. A Final EIS and ROD was issued in September and October of 2008 for a Multi-species Habitat Conservation Plan (USFWS 2008a,b). The Plan provided an incidental take permit for the desert tortoise, the banded gila monster, and western burrowing owl. The approved EIS alternative provided for 21,454 acres of residential development, and 13,767 acres of leased conservation land to be administered by the BLM and USFWS.
- Project Description. A golf course for the project was completed, and is currently operational. The remainder of the private land is undeveloped, pending improvement in regional economic conditions, and resolution of lawsuits among the developers. Water for the development is to be provided by water rights held by Lincoln County Water District associated with the Kane Springs Groundwater Development Project (1,000 afy); and by water rights held by Coyote Springs Investment (CSI) associated with existing wells CSI-1 through CSI-4 (4,600 afy) located on the property and water rights held in Lake Valley (11,300 afy).

Silver State Energy Association Eastern Nevada Transmission Project

- Location. This 230-kV transmission line project is proposed in two separate alignments in Clark County, Nevada. One of the alignments would extend 21 miles from the Gemmill substation near the intersection of U.S. Highway 93 and Nevada Highway 168 (south of the Coyote Springs private land block) to a terminus at the Tortoise substation near Moapa. The second alignment would extend 33 miles from the Silverhawk power plant to the Newport Substation south of Henderson (**Figures 2.9-1** and **2.9-2**).

- Permitting/Development Status. A draft EA currently is under review by the BLM Southern Nevada District. It is possible that a FONSI may be reached by the BLM for the Gemmill Substation to Moapa Substation in 2011. The BLM's ROW grant for the Silverhawk to Newport segment may be delayed, pending resolution of whether a new transmission line ROW is available across the Sunrise Mountain Instant Study Area east of Las Vegas.

Project Description. The following is a summary of facilities, and land requirements.

- Transmission line and roads. The two project transmission line alignments are proposed within a 150 foot wide permanent ROW. Both alignments would be located in existing utility corridors in which other transmission lines and roads are present. For purposes of analysis, it is assumed that surface disturbance would average 12 acres per mile. This disturbance area would include staging, conductor stringing areas, and temporary access roads. It also is assumed that permanent surface disturbance (structure sites, spur roads) represents 10 percent of the construction surface disturbance, or 1.2 acres per mile.
- Project surface disturbance.
  - Gemmill Substation to Moapa Substation. It is assumed that this segment would require a construction surface disturbance area of 252 acres, and a permanent commitment of 25 acres to spur roads and transmission structure sites.
  - Silverhawk Substation to Newport Substation. It is assumed that this segment would require a construction surface disturbance area of 396 acres, and permanent commitment of 40 acres to spur roads and transmission structure sites.

- Relationship to the GWD Project.
  - Gemmill Substation to Moapa Substation. The Gemmill Substation would be located on the east side U.S. Highway 93; the GWD Project ROW would be located parallel to Highway 93 on the west side of the highway. The Eastern Nevada Transmission project would traverse approximately 6 miles of the Coyote Spring Valley, a hydrographic basin shared with the GWD Project.
  - Silverhawk Substation to Newport Substation. The proposed transmission line ROW would parallel the proposed GWD Project main pipeline ROW for approximately four miles in the Garnet Valley between the Silverhawk power plant and the vicinity of Apex, where the two ROWs would diverge.
  - The GWD Project and the two segments of the Eastern Nevada Transmission Project are located within the BLM Coyote Springs ACEC, which spans the Coyote Springs, Hidden Valley North, and Garnet Valleys. This ACEC was established for desert tortoise protection.

TransWest Express Transmission Line Project

- Location. An alternative for this high voltage transmission line project would be located within the LCCRDA corridor from the intersection of the corridor with Highway 93 in the Delamar Valley, and then would extend south within the existing utility corridor to point near the Harry Allen Power Plant near Apex where the project would join other transmission lines that connect to the Marketplace substation south of Las Vegas (**Figures 2.9-1** and **2.9-2**).
- Permitting/Development Status. A Draft EIS is being developed by the BLM and Western Area Power Authority, with an anticipated release date in mid-2012. The in-service date for the project is estimated to be 2015.
- Project Description. This 600-kV direct current transmission line would connect renewable and fossil fuel electricity generation sources with interconnections with the southwest U.S. utility grid at the Marketplace Substation west of Boulder City, Nevada. The transmission line would be constructed within a 250 foot permanent ROW, which would include the transmission line structures as well as an unimproved access road. Using the same surface disturbance assumptions as the ON Transmission Line, it is assumed that construction surface disturbance would be 12 acres per mile; and permanent land requirements for structures and roads would be 3 acres per mile. Assuming an overlap with the GWD Project facilities in the same utility corridor for 90 miles, temporary surface

disturbance would be 1080 acres; permanent land commitments to access roads and transmission line structures would be 270 acres.

- Relationship to the GWD Project. Groundwater development facilities (pipeline and transmission line) would share the same utility corridor with the TransWest Express and Zephyr transmission lines in Delamar, Pahranagat, Coyote Springs, Hidden, and Garnet Valleys over a distance of approximately 90 miles. ROWs of the three projects could be adjacent (see description of the Zephyr project below).

Zephyr Transmission Project

- Location. An alternative for this high voltage transmission line project would be located within the LCCRDA corridor from the intersection of the corridor with Highway 93 in the Delamar Valley, and then would extend south within the existing utility corridor to point near the Harry Allen Power Plant near Apex where the project would join other transmission lines that connect to the Marketplace substation south of Las Vegas (**Figures 2.9-1** and **2.9-2**).
- Permitting/Development Status. Zephyr Power Transmission, LLC filed A ROW Standard Form 2599 application and preliminary POD were filed with the Wyoming State Office on March 13, 2012.
- Project Description. This 950-mile 500 kV direct current transmission line would connect renewable and fossil fuel electricity generation sources in eastern Wyoming with interconnections with the southwest U.S. utility grid at the Marketplace Substation west of Boulder City, Nevada. The transmission line would be constructed within a 200- foot wide permanent ROW, which would include the transmission line structures as well as an unimproved access road. Using the same surface disturbance assumptions as the ON Transmission Line, it is assumed that construction surface disturbance would be 12 acres per mile; and permanent land requirements for structures and roads would be 3 acres mile. Assuming an overlap with the GWD Project facilities in the same utility corridor for 90 miles, temporary surface disturbance would be 1080 acres; permanent land commitments to access roads and transmission line structures would be 270 acres.
- Relationship to the GWD Project. Groundwater development facilities (pipeline and transmission line) would share the same utility corridor with the Zephyr and TransWest Express transmission lines in Delamar, Pahranagat, Coyote Springs, Hidden, and Garnet Valleys over a distance of approximately 90 miles. ROWs of the three projects could be adjacent.

Table 2.9-1 provides a summary of the land requirements (estimated construction surface disturbance) by hydrologic basin for the GWD Project Proposed Action (ROWs and groundwater development facilities), Past and Present Actions, and the Reasonably Foreseeable Future Projects. **Table 2.9-2** includes known projects and actions that have not been included in the cumulative surface analysis.

2.9.2 Subsequent NEPA Tiers – Groundwater Development

Groundwater consumptive uses included for the cumulative impact evaluations include:

- Continuation of historical and permitted groundwater uses incorporated under the No Action Alternative;
- Pumping associated with the Proposed Action or alternatives to the Proposed Action (Alternatives A through F) specific to the cumulative impact evaluations for each alternative groundwater development scenario.
- Reasonably foreseeable future groundwater development, including:
  - Future development of existing permitted groundwater rights that are likely to occur associated with private lands and previously authorized projects; and
  - Additional groundwater developments that may occur in the future associated with proposed projects that have submitted formal development plans to regulatory agencies for permitting purposes.

Table 2.9-1 Summary of Surface Disturbing Actions for Past and Present and Reasonably Foreseeable Future Actions in Basins Crossed by the GWD Project Facilities

Hydrologic Basin	Total Acres in Hydrologic Basin	Past and Present Actions (acres)	Groundwater Development Proposed Action Project ROW Construction Impacts (acres)	Groundwater Development Proposed Action Groundwater Development Impacts (acres)	Reasonably Foreseeable Future Actions (acres)	Sum of Past and Present Actions, Proposed Action, and RFFAS
Cave Valley	229,646	5,723	712	523	0	6,958
Coyote Spring Valley	392,730	43,404	1,727	0	22,944	69,986
Delamar Valley	231,443	52,681	891	523	628	54,991
Dry Lake/Muleshoe Valleys	573,399	10,846	2,631	523	1,588	15,588
Garnet Valley	100,936	1,941	306	0	156	2,499
Hamlin Valley	520,085	33,196	384	0	0	33,580
Hidden Valley (North)	53,475	357	478	0	66	901
Lake Valley	354,464	27,019	804	0	990	28,813
Las Vegas Valley	987,568	317,845	223	0	0	318,068
Lower Meadow Valley Wash	605,291	224,433	121	0	0	224,554
Pahranagat Valley	495,042	14,380	252	0	162	14,896
Snake Valley	1,766,192	57,762	879	2,280	0	60,921
Spring Valley	1,066,063	54,854	2,553	4,416	337	62,175
Steptoe Valley	1,248,646	72,690	327	0	0	73,017
Total	**8,624,980**	**917,131**	**12,288**	**8,265**	**26,871**	**966,785**

Table 2.9-2 **Projects and Actions not Included in the GWD Project Tier 1 Analysis**

Hydrographic Basin(s)	Proponent	Project/Action	Rationale for not including in the Tier 1 analysis.
Renewable Energy Projects			
Steptoe	Apex (formerly NV Wind)	Wind energy projects, multiple sites (Cherry Creek, Egan, Robinson Summit, Schell)	Apex acquired projects from NV Wind; existing PODs being reviewed; no time frame for re-starting project permitting.
Steptoe	Gridflex Energy	White Pine Pumped Storage	On hold.
Spring	NextEra	Blackhorse Wind	Monitoring, no POD filed.
Hamlin	Wasatch Wind	Hamlin Valley Wind	Monitoring, no POD filed.
Lake	Windlabs	Horse Corral Pass Wind	Monitoring, no POD filed.
Delamar	Solar Reserve	Pahroc South Solar	On hold.
Coyote Spring	BrightSource	Coyote Springs Solar	No evidence of current development.
Power Plants			
Virgin River, Tule Desert	Sithe Global	Toquop Power Plant (natural gas)	Surface facilities – located outside hydrologic basins potentially affected by the GWD Project. On hold.
Steptoe	LS Power	White Pine Power Project	NEPA process completed; on hold.
Transmission Lines			
Existing Transmission Line Utility Corridor (Apex to Marketplace)	Great Basin Transmission	SWIP Extension (Harry Allen Power Plant to Marketplace)	Project would be outside the utility corridors being proposed for the GWD Project. Determination needs to be made whether this transmission line project can be constructed across the Sunrise Mountain Instant Study Area. An alternative would be to utilize an available circuit on an existing double circuit transmission line.
Groundwater Development and Conveyance Projects			
Clover	Lincoln County Water District	Lincoln County Land Act	Surface facilities – located outside hydrologic basins potentially affected by GWD Project. Groundwater requirements included in groundwater development foreseeable projects.

2.9.2.1 Past and Present Actions

The past and present groundwater uses include continuation of the estimated historical groundwater consumptive uses estimated for the water resources region of study. The estimated historical groundwater consumptive uses for the study area are provided in Appendix C of the Transient Numerical Model Report (SNWA 2009) and summarized in **Table 2.9-3**.

Table 2.9-3 Past and Present Consumptive Groundwater Use, by Hydrologic Basin[1]

Basin Number	Hydrographic Basin	Total (afy)
195	Snake Valley	21,649
184	Spring Valley	9,045
215	Black Mountains Area	1,688
204	Clover Valley	742
198	Dry Valley	3,520
200	Eagle Valley	129
216	Garnet Valley	770
183	Lake Valley	13,373
205	Lower Meadow Valley Wash	3,077
220	Lower Moapa Valley	2,705
219	Muddy River Springs Area	8,117
209	Pahranagat Valley	2,754
203	Panaca Valley	9,325
202	Patterson Valley	2,819
194	Pleasant Valley	232
199	Rose Valley	362
179	Steptoe Valley	11,673
207	White River Valley	11,671

[1] Sources used for No Action Alternative as shown on **Figure 3.3.2-20**.

2.9.2.2 Reasonably Foreseeable Groundwater Use

The reasonably foreseeable groundwater uses include: (1) continuation of the estimated historical groundwater consumptive uses (incorporated under the No Action Alternative); and (2) an estimate of the reasonably foreseeable future groundwater development. Reasonably foreseeable future groundwater developments include estimated groundwater consumptive uses associated with the future development of existing permitted groundwater rights that are likely to occur associated with private lands and previously authorized projects; and additional groundwater developments that may occur in the future associated with proposed projects that have submitted formal development plans to regulatory agencies for permitting purposes. The estimated reasonably foreseeable future groundwater developments for each of the proposed pumping basins and additional basins included in the water resources region of study are listed in **Table 2.9-4.**

Table 2.9-4 Estimated Reasonably Foreseeable, Future Groundwater Developments Included in the Cumulative Analysis

Hydrographic Basin	Reasonably Foreseeable Future Groundwater Developments			Comments
	Quantity (afy)	Use Type	Water Right Status	
Project Groundwater Development Basins				
Delamar Valley	—	—	—	No additional reasonably foreseeable, future uses
Dry Lake Valley	1,009	Irrigation	Permit	Lincoln County Water District
Cave Valley	—	—	—	No additional reasonably foreseeable, future uses
Spring Valley	1,426	Irrigation	Permit	—
Snake Valley	—	—	—	No additional reasonably foreseeable, future uses
Other Basins				
Coyote Spring Valley	9,000	Municipal	Permit	SNWA Coyote Spring Pipeline
	4,600		Permit	Coyote Spring Investment, Inc.
Steptoe Valley	2,046	Irrigation	Permit	—
	8,000	Industrial	Permit	White Pine County lease to LS Power Co. (project start assumed in 2020)
	20		Permit	Other existing permitted industrial
	2,635	Mining	Permit	Robinson Nevada Mining Co.
Garden Valley	83	Irrigation	Permit	—
	5	Industrial	Permit	—
Kane Springs Valley	1,000	Municipal	Permit	Lincoln County Water District/Vidler groundwater rights based on NSE Ruling Nos. 5712 and 5987
Panaca Valley	1,240	Irrigation	Permit	—
Clover Valley	37	Irrigation	Permit	—
	14,480	Municipal	Application	Lincoln County Water District/ Vidler groundwater applications (67964, 67965, 67966, 67967); Lincoln County Land Act Project
Lower Meadow Valley Wash	380	Irrigation	Permit	—
	580	Municipal	Permit	Coyote Springs Investment, Inc.
Pahranagat Valley	924	Irrigation	Permit	—

Table 2.9-5 provides a summary of the total estimated cumulative groundwater consumptive use for the hydrologic basins within the overall hydrologic Region of Study. The Proposed Action represents the GWD Project alternative with the maximum potential groundwater withdrawal from the five project basins. No past or current pumping is occurring in Delamar, Dry Lake, and Cave valleys. Very small groundwater pumping volumes, or no additional pumping are foreseeable in the five project basins. Based on these estimates, the GWD Project would be the primary groundwater user in all five groundwater development basins proposed for pumping and in the water resource region of study for the EIS.

Table 2.9-5 Estimated Cumulative Total Groundwater Consumptive Use by Hydrologic Basin

Hydrographic Basin	GWD Project – Proposed Action (afy)	Past and Present Actions (afy)	RFFAs (afy)	Total (afy)
Cave Valley	11,584	0	0	11,584
Delamar Valley	11,584	0	0	11,584
Dry Lake Valley	11,584	0	1,009	12,593
Snake Valley	50,679	21,649	0	72,328
Spring Valley	91,224	9,045	1,426	101,695
Clover Valley	0	742	14,517	15,259
Coyote Spring Valley	0	0	13,600	13,600
Dry Valley	0	3,520	0	3,520
Eagle Valley	0	129	0	129
Garden Valley	0	0	88	88
Garnet Valley	0	770	0	770
Kane Springs Valley	0	0	1,000	1,000
Lake Valley	0	13,373	0	13,373
Lower Meadow Valley Wash	0	3,077	960	4,037
Lower Moapa Valley	0	2,705	0	2,705
Muddy River Springs Area	0	8,117	0	8,117
Pahranagat Valley	0	2,754	924	3,678
Panaca Valley	0	9,325	1,240	10,565
Patterson Valley	0	2,819	0	2,819
Pleasant Valley	0	232	0	232
Rose Valley	0	362	0	362
Steptoe Valley	0	11,673	12,701	24,374
White River Valley	0	11,671	0	11,671

2.10 Environmental Impact Summary

Five tables are used to summarize impacts of the GWD Project on environmental resources. **Table 2.10-1** identifies the impacts of main conveyance pipeline ROW and ancillary facilities on environmental resources. **Table 2.10-2** identifies the impacts resulting from future groundwater development surface disturbing activities including the construction of collector pipelines, power lines, wells, and ancillary facilities.

Information provided in **Tables 2.10-3** and **2.10-4** summarizes potential groundwater pumping impacts on water resources and water-dependent resources. The impact summary applies to all alternatives, with impact parameters being used to differentiate the relative risk for the action and No Action alternatives. As described in Water Resources, Section 3.3.2, the potential impacts to individual seeps, springs, or stream reaches (and their associated water dependant resources) would depend on the extent of drawdown that occurs in the area and the interconnection between the surface water feature and the aquifers affected by drawdown. The drawdown impact evaluation for springs and streams was limited to a prediction of areas of risk with the recognition that actual impacts to individual springs and streams distributed over this broad region cannot be determined precisely prior to pumping. The impact parameters provided in **Tables 2.10-3** and **2.10-4** for water-dependent resources represent the total resources situated within both the high or moderate risk zones for each groundwater pumping drawdown simulation, as defined in Section 3.3.2.8. It is important to recognize that the values provided in these tables indicate the resources at risk without accounting for the implementation of ACM's, adaptive management practices, or other water resource related mitigation measures described in Section 3 for each water-dependent resource (and summarized for all resources in Section 3.20, Monitoring and Mitigation Summary).

Table 2.10-5 summarizes the key differences for the local alignment options as compared to those under the Proposed Action.

Table 2.10-1 ROW Areas and Ancillary Facility Impact Summary for the Proposed GWD Project[1]

Resource	Proposed Action and Alternatives A, B, and C	Alternative D	Alternatives E and F	No Action
Air	Air pollutant emissions from construction equipment over an area of approximately 12,288 acres and an 8-year period.	Air pollutant emissions from construction equipment over an area of approximately 8,828 acres and a 6-year period.	Air pollutant emissions from construction equipment over an area of approximately 10,681 acres and a 6-year period.	Regional air pollutant concentrations would remain similar to current levels because land uses (agriculture, mining) would continue at a similar activity level.
	Slight increase in air pollutant emissions from operation and maintenance activities.	Slight increase in air pollutant emissions from operation and maintenance activities but at a reduced scale.	Slight increase in air pollutant emissions from operation and maintenance activities but at a reduced scale.	No increases in air pollutant emissions would occur from construction and operations equipment.
	Minor contribution of greenhouse gas emissions.	Minor contribution of greenhouse gas emissions.	Minor contribution of greenhouse gas emissions.	Continued contribution of greenhouse gas emissions from current activities.
Geology/ Paleontology	Even if trench monitoring is implemented, some scientifically valuable fossils would be disturbed and lost during trench excavation and ROW grading over a distance of approximately 150 miles.	Same type of impact as the Proposed Action and Alternatives A through C except that ROWs would not occur in White Pine County.	Same type of impact as the Proposed Action and Alternatives A through C except that ROWs would not occur in Snake Valley.	Locations of scientifically valuable fossils would remain undisturbed on BLM lands, based on current land uses and activities.
Water	Channel alteration and potential water quality effects on one perennial stream crossed by the pipeline ROW.	No perennial streams crossed by the pipeline ROW.	No perennial streams crossed by the pipeline ROW.	No human-caused disturbance would occur in these perennial streams, although channels may be altered by natural high flow events (flash floods, high spring runoff).
	Potential water quality effects on two perennial streams by the power line ROW.	No perennial streams crossed by the power line ROW.	No perennial streams crossed by the power line ROW.	No human-caused disturbance would occur in these perennial streams, although channels may be altered by natural high flow events (flash floods, high spring runoff).
	Potential channel alteration and water quality effects on numerous intermittent and ephemeral streams by the pipeline and power linc ROWs.	Fewer intermittent streams crossed by the pipeline and power line ROWs.	Fewer intermittent streams crossed by the pipeline and power line ROWs.	No human-caused disturbance would occur in these intermittent and ephemeral stream channels, although these channels may be altered by natural high flow events (flash floods, high spring runoff).
	Potential groundwater withdrawal for the construction water supply could result in localized drawdown effects.	Same type of impact as the Proposed Action and Alternative A through C but less areas affected.	Same type of impact as the Proposed Action and Alternative A through C but less areas affected.	No localized drawdown effects would occur.

Table 2.10-1 ROW Areas and Ancillary Facility Impact Summary for the Proposed GWD Project[1] (Continued)

Resource	Proposed Action and Alternatives A, B, and C	Alternative D	Alternatives E and F	No Action
Soils	Short-term disturbance to the following acres of sensitive soils: highly wind erodible (1,476), highly water erodible (615), compaction prone (123), and low revegetation potential (10,211).	Short-term disturbance to same types of sensitive soils but fewer acres.	Short-term disturbance to same types of sensitive soils but fewer acres.	No surface disturbance to soils underlying native vegetation would occur, and therefore soil losses from wind and soil erosion would continue at current rates.
	Short-term disturbance to approximately 2,338 acres of soil with prime farmland characteristics (no currently active cropland would be affected).	Short-term disturbance to 2,295 acres of soils with prime farmland characteristics (no currently active cropland would be affected).	Short-term disturbance to 2,350 acres of soils with prime farmland characteristics (no currently active cropland would be affected).	No surface disturbance to soils with prime farmland characteristics would occur.
Vegetation	Long restoration period for removal of approximately 12,288 acres of vegetation during construction. Permanent removal of 999 acres due to facility installation.	Long restoration period for removal of approximately 8,828 acres of vegetation. Permanent removal of 808 acres due to facility installation.	Long restoration period for removal of approximately 10,681 acres of vegetation. Permanent removal of 945 acres due to facility installation.	No surface disturbance to vegetation communities would occur. The stability of vegetation communities may be affected by other factors (noxious weed invasion, wild fires).
	Potential spread of noxious weeds due to construction equipment.	Potential spread of noxious weeds due to construction equipment, but affected area would be 25 percent less than the Proposed Action and Alternatives A through C.	Potential spread of noxious weeds due to construction equipment, but affected area would be 20 percent less than the Proposed Action and Alternatives A through C.	Noxious weed populations may continue to spread in response to existing surface disturbance (roadways, agriculture, grazing), and wildfires.
	Potential fire risk due to construction areas.	Potential fire risks due to construction equipment, but affected area would be 25 percent less than the Proposed Action and Alternatives A through C.	Potential fire risks due to construction equipment, but affected area would be 20 percent less than the Proposed Action and Alternatives A through C.	The potential for wildfires caused by both human and natural sources would continue in all vegetation communities.
	Salvage of yucca and cacti in disturbance areas.	Same as the Proposed Action and Alternatives A through C.	Same as the Proposed Action and Alternatives A through C.	No surface disturbance to yucca and cacti populations would occur.
	Potential disturbance to six BLM sensitive plant species populations.	Same as the Proposed Action.	Same as the Proposed Action.	No disturbance to six BLM sensitive plant species populations would occur.

Table 2.10-1 ROW Areas and Ancillary Facility Impact Summary for the Proposed GWD Project[1] (Continued)

Resource	Proposed Action and Alternatives A, B, and C	Alternative D	Alternatives E and F	No Action
Wildlife	Big game range construction impacts include: antelope (7,950 acres), elk (4,019 acres), mule deer (3,918 acres), and desert bighorn sheep (285 acres).	Big game range construction impacts are reduced: antelope (4,571 acres); elk (2,704 acres); mule deer (2,949 acres). Desert bighorn sheep (260 acres).	Big game range construction impacts are reduced: antelope (6,345 acres); elk (4,019 acres); mule deer (3,547 acres). Desert big horn sheep (260 acres).	No big game habitat would be removed.
	Habitat impacts for special status wildlife species (desert tortoise, sage-grouse, pygmy rabbit, western burrowing owl, bald eagle, golden eagle, ferruginous hawk, bats, dark kangaroo mouse, Gila monster, and Mojave poppy bee).	Habitat impact for special status wildlife species reduced by 23 to 59 percent. Mojave poppy bee impacts the same.	Habitat impact for special status wildlife species reduced by 20 to 50 percent. Mojave poppy bee impacts the same.	No special status species habitat would be removed.
	Operation of electrical power lines could result in bird collisions, electrocution, and increased predation on desert tortoise, pygmy rabbit, and other wildlife species.	Same potential impacts as listed for the Proposed Action.	Same potential impacts as listed for the Proposed Action.	No new electrical power lines would be constructed. Existing power lines would continue to allow predation on vulnerable wildlife species.
Aquatic Biology	Habitat alteration and potential water quality effects on one perennial stream containing game fish species crossed by the pipeline ROW.	No perennial streams crossed by the pipeline ROW.	No perennial streams crossed by the pipeline ROW.	No human-caused disturbance would occur in these perennial streams, although channels may be altered by natural high flow events (flash floods, high spring runoff).
	Potential water quality effects on two perennial streams containing game fish species crossed by the power line ROW.	No perennial streams crossed by the power line ROW.	No perennial streams crossed by the power line ROW.	No human-caused disturbance would occur in these perennial streams, although channels may be altered by natural high flow events (flash floods, high spring runoff).
	Potential habitat alteration and water effects on numerous intermittent streams potentially containing macroinvertebrates crossed by the pipeline and power line ROWs.	Fewer intermittent streams potentially containing macroinvertebrates crossed by the pipeline and power line ROWs.	Fewer intermittent streams potentially containing macroinvertebrates crossed by the pipeline and power line ROWs.	No human-caused disturbance would occur in these perennial streams, although channels may be altered by natural high flow events (flash floods, high spring runoff).
	Potential amphibian mortalities near waterbodies from vehicle traffic within the ROWs (431 miles).	Potential amphibian mortalities near waterbodies from vehicle traffic within the ROWs (315 miles).	Potential amphibian mortalities near waterbodies from vehicle traffic within the ROWs (388 miles).	No surface disturbance or increased traffic would cause amphibian mortalities.

Table 2.10-1 ROW Areas and Ancillary Facility Impact Summary for the Proposed GWD Project[1] (Continued)

Resource	Proposed Action and Alternatives A, B, and C	Alternative D	Alternatives E and F	No Action
Land Use	Short-term disturbance to 12,288 acres of which 97 percent is managed by the BLM.	Short-term disturbance to 8,828 acres of which 97 percent is managed by the BLM.	Short-term disturbance to 10,681 acres of which 97 percent is managed by the BLM.	No surface disturbance would occur on BLM lands.
	Short-term disturbance to 8.5 acres of agricultural land.	Short-term disturbance to 8.5 acres of agricultural land.	Short-term disturbance to 8.5 acres of agricultural land.	No surface disturbance would occur on agricultural lands.
	Approximately 25 percent of disturbance located outside of designated utility corridors.	Approximately 10 percent of disturbance located outside of designated utility corridors.	Approximately 15 percent of disturbance located outside of designated utility corridors.	No disturbance would occur outside designated utility corridors.
Recreation	Short-term effects on access for off-highway vehicle (OHV) race routes.	Short-term effects on access for off-highway vehicle (OHV) race routes but only in Lincoln County.	Same as the Proposed Action and Alternatives A through C.	No change in access would occur on OHV race routes.
	Short-term disturbance to the Caliente Special Recreation Permits, Chief Mountain Special Recreational Management Areas (SRMA), Las Vegas Valley SRMA, Loneliest Highway SRMA, Pioche Special Recreation Permits, and Steptoe Valley WMA.	Same as the Proposed Action and Alternatives A through C except the Loneliest Highway SRMA and Steptoe Valley WMA would not be crossed.	Same as the Proposed Action and Alternatives A through C.	No surface disturbance would occur in recreational management areas.
	Short-term interference with hunting access.	Same as the Proposed Action and Alternatives A through C but fewer miles of ROW involved.	Same as the Proposed Action and Alternatives A through C but fewer miles of ROW involved.	No short-term interference with hunting access would occur.
Transportation	Short-term disturbance to traffic and potential vehicle/animal collisions.	Reduced traffic levels and animal collisions due to elimination of Snake Valley and most of Spring Valley.	Reduced traffic levels and animal collisions due to elimination of Snake Valley.	No short-changes in traffic volume would occur on regional roads and highways.
Minerals	Potential short-term reductions in access to minerals and minor use of sand and gravel supplies.	Same as Alternatives A through C except that no impacts would occur in Snake Valley and most of Spring Valley.	Same as Alternatives A through C except that no impacts would occur in Snake Valley.	No potential short-reductions in access to minerals and sand and gravel sources would occur.
Rangeland	Total of 23 grazing allotments involving approximately 10,544 acres.	Total of 14 grazing allotments involving 7,083 acres.	Total of 20 grazing allotments involving 8,937 acres.	No forage losses would occur.
	Long-term disturbance to 708 acres in 18 allotments.	Long-term disturbance to 564 acres in 11 allotments.	Long-term disturbance to 562 acres in 16 allotments.	No forage losses would occur.

Table 2.10-1 ROW Areas and Ancillary Facility Impact Summary for the Proposed GWD Project[1] (Continued)

Resource	Proposed Action and Alternatives A, B, and C	Alternative D	Alternatives E and F	No Action
Wild Horses	Two herd management areas (HMAs) crossed by ROWs; involving 3,015 acres, long-term loss of 164 acres within 2 HMAs.	Same as the Proposed Action and Alternatives A through C.	Same as the Proposed Action and Alternatives A through C.	No surface disturbance would occur in HMAs.
Special Designations	Project surface disturbance within two Special Designations: Coyote Springs ACEC and Kane Springs ACEC.	Same as the Proposed Action and Alternatives A through C.	Same as the Proposed Action and Alternatives A through C.	No surface disturbance would occur in Special Designation areas.
Visual	VRM Class II areas impacted by surface disturbance of 166 acres; crossed by 1 mile of pipeline and 12 miles of power line.	VRM Class II areas impacted by surface disturbance of 36 acres; crossed by 1 mile of pipeline and 1 mile of power line.	Surface disturbance of 166 acres; crossed by 1 mile of pipeline and 12 miles of power lines.	No surface disturbance would occur, and landscape appearance would remain the same where current land uses are present (agriculture, grazing, mining).
	VRM Class III areas impacted by surface disturbance of 2,833 acres; crossed by 69 miles of pipeline and 64 miles of power line.	VRM Class III areas surface disturbance of 2,251 acres; crossed by 57 miles of pipeline and 43 miles of power line.	VRM Class III Areas: Surface disturbance of 2,531 acres; crossed by 58 miles of pipeline and 56 miles of power line.	
	Scenic byways: 28 miles of power lnes within foreground; 65 miles of power lines within middle ground.	Scenic byways: 2 miles of power lines within foreground; 10 miles of power lines within middle ground.	Impacts to scenic byways is the same as Proposed Action.	
	VRM Class objectives are met with application of mitigation measures.	VRM Class objectives are met with application of mitigation measures.	VRM Class objectives are met with application of mitigation measures.	
Cultural	Potential adversc effects to historic properties would be minimized or mitigated as stipulated in the PA.	Same as the Proposed Action and Alternatives A through C; except no disturbance in White Pine County.	Same as the Proposed Action and Alternatives A through C; except no disturbance in Snake Valley.	No surface disturbance would occur; therefore, no mitigation would be required.
	Unanticipated discoveries of cultural resources would be handled as stipulated in the PA.	Same as the Proposed Action and Alternatives A through C; except no disturbance in White Pine County.	Same as the Proposed Action and Alternatives A through C; except no disturbance in Snake Valley.	No surface disturbance would occur; therefore no unanticipated discoveries would occur.
	Potential illegal collection of artifacts or vandalism to cultural resources.	Same as the Proposed Action and Alternatives A through C; except no disturbance in White Pine County.	Same as the Proposed Action and Alternatives A through C; except no disturbance in Snake Valley.	The risk of potential collection of artifacts or vandalism would occur on all lands accessible to the public.

Table 2.10-1 ROW Areas and Ancillary Facility Impact Summary for the Proposed GWD Project[1] (Continued)

Resource	Proposed Action and Alternatives A, B, and C	Alternative D	Alternatives E and F	No Action
Native American Traditional Values	Potential adverse effects to properties of traditional, religious, and cultural importance, including traditional cultural properties and sacred sites, would be minimized or mitigated as stipulated in the PA and through tribal consultation.	Same as the Proposed Action and Alternatives A through C; except no disturbance in White Pine County.	Same as the Proposed Action and Alternatives A through C; except no disturbance in Snake Valley.	No surface disturbance would occur; therefore, no mitigation would be required.
Socioeconomics	Construction employment increases demand for temporary housing that may exceed availability, especially in Lincoln County.	Same as the Proposed Action and Alternatives A through C except for shorter duration and less demand mainly in White Pine County.	Same as the Proposed Action and Alternatives A through C except for shorter duration and less demand mainly in Snake Valley.	No workforce would be assembled; therefore no temporary housing would be needed.
	Construction employment temporarily increases demand on local law enforcement and emergency service that may strain rural communities.	Same as the Proposed Action and Alternatives A through C except for shorter duration and lower demand mainly in White Pine County.	Same as the Proposed Action and Alternatives A through C except for shorter duration and lower demand mainly in Snake Valley.	No workforce would be assembled; therefore no additional requirements for law enforcement or emergency service would be needed.
	Temporary increased demand on county services in White Pine and Lincoln counties could result in fiscal budget pressures.	Same as the Proposed Action and Alternatives A through C except for shorter duration and less demand mainly in White Pine County.	Same as the Proposed Action and Alternatives A through C except for shorter duration and less demand mainly in Snake Valley.	There would be no increase in demand on county services; there would be no change in sales and use tax receipts.
	SNWA facilities exempt from property taxes.	Same as the Proposed Action and Alternatives A through C but with no facilities in White Pine County.	Same as the Proposed Action and Alternatives A through C but with no facilities in Snake Valley.	No change in the SNWA exemption from property taxes.

Table 2.10-1 ROW Areas and Ancillary Facility Impact Summary for the Proposed GWD Project[1] (Continued)

Resource	Proposed Action and Alternatives A, B, and C	Alternative D	Alternatives E and F	No Action
Public Safety	Potential spills or leaks from use of hazardous materials mostly consisting of fuels and lubricants during construction and operation.	Same as the Proposed Action and Alternatives A through C.	Same as the Proposed Action and Alternatives A through C.	No transportation or storage of hazardous materials would occur, eliminating the risk of leaks and spills.
	Low risk of encountering contaminated media during construction.	Same as the Proposed Action and Alternatives A through C.	Same as the Proposed Action and Alternatives A through C.	No excavation activities would occur; therefore there would be no risk of encountering contaminated media.
	Temporary noise would be generated by construction equipment. Aboveground facilities (pumping stations) would generate long-term noise from water pumps. All noise sensitive noise locations would be located more than a mile from pumping stations, and noise would be less than a commonly accepted residential standard (55 A-weighted decibel).	Temporary construction noise would be the same as the Proposed Action and Alternatives A through C but with no construction activities in White Pine County. All noise sensitive locations be located more than a mile from pumping stations, and noise would be less than a commonly accepted residential noise standard (55 A-weighted decibel).	Temporary construction noise would be the same as the Proposed Action and Alternatives A through C but with no construction activities in Snake Valley. All noise sensitive locations be located more than a mile from pumping stations, and noise would be less than a commonly accepted residential noise standard (55 A-weighted decibel).	No temporary or long-term noise would be generated. It is anticipated that the rural character of the noise environment would be maintained, because of low population density, and high percentage of BLM lands.

[1] Construction and permanent acreage numbers in the table include a minimal acreage of facilities that currently exist. Therefore, the reported acreages conservatively overestimate the amount of disturbance anticipated by the proposed project by approximately 1 percent across all alternatives.

Table 2.10-2 Summary of Potential Future Groundwater Development Impacts Associated with Surface Disturbance for the Proposed GWD Project Alternatives

Disturbance/Impacts	Proposed Action	Alternatives A and C	Alternative B	Alternative D	Alternative E	Alternative F
Disturbance (Acres)[1]						
Spring Valley	1,206-2,853	826-1,905	2,504	1,586-1,832	826-1,905	1,136-2,605
Snake Valley	450-985	316-735	1,183	0	0	0
Cave Valley	575-1,652	230-751	312	230-751	230-751	577-1,651
Dry Lake Valley	402-849	402-849	323	402-849	402-849	405-864
Delamar Valley	957-2,071	296-573	342	296-573	296-573	580-1,509
Total	3,590-8,410	2,069-4,814	4,664	2,513-4,005	1,754-4,079	2,698-6,629
Pumping Stations	2	2	2	2	2	2
Substations	2	2	2	2	2	2
Air Resources, Geology, Soils, Vegetation, Terrestrial Wildlife, Land Use, Transportation, Minerals, Rangeland, Wild Horses, Cultural Resources, Native American Traditional Values, Public Health and Safety	Construction and operation-related disturbance impacts could occur in all five groundwater development basins with relative effects related to the range in acres listed above. The types of impacts would be the same as those discussed for ROWs.			Construction and operation-related disturbance impacts could occur in four groundwater development basins (Snake Valley eliminated) with relative effects related to the range in acres listed above. The types of impacts would be the same as those discussed for ROWs.		
Water Resources	• Potential disturbance to 28 perennial stream reaches in Spring and Snake valleys. • Potential disturbance to 60 springs in all 5 valleys.	• Same as the Proposed Action.	• Potential disturbance to 3 perennial stream reaches in Snake Valley. • Potential disturbance to 7 springs in Snake Valley.	• No disturbance to perennial stream reaches. • Potential disturbance to 13 springs in Spring, Cave, Dry Lake, and Delamar valleys.	• Potential disturbance to 23 perennial stream reaches in Spring Valley. • Potential disturbance to 49 springs in Spring, Cave, Dry Lake, and Delamar valleys.	• Same as Alternative E

Table 2.10-2 Summary of Potential Future Groundwater Development Impacts Associated with Surface Disturbance for the Proposed GWD Project Alternatives (Continued)

Disturbance/Impacts	Proposed Action	Alternatives A and C	Alternative B	Alternative D	Alternative E	Alternative F
Aquatic Biological Resources	• Potential disturbance to aquatic habitat and species in 17 perennial streams and 3 springs with game fish or special status species in Spring and Snake valleys. • Potential mortalities to amphibians during movement periods from vehicle traffic within or accessing pipeline ROWs.	• Potential disturbance to aquatic habitat and species in 17 perennial streams and 3 springs with game fish or special status species in Spring and Snake valleys. • Potential mortalities to amphibians during movement periods from vehicle traffic within or accessing pipeline ROWs.	• Potential disturbance to aquatic habitat and species in 1 perennial stream in Snake valley and 1 spring in Snake Valley. No special status species occur in these waterbodies. • Potential mortalities to amphibians during movement periods from vehicle traffic within or accessing pipeline ROWs.	• No disturbance to perennial streams or springs with game fish or special status species. • Potential mortalities to amphibians during movement periods from vehicle traffic within or accessing pipeline ROWs.	• Potential disturbance to aquatic habitat and species in 13 perennial streams in Spring Valley and 3 springs in Spring Valley with game fish or special status species. • Potential mortalities to amphibians during movement periods from vehicle traffic within or accessing pipeline ROWs.	• Potential disturbance to aquatic habitat and species in 13 perennial streams in Spring Valley and 3 springs in Spring Valley with game fish or special status species. • Potential mortalities to amphibians during movement periods from vehicle traffic within or accessing pipeline ROWs.
Recreation	• Potential disturbance to 5 recreation areas.	• Same as Proposed Action.	• Potential disturbance to 2 recreation areas.	• Potential disturbance to 4 recreation areas.	• Potential disturbance to 5 recreation areas.	• Same as Alternative E.
Special Designations	• Potential disturbance to three special designation areas in Spring and Snake valleys.	• Same as Proposed Action.	• Same as Proposed Action.	• No special designations would fall within the groundwater development areas.	• Potential disturbance to 2 special designation areas in Spring Valley.	• Same as Alternative E.
Socioeconomics	• Temporary employment and population gains. Limited scale and duration for each well. Multiple rigs could operate simultaneously in different locations. Increased intensity of social effects, both for those opposed and supporting the project.			• Same as the Proposed Action but less intense in White Pine County.	• Same as the Proposed Action but less intense in White Pine County.	• Same as the Proposed Action but less intense in White Pine County.
Visual	• 23,409 acres of disturbance in VRM Class II. • May not meet intent of GBNP Visual Objectives.			• 12,822 acres of disturbance in VRM Class II. • Meets intent of GBNP Visual Objectives.	• 22,938 acres of disturbance in VRM Class II. • May not meet intent of GBNP Visual Objectives.	• 22,938 acres of disturbance in VRM Class II. • May not meet intent of GBNP Visual Objectives.

[1] Disturbance was estimated based on the addition of temporary and permanent ROWs (pipeline and power line), wells, and other ancillary facilities.

Table 2.10-3 Summary of Potential Groundwater Pumping Impacts for the Proposed GWD Project – Full Build Out Plus 75 Years

Resource[1]	Potential Impacts	Impact Parameters	Alternative							
			Proposed Action	A	B	C	D	E	F	No Action
Air	Increase in windblown particulates as a result of reductions in hydric soils and vegetation cover and density in the drawdown area	PM_{10} emissions (tons per year) from windblown dust compared to no action conditions	14,046	11,826	12,104	5,416	2,474	7,464	8,747	1,869
	Wind blown dust generated by drawdown from pumping	Air quality standards and visibility	Meets air quality standards-could impair visibility at GBMP	Same as proposed action						Meet air quality standards not predicted to impair GBNP visibility
Geology	Risk of ground surface subsidence from reduced groundwater levels in the drawdown area	Square miles of high (>5 feet) ground surface subsidence risk from groundwater drawdown.	147	5	172	<1	152	5	71	0
Water	Reduction in flow or drying up of springs in the drawdown area	Number of inventoried springs with moderate or high risks of potential flow reductions	44	29	54	19	13	19	30	12
	Reduction of flow and reduction of length of perennial stream reaches in the drawdown area	Miles of perennial streams with moderate or high risks of potential flow reductions	80	58	91	37	4	7	21	19
	Reduction of flow available at the point of diversion for beneficial uses in the drawdown area	Number of surface water rights in drawdown area with moderate or high risks of effects	145	109	141	78	23	60	88	105
	Reduction (or elimination) of yield, increased pumping cost	Total groundwater rights in drawdown area (>10 feet)	199	174	184	133	27	70	84	372
	Reduction in spring discharge and associated vegetation in ET areas in the drawdown area	Percent reduction in spring valley groundwater discharge to ET	77	51	66	37	18	52	73	7
		Percent reduction in snake valley groundwater discharge to ET	28	23	18	15	4	0	1	3
		Percent reduction in great salt lake desert flow system groundwater discharge to ET	48	34	37	24	10	21	30	5

Table 2.10-3 Summary of Potential Groundwater Pumping Impact Summary for the Proposed GWD Project – Full Build Out Plus 75 Years (Continued)

Resource[1]	Potential Impacts	Impact Parameter	Alternative							
			Proposed Action	A	B	C	D	E	F	No Action
Soils	Reduction in water sources for hydric soils in the groundwater drawdown area	Acres of hydric soils within drawdown area (>10 feet)	13,143	7,374	6,817	2,626	1,143	5,586	4,949	1,571
Vegetation	Reduction in density and composition of wetland/meadow vegetation from lower groundwater levels in the drawdown area	Wetland/meadows with risk of composition and growth effects (acres)	5,460	4,624	5,794	2,287	1,507	2,548	3,096	261
	Reduction in density and composition of shrubland vegetation from lower groundwater levels in the drawdown area	Basin shrublands with risk of composition and growth effects (acres)	136,990	106,414	97,174	42,703	16,747	71,429	89,049	32,229
Wildlife	Reduction in wetland/meadow and shrubland habitat and perennial water sources for wildlife species in the drawdown area. Effects on habitat and water sources could reduce water for consumption; vegetation for breeding, foraging; reduce food sources; and reduce animal numbers and populations.	Number of important bird areas with springs or perennial streams in drawdown area	2	2	2	0	0	0	0	1
		Pumping effects on wildlife habitats	Wildlife habitats may be modified by changes in composition of groundwater dependent vegetation, and seasonal availability of surface water. For this alternative, see: • Water – risks to springs and streams; • Vegetation – risks to Wetland/ Meadows and Basin Shrublands							No changes in wildlife habitats would occur because no groundwater pumping would occur in project hydrographic basins.

Table 2.10-3 Summary of Potential Groundwater Pumping Impact Summary for the Proposed GWD Project – Full Build Out Plus 75 Years (Continued)

Resource[1]	Potential Impacts	Impact Parameter	Alternative							
			Proposed Action	A	B	C	D	E	F	No Action
Aquatic Biological Resources	Reduction in perennial stream flows and habitat for aquatic species in the drawdown area. Reduction could adversely affect aquatic species in streams by reducing abundance and diversity, altering composition, reducing food sources, limiting spawning and early life stage development, and decreasing overall health.	Number of perennial streams with game fish and special status species in drawdown area with moderate or high risk of flow reductions	25	14	18	12	2	7	15	3
		Miles of perennial streams with game fish and special status species in drawdown area with moderate or high risk of flow reductions	60	45	59	29	3	5	16	6
	Reduction in perennial spring and wetland flows and habitat for aquatic species in the drawdown area. Reduction could adversely affect aquatic species in springs and wetlands by reducing abundance and diversity, altering composition, reducing food sources, limiting spawning and early life stage development, and decreasing overall health.	Number of springs/ponds/lakes with aquatic species in drawdown area with moderate or high risk of flow reductions	27	19	27	13	4	8	14	7
		number of small springs (<100 gpm) with aquatic species in drawdown area with moderate or high risk of flow reductions	13	7	9	3	1	1	5	1
		Number of springs/ponds/lakes containing game and special status fish species in drawdown area with moderate or high risk of flow reductions	9	8	10	7	2	4	5	5
Land Use	Reduction in water sources for agricultural lands in the drawdown area	Acres of private agricultural land in drawdown area (>10 feet)	15,792	14,605	13,865	12,359	299	3,635	4,400	14,204
	Reduction in water sources for public lands for disposal	Acres of public land for disposal	4,926	4,926	4,926	4,926	915	107	107	29,612

Table 2.10-3 Summary of Potential Groundwater Pumping Impact Summary for the Proposed GWD Project – Full Build Out Plus 75 Years (Continued)

Resource[1]	Potential Impacts	Impact Parameter	Alternative							
			Proposed Action	A	B	C	D	E	F	No Action
Recreation	Reduction in spring flows within recreation areas in the drawdown area	Number of springs in drawdown area with moderate or high risk of flow reductions	20	13	40	3	0	5	9	14
	Reduction in perennial stream flows within recreation areas in the drawdown area. Flow reduction could reduce game fish numbers.	Miles of game fish streams in drawdown area with moderate or high risk of flow reductions	8	7	17	1	0	0	0	<1
Rangeland	Reduction in spring and stream water sources for rangeland in the drawdown area	Number of perennial springs within grazing allotments and drawdown area with moderate or high risk of flow reductions	210	118	156	63	41	55	131	46
		Perennial stream miles within grazing allotments and drawdown area with moderate or high risk of flow reductions	73	52	78	37	5	6	21	19
	Reduction in forage vegetation for rangeland in the drawdown area	Acres of phreatophytic vegetation and wet meadow vegetation in grazing allotments and drawdown area	142,975	111,564	103,467	45,413	18,245	73,977	92,145	32,490
Wild Horses	Reduction in spring water sources for wild horse HMAs in the drawdown area	Number of perennial springs within HMAs and drawdown area with moderate or high risk of flow reductions	2	2	2	2	7	2	2	19
	Reduction in forage vegetation for rangeland in the drawdown area	Acres of phreatophytic vegetation and wet meadow vegetation in HMAs and drawdown area	0	0	0	0	0	0	0	2,511
Special Designations	Reduction in phreatophytic vegetation within special designations in the drawdown area	Number of special designations with phreatophytic vegetation potentially affected by drawdown	3	3	3	3	1	3	3	0
		Acres of phreatophytic vegetation in special designations and drawdown area	13,729	11,222	13,534	4,912	8,262	11,222	13,333	0

Table 2.10-3 Summary of Potential Groundwater Pumping Impact Summary for the Proposed GWD Project – Full Build Out Plus 75 Years (Continued)

Resource[1]	Potential Impacts	Impact Parameter	Alternative: Proposed Action	A	B	C	D	E	F	No Action
Visual	Changes in appearance of wetland/meadows and basin shrublands from drawdown effects	Vegetation changes related to perennial springs and streams	Changes in the appearance of the landscape from groundwater drawdown may result from broad scale vegetation changes. See also: • Water-risks to springs and streams; and • Vegetation-risks to wetland/meadows and basin shrublands.							No changes in visual resources would occur because no groundwater pumping would occur in the project hydrographic basins.
Native American Traditional Values	Reduction in the availability of water sources and food used for traditional and religious purposes in the drawdown area	Drawdown effects on water and biological resources (vegetation, aquatic biology, and wildlife)	See the following resources for impact parameters: • Water – risks to springs and streams; • Aquatic Biology – risks to game fish and special status species. • Vegetation – risks to Wetland/ Meadows and Basin Shrublands							No changes in the availability of plants used for food and traditional uses, and flows in springs and streams because no groundwater pumping would occur in project hydrographic basins.

Table 2.10-3 Summary of Potential Groundwater Pumping Impact Summary for the Proposed GWD Project – Full Build Out Plus 75 Years (Continued)

Resource[1]	Potential Impacts	Impact Parameter	Alternative							
			Proposed Action	A	B	C	D	E	F	No Action
Socioeconomics	Reduction in water sources for agricultural lands in the drawdown area	Acres of private agricultural land potentially affected by drawdown of ≥ 10 feet	15,792	14,605	13,865	12,359	299	3,635	3,382	1,654
		Acres of private agricultural land potentially affected by drawdown of ≥ 50 feet	8,564	140	3,289	0	0	0	642	0
	Adverse Social Impacts in Rural Areas Due to Uncertainty and Risks Associated with Drawdown	No parameters	Yes	Yes	Yes	Yes	Yes, but reduced compared to Proposed Action and Alternatives A through C	Yes, but reduced compared to Proposed Action and Alternatives A through C	Yes, but reduced compared to Proposed Action and Alternatives A through C	No

[1] No pumping effects would occur for transportation, cultural resources, and public safety, since there is no connection to surface water or affected vegetation.

Table 2.10-4 Summary of Potential Groundwater Pumping Impacts for the Proposed GWD Project – Full Build Out Plus 200 Years

Resource	Potential Impacts	Impact Parameters	Alternative							
			Proposed Action	A	B	C	D	E	F	No Action
Air	Increase in windblown particulates as a result of reductions in hydric soils and vegetation cover and density in the drawdown area	PM_{10} emissions (tons per year) from windblown dust compared to no action conditions	17,840	13,327	15,995	6,690	8,252	8,563	11,608	3,234
	Wind blown dust generated by drawdown from pumping	Air quality standards and visibility	Meets air quality standards- could impair visibility at GBMP	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action	Same as proposed action	Meet air quality standards not predicted to impair GBNP visibility
Geology	Risk of ground surface subsidence from reduced groundwater levels in the drawdown area	Square miles of high (>5 feet) ground surface subsidence risk from groundwater drawdown.	525	159	669	1	269	153	242	0
Water	Reduction in flow or drying up of springs in the drawdown area	Number of inventoried springs with moderate or high risks of potential flow reductions	57	46	78	26	31	30	41	20
	Reduction of flow and reduction of length of perennial stream reaches in the drawdown area	Miles of perennial streams with moderate or high risks of potential flow reductions	112	81	120	59	48	23	46	52
	Reduction of flow available at the point of diversion for beneficial uses in the drawdown area	Number of surface water rights in drawdown area with moderate or high risks of effects	212	151	186	98	56	94	132	164
	Reduction (or elimination) of yield, increased pumping cost	Total groundwater rights in drawdown area (>10 feet)	264	223	301	171	213	110	131	409
	Reduction in spring discharge and associated vegetation in ET areas in the drawdown area	Percent reduction in spring valley groundwater discharge to ET	84	57	73	37	28	56	80	7
		Percent reduction in snake valley groundwater discharge to ET	33	27	24	17	8	3	3	3
		Percent reduction in great salt lake desert flow system groundwater discharge to ET	54	39	44	25	16	24	34	5
Soils	Reduction in water sources for hydric soils in the groundwater drawdown area	Acres of hydric soils within drawdown area (>10 feet)	20,077	11,924	12,005	2,995	6,377	9,696	8,403	3,068
Vegetation	Reduction in density and composition of wetland/meadow vegetation from lower groundwater levels in the drawdown area	Wetland/meadows with composition and growth effects (acres)	8,048	6,137	9,190	3,250	4,453	3,835	5,519	2,023

Table 2.10-4 Summary of Potential Groundwater Pumping Incremental Impacts for the Proposed GWD Project – Full Build Out Plus 200 Years (Continued)

Resource	Potential Impact	Impact Parameter	Alternative: Proposed Action	A	B	C	D	E	F	No Action
Vegetation (Continued)	Reduction in density and composition of shrubland vegetation from lower groundwater levels in the drawdown area	Basin shrublands with composition and growth effects (acres)	191,506	123,714	146,998	50,076	81,349	81,389	130,591	41,436
Wildlife	Reduction in wetland/meadow and shrubland habitat and perennial water sources for wildlife species in the drawdown area. Effects on habitat and water sources could reduce water for consumption; vegetation for breeding, foraging; reduce food sources; and reduce animal numbers and populations.	Number of important bird areas with springs or perennial streams in drawdown area	4	2	4	2	1	0	2	1
		Pumping effects on wildlife habitats (see water, vegetation)	Wildlife habitats may be modified by changes in composition of groundwater dependent vegetation, and seasonal availability of surface water. For this alternative, see: • Water – risks to springs and streams; • Vegetation – risks to Wetland/ Meadows and Basin Shrublands • Water – risks to springs and streams; • Vegetation – risks to Wetland/ Meadows and Basin Shrublands							No changes in wildlife habitats would occur because no groundwater pumping would occur in project hydrographic basins.
Aquatic Biological Resources	Reduction in perennial stream flows and habitat for aquatic species in the drawdown area. Reduction could adversely affect aquatic species in streams by reducing abundance and diversity, altering composition, reducing food sources, limiting spawning and early life stage development, and decreasing overall health.	Number of perennial streams with game fish and special status species in drawdown area with moderate or high risk of flow reductions	31	19	24	13	10	15	25	7
		Miles of perennial streams with game fish and special status species in drawdown area with moderate or high risk of flow reductions	75	58	72	43	29	13	28	26
	Reduction in perennial spring and wetland flows and habitat for aquatic species in the drawdown area. Reduction could adversely affect aquatic species in springs and wetlands by reducing abundance and diversity, altering composition, reducing food sources, limiting spawning and early life stage development, and decreasing overall health.	Number of springs/ponds/lakes with aquatic species in drawdown area with moderate or high risk of flow reductions	30	28	33	20	13	14	18	10
		Number of small springs (<100 gpm) with aquatic species in drawdown area with moderate or high risk of flow reductions	15	12	13	6	5	5	8	2
		Number of springs/ponds/lakes containing game and special status fish species in drawdown area with moderate or high risk of flow reductions	11	10	14	9	5	6	7	5

Table 2.10-4 Summary of Potential Groundwater Pumping Incremental Impacts for the Proposed GWD Project – Full Build Out Plus 200 Years (Continued)

Resource	Potential Impact	Impact Parameter	Alternative							
			Proposed Action	A	B	C	D	E	F	No Action
Land Use	Reduction in water sources for agricultural lands in the drawdown area	Acres of private agricultural land in drawdown area (>10 feet)	17,203	15,021	17,522	13,749	7,320	3,791	4,857	14,913
	Reduction in water sources for public lands for disposal	Acres of public land for disposal	5,399	5,399	7,255	5,399	915	107	107	35,632
Recreation	Reduction in spring flows within recreation areas in the drawdown area	Number of springs in drawdown area with moderate or high risk of flow reductions	23	19	53	12	11	8	12	14
	Reduction in perennial stream flows within recreation areas in the drawdown area. Flow reduction could reduce game fish numbers.	Miles of game fish streams in drawdown area with moderate or high risk of flow reductions	14	12	28	10	8	2	4	9
Rangeland	Reduction in spring and stream water sources for rangeland in the drawdown area	Number of perennial springs within grazing allotments and drawdown area with moderate or high risk of flow reductions	303	180	259	94	121	104	203	86
		Perennial stream miles within grazing allotments and drawdown area with moderate or high risk of flow reductions	102	72	105	50	39	20	41	52
	Reduction in forage vegetation for rangeland in the drawdown area	Acres of phreatophytic vegetation and wet meadow vegetation in grazing allotments and drawdown area	200,080	130,378	156,713	53,799	85,811	87,224	136,110	43,460
Wild Horses	Reduction in spring water sources for wild horse HMAs in the drawdown area	Number of perennial springs within HMAs and drawdown area with moderate or high risk of flow reductions	14	5	9	2	27	5	11	30
	Reduction in forage vegetation for rangeland in the drawdown area	Acres of phreatophytic vegetation and wet meadow vegetation in HMAs and drawdown area	2,511	0	2,511	0	2,511	0	1,266	2,511

Table 2.10-4 Summary of Potential Groundwater Pumping Incremental Impacts for the Proposed GWD Project – Full Build Out Plus 200 Years (Continued)

Resource	Potential Impact	Impact Parameter	Alternative							
			Proposed Action	A	B	C	D	E	F	No Action
Special Designations	Reduction in phreatophytic vegetation within special designations in the drawdown area	Number of special designations with phreatophytic vegetation potentially affected by drawdown	5	3	5	3	2	3	4	1
		Acres of phreatophytic vegetation in special designations and drawdown area	14,032	12,635	14,032	6,673	10,407	12,408	13,954	202
Visual	Changes in appearance of wetland/meadows and basin shrublands from drawdown effects	Vegetation changes related to perennial springs and streams	Changes in the appearance of landscapes from groundwater drawdown may result from borad scale vegetation changes. See also: • Water-risks to springs and streams, and • Vegetation-risks to wetland/meadow and basin shrubland.							No changes in visual resources would occur because no groundwater pumping would occur in the project hydrographic basin.
Native American Traditional Values	Reduction in the availability of water sources and food used for traditional and religious purposes in the drawdown area	Drawdown effects on water and biological resources (vegetation, aquatic biology, and wildlife)	See the following resources for impact parameters: • Water – risks to springs and streams; • Aquatic Biology – risks to game fish and special status species. Vegetation – risks to Wetland/ Meadows and Basin Shrublands							No changes in the availability of plants used for food and traditional uses, and flows in springs and streams because no groundwater pumping would occur in project hydrographic basins.
Socio-economics	Reduction in water sources for agricultural lands in the drawdown area	Acres of private agricultural land potentially affected by drawdown of ≥ 10 feet	17,203	15,021	17,522	13,749	7,320	3,791	4,857	14,913
		Acres of private agricultural land potentially affected by drawdown of ≥ 50 feet	13,439	11,592	13,224	0	198	2,916	3,030	3,730
	Adverse Social Impacts in Rural Areas Due to Uncertainty and Risks Associated with Drawdown	No parameters	Yes	Yes	Yes	Yes	Yes, but reduced compared to Proposed Action and Alternatives A through C	Yes, but reduced compared to Proposed Action and Alternatives A through C	Yes, but reduced compared to Proposed Action and Alternatives A through C	No

[1] No pumping effects would occur for transportation, cultural resources, and public safety, since there is no connection to surface water or affected vegetation.

Table 2.10-5 **Key Differences in Impacts for the Local Alignment Options as Compared to those under the Proposed Action**

Alignment Option	Key Differences in Impacts
1 Humboldt-Toiyabe Power line	This option is approximately 6 miles shorter and steeper than the relevant segment of the Proposed Action. The estimated disturbance is 150 acres, compared to 245 acres under the Proposed Action. Key impact differences include: • Vegetation – There would be 24 fewer acres of vegetation disturbance (primary sagebrush) and less removal of mature juniper and pinyon pine trees. • Wildlife – Reduced impacts to some big game species and 8 special status species (including sagegrouse and pygmy rabbit) or species groups. • Land Use – USFS lands (104 acres) would be crossed. • Recreation – There would be 43 percent less disturbance to the Loneliest Highway SMRA. • Visual – Overall visual effects would be reduced by following an existing transmission line and road corridors.
2 North Lake Valley Pipeline	This option requires an additional Pumping Station in southern Spring Valley, reduces the power line voltage from 230 to 69 kV, and adds approximately 5 miles compared to the relevant segment of the Proposed Action. A net increase in disturbance of 60 acres. Key impact differences include: • Water Resources – Potential water quality changes to one perennial stream (Geyser Creek in Lake Valley) and three springs located within the ROW. • Vegetation – There would be 23 additional acres of sagebrush shrubland removed and the long-term loss of 5 acres for pump station site. • Wildlife – Both increased and decreased disturbance to various big game and special status species. • Aquatic Resources – Potential habitat alteration and effects on species in Geyser Creek and Wambolt Spring. • Visual – Overall visual effects would increase due to facilities being visible from a scenic byway.
3 Muleshoe Substation	This option requires completion of at least one other regional power line in the region, thereby allowing a new power line tie-in and eliminating the need for the Gonder to Spring Valley transmission line. Disturbance would be approximately 365 acres less than for the relevant segment of the Proposed Action. Key impact differences include: • Water and Aquatic Resources – Impacts would be reduced by the elimination of the Steptoe Creek crossing. • Vegetation – Vegetation disturbance would be reduced due to the elimination of the power line, but with 43 acres of disturbance to sagebrush shrubland for the Muleshoe Substation. • Wildlife - Both increased and decreased disturbance to various big game and special status species. • Recreation – There would be 47 percent less disturbance to the Loneliest Highway SMRA. • Visual – Overall visual effects would be reduced, eliminating 34 miles of power lines and access roads.
4 North Delamar Valley Pipeline	This option would place the pipeline and transmission lines within the LCCRDA corridor in an area where the current alignment goes around a hill. An additional pumping station would be required, but the ROW would be approximately 3 miles shorter than the Proposed Action. Net disturbance would be 53 acres less than under the Proposed Action. Key impact differences include: • Vegetation – Vegetation disturbance would be reduced due to co-locating the power line with the pipeline in northern Delamar Valley. • Wildlife - Both increased and decreased disturbance to various big game and special status species. • Recreation – There would be increased disturbance for the Caliente Special Recreation Permit (SRP) (6 percent) and Chief Mountain SMRA (12 percent). • Special Designations – Impacts to Lands with Wilderness Characteristics would be reduced by eliminating 1 of 2 roadless units. • Visual Resources – Overall visual effects would be increased due to construction of a new pumping station near Highway 93.

After consideration of the potential resource effects of implementing each option, the following are brief conclusions concerning the tradeoffs as compared to the Proposed Action, and other applicable alternatives:

- Humboldt-Toiyabe Power Line. This option provides an opportunity to reduce both surface disturbance area and visual resource effects to scenic byways by locating the transmission line in an existing USFS transmission line corridor. It would also decrease impacts in the sagebrush vegetation communities and those species dependent upon that community.
- North Lake Valley Pipeline. This option allows reduction in transmission line voltage, but increases the number of aboveground facilities near and adjacent to Highway 93, thereby increasing the overall project visibility from a scenic byway.
- Muleshoe Substation. This option would eliminate the need for constructing a 230-kV transmission line from Gonder Substation to Spring Valley, with a consequent reduction in long term visible surface disturbance in the vicinity of a scenic byway, and an overall reduction of wildlife habitat disturbance. The feasibility of this option is substantially improved by the current construction of the ON Transmission Line where the Muleshoe Substation would interconnect.
- North Delamar Valley Pipeline. This option would reduce the overall surface disturbance effects to Mojave Desert shrublands (including mature Joshua trees) by using an existing utility ROW. However, this option would require construction of a new pumping station which would be located very close to Highway 93, adding a new aboveground structure that would be visible to highway travelers.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3. Affected Environment and Environmental Consequences

3.0.1 Introduction

This chapter describes the environment that would be affected by the construction and operation of the Proposed Action and alternatives analyzed in this EIS (**Table 2.1-1**). It is organized by individual environmental resource, with information on existing conditions, direct and indirect impacts, cumulative impacts, mitigation, and residual effects. This chapter answers the following questions for each environmental resource section:

- What are the current conditions from which an identification of environmental effects is made from implementing the Proposed Action and alternatives?
- What are the direct and indirect impacts of the Proposed Action and the alternatives as well as cumulative impacts on the resource?
- What are the ACMs and the BLM RMP Management Actions and BMPs that would be implemented to reduce impacts on the resource?
- If impacts still occur at a higher relative level of intensity after applying all avoidance and protection measures, what mitigation measures are recommended to provide additional resource protection? What is the effectiveness of proposed mitigation measures for avoiding or reducing the identified impacts?
- What are the residual effects after applying these resource protection measures and proposed mitigation measures?

The remaining portion of this introduction provides important background information on the characterization of existing resource conditions, as well as assumptions and approaches that were used in analyzing project impacts on each environmental resource.

Affected Environment. The affected environment is the physical area that bounds the natural and human resources that could be affected by the Proposed Action and other alternatives.

QUICK REFERENCE

ACM – Applicant Committed Protection Measures

BLM – Bureau of Land Management

BMP – Best Management Practice

GBNP – Great Basin National Park

EIS – Environmental Impact Statement

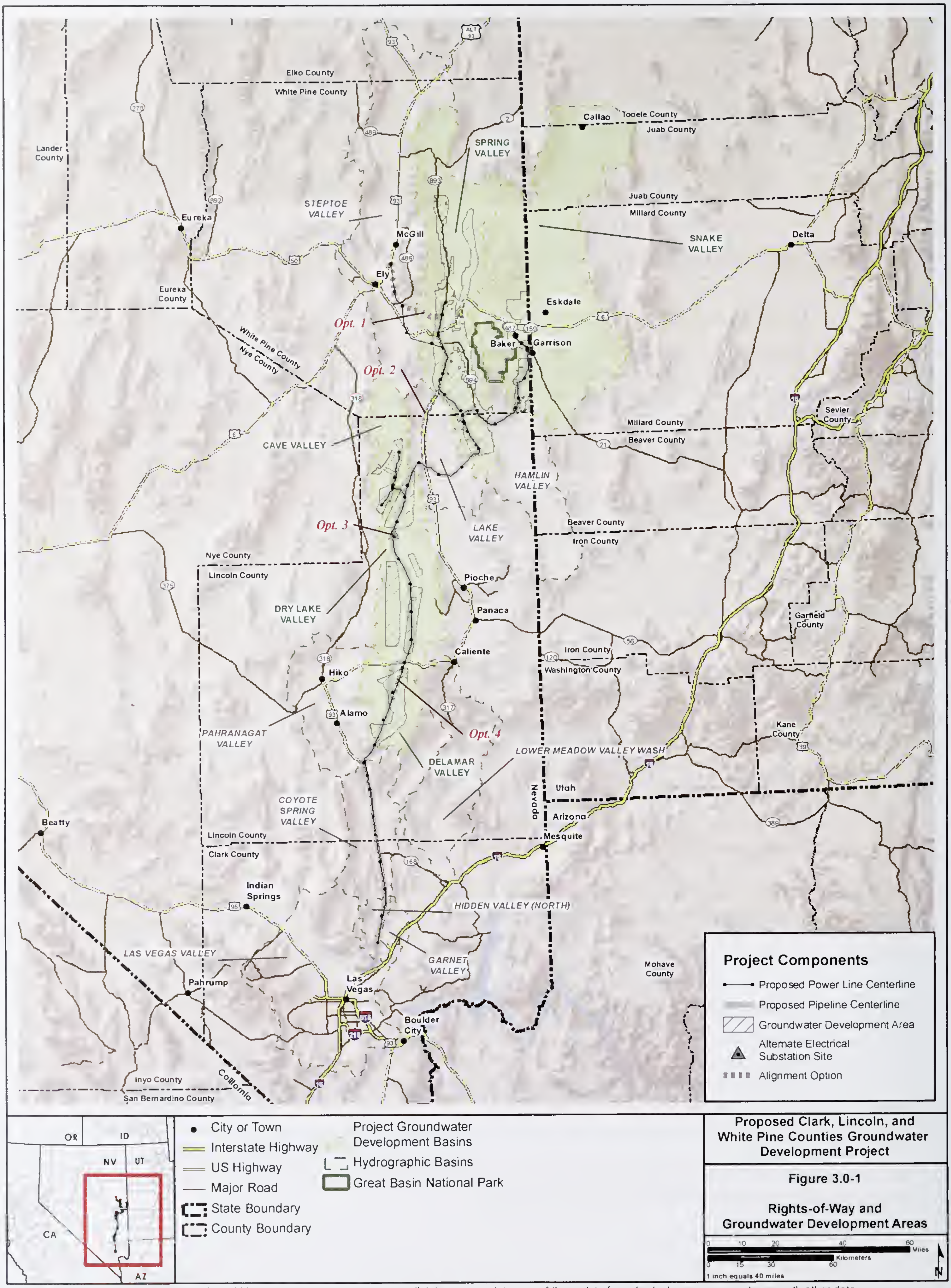
NEPA – National Environmental Policy Act

RFFA – Reasonably Foreseeable Future Actions

ROW – Right-of-way

3.0.2 Affected Environment

The affected environment is described at two geographic levels to provide the basis for the impact analysis sections in this chapter (**Figure 3.0-1**). The first geographic level involves the area of direct effects from the ROWs and groundwater development areas. The second level is the project study area included in the groundwater model to represent the area potentially affected by groundwater pumping. The BLM defined the natural resources study area, with assistance from the Natural Resources Technical Work Group, as the region of interest based on their assessment of the natural resources in the area. The work group included technical specialists with representatives from federal and state agencies and SNWA. When defining this area, the BLM and the work group took into account special status species and other resources of special management concern.



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.0-1

Rights-of-Way and Groundwater Development Areas

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

Right-of-way/Groundwater Development Areas

The first geographic level represents the area of potential direct effects to natural and human resources from construction-related surface disturbance related to the ROW and ancillary facilities plus the construction and operation of future facilities related to groundwater withdrawal. A specific direct effects study area is further defined and discussed for each resource. The extent of the potential direct effects may extend beyond the immediate project disturbance footprint, depending on the resource being analyzed. This study area also includes the area of influence surrounding aboveground facilities (i.e., noise, visual resources). As described in Section 2.1, Introduction, specific groundwater pumping locations have not yet been identified. However, the BLM is able to make certain assumptions about the number of wells that may be required and the groundwater development area in which the wells would be located. Thus, this EIS provides a more general characterization of existing resource conditions within the groundwater development areas, and of the direct, indirect, and cumulative effects on those resources. Subsequent environmental analyses tiered to this EIS will focus on site-specific resource development areas where wells, associated gathering pipelines, roads, and electrical service lines are proposed.

Project Study Areas

The second geographic level was defined by an initial assessment of the areas with: 1) the potential to be affected by groundwater drawdown or 2) that contain species or habitat of special environmental concern. The area of potential effects is based upon results of groundwater modeling and initial species or habitat occurrence information. These initial assessments were conducted with the BLM and the Natural Resources Technical Task Group. The project study area varies depending on the resource. A description of the water resources region of study and natural resources region of study are found in Section 3.0.4, Environmental Consequences. Additionally, as part of the introduction for each resource discussion, a brief description of the resource-specific project study area is provided.

Potential effects on the Death Valley groundwater flow system were raised during public scoping. This area is not included in this EIS because the BLM, after consultation with an interagency technical review team, concluded that: 1) the five hydrologic basins proposed for groundwater pumping under the Proposed Action and alternatives are not within the Death Valley groundwater flow system; and 2) based on the conceptual understanding of the groundwater flow system for the region, pumping from these basins is unlikely to result in impacts to water availability in the Death Valley groundwater flow system.

Based on public scoping and internal review by the EIS Interdisciplinary Team (BLM management and resource specialists), the following resources were included in this EIS. The EIS section for each resource is noted.

- Air and Atmospheric Values – Section 3.1;
- Geologic Resources including Paleontology – Section 3.2;
- Water Resources including Surface Water, Groundwater, and Water Rights – Section 3.3;
- Soils – Section 3.4;
- Vegetation including Wetlands – Section 3.5;
- Terrestrial Wildlife – Section 3.6;
- Aquatic Biological Resources – Section 3.7;
- Land Use – Section 3.8;
- Recreation – Section 3.9;
- Transportation – Section 3.10;
- Mineral Resources – Section 3.11;
- Rangelands and Grazing – Section 3.12;
- Wild Horses and Burro Herd Management Areas – Section 3.13;

- Special Designations – Section 3.14;
- Visual Resources – Section 3.15;
- Cultural Resources – Section 3.16;
- Native American Traditional Values – Section 3.17;
- Socioeconomics and Environmental Justice – Section 3.18; and
- Public Safety and Health – Section 3.19.

As part of the baseline data collection effort for this EIS, a work group process was used to obtain all available and relevant information for water resources, biological resources, and soils (i.e., natural resources), and socioeconomics. A series of meetings were held to compile and evaluate baseline data for the EIS. Resource reports were prepared for water and natural resources. Details on these work groups and the reports are provided in Sections 3.3, Water Resources; and 3.5, Vegetation Resources. The work group process for socioeconomics is described in Section 3.18, Socioeconomics and Environmental Justice.

A key part of the baseline data collection for Native American Traditional Values was the preparation of an Ethnographic Assessment. The assessment included the identification, documentation, and evaluation of places of particular importance to Native Americans. The process involved contacts with tribal councils and individuals for participation in the data collection and evaluation. Details on the ethnographic process are provided in Section 3.17, Native American Traditional Values.

3.0.3 Incomplete and Unavailable Information

As required under Section 1502.22 of the CEQ NEPA regulations, an EIS must disclose any incomplete and unavailable information. For this EIS, information was incomplete or unavailable for the topics listed below. These areas of incomplete and/or unavailable information are relevant to different degrees for the evaluation of impacts. However, sufficient information was available to complete this Tier 1 NEPA analysis using a variety of information, professional assumptions, or processes. Subsequent NEPA analysis will focus on obtaining information for these, and any identified in the future, incomplete and unavailable areas where time, funds, and resources are available.

- **Affected Environment Resource Information** – The affected environment descriptions for resources were based on all available and known information. As a result of the relatively large regional study area for the pumping impact analysis (up to 35 hydrological basins), many springs and streams were lacking specific information regarding water resource characteristics and species occurrence. Additional information on limited or incomplete data is discussed in specific resource sections. If these waterbodies and associated sensitive resources are considered to be at moderate or high risk from the GWD Project pumping under this Tier 1 analysis, information will be collected as time and funds are available for subsequent NEPA analyses. Section 3.20 also contains a discussion of future data which will inform future NEPA analyses.
- **Climate Change** – In accordance with Secretarial Orders 3289 and 3226, the Final EIS considers and analyzes the potential effects of climate change. Secretarial Order No. 3289 establishes a Department-wide approach for applying scientific tools to increase understanding of climate change and to coordinate an effective response to its impacts on tribes and the land, surface and subsurface waters, fish and wildlife, and cultural heritage resources that the Department manages. Secretarial Order No. 3289 also reestablished the requirements set forth in Secretarial Order No. 3226 that each bureau and office of the Department must consider and analyze potential climate change impacts when undertaking long-range planning exercises, setting priorities for scientific research and investigations, developing multi-year management plans, and making major decisions regarding potential use of resources under the Department's purview. Secretarial Order No. 3289 did not alter or affect any existing duty or authority of individual bureaus. Consistent with Secretarial Order No. 3289 and Secretarial Order No. 3226, and to the extent reasonably possible, the BLM considers and analyzes potential climate change impacts in the EIS. Climate change effects are addressed for all affected resources. In addition, the findings of the Final EIS associated with the project's contribution to climate change were considered when making decisions regarding the

selection of the preferred alternative for this project. Finally, the information in the Final EIS will be considered when setting priorities for developing appropriate project monitoring and mitigation plans.

- **Groundwater Flow Modeling/Water Resource Information** – A detailed discussion of model limitations and unavailable water resource information is provided in Section 3.3, Water Resources. Two major limitations resulting from incomplete or unavailable information were identified as part of the water analysis: 1) lack of reliable information regarding hydraulic properties of faults; and 2) representation of future climate conditions. Other uncertainties with the model resulting from incomplete or unavailable information included historic pumping estimates, ET discharge estimates, hydrogeologic conditions in the region, hydraulic interconnection across the region, groundwater recharge rates, and presence and functioning of faults as possible hydrologic barriers. The best available information was used to make assumptions regarding these input parameters for the model. Future update and revisions to water resource information is expected and will be used as appropriate in future NEPA documents (see Section 3.3, Water Resources).
- **Project Descriptions for Groundwater Development and Pumping Locations** – Final groundwater development areas and specific pumping locations have not been defined at this stage of the GWD Project. Professional assumptions have been used to describe a reasonable representation of the number and location of pumping wells that might be sited, other than those requested in the SNWA groundwater applications, as part of this programmatic (Tier 1) level analysis. This information will be provided to the BLM before subsequent NEPA analyses of proposed locations for groundwater development facilities and pumping wells and groundwater pumping effects.
- **Floodplain (EO 11988) and Wetland (EO 11990) Protection**. EO 11990, Protection of Wetlands (42 Federal Register 26961), directs all federal agencies to minimize the destruction, loss, or degradation of wetlands, and to enhance the natural and beneficial values of wetlands. As a result, federal regulation and management of both USACE jurisdictional and non-jurisdictional wetlands follows a "no net loss" policy. Executive Order 11988 (42 *Federal Register* 26951), floodplain management requires federal agencies to avoid to the extent possible the long and short-term adverse impacts associated with the occupancy and modification of flood plains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. The analysis for Tier I related to the main conveyance pipeline and related facilities is sufficient, however, subsequent NEPA analysis would need to further identify and quantify wetland associated with the groundwater development project and develop mitigation measures. The vegetation section (3.5) contains an analysis of the compliance of these EOs.
- **Soils** – Portions of Coyote Spring, Las Vegas, Pahranagat, Spring (#184), and Steptoe valleys have no detailed soils data at this time. New soil mapping is underway in Snake Valley (Soil Survey Area UT617), but it will not be available during the time frame of this EIS. It should be available for use in future NEPA analyses in Snake Valley.
- **Native American Traditional Values** – Native American traditional values vary greatly; some tribal concerns are highly focused geographically, and others are very large and landscape-level in nature. Possible changes to the physical environment resulting from implementation of the GWD Project (including movement of water), are described in this EIS. Tribal concerns that project implementation eventually may be associated with adverse or negative effects to both individual sites of tribal concern and to the larger landscape/environment are connected to loss of vegetation or animal species as related to groundwater drawdown. Inventories related to the Native American traditional values likely have not identified all resources or areas of concern. Additional future commitments in the PA are intended to complete and supplement the identification and determination of steps to be taken to avoid, minimize, or mitigate to the extent practicable, in accordance with law and regulation. Ongoing government-to-government consultation throughout the implementation of the project also would supplement current knowledge and inform the PA process, Historic Properties Treatment Plans, and subsequent NEPA analysis.
- **Caves** – The source of water in caves generally is unknown. Ongoing studies will help to determine the origin of the water. See Great Basin National Park, above.
- **Great Basin National Park** – An ongoing Snake Valley hydrogeological investigation, entitled A Study of the Connection Among Basin-fill Aquifers, Carbonate-Rock Aquifers, and Surface-Water Resources in Southern Snake Valley, Nevada, is being conducted by the USGS and the University of Nevada, Reno. The four principal

research elements include: 1) a characterization of geologic and hydraulic properties of basin-fill sediments; 2) a quantitative assessment of groundwater – surface water interactions along Lehman, Baker, and Snake creeks; 3) delineation of the sources of water to Rowland Spring and Big Springs; and 4) a refinement of estimates of inter-basin groundwater flow from southern Spring Valley to Snake Valley. The final report from this investigation will help to address current uncertainties regarding the interaction of groundwater and surface water in the Lehman, Baker, and Snake Creek watersheds within and adjacent to GBNP; and the source and hydrogeologic dynamics of Rowland Spring and Big Springs. Aside from this ongoing study, other ongoing studies in the area include preparation of a regional potentiometric-surface map of Snake Valley and adjacent basins; a USGS study of the water quality of caves, springs, and streams in the Baker Creek drainage; an independent dye-tracing study in the Baker Creek drainage; and development by the USGS of two or three hydrogeologic cross-sectional diagrams in the vicinity of Lehman, Baker, and Snake Creek drainages. All of this information could be used to further the understanding of the conceptualization of the flow system in these areas, especially with regard to the lateral connectivity of flow systems, and the connectivity among surface waters, basin-fill aquifers, and the karstic carbonate-rock aquifer. More detail is provided in **Appendix B**. As this information becomes available it will be utilized in the appropriate NEPA process.

3.0.4 Environmental Consequences

The environmental consequences section for each resource is divided into three impact analysis sub-sections, based on the proposed facilities, the geographic study areas previously described for the Affected Environment, and the decisions that the BLM will make as lead agency for this EIS. **Table 3.0-1** summarizes the three impact analysis categories.

Table 3.0-1 Impact Analysis Categories

Project Components or Effects Evaluated	BLM Decisions to be Made
ROWs and Ancillary Facilities. Project components include mainline pipeline, pump stations, water treatment and storage facility, and electrical power lines. The construction, operation, and maintenance of these facilities have been evaluated for site-specific locations.	The ROWs required for these facilities may be approved, modified or denied in the BLM ROD and ROW grant at the conclusion of the EIS process (Tier 1).
Groundwater Development Areas. Project components include groundwater wells, access roads, gathering water pipelines, and power lines distributed within broadly defined groundwater development areas within each hydrologic basin. With the exception of Alternative B, no site-specific locations have yet been defined for these facilities.	The effects of constructing and maintaining these project components will be considered by the BLM in the ROD for the current ROW applications. The applicable BMPs, ACMs, and mitigation measures may be applied or updated during the NEPA process (subsequent tiers) for future groundwater development proposals submitted to BLM by the SNWA.
Pumping Effects. Pumping effects (groundwater drawdown elevations, groundwater drawdown areas) on underlying aquifers have been estimated from the completion of a regional groundwater model. Groundwater modeling was completed for the No Action Alternative, the Proposed Action, the Pumping Alternatives (A through F), and a cumulative pumping scenario.	The effects of groundwater pumping on groundwater quantity and quality, as well as water-dependent natural resources and human uses, will be considered by the BLM in its ROW approval decisions. The multi-agency stipulations, ACMs, and additional mitigation measures will be required by the BLM, as appropriate, following assessment of any future groundwater development proposals by the SNWA. Updates and revisions to the Stipulated Agreements could occur to address requirements on future groundwater project proposals.

Rights-of-way and Ancillary Facilities

- ROW Surface Disturbance Assumptions. Based on the ROWs requested by the SNWA and the dimensions of these ROWS, the BLM estimated: 1) the total project construction surface disturbance area associated with each pumping alternative; 2) the disturbed area that would be revegetated after construction; and 3) the surface area committed to life of project industrial uses (e.g., access roads, aboveground facilities). **Table 3.0-2** summarizes these estimates. These numbers are based on GIS estimates of surface disturbance and areas to be reclaimed.

Table 3.0-2 Right-of-way and Ancillary Facility Disturbance Assumptions[1]

Assumptions	Alternatives					
	Proposed Action	A	B	C	D	E and F
Total Construction Disturbance Area (temporary and permanent) (acres)	12,288	12,288	12,288	12,288	8,828	10,681
Temporary Disturbed Area to be Revegetated (acres)	11,289	11,289	11,289	11,289	8,020	9,736
Permanent Disturbance (acres)	999	999	999	999	808	945

[1] Construction and permanent acreage numbers in the table include a minimal acreage of facilities that currently exist. Therefore, the reported acreages conservatively overestimate the amount of disturbance anticipated by the proposed project by approximately 1 percent across all alternatives. Disturbance information for the Alignment Options (1 through 4) is provided in Chapter 2, Section 2.7, Alignment Options 1 through 4.

- Impact Time Frames (Duration). Short-term impacts are considered to be those that occur within 2 years after the inception of project construction; most of the physical and human activity impacts of construction to resources at any particular location along the ROWs would occur within this time period. An example of a short-term impact is the potential displacement of wildlife from the mainline pipeline ROW as a result of human activity and construction equipment noise. Long-term impacts are considered those that occur over a period longer than 2 years. An example of a long-term impact is reestablishment of vegetation in a previously-cleared ROW to a composition and structure similar to adjacent undisturbed areas.

- Impact Assumptions and Methods. The impact assumptions and methods are documented under each resource. In addition to duration, the impact analysis for each resource also discusses effects in terms of intensity and context. In general, the intensity (extent) or degree of resource change resulting from project construction surface disturbance and human activity were estimated for short- and long-term time frames. Context describes the geographic, social, and environmental conditions within which the project may have effects on a resource. As discussed in the BLM NEPA Handbook (BLM 2008), direct and indirect effects often are difficult to differentiate; both direct and indirect effects have been evaluated in this EIS, but a specific differentiation in the EIS text between these effects has not been made. It has been assumed that surface disturbance effects to all natural resources are detrimental or adverse. This assumption is based on the multi-year native vegetation composition and structure recovery times in the ecosystems encompassed by the GWD Project, and the consequent long-term recovery of support functions that vegetation provides to other natural resources and human uses (e.g., soils, wildlife, aquatic biological resources, livestock, and visual resource quality). Construction-related socioeconomic effects may be both detrimental and beneficial.

- BMPs and ACMs. The following plans and commitments have been developed to date to address the effects of groundwater pumping on water dependent resources. Additional monitoring and mitigation also is recommended to supplement these existing plans and commitments. The SNWA would be required to implement a comprehensive COM Plan that would address all ROW and facilities associated with the SNWA GWD Project. The COM Plan framework includes a comprehensive monitoring and mitigation program for the entire project that would integrate the various required monitoring and mitigation actions. The following regulations and commitments provide direction for these actions: BLM RMP Management Actions, BMPs, BO, ACMs, Stipulated Agreements, Section 106 PA, and additional mitigation recommended in this EIS. See Section 3.20, Monitoring and Mitigation Summary, for a description of the COM Plan. For the programmatic impact analysis in this Final EIS, the COM Plan would help develop and focus on the process and key elements that would be considered in this and subsequent NEPA analyses.

- Proposed Mitigation and Mitigation Effectiveness. Proposed mitigation measures were developed that could be required or recommended by the BLM as part of its ROW grant. The effectiveness of each proposed measure (the degree to which a predicted effect could be avoided or further reduced) was then estimated. The potential for application of the proposed mitigation measure to create new environmental effects also was considered and documented.

- Residual Effects. Residual effects are "those effects remaining after mitigation has been applied to the proposed action or alternative" (BLM 2008).
- Comparison of Alternatives. The environmental effects of the Proposed Action are discussed in a separate text section. The relative surface disturbance and human activity effects of the other pumping alternatives (A through F) are systematically compared in summary tables so that the relative differences among the alternatives can be discerned. Impacts associated with the alignment options are discussed following the Proposed Action ROW section for each resource.

Groundwater Development Areas

- ROW Surface Disturbance Assumptions. Based on future facility assumptions provided by the SNWA and assumptions about land requirements, the BLM estimated: 1) the total project construction surface disturbance area associated with each pumping alternative; 2) the disturbed area that would be revegetated after construction; and 3) the surface area committed to life of project industrial uses (i.e., access roads, aboveground facilities). For purpose of this analysis, it was assumed that the maximum number of wells estimated by the SNWA would be installed and operated for each alternative (**Table 3.0-3**).

Table 3.0-3 Acres of Groundwater Development Area Surface Disturbance Assumptions

Assumptions	Proposed Action	A and C	B	D	E	F
Total Construction Disturbance Area (temporary and permanent)	3,590 – 8,410	2,069 – 4,814	4,664	2,513 – 4,005	1,754 – 4,079	2,698 – 6,629
Temporary Disturbed Area to be revegetated	1,216 – 2,874	699 – 1,643	1,587	858 – 1,370	595 – 1,396	916 – 2,270
Permanent Disturbance	2,374 – 5,536	1,370 – 3,171	3,077	1,655 – 2,635	1,158 – 2,683	1,782 – 4,359

- Impact Time Frames. Because the activities required to construct and maintain the groundwater development facilities and ROWs are the same as those described for the primary pipeline and ancillary facilities, the same time frames were used for the analysis.
- Impact Assumptions and Methods. The overall impact assessment process follows the same steps described for the ROWs and ancillary facilities. The impact assessment in this section primarily addresses the direct and indirect effects on surface resources (surface disturbance, human activities); the effects of groundwater drawdown from pumping are discussed separately (see below).
- BMPs and ACMs. The following plans and commitments have been developed to date to address the effects of groundwater pumping on water dependent resources. Additional monitoring and mitigation also is recommended to supplement these existing plans and commitments. The SNWA would be required to implement a comprehensive COM Plan that would address all ROW and facilities associated with the SNWA GWD Project. The COM Plan framework includes a comprehensive monitoring and mitigation program for the entire project that would integrate the various required monitoring and mitigation actions. The following regulations and commitments provide direction for these actions: BLM RMP Management Actions, BMPs, BO, ACMs, Stipulated Agreements, Section 106 PA, and additional mitigation recommended in this EIS. See Section 3.20, Monitoring and Mitigation Summary, for a description of the COM Plan. For the programmatic impact analysis in this Final EIS, the COM Plan would help develop and focus on the process and key elements that would be considered in this and subsequent NEPA analyses.
- Mitigation and Mitigation Effectiveness. The same proposed mitigation measures discussed for ROWs and ancillary facilities would be applicable to groundwater development areas. The BLM also has developed additional measures that are recommended for consideration in future NEPA analysis and associated ROW grants. Since there are no specific locations for the groundwater development surface facilities, the emphasis was placed on identifying sensitive resources and uses that should be avoided (or mitigated) when specific proposals for future well sites and associated facilities are developed. Proposed mitigation measure effectiveness was estimated

for measures specifically developed for the groundwater development areas in general terms. Subsequent NEPA analyses will discuss effectiveness for specific locations (where appropriate).

- Comparison of Alternatives. The format for presenting the effects of the Proposed Action and the other pumping alternatives (A through F) is the same as for ROWs and Ancillary Facilities.

Pumping Effects

- ROW Surface Disturbance Assumptions. No additional project construction surface disturbance is anticipated from groundwater pumping. However, groundwater drawdown could cause ground-surface subsidence with consequent changes in drainage patterns.
- Impact Time Frames. Three representative points in time were used to evaluate the potential groundwater related drawdown effects in the future:
  1. Full build out is defined as the completion of groundwater wells in all the hydrologic basins planned for pumping under each alternative. Because the project would be built progressively from south to north, pumping would be initiated in the southern basins (Delamar, Dry Lake, and Cave) before pumping would start in the northern basins (Spring and Snake). The time frames for complete build out of the Proposed Action plus Alternatives A through C would be the year 2050. The time frames for complete build out of Alternatives D through F would be the year 2043 (no facilities would be constructed in Snake Valley, resulting in an earlier project completion date).
  2. Full build out plus 75 years for each alternative.
  3. Full build out plus 200 years for each alternative.

For purposes of comparison among alternatives, the pumping effects of the No Action Alternative were compared to the Proposed Action and other action alternatives A through F at the same benchmark time frame intervals. In this case, the reference to "full build out" or "full build out time frame" refers to a benchmark time point, and not a specific groundwater development program.

- Impact Assumptions and Methods. The analysis of pumping effects on environmental resources followed a series of steps that linked the results of the groundwater flow modeling to those resources with dependence on surface water and/or groundwater as a source of water or habitat (**Figure 3.0-2**). The groundwater flow model was used to predict the reductions in groundwater elevation (i.e., drawdown) that would occur over time resulting from pumping from the Proposed Action or other action alternatives. The model predictions were then used to define a drawdown area to evaluate potential drawdown effects on surface water and associated habitat (i.e., springs, ponds, wetlands, meadows, perennial streams, playas, and swamp cedar woodlands) and phreatophytic shrubland vegetation. Surface water resources within the drawdown area were further evaluated to identify the potential risk to springs and streams and associated vegetation/habitats located within the defined drawdown area. In addition to the groundwater drawdown contour analysis, the groundwater flow model predicted potential flow changes in selected springs, streams, and rivers. The flow change was expressed as the percent reduction of the project-affected flow compared to base flow conditions. The methodology used for the groundwater flow modeling and the water resources impact evaluation is discussed in Section 3.3, Water Resources. The following were used in the analysis of pumping effects on environmental resources.
  - Predict Affected Areas – The calibrated groundwater flow model was used to predict the potential changes in groundwater elevation at representative times for each alternative. The defined drawdown area was used to identify the areas that were in an area of risk of pumping effects.
  - Identify Potentially Affected Surface Water – As part of the water resource impact analysis, perennial streams and springs were further evaluated to identify areas where impacts to perennial waters would likely occur. For example, if flow from a specific water resource was determined to be controlled by discharge from the regional groundwater flow system and the water resource is within the drawdown area, impacts to flow would likely occur. This step identified aquatic habitats that could be affected by pumping in terms of flow or water level reductions. The overall study area for water resources was defined as the water resource model area, as shown in **Figure 3.0-3**.

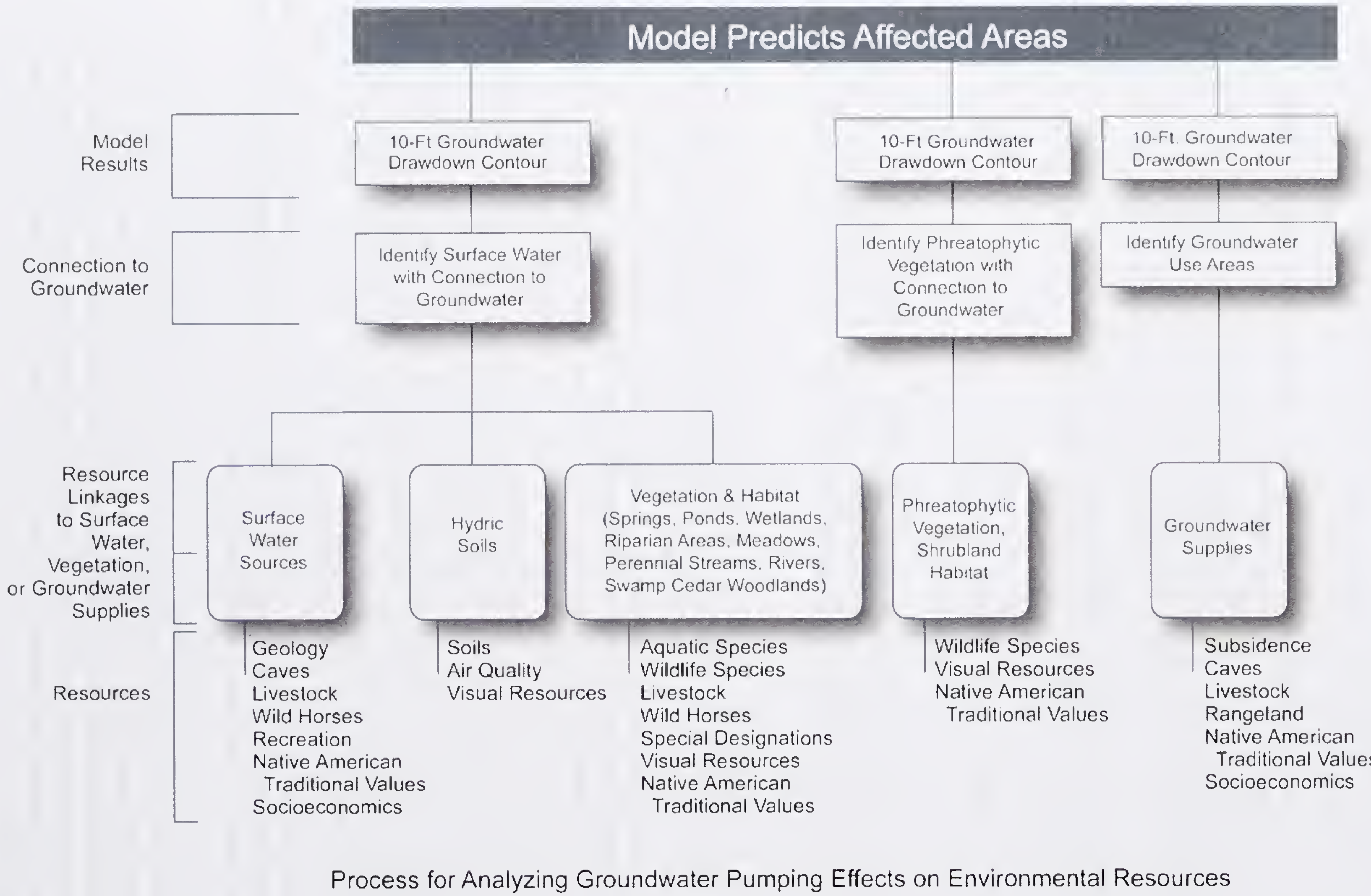
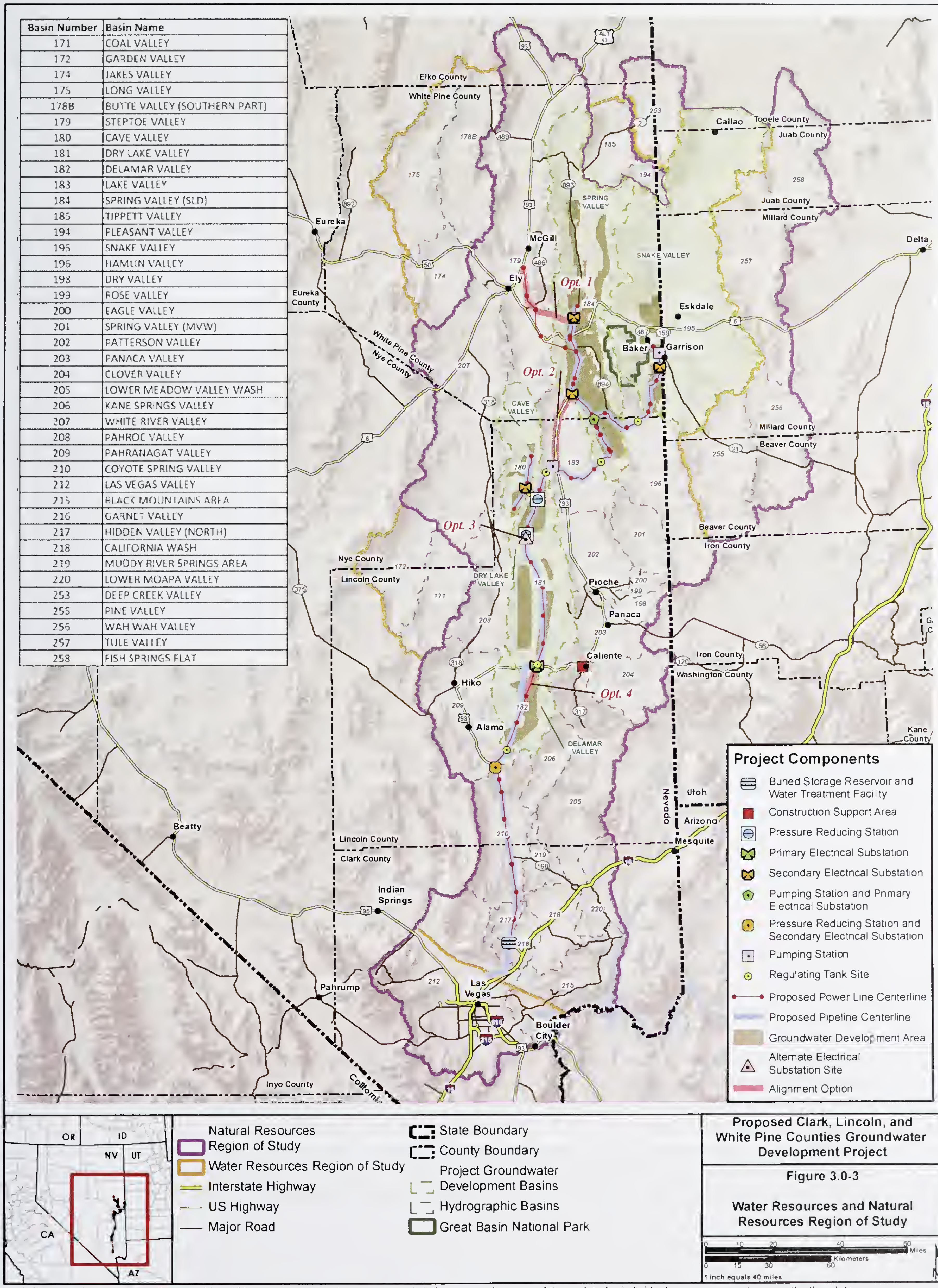


Figure 3.0-2 Process for Analyzing Groundwater Pumping Effects on Environmental Resources

Basin Number	Basin Name
171	COAL VALLEY
172	GARDEN VALLEY
174	JAKES VALLEY
175	LONG VALLEY
178B	BUTTE VALLEY (SOUTHERN PART)
179	STEPTOE VALLEY
180	CAVE VALLEY
181	DRY LAKE VALLEY
182	DELAMAR VALLEY
183	LAKE VALLEY
184	SPRING VALLEY (SLD)
185	TIPPETT VALLEY
194	PLEASANT VALLEY
195	SNAKE VALLEY
196	HAMLIN VALLEY
198	DRY VALLEY
199	ROSE VALLEY
200	EAGLE VALLEY
201	SPRING VALLEY (MVW)
202	PATTERSON VALLEY
203	PANACA VALLEY
204	CLOVER VALLEY
205	LOWER MEADOW VALLEY WASH
206	KANE SPRINGS VALLEY
207	WHITE RIVER VALLEY
208	PAHROC VALLEY
209	PAHRANAGAT VALLEY
210	COYOTE SPRING VALLEY
212	LAS VEGAS VALLEY
215	BLACK MOUNTAINS AREA
216	GARNET VALLEY
217	HIDDEN VALLEY (NORTH)
218	CALIFORNIA WASH
219	MUDDY RIVER SPRINGS AREA
220	LOWER MOAPA VALLEY
253	DEEP CREEK VALLEY
255	PINE VALLEY
256	WAH WAH VALLEY
257	TULE VALLEY
258	FISH SPRINGS FLAT



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.0-3

Water Resources and Natural Resources Region of Study

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

- Identify Effects on Water Sources and Vegetation/Habitat – The identified perennial streams and springs used to identify potential effects on surface water sources and vegetation/habitat consisting of springs, ponds, wetlands, meadows, perennial streams, playas, and swamp cedar woodlands. The overall study area for vegetation and other natural resources is shown in **Figure 3.0-3**.

- Identify Phreatophytic Shrublands with Connection to Groundwater – The defined drawdown area was used to identify and evaluate effects on phreatophytic vegetation.

- Identify Resource Connections to Surface Water and Vegetation/Habitat – Resource connections to surface water, hydric soils, vegetation, or habitat were used as the focus of the impact analysis. The potential reduction in water levels or flows were discussed relative to each resource's connection to surface water or associated vegetation and habitat types.

- Identify Other Resource Connections to Groundwater Drawdown – Other examples of resources where drawdown effects were evaluated: Air and Climate – dust generation risk from soil surface drying and vegetation alterations; Geology – effects on caves and ground surface subsidence; Soils – potential structural and functional changes in hydric soils; Wild Horses and Burros – changes in water availability and forage quality and quantity resulting in a decrease of the appropriate management level (AML) of horses; Rangeland and Livestock Grazing – changes in water sources and forage resulting in changes to the carrying capacity of a grazing allotment; Special Designations – potential changes in the natural and cultural values for which areas were designated; Recreation – potential changers in surface water and resources used for recreational activities; Visual Resources – potential changes in landscape views from soil and vegetation alterations; Native American Concerns – changes in vegetation, biological diversity, water quantity and quality that could affect resources and places of traditional value; and Socioeconomics – potential changes in economics and lifestyles.

- BMPs and ACMs. The following plans and commitments have been developed to date to address the effects of groundwater pumping on water dependent resources. Additional monitoring and mitigation also is recommended to supplement these existing plans and commitments. The SNWA would be required to implement a comprehensive COM Plan that would address all ROW and facilities associated with the SNWA GWD Project. The COM Plan framework includes a comprehensive monitoring and mitigation program for the entire project that would integrate the various required monitoring and mitigation actions. The following regulations and commitments provide direction for these actions: BLM RMP Management Actions, BMPs, BO, ACMs, Stipulated Agreements, Section 106 PA, and additional mitigation recommended in this EIS. See Section 3.20, Monitoring and Mitigation Summary, for a description of the COM Plan. For the programmatic impact analysis in this Final EIS, the COM Plan would help develop and focus on the process and key elements that would be considered in this and subsequent NEPA analyses.

- Groundwater, surface water, and water dependent resource monitoring requirements were established in existing agreements (Spring Valley Stipulation; Delamar, Dry Lake, and Cave Valley Stipulation; and their associate Hydrologic and Biologic Monitoring and Mitigation Plans).

- A conceptual adaptive management plan has been developed by the SNWA (Appendix C of the SNWA ACMs, included in **Appendix E**). The SNWA conceptual Adaptive Management Plan references the DOI NEPA regulations that define adaptive management as "a system of management practices based on clearly identified outcomes and monitoring to determine whether management actions are meeting desired outcomes; and if not, facilitating management changes that will best ensure that outcomes are met or re-evaluated 43 CFR Section 46.30." The plan includes goals to address adverse impacts; outlines baseline data collection and monitoring programs; identifies a process for selecting environmental indicators and establishing adaptive management thresholds; and outlines an interactive decision process for determining if adverse impacts are occurring, and an assessment of appropriate management responses. The conceptual plan includes a section on Adaptive Management Measures that the SNWA would implement in response to triggering of "early warning" environmental change thresholds. The measures include changes in operational practices, specific biological measures for managing terrestrial and aquatic habitats, changes in agricultural and rangeland management to benefit natural resources, and opportunities for groundwater recharge and precipitation enhancement.

- Additional Monitoring and Mitigation. Potential mitigation measures were focused on protecting sensitive water dependent resources. Monitoring and mitigation recommendations are made for streams and springs that could be adversely affected by pumping and are not identified in the Spring Valley and the Delamar, Dry Lake, and Cave valleys stipulations. In addition, a comprehensive monitoring and mitigation plan could be fully developed for Snake Valley in Utah and Nevada by the BLM, other Department of Interior agencies, and with input from the States of Utah and Nevada (see **Appendix B**). A description of the COM Plan and additional monitoring and mitigation is provided in Section 3.20, Monitoring and Mitigation Summary.
- Comparison of Alternatives. The format for presenting the effects of the Proposed Action and the other pumping alternatives (A through F) is the same as for ROWs and Ancillary Facilities.
- Mitigation measures discussed in this resource section focus on new measures. Where applicable, some of the ROW mitigation measures may apply to surface disturbance activities associated with groundwater development. These ROW mitigation measures also would be considered in subsequent NEPA tiers.

Cumulative Impacts

The Proposed Action and other action alternatives may result in cumulative effects when considered with other past and present actions (PPAs) and RFFAs in the project study area. Cumulative effects are the impacts associated with this project, combined with the effects of all PPAs and RFFAs (cumulative actions) in the project study area. Cumulative actions considered in this analysis are listed in Chapter 2, Description of the Proposed Action and Alternatives. A cumulative effects study area was defined in the overview section for each resource. The effects associated with the proposed project were evaluated together with the cumulative actions. For each alternative and cumulative effect issue, effects were described for the existing conditions (combination of natural conditions and past actions), present actions, and RFFAs. Cumulative impacts were analyzed for each alternative by identifying the impact contributions from No Action cumulative actions, the individual alternative, and cumulative with the specific alternative. Tables and/or bar charts were used as a way of identifying the relative contribution of impacts for these three cumulative action scenarios. This type of analysis was done for those resources where impact parameter information was available. The short- and long-term impact duration definitions for surface disturbance impacts are the same as those for ROWs and Ancillary Facilities. The same three benchmark time frames described for Pumping Effects above were used as the basis for the cumulative effects analysis.

Impacts on Productivity and Commitment of Resources

Project effects on the productivity and commitment of resources were evaluated. The short-term use of the environment relative to the long-term productivity is discussed for each resource. The GWD Project is unique because of the very long time frames for both project development and operation (which would be at least 75 years and likely much longer). Short-term use of the environment is defined as the period of construction and operation up to the point that the entire system would be operational (full build out). Long-term impacts are defined as effects that would continue past the project operation period (after full build out). Long-term productivity is the ability of a resource to maintain a stable level of production over a long period of time. The irreversible or irretrievable commitment of resources also is described for each resource in Chapter 4.

3.1 Air and Atmospheric Values

3.1.1 Affected Environment

3.1.1.1 Overview

Nevada air quality airsheds are defined by hydrologic basin boundaries. Thus, the study area for air quality consists of the hydrologic basins within which project facilities would be constructed. Because of the potential for indirect effect on soils from groundwater level declines, the air quality study area also encompasses the region of study shown in **Figure 3.3.1-1** of Section 3.3, Water Resources. This section describes air quality on a regional level without distinguishing between the ROWs, groundwater development areas and the larger area that may be affected indirectly by groundwater pumping.

3.1.1.2 Air Quality and Air Quality Related Values

Regulatory Framework

Air quality is defined by the concentration of various pollutants and their interactions in the atmosphere. Pollution effects on receptors have been used to establish a definition of air quality. Measurement of pollutants in the atmosphere is expressed in units of parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$). Both long-term climatic factors and short-term weather fluctuations are considered part of the air quality resource because they control dispersion and affect concentrations. Physical effects of air quality depend on the characteristics of the receptors and the type, amount, and duration of exposure. Ambient Air Quality Standard (AAQS) specify acceptable upper limits of pollutant concentrations and duration of exposure. Air pollutant concentrations below the standards generally are not considered to be detrimental to public health and welfare.

Ambient air quality and the emission of air pollutants are regulated under both federal and State of Nevada laws and regulations. A summary of the pertinent federal and state regulations governing air pollutant emissions (including particulates, such as construction generated dust) is contained in **Appendix F3.1**.

The relative importance of pollutant concentrations can be determined by comparison with an appropriate national and/or state AAQS. An area is designated by the USEPA as being in attainment for a pollutant if ambient concentrations of that pollutant are below the National AAQS. An area is not in attainment if violations of the National AAQS for that pollutant occur. Areas where insufficient data are available to make an "attainment" status designation are listed as unclassifiable and are treated as being in attainment for regulatory purposes.

QUICK REFERENCE

AAQS – Ambient Air Quality Standard

AQRV – Air Quality Related Values

CCA – Clean Air Act

CO – Carbon monoxide

CO_2 – Carbon Dioxide

ET– Evapotranspiration

GBNP – Great Basin National Park

HB – Hydrologic Basin

IMPROVE – Interagency Monitoring of Protected Visual Environment

IPCC – Intergovernmental Panel on Climate Change

Mm^{-1} – Inverse Megameters

NDEP – Nevada Division of Environmental Protection

NO_2 – Nitrogen dioxide

NO_x – Nitrogen oxides

NRCS – Natural Resources Conservation Service

PM_{10} – Particles of 10 microns or less

PM – Particulate matter

$PM_{2.5}$ – Particles of 2.5 microns or less

ppm – Parts per million

ppmw – Parts per million by weight

SO_2 – Sulfur dioxide

TSP – Total Suspended Particulate

VOCs – Volatile Organic Compounds

$\mu g/m^3$ – micrograms per cubic meter

USEPA – United States Environmental Protection Agency

WEG – Wind Erodeability Group

USEPA regulations allow exceptional events, if properly documented and approved, to be excluded from attainment status designation. An exceptional event refers to high pollution levels caused by a natural or human activity, such as a wildfire or high wind event, which is not reasonably controllable or preventable and is unlikely to reoccur at a particular location (USEPA 2007).

Regional Air Quality

The existing air quality of most of the project area is typical of the largely undeveloped regions of the western U.S. Current sources of air pollutants in the region include wildland fire, mining, agriculture, industrial sources, urban transportation, rural transportation on unpaved roads, construction activities, and disturbed land. With the exception of urban transportation, which emits other air pollutants, all of these sources predominately emit PM. Urban transportation combined with naturally occurring sources of volatile organic compounds (VOCs) react and create tropospheric ozone. PM and ozone are the primary pollutants of concern in the ROW/groundwater development area.

For the purposes of statewide regulatory planning, all of the northern portions of the project area have been designated as attainment areas for all pollutants that have an AAQS; however, parts of Nevada and Utah are designated as nonattainment or maintenance areas for specific pollutants as described below.[1]

Particulate Matter

Natural sources of PM are dust generated by wind across unvegetated soil surfaces and wildland fire. Dry playa basins and areas cleared of vegetation are particularly susceptible to dust generation, particularly where soils are silty. In the Las Vegas area, most PM air pollution is a result of windblown dust from disturbed ground.

The size of PM is important from a human health perspective. There are three common size classifications of PM: the largest size classification is total suspended particulates (TSP); the second largest classification is particulate matter with an aerodynamic diameter of 10 microns or less (PM_{10}); and the smallest classification is particulate matter with an aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$).

The current AAQS for PM are: the 24-hour average PM_{10} concentration is not to exceed 150 $\mu g/m^3$ more than once per year; the 3 year average of the 98^{th}-percentile 24-hour average $PM_{2.5}$ concentration is not to exceed 35 $\mu g/m^3$ more than once per year; the annual average PM_{10} concentration is not to exceed 50 $\mu g/m^3$; and the 3-year average of the annual mean $PM_{2.5}$ concentration is not to exceed 15 $\mu g/m^3$. For a complete listing of all applicable state and national AAQS, see **Appendix F3.1**.

The most recent and available monitoring data were analyzed over a 3-year period at sites in Nevada and Utah. These data are used to define the current ambient concentrations for PM_{10} and $PM_{2.5}$ in the project area and nearby population centers. The sites were selected for analysis based on: the location relative to the region of study, the frequency of observations, and data capture. The design values were calculated from the 3-year dataset at each site and compared to the AAQS.

Particulate data are collected in GBNP by the Interagency Monitoring of Protected Visual Environments (IMPROVE) monitor. These data are considered representative of the project area and are provided in **Table 3.1-1**.

Importantly, IMPROVE data are not collected for the purpose of an AAQS comparison; however, the data are considered to be high quality and provide information about existing air quality in the project area. IMPROVE data do not contain flags to exclude exceptional events, such as high wind events or natural fires. The air quality data collected at the GBNP IMPROVE site demonstrate that the area is well below all applicable air quality standards for PM_{10} and $PM_{2.5}$.

[1] Attainment, maintenance, and nonattainment designations as described throughout the text are based on the current status of these areas as of March 23, 2012.

Table 3.1-1 Great Basin National Park PM_{10} and $PM_{2.5}$ Concentrations in 2008-2010

Year	24-hour (μg/m³)		Annual (μg/m³)	
	PM_{10} (Second highest)	$PM_{2.5}$ (98th percentile)	PM_{10}	$PM_{2.5}$
2008	48	21	7.3	3.6
2009	21	7.2	5.8	2.3
2010	41	7.5	5.7	2.3
2008-2012 Design Value	48	12	6.3	2.7

Source: IMPROVE 2012.

Particulate data in Clark County, Nevada, is collected by the NDEP. These data are considered representative of air quality conditions in the southern portion of the study area and are shown in **Table 3.1-2**. In comparison to the more rural GBNP IMPROVE site, the monitored particulate values are higher in the urban Las Vegas area. Of the 3 years that were analyzed for particulates, only year 2010 had monitored exceptional event(s) for $PM_{2.5}$[2].

Table 3.1-2 Las Vegas, Nevada PM_{10} and $PM_{2.5}$ Concentrations 2008-2010 (Monitor 32-003-2002)

Year	24-hour (μg/m³)		Annual (μg/m³)	
	PM_{10} (Second highest)	$PM_{2.5}$ (98th percentile)	PM_{10}	$PM_{2.5}$
2008	91	19	31	9.0
2009	74	16	28	7.7
2010	61	13	24	6.5
2008-2012 Design Value	91	16	28	7.7

Source: USEPA 2012a.

While the groundwater development area is located in rural areas and is classified as attainment for all applicable AAQS, portions of the project area and nearby surrounding areas are designated nonattainment of particulate AAQS. In the past, monitors in Clark County, Nevada, have exceeded the 24-hour PM_{10} AAQS. This has caused a portion of Clark County to be designated as a nonattainment area for PM_{10} (see **Appendix F3.1** for additional information regarding attainment designations). Recently, Clark County was declared as attainment of the PM_{10} AAQS and will be re-designated as attainment following approval of the maintenance plan[3]. Average annual PM_{10} concentrations in this region generally range from 20 to 30 μg/m³, which is below the 50 μg/m³ State of Nevada AAQS (USEPA 2008a). Monitored $PM_{2.5}$ in Clark County are below the applicable AAQS.

Salt Lake, Provo, and Logan counties in Utah are collectively referred to as the Wasatch Front. Particulate data are collected in the Wasatch Front by the State of Utah. These data are considered representative of air quality conditions in the Wasatch Front, including the cities of Ogden, Salt Lake City, and Provo, Utah. These data are shown in **Tables 3.1-3** through **Tables 3.1-5**, respectively. Each of these sites has higher monitored particulate values than found in either the project area or the Las Vegas area. Exceptional events were monitored in Ogden for PM_{10} in the years 2009 and 2010 and $PM_{2.5}$ in 2008, 2009, and 2010. Exceptional events were monitored in Salt Lake City for PM_{10} in 2008, 2009, and 2010 and for $PM_{2.5}$ in 2009 and 2010. Exceptional events were monitored in Provo for $PM_{2.5}$ in 2008 and 2010[4].

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[2] http://www.epa.gov/airquality/airdata/ad_rep_mon.html

[3] http://www.clarkcountynv.gov/Depts/daqem/Documents/Planning/SIP/PM10/75_%20FR_45485.pdf

[4] http://www.epa.gov/airquality/airdata/ad_rep_mon.html

Table 3.1-3 Ogden, Utah PM_{10} and $PM_{2.5}$ Concentrations in 2008-2010 (Monitor 49-057-0002)

Year	24-hour (µg/m³)		Annual (µg/m³)
	PM_{10} (Second highest)	$PM_{2.5}$ (98th percentile)	$PM_{2.5}$
2008	118	32	9.8
2009	100	37	10.2
2010	102	42	9.1
2008-2010 Design Value	118	37	9.7

Source: USEPA 2012a.

Table 3.1-4 Salt Lake City, Utah PM_{10} and $PM_{2.5}$ Concentrations in 2008-2010 (Monitor 49-035-3006)

Year	24-hour (µg/m³)		Annual (µg/m³)
	PM_{10} (Second highest)	$PM_{2.5}$ (98th percentile)	$PM_{2.5}$
2008	99	36	10.3
2009	102	45	10.8
2010	125	49	9.7
2008-2010 Design Value	125	43	10.3

Source: USEPA 2012a.

Table 3.1-5 Provo, Utah PM_{10} and $PM_{2.5}$ Concentrations in 2008-2010 (Monitor 49-049-0002)

Year	24-hour (µg/m³)		Annual (µg/m³)
	PM_{10} (Second highest)	$PM_{2.5}$ (98th percentile)	$PM_{2.5}$
2008	90	33	9.7
2009	80	42	9.9
2010	55	31	8.5
2008-2010 Design Value	90	35	9.4

Source: USEPA 2012a.

Along the Wasatch Front in Utah, several counties have been designated as nonattainment for PM_{10} and/or $PM_{2.5}$, including the metropolitan areas of Ogden, Salt Lake City, and Provo (see **Appendix F3.1** for additional information regarding attainment designations). In 2005, the State of Utah requested the PM_{10} nonattainment areas be re-designated to attainment. Approval of this request by the USEPA is pending. In this area, average annual $PM_{2.5}$ monitored values are below the AAQS, while 24-hour PM_{10} monitored values are also below the AAQS but generally elevated and 24-hour $PM_{2.5}$ values are at or above the AAQS. There is no annual PM_{10} standard in Utah.

Ozone

In the past, monitoring results in Las Vegas Valley (HB 212) in Clark County have exceeded the 1997 8-hour ozone standard (see **Appendix F3.1** for additional information regarding attainment designations). In 2004, the USEPA designated hydrograhic basins 164A, 164B, 165, 166, 167, 212, 213, 214, 216, 217, and 218 as nonattainment for the 1997 8-hour ozone standard.[5] On March 31, 2011, the USEPA determined that the Clark County 8-hr ozone nonattainment area has attained the 1997 8-hr ozone National AAQS. Although the USEPA has not formally re-designated Clark County as "attainment", the area is now considered to be following a maintenance strategy and continues to meet the 1997 8-hour ozone standard. In 2008, the USEPA lowered the 8-hour ozone standard from 0.08 ppm to 0.075 ppm. In a letter issued by the USEPA to the Governor of Nevada in December, 2011, the USEPA indicated their plans to designate Clark County and all of Nevada as unclassifiable or attainment for the 2008 8-hour ozone standard.

[5] Federal Register Volume 69, Number 180. September 17, 2004. p. 55956.

Current levels of ozone monitored in the groundwater development area are also of concern. Ozone is monitored at GBNP and values are close to the 2008 8-hour ozone standard, as shown in **Table 3.1-6**. The USEPA will consider revising the 2008 8-hour ozone standard in 2013. If the standard is lowered to 0.070 ppm or below, the region surrounding the Great Basin monitoring station and portions of Clark County will likely be classified as a nonattainment area for the new 8-hour ozone standard.

Table 3.1-6 Great Basin National Park 8-hour Average Ozone Concentrations in 1998-2008

	8-hour Ozone (ppm)	
Year	**Fourth Highest Daily Maximum**	**Number of Exceedences[1]**
1998	0.070	0
1999	0.072	0
2000	0.077	0
2001	0.067	0
2002	0.074	0
2003	0.071	0
2004	0.072	0
2005	0.073	0
2006	0.072	0
2007	0.075	0
2008	0.071	0

[1] The 2008 8-hour ozone standard is that the 3-year average of the fourth-highest daily maximum 8-hour average ozone must not exceed 0.075 ppm. Therefore, although the fourth-highest daily maximum 8-hour average value exceeded 0.075 ppm in 2000, there has not been a 3-year period with an average over the AAQS.

Source: USEPA 2008a.

Prevention of Significant Deterioration

In addition to the designations relative to attainment of conformance with the National AAQS, the CAA requires the USEPA to place selected areas within the U.S. into one of three categories, which are designed to limit the deterioration of air quality when it is better than the National AAQS. Class I is the most restrictive air quality category. It was created by Congress to prevent further deterioration of air quality in national parks and wilderness areas of a given size, which were in existence prior to 1977, or those additional areas that have since been designated Class I under federal regulations (40 CFR 52.21). The Jarbidge Wilderness northeast of Elko is the only Federal Class I area in Nevada. The closest Class I area in Utah is Zion National Park, which lies about 90 miles east of the project area. All remaining areas outside of the designated Class I boundaries are designated as Class II areas, which are allowed a relatively greater deterioration of air quality, although it must still be maintained below National AAQS. The GBNP is a Class II area, based on the Congressional legislation that brought the park into existence. Additionally, Lake Mead National Recreation Area is a Class II area. No Class III areas have been designated in the U.S.

The project impacts to the GBNP are analyzed due to the proximity of the park to the project area. Project impacts to all other designated Class I and Class II area are anticipated to be less than the impacts predicted at the GBNP.

Regional Air Quality Related Values

Air quality related values include changes in visibility or atmospheric deposition of pollutants to soils and waterbodies. Regional haze is visibility impairment caused by the cumulative air pollutant emissions from numerous sources over a wide geographic area. Visibility impairment is caused by particles and gases in the atmosphere. Some particles and gases scatter light while others absorb light. The primary cause of regional haze in many parts of the country is light scattering resulting from fine particles (i.e., $PM_{2.5}$) in the atmosphere. Additionally, coarse particles between 2.5 and 10 microns in diameter can contribute to light extinction. Coarse particulates and $PM_{2.5}$ can be naturally occurring or the result of human activity. The natural levels of these species result in some level of visibility impairment, in the absence of any human influences, and will vary with season, daily meteorology, and geography (Malm 1999).

The visibility at the GBNP is one of the best in the nation.[6] In other words, at the GBNP, one can see farther distances than in other areas of the U.S. During the regional haze baseline period from 2000-2004, the total light extinction for the 20 percent best days was 13.4 inverse megameters (Mm^{-1}), for the worst 20 percent days it was 29.2 Mm^{-1}, and averaged over the whole baseline period, it was 19.7 Mm^{-1} (IMPROVE 2010). Most of the particulate matter at the GBNP is composed of organic material, sulfates, and soil. The relative fractions of each component vary seasonally. The summer season is typically the time of year when the Great Basin region experiences the greatest reduction in visible range (IMPROVE 2010). Currently, there are no concerns regarding the atmospheric deposition of pollutants to soils or waterbodies in Class II areas of Nevada and there are no Class I areas of concern for this project. The total nitrogen deposition trend is relatively stable at around 2.0 kilograms per hectare per year (approximately 40 percent from dry deposition and the remaining 60 percent from wet deposition). The total sulfur deposition trend is relatively stable, perhaps decreasing slightly over the last 10 years, and is approximately 0.7 kilograms per hectare per year (approximately 30 percent from dry deposition and the remaining 70 percent from wet deposition) (Clean Air and Trends Network [CASTNet] 2010).

3.1.1.3 Climate

The climate study area is part of two different climate regions: the Southwest and Great Basin Desert. The Southwest climate region generally is a low-elevation area extending from the Mohave Desert in southern California in the west to the western edge of Texas, reaching as far north as the Four Corners area and extending into the northern portions of Mexico. The Great Basin Desert is a mountainous desert, primarily contained within the state of Nevada, bordered by the Sierra Nevada mountain range on the west and the Great Salt Lake Desert on the east.

Generally, the Southwest climate region is warmer in the summer and drier in the winter than the Great Basin Desert. The Southwest also experiences summer precipitation associated with the North American Monsoon system, a system that does not reach as far north as the Great Basin Desert.

The climatic conditions across the hydrologic study area are highly variable and reflect the wide variations in elevation, the presence of numerous mountain ranges, and the wide range in latitude. Precipitation generally increases with elevation (Welch and Bright 2007, Figure 20). In the Great Basin, the mean annual precipitation ranges from less than 5 inches to 16 inches in the valleys and approximately 16 inches to 60 inches in the mountains (Harrill and Prudic 1998).

Meteorological stations within the region typically are located at lower elevations. This is due to access and maintenance difficulties at higher elevations and because more intensive land uses commonly take place in valleys. Precipitation estimates at high elevations are largely based on snowpack measurements taken by the Natural Resources Conservation Service (NRCS) or other agencies.

Average annual precipitation values for selected monitoring stations distributed throughout the project study area are shown in **Table 3.1-7**. The station locations are listed from north to south. Most of these station locations are situated in valley settings. Elevation and precipitation generally decreases from north to south across the region. An example of localized effects of mountainous terrain and elevation on precipitation is made evident by comparison of the average annual precipitation for the GBNP (13.24 inches) with Garrison, Utah (7.61 inches), which is located approximately 10 miles east of the park.

In addition to the trend of increasing precipitation with increasing elevation, the seasonal distribution of precipitation changes generally from north to south. In the northern portion of the hydrologic study area, the greatest amount of precipitation normally falls in March, April, and May. This is illustrated by data for Ely, the GBNP, and Garrison in **Table 3.1-8**. The months of June and July typically are drier, and a slight increase in rainfall occurs in the late summer and early fall. Further south, precipitation is greatest in January and February at Overton and Las Vegas. Precipitation dramatically decreases in April, May, and June, and then recovers to mid-range levels for the rest of the year. In the extreme south, at Las Vegas, an increase in mid- to late-summer precipitation (July and August) is typical.

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[6] Maps of regional haze measured across the U.S. can be viewed at http://vista.cira.colostate.edu/improve/Data/Graphic_Viewer/seasonal.htm.

Table 3.1-7 Average Annual Precipitation for Selected Meteorological Stations in the Region of Study

Station Location	Elevation (feet)	Average Annual Precipitation (inches)
Lages, Nevada	5,960	8.2
Ely, Nevada	6,250	9.6
GBNP, Nevada	6,830	13.2
Garrison, Utah	5,280	7.6
Lund, Nevada	5,570	10.2
Pioche, Nevada	6,170	13.2
Pahranagat Wildlife Refuge, Nevada	3,400	6.3
Overton, Nevada	1,290	4.4
Las Vegas, Nevada	2,160	4.2

Table 3.1-8 Monthly Precipitation at Lower Elevations in the Study Area

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ely	0.74	0.74	0.97	1.02	1.09	0.68	0.60	0.81	0.75	0.85	0.68	0.62
GBNP	1.02	1.11	1.41	1.18	1.24	0.90	0.97	1.18	1.08	1.26	1.00	0.87
Garrison	0.45	0.45	0.86	0.76	0.73	0.50	0.57	0.77	0.69	0.78	0.58	0.46
Overton	0.56	0.67	0.46	0.33	0.13	0.07	0.31	0.27	0.34	0.33	0.48	0.45
Las Vegas	0.51	0.58	0.46	0.21	0.15	0.07	0.44	0.44	0.32	0.26	0.36	0.39

Regional trends in precipitation and temperature over a 66-year period of record were evaluated for Las Vegas, Caliente, and Ely. The purpose of this analysis was to provide background on the annual precipitation input to the region over time and to provide data for a discussion of potential climate change.

Variations in mean annual precipitation from 1930 through 2007 for Ely, Caliente, and Las Vegas are shown in **Figure 3.1-1**. The graph illustrates that all of the sites have experienced wet and dry cycles lasting up to a decade or more.

In addition, there was a slight trend towards wetter conditions over the period for both Ely and Caliente while the overall precipitation trend for Las Vegas essentially was flat (i.e., does not exhibit a long-term trend towards either wetter or drier conditions).

Average annual temperatures at these three stations have shown a slight upward trend for Caliente and Ely and a 3 to 4 degrees Fahrenheit (°F) average annual increase in Las Vegas over the 66-year period of record illustrated on **Figure 3.1-2**. An analysis of the annual maximum temperatures at the three stations indicates little or no difference over the period of record (**Figure 3.1-3**). However, the analysis of the annual minimum temperatures indicates a very strong upward trend in Las Vegas (nearly 10°F), and a moderate upward trend in Caliente (2 to 3°F), and no trend in Ely (**Figure 3.1-4**). One possible explanation for the upward temperature trend in Las Vegas annual minimum temperatures is the increasing urbanization of this area, with an associated increase in relative humidity and greater area of heat absorbing surfaces.

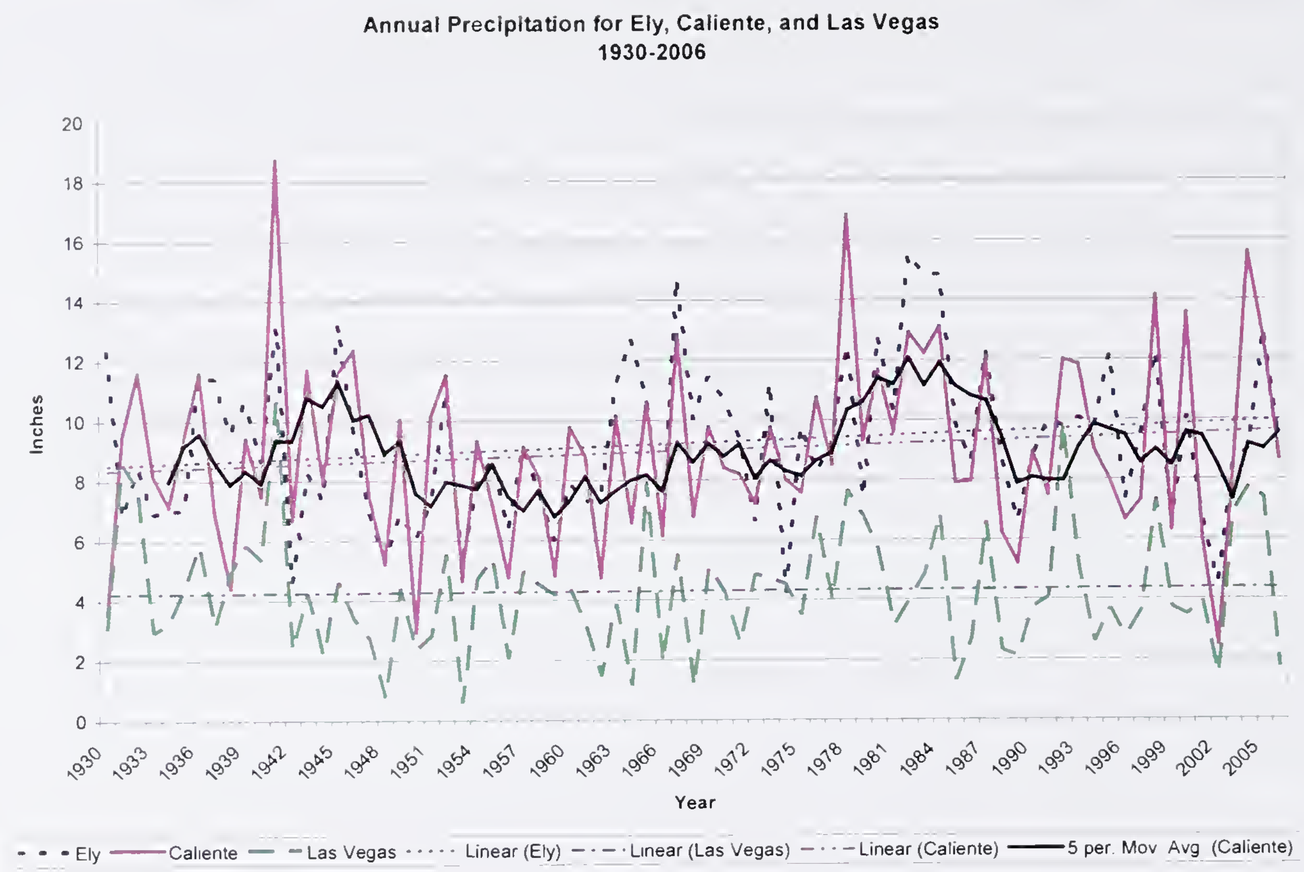
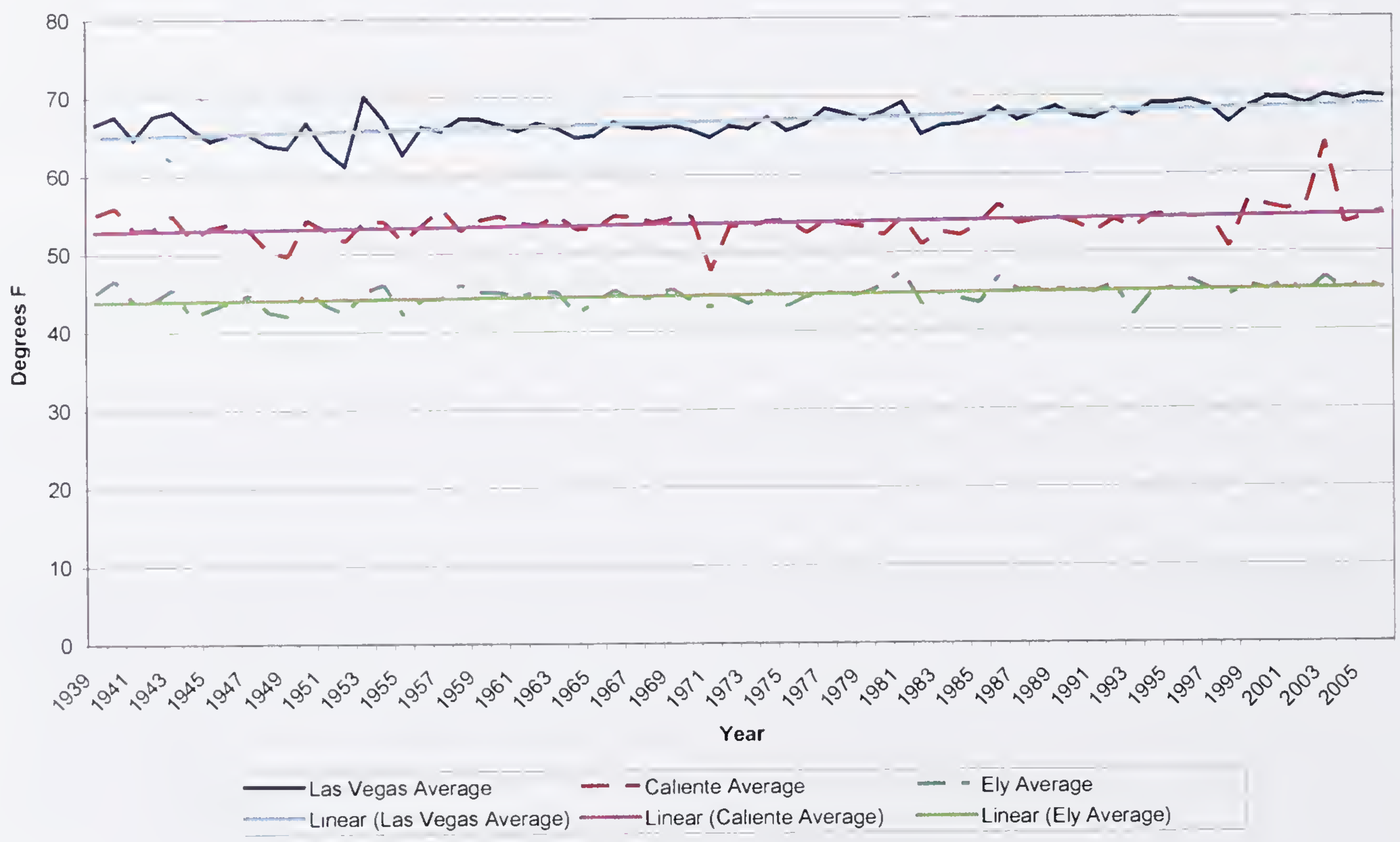


Figure 3.1-1 Annual Precipitation for Ely, Caliente, and Las Vegas with 5 Year Moving Average for



Caliente and Linear Trend Line

Figure 3.1-2 Average Annual Temperature 1938-2006, Las Vegas, Caliente, and Ely

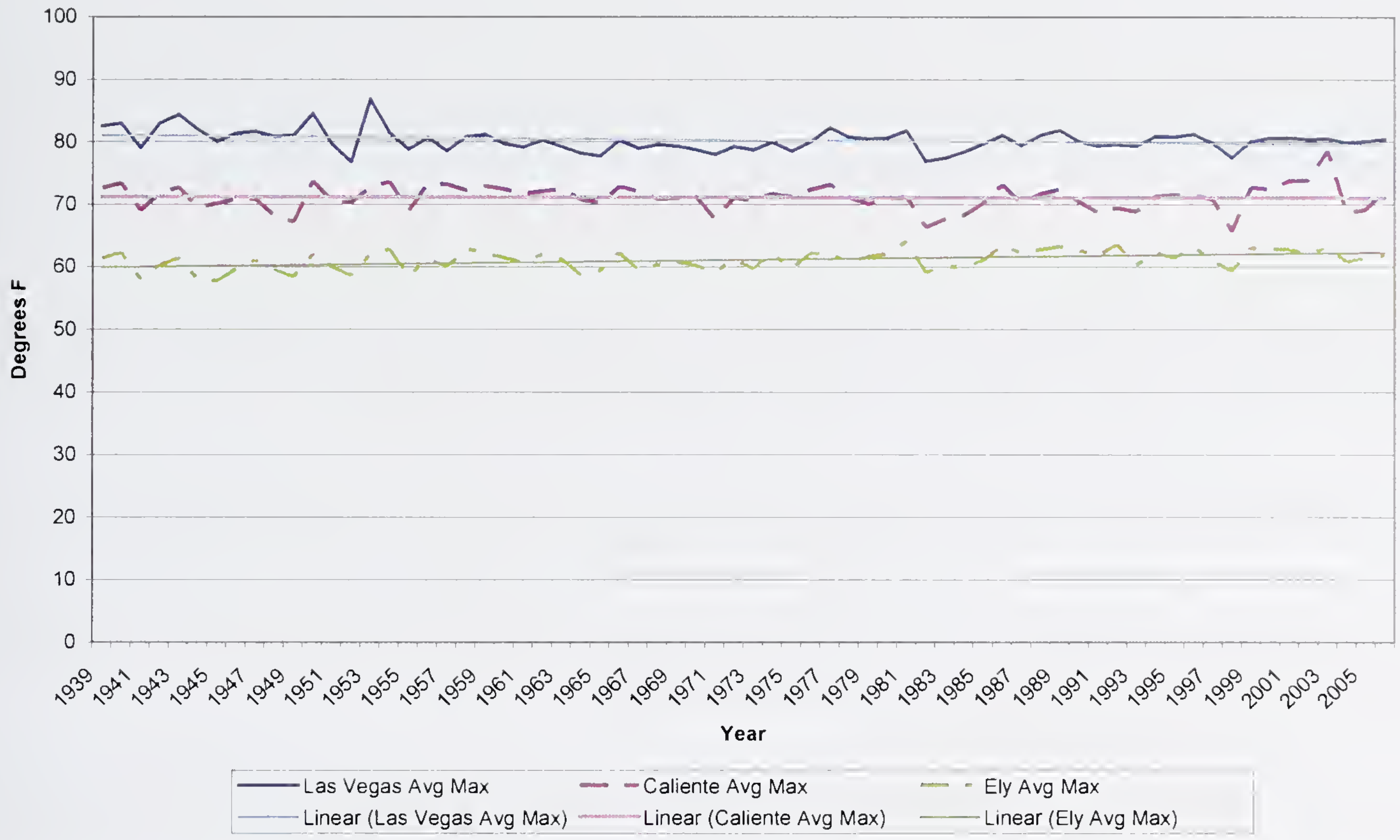


Figure 3.1-3 Annual Average Maximum Temperature 1938-2006, Las Vegas, Caliente, and Ely

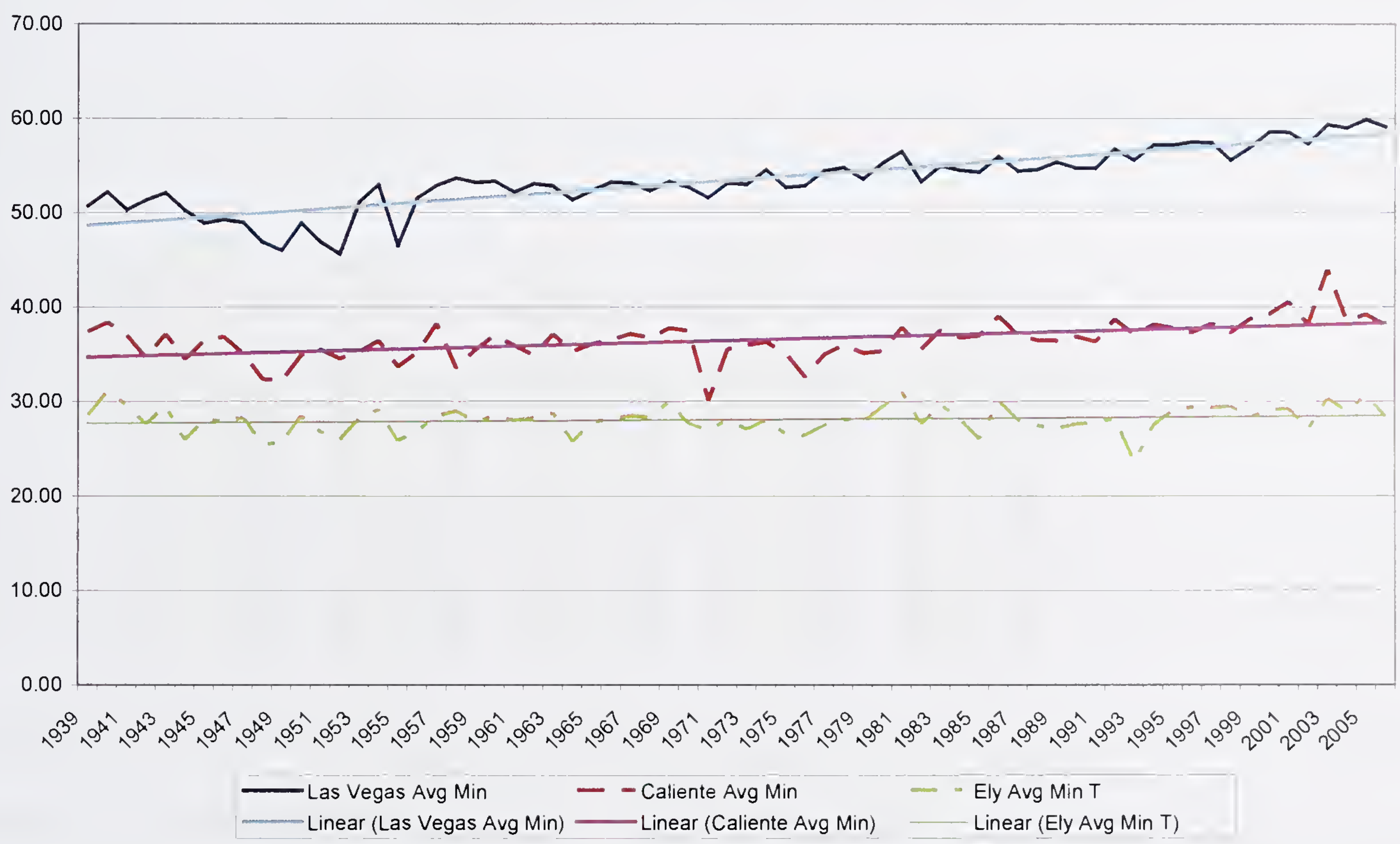


Figure 3.1-4 Annual Average Minimum Temperature 1938-2006, Las Vegas, Caliente, Ely

3.1.1.4 Climate Change Trends

Global Changes

Ongoing scientific research has identified the potential impacts of anthropogenic (man-made) greenhouse gas emissions and changes in biological carbon sequestration due to land management activities on global climate. Through complex interactions on a regional and global scale, these greenhouse gas emissions and net losses of biological carbon sinks (e.g., vegetation) could cause a net warming effect of the atmosphere, primarily by decreasing the amount of heat energy radiated by the earth back into space. Although greenhouse gas levels have varied for millennia, recent industrialization and burning of fossil carbon sources have caused carbon dioxide equivalent concentrations to increase dramatically, and are likely to contribute to overall global climatic changes. The Intergovernmental Panel on Climate Change recently concluded that "warming of the climate system is unequivocal" and "most of the observed increase in globally average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentration" (Intergovernmental Panel on Climate Change [IPCC 2007).

Global mean surface temperatures have increased nearly 1.8°F from 1890 to 2006. From the IPCC (2007), Global Climate Models indicate that average temperature changes are likely to be greater in the Northern Hemisphere. Northern latitudes (above 24 degrees north) have exhibited temperature increases of nearly 2.1°F since 1900, with nearly a 1.8°F increase since 1970 alone. Without additional meteorological monitoring systems, it is difficult to determine the spatial and temporal variability and change of climatic conditions, but increasing concentrations of greenhouse gases are anticipated to accelerate the rate of climate change.

In 2001, the IPCC indicated that by the year 2100, the global average surface temperatures would increase 2.5 to 10.4°F above 1990 levels. The National Academy of Sciences has confirmed these findings, but has also indicated there are uncertainties regarding how climate change may affect different regions. Global climate model predictions indicate that increases in temperature will not be equally distributed, but are likely to be accentuated at higher latitudes (IPCC 2007). Warming during the winter months is expected to be greater than increases in daily maximum temperatures. Increases in temperatures would increase water vapor in the atmosphere and reduce soil moisture, increasing generalized drought conditions, while at the same time enhancing heavy storm events. Although large-scale spatial shifts in precipitation distribution may occur, these changes are more uncertain and difficult to predict.

As with any field of scientific study, there are uncertainties associated with the science of climate change. This does not imply that scientists do not have confidence in many aspects of climate change science. Some aspects of the science are known with virtual certainty, because they are based on well-known physical laws and documented trends (USEPA 2008b).

Several activities contribute to the phenomena of climate change, including emissions of greenhouse gases (especially carbon dioxide [CO_2] and methane) from fossil fuel development, large wildfires, and activities using combustion engines; changes to the natural carbon cycle; and changes to radiative forces and surface reflectivity (i.e., albedo). It is important to note that greenhouse gases will have a sustained climatic impact over different temporal scales. For example, recent emissions of CO_2 can influence climate for hundreds of years.

It may be difficult to discern whether global climate change is already affecting resources, let alone the study area. In most cases, there is more information about potential or projected effects of global climate change on resources. It is important to note that projected changes are likely to occur over several decades to a century. Therefore, many of the projected changes associated with climate change described below may not be measurably discernable within the reasonably foreseeable future.

Existing and anticipated effects of climate change on regional natural resources and resource uses are described in the Historical Regional Climate and Predicted Future Trends sections.

Historical Regional Climate

The climate in the Southwest and Great Basin Desert is and historically has been highly variable due to their locations with respect to atmospheric circulation patterns and complex topography. Historic precipitation and temperature events have been assessed using many types of paleoclimate indicators, including tree-ring chronologies, packrat middens, pollen records, and oxygen 18 data from sediment cores.

Based on paleoclimate records, both the Southwest and Great Basin Desert have experienced several "megadroughts" over the last millennia (Mensing et al. 2008; Benson et al. 2002; Ni et al. 2002; Herweijer et al. 2007; Sheppard et al. 2002). Megadrought is defined as a drought with the severity of present-day major droughts, but lasting 20 to 40 years. Less severe, but longer lasting droughts of 100 years or more, also have been documented as occurring in the regions (Mensing et al. 2008; Benson et al. 2002; Sheppard et al. 2002). Generally, precipitation events simultaneously affect both the Southwest and the Great Basin Desert, such as the severe droughts documented in the late 1500s and 1950s (Benson et al. 2002; Ni et al. 2002; Swetnam and Betancourt 1998), and anomalously wet periods in the 1330s, 1610s, and the 1910s-1920s (Ni 2002; Schwinning et al. 2008).

As is discussed throughout this EIS, the timing, amount, and form of precipitation are important factors for groundwater recharge rates, and temperature plays an important role in the form of precipitation. Temperature records typically have an inverse relationship to precipitation (i.e., lower temperatures during periods of higher than normal precipitation). This pattern is consistent with observed present day climate influenced by the El Nino/La Nina cycles (Jin et al. 2006; Sheppard et al. 2002; Cayan et al. 1999). Evidence suggests that multi-decade periods of warmer or cooler than normal temperatures have been increasing in their severity since the 1700s and temperature is increasing to an unprecedented extent in the last 400 years (Sheppard et al. 2002).

A historical analysis of temperature in White Pine County conducted by Redmond (2009) indicates that decadal means since the late 1990s are higher than any other decadal mean on record, with spring time temperatures rising more than other seasons. Data from 1948 to 2009 were used to analyze seasonal changes in freezing levels in White Pine County (Redmond 2009) and spring is the season that shows the greatest rise in the freezing level. Spring time temperatures and freezing levels are important considerations for the timing and rate of spring snowmelt and the manner that snow is converted into soil moisture, groundwater, and streamflow.

State-wide decadal precipitation has increased in Arizona, New Mexico, Utah, and Nevada each 30-year "normal" period from 1930 through 2000 as shown in **Figure 3.1-5**[7]. The measured average annual precipitation has increased approximately 1 to 1.5 inches in each state over this 70-year period. Precipitation has changed the least amount in Utah, while precipitation in New Mexico increased the most over this same period of time. Annual average 30-year normal state-wide precipitation increased by 1.25 inches in Nevada.

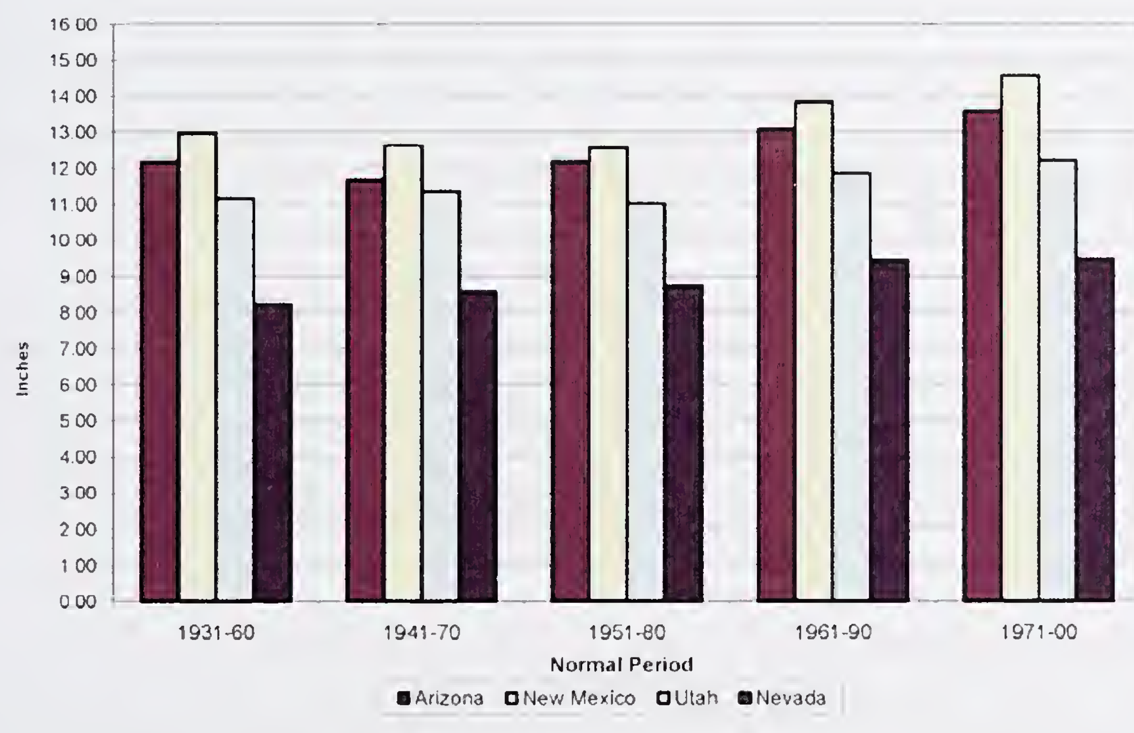


Figure 3.1-5 Southwest Statewide Normal Precipitation, 1931 to 2000

[7] These statewide averages are obtained as follows: Each state is divided into climate divisions and an average precipitation value is calculated for each division. These division averages are then weighted by the amount of area within each division. Source: National Climatic Data Center, Historical Climatography Series 4-2. http://www.wrcc.dri.edu/htmlfiles/avgstate.ppt.html.

Predicted Future Trends

Temperature

Temperatures in North America are projected to increase with a greater than 66 percent probability (Christensen et al. 2007). Global climate models predict that temperatures in the western U.S. will increase between 4.5 to 10.8°F, relative to pre-1900 levels, over the next 100 years (Christensen et al. 2007). Seasonally, warming is likely to be the largest in the summer for the American Southwest. Model-predicted temperatures in the Great Basin are anticipated to increase as well; however, the change in temperature is not predicted to be as large as the predicted changes in the Southwest. It is predicted that warm extremes will be more frequent and last longer (Field et al. 2007).

The Redmond report (Redmond 2009) analyzed results from 15 different global climate models with grid resolutions of about 2x2 degrees of latitude/longitude (approximately 140x100 miles) containing Spring Valley. The 15 global climate models all were in agreement that temperatures in Spring Valley will likely increase for all seasons relative to the 1971-2000 period. The magnitude of this increase varied by model; however, the median increase for all 15 models suggest that annual average temperature in Spring Valley will increase approximately 7.2°F in the next century.

Monitored temperatures in valleys within the region of study during the last 65 years generally support global climate model predictions for the Great Basin. Temperature records are widely available for much of the 20th century. As shown in **Figure 3.1-2**, these records demonstrate that annual average temperatures have increased between 1° and 4°F in the region of study. In addition to this change in monitored annual average temperature, the largest temperature changes in the region of study have been between1° to 10°F increases in the annual average minimum temperatures over the last 65 years, which are shown in **Figure 3.1-4**. At the three monitoring stations examined, the largest change in seasonal warming occurred during the winter months. This trend differs from Christensen et al. (2007) prediction that the largest change in warming in the southwest would occur during the summer season.

Precipitation

The confidence in precipitation predictions for the Southwest is somewhat weaker than the confidence in temperature predictions. This is primarily due to the complexity of circulation patterns bringing moisture to the area. Generally, global climate models predict that arid regions of the world will experience decreased precipitation levels and the Southwest is no exception (Christensen et al. 2007; Seager et al. 2007). The available moisture (precipitation minus evaporation) in the Southwest is predicted to decrease by 0.01 to 0.18 millimeters per day relative to available moisture during the period 1950-2000, with an average decrease of 0.1 millimeters per day. This change is predicted to occur sometime mid-21st century, with a quarter of the global climate models predicting this decrease over the next several decades (Seager et al. 2007). As a reference, precipitation between 1948 and 1957 (the 1950s drought) decreased by 0.13 millimeters per day, indicating that the recent year droughts may become the new baseline level of precipitation. As shown in **Figure 3.1-1**, monitored precipitation at sites in the Great Basin region has shown an increased level of precipitation relative to the 1948-1957 drought.

The Redmond report (Redmond 2009) analyzed results from 15 global climate models with grid resolutions of about 2x2 degrees of latitude/longitude (approximately 140x100 miles) containing Spring Valley. The 15 global climate models generally agreed that there will be no net annual change in precipitation in Spring Valley in the next century. However, the seasonal distribution of precipitation could potentially change. Using the Spring Valley data as a proxy, the Redmond report (Redmond 2009) concludes that the Great Basin is likely to experience an increase in winter precipitation amount in the latter part of the 21st century, which may be offset by reduced precipitation in the spring and summer seasons (Redmond 2009).

Water Availability (Combination of Precipitation and Temperature)

There is a high level of confidence that due to increasing temperatures, western mountains will experience a change in the timing, amount, and form of precipitation (Field et al. 2007). The Great Basin region might not see any change in the amount of annual precipitation (neither an increase nor decrease, which is supported by the Redmond report [2009]); however, water resources still could be diminished due to the higher temperatures alone (affecting evaporation, transpiration rates, etc.) (Christensen et al. 2007). The distribution of precipitation over the year is important for plant growing cycles and water availability. Generally, it is predicted (with >66 percent probability) that summertime precipitation in the Southwest associated with the North American Monsoon System will be reduced as the circulation system is forced northward due to differences in land/sea heating (Christensen et al. 2007). How this will impact the Great Basin Desert (located to the north of the Southwest) is dependent upon how far to the north the North American Monsoon is displaced. Wintertime precipitation in the Great Basin Desert typically is in the form of snow, and the accumulation and timing of snow melt are important for ecological and economic resources. It is predicted that there will be a decline in snowpack associated with warmer temperatures due to a latter onset and earlier spring melting (Field et al. 2007). A declining snowpack already has been documented in much of the western U.S. (Miller and Piechota 2008; Pierce et al. 2008; Jin et al. 2006; McCabe and Wolock 1999; Regonda et al. 2005).

Anticipated effects of climate change on resources and resource uses in the region of study are described and analyzed in Section 3.1.3, Climate Change Effects. The following resources have been or are anticipated to be affected by climate change: air quality, aquatic resources, range and livestock grazing/wild horses and burros, soil, vegetative communities, water resources, wildlife, and wildland fire ecology and management.

3.1.2 Environmental Consequences

3.1.2.1 Rights-of-way

Issues

- Air pollutants emitted from the tailpipes of construction equipment, including criteria pollutants, ozone precursors, and greenhouse gas emissions.
- Fugitive dust generated during construction and facility maintenance.
- Windblown dust generated due to wind erosion of disturbed surfaces.
- Impairment of visibility conditions at the GBNP.
- Conformity requirements in nonattainment areas.
- Entrainment and transport of radioactive material and erionite due to wind erosion of disturbed surfaces.

Assumptions

Assumptions regarding compliance with regulatory requirements, detailed project operations, inputs for emission factors, and future conditions are required to estimate impacts to air quality and climate.

Key assumptions regarding compliance with regulatory requirements include:

- All state and local air quality construction permits will be received prior to initiation of project construction.
- Any operating permits or dust control plans required in nonattainment areas will address conformity requirements or demonstrate that total emissions in nonattainment areas will be below applicable thresholds.

In order to estimate emission rates of air pollutants and greenhouse gases, two types of data are required: activity data and emission factors. To develop activity data, several operational assumptions were necessary due to a lack of detailed project information at this stage. Additionally, in some cases, site-specific information is required to select the appropriate emission factors. The following assumptions will be revised, as required, based on project-specific data during the permit application phase:

- For tailpipe emissions from construction equipment, assumptions include:
  - All construction equipment, except for pick-up trucks, will consume ultra low sulfur diesel fuel. Pick-up trucks are assumed to be equivalent to light-duty, gasoline powered, passenger vehicles.
  - Construction activities will occur for 12 hours per day, 6 days a week, 50 weeks per year.
  - Not all pieces of construction equipment will operate simultaneously. At any given time, roughly a third of the equipment will be operating; thus, it is assumed that each piece of equipment operates 4 hours out of a 12-hour construction day. This is a conservative approach since a particular piece of equipment, such as a crane, has a very specific function and must remain on-site to perform this function, but this function is not required to occur continuously.
  - Pick-up trucks used for transporting crew and as lead cars for road closers will make 2 trips per hour on average over a 12-hour work day (24 trips per day). Each trip is assumed to be 4 miles on average.
  - Emission factors for year 2012 are used since this is predicted to be the first year of construction. Future years are anticipated to have lower emission rates due to federal and state emission reduction programs for mobile equipment.
- For fugitive dust from construction and maintenance, assumptions include:
  - One mile of pipeline and 1 mile of power line are under active construction per day. With the requested ROWs for construction, this equates to 36 acres per day. This is a conservative assumption for the purposes of estimating the maximum daily emissions of fugitive dust from construction equipment.

- For ancillary facilities, 2.5 acres are actively being constructed per day. This is a conservative assumption for the purposes of estimating the maximum daily emissions of fugitive dust from construction equipment.
- For the purposes of estimating the $PM_{2.5}$ emissions associated with construction fugitive dust, the USEPA recommends that 10 percent of the PM_{10} is in the $PM_{2.5}$ size range (USEPA 1998; Western Regional Air Partnership [WRAP] 2005, 2006).
- A control efficiency of 50 percent is assumed for purposes of emission calculations based on the ACM described in Chapter 2.5. Controls will be described in the dust control plan.
- Maintenance of equipment is independent of pumping (e.g., once the facilities are built they will require maintenance regardless of groundwater pumping actions). It is assumed that the ROW facilities will be regularly maintained and a light-duty truck will travel the length of the pipeline and power line once per month.

- SNWA would be required to implement a comprehensive COM Plan that would include all future hydrographic basins and all facilities associated with the SNWA GWD Project. The COM Plan includes a requirement for comprehensive monitoring and mitigation program for the entire project that would integrate the various required monitoring and mitigation actions. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary, along with measures to protect air resources from ROW construction and operation activities.

Methodology for Analysis

For the estimation of air quality related impacts, the methodology depends on the activity (construction equipment, windblown dust, etc.) and the type of air impacts (criteria emissions, greenhouse gases, etc.). The activity/air impact combinations are grouped together based on the issues identified above. The calculation methodology for each activity impacting air quality is described below.

Tailpipe Emissions from Construction Equipment and Facility Maintenance

Tailpipe emissions from construction are based on equipment-specific emission factors, the equipment type, the number of each type of equipment, and estimated hours of operation. At any given time, roughly a third of the equipment will be operating; thus, it is assumed that each piece of equipment operates 4 hours out of a 12-hour construction day. Equipment-specific emission factors are from the California Environmental Quality Act, Air Quality Handbook (South Coast Air Quality Management District 2010). The estimated amount and type of construction equipment is provided in the POD in **Appendix E**, Tables 4-3, 4-4, and 4-5 for the pipeline, power line, and ancillary facilities, respectively. The hours of operation were calculated based on assumptions regarding typical construction activities.

Tailpipe emissions from maintenance vehicles are calculated the same as for construction equipment. Emissions are based on the emission factors for light-duty passenger vehicles (South Coast Air Quality Management District 2010) and the calculated maintenance trips.

Fugitive Dust Emissions from Construction Equipment and Facility Maintenance

Fugitive dust is lofted into the air by construction equipment during many types of activities: driving over unpaved surfaces, excavation of top soil and rock, and transfer of excavated material from one place to another, etc. The USEPA has developed a generic emission factor for fugitive dust that includes all construction activities (USEPA 1995). The emission calculations for fugitive dust associated with ROW construction activities are based on the estimated acres of land actively undergoing construction and emission factors for heavy construction operations from the USEPA (USEPA 1995). The estimate of area actively constructed on includes the pipeline ROW plus the temporary ROW, power line ROW, temporary construction staging areas and access roads, and other ancillary facilities. However, all this area is not undergoing construction simultaneously; for the purposes of project emission calculations, it is estimated that approximately 40 acres per day (36 acres for pipelines and power lines, and 2.5 acres for ancillary facilities) are under active construction. Fugitive dust emissions during construction will be controlled as specified in the required dust control plan. For the purposes of emission calculations, the estimated fugitive dust emissions are assumed to be reduced by 50 percent through use of appropriate control measures.

Fugitive dust from maintenance of project facilities is expected to be minimal. As a result, emissions calculations were not performed; impacts were qualitatively compared with fugitive dust generated by construction activities.

Wind Erosion from Disturbed Surfaces

In addition to fugitive dust that is lofted into the air from construction equipment, construction activities disturb the soil surface, leaving the surface susceptible to wind erosion. Emissions calculations for windblown dust are based on the total estimated acres of land disturbed from construction and the PM_{10} emission factor for wind erosion from the Clark County Wind Tunnel Study (Wacaser et al. 2006). The $PM_{2.5}$ size range is estimated based on USEPA guidance (USEPA 1998; WRAP 2005, 2006), whereby 10 percent of the PM_{10} is in the $PM_{2.5}$ size range.

Conformity Requirements in Nonattainment Areas

As described in Section 3.1.1.1 and **Appendix F3.1**, portions of Clark County, Nevada, and Tooele County, Utah, are designated nonattainment or maintenance for one or more federally regulated pollutants.[8] On September 27, 2010, Clark County (Hydrographic area 212) was re-designated as attainment for carbon monoxide (CO) by the USEPA. March 31, 2011, USEPA published a final rule determining that the Clark County, Nevada, nonattainment area has attained the 1997 8-hour ozone National AAQS and that Clark County is currently attaining the ozone 8-hour standard. On August 3, 2010, USEPA published a final rule determining that the Las Vegas Valley nonattainment area has attained the National AAQS for PM_{10} by the applicable attainment date (December 31, 2006), and that the Las Vegas Valley nonattainment area is currently attaining the standard. However, until the USEPA officially re-designates Clark County as attainment for PM_{10} and ozone, project activities in the hydrographic basins in Clark County must continue to meet conformity requirements. Portions of Tooele County, Utah, are designated nonattainment for sulfur dioxide (SO_2). There are no areas of the ROW that extend into Utah; therefore, Utah nonattainment designations are not considered in the evaluation of the ROW impacts.

Since the project is predicted to emit all of these emissions (or precursors in the case of ozone), a conformity review was conducted based on U.S. Department of Energy (USDOE) guidance (USDOE 2000). To conduct the conformity review, the impact of the project ROW construction and facility maintenance activities was assessed in the nonattainment areas and maintenance areas. The nonattainment and maintenance areas are a small subset of the whole project area. Emissions in these nonattainment and maintenance areas were calculated using the methodology described above for tailpipe emission and fugitive dust emissions, except calculations were limited to the nonattainment and maintenance areas. Estimated emissions were compared with the emissions threshold for conformity determinations as published by USDOE (2000).

Radionuclides and Erionite

There is not anticipated to be re-suspension and transport of radionuclides from past nuclear testing at levels considered to be harmful to human health. Erionite has not been identified in the project area and is not expected to be an air contaminant resulting from project activities. For more information on these compounds, please refer to Sections 3.2, Geologic Resources, and 3.4, Soil Resources.

3.1.2.2 Proposed Action, Alternatives A through C

The development associated with the primary pipeline and power line ROWs would be the same for the Proposed Action and Alternatives A through C. The proposed development within the ROW areas is described in detail in Chapter 2. Chapter 2 also provides estimates of surface disturbance from construction related activities. In summary, the development would include construction of 306 miles of pipeline, 323 miles of overhead power lines, and two primary and five secondary electrical substations. Ancillary facilities that would be developed include five pumping stations, six regulating tanks, three pressure reducing stations, a water treatment facility, a buried storage reservoir, access roads, and communication facilities.

[8] Attainment, maintenance, and nonattainment designations as described throughout the text are based on the current status of these areas as of April 4, 2011.

The proposed GWD Project would generate air emissions through short-term construction activities. Construction air emissions include criteria pollutants, ozone precursors, fugitive dust, and greenhouse gas emissions. The actual fugitive dust emissions would depend on many site-specific factors such as the moisture content and texture of the soils that would be disturbed. Continued air quality impacts due to wind erosion of surfaces disturbed during construction will occur, at decreasing levels, until most surfaces are revegetated.

Emissions from all phases of construction would be subject to applicable state, local, and federal air regulations.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on air resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

Construction and Facility Maintenance

Tailpipe Emissions from Construction Equipment and Facility Maintenance

Localized air quality emissions at a given location due to construction activities are expected to be short term, which is consistent with the project schedule shown in **Figure 2.5-7**. Short-term impacts are defined as being 5 years or less for all resources. Emissions from construction equipment will be controlled by following state and local regulations. As part of the ACMs, the SNWA will complete a final POD (ACM A.1.1), which will detail actual construction control measures as part of a Construction Plan and a Dust Control Plan (ACM A.10.1). In addition, operating permits for stationary sources, such as aggregate handling equipment, and operating permits for major combustion sources, such as engines greater than 250 horsepower, will be obtained prior to construction activities (ACMs A.10.4 and A.10.5). The development of a Construction Traffic Management Plan (ACM A.1.28) with measures to reduce the number of construction trips will also reduce air emissions from construction transportation vehicles.

Based on the POD presented in **Appendix E**, the proposed construction equipment is comprised primarily of heavy-duty, non-road mobile equipment powered by diesel fuel. Only pick-up trucks will operate on gasoline rather than diesel fuel. Emissions from diesel engines would be minimized because engines must be built to meet the standards for mobile sources established by the USEPA mobile source emissions regulations (40 CFR Part 85). In addition, the USEPA is requiring that the maximum sulfur content of diesel fuel for highway vehicles be reduced from 500 ppm by weight (ppmw) to 15 ppmw, making ultra low sulfur diesel available nationwide.

Table 3.1-9 shows the construction emissions for each criteria pollutant, ozone precursors, and greenhouse gases that are estimated to result for the Proposed Action and Alternatives A through C.

Greenhouse gas emissions from construction would be short term and have an inconsequential contribution to long-term global climate change. For context, the estimated greenhouse gas emissions from construction equipment (in carbon dioxide equivalent) are less than 0.00045 percent of the carbon dioxide equivalent estimated to be emitted in 2010 by the U.S. (USEPA 2012b) , and 0.04 percent of the of the carbon dioxide equivalent estimated to be emitted in the state of Nevada in 2005 (NDEP 2008). The total estimated annual emissions of carbon dioxide equivalent associated with construction activities are approximately 24,000 metric tons, which is less than the recommended threshold of 25,000 metric tons, a USEPA reporting threshold for certain industrial and intensive agricultural activities (40 CFR 98.2; 74 FR 56374).

The estimated emissions published in **Table 3.1-9** are based on very general information and cover the whole project area. In many cases the assumptions lead to a large over-prediction of the values. Therefore, it is reasonable to assume that the actual emissions would potentially be much lower than is reported in **Table 3.1-9**. Emissions will be calculated as required for project permits and will comply with applicable local, state, and federal air regulations. Emissions from construction are not expected to cause or contribute to exceedences of any AAQS. Emissions from construction are not expected to impair visibility conditions at GBNP.

While most emissions shown in **Table 3.1-9** are expected to be short-term in duration and impact local air quality only during periods of construction, the emissions from maintenance vehicles are anticipated to last the life of the project.

Table 3.1-9 Emissions from Right-of-way Construction Equipment for Proposed Action, Alternatives A through C

Source	CO		VOC		Nitrogen Oxides (NO_X)		SO_2		PM_{10} and $PM_{2.5}$		Carbon Dioxide Equivalent	
	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Metric Tons per Year
Pipeline Construction Equipment Operations	254	38.1	75	11.3	608	91.3	0.69	0.10	29	4.3	64,514	8,777
Power line Construction Equipment Operations	86	12.9	26	3.8	220	33.1	0.27	0.04	10	1.4	25,541	3,475
Facilities Construction Equipment Operations	297	44.5	88	13.3	723	108.5	0.83	0.12	33	5.0	78,157	10,634
Construction Transportation Vehicles	56	8.3	6	0.9	6	0.9	0.07	0.01	0.60	0.09	7,420	1,009
Maintenance Vehicles	0	0.1	0	0.0	0	0.0	0	0.0	0	0.0	55	8
Total Tailpipe Emissions[1]	**693**	**104**	**195**	**29**	**1,558**	**234**	**2**	**0.3**	**72**	**11**	**175,688**	**23,903**

[1] Totals are rounded.

Note: Construction and permanent acreage numbers in the table include a minimal acreage of facilities that currently exist. Therefore the reported acreages conservatively overestimate the amount of disturbance anticipated by the proposed project by approximately 1 percent across all alternatives.

Conclusion. Localized air quality emissions due to construction activities are expected to be short term (5 years or less). Conservative assumptions were used to estimate tailpipe emissions from construction and maintenance vehicles. Based on these assumptions, the potential annual emissions vary from less than 1 ton per year of SO_2, to approximately 24,000 metric tons of carbon dioxide equivalent. Emissions from construction are not expected to cause or contribute to exceedences of any AAQS nor impair visibility conditions at GBNP because the construction equipment would be operated in accordance with required permits on an as-needed-basis over a large project area.

Application of the ACMs to obtain required air permits should minimize the potential impacts to local air quality and ensure protection of applicable AAQS. Although the ACMs would minimize air quality impacts, some criteria pollutants may have elevated concentrations locally.

Proposed mitigation measures:

None.

Residual impacts include:

In close proximity to construction sites, some criteria pollutants may have elevated concentrations relative to current background conditions; however, any elevated concentrations are expected to be limited to construction areas, be short-term in duration, and below applicable AAQS. Long-term impacts to air quality from maintenance vehicles are minimal and range from close to 0 tons per year of SO_2 up to approximately 8 metric tons per year of carbon dioxide equivalent.

Fugitive Dust from Construction and Facility Maintenance Activities

Construction of the proposed pipeline and ancillary facilities would result in intermittent and short-term fugitive emissions. Dust control permits (required in Clark County) and Surface Area Disturbance permits (required in Lincoln and White Pine counties) will be obtained prior to construction activities (ACMs A.1.1 and A.10.1). Dust control permits require a Dust Control Plan and description of all the BMPs that will be used to minimize fugitive dust from construction. The Dust Control Plan will detail the use and application of an approved dust suppression method (ACMs A.10.1 and A.10.3). The application of a dust suppressant (e.g., water, or appropriate tackifier) will be added to active construction sites (ACM A.10.6), unpaved roads (ACM A.10.6), and soil stockpiles (ACM A.10.8). In addition to these ACMs specifically designed to protect air resources, there are several ACMs developed for other purposes (e.g., protection of other resources, safety, etc.) that also will control fugitive dust from construction and maintenance activities. Additional ACMs that will reduce fugitive dust emissions include: crushing rather than removing vegetation when possible (ACM A.1.20), the development of a Construction Traffic Management Plan (ACM A.1.28), limiting the vehicle speeds on unpaved roads (ACM A.1.29), and minimization and removal of dust from paved surfaces (ACMs A.1.33 and A.1.34).

The fugitive dust emissions associated with active construction activities can be calculated by making conservative assumptions of daily construction rates. A rate of construction of 1 mile per day was assumed for the pipeline and 1 mile per day for the power line. This assumption results in a conservatively high estimate of emissions of fugitive dust. When this assumed construction rate is combined with the requested permanent and temporary construction ROW width, a total of 36 acres is under active construction on any given day. In addition, it is assumed that 2.5 acres for building required ancillary facilities are under active construction on any given day. Altogether, approximately 40 acres per day are under active construction. Based on this estimate, the total fugitive dust emission rate can be calculated by multiplying the active construction area by the appropriate emission factor for uncontrolled heavy construction operations (USEPA 1995). By applying water or other dust suppressants as an ACM (ACM A.10.6), potential emissions may be reduced 50 to 80 percent. For the purposes of estimating emissions, it is assumed that ACM A.10.6 will control fugitive dust emissions by 50 percent. Based on these calculations and assumptions, it is estimated that 1,172 pounds per day of PM_{10} (176 tons per year) and 117 pounds per day of $PM_{2.5}$ (18 tons per year) will be emitted in the project area due to fugitive dust during construction activities.

Emissions from construction activities would be restricted to the short-term construction period along the pipeline and power line routes or near the proposed locations of ancillary facilities. In close proximity to construction sites and the ROW, there may be elevated concentrations of PM relative to current background conditions. Any elevated concentrations are expected to be limited to areas in close proximity to construction and the ROW, be short-term in duration, below applicable AAQS, and not impair visibility conditions at GBNP. Construction impacts would diminish once construction activities end.

Fugitive dust from maintenance of project facilities is expected to be minimal. Tailpipe emissions from maintenance vehicles were estimated to be approximately 1 percent of tailpipe emissions from construction transportation vehicles. Similarly, it is anticipated that fugitive dust from maintenance will be one percent of the construction fugitive dust. Therefore, it is estimated that 1 ton per year of PM_{10} and 0.1 ton per year of $PM_{2.5}$ will be emitted in the project area due to fugitive dust associated with maintenance vehicles. At these low levels, fugitive dust emissions from maintenance vehicles are expected to be below applicable AAQS and not impair visibility conditions at the GBNP. Emissions from maintenance activities are anticipated to be long-term (lasting the life of the project).

Conclusion. Localized fugitive dust emissions due to construction activities are expected to be short term (5 years or less). Conservative assumptions were used to estimate fugitive dust emissions from construction activities. Based on these assumptions, it is estimated that 1,172 pounds per day of PM_{10} (176 tons per year) and 117 lbs/day of $PM_{2.5}$ (18 tons per year) will be emitted in the project area. In close proximity to construction sites and the ROW, there may be elevated concentrations of PM relative to current background conditions. Any elevated concentrations are expected to be limited to areas in close proximity to construction and the ROW, be short-term in duration, below applicable AAQS, and not impair visibility conditions at GBNP.

Localized fugitive dust emissions due to maintenance activities are expected to continue for the life of the project. It is estimated that 1 ton per year of PM_{10} and 0.1 ton per year of $PM_{2.5}$ will be emitted in the project area due to fugitive dust associated with maintenance vehicles. At these low levels, fugitive dust emissions from maintenance vehicles are expected to be below applicable AAQS and not impair visibility conditions at the GBNP.

Application of the ACMs to develop a Dust Control Plan and obtain required air permits should minimize the potential impacts to local air quality and ensure protection of applicable AAQS. Although the ACMs would minimize impacts from fugitive dust, areas in close proximity to construction sites and the ROW may experience elevated concentrations of PM during periods of construction or maintenance activities.

Proposed mitigation measures:

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on air resources.

The following proposed mitigation measures are not currently addressed in SNWA's ACMs and are intended to bring SNWA's ACMs into conformance with the BLM RMPs.

ROW-AQ-1: Project Road Inspections to Reduce Wind and Water Erosion. The SNWA and the BLM's Environmental Compliance Monitor would inspect project roads in areas prone to air and water erosion bi-weekly during construction, or more frequently during periods of adverse weather conditions. Repairs would be completed within 5 working days of notification to the SNWA or sooner depending on public safety and the nature of the issue detected. SNWA would make a photographic documentation of the road condition prior to and immediately after road repairs. Effectiveness: This mitigation measure would be very effective at reducing construction related fugitive dust impacts. Implementation of this mitigation measure combined with other federal and state requirements, would likely result in a substantial reduction of short-term fugitive dust impacts. Effects on other resources: This mitigation measure would have a small (negligible) increase in vehicular traffic along the ROW during construction activities.

ROW-AQ-2: **Alternative Dust Control Measures**. Areas where soil tackifiers are prohibited (e.g., threatened and endangered species habitat, perennial stream drainages) would be determined in cooperation with the BLM and the USFWS prior to construction, and identified in both the Construction and Mitigation Plans. Other mitigation (e.g., gravel application) may be required to reduce impacts and to ensure protection of public safety. This measure would supplement SNWA ACM A.10.3. Effectiveness: This mitigation measure would be moderately effective at reducing construction related fugitive dust impacts. Implementation of this mitigation measure combined with other federal and state requirements, would likely result in a noticeable reduction of short-term fugitive dust impacts. Effects on other resources: This measure would have a minor positive effect on threatened and endangered species habitat by reducing dust cover and on sensitive aquatic species by reducing water contamination by chemicals.

Residual impacts include:

Implementation of the federal and state requirements, ACMs, and proposed mitigation measures should effectively mitigate fugitive dust impacts to air quality. It is estimated that 1 ton per year of PM_{10} and 0.1 ton per year of $PM_{2.5}$ will be emitted long-term in the project area due to fugitive dust associated with maintenance vehicles. In close proximity to construction sites and the ROW, there may be elevated concentrations of PM relative to current background conditions; however, any elevated concentrations are expected to be limited to areas in close proximity to construction and the ROW, be short-term in duration, and below applicable AAQS.

Wind Blown Dust from Disturbed Surfaces

Construction of the proposed pipeline and ancillary facilities would result in tracts of disturbed surfaces that are prone to wind erosion. Dust control permits (required in Clark County) and Surface Area Disturbance permits (required in Lincoln and White Pine counties) will be obtained prior to construction activities (ACMs A.1.1 and A.10.1). Dust control permits require a Dust Control Plan and description of all the BMPs that will be used to minimize windblown dust from disturbed surfaces. The Dust Control Plan will detail the use and application of an approved dust suppression method (ACMs A.10.1 and A.10.3). The application of a dust suppressant (e.g., water, or appropriate tackifier) will be added to active construction sites (ACM A.10.6), unpaved roads (ACM A.10.6), and soil stockpiles (ACM A.10.8). Since the generation of windblown dust is strongly dependent on wind speed, the Dust Control permit will include measures for assessing the need to stop work or increase dust control measures based on wind and/or air quality monitoring (ACMs A.10.2 and A.10.7).

In addition to these ACMs specifically designed to protect air resources, there are several ACMs developed for other purposes (e.g., protection of other resources, safety, etc.) that will also control windblown dust from disturbed surfaces. Additional ACMs that will reduce windblown dust include: crushing rather than removing vegetation when possible (ACM A.1.20), minimization and removal of dust from paved surfaces (ACMs A.1.33 and A.1.34), and the development of a Restoration Plan (ACM A.1.69).

Based on the estimated total acres of surface disturbed during construction of ROW and ancillary facilities (12,303 acres) and the Clark County emission factors for windblown dust of open exposed land (0.01 tons PM_{10} per acre-year) (Wacaser et al. 2006), the total windblown dust emission rate can be calculated. Given the level of ACMs aimed to minimize windblown dust, it is reasonable to assume a 50 percent control efficiency will be obtained. By multiplying the emission factor by the estimated total acres of disturbed surface and applying a 50 percent control efficiency, a maximum PM_{10} emission rate for the project is approximately 62 tons PM_{10} per year. For the western region, it is a conservative assumption that $PM_{2.5}$ is 10 percent of PM_{10} (WRAP 2005, 2006). Therefore, the $PM_{2.5}$ emission rate is estimated to be 6 tons per year. At these levels, windblown dust emissions from disturbed surfaces associated with ROW construction are not expected to impair visibility conditions at the GBNP.

Windblown dust impacts would diminish once construction activities end and after disturbed areas are reclaimed. Revegetation measures will be conducted as part of the reclamation process (ACM A.1.69). Disturbed soils would be protected by mulches and other surface treatments as specified in the approved POD, thereby reducing the risk of wind erosion.

Emission impacts from facility maintenance would be much less than those impacts during the construction phase. Only 1,014 acres (primarily access roads) of the original 12,303 acres of disturbed surfaces would remain prone to wind erosion. Long-term windblown dust impacts would be approximately 8 percent (1,014 acres ÷ 12,303 acres) of the estimated maximum windblown dust impacts. Therefore, the long-term PM_{10} emission rate is estimated to be 5 tons per year and the $PM_{2.5}$ emission rate is estimated to be 1 tons per year over the project area. Windblown dust emissions from disturbed surfaces associated with ROW construction and maintenance are not expected to impair visibility conditions at the GBNP.

Conclusion. A majority of the windblown dust emissions due to surfaces disturbed due to construction are expected to be short term (5 years or less) until surfaces are revegetated. It is estimated the short-term PM_{10} windblown dust would be 62 tons per year and the $PM_{2.5}$ windblown dust would be 6 tons per year over the whole project area. The windblown dust over the ROW areas that will not be revegetated (and the impacts are therefore long-term) is estimated to be 5 tons per year of PM_{10} and 1 tons per year of $PM_{2.5}$ near the permanent ROW. Windblown dust emissions from disturbed surfaces are not expected to impair visibility conditions at the GBNP.

Application of the ACMs to develop a Dust Control Plan and obtain required air permits should minimize the potential impacts to local air quality and ensure protection of applicable AAQS. Although the ACMs would minimize impacts from windblown dust, areas in close proximity to construction sites and the ROW may experience elevated concentrations of PM during periods of high winds.

Proposed mitigation measures:

None.

Residual impacts include:

Implementation of the federal and state requirements and ACMs should effectively mitigate windblown dust impacts to air quality in the short-term. Revegetation measures should effectively mitigate of windblown dust impacts to air quality in the long-term. The long-term windblown dust over the permanent ROW areas, which will not be revegetated, is estimated to be 5 tons per year of PM_{10} and 1 tons per year of $PM_{2.5}$. There may be elevated concentrations of PM relative to current background conditions caused by windblown dust near the permanent ROW; however, any elevated concentrations are expected to be limited to areas in close proximity to the ROW, be short-term in duration, below applicable AAQS, and not impair visibility conditions at GBNP.

Conformity Review for Nonattainment Areas

For areas classified as nonattainment or maintenance, a conformity review is required. To conduct the conformity review, emissions from ROW construction and facility maintenance activities predicted to occur in the nonattainment areas and maintenance areas were calculated. The nonattainment and maintenance areas are a small subset of the whole project area (see **Appendix F3.1** for more information regarding attainment classifications and pending redesignations). As part of the conformity review, the emission rates of the project are compared with thresholds defined in 40 CFR 93.153(b). If the project emissions exceed the thresholds, a conformity determination is required. For the purposes of the conformity review, estimates of the project emissions are conducted following the approach outlined above for tailpipe emissions, fugitive dust, and windblown dust.

The conformity threshold for the ozone precursors, VOCs, or NO_X, emitted in the ozone nonattainment area is 100 tons per year for each type of precursor. The Nevada nonattainment area for ozone that also contains the ROW development areas includes HB 212, Las Vegas Valley; HB 216, Garnet Valley; HB 217, Hidden Valley; and HB 218, California Wash Valley.

For areas classified as serious nonattainment for PM_{10}, a conformity determination would be required if the PM_{10} emission rates exceed 70 tons per year. The portion of Clark County, Nevada, that is designated as a serious nonattainment area for PM_{10}, is limited to HB 212, Las Vegas Valley.

Using the approach presented in the preceding sections to estimate the impacts to air quality due to ROW construction and facility maintenance, the emissions in the nonattainment areas can be calculated and compared with the applicable thresholds. Since the emissions thresholds defined under 40 CFR 93.153(b) are for any given year of the project, the maximum possible annual emissions are calculated for the nonattainment and maintenance areas.

Only tailpipe emissions from construction equipment emit ozone precursors (i.e., fugitive dust and windblown dust do not produce NO_X or VOC emissions). The amount of NO_X and VOC emitted by construction equipment in the nonattainment area is based on the proposed length of pipeline (28.1 miles) and power line (14.6 miles) to be constructed in HB 212, Las Vegas Valley; HB 216, Garnet Valley; HB 217, Hidden Valley; and HB 218, California Wash Valley. It can be conservatively assumed that construction of 28.1 miles of pipeline and 14.6 miles of power line will take less than 150 days. One hundred and fifty days of pipeline construction, power line construction, and associated construction transportation would emit 8 tons per year of VOC and 63 tons per year of NO_X in the nonattainment area, well below the 100 tons per year conformity threshold. Therefore, a conformity determination is not required for this project for ozone.

To assess the PM_{10} project emissions in the nonattainment area, all sources of PM_{10} were estimated, including tailpipe emissions, fugitive dust, and windblown dust. The Nevada PM_{10} nonattainment area is limited to HB 212, Las Vegas Valley. The amount of PM_{10} emitted by construction equipment in the nonattainment area is based on the proposed length of pipeline (8.8 miles) and power line (0 mile) to be constructed in Las Vegas Valley. It can be conservatively assumed that construction of 8.8 miles of pipeline will take less than 100 days. One hundred days of pipeline construction and associated construction transportation would emit 2 tons per year of PM_{10} in the nonattainment area. To calculate the fugitive and windblown dust in the Nevada PM_{10} nonattainment area, the estimated area of surface disturbance during construction is 241 acres in Las Vegas Valley. If this whole area was actively being constructed in a year, the USEPA emission factor for fugitive dust could be multiplied by the estimated acres of active construction and applying a 50 percent control efficiency. With these assumptions, the maximum fugitive dust PM_{10} emission rate for the nonattainment portions of the project area is 4 tons per year. Similarly, the PM_{10} emissions from windblown dust can be calculated by multiplying the Clark County emission factor for windblown dust by the estimated acres of surface disturbance. The resulting estimated PM_{10} windblown dust emissions for the nonattainment portions of the project area are 1 tons per year.

Altogether the maximum annual PM_{10} emission rate within the nonattainment area due to ROW activities would be 7 tons per year, this includes tailpipe emissions, fugitive dust, and windblown dust. The PM_{10} emissions in the nonattainment area are less than the conformity threshold of 70 tons per year. Therefore, a conformity determination is not required for this project for PM_{10}.

Conclusion. Portions of Clark County, Nevada, are designated as nonattainment or maintenance for PM_{10} and ozone. There are no areas of the ROW that extend into Utah; therefore, Utah nonattainment designations are not considered in the evaluation of the ROW impacts. It is estimated that the project would emit 8 tons of VOC per year, 63 tons of NO_X per year, and 8 tons of PM_{10} per year in the Nevada nonattainment areas. These emissions levels are well below the conformity threshold for each pollutant. Therefore, a conformity determination is not required for this project.

Proposed mitigation measures:

None.

Residual impacts include:

None.

Entrainment of Radionuclides or Erionite from Construction Activities

As described in Section 3.4, Soil Resources, soil testing for radioactive nuclides in the project area has shown that any fallout from nuclear testing conducted in the past has decayed to low levels that are not considered harmful to human health. Likewise, any fugitive dust generated by construction activities will not contain radioactive material from past nuclear testing at levels that are harmful to human health.

As described in Section 3.2, Geologic Resources, erionite has not been identified in the project area. Therefore, it not expected that erionite deposits will be exposed and suspended into the air during construction activities.

Conclusion. The project is not expected to contribute to increases in radionuclides or erionite.

Proposed mitigation measures:

None.

Residual impacts include:

None.

Summary of Proposed Action and Alternatives A, B, and C

The estimated long-term (residual) emissions from construction and maintenance of the ROW are shown in **Table 3.1-10**.

Tailpipe Emissions from Construction Equipment and Facility Maintenance

It is assumed that construction occurs 12 hours per day, 300 days per year. It is assumed that only a third of the construction fleet is operating at a given time. Maintenance vehicles will inspect the length of the pipeline and power line once a week. ACMs include measures that are required by state and local regulations, such as obtaining dust control permits and operating permits. Implementation of these measures would result in estimated annual emissions from construction and maintenance activities varying between less than 1 ton per year of SO_2 to approximately 24,000 metric tons of carbon dioxide equivalent. Localized air emissions due to construction activities are expected to be short term (5 years or less), while maintenance activities are expected to occur for the life of the project. Long-term impacts to air quality from maintenance vehicles are minimal and range from close to 0 tons per year of SO_2 up to approximately 8 metric tons per year of carbon dioxide equivalent. Emissions from construction and maintenance are not expected to cause or contribute to exceedences of any AAQS. Emissions from construction and maintenance are not expected to impair visibility conditions at the GBNP.

Fugitive Dust from Construction and Facility Maintenance Activities

The construction of 306 miles of pipeline, 322 miles of power lines, and ancillary facilities requires disturbance of a large surface area. Fugitive dust is generated during construction and maintenance activities. Mitigation measures ROW-AQ-1 (inspection and repair of project roads) and ROW-AQ-2 (application of tackifiers and gravel) can be effective at minimizing fugitive dust. Implementation of the federal and state requirements, ACMs, and proposed mitigation measures should effectively mitigate fugitive dust impacts to air quality. Localized fugitive dust emissions due to construction activities are expected to be short term (5 years or less). It is estimated that 176 tons per year of PM_{10} and 18 tons per year of $PM_{2.5}$ will be emitted in the project area during construction. In close proximity to construction sites and the ROW, there may be elevated concentrations of PM relative to current background conditions. Any elevated concentrations are expected to be limited to areas in close proximity to construction and the ROW, be short-term in duration, below applicable AAQS, and are not expected to impair visibility conditions at the GBNP. Localized fugitive dust emissions due to maintenance activities are expected to continue for the life of the project. It is estimated that 6 tons per year of PM_{10} and 1 ton per year of $PM_{2.5}$ will be emitted in the project area due to fugitive dust associated with maintenance vehicles. Fugitive dust emissions from maintenance vehicles are expected to be below applicable AAQS and not impair visibility conditions at the GBNP.

Wind Blown Dust from Disturbed Surfaces

The construction activities are anticipated to disturb the surface of 12,303 acres and create a permanent ROW of 1,014 acres. Disturbed surfaces are more prone to wind erosion. A majority of the windblown dust emissions due to surfaces disturbed during construction are expected to be short term (5 years or less) until surfaces are revegetated as part of ACMs. It is estimated the short-term PM_{10} windblown dust would be 62 tons per year and the $PM_{2.5}$ windblown dust would be 6 tons per year over the whole project area. The windblown dust over the ROW areas that will not be revegetated (and the impacts are therefore long-term) is estimated to be 5 tons per year of PM_{10} and 1 tons per year of $PM_{2.5}$ near the permanent ROW. Windblown dust emissions from disturbed surfaces associated with ROW construction and maintenance are not expected to impair visibility conditions at the GBNP.

Conformity Review for Nonattainment Areas

Portions of Clark County, Nevada, are designated as nonattainment or maintenance for PM_{10} and ozone. There are no areas of the ROW that extend into Utah; therefore, Utah nonattainment designations are not considered in the evaluation of the ROW impacts. It is estimated that the project would emit 8 tons of VOC per year, 63 tons of NO_X per year, and 7 tons of PM_{10} per year in the Nevada nonattainment areas. These emissions levels are well below the conformity threshold for each pollutant. Therefore, a conformity determination is not required for this project.

Entrainment of Radionuclides or Erionite from Construction Activities

The project is not expected to contribute to increases in radionuclides or erionite.

Table 3.1-10 Long-term Emissions from Right-of-way Construction and Maintenance for Proposed Action, Alternatives A through C

Source	CO		VOC		NO_X		SO_2		PM_{10}		Carbon Dioxide Equivalent	
	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Metric Tons per Year
Tailpipe Emissions from Maintenance Vehicles	0	0.06	0.04	0.01	0.04	0.01	0.00	0.00	0.00	0.00	55	7.55
Fugitive Dust from Maintenance	-	-	-	-	-	-	-	-	9	1	-	-
Windblown Dust from Permanent ROW	-	-	-	-	-	-	-	-	28	5	-	-
Total Long-term Emissions	**0**	**0.06**	**0.04**	**0.01**	**0.04**	**0.01**	**0.00**	**0.00**	**37**	**6**	**55**	**8**

Note: Construction and permanent acreage numbers in the table include a minimal acreage of facilities that currently exist. Therefore the reported acreages conservatively overestimate the amount of disturbance anticipated by the proposed project by approximately 1 percent across all alternatives.

3.1.2.3 Alternative D

The proposed development of Alternative D within the ROW areas is described in detail in Chapter 2. Chapter 2 also provides estimates of surface disturbance from construction related activities. In summary, the development would include construction of 225 miles of pipeline, 208 miles of overhead power lines, and 2 primary and 2 secondary electrical substations. Ancillary facilities that would be developed include two pumping stations, five regulating tanks, three pressure reducing stations, a water treatment facility, a buried storage reservoir, access roads, and communication facilities.

The proposed GWD Project would generate air emissions through short-term construction activities. Construction air emissions include criteria pollutants, ozone precursors, fugitive dust, and greenhouse gas emissions. The actual fugitive dust emissions would depend on many site-specific factors such as the moisture content and texture of the soils that would be disturbed. Continued air quality impacts due to wind erosion of surfaces disturbed during construction will continue, at decreasing levels, until most surfaces are revegetated. The estimated long-term emissions from construction and maintenance of the ROW for Alternative D are shown in **Table 3.1-11**.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on air resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

Summary of Alternative D

Tailpipe Emissions from Construction Equipment and Facility Maintenance

It is assumed that construction occurs 12 hours per day, 300 days per year. It is assumed that only a third of the construction fleet is operating at a given time. Maintenance vehicles will inspect the length of the pipeline and power line once a week. ACMs include measures that are required by state and local regulations, such as obtaining dust control permits and operating permits. Implementation of these measures would result in an estimated annual emissions from construction and maintenance activities varying between less than 1 ton per year of SO_2 to approximately 24,000 metric tons of carbon dioxide equivalent. Localized air emissions due to construction activities are expected to be short term (5 years or less), while maintenance activities are expected to occur for the life of the project. Long-term impacts to air quality from maintenance vehicles are minimal and range from close to 0 tons per year of SO_2 up to approximately 5 metric tons per year of carbon dioxide equivalent. Emissions from construction and maintenance are not expected to cause or contribute to exceedences of any AAQs. Emissions from construction and maintenance are not expected to impair visibility conditions at the GBNP.

Proposed mitigation measures:

None.

Residual impacts include:

In close proximity to construction sites, some criteria pollutants may have elevated concentrations relative to current background conditions; however, any elevated concentrations are expected to be limited to construction areas, be short-term in duration, and below applicable AAQS. Long-term impacts to air quality from maintenance vehicles are minimal and range from close to 0 tons per year of SO_2 up to approximately 5 metric tons per year of carbon dioxide equivalent.

Fugitive Dust from Construction and Facility Maintenance Activities

The construction of 225 miles of pipeline, 208 miles of power lines, and ancillary facilities require disturbance of a large surface area. Fugitive dust is generated during construction and maintenance activities. Mitigation measures ROW-AQ-1 (inspection and repair of project roads) and ROW-AQ-2 (application of tackifiers and gravel) can be effective at minimizing fugitive dust. Implementation of the federal and state requirements, ACMs, and proposed mitigation measures should effectively mitigate fugitive dust impacts to air quality. Localized fugitive dust emissions due to construction activities are expected to be short term (5 years or less). It is estimated that 174 tons per year of PM_{10} and 17 tons per year of $PM_{2.5}$ will be emitted in the project area during construction. In close proximity to

Table 3.1-11 Long-term Emissions from Right-of-way Construction and Maintenance for Alternative D

Source	CO		VOC		NO_X		SO_2		PM_{10}		Carbon Dioxide Equivalent	
	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Metric Tons per Year
Tailpipe Emissions from Maintenance Vehicles	0	0.04	0.03	0.00	0.03	0.00	0.00	0.00	0.00	0.00	38	5.20
Fugitive Dust from Maintenance	-	-	-	-	-	-	-	-	6	1	-	-
Windblown Dust from Permanent ROW	-	-	-	-	-	-	-	-	23	4	-	-
Total Long-term Emissions	**0**	**0.04**	**0.03**	**0.00**	**0.03**	**0.00**	**0.00**	**0.00**	**29**	**5**	**38**	**5**

Note: Construction and permanent acreage numbers in the table include a minimal acreage of facilities that currently exist. Therefore the reported acreages conservatively overestimate the amount of disturbance anticipated by the proposed project by approximately 1 percent across all alternatives.

construction sites and the ROW, there may be elevated concentrations of PM relative to current background conditions. Any elevated concentrations are expected to be limited to areas in close proximity to construction and the ROW, be short-term in duration, below applicable AAQS, and not impair visibility conditions at the GBNP. Localized fugitive dust emissions due to maintenance activities are expected to continue for the life of the project. It is estimated that 1 ton per year of PM_{10} and less than 1 ton per year of $PM_{2.5}$ will be emitted in the project area due to fugitive dust associated with maintenance vehicles. Fugitive dust emissions from maintenance vehicles are expected to be below applicable AAQS and not impair visibility conditions at the GBNP.

Proposed mitigation measures:

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on air resources.

The following proposed mitigation measures are not currently addressed in SNWA's ACMs and are intended to bring SNWA's ACMs into conformance with the BLM RMPs.

ROW-AQ-1: Project Road Inspections to Reduce Wind and Water Erosion. The SNWA and the BLM's Environmental Compliance Monitor would inspect project roads in areas prone to air and water erosion bi-weekly during construction, or more frequently during periods of adverse weather conditions. Repairs would be completed within 5 working days of notification to the SNWA or sooner depending on public safety and the nature of the issue detected. SNWA would make a photographic documentation of the road condition prior to and immediately after road repairs. Effectiveness: This mitigation measure would be very effective at reducing construction related fugitive dust impacts. Implementation of this mitigation measure combined with other federal and state requirements, would likely result in a substantial reduction of short-term fugitive dust impacts. Effects on other resources: This mitigation measure would have a small (negligible) increase in vehicular traffic along the ROW during construction activities.

ROW-AQ-2: **Alternative Dust Control Measures**. Areas where soil tackifiers are prohibited (e.g., threatened and endangered species habitat, perennial stream drainages) would be determined in cooperation with the BLM and the USFWS prior to construction, and identified in both the Construction and Mitigation Plans. Other mitigation (e.g., gravel application) may be required to reduce impacts and to ensure protection of public safety. This measure would supplement SNWA ACM A.10.3. Effectiveness: This mitigation measure would be moderately effective at reducing construction related fugitive dust impacts. Implementation of this mitigation measure combined with other federal and state requirements, would likely result in a noticeable reduction of short-term fugitive dust impacts. Effects on other resources: This measure would have a minor positive effect on threatened and endangered species habitat by reducing dust cover and on sensitive aquatic species by reducing water contamination by chemicals.

Residual impacts include:

Implementation of the federal and state requirements, ACMs, and proposed mitigation measures should effectively mitigate fugitive dust impacts to air quality. It is estimated that 1 ton per year of PM_{10} and 0.1 ton per year of $PM_{2.5}$ will be emitted long-term in the project area due to fugitive dust associated with maintenance vehicles. In close proximity to construction sites and the ROW, there may be elevated concentrations of PM relative to current background conditions; however, any elevated concentrations are expected to be limited to areas in close proximity to construction and the ROW, be short-term in duration, below applicable AAQS, and not impair visibility conditions at GBNP.

Wind Blown Dust from Disturbed Surfaces

The construction activities associated with this alternative are anticipated to disturb the surface of 8,843 acres and have a permanent ROW of 823 acres. Disturbed surfaces are more prone to wind erosion. A majority of the windblown dust emissions due to surfaces disturbed during construction are expected to be short term (5 years or less) until surfaces are revegetated as part of ACMs. It is estimated the short-term PM_{10} windblown dust would be 44 tons per year and the $PM_{2.5}$ windblown dust would be 4 tons per year over the whole project area. The windblown dust over the ROW areas that will not be revegetated (and the impacts are therefore long-term) is estimated to be 4 tons per year of PM_{10} and less than 1 ton per year of $PM_{2.5}$ near the permanent ROW. Windblown dust emissions from disturbed surfaces associated with ROW construction and maintenance are not expected to impair visibility conditions at the GBNP.

Proposed mitigation measures:

None.

Residual impacts include:

Implementation of the federal and state requirements and ACMs should effectively mitigate windblown dust impacts to air quality in the short-term. Revegetation measures should effectively mitigate of windblown dust impacts to air quality in the long-term. The long-term windblown dust over the permanent ROW areas, which will not be revegetated, is estimated to be 4 tons per year of PM_{10} and less than 1 ton per year of $PM_{2.5}$. There may be elevated concentrations of PM relative to current background conditions caused by windblown dust near the permanent ROW; however, any elevated concentrations are expected to be limited to areas in close proximity to the ROW, be short-term in duration, below applicable AAQS, and not impair visibility conditions at GBNP.

Conformity Review for Nonattainment Areas

Portions of Clark County, Nevada, are designated as nonattainment or maintenance for PM_{10} and ozone. There are no areas of the ROW that extend into Utah; therefore, Utah nonattainment designations are not considered in the evaluation of the ROW impacts. It is estimated that the project would emit 8 tons of VOC per year, 63 tons of NO_X per year, and 8 tons of PM_{10} per year in the Nevada nonattainment areas. These emissions levels are well below the conformity threshold for each pollutant. Therefore, a conformity determination is not required for this project.

Proposed mitigation measures:

None.

Residual impacts include:

None.

Entrainment of Radionuclides or Erionite from Construction Activities

The project is not expected to contribute to increases in radionuclides or erionite.

Proposed mitigation measures:

None.

Residual impacts include:

None.

3.1.2.4 Alternatives E and F

The proposed development of Alternatives E and F within the ROW areas is described in detail in Chapter 2. Chapter 2 also provides estimates of surface disturbance from construction related activities. In summary, the development would include construction of 263 miles of pipeline, 280 miles of overhead power lines, and two primary and four secondary electrical substations. Ancillary facilities that would be developed include three pumping stations, five regulating tanks, three pressure reducing stations, a water treatment facility, a buried storage reservoir, access roads, and communication facilities.

The proposed GWD Project would generate air emissions through short-term construction activities. Construction air emissions include criteria pollutants, ozone precursors, fugitive dust, and greenhouse gas emissions. The actual fugitive dust emissions would depend on many site-specific factors such as the moisture content and texture of the soils that would be disturbed. Continued air quality impacts due to wind erosion of surfaces disturbed during construction will continue, at decreasing levels, until most surfaces are revegetated. The estimated long-term emissions from construction and maintenance of the ROW for Alternatives E and F are shown in **Table 3.1-12**.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on air resources. The COM Plan would integrate protective measures from the following: BLM RMPs, BO, ACMs, Stipulated Agreements, BMPs, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

Summary of Alternatives E and F

Tailpipe Emissions from Construction Equipment and Facility Maintenance

It is assumed that construction occurs 12 hours per day, 300 days per year. It is assumed that only a third of the construction fleet is operating at a given time. Maintenance vehicles will inspect the length of the pipeline and power line once a week. ACMs include measures that are required by state and local regulations, such as obtaining dust control permits and operating permits. Implementation of these measures would result in an estimated annual emissions from construction and maintenance activities varying between less than 1 ton per year of SO_2, to approximately 24,000 metric tons of carbon dioxide equivalent. Localized air emissions due to construction activities are expected to be short term (5 years or less), while maintenance activities are expected to occur for the life of the project. Long-term impacts to air quality from maintenance vehicles are minimal and range from close to 0 tons per year of SO_2 up to approximately 7 metric tons per year of carbon dioxide equivalent. Emissions from construction and maintenance are not expected to cause or contribute to exceedences of any AAQs. Emissions from construction and maintenance are not expected to impair visibility conditions at the GBNP.

Proposed mitigation measures:

None.

Residual impacts include:

In close proximity to construction sites, some criteria pollutants may have elevated concentrations relative to current background conditions; however, any elevated concentrations are expected to be limited to construction areas, be short-term in duration, and below applicable AAQS. Long-term impacts to air quality from maintenance vehicles are minimal and range from close to 0 tons per year of SO_2 up to approximately 7 metric tons per year of carbon dioxide equivalent.`

Fugitive Dust from Construction and Facility Maintenance Activities

The construction of 263 miles of pipeline, 280 miles of power lines, and ancillary facilities require disturbance of a large surface area. Fugitive dust is generated during construction and maintenance activities. Mitigation measures ROW-AQ-1 (inspection and repair of project roads) and ROW-AQ-2 (application of tackifiers and gravel) can be effective at minimizing fugitive dust. Implementation of the federal and state requirements, ACMs, and proposed mitigation measures should effectively mitigate fugitive dust impacts to air quality. Localized fugitive dust emissions due to construction activities are expected to be short term (5 years or less). It is estimated that 175 tons per year of PM_{10} and 18 tons per year of $PM_{2.5}$ will be emitted in the project area during construction. In close proximity to construction sites and the ROW, there may be elevated concentrations of PM relative to current background conditions. Any elevated concentrations are expected to be limited to areas in close proximity to construction and the ROW, be short-term in duration, below applicable AAQS, and not impair visibility conditions at GBNP. Localized fugitive dust emissions due to maintenance activities are expected to continue for the life of the project. It is estimated that 1 ton per year of PM_{10} and less than 1 ton per year of $PM_{2.5}$ will be emitted in the project area due to fugitive dust associated with maintenance vehicles. Fugitive dust emissions from maintenance vehicles are expected to be below applicable AAQS and not impair visibility conditions at the GBNP.

Table 3.1-12 Long-term Emissions from Right-of-way Construction and Maintenance for Alternatives E and F

Source	CO		VOC		NO_x		SO_2		PM_{10}		Carbon Dioxide Equivalent	
	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Tons per Year	Pounds per Day	Metric Tons per Year
Tailpipe Emissions from Maintenance Vehicles	0	0.05	0.04	0.01	0.04	0.01	0.00	0.00	0.00	0.00	48	6.53
Fugitive Dust from Maintenance	-	-	-	-	-	-	-	-	8	1	-	-
Windblown Dust from Permanent ROW	-	-	-	-	-	-	-	-	26	5	-	-
Total Long-term Emissions	**0**	**0.05**	**0.04**	**0.01**	**0.04**	**0.01**	**0.00**	**0.00**	**34**	**6**	**48**	**7**

Note: Construction and permanent acreage numbers in the table include a minimal acreage of facilities that currently exist. Therefore the reported acreages conservatively overestimate the amount of disturbance anticipated by the proposed project by approximately 1 percent across all alternatives.

Proposed mitigation measures:

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on air resources.

The following proposed mitigation measures are not currently addressed in SNWA's ACMs and are intended to bring SNWA's ACMs into conformance with the BLM RMPs.

ROW-AQ-1: Project Road Inspections to Reduce Wind and Water Erosion. The SNWA and the BLM's Environmental Compliance Monitor would inspect project roads in areas prone to air and water erosion bi-weekly during construction, or more frequently during periods of adverse weather conditions. Repairs would be completed within 5 working days of notification to the SNWA or sooner depending on public safety and the nature of the issue detected. SNWA would make a photographic documentation of the road condition prior to and immediately after road repairs. Effectiveness: This mitigation measure would be very effective at reducing construction related fugitive dust impacts. Implementation of this mitigation measure combined with other federal and state requirements, would likely result in a substantial reduction of short-term fugitive dust impacts. Effects on other resources: This mitigation measure would have a small (negligible) increase in vehicular traffic along the ROW during construction activities.

ROW-AQ-2: **Alternative Dust Control Measures**. Areas where soil tackifiers are prohibited (e.g., threatened and endangered species habitat, perennial stream drainages) would be determined in cooperation with the BLM and the USFWS prior to construction, and identified in both the Construction and Mitigation Plans. Other mitigation (e.g., gravel application) may be required to reduce impacts and to ensure protection of public safety. This measure would supplement SNWA ACM A.10.3. Effectiveness: This mitigation measure would be moderately effective at reducing construction related fugitive dust impacts. Implementation of this mitigation measure combined with other federal and state requirements, would likely result in a noticeable reduction of short-term fugitive dust impacts. Effects on other resources: This measure would have a minor positive effect on threatened and endangered species habitat by reducing dust cover and on sensitive aquatic species by reducing water contamination by chemicals.

Residual impacts include:

Implementation of the federal and state requirements, ACMs, and proposed mitigation measures should effectively mitigate fugitive dust impacts to air quality. It is estimated that 1 ton per year of PM_{10} and 0.1 ton per year of $PM_{2.5}$ will be emitted long-term in the project area due to fugitive dust associated with maintenance vehicles. In close proximity to construction sites and the ROW, there may be elevated concentrations of PM relative to current background conditions; however, any elevated concentrations are expected to be limited to areas in close proximity to construction and the ROW, be short-term in duration, below applicable AAQS, and not impair visibility conditions at GBNP.

Windblown Dust from Disturbed Surfaces

The construction activities associated with this alternative are anticipated to disturb the surface of 10,696 acres and creat a permanent ROW of 960 acres. Disturbed surfaces are more prone to wind erosion. A majority of the windblown dust emissions due to surfaces disturbed during construction are expected to be short term (5 years or less) until surfaces are revegetated as part of ACMs. It is estimated the short-term PM_{10} windblown dust would be 53 tons per year and the $PM_{2.5}$ windblown dust would be 5 tons per year over the whole project area. The windblown dust over the ROW areas that will not be revegetated (and the impacts are therefore long-term) is estimated to be 5 tons per year of PM_{10} and less than 1 ton per year of $PM_{2.5}$ near the permanent ROW. Windblown dust emissions from disturbed surfaces associated with ROW construction and maintenance are not expected to impair visibility conditions at the GBNP.

Proposed mitigation measures:

None.

Residual impacts include:

Implementation of the federal and state requirements and ACMs should effectively mitigate windblown dust impacts to air quality in the short-term. Revegetation measures should effectively mitigate of windblown dust impacts to air quality in the long-term. The long-term windblown dust over the permanent ROW areas, which will not be revegetated, is estimated to be 5 tons per year of PM_{10} and 1 tons per year of $PM_{2.5}$. There may be elevated concentrations of PM relative to current background conditions caused by windblown dust near the permanent ROW; however, any elevated concentrations are expected to be limited to areas in close proximity to the ROW, be short-term in duration, and below applicable AAQS.

Conformity Review for Nonattainment Areas

Portions of Clark County, Nevada, are designated as nonattainment or maintenance for PM_{10} and ozone. There are no areas of the ROW that extend into Utah; therefore, Utah nonattainment designations are not considered in the evaluation of the ROW impacts. It is estimated that the project would emit 8 tons of VOC per year, 63 tons of NO_X per year, and 8 tons of PM_{10} per year in the Nevada nonattainment areas. These emissions levels are well below the conformity threshold for each pollutant. Therefore, a conformity determination is not required for this project.

Proposed mitigation measures:

None.

Residual impacts include:

None.

Entrainment of Radionuclides or Erionite from Construction Activities

The project is not expected to contribute to increases in radionuclides or erionite.

Proposed mitigation measures:

None.

Residual impacts include:

None.

3.1.2.5 Alignment Options 1 through 4

There is a negligible change to air quality impacts for Alignment Options 1 through 4 relative to the Proposed Action. The change in the acres of surface disturbance for these alignment options is less than 1 percent, which is less than the uncertainty in the emission factors used to estimate emissions. For all intents and purposes, the air quality impacts estimated for the ROW Proposed Action are considered to be applicable to Alignment Options 1 through 4.

3.1.2.6 No Action

Under the No Action Alternative, the proposed project would not be constructed or maintained. No project-related surface disturbance would occur. Natural (biogenic) and human (anthropogenic) sources of pollutant emissions would continue. Anthropogenic emissions are expected to increase in proportion to projected population increases in Lincoln County (see Section 3.18, Socioeconomics and Environmental Justice). Without project surface disturbance, there would be some increase in current levels of fugitive dust generation due to continued groundwater pumping activities. Current anthropogenic activities, as well as natural wind conditions, would continue to generate dust as discussed in Section 3.1.1.1. Climate changes would continue; the scale of these changes would depend on the interactions of the atmospheric and oceanic circulation patterns and level of future anthropogenic emissions of greenhouse gases.

3.1.2.7 Comparison of Alternatives

Generally, the impacts to air quality from the ROW construction and maintenance are very similar among alternatives. **Table 3.1-13** shows the estimated maximum annual construction emissions for each alternative for each pollutant. Only the emissions of PM_{10} and $PM_{2.5}$ vary between alternatives since PM emissions depend on the acres of surface disturbance. The emissions of all other pollutants depend on the tailpipe emissions from construction activities, which, over a year, are the same for each alternative. **Table 3.1-14** shows the estimated long-term (residual) maintenance emissions for each alternative for each pollutant. The maintenance emissions for all pollutants depend on the length and area of the permanent ROWs for the pipeline and power line, which vary slightly for each alternative. **Table 3.1-15** summarizes the impacts to all air quality metrics from ROW construction and maintenance activities for each alternative.

Table 3.1-13 Estimated Maximum Annual Emissions from Right-of-way Construction of the Proposed Action, Alternatives A through F and Alignment Options 1 through 4

	CO	VOC	NO_X	SO_2	PM_{10}	$PM_{2.5}$	Carbon Dioxide Equivalent
Alternative	**Tons per Year**	**Tons per Year**	**Tons per Year**	**Tons per Year**	**Tons per Year**	**Tons per Year**	**Metric Tons per Year**
Proposed Action, Alternatives A through C, and Alignment Options 1 through 4	104	29	234	0.3	248	35	23,903
Alternative D	104	29	234	0.3	229	33	23,901
Alternatives E and F	104	29	234	0.3	239	34	23,902

Note: Construction and permanent acreage numbers in the table include a minimal acreage of facilities that currently exist. Therefore the reported acreages conservatively overestimate the amount of disturbance anticipated by the proposed project by approximately 1 percent across all alternatives.

Table 3.1-14 Estimated Long-term Annual Emissions from Right-of-way Maintenance of the Proposed Action, Alternatives A through F and Alignment Options 1 through 4

	CO	VOC	NO_X	SO_2	PM_{10}	$PM_{2.5}$	Carbon Dioxide Equivalent
Alternative	**Tons per Year**	**Tons per Year**	**Tons per Year**	**Tons per Year**	**Tons per Year**	**Tons per Year**	**Metric Tons per Year**
Proposed Action, Alternatives A through C, and Alignment Options 1 through 4	0.06	0.01	0.01	8.1E-05	6.4	0.6	8
Alternative D	0.04	0.00	0.00	5.6E-05	5.0	0.5	5
Alternatives E and F	0.05	0.01	0.01	7.0E-05	5.9	0.6	7

Note: Construction and permanent acreage numbers in the table include a minimal acreage of facilities that currently exist. Therefore the reported acreages conservatively overestimate the amount of disturbance anticipated by the proposed project by approximately 1 percent across all alternatives.

Table 3.1-15 Summary of Impacts to Air Quality from Right-of-way Construction and Maintenance of the Proposed Action and Alternatives A through F, and Alignment Options 1 through 4

Parameter	Proposed Action, Alternatives A through C, and Alignment Options 1 through 4	Alternative D	Alternatives E and F
Tailpipe emissions	Maximum annual emissions from construction equipment range from less than 1 ton per year of SO_2, to approximately 24,000 metric tons of carbon dioxide equivalent. Long-term annual emissions from maintenance equipment range from close to 0 tons per year of SO_2 up to approximately 8 metric tons per year of carbon dioxide equivalent.	Maximum annual emissions from construction equipment range from less than 1 ton per year of SO_2, to approximately 24,000 metric tons of carbon dioxide equivalent. Long-term annual emissions from maintenance equipment range from close to 0 tons per year of SO_2 up to approximately 5 metric tons per year of carbon dioxide equivalent.	Maximum annual emissions from construction equipment range from less than 1 ton per year of SO_2, to approximately 24,000 metric tons of carbon dioxide equivalent. Long-term annual emissions from maintenance equipment range from close to 0 tons per year of SO_2 up to approximately 7 metric tons per year of carbon dioxide equivalent.
Fugitive Dust	Maximum annual emissions from construction fugitive dust are 176 tons per year of PM_{10} and 18 tons per year of $PM_{2.5}$. Long-term annual emissions from maintenance fugitive dust are 1 ton per year of PM_{10} and less than 1 ton per year of $PM_{2.5}$.	Maximum annual emissions from construction fugitive dust are 174 tons per year of PM_{10} and 17 tons per year of $PM_{2.5}$. Long-term annual emissions from maintenance fugitive dust are 1 ton per year of PM_{10} and less than 1 ton per year of $PM_{2.5}$.	Maximum annual emissions from construction fugitive dust are 175 tons per year of PM_{10} and 18 tons per year of $PM_{2.5}$. Long-term annual emissions from maintenance fugitive dust are 1 ton per year of PM_{10} and less than 1 ton per year of $PM_{2.5}$.
Windblown Dust	Maximum annual emissions from windblown dust due to surfaces disturbed by construction activities are 62 tons per year of PM_{10} and 6 tons per year of $PM_{2.5}$. Long-term annual emissions of windblown dust from surfaces disturbed by maintenance activities are 5 tons per year of PM_{10} and less than 1 tons per year of $PM_{2.5}$.	Maximum annual emissions from windblown dust due to surfaces disturbed by construction activities are 44 tons per year of PM_{10} and 4 tons per year of $PM_{2.5}$. Long-term annual emissions of windblown dust from surfaces disturbed by maintenance activities are 4 tons per year of PM_{10} and less than 1 tons per year of $PM_{2.5}$.	Maximum annual emissions from windblown dust due to surfaces disturbed by construction activities are 53 tons per year of PM_{10} and 5 tons per year of $PM_{2.5}$. Long-term annual emissions of windblown dust from surfaces disturbed by maintenance activities are 4 tons per year of PM_{10} and less than 1 tons per year of $PM_{2.5}$.
Conformity Review	All project emissions in nonattainment areas are less than conformity thresholds. No conformity determination is required for this project.	All project emissions in nonattainment areas are less than conformity thresholds. No conformity determination is required for this project.	All project emissions in nonattainment areas are less than conformity thresholds. No conformity determination is required for this project.
Radionuclides and erionite	The project is not expected to contribute to increases in radionuclides or erionite.	The project is not expected to contribute to increases in radionuclides or erionite.	The project is not expected to contribute to increases in radionuclides or erionite.

3.1.2.8 Groundwater Development and Groundwater Pumping

Issues

Groundwater Development Construction and Facility Maintenance

- Air pollutants emitted from the tailpipes of construction equipment, including criteria pollutants, ozone precursors, and greenhouse gas emissions.
- Fugitive dust generated during construction and facility maintenance.
- Windblown dust generated due to wind erosion of surfaces disturbed by construction and facility maintenance.
- Impairment of visibility conditions at the GBNP due to construction and facility maintenance.
- Entrainment and transport of radioactive material and erionite due to wind erosion of disturbed surfaces.

Groundwater Pumping

- Windblown dust generated due to wind erosion of surfaces disturbed from groundwater pumping.
- Impairment of visibility conditions at the GBNP due to wind erosion of surfaces disturbed from groundwater pumping.
- Indirect greenhouse gas emissions from groundwater pumping energy requirements.
- Changes in Salt Lake City's PM_{10} air quality due to the effects of groundwater pumping on soils and vegetation.

Assumptions

Assumptions regarding compliance with regulatory requirements, detailed project operations, inputs for emission factors, and future conditions are required to estimate impacts to air quality and climate.

Key assumptions regarding compliance with regulatory requirements include:

- All state and local air quality construction permits will be received prior to initiation of project construction.
- Any operating permits or dust control plans required in nonattainment areas will address any conformity requirements (although no groundwater development activities are planned in nonattainment areas at this time) or demonstrate that total emissions in nonattainment areas will be below applicable thresholds.

Groundwater Development Construction and Facility Maintenance

- The Ely and Las Vegas RMP management actions and BMPs would be applied to all proposed construction activities, based on the most current RMPs – Ely 2008; Las Vegas 1998 (BLM 2008, 1998).
- The ACMs included in the SNWA POD to manage surface disturbance effects for ROWs provide a basis for appropriate measures that may be submitted in future SNWA ROW applications. For purposes of impact analysis, it has been assumed that measures appropriate for ROW construction would be applied to construction in groundwater development areas.
- In order to estimate emission rates of air pollutants and greenhouse gases, two types of data are required: activity data and emission factors. In the absence of actual activity data (e.g., estimates of the number and types of required construction equipment), emissions calculations for groundwater development construction activities cannot be performed. Rather, it is assumed that the magnitude of groundwater development construction emissions will be qualitatively similar to the ROW construction on a annual basis. This assumption implies that the assumptions made in the estimation of ROW construction emissions are appropriate for groundwater development construction emissions.
- Similarly, the long-term impacts associated with maintenance of groundwater development wells and collector pipelines are assumed to be qualitatively similar to the ROW maintenance impacts. This assumption implies that the assumptions made in the estimation of ROW maintenance emissions are appropriate for groundwater development maintenance emissions.

- SNWA would be required to implement a comprehensive COM Plan that would include all future hydrographic basins and all facilities associated with the SNWA GWD Project. The COM Plan includes a requirement for comprehensive monitoring and mitigation program for the entire project that would integrate the various required monitoring and mitigation actions. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary, along with measures to protect air resources from ROW construction and operation activities.

Groundwater Pumping

Assumptions regarding future conditions are required to estimate future long-term project impacts. Importantly, the expected changes in vegetation and soil surface conditions are critical for the estimation of future fugitive dust impacts due to groundwater drawdown. It is possible that there would be no net increase in soil erosion in groundwater drawdown areas undisturbed by construction activities. However, there is inherent uncertainty and spatial variability in plant communities' response to drawdown, as discussed in Section 3.5, Vegetation Resources. Therefore, to provide an upper bound on the uncertainty associated with the effects of soil erosion and plant cover on air quality, a 10 percent decrease of the current plant cover is assumed to result from drawdown. This assumption provides a conservatively high estimate of potential air quality impacts from groundwater drawdown. Current plant cover and calculated changes were categorized based on ET units defined for the groundwater modeling analysis (see Section 3.3, Water Resources) and vegetation analysis (see Section 3.5, Vegetation Resources). ET units and assumptions regarding their capability to generate fugitive dust are further explained in the next section.

- The COM Plan would integrate protective measures from the following: BLM RMPs, BO, ACMs, Stipulated Agreements, BMPs, and additional mitigation recommended in this EIS. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary, along with measures to protect air resources from groundwater pumping activities.

Methodology for Analysis

For the estimation of air quality related impacts, the methodology depends on the activity (construction, pumping, etc.) and the type of air impacts (criteria emissions, greenhouse gases, etc.). The activity/air impact combinations are grouped based on the methodology used to estimate impacts. The calculation methodology for each category is described below.

The different methodologies for developing air impacts are grouped into the following categories:

- Groundwater Development Construction and Operational Maintenance
  - Tailpipe emissions
  - Fugitive dust
  - Greenhouse gases
  - Radionuclides and erionite
  - Fugitive dust from maintenance activities

- Groundwater Pumping
  - Windblown dust from soils exposed as a result of groundwater pumping
  - Indirect greenhouse gas emissions from groundwater pumping energy requirements

Groundwater Development Construction and Facility Maintenance

In the absence of actual estimates of the number and type of required construction equipment, actual emissions estimates from construction activities cannot be calculated. Rather, it is assumed that the magnitude of groundwater field development construction and maintenance emissions will be qualitatively similar to the ROW construction and maintenance. Actual emissions calculations for groundwater development construction and maintenance activities will be revised, as required, based on project-specific data during the permit application phase. The methods outlined for ROW emissions calculations are applicable to emissions calculations for groundwater development surface development.

Groundwater Pumping

Windblown Dust Impacts from Groundwater Drawdown

Windblown dust impacts from groundwater drawdown are estimated by first generating emissions estimates, then the emissions estimates are modeled, and the model-predicted impacts are analyzed and summarized.

Future windblown dust estimates are based on the primary ET units that were used for estimating water losses from the groundwater system via evaporation from soils and playas, and via vegetation transpiration, as described in Section 3.5, Vegetation Resources. Windblown dust impacts for each alternative are estimated based on the change in area for each ET unit. The percentage of soil surface that is covered is a critical factor in windblown dust erosion. Soil cover is measured by the canopy of live vegetation, plant residue, rock fragments, and soil crusts. As described in Section 3.5, Vegetation Resources, plant species are anticipated to change due to groundwater drawdown in some affected communities; however, total plant cover is not expected to decrease as a result of groundwater drawdown. As described in Section 3.4, Soil Resources, biological and physical soil crusts, where they currently exist, would not be affected by drawdown. As such, it is possible that there would be no net increase in soil erosion in groundwater drawdown areas undisturbed by construction activities. However, there is inherent uncertainty and spatial variability in plant communities' response to drawdown, as discussed in Section 3.5, Vegetation Resources. Therefore, to provide an upper bound on the uncertainty associated with the effects of soil erosion and plant cover on air quality, a 10 percent decrease of the current plant cover is assumed to result from drawdown. This approach provides an upper bound on the estimated windblown dust and associated impacts that may occur as a result of drawdown. The percent of the area that is estimated to become susceptible to wind erosion is calculated for each ET unit as shown in **Table 3.1-16**. The susceptible ET units are described below.

Playas: It is assumed that the soil binding properties of this cover type would not change as a result of groundwater drawdown. It is assumed that windblown dust from playa surfaces would remain at baseline levels.

Bare soil/sparse vegetation: It is assumed that plant canopy and soil stabilization by plant roots may vary from place to place.

Phreatophyte/medium vegetation: It is predicted that the composition and structure of this cover type may change toward higher dominance by upland and exotic annual species, and lower dominance by existing phreatophytic shrubs under long-term pumping regimes. It is expected that annual species would continuously bind the soil surface with living or dead root systems, even though the individual annual plants would not act as long-term barriers to wind. As is discussed in Section 3.5, Vegetation Resources, it is not expected that these affected areas would become barren of vegetation, rather there would be changes to species composition over time. In addition, plant canopy and soil stabilization by plant roots may vary from place to place.

Wetland/meadow: It is predicted that this cover type may change in species composition toward a greater fraction of shrubs and drought tolerant grasses and forbs. It is assumed that the soil binding properties of this cover type would not change, even though species composition may change.

Table 3.1-16 Current and Estimated Future Plant Coverage Percent for Each ET Unit

ET Unit	Current Plant Coverage (% of Area)	Plant Coverage Change due to Groundwater Drawdown (%)	Future (Post-Groundwater Drawdown) Plant Coverage (% of Area)	Change in Bare Soil Susceptible to Wind Erosion (% of Area) Relative to Current Conditions
Playa	0	10	0	0
Wetland/Meadow	90	10	81	9
Phreatophyte/Medium Vegetation	25	10	22.5	2.5
Bare Soil/Low Vegetation	10	10	9	1

The change in exposed area for each ET unit is calculated relative to the No Action Alternative for a 10-foot groundwater drawdown contour for each alternative. See **Figure 3.1-6**, for a visual representation of how the impacts from alternatives are calculated relative to current conditions and the No Action Alternative. The estimated change in surface area for each ET unit is projected for three model time frames for each alternative: at full build out, at full build out plus 75 years, and at full build out plus 200 years. For example, the total acres of Phreatophyte/Medium Vegetation predicted to be affected by a 10-foot groundwater drawdown under the Proposed Action at full build out is 19,099 acres; however, 6,298 of these acres are predicted to be affected under the No Action Alternative. Therefore, only 12,801 acres of Phreatophyte/Medium Vegetation is directly attributable to the Proposed Action (project-specific) impacts.

Alternative Impacts (acres) = Total Area Affected by 10-foot Groundwater Drawdown (acres) - No Action Alternative (acres).

The amount of this area that may become susceptible to wind erosion is calculated based on the estimated change in bare soil for each ET unit shown in **Table 3.1-16**. Using the same example as above, the value in the last column of **Table 3.1-16** for Phreatophyte/Medium Vegetation (2.5 percent) is multiplied by the affected 12,801 acres of Phreatophyte/Medium Vegetation. This results in an estimate that, at full build out, an additional 320 acres of Phreatophyte/Medium Vegetation may become susceptible to wind erosion under the Proposed Action relative to current conditions and the No Action Alternative.

The area of each ET unit that is susceptible to wind erosion is classified by wind erodeability group (WEG) and multiplied by the PM_{10} emission factor for wind erosion from the Clark County Wind Tunnel Study (Wacaser et al. 2006). This results in an estimate of hourly PM_{10} windblown emissions as a function of hourly wind speed. The Clark County emission factors were developed from field measurements using a portable wind tunnel at a variety of sites, encompassing tests on different soil types (stable, unstable, and stabilized) and WEGs. The result of the Clark County Wind Tunnel Study is a mathematical relationship between particulate matter flux rates (with units of tons/acre-hr-wind band) that vary as a function of wind erodeability group and soil stability. The Clark County emission factors are applied using the following equation.

$$E_{WB} = \sum_{ET=1}^{ET=4} \sum_{WEG=1}^{WEG=8} A_{ET,WEG} \times EF_{WEG,WB} \times (\%PC/100)$$

Where:

E_{WB} = PM_{10} Emissions Rate (ton/hr-windband) for each Alternative

$A_{ET,WEG}$ = Area of each alternative affected by the 10-foot groundwater drawdown relative to the No Action Alternative classified by ET unit and WEG (acres)

$EF_{WEG,WB}$ = Windblown dust emission factor, by WEG and Wind Band (ton/acre-hr-windband)

%PC = Percent Change in Bare Soil for Each ET Unit Susceptible to Wind Erosion (% of area) Relative to Current Conditions (%) (from **Table 3.1-16**)

This calculation is performed for each combination of ET unit and WEG category. Using the same example as above, the predicted additional 320 acres of Phreatophyte/Medium Vegetation that are susceptible to wind erosion is divided into WEG classifications and multiplied by each combination of $EF_{WEG,WB}$ from the Clark County Wind Tunnel Study. The resulting emission rates are added together for each WEG type and ET unit for a specific wind band, resulting in an estimate in the total tons/hour-windband for each Alternative.

The PM_{10} emission rate is then converted from units of tons per hour per windband into estimates of tons per year using the average number of hours per year that the wind speed is with each wind band. This wind speed frequency distribution is shown in **Table 3.1-17**. The typical number of hours per year with a wind speed in each wind band was calculated based on 10 years of monitoring data collected at the Ely, National Weather Service Station. This frequency distribution is used to convert the PM_{10} emission rate from units of tons per hour per windband into estimates of total tons per year. The $PM_{2.5}$ size range is estimated based on USEPA guidance (USEPA 1998; WRAP 2005, 2006), whereby 10 percent of the PM_{10} is in the $PM_{2.5}$ size range.

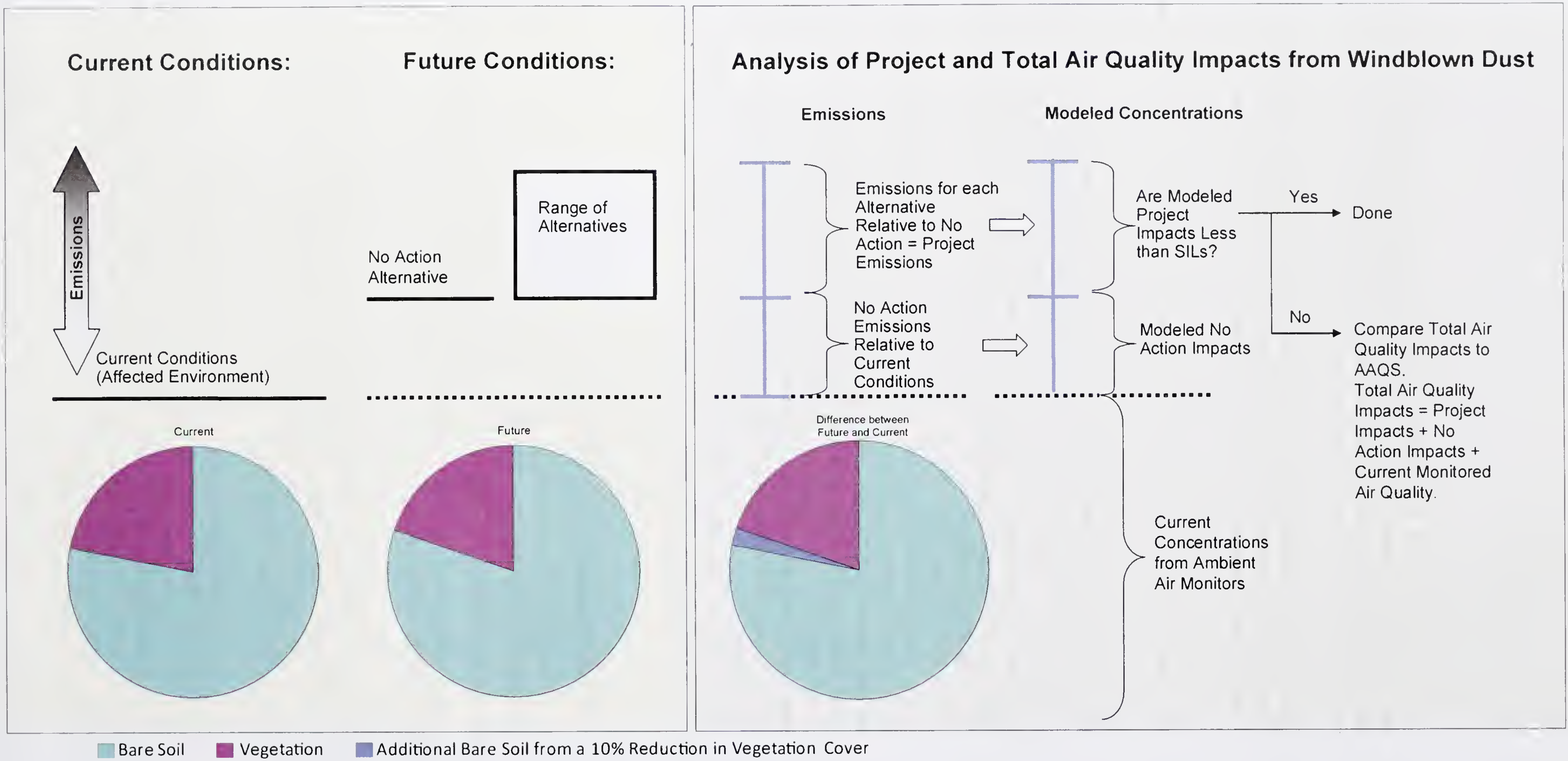


Figure 3.1-6 Visual Representation of the Groundwater Drawdown Windblown Dust Impact Analysis

Table 3.1-17 Frequency Distribution for Each Wind Band

Wind Band (Wind Speed mph)	Frequency (%)	Number of Hours Per Year for Each Wind Band
0 - 10	57.2	5,011.78
10 - 15	32.1	2,815.14
15 - 20	7.0	612.74
20 - 25	2.4	212.72
25 - 30	1.0	89.32
30 - 35	0.167	14.64
35 - 40	0.032	2.82
40 - 45	0.010	0.84
Total[1]	**100**	**8,760**

[1] Values may not sum to the total due to rounding.
Source: National Climatic Data Center (2011).

The hourly emissions were used in a modeling analysis to estimate the potential air quality and air quality related impacts of the groundwater drawdown. The CALPUFF model (Scire et al. 2000a,b) was used to evaluate changes in air quality and regional haze impacts associated with a reduction or loss of vegetation due to potential groundwater drawdown. CALPUFF modeling assessed air concentrations in areas currently designated as nonattainment for PM_{10} and $PM_{2.5}$. This includes areas in Clark County, Nevada, as well as along the Wasatch Mountain Range in Utah and southern Idaho, referred to collectively as the Wasatch Front. The Wasatch Front includes cities of Ogden, Salt Lake City, and Provo, Utah. In addition to modeling the impacts at nonattainment areas, air quality impacts were assessed at GBNP. In addition to the assessment of air quality impacts, visibility impacts are analyzed for GBNP, which is a Class II area. Class II areas do not have visibility protection under federal or state law. Visibility impacts at GBNP are provided for informational purposes only.

Only several alternatives were selected for modeling: Alternative A, Alternative E, Alternative F, and the No Action Alternative. Given the large uncertainty in the emissions estimates for groundwater drawdown, it is more appropriate to apply the modeling results in a relative sense than in an absolute sense. Therefore, impacts for alternatives not explicitly modeled are assessed qualitatively using the relative difference in predicted emission levels. Alternative A was selected for modeling to assess the relative differences between alternatives that include groundwater pumping in all 5 basins (Spring, Delamar, Dry Lake, Cave, and Snake Valleys). The Proposed Action and Alternatives A, B, and C all would allow groundwater pumping in the 5 basins. Alternatives E and F were selected for modeling to evaluate the effects of groundwater pumping in 4 basins (Spring, Delamar, Dry Lake, and Cave Valleys). Alternatives D, E, and F all would allow groundwater pumping in 4 basins. Alternative E allows groundwater pumping at reduced levels relative to Alternatives A and F. Importantly, Alternative E is the alternative that is most closely aligned with the water right quantities granted by the Nevada State Engineer. Alternatives A and F allow similar levels of groundwater pumping; however, Alternative A includes pumping in Snake Valley, while Alternative F does not. More information about the alternatives is provided in Chapter 2, and **Table 2.6-2** provides a comparison of the alternatives.

Importantly, as shown in **Figure 3.1-6**, some air quality thresholds, such as Significant Impact Levels (SILs) are used to assess project-alone impacts, while others are used to assess total air quality impacts. The project-alone impacts were modeled using the predicted emissions for each alternative. The total impacts are assessed by modeling emissions from both the No Action and the alternative being modeled. This analysis is performed since the emissions for each alternative are not the total emissions expected to occur under the alternative, rather the emissions presented for each alternative is the additional amount of emissions from the alternative alone. The total emissions anticipated for each alternative are the combination of the alternative's emissions and the No Action emissions. Therefore, the total air quality impacts were modeled using the combined emissions from the alternative being evaluated (e.g. Alternative A 75 years after full build out) and the No Action Alternative (at 75 years after full build out). The modeling analysis compares the model-predicted concentrations to established significance thresholds, AAQS, and other environmental parameters.

For more detail regarding the modeling methods, configuration options, assessment areas, and input data, please see **Appendix F3.1.2**.

There are two caveats with the use of Clark County emission factors and the resulting model impacts: 1) the Clark County emission factors were developed using disturbed the soils, thus the emission factors are conservatively high for surfaces affected by groundwater drawdown, where the soil crusts are otherwise undisturbed; and 2) the emission factors assume that all material is lofted into the air and not immediately deposited. However, regional scale emissions flux estimates are likely an overestimate since not all particles lofted into the air are transported out of the immediate area.

Generally, particulate matter flux refers to the rate at which dust particles are created and suspended in air under the influence of wind. Three processes contribute to flux: 1) aerodynamic entrainment, where dust particles are lifted directly off the ground surface; 2) saltation bombardment, in which sand or aggregate grains strike the surface and eject dust particles; and 3) aggregate disintegration where dust particles attached to sand grains disintegrate under strong winds. The Clark County wind tunnel studies determined vertical flux rates experimentally.

One of the principal findings of a WRAP study published in 2000 (Countess 2001) is that not all suspendable dust particles are transported long distances. The WRAP study concluded that the fraction of windblown dust emissions that are transported long distances from the source of emissions varies and is influenced by a number of factors, including dust deposition rates, vertical mixing height, and transport time. Further, this study reported that the fraction of windblown dust emissions that is transported beyond the source area can vary between 100 percent and zero due to these factors. The study concluded that knowledge about, and integration of, the combined effects of the landscape, particle size and density, and meteorological conditions should be considered during emission flux calculations. In this regard, regional scale dust flux is smaller than local scale dust flux. The emission estimates for this EIS, however, conservatively assume a transport fraction of 100 percent (i.e., all of the particles that are suspended are transported out of their source area). Since no information was available to account for near-field particle deposition, the particulate matter emissions and air quality impacts resulting from windblown dust generation are conservatively high.

Greenhouse Gas Emissions

The amount of electricity required to operate the pumps was estimated for each alternative. Annual electricity consumption was used to estimate how much carbon dioxide equivalent would be released annually during the generation of the electricity. This calculation is based on the typical emissions of carbon dioxide equivalent from natural gas combustion in the project area.

3.1.2.9 Proposed Action

The construction and maintenance methods for well pad, collector pipelines, access roads, and distribution power lines are anticipated to be the same as those described for the mainline pipeline and ancillary facilities. Effects on air quality would also be similar, since the same activities will be conducted, with the exception that no construction will occur in Clark County nonattainment areas and therefore, a conformity review is not required. The major effect of future groundwater field development would be an expansion of surface disturbance activities over a large area within each hydrographic basin. Consequently, the ACMs for ROWs are applicable, and likely to be proposed as part of future ROW applications to the BLM.

The COM Plan would be developed and implemented to protect air resources from groundwater development activities. The COM Plan would integrate protective measures from the following: BLM RMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

Groundwater Development Area

Groundwater Development Construction and Facility Maintenance

Short-term Emissions from Construction Equipment

Localized air quality emissions due to construction activities are expected to be short term (5 years or less). Qualitatively, emissions will be similar to the values estimated for ROW construction activities for the Proposed Action (shown in **Table 3.1-10**), except for construction fugitive and windblown dust (PM_{10} and $PM_{2.5}$) which are a function of surface disturbance. Under the Proposed Action, groundwater development construction of well pads, access roads, collector pipelines, and power lines would result in an estimated maximum surface disturbance of approximately 8,400 acres. Based on the estimated disturbed surface area, fugitive and windblown dust emissions due to construction activities in the groundwater development areas would be approximately two-thirds of the emissions estimated for ROW construction activities for the Proposed Action (shown in **Table 3.1-15**). Maximum annual emissions from ROW construction activities are 176 tons per year of PM_{10} and 18 tons per year of $PM_{2.5}$ from fugitive dust and 62 tons per year of PM_{10} and 6 tons per year of $PM_{2.5}$ from windblown dust. Therefore, maximum annual emissions from groundwater development construction activities are 120 tons per year of PM_{10} and 12 tons per year of $PM_{2.5}$ from fugitive dust and 42 tons per year of PM_{10} and 4 tons per year of $PM_{2.5}$ from windblown dust. Emissions from construction are not expected to impair visibility conditions at the GBNP.

Proposed mitigation measures:

ROW-AQ-1: Project Road Inspections to Reduce Wind and Water Erosion. The SNWA and the BLM's Environmental Compliance Monitor would inspect project roads in areas prone to air and water erosion bi-weekly during construction, or more frequently during periods of adverse weather conditions. Repairs would be completed within 5 working days of notification to the SNWA or sooner depending on public safety and the nature of the issue detected. SNWA would make a photographic documentation of the road condition prior to and immediately after road repairs. Effectiveness: This mitigation measure would be very effective at reducing construction related fugitive dust impacts. Implementation of this mitigation measure combined with other federal and state requirements, would likely result in a substantial reduction of short-term fugitive dust impacts. Effects on other resources: This mitigation measure would have a small (negligible) increase in vehicular traffic along the ROW during construction activities.

ROW-AQ-2: **Alternative Dust Control Measures**. Areas where soil tackifiers are prohibited (e.g., threatened and endangered species habitat, perennial stream drainages) would be determined in cooperation with the BLM and the USFWS prior to construction, and identified in both the Construction and Mitigation Plans. Other mitigation (e.g., gravel application) may be required to reduce impacts and to ensure protection of public safety. This measure would supplement SNWA ACM A.10.3. Effectiveness: This mitigation measure would be moderately effective at reducing construction related fugitive dust impacts. Implementation of this mitigation measure combined with other federal and state requirements, would likely result in a noticeable reduction of short-term fugitive dust impacts. Effects on other resources: This measure would have a minor positive effect on threatened and endangered species habitat by reducing dust cover and on sensitive aquatic species by reducing water contamination by chemicals.

Potential residual impacts include:

- Impacts to air quality from groundwater development construction activities are predicted to range from less than 1 ton per year of SO_2 up to approximately 24,000 metric tons per year of carbon dioxide equivalent. Importantly, no construction activity is proposed for the nonattainment hydrologic basins; therefore, construction emissions do not need to be compared with conformity thresholds.

Long-term Emissions from Facility Maintenance

Long-term air pollutant emissions in the groundwater development areas from maintenance activities would be much less than the emissions generated from construction activities. Maintenance vehicles would generate small volumes of fugitive dust and tailpipe emissions, and groundwater development maintenance emissions are assumed to be qualitatively similar to the ROW maintenance emissions for the Proposed Action (shown in **Table 3.1-14**). Air emissions from groundwater development maintenance activities are predicted to range from almost 0 tons per year of SO_2 up to approximately 8 tons per year of carbon dioxide equivalent. Emissions from maintenance are not expected to cause or contribute to exceedences of any AAQS. Emissions from maintenance are not expected to impair visibility conditions at the GBNP.

Entrainment of Radionuclides or Erionite from Construction Activities

Similar to the analysis for the ROW impact, there would not be re-suspension and transport of radionuclides from past nuclear testing at levels considered to be harmful to human health.

Conclusion. Construction of well pads, access roads, collector pipelines, and power lines would result in an estimated maximum surface disturbance of approximately 8,300 acres. It is assumed that short-term construction emissions will be qualitatively similar to the values estimated for ROW construction activities for the Proposed Action, although somewhat reduced levels of PM will be emitted due to the smaller amount of disturbed surface area. Long-term emissions from groundwater development maintenance activities are anticipated to be similar to the long-term emissions from ROW maintenance activities. The project is not expected to contribute to increases in radionuclides or erionite. It is assumed that: 1) SNWA would implement its ROW ACMs, including measures required as part of Dust Control Permits and other required operating permits; 2) SNWA would routinely inspect and repair project roads with a BLM inspector; and 3) SNWA would use soil tackifiers and other materials to suppress dust in accordance with the BLM approval. Based on these measures, it is expected that impacts due to construction would be minimized and short-term in nature and impacts are not expected to impair visibility conditions at GBNP. There would be a small incremental increase in the concentration of air pollutants in areas near the permanent groundwater development ROW during periods of maintenance.

Groundwater Pumping

Windblown Dust Emissions from Groundwater Drawdown

It is predicted that increased dust may be generated as the result of 10-foot or greater drawdown over different pumping time frames (**Table 3.1-18**). The Proposed Actions incremental PM_{10} emissions due to windblown dust after full build out are estimated to be up to 2,226 tons per year more than the No Action Alternative. Given that the USEPA estimates $PM_{2.5}$ to be 10 percent of PM_{10} (WRAP 2005, 2006), the corresponding increase in $PM_{2.5}$ emissions due to windblown dust after full build out under the Proposed Action are estimated to be up to 223 tons per year. The increase in PM_{10} emissions are estimated to be up to 12,104 tons per year and 17,840 tons per year, after full build out plus 75 and full build out plus 200 years, respectively. The increase in $PM_{2.5}$ emissions are estimated to be up to 1,405 tons per year and 1,784 tons per year after full build out plus 75 years and full build out plus 200 years, respectively.

Table 3.1-18 Proposed Action, Estimated Increases in Windblown Dust from Evapotranspiration Affected by 10-foot or Greater Pumping Drawdown Over Different Time Periods

ET Unit[1]	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year) (full build out plus 75 years)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year) (full build out plus 200 years)
Bare Soil/Sparse Vegetation	4,901	78,821	114,168	289	4,189	5,685
Phreatophyte/ Medium Vegetation	12,801	58,169	77,338	1,883	7,929	9,386
Wetland/Meadow	117	5,460	8,048	54	1,927	2,770
Total				**2,226**	**14,046**	**17,840**

[1] ET units are defined based on vegetation cover type (see Section 3.5, Vegetation Resources).

[2] These emissions are the upper limit of the range of potential estimates.

As described in the methodology section, the predicted emissions associated with groundwater drawdown were modeled for Alternative A and the estimated impacts for other alternatives are assessed qualitatively relative to Alternative A. The modeling analysis shows that the predicted concentrations of PM_{10} and $PM_{2.5}$ in Clark County and in the Wasatch Front are insignificant for Alternative A (**Table 3.1-20**). The emissions for the Proposed Action are approximately 19 percent greater than Alternative A at 75 years after full build out. Based on the differences in the emissions between the Proposed Action and Alternative A, it can be inferred that the future impacts from the Proposed Action are marginally higher than Alternative A. Even if the impacts from the Proposed Action are marginally higher than Alternative A, it is anticipated that the Proposed Action impacts would also be insignificant at Clark County and the Wasatch Front. Based on this no further analyses are required for Clark County and the Wasatch Front since the project would not cause or contribute to an exceedance of applicable AAQS.

Model-predicted concentrations for Alternative A at 75 years after full build out are above the SILs at GBNP. Therefore, a more refined analysis was conducted to assess the total air quality impacts at GBNP. The model-predicted total concentrations at GBNP show compliance with applicable National and State AAQS (**Table 3.1-21**). The emissions for the Proposed Action are approximately 19 percent greater than Alternative A at 75 years after full build out. Based on the differences in the emissions between the Proposed Action and Alternative A, it can be inferred that the future impacts from the Proposed Action would be marginally higher than the modeled impacts for Alternative A. Even if the impacts from the Proposed Action are marginally higher than Alternative A, it is anticipated that the Proposed Action impacts would also be in compliance with applicable National and State AAQS at GBNP.

The modeled visibility impacts indicate that Alternative A has the potential to contribute to visibility impairment at GBNP (**Table 3.1-22**). The emissions for the Proposed Action are approximately 19 percent greater than Alternative A at 75 years after full build out. Based on the differences in the emissions between the Proposed Action and Alternative A, it can be inferred that the future visibility impacts from the Proposed Action would be marginally higher than Alternative A. However, these results are conservatively high and further evaluation of visibility impacts would be required to definitively assess the potential visibility impacts to GBNP (see **Appendix F3.1.2** for more information regarding limitations of the modeling analysis).

Greenhouse Gas Emissions from Groundwater Pumping

Since the pump stations would be electrically powered and greenhouse gases are emitted during the generation of most electricity, the power requirements of this project have an indirect contribution to the emissions of greenhouse gases. The continuous power requirements to operate the pump stations and other ancillary equipment are estimated to be approximately 97 MW (**Table 2.6-2**). The continuous generation of this electricity amount is estimated to release approximately 327,000 metric tons of carbon dioxide equivalent per year, and is comparable to the emissions from the electricity use of nearly 35,000 homes for 1 year. For context, the estimated indirect greenhouse gas emissions from electricity generation for this alternative are less than 0.006 percent of the carbon dioxide equivalent estimated to be emitted by the U.S. in 2010 (USEPA 2012b) and less than 0.6 percent of the carbon dioxide equivalent estimated to be emitted in Nevada in 2005 (NDEP 2008).

The power requirements, and thus the associated carbon dioxide equivalent emissions, would be offset by electrical generation as part of the project via installation of hydroturbines (detailed in **Appendix E**) and solar panels to the extent possible. It is estimated that as much as 40 percent of the project's power requirements could be provided by the installation of hydroturbines at the three pressure reducing stations.

Monitoring and Mitigation

In its Protection Measures, **Appendix E**, SNWA outlined measures that could be used to mitigate adverse effects resulting from groundwater pumping. As part of ACM B.1.2, solar panels will be used at monitoring wells to the extent possible to reduce power requirements. This measure would offset the estimated indirect greenhouse gas emissions associated with power needs.

COM Plan

The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMPs, BO, ACMs, Stipulated Agreements, and additional mitigation (air-specific protection measures are summarized below). Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. One of the objectives of the COM Plan is to avoid, minimize or mitigate degradation of visibility and air quality due to potential increases in airborne particulates and loss of surface vegetation. In alignment with this objective, protective measures for air resources are summarized below for ACMs and mitigation recommendations.

Given the potential for large quantities of windblown dust to be generated as a result of groundwater pumping, the following mitigation measure is recommended:

GW-AQ-3: Monitoring, Mitigation, and Management Plan for Air Quality. SNWA would develop an air monitoring plan approved by the BLM, which would detail the siting and operation of at least three collocated PM_{10} and $PM_{2.5}$ air monitoring stations, one of which would be upwind of the project area. Recommended monitoring locations include Snake, Spring, and Lake valleys. These valleys are selected for consideration based on predicted changes to the bare soil/sparse vegetation ET unit, which has the greatest potential for windblown dust impacts. Baseline air measurements would be initiated at least a year prior to groundwater pumping construction activities, since these activities may increase measured particulate values. Once baseline air quality levels are established, monitoring would continue for the duration of groundwater pumping activities. Finally, the monitoring plan would comply with USEPA monitoring guidance when selecting the site locations and instruments, developing the data management plan, and establishing quality assurance criteria. Effectiveness: It is anticipated that the Plan would be effective in identifying early warning of potentially undesirable impacts to air resources and provide a substantial amount of time and flexibility to implement management measures and gage their effects. However, since groundwater development presumes some level of change to air quality and visibility, not all impacts would be avoided by this mitigation measure. Effects on other resources: This measure would have minor effects on resources impacted by proximity to the monitoring sites. In addition, this measure increases the project's overall power requirements due to power required for operation of the monitoring equipment.

Potential residual impacts include:

- The COM Plan, ACMs, and monitoring and mitigation measures for air and water resources could be effective in reducing impacts to air quality. An objective of the COM Plan is to avoid, minimize, or mitigate degradation of visibility and air quality due to potential increases in airborne particulates and loss of surface vegetation. By avoiding or minimizing drawdown effects on soil and vegetation, the magnitude of airborne particulates could be reduced. However, residual effects on air quality could occur considering the long recovery period for soils and vegetation conditions. Some unavoidable adverse effects could occur at some locations.

Conclusion

- The level and extent of impacts from a groundwater drawdown contour of 10-feet and greater are highly uncertain and the following estimated impacts should be used for comparison purposes only. It is estimated that an additional 2,226 tons of PM_{10} would be emitted per year after full build out, 14,046 tons of PM_{10} would be emitted per year for full build out plus 75 years, and 17,840 tons of PM_{10} would be emitted per year for full build out plus 200 years. Also, it is estimated that an additional 223 tons of $PM_{2.5}$ would be emitted per year after full build out, 1,405 tons of $PM_{2.5}$ would be emitted per year for full build out plus 75 years, and 1,784 tons of $PM_{2.5}$ would be emitted per year for full build out plus 200 years. At these levels, air quality impacts are not anticipated to contribute to nearby PM_{10} or $PM_{2.5}$ nonattainment area such as Clark County or the Wasatch Front. Model-predicted impacts indicate that applicable AAQS at GBNP would be met. However, it is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at GBNP. The extent of possible visibility impairment is highly uncertain.
- Based on predicted power requirements for pumping activities, indirect emissions of greenhouse gases associated with electricity generation would be approximately 327,000 metric tons of carbon dioxide equivalent per year. These power requirements would be offset by electrical generation via installation of hydroturbines (**Appendix E**) and solar panels to the extent possible.
- The 3M Plan for Snake Valley (**Appendix B**) will include PM_{10} and meteorological monitoring in Snake Valley, Utah. In order to strengthen the SNWA's adaptive management program, mitigation measure GW-AQ-3 is recommended.

3.1.2.10 Alternative A

Groundwater Development Area

Construction of well pads, access roads, collector pipelines, and power lines would result in an estimated maximum surface disturbance of approximately 4,700 acres. It is assumed that short-term construction emissions will be qualitatively similar to the values estimated for ROW construction activities for the Proposed Action, although somewhat reduced levels of PM will be emitted due to the smaller amount of disturbed surface area. Long-term emissions from groundwater development maintenance activities are anticipated to be similar to the long-term emissions from ROW maintenance activities. The project is not expected to contribute to increases in radionuclides or erionite.

The COM Plan would be developed and implemented to protect air resources from groundwater development activities. The COM Plan would integrate protective measures from the following: BLM RMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

It is assumed that: 1) the SNWA would implement its ROW ACMs, including measures required as part of Dust Control Permits and other required operating permits; 2) the SNWA would routinely inspect and repair project roads with a BLM inspector; and 3) the SNWA would use soil tackifiers and other materials to suppress dust in accordance with the BLM approval. Based on these measures, it is expected that impacts due to construction would be minimized and short-term in nature and impacts are not expected to impair visibility conditions at the GBNP. There would be a small incremental increase in the concentration of air pollutants in areas near the permanent groundwater development ROW during periods of maintenance.

Groundwater Pumping

Windblown Dust Emissions from Groundwater Drawdown

It is predicted that increased dust may be generated as the result of 10-foot or greater drawdown over different pumping time frames (**Table 3.1-19**). The incremental increase in PM_{10} emissions due to windblown dust after full build out are estimated to be approximately 1,518 tons per year relative to the No Action Alternative. Given that the USEPA estimates $PM_{2.5}$ to be 10 percent of PM_{10} (WRAP 2006), the corresponding increase in $PM_{2.5}$ emissions due to windblown dust after full build out under Alternative A are estimated to be approximately 152 tons per year. The increase in PM_{10} emissions are estimated to be 11,826 tons per year and 13,327 tons per year for full build out plus 75 years and full build out plus 200 years, respectively. The increase in $PM_{2.5}$ emissions are estimated to be 1,183 and 1,333 tons per year for after full build out plus 75 years and full build out plus 200 years, respectively.

Table 3.1-19 Alternative A, Estimated Increases in Windblown Dust from Evapotranspiration Affected by 10-foot or Greater Pumping Drawdown Over Different Time Periods

ET Unit[1]	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year) (full build out plus 75 years)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year) (full build out plus 200 years)
Bare Soil/Sparse Vegetation	2,785	55,224	67,422	160	3,124	3,643
Phreatophyte/ Medium Vegetation	9,274	51,190	56,017	1,319	7,035	7,509
Wetland/Meadow	92	4,624	6,118	39	1,667	2,175
Total				**1,518**	**11,826**	**13,327**

[1] ET units are defined based on vegetation cover type (see Section 3.5, Vegetation Resources).

The modeling analysis shows that the predicted concentrations of PM_{10} and $PM_{2.5}$ in Clark County and in the Wasatch Front are insignificant for Alternative A (**Table 3.1-20**). No further analyses are required for Clark County and the Wasatch Front since the modeling results indicate that the project would not cause or contribute to an exceedance of applicable AAQS. Model-predicted concentrations for Alternative A at 75 years after full build out are above the SILs for PM_{10} at GBNP. Therefore, a more refined analysis was conducted to assess the total PM_{10} impacts at GBNP. The model-predicted total concentrations at GBNP show compliance with applicable National and State AAQS (**Table 3.1-21**).

Table 3.1-20 Air Quality Impacts from Alternative A Compared to SILs

Pollutant	Area	Averaging Period	Maximum Modeled Concentrations[1] Project-Alone (Alternative A Full Build Out+ 75 Years) (μg/m³)	SIL (μg/m³)	Model Impacts Exceed SILs?
$PM_{2.5}$	Clark County	24-hr	0.10	1.2	No
		Annual	0.002	0.3	No
	GBNP	24-hr	1.17	1.2	No
		Annual	0.16	0.3	No
	Wasatch Front	24-hr	0.18	1.2	No
		Annual	0.003	0.3	No
PM_{10}	Clark County	24-hr	0.25	5	No
	GBNP	24-hr	9.92	5	Yes
	Wasatch Front	24-hr	0.51	5	No

[1]Concentrations represent the highest modeled concentrations.

Table 3.1-21 Total Air Quality Impacts from Alternative A Compared to Ambient Air Quality Standards

Pollutant	Area	Averaging Period	Maximum Modeled Concentrations[1]: Project-Alone (Alt A Full Build Out + 75 Years) (μg/m³)	Maximum Modeled Concentrations[1]: Total Future (No Action + Alt A Full Build Out + 75 Years) (μg/m³)	Background[2] (μg/m³)	Cumulative Impacts (Total Future + Background) (μg/m³)	AAQS (μg/m³)	Cumulative Impacts as a percent of AAQS (μg/m³)
PM_{10}	GBNP	24-hr	9.92	9.92	48.00	57.92	150	39%

[1] Concentrations represent the highest modeled concentrations.
[2] PM_{10} 24-hr concentration is the highest second highest over 3 years (2008-2010) from GBNP IMPROVE monitor.

The modeled visibility impacts indicate that Alternative A has the potential to contribute to visibility impairment at GBNP (**Table 3.1-22**). However, these results are conservatively high and further evaluation of visibility impacts would be required to definitively assess the potential visibility impacts to GBNP (see **Appendix F3.1.2** for more information regarding limitations of the modeling analysis).

Table 3.1-22 Modeled-Predicted Visibility Impacts for Alternative A at Great Basin National Park

Great Basin National Park	Days > than 5% ΔB_{ext}	Days > than 10% ΔB_{ext}	8th Highest % ΔB_{ext}
Alternative A (Full Build Out + 75 Years)	149	60	22.48
Total (No Action + Alt A Full Build Out + 75 Years)	149	60	22.48

Note that GBNP is a Class II area, which does not have visibility protection under federal or state law. Impacts are presented for informational purposes only.

Greenhouse Gas Emissions from Groundwater Pumping

Since the pump stations would be electrically powered and greenhouse gases are emitted during the generation of most electricity, the power requirements of this project have an indirect contribution to the emissions of greenhouse gases. The continuous power requirements to operate the pump stations and other ancillary equipment are estimated to be approximately 74.4 MW (**Table 2.6-2**). The continuous generation of this electricity amount is estimated to release approximately 250,400 metric tons of carbon dioxide equivalent per year, and is comparable to the emissions from the electricity use of nearly 27,000 homes for 1 year. For context, the estimated indirect greenhouse gas emissions from electricity generation for this alternative are less than 0.005 percent of the carbon dioxide equivalent estimated to be emitted by the U.S. in 2010 (USEPA 2012b) and less than 0.5 percent of the carbon dioxide equivalent estimated to be emitted in Nevada in 2005 (NDEP 2008).

These power requirements, and thus the associated carbon dioxide equivalent emissions, would be offset by electrical generation as part of the project via installation of hydroturbines (detailed in **Appendix E**) and solar panels to the extent possible. It is estimated that as much as 40 percent of the project's power requirements could be provided by the installation of hydroturbines at the three pressure reducing stations.

Conclusion

- The level and extent of air impacts from groundwater drawdown of 10-feet and greater are highly uncertain and the following estimated impacts should be used for comparison purposes only. It is estimated that an additional 1,518 tons of PM_{10} would be emitted per year after full build out; 11,826 tons of PM_{10} would be emitted per year for full build out plus 75 years; and 13,327 tons of PM_{10} would be emitted per year for full build out plus 200 years. Also, it is estimated that an additional 152 tons of $PM_{2.5}$ would be emitted per year after full build out; 1,183 tons of $PM_{2.5}$ would be emitted per year for full build out plus 75 years; and 1,333 tons of $PM_{2.5}$ would be emitted per year for full build out plus 200 years. At these levels, air quality impacts are not anticipated to contribute to nearby PM_{10} or $PM_{2.5}$ nonattainment area such as Clark County or the Wasatch Front. Model-predicted impacts indicate that applicable AAQS at GBNP would be met. However, it is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at GBNP. The extent of possible visibility impairment is highly uncertain.
- Based on predicted power requirements for pumping activities, indirect emissions of greenhouse gas associated with electricity generation would be approximately 250,400 metric tons of carbon dioxide equivalent per year. These power requirements would be offset by electrical generation via installation of hydroturbines (**Appendix E**) and solar panels to the extent possible.
- The monitoring, mitigation, and management plan for Snake Valley will include PM_{10} and meteorological monitoring in Snake Valley, Utah. In order to strengthen SNWA's adaptive management program, mitigation measure GW-AQ-3 (Monitoring, Mitigation, and Management Plan for Air Quality) is recommended. In addition, the Snake Valley 3M Plan (**Appendix B**), which is part of the project-wide COM Plan, would be implemented.

Potential residual impacts include:

- The COM Plan, ACMs, and monitoring and mitigation measures for air and water resources could be effective in reducing impacts to air quality. An objective of the COM Plan is to avoid, minimize, or mitigate degradation of visibility and air quality due to potential increases in airborne particulates and loss of surface vegetation. By avoiding or minimizing drawdown effects on soil and vegetation, the magnitude of airborne particulates could be reduced. However, residual effects on air quality could occur considering the long recovery period for soils and vegetation conditions. Some unavoidable adverse effects could occur at some locations.

3.1.2.11 Alternative B

Groundwater Development Area

Construction of well pads, access roads, collector pipelines, and power lines would result in an estimated maximum surface disturbance of approximately 4,600 acres. It is assumed that short-term construction emissions will be qualitatively similar to the values estimated for ROW construction activities for the Proposed Action, although somewhat reduced levels of PM will be emitted due to the smaller amount of disturbed surface area. Long-term emissions from groundwater development maintenance activities are anticipated to be similar to the long-term emissions from ROW maintenance activities. The project is not expected to contribute to increases in radionuclides or erionite.

The COM Plan would be developed and implemented to protect air resources from groundwater development activities. The COM Plan would integrate protective measures from the following: BLM RMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

It is assumed that: 1) the SNWA would implement its ROW ACMs, including measures required as part of Dust Control Permits and other required operating permits; 2) the SNWA would routinely inspect and repair project roads with a BLM inspector; and 3) the SNWA would use soil tackifiers and other materials to suppress dust in accordance with the BLM approval. Based on these measures, it is expected that impacts due to construction would be minimized and short-term in nature and impacts are not expected to impair visibility conditions at the GBNP. There would be a small incremental increase in the concentration of air pollutants in areas near the permanent groundwater development ROW during periods of maintenance.

Groundwater Pumping

Windblown Dust Emissions from Groundwater Drawdown

It is predicted that increased dust may be generated as the result of 10-foot or greater drawdown over different pumping time frames (**Table 3.1-23**). It is estimated that an additional 2,233 tons of PM_{10} would be emitted per year after full build out, 12,104 tons of PM_{10} would be emitted per year after full build out plus 75 years, and 15,995 tons of PM_{10} would be emitted per year after full build out plus 200 years. Also, it is estimated that an additional 223 tons of $PM_{2.5}$ would be emitted per year after full build out, 1,210 tons of $PM_{2.5}$ would be emitted per year after full build out plus 75 years, and 1,599 tons of $PM_{2.5}$ would be emitted per year after full build out plus 200 years.

As described in the methodology section, the predicted emissions associated with groundwater drawdown were modeled for Alternative A and the estimated impacts for other alternatives are assessed qualitatively relative to Alternative A. The modeling analysis shows that the predicted concentrations of PM_{10} and $PM_{2.5}$ in Clark County and in the Wasatch Front are insignificant for Alternative A (**Table 3.1-20**). The emissions for the Alternative B are approximately 2 percent greater than Alternative A at 75 years after full build out. Based on the similarity in the emissions between the Alternative B and Alternative A, it can be inferred that the future impacts from the Alternative B would be similar to the modeled impacts for Alternative A. Therefore, the Alternative B impacts would also be insignificant at Clark County and the Wasatch Front and no further analyses are required for Clark County and the Wasatch Front since the project would not cause or contribute to an exceedance of applicable AAQS.

Model-predicted concentrations for Alternative A at 75 years after full build out are above the SILs at GBNP. Therefore, a more refined analysis was conducted to assess the total air quality impacts at GBNP. The model-predicted total concentrations at GBNP show compliance with applicable National and State AAQS (**Table 3.1-21**). Since the emissions for the Alternative B are approximately 2 percent greater than Alternative A at 75 years after full build out, then it can be inferred that the future impacts from the Alternative B are the same as Alternative A, and the Alternative B impacts would also be in compliance with applicable National and State AAQS at GBNP.

Table 3.1-23 Alternative B, Estimated Increases in Windblown Dust from Evapotranspiration Affected by 10-foot or Greater Pumping Drawdown Over Different Time Periods

ET Unit[1]	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year) (full build out plus 75 years)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year) (full build out plus 200 years)
Bare Soil/Sparse Vegetation	4,759	42,781	72,112	257	2,550	3,731
Phreatophyte/Medium Vegetation	13,545	54,393	74,886	1,798	7,484	9,127
Wetland/Meadow	441	5,794	9,190	178	2,070	3,136
Total				**2,233**	**12,104**	**15,995**

[1] ET units are defined based on vegetation cover type (see Section 3.5, Vegetation Resources).

The modeled visibility impacts indicate that Alternative A has the potential to contribute to visibility impairment at GBNP (**Table 3.1-22**). Since the emissions for the Alternative B are approximately 2 percent greater than Alternative A at 75 years after full build out, then it can be inferred that the future visibility impacts from the Alternative B are similar to Alternative A. However, these results are conservatively high and further evaluation of visibility impacts would be required to definitively assess the potential visibility impacts to GBNP (see **Appendix F3.1.2** for more information regarding limitations of the modeling analysis).

Greenhouse Gas Emissions from Groundwater Pumping

Since the pump stations would be electrically powered and greenhouse gases are emitted during the generation of most electricity, the power requirements of this project have an indirect contribution to the emissions of greenhouse gases. The continuous power requirements to operate the pump stations and other ancillary equipment are estimated to be approximately 97 MW (**Table 2.6-2**). The continuous generation of this electricity amount is estimated to release approximately 327,000 metric tons of carbon dioxide equivalent per year, and is comparable to the emissions from the electricity use of nearly 35,000 homes for 1 year. For context, the estimated indirect greenhouse gas emissions from electricity generation for this alternative are less than 0.006 percent of the carbon dioxide equivalent estimated to be emitted by the U.S. in 2010 (USEPA 2012b) and less than 0.6 percent of the carbon dioxide equivalent estimated to be emitted in Nevada in 2005 (NDEP 2008).

These power requirements, and thus the associated carbon dioxide equivalent emissions, would be offset by electrical generation as part of the project via installation of hydroturbines (detailed in **Appendix E**) and solar panels to the extent possible. It is estimated that as much as 40 percent of the project's power requirements could be provided by the installation of hydroturbines at the three pressure reducing stations.

Conclusion

- The level and extent of air impacts from groundwater drawdown of 10-feet and greater are highly uncertain and the following estimated impacts should be used for comparison purposes only. It is estimated that an additional 2,233 tons of PM_{10} would be emitted per year after full build out, 12,104 tons of PM_{10} would be emitted per year for full build out plus 75 years, and 15,995 tons of PM_{10} would be emitted per year for full build out plus 200 years. Also, it is estimated that an additional 223 tons of $PM_{2.5}$ would be emitted per year after full build out, 1,210 tons of $PM_{2.5}$ would be emitted per year for full build out plus 75 years, and 1,599 tons of $PM_{2.5}$ would be emitted per year for full build out plus 200 years. At these levels, air quality impacts are not anticipated to contribute to nearby PM_{10} or $PM_{2.5}$ nonattainment area such as Clark County or the Wasatch Front. Model-predicted impacts indicate that applicable AAQS at GBNP would be met. However, it is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at the GBNP. The extent of possible visibility impairment is highly uncertain.

- Based on predicted power requirements for pumping activities, indirect emissions of greenhouse gases associated with electricity generation would be approximately 327,000 metric tons of carbon dioxide equivalent per year. These power requirements would be offset by electrical generation via installation of hydroturbines (**Appendix E**) and solar panels to the extent possible.
- The monitoring, mitigation, and management plan for Snake Valley (**Appendix B**) will include PM_{10} and meteorological monitoring in Snake Valley, Utah. In order to strengthen the SNWA's adaptive management program, mitigation measure GW-AQ-3 (Monitoring, Mitigation, and Management Plan for Air Quality) is recommended.

Potential residual impacts include:

- The COM Plan, ACMs, and monitoring and mitigation measures for air and water resources could be effective in reducing impacts to air quality. An objective of the COM Plan is to avoid, minimize, or mitigate degradation of visibility and air quality due to potential increases in airborne particulates and loss of surface vegetation. By avoiding or minimizing drawdown effects on soil and vegetation, the magnitude of airborne particulates could be reduced. However, residual effects on air quality could occur considering the long recovery period for soils and vegetation conditions. Some unavoidable adverse effects could occur at some locations.

3.1.2.12 Alternative C

Groundwater Development Area

Construction of well pads, access roads, collector pipelines, and power lines would result in an estimated maximum surface disturbance of approximately 4,800 acres. It is assumed that short-term construction emissions will be qualitatively similar to the values estimated for ROW construction activities for the Proposed Action, although somewhat reduced levels of PM will be emitted due to the smaller amount of disturbed surface area. Long-term emissions from groundwater development maintenance activities are anticipated to be similar to the long-term emissions from ROW maintenance activities. The project is not expected to contribute to increases in radionuclides or erionite.

The COM Plan would be developed and implemented to protect air resources from groundwater development activities. The COM Plan would integrate protective measures from the following: BLM RMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

It is assumed that: 1) the SNWA would implement its ROW ACMs, including measures required as part of Dust Control Permits and other required operating permits; 2) the SNWA would routinely inspect and repair project roads with a BLM inspector; and 3) the SNWA would use soil tackifiers and other materials to suppress dust in accordance with the BLM approval. Based on these measures, it is expected that impacts due to construction would be minimized and short-term in nature and impacts are not expected to impair visibility conditions at the GBNP. There would be a small incremental increase in the concentration of air pollutants in areas near the permanent groundwater development ROW during periods of maintenance.

Groundwater Pumping

Windblown Dust Emissions from Groundwater Drawdown

It is predicted that increased dust may be generated as the result of 10-foot or greater drawdown over different pumping time frames (**Table 3.1-24**). It is estimated that an additional 1,518 tons of PM_{10} would be emitted per year after full build out; 5,416 tons of PM_{10} would be emitted per year for full build out plus 75 years; and 6,690 tons of PM_{10} would be emitted for full build out plus 200 years. Also, it is estimated that an additional 152 tons of $PM_{2.5}$ would be emitted per year after full build out; 542 tons of $PM_{2.5}$ would be emitted for full build out plus 75 years; and 669 tons of $PM_{2.5}$ would be emitted for full build out plus 200 years.

Table 3.1-24 Alternative C, Estimated Increases in Windblown Dust from Evapotranspiration Affected by 10-foot or Greater Pumping Drawdown Over Different Time Periods

ET Unit[1]	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year) (full build out plus 75 years)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year) (full build out plus 200)
Bare Soil/Sparse Vegetation	2,785	19,262	22,017	160	1,278	1,457
Phreatophyte/Medium Vegetation	9,274	23,440	28,059	1,319	3,462	4,173
Wetland/Meadow	92	2,287	3,250	39	676	1,060
Total				**1,518**	**5,416**	**6,690**

[1] ET units are defined based on vegetation cover type (see Section 3.5, Vegetation Resources).

As described in the methodology section, the predicted emissions associated with groundwater drawdown were modeled for Alternative A and the estimated impacts for other alternatives are assessed qualitatively relative to Alternative A. The modeling analysis shows that the predicted concentrations of PM_{10} and $PM_{2.5}$ in Clark County and in the Wasatch Front are insignificant for Alternative A (**Table 3.1-20**). The emissions for the Alternative C are approximately 54 percent less than Alternative A at 75 years after full build out. Based on the differences in the emissions between the Alternative C and Alternative A, it can be inferred that the future impacts from the Alternative C would be somewhat lower than the modeled impacts for Alternative A. If the impacts from the Alternative C are somewhat lower than Alternative A, it is anticipated that the Alternative C impacts would also be insignificant at Clark County and the Wasatch Front and no further analyses are required for Clark County and the Wasatch Front since the project would not cause or contribute to an exceedance of applicable AAQS.

Model-predicted concentrations for Alternative A at 75 years after full build out are above the SILs at GBNP. Therefore, a more refined analysis was conducted to assess the total air quality impacts at GBNP. The model-predicted total concentrations at GBNP show compliance with applicable National and State AAQS (**Table 3.1-21**). Since the emissions for the Alternative C are approximately 54 percent less than Alternative A at 75 years after full build out, then it can be inferred that the future impacts from the Alternative C are somewhat lower than Alternative A and the Alternative C impacts would also be in compliance with applicable National and State AAQS at GBNP.

The modeled visibility impacts indicate that Alternative A has the potential to contribute to visibility impairment at GBNP (**Table 3.1-22**). Since the emissions for the Alternative C are approximately 54 percent less than Alternative A at 75 years after full build out, then it can be inferred that the future visibility impacts from the Alternative C are somewhat lower than Alternative A. However, these results are conservatively high and further evaluation of visibility impacts would be required to definitively assess the potential visibility impacts to GBNP (see **Appendix F3.1.2** for more information regarding limitations of the modeling analysis).

Greenhouse Gas Emissions from Groundwater Pumping

Since the pump stations would be electrically powered and greenhouse gases are emitted during the generation of most electricity, the power requirements of this project have an indirect contribution to the emissions of greenhouse gases. The continuous power requirements to operate the pump stations and other ancillary equipment are estimated to be approximately 74.4 MW (**Table 2.6-2**). The continuous generation of this electricity amount is estimated to release approximately 250,400 metric tons of carbon dioxide equivalent per year, and is comparable to the emissions from the electricity use of nearly 27,000 homes for 1 year. For context, the estimated indirect greenhouse gas emissions from electricity generation for this alternative are less than 0.005 percent of the carbon dioxide equivalent estimated to be emitted by the U.S. in 2010 (USEPA 2012b) and less than 0.5 percent of the carbon dioxide equivalent estimated to be emitted in Nevada in 2005 (NDEP 2008).

These power requirements, and thus the associated carbon dioxide equivalent emissions, would be offset by electrical generation as part of the project via installation of hydroturbines (detailed in **Appendix E**) and solar panels to the extent possible. It is estimated that as much as 40 percent of the project's power requirements could be provided by the installation of hydroturbines at the three pressure reducing stations.

Conclusion

- The level and extent of air impacts from groundwater drawdown of 10-feet and greater are highly uncertain and the following estimated impacts should be used for comparison purposes only. It is estimated that an additional 1,518 tons of PM_{10} would be emitted per year after full build out; 5,416 tons of PM_{10} would be emitted per year for full build out plus 75 years; and 6,690 tons of PM_{10} would be emitted per year for full build out plus 200 years. Also, it is estimated that an additional 152 tons of $PM_{2.5}$ would be emitted per year after full build out; 542 tons of $PM_{2.5}$ would be emitted per year for full build out plus 75 years; and 669 tons of $PM_{2.5}$ would be emitted per year for full build out plus 200 years. At these levels, air quality impacts are not anticipated to contribute to nearby PM_{10} or $PM_{2.5}$ nonattainment area such as Clark County or the Wasatch Front. Model-predicted impacts indicate that applicable AAQS at GBNP would be met. However, it is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at the GBNP. The extent of possible visibility impairment is highly uncertain.
- Based on predicted power requirements for pumping activities, indirect emissions of greenhouse gases associated with electricity generation would be approximately 250,400 metric tons of carbon dioxide equivalent per year. These power requirements would be offset by electrical generation via installation of hydroturbines (**Appendix E**) and solar panels to the extent possible.
- The monitoring, mitigation, and management plan for Snake Valley (**Appendix B**) will include PM_{10} and meteorological monitoring in Snake Valley, Utah. In order to strengthen the SNWA's adaptive management program, mitigation measure GW-AQ-3 (Monitoring, Mitigation, and Management Plan for Air Quality) is recommended. This measure is part of the COM Plan, which is described in Section 3.20.

Potential residual impacts include:

- The COM Plan, ACMs, and monitoring and mitigation measures for air and water resources could be effective in reducing impacts to air quality. An objective of the COM Plan is to avoid, minimize, or mitigate degradation of visibility and air quality due to potential increases in airborne particulates and loss of surface vegetation. By avoiding or minimizing drawdown effects on soil and vegetation, the magnitude of airborne particulates could be reduced. However, residual effects on air quality could occur considering the long recovery period for soils and vegetation conditions. Some unavoidable adverse effects could occur at some locations.

3.1.2.13 Alternative D

The COM Plan would be developed and implemented to protect air resources from groundwater development activities. The COM Plan would integrate protective measures from the following: BLM RMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

Groundwater Development Area

Construction of well pads, access roads, collector pipelines, and power lines would result in an estimated maximum surface disturbance of approximately 4,000 acres. It is assumed that short-term construction emissions will be qualitatively similar to the values estimated for ROW construction activities for the Proposed Action, although somewhat reduced levels of PM will be emitted due to the smaller amount of disturbed surface area. Long-term emissions from recommended monitoring maintenance activities are anticipated to be similar to the long-term emissions from ROW maintenance activities. The project is not expected to contribute to increases in radionuclides or erionite.

It is assumed that: 1) the SNWA would implement its ROW ACMs, including measures required as part of Dust Control Permits and other required operating permits; 2) the SNWA would routinely inspect and repair project roads with a BLM inspector; and 3) the SNWA would use soil tackifiers and other materials to suppress dust in accordance with the BLM approval. Based on these measures, it is expected that impacts due to construction would be minimized and short-term in nature and impacts are not expected to impair visibility conditions at GBNP. There would be a small incremental increase in the concentration of air pollutants in areas near the permanent recommended monitoring ROW during periods of maintenance.

Groundwater Pumping

Windblown Dust Emissions from Groundwater Drawdown

It is predicted that increased dust may be generated as the result of 10-foot or greater drawdown over different pumping time frames (**Table 3.1-25**). It is estimated that no additional PM_{10} would be emitted per year after full build out; 2,474 tons of PM_{10} would be emitted per year after full build out plus 75 years; and 8,252 tons of PM_{10} would be emitted per year after full build out plus 200 years. Also, it is estimated that no additional $PM_{2.5}$ would be emitted per year after full build out; 247 tons of $PM_{2.5}$ would be emitted per year after full build out plus 75 years; and 825 tons of $PM_{2.5}$ would be emitted per year after full build out plus 200 years.

Table 3.1-25 Alternative D, Estimated Increases in Windblown Dust from Evapotranspiration Affected by 10-foot or Greater Pumping Drawdown Over Different Time Periods

ET Unit[1]	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year) (full build out plus 75 years)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year) (full build out plus 200 years)
Bare Soil/Sparse Vegetation	0	5,901	35,066	0	363	1,385
Phreatophyte/Medium Vegetation	0	10,846	46,282	0	1,678	5,326
Wetland/Meadow	0	1,507	4,453	0	433	1,541
Total				**0**	**2,474**	**8,252**

[1] ET units are defined based on vegetation cover type (see Section 3.5, Vegetation Resources).

As described in the methodology section, the predicted emissions associated with groundwater drawdown were modeled for Alternatives A, E, and F. The estimated impacts for other alternatives are assessed qualitatively relative to the modeled alternatives. Alternative D is most similar to Alternative E both in terms of allowable pumping quantities and basins. The modeling analysis shows that the predicted concentrations of PM_{10} and $PM_{2.5}$ are insignificant for Alternative E for all areas modeled (**Table 3.1-27**). The emissions for Alternative D are approximately 66 percent less than Alternative E at 75 years after full build out. Based on the differences in the emissions between the Alternative D and Alternative E, it can be inferred that the future impacts from Alternative D would be notably lower than the modeled impacts for Alternative E. If the impacts from the Alternative D are notably lower than Alternative E, it is anticipated that the Alternative D impacts would also be insignificant at Clark County, GBNP, and the Wasatch Front and no further air quality analyses are required since the project would not cause or contribute to an exceedance of applicable AAQS.

The modeled visibility impacts for Alternative E (**Table 3.1-28**) indicate that eighth highest day has less than a 5 percent change in light extinction and therefore visibility at GBNP would be unlikely to be impaired. The eighth highest percent change in visibility is a threshold used by the FLMs (Federal Land Manager's Air Quality Related Values Workgroup [FLAG] 2010). Since the emissions for the Alternative D are approximately 66 percent less than Alternative E at 75 years after full build out, then it is likely that the future visibility impacts from Alternative D are even lower than Alternative E (see **Appendix F3.1.2** for more information regarding limitations of the modeling analysis).

Greenhouse Gas Emissions from Groundwater Pumping

Since the pump stations would be electrically powered and greenhouse gases are emitted during the generation of most electricity, the power requirements of this project have an indirect contribution to the emissions of greenhouse gases. The continuous power requirements to operate the pump stations and other ancillary equipment are estimated to be approximately 54 MW (**Table 2.6-2**). The continuous generation of this electricity amount is estimated to release approximately 182,000 metric tons of carbon dioxide equivalent per year, and is comparable to the emissions from the electricity use of nearly 19,000 homes for 1 year. For context, the estimated indirect greenhouse gas emissions from electricity generation for this alternative are less than 0.004 percent of the carbon dioxide equivalent estimated to be emitted by the U.S. in 2012 (USEPA 2012b) and less than 0.4 percent of the carbon dioxide equivalent estimated to be emitted in Nevada in 2005 (NDEP 2008).

These power requirements, and thus the associated carbon dioxide equivalent emissions, would be offset by electrical generation as part of the project via installation of hydroturbines (detailed in **Appendix E**) and solar panels to the extent possible. It is estimated that as much as 40 percent of the project's power requirements could be provided by the installation of hydroturbines at the three pressure reducing stations.

Conclusion

- The level and extent of air impacts from groundwater drawdown of 10-feet and greater are highly uncertain and the following impacts should be used for comparison purposes only. It is estimated that no additional PM_{10} would be emitted per year after full build out; 2,474 tons of PM_{10} would be emitted per year after full build out plus 75 years; and 8,252 tons of PM_{10} would be emitted per year after full build out plus 200 years. Also, it is estimated that no additional $PM_{2.5}$ would be emitted per year after full build out; 247 tons of $PM_{2.5}$ would be emitted per year for full build out plus 75 years; and 825 tons of $PM_{2.5}$ would be emitted per year for full build out plus 200 years. At these levels, air quality impacts are not anticipated to contribute to nearby PM_{10} or $PM_{2.5}$ nonattainment area such as Clark County or the Wasatch Front. Model-predicted impacts indicate that applicable AAQS at GBNP would be met and visibility conditions at the GBNP are unlikely to be impaired. The extent of possible visibility impairment is highly uncertain.
- Based on predicted power requirements for pumping activities, indirect emissions of greenhouse gases associated with electricity generation would be approximately 182,000 metric tons of carbon dioxide equivalent per year. These power requirements would be offset by electrical generation via installation of hydroturbines (**Appendix E**) and solar panels to the extent possible.
- In order to strengthen the SNWA's adaptive management program, mitigation measure GW-AQ-3 (Monitoring, Mitigation, and Management Plan for Air Quality) is recommended. This measure is part of the COM Plan, which is described in Section 3.20.

Potential residual impacts include:

- The COM Plan, ACMs, and monitoring and mitigation measures for air and water resources could be effective in reducing impacts to air quality. An objective of the COM Plan is to avoid, minimize, or mitigate degradation of visibility and air quality due to potential increases in airborne particulates and loss of surface vegetation. By avoiding or minimizing drawdown effects on soil and vegetation, the magnitude of airborne particulates could be reduced. However, residual effects on air quality could occur considering the long recovery period for soils and vegetation conditions. Some unavoidable adverse effects could occur at some locations.

3.1.2.14 Alternative E

Groundwater Development Area

Construction of well pads, access roads, collector pipelines, and power lines would result in an estimated maximum surface disturbance of approximately 4,000 acres. It is assumed that short-term construction emissions will be qualitatively similar to the values estimated for ROW construction activities for the Proposed Action, although somewhat reduced levels of PM will be emitted due to the smaller amount of disturbed surface area. Long-term emissions from groundwater development maintenance activities are anticipated to be similar to the long-term emissions from ROW maintenance activities. The project is not expected to contribute to increases in radionuclides or erionite.

The COM Plan would be developed and implemented to protect air resources from groundwater development activities. The COM Plan would integrate protective measures from the following: BLM RMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

It is assumed that: 1) the SNWA would implement its ROW ACMs, including measures required as part of Dust Control Permits and other required operating permits; 2) the SNWA would routinely inspect and repair project roads with a BLM inspector; and 3) the SNWA would use soil tackifiers and other materials to suppress dust in accordance with the BLM approval. Based on these measures, it is expected that impacts due to construction would be minimized and be short-term in nature and impacts are not expected to impair visibility conditions at GBNP. There would be a small incremental increase in the concentration of air pollutants in areas near the permanent groundwater development ROW during periods of maintenance.

Groundwater Pumping

Windblown Dust Emissions from Groundwater Drawdown

It is predicted that increased dust may be generated as the result of 10-foot or greater drawdown over different pumping time frames (**Table 3.1-26**). It is estimated that an additional 1,518 tons of PM_{10} would be emitted per year after full build out; 7,464 tons of PM_{10} would be emitted per year after full build out plus 75 years; and 8,563 tons of PM_{10} would be emitted per year after full build out plus 200 years. Also, it is estimated that an additional 152 tons of $PM_{2.5}$ would be emitted per year after full build out; 746 tons of $PM_{2.5}$ would be emitted per year for full build out plus 75 years, and 856 tons of $PM_{2.5}$ would be emitted per year for full build out plus 200 years.

Table 3.1-26 Alternative E, Estimated Increases in Windblown Dust from Evapotranspiration Affected by 10-foot or Greater Pumping Drawdown Over Different Time Periods

ET Unit[1]	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year) (full build out plus 75 years)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year) (full build out plus 200 years)
Bare Soil/Sparse Vegetation	2,785	32,882	40,586	160	1,595	1,834
Phreatophyte/Medium Vegetation	9,274	38,548	42,803	1,319	4,986	5,400
Wetland/Meadow	92	2,548	3,835	39	882	1,329
Total				**1,518**	**7,464**	**8,563**

[1] ET units are defined based on vegetation cover type (see Section 3.5, Vegetation Resources).

As described in the methodology section, the predicted emissions associated with groundwater drawdown were modeled for Alternative E. The modeling analysis shows that the predicted concentrations of PM_{10} and $PM_{2.5}$ in Clark County, GBNP, and the Wasatch Front are insignificant (below the SILs) for Alternative E (**Table 3.1-27**). The modeled impacts of Alternative E are less than that of Alternative A, as expected since the emissions for the Alternative E are approximately 37 percent less than Alternative A at 75 years after full build out. Therefore, all PM_{10} and $PM_{2.5}$ impacts are insignificant in the areas analyzed for Alternative E.

Table 3.1-27 Air Quality Impacts from Alternative E Compared to SILs

Pollutant	Area	Averaging Period	Maximum Modeled Concentrations[1] Project-Alone (Alternative E Full Build Out+ 75 Years) (μg/m³)	SIL (μg/m³)	Model Impacts Exceed SILs?
$PM_{2.5}$	Clark County	24-hr	0.06	1.2	No
		Annual	0.001	0.3	No
	GBNP	24-hr	0.36	1.2	No
		Annual	0.03	0.3	No
	Wasatch Front	24-hr	0.10	1.2	No
		Annual	0.002	0.3	No
PM_{10}	Clark County	24-hr	0.18	5	No
	GBNP	24-hr	2.07	5	No
	Wasatch Front	24-hr	0.24	5	No

[1]Concentrations represent the highest modeled concentrations.

The modeled visibility impacts for Alternative E (**Table 3.1-28**) indicate that the eighth highest day would have less than a 5 percent change in light extinction and visibility at GBNP would be unlikely to be impaired. The eighth highest percent change in visibility is a threshold used by the FLMs (FLAG 2010) (see **Appendix F3.1.2** for more information regarding limitations of the modeling analysis).

Table 3.1-28 Modeled-Predicted Visibility Impacts for Alternative E at Great Basin National Park

Great Basin National Park	Days > than 5% ΔB_{ext}	Days > than 10% ΔB_{ext}	8th Highest % ΔB_{ext}
Alternative E (Full Build Out + 75 Years)	3	0	4.13
Total (No Action + Alt E Full Build Out + 75 Years)	4	0	4.37

Note that GBNP is a Class II area, which does not have visibility protection under federal or state law. Impacts are presented for informational purposes only.

Greenhouse Gas Emissions from Groundwater Pumping

Since the pump stations would be electrically powered and greenhouse gases are emitted during the generation of most electricity, the power requirements of this project have an indirect contribution to the emissions of greenhouse gases. The continuous power requirements to operate the pump stations and other ancillary equipment are estimated to be an additional 55 MW (**Table 2.6-2**). The continuous generation of this electricity amount is estimated to release approximately 185,000 metric tons of carbon dioxide equivalent per year, and is comparable to the emissions from the electricity use of nearly 20,000 homes for 1 year. For context, the estimated indirect greenhouse gas emissions from electricity generation for this alternative are less than 0.004 percent of the carbon dioxide equivalent estimated to be emitted by the U.S. in 2010 (USEPA 2012b) and less than 0.4 percent of the carbon dioxide equivalent estimated to be emitted in Nevada in 2005 (NDEP 2008).

These power requirements, and thus the associated carbon dioxide equivalent emissions, would be offset by electrical generation as part of the project via installation of hydroturbines (detailed in **Appendix E**) and solar panels to the extent possible. It is estimated that as much as 40 percent of the project's power requirements could be provided by the installation of hydroturbines at the three pressure reducing stations.

Conclusion

- The level and extent of air impacts from groundwater drawdown of 10-feet and greater are highly uncertain and the following impacts should be used for comparison purposes only. It is estimated that an additional 1,518 tons of PM_{10} would be emitted per year after full build out, 7,464 tons of PM_{10} would be emitted per year after full build out plus 75 years, and 8,563 tons of PM_{10} would be emitted per year after full build out plus 200 years. Also, it is estimated that an additional 152 tons of $PM_{2.5}$ would be emitted per year after full build out, 746 tons of $PM_{2.5}$ would be emitted per year after full build out plus 75 years, and 856 tons of $PM_{2.5}$ would be emitted per year after full build out plus 200 years. At these levels, air quality impacts are not anticipated to contribute to nearby PM_{10} or $PM_{2.5}$ nonattainment area such as Clark County or the Wasatch Front. Model-predicted impacts indicate that applicable AAQS at GBNP would be met and visibility conditions at the GBNP are unlikely to be impaired. The extent of possible visibility impairment is highly uncertain.

- Based on predicted power requirements for pumping activities, indirect emissions of greenhouse gases associated with electricity generation would be approximately 185,000 metric tons of carbon dioxide equivalent per year. These power requirements would be offset by electrical generation via installation of hydroturbines (**Appendix E**) and solar panels to the extent possible.
- In order to strengthen the SNWA's adaptive management program, mitigation measure GW-AQ-3 (Monitoring, Mitigation, and Management Plan for Air Quality) is recommended. This measure is part of the COM Plan, which is described in Section 3.20.

Potential residual impacts include:

- The COM Plan, ACMs, and monitoring and mitigation measures for air and water resources could be effective in reducing impacts to air quality. An objective of the COM Plan is to avoid, minimize, or mitigate degradation of visibility and air quality due to potential increases in airborne particulates and loss of surface vegetation. By avoiding or minimizing drawdown effects on soil and vegetation, the magnitude of airborne particulates could be reduced. However, residual effects on air quality could occur considering the long recovery period for soils and vegetation conditions. Some unavoidable adverse effects could occur at some locations.

3.1.2.15 Alternative F

Groundwater Development Area

Construction of well pads, access roads, collector pipelines, and power lines would result in an estimated maximum surface disturbance of approximately 4,000 acres. It is assumed that short-term construction emissions will be qualitatively similar to the values estimated for ROW construction activities for the Proposed Action, although somewhat reduced levels of PM will be emitted due to the smaller amount of disturbed surface area. Long-term emissions from groundwater development maintenance activities are anticipated to be similar to the long-term emissions from ROW maintenance activities. The project is not expected to contribute to increases in radionuclides or erionite.

The COM Plan would be developed and implemented to protect air resources from groundwater development activities. The COM Plan would integrate protective measures from the following: BLM RMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

It is assumed that: 1) the SNWA would implement its ROW ACMs, including measures required as part of Dust Control Permits and other required operating permits; 2) the SNWA would routinely inspect and repair project roads with a BLM inspector; and 3) the SNWA would use soil tackifiers and other materials to suppress dust in accordance with the BLM approval. Based on these measures, it is expected that impacts due to construction would be minimized and be short-term in nature and impacts are not expected to impair visibility conditions at GBNP. There would be a small incremental increase in the concentration of air pollutants in areas near the permanent groundwater development ROW during periods of maintenance.

Groundwater Pumping

Windblown Dust Emissions from Groundwater Drawdown

It is predicted that increased dust may be generated as the result of 10-foot or greater drawdown over different pumping time frames (**Table 3.1-29**). It is estimated that an additional 1,068 tons of PM_{10} would be emitted per year after full build out; 8,747 tons of PM_{10} would be emitted per year after full build out plus 75 years; and 11,608 tons of PM_{10}

would be emitted per year after full build out plus 200 years. Also, it is estimated that an additional 107 tons of $PM_{2.5}$ would be emitted per year after full build out; 875 tons of $PM_{2.5}$ would be emitted per year for full build out plus 75 years; and 1,161 tons of $PM_{2.5}$ would be emitted per year for full build out plus 200 years.

Table 3.1-29 Alternative F, Estimated Increases in Windblown Dust from Evapotranspiration Affected by 10-foot or Greater Pumping Drawdown Over Different Time Periods

ET Unit[1]	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year) (full build out plus 75 years)	PM_{10} Emissions from Windblown Dust Relative to No Action (tons per year) (full build out plus 200 years)
Bare Soil/Sparse Vegetation	1,585	45,448	70,312	94	2,134	2,928
Phreatophyte/Medium Vegetation	6,687	43,600	60,280	939	5,590	6,890
Wetland/Meadow	85	3,097	5,519	36	1,023	1,790
Total				**1,068**	**8,747**	**11,608**

[1] ET units are defined based on vegetation cover type (see Section 3.5, Vegetation Resources).

As described in the methodology section, the predicted emissions associated with groundwater drawdown were modeled for Alternative F. The modeling analysis shows that the predicted concentrations of PM_{10} and $PM_{2.5}$ in Clark County, GBNP, and in the Wasatch Front are insignificant (below the SILs) for Alternative F (**Table 3.1-30**). Therefore, all PM_{10} and $PM_{2.5}$ impacts are insignificant in the areas analyzed for Alternative F.

Table 3.1-30 Air Quality Impacts from Alternative F Compared to SILs

Pollutant	Area	Averaging Period	Maximum Modeled Concentrations[1] Project-Alone (Alternative F Full Build Out+ 75 Years) ($\mu g/m^3$)	SIL ($\mu g/m^3$)	Model Impacts Exceed SILs?
$PM_{2.5}$	Clark County	24-hr	0.06	1.2	No
		Annual	0.001	0.3	No
	GBNP	24-hr	0.25	1.2	No
		Annual	0.02	0.3	No
	Wasatch Front	24-hr	0.09	1.2	No
		Annual	0.002	0.3	No
PM_{10}	Clark County	24-hr	0.16	5	No
	GBNP	24-hr	1.34	5	No
	Wasatch Front	24-hr	0.24	5	No

[1]Concentrations represent the highest modeled concentrations.

The modeled visibility impacts for Alternative F (**Table 3.1-31**) indicate that the eighth highest day would have less than a 5 percent change in light extinction and visibility at GBNP would be unlikely to be impaired. The eighth highest percent change in visibility is a threshold used by the FLMs (FLAG 2010) (see **Appendix F3.1.2** for more information regarding limitations of the modeling analysis).

Table 3.1-31 Modeled-Predicted Visibility Impacts for Alternative F at Great Basin National Park

Great Basin National Park	Days > than 5% ΔB_{ext}	Days > than 10% ΔB_{ext}	8th Highest % ΔB_{ext}
Alternative F (Full Build Out + 75 Years)	1	0	2.94
Total (No Action + Alt F Full Build Out + 75 Years)	2	0	3.33

Note that GBNP is a Class II area, which does not have visibility protection under federal or state law. Impacts are presented for informational purposes only.

Greenhouse Gas Emissions from Groundwater Pumping

Since the pump stations would be electrically powered and greenhouse gases are emitted during the generation of most electricity, the power requirements of this project have an indirect contribution to the emissions of greenhouse gases. The continuous power requirements to operate the pump stations and other ancillary equipment are estimated to be an additional 55 MW (**Table 2.6-2**). The continuous generation of this electricity amount is estimated to release approximately 185,000 metric tons of carbon dioxide equivalent per year, and is comparable to the emissions from the electricity use of nearly 20,000 homes for 1 year. For context, the estimated indirect greenhouse gas emissions from electricity generation for this alternative are less than 0.004 percent of the carbon dioxide equivalent estimated to be emitted by the U.S. in 2010 (USEPA 2012b) and less than 0.4 percent of the carbon dioxide equivalent estimated to be emitted in Nevada in 2005 (NDEP 2008).

These power requirements, and thus the associated carbon dioxide equivalent emissions, would be offset by electrical generation as part of the project via installation of hydroturbines (detailed in **Appendix E**) and solar panels to the extent possible. It is estimated that as much as 40 percent of the project's power requirements could be provided by the installation of hydroturbines at the three pressure reducing stations.

Conclusion

- The level and extent of air impacts from groundwater drawdown of 10-feet and greater are highly uncertain and the following impacts should be used for comparison purposes only. It is estimated that an additional 1,068 tons of PM_{10} would be emitted per year after full build out, 8,747 tons of PM_{10} would be emitted per year after full build out plus 75 years, and 11,608 tons of PM_{10} would be emitted per year after full build out plus 200 years. Also, it is estimated that an additional 107 tons of $PM_{2.5}$ would be emitted per year after full build out, 875 tons of $PM_{2.5}$ would be emitted per year after full build out plus 75 years, and 1,161 tons of $PM_{2.5}$ would be emitted per year after full build out plus 200 years It has been demonstrated that these emission will not significantly contribute to nearby PM_{10} or $PM_{2.5}$ nonattainment area such as Clark County or the Wasatch Front. Model-predicted impacts also indicate that applicable AAQS at GBNP would be met and visibility conditions at the GBNP are unlikely to be impaired.
- Based on predicted power requirements for pumping activities, indirect emissions of greenhouse gases associated with electricity generation would be approximately 185,000 metric tons of carbon dioxide equivalent per year. These power requirements would be offset by electrical generation via installation of hydroturbines (**Appendix E**) and solar panels to the extent possible.
- In order to strengthen the SNWA's adaptive management program, mitigation measure GW-AQ-3 (Monitoring, Mitigation, and Management Plan for Air Quality) is recommended. This measure is part of the COM Plan, which is described in Section 3.20.

Potential residual impacts include:

- The COM Plan, ACMs, and monitoring and mitigation measures for air and water resources could be effective in reducing impacts to air quality. An objective of the COM Plan is to avoid, minimize, or mitigate degradation of visibility and air quality due to potential increases in airborne particulates and loss of surface vegetation. By avoiding or minimizing drawdown effects on soil and vegetation, the magnitude of airborne particulates could be reduced. However, residual effects on air quality could occur considering the long recovery period for soils and vegetation conditions. Some unavoidable adverse effects could occur at some locations.

3.1.2.16 No Action

Groundwater Development Area

Under the No Action Alternative, the proposed project would not be constructed or maintained. No project-related surface disturbance would occur. Without project construction and operation activities, there are no emissions of criteria pollutants, fugitive dust, or greenhouse gases. It is expected that natural (biogenic) and human (anthropogenic) sources of pollutant emissions would continue. Anthropogenic emissions are expected to increase in proportion to projected population increases in Lincoln County (see Section 3.18, Socioeconomics and Environmental Justice). Current anthropogenic activities, as well as natural wind conditions, would continue to generate dust as discussed in Section 3.1.1.1. Climate change would continue but the scale of these changes would depend on the interactions of the atmospheric and oceanic circulation patterns and the level of future anthropogenic emissions of greenhouse gases.

Groundwater Pumping

Windblown Dust Emissions from Groundwater Drawdown

Current groundwater pumping for agricultural and municipal purposes would continue, without addition of new wells, pipelines or pumping stations from the proposed project. There would be some increase in current levels of fugitive dust generation due to continued groundwater pumping activities. The amount of dust generated by areas affected by a 10-foot or greater drawdown are shown in **Table 3.1-32**.

Table 3.1-32 No Action, Estimated Increases in Windblown Dust from Evapotranspiration Affected by 10-foot or Greater Pumping Drawdown Over Different Time Periods

ET Unit[1]	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	PM_{10} Emissions from Windblown Dust (tons per year)	PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 75 years)	PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 200 years)
Bare Soil/Sparse Vegetation	4,296	14,966	18,830	109	399	511
Phreatophyte/Medium Vegetation	6,298	17,263	22,606	418	1,374	1,928
Wetland/Meadow	1	261	2,023	0	95	795
Total				**527**	**1,869**	**3,234**

[1] ET units are defined based on vegetation cover type (see Section 3.5, Vegetation Resources).

The potential increases in dust generation from areas affected by a 10-foot or greater drawdown under the No Action Alternative are estimated to be approximately 527 tons of PM_{10} per year gradually increasing to 1,869 tons of PM_{10} per year in roughly 75 years, and would reach 3,234 tons of PM_{10} per year in roughly 200 years. Also, it is estimated that approximately 53 tons of $PM_{2.5}$ would be emitted per year; 187 tons of $PM_{2.5}$ would be emitted per year after 75 years; and 323 tons of $PM_{2.5}$ would be emitted per year after 200 years.

The modeling results show that the predicted concentrations of PM_{10} and $PM_{2.5}$ in Clark County, GBNP, and in the Wasatch Front are insignificant (below the SILs) for the No Action Alternative (**Table 3.1-33**); therefore no further air quality analyses were conducted since the No Action Alternative would not cause or contribute to an exceedance of applicable AAQS.

Table 3.1-33 Air Quality Impacts from No Action Alternative Compared to SILs

Pollutant	Area	Averaging Period	Maximum Modeled Concentrations[1] (No Action Alternative Full Build Out+ 75 Years) (μg/m³)	SIL (μg/m³)	Model Impacts Exceed SILs?
$PM_{2.5}$	Clark County	24-hr	0.020	1.2	No
		Annual	0.0004	0.3	No
	GBNP	24-hr	0.072	1.2	No
		Annual	0.004	0.3	No
	Wasatch Front	24-hr	0.027	1.2	No
		Annual	0.0004	0.3	No
PM_{10}	Clark County	24-hr	0.039	5	No
	GBNP	24-hr	0.200	5	No
	Wasatch Front	24-hr	0.037	5	No

[1]Concentrations represent the highest modeled concentrations.

The modeled visibility impacts for the No Action Alternative (**Table 3.1-34**) indicate that eighth highest day would have less than the 5 percent change in light extinction and visibility at GBNP would be unlikely to be impaired. The eighth highest percent change in visibility is a threshold used by the FLMs (FLAG 2010) (see **Appendix F3.1.2** for more information regarding limitations of the modeling analysis).

Table 3.1-34 Modeled-Predicted Visibility Impacts for No Action Alternative at Great Basin National Park

Great Basin National Park	Days > than 5% ΔB_{ext}	Days > than 10% ΔB_{ext}	8th Highest % ΔB_{ext}
No Action (Full Build Out + 75 Years)	0	0	0.47

Note that GBNP is a Class II area, which does not have visibility protection under federal or state law. Impacts are presented for informational purposes only.

Greenhouse Gas Emissions from Groundwater Pumping

Since there would be no pump stations constructed under the No Action alternative, there would be no increase to greenhouse gas emissions from power requirements.

Conclusion. Without project construction and operation activities, there are no additional emissions of criteria, fugitives dust, nor greenhouse gas pollutants from the proposed project. It is expected that:

- Natural (biogenic) and human (anthropogenic) sources of pollutant emissions would continue. Anthropogenic emissions are expected to increase in proportion to projected population increases in Lincoln County.
- Current anthropogenic activities, as well as natural wind conditions, would continue to generate dust as discussed in Section 3.1.1.1.
- Climate change would continue but the scale of these changes would depend on the interactions of the atmospheric and oceanic circulation patterns and level of future anthropogenic emissions of greenhouse gases.
- Current groundwater pumping for agricultural and municipal purposes would continue. At current levels of groundwater pumping, there may be some increase in current levels of windblown dust generation due to changes in vegetation and groundcover. The potential increases in dust generation from areas affected by a 10-foot or greater drawdown are estimated to be approximately 527 tons of PM_{10} per year gradually increasing to 1,869 tons of PM_{10} per year in roughly 75 years, and would reach 3,234 tons of PM_{10} per year in roughly 200 years. Also, it is estimated that approximately 53 tons of $PM_{2.5}$ would be emitted per year, 187 tons of $PM_{2.5}$ would be emitted per year after 75 years, and 323 tons of $PM_{2.5}$ would be emitted per year after 200 years. Windblown dust emissions

from groundwater drawdown under the No Action Alternative are not predicted to impair visibility conditions at the GBNP.

3.1.2.17 Alternatives Comparison

Generally, the impacts to air quality from the groundwater field development construction and maintenance are very similar between alternatives. **Table 3.1-35** shows the estimated maximum annual construction emissions for each alternative for PM_{10} and $PM_{2.5}$. Only the emissions of PM_{10} and $PM_{2.5}$ vary between alternatives since PM emissions depend on the acres of surface disturbance. The emissions of all other pollutants depend on the tailpipe emissions from construction activities which over a year, are the same for each alternative.

Table 3.1-35 Estimated Maximum Annual PM_{10} and $PM_{2.5}$ Emissions from Groundwater Field Development Construction of the Proposed Action and Alternatives A through F

Alternative	PM_{10} (tons per year)	$PM_{2.5}$ (tons per year)
Proposed Action	173	27
Alternative A	104	20
Alternative B	101	20
Alternative C	104	20
Alternative D	88	19
Alternative E	89	19
Alternative F	89	19

Table 3.1-36 shows the estimated windblown dust emissions that would result from groundwater drawdown for each alternative. As described in the preceding sections, the impacts for the alternatives are the project-alone impacts (i.e. the total impacts for an alternative would be the No Action impact plus the alternative's impacts). Generally, the impacts to air quality vary considerably between the groundwater drawdown alternatives. The Proposed Action is predicted to have the highest impacts to air quality. The air quality impacts due to the Proposed Action may be up to two-thirds higher than any other alternative. Alternative C is predicted to have the lowest air quality impacts out of the project alternatives.

Table 3.1-36 Estimated Long-Term Windblown Dust Emissions from Groundwater Drawdown for the Proposed Action and Alternatives A through F

Alternative	PM_{10} Emissions from Windblown Dust (tons per year) (full build out)	PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 75 years)	PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 200 years)	$PM_{2.5}$ Emissions from Windblown Dust (tons per year) (full build out)	$PM_{2.5}$ Emissions from Windblown Dust (tons per year) (full build out plus 75 years)	$PM_{2.5}$ Emissions from Windblown Dust (tons per year) (full build out plus 200 years)
No Action	527	1,869	3,234	53	187	323
Proposed Action[1]	2,226	14,046	17,840	223	1,405	1,784
Alternative A[1]	1,518	11,826	13,327	152	1,183	1,333
Alternative B[1]	2,233	12,104	15,995	223	1,210	1,599
Alternative C[1]	1,518	5,416	6,690	152	542	669
Alternative D[1]	0	2,474	8,252	0	247	825
Alternative E[1]	1,518	7,464	8,563	152	746	856
Alternative F[1]	1,068	8,747	11,608	107	875	1,161

[1] Project-alone impacts are shown for each alternative. Total impacts for each alternative are the No Action impacts plus the Alternative's impact.

3.1.3 Cumulative Impacts

3.1.3.1 Climate Change Effects to Air Quality and Other Resources

Climate Change Effects

Climate change already appears to be influencing both natural and managed ecosystems of the American Southwest and Great Basin Desert (Breshears et al. 2005, Westerling et al. 2006, Seager et al. 2007) and models indicate the likelihood of the Southwest being a climate change "hotspot" in the coming decades (Diffenbaugh et al. 2008). Recent warming in the Southwest is among the most rapid in the nation, significantly more than the global average in some areas (USGCRP 2009). Projections suggest continued strong warming in the study area, with significant increases in temperature (USGCRP 2009) and decreases in precipitation (Seager et al. 2007). In the coming century, mean global temperature could increase significantly, with an associated increase in both the frequency of extreme events (heat waves, droughts, storms) and the frequency and extent of wildfire (IPCC 2007; Westerling & Bryant 2008; Krawchuk et al. 2009). Under such conditions, future impacts could be substantial for some resources, impacting biodiversity, protected areas, and agricultural lands.

Climate change effects are evaluated separately for air resources versus all other resources. While air resources may directly affect the magnitude of climate change with the emissions of greenhouse gases, other resources are affected by climate change. Due to the nature of greenhouse gas emissions into the atmosphere, it is impossible to link a specific greenhouse emission and a specific climate change.

Proposed Project's Air Impacts to Climate Change

The USEPA has new regulations that now require mandatory reporting of greenhouse gases if production exceeds 25,000 metric tons of carbon dioxide equivalent per year for certain industrial and intensive agricultural activities (40 CFR 98.2; 74 FR 56374). Twenty-five thousand metric tons represent approximately 0.0000041 of 1 percent of annual national emissions, which is estimated to be six billion metric tons (USEPA 2009). It is important to note that this new USEPA reporting requirement does not apply to any of the proposed actions and it is shown here to give a sense of scope and scale to potential impacts. It is for comparison purposes only.

Table 3.1-37 shows the estimated annual greenhouse gas emissions for each project alternative. The estimated maximum annual greenhouse gas emissions during the ROW construction and maintenance activities for all alternatives are anticipated to be less than 25,000 metric tons a year in terms of carbon dioxide equivalent, while indirect emissions of greenhouse gases from power generation required for groundwater pumping could be as high as 327,000 metric tons of carbon dioxide equivalent, which is less than 0.006 of 1 percent of annual U.S. emissions in 2010 (USEPA 2012b) and less than 0.6 percent of Nevada emissions in 2005 (NDEP 2008). The greenhouse gas emissions would be highest for the Proposed Action and lowest for Alternative D.

Table 3.1-37 Estimated Direct and Indirect Greenhouse Gas Emissions for the Proposed Action and Alternatives A through F

Alternative	Maximum Emissions from ROW Construction and Maintenance (Tonnes of Carbon Dioxide Equivalent per year)	Long-term Direct Emissions from ROW Maintenance (Tonnes of Carbon Dioxide Equivalent per year)	Long-term Indirect Emissions from Groundwater Pumping (Tonnes of Carbon Dioxide Equivalent per year)
No Action	0	0	0
Proposed Action	23,896	8	327,000
Alternative A	23,896	8	250,000
Alternative B	23,896	8	327,000
Alternative C	23,896	8	250,000
Alternative D	23,896	5	182,000
Alternative E	23,896	7	185,000
Alternative F	23,896	8	185,000

The power requirements, and therefore the greenhouse gas emissions, for all alternatives would be offset by electrical generation as part of the project via installation of hydroturbines and solar panels (detailed in **Appendix E**) to the extent possible. It is estimated that as much as 40 percent of the project's power requirements could be provided by the installation of hydroturbines at the three pressure reducing stations.

Climate Change Effects to Air Resources

Climate change is not shown to have a direct effect on any criteria pollutants other than ozone. It has been found that concentrations of ground level ozone are likely to increase due to increasing temperatures (Wise 2009). This indicates that areas currently designated as "maintenance" status for ozone are likely to have added difficulty maintaining levels below the ozone standard. Although no other criteria pollutants have been shown to be directly impacted by climate change, potential future regulations aimed to reduce greenhouse gas emissions may have an indirect effect on other pollutants (such as nitrogen dioxide [NO_2] or SO_2) co-emitted with greenhouse gas. Increases in wildland fire, described below, also will contribute in increased emissions of air pollutants.

Climate Change Effects to Other Resources

While air resources has the potential to directly affect climate change with the emissions of greenhouse gases, alterations to regional climate could potentially affect other resources such as vegetation, wildfires, etc. The potential effects of climate change on other resources are described in detail in the relevant resource sections. **Table 3.1-38** shows the resources predicted to be affected by climate change, the potential affects, and the reference section of this document that provides additional information.

Table 3.1-38 Summary of Potential Climate Change Effects to Resources

Resource	Summary of Potential Climate Change Effects to Resources in the Project Area	Reference Section
Air	• Increased ozone concentrations in areas predicted to have increased temperature. • Increased air quality impacts from increased wildfires.	3.1.3.1
Geology	• Climate change effects were not evaluated for this resource because potential effects to Geology as a result of climate change cannot be directly quantified.	3.2.3.1
Water	• Altered patterns, timing and amounts of precipitation • Altered surface hydrology (volume and timing of surface flows, rainfall-runoff response, flood events, water quality, sediment and contaminant transport). • Altered vadose zone hydrology (runoff, ET, infiltration, groundwater recharge). • Altered hydrogeology (groundwater flow).	3.3.3.1
Soils	• Soil moisture: projections of decreasing or more variable precipitation could lead to lower soil moistures, potentially affecting agriculture, regional plant and animal species composition, and regional weather patterns. • Erosion: projections of increasing rates or amounts of precipitation and/or changes in vegetation as a result of synergistic climate changes could lead to significant increases in erosion rates.	3.4.3.1
Vegetation and Wildland Fire	• Altered distribution of vegetation at local spatial scales. • Altered vegetation types and spatial arrangements (i.e., woody vs. herbaceous species). • Altered amounts, spatial arrangement, connectivity, and types of surface fuels. • Altered precipitation patterns, which could lead to prolonged drought, exacerbating the risk of wildland fire. • Altered species' phenology	3.5.3.1
Wildlife	• Altered or restricted physical ranges of species present. • Altered disease dynamics and the introduction of novel pathogens. • Modification, shifting, or elimination of habitats. • Altered species' phenology.	3.6.3.1
Aquatic	• Modified or altered aquatic habitats due to changes in precipitation. • Altered water quality parameters such as water temperature and dissolved oxygen. • Altered aquatic species abundance, distribution, phenology, and community composition in response to habitat and water quality changes.	3.7.3.1

Table 3.1-38 Summary of Climate Change Effects to Resources (Continued)

Resource	Summary of Potential Climate Change Effects to Resources in the Project Area	Reference Section
Land Use	• Temperature and atmospheric CO_2: while some crops show positive responses to elevated CO_2 and lower levels of warming, higher levels of warming often negatively affect growth and yields. • Precipitation: extreme events such as heavy downpours and droughts are likely to reduce crop yields because excesses or deficits of water have negative impacts on plant growth. • Invasive species: weeds, diseases, and insect pests benefit from warming and weeds also benefit from a higher CO_2 concentration, increasing stress on crop plants and requiring more attention to pest and weed control.	3.8.3.1
Recreation	• Climate change effects were not evaluated for this resource because potential effects to Recreation as a result of climate change cannot be directly quantified.	3.9.3.1
Transportation	• Climate change effects were not evaluated for this resource because potential effects to Transportation as a result of climate change cannot be directly quantified.	3.10.3.1
Mineral	• Climate change effects were not evaluated for this resource because potential effects to Minerals as a result of climate change cannot be directly quantified.	3.11.3.1
Range and Grazing	• Temperature and atmospheric CO_2: while some forage species may have positive responses to elevated CO_2 and lower levels of warming, higher levels of warming may negatively affect growth and yields of rangeland plants. • Precipitation: extreme events such as heavy downpours and droughts are likely to reduce forage yields because excesses or deficits of water have negative impacts on plant growth. • Invasive species: weeds, diseases, and insect pests benefit from warming and weeds also benefit from a higher CO_2 concentration, increasing stress on crop plants and requiring more attention to pest and weed control. • Forage: quality in pasture and rangeland generally declines with increasing CO_2 concentration because of the effects on plant nitrogen and protein content, reducing the land's ability to supply adequate livestock feed.	3.12.3.1
Wild Horses	• Altered vector and pathogen distribution. • Altered thermal extremes. • Modification, shifting, or elimination of habitats. • Forage: quality in pasture and rangeland generally declines with increasing CO_2 concentration because of the effects on plant nitrogen and protein content, reducing the land's ability to supply adequate livestock feed.	3.13.3.1
Special Designation	• Climate change effects were not evaluated for this resource because potential effects to Special Designation as a result of climate change cannot be directly quantified.	3.14.3.1
Visual	• Climate change effects were not evaluated for this resource because potential effects to Visual Resources as a result of climate change cannot be directly quantified.	3.15.3.1
Cultural	• Climate change effects were not evaluated for this resource because potential effects to Cultural Resources as a result of climate change cannot be directly quantified.	3.16.3.1
Native American	• Climate change effects were not evaluated for this resource because potential effects to Native American Resources as a result of climate change cannot be directly quantified.	3.17.3.1
Socioeconomics	• Climate change effects were not evaluated for this resource because potential effects to Socioeconomics as a result of climate change cannot be directly quantified.	3.18.3.1
Public Safety and Health	• Climate change effects were not evaluated for this resource because potential effects to Public Safety and Health as a result of climate change cannot be directly quantified.	3.19.3.1

3.1.3.2 Issues

Rights-of-way and Groundwater Development Area Construction and Maintenance

- Short-term air pollutants emitted from the tailpipes of construction equipment, including criteria pollutants, ozone precursors, and greenhouse gas emissions.
- Short-term fugitive dust generated during construction and long-term fugitive dust generated during facility maintenance.
- Short-term and long-term windblown dust generated due to wind erosion of surfaces disturbed during construction and maintenance.
- Entrainment and transport of radioactive material and erionite due to wind erosion of disturbed surfaces.

Groundwater Pumping

- Short-term, long-term, and permanent windblown dust generated due to wind erosion of surfaces disturbed due to groundwater drawdown.
- Short-term, long-term, and permanent impairment of visibility conditions at GBNP due to wind erosion of surfaces disturbed from groundwater pumping.
- Changes in Salt Lake City's PM_{10} air emissions due to the effects of groundwater pumping on soils and vegetation.

3.1.3.3 Assumptions

Assumptions regarding compliance with regulatory requirements, detailed project operations, inputs for emission factors, and future conditions are required to estimate impacts to air quality and climate.

Key assumptions regarding compliance with regulatory and the BLM requirements include:

- All state and local air quality construction permits will be received prior to initiation of project construction.
- Any operating permits or dust control plans required in nonattainment areas will address any conformity requirements (although no groundwater development activities are planned in nonattainment areas at this time) or demonstrate that total emissions in nonattainment areas will be below applicable thresholds.
- The Ely and Las Vegas RMP management actions and best management practices would be applied to all proposed construction activities, based on the most current RMPs – Ely 2008; Las Vegas 1998 (BLM 2008, 1998).
- The ACMs included in the SNWA POD to manage surface disturbance effects for ROWs provide a basis for appropriate measures that may be submitted in future SNWA ROW applications. For purposes of impact analysis, it has been assumed that measures appropriate for ROW construction would be applied to construction in groundwater development areas.

Rights-of-way and Groundwater Development Area Construction and Maintenance

- Construction and maintenance impacts for the groundwater development phase are assumed to be qualitatively similar to the ROW construction and maintenance impacts. This implies that the assumptions made in the estimation of ROW construction and maintenance emissions are appropriate for groundwater development maintenance emissions.
- Total construction and maintenance emissions are such a negligible fraction of total emissions in the project area that the project has a negligible contribution to cumulative air quality.

Groundwater Pumping

- The cumulative surface disturbance effects were estimated by overlaying the existing surface disturbances for PPAs, RFFAs, and the development areas for the project alternative being evaluated (**Figure 3.1-6**). The expected cumulative changes in vegetation communities and soil surface conditions are used to estimate future fugitive dust impacts for each alternative due to groundwater drawdown. Surface conditions were categorized based on ET units defined for the groundwater modeling analysis in the manner identical to the estimation of project-specific windblown dust due to groundwater pumping in Section 3.1.2.2. Impacts are reported for the total cumulative impact due to the project alternative and any past and present actions and RFFAs.

3.1.3.4 Methodology for Analysis

For the estimation of air quality related impacts, the methodology depends on the activity (construction, pumping, etc.) and the type of air impacts (criteria emissions, greenhouse gases, etc.). The activity/air impact combinations are grouped based on the methodology used to estimate impacts. The calculation methodology for each category is described below.

The different methodologies for developing air impacts are grouped into the following categories:

- Groundwater Development Area Construction and Operational Maintenance
  - Tailpipe emissions
  - Fugitive dust
  - Greenhouse gases
- Groundwater Pumping
  - Windblown dust from soils exposed as a result of groundwater pumping
  - Windblown dust impacts to Utah

Rights-of-way and Groundwater Development Area Construction and Maintenance

Estimated project air quality impacts are presented in the form of total estimated ROW and groundwater field development construction and operational maintenance emissions for each alternative. For every alternative, the construction emissions are temporary and transient. The emissions from maintenance are minimal. Total project emissions for each alternative are predicted to be much less than 1 percent of total future emissions in the project area. Therefore, the cumulative impacts to air quality due to ROW and groundwater development construction and maintenance are anticipated to be negligible. Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change as a result of ROW and groundwater field development construction and maintenance activities. A formal cumulative air quality impact analysis to demonstrate compliance with applicable AAQS will be conducted with project-specific emissions as part of any required operating permits.

Groundwater Pumping

Windblown Dust Emissions from Groundwater Drawdown

Methods described for calculating the project-specific impacts from groundwater pumping (described in Section 3.1.2.7) are identical for estimating the total impacts from groundwater pumping. The only difference is that the cumulative estimates include all known past and present actions and RFFAs in addition to the Proposed Alternative.

Future fugitive dust estimates are based on the primary ET units that were used for estimating water losses from the groundwater system via evaporation from soils and playas and via vegetation transpiration.

The area for each ET unit affected by a 10-foot groundwater drawdown contour is estimated for each alternative with all known past and present actions and RFFAs. The estimated area is projected for three model time frames: at full build out, at full build out plus 75 years, and at full build out plus 200 years. The percent of the area that will become susceptible to wind erosion is calculated for each ET unit and WEG. The total area that is susceptible to wind erosion is multiplied by the emission factor for wind erosion from the Clark County Wind Tunnel Study (Wacaser et al. 2006) to estimate hourly PM_{10} emissions of windblown dust for a specific wind band. The PM_{10} emission rate is then converted from units of tons per hour per windband into estimates of tons per year using the wind speed frequency distribution for Ely, Nevada. The $PM_{2.5}$ size range is estimated based on USEPA guidance (USEPA 1998; WRAP 2005, 2006), whereby 10 percent of the PM_{10} is in the $PM_{2.5}$ size range.

3.1.3.5 Proposed Action

Past and present actions consist primarily of existing roads, energy utility corridors, mining districts, and recent wildfires (**Figures 2.9-1** and **2.9-2**). Other activities that have influenced vegetation community composition and area include livestock grazing over nearly all public lands, and the development of towns and rural communities (Ely, McGill, Baker, Garrison, Pioche, Panaca). The primary future actions consist of construction of new utilities (pipelines and electrical distribution lines), roads and turbine pads for wind energy projects, and collector fields for solar energy projects, which would be located in Spring, Dry Lake, Muleshoe, Delamar, and Coyote Springs valleys.

Groundwater Development Area

The cumulative impacts to air quality due to ROW and groundwater field development construction and maintenance and known past and present actions and RFFAs are anticipated to be negligible. Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably. A formal cumulative air quality impact analysis to demonstrate compliance with applicable AAQS will be conducted with project-specific emissions as part of any required operating permits.

Groundwater Pumping Effects

Windblown Dust Emissions from Groundwater Drawdown

It is predicted that increased dust may be generated as the result of cumulative drawdown over different pumping time frames (**Table 3.1-39**). After full build out, windblown dust emissions due to the cumulative effects of groundwater drawdown are predicted to be 119 percent more than the project-specific windblown dust emissions. A majority of this increase is attributable to cumulative impacts from other projects (see Section 3.1.3.12, No Action Cumulative Impacts). In full build out plus 75 years, emissions are predicted to be 29 percent more than project-specific emissions. In full build out plus 200 years, emissions are predicted to be 21 percent more than project-specific emissions.

Table 3.1-39 Proposed Action, Estimated Cumulative Increases in Windblown Dust From Evapotranspiration Affected By 10-foot Or Greater Pumping Drawdown Over Different Time Periods

Cumulative ET Unit[1]	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	Total PM_{10} Emissions from Windblown Dust (tons per year)	Total PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 75 years)	Total PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 200 years)
Bare Soil/Sparse Vegetation	20,391	108,370	129,876	890	5,244	6,437
Phreatophyte/ Medium Vegetation	24,417	79,517	87,620	3,018	9,853	10,717
Wetland/Meadow	1,755	7,789	11,136	968	3,075	4,364
Total Cumulative (tons per year)				**4,876**	**18,173**	**21,518**
Percent Change Relative to Project-specific Emissions (%)				**119**	**29**	**21**

[1] ET units are defined based on vegetation cover type (see Section 3.5, Vegetation Resources).

Similar to the approach used in the assessment of project impacts from groundwater pumping (described in Section 3.1.2.7) the project-specific emissions associated with groundwater drawdown were modeled for Alternatives A, E, F and the No Action Alternative. The estimated cumulative impacts are assessed qualitatively relative to the alternatives explicitly modeled. The modeling analysis shows that the predicted concentrations of PM_{10} and $PM_{2.5}$ in Clark County and in the Wasatch Front are insignificant for all Alternatives (**Tables 3.1-20, 3.1-27**, and **3.1-30**). Since the emissions for the cumulative Proposed Action are approximately 54 percent greater than the project-specific emissions for Alternative A at 75 years after full build out, then it can be inferred that the future impacts from the cumulative Proposed Action would be moderately higher than project-specific emissions for impacts for Alternative A. However, even with an increase in the emissions, it is anticipated that the cumulative Proposed Action impacts would also be insignificant at Clark County and the Wasatch Front and no further analyses are required for Clark County and the Wasatch Front since the project and RFFAs would not cause or contribute to an exceedance of applicable AAQS.

Model-predicted concentrations for Alternative A at 75 years after full build out are above the SILs at GBNP. Therefore, a more refined analysis was conducted to assess the total air quality impacts at GBNP. The model-predicted total concentrations at GBNP show compliance with applicable National and State AAQS (**Table 3.1-21**). Since the emissions for the cumulative Proposed Action are approximately 54 percent greater than the project-specific emissions for Alternative A at 75 years after full build out, then it can be inferred that the future cumulative impacts from the Proposed Action would be moderately higher than project-specific impacts for Alternative A. Even with an increase in impacts, the cumulative Proposed Action impacts are anticipated to be in compliance with applicable National and State AAQS at GBNP.

The modeled visibility impacts indicate that Alternative A has the potential to contribute to visibility impairment at GBNP (**Table 3.1-22**). Since the emissions for the cumulative Proposed Action are approximately 54 percent greater than project-specific emissions for Alternative A at 75 years after full build out, then it can be inferred that the future visibility impacts from the cumulative Proposed Action would be moderately higher than project-specific impacts for Alternative A. However, these results are conservatively high and further evaluation of visibility impacts would be required to definitively assess the potential visibility impacts to GBNP (see **Appendix F3.1.2** for more information regarding limitations of the modeling analysis).

Cumulative Effects

- Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably due to ROW and groundwater field development construction and maintenance activities.
- The level and extent of air impacts from groundwater drawdown of 10-feet and greater are highly uncertain and estimated impacts should be used for comparison purposes only. After full build out, windblown dust emissions due to the cumulative effects of groundwater drawdown are predicted to be 119 percent more than the project-specific windblown dust emissions. In full build out plus 75 years, emissions are predicted to be 29 percent more than project-specific emissions. In full build out plus 200 years, emissions are predicted to be 21 percent more than project-specific emissions. At these levels, air quality impacts are not anticipated to contribute to nearby PM_{10} or $PM_{2.5}$ nonattainment area such as Clark County or the Wasatch Front. Model-predicted impacts indicate that applicable AAQS at GBNP would be met. However, it is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at the GBNP. The extent of possible visibility impairment is highly uncertain.

3.1.3.6 Alternative A

Rights-of-way and Groundwater Development Area Construction and Maintenance

The cumulative impacts to air quality due to ROW and groundwater development construction and maintenance and known past and present actions and RFFAs are anticipated to be negligible. Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably. A formal cumulative air quality impact analysis to demonstrate compliance with applicable AAQS will be conducted with project-specific emissions as part of any required operation permits.

Groundwater Pumping Effects

Windblown Dust Emissions from Groundwater Drawdown

It is predicted that increased dust may be generated as the result of cumulative drawdown over different pumping time frames (**Table 3.1-40**). At build out, windblown dust emissions due to the cumulative effects of groundwater drawdown are predicted to be 167 percent more than the project-specific windblown dust emissions. At full build out plus 75 years, emissions are predicted to be 33 percent more than project-specific emissions. At full build out plus 200 years, emissions are predicted to be 38 percent more than project-specific emissions.

Table 3.1-40 Alternative A. Estimated Cumulative Increases in Windblown Dust from Evapotranspiration Affected By 10-foot or Greater Pumping Drawdown Over Different Time Periods

Cumulative ET Unit[1]	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	Total PM_{10} Emissions from Windblown Dust (tons per year)	Total PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 75 years)	Total PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 200 years)
Bare Soil/Sparse Vegetation	17,808	86,386	99,359	684	4,085	4,800
Phreatophyte/ Medium Vegetation	21,707	72,144	80,691	2,541	8,902	9,829
Wetland/Meadow	1,525	6,881	9,567	834	2,797	3,797
Total Cumulative (tons per year)				**4,058**	**15,784**	**18,426**
Percent Change Relative to Project-specific Emissions (%)				**167**	**33**	**38**

[1] ET units are defined based on vegetation cover type (see Section 3.5, Vegetation Resources).

Similar to the approach used during the assessment of project impacts from groundwater pumping (described in Section 3.1.2.7), the project-specific emissions associated with groundwater drawdown were modeled for Alternative A and the estimated cumulative impacts for are assessed qualitatively. The modeling analysis shows that the predicted concentrations of PM_{10} and $PM_{2.5}$ in Clark County and in the Wasatch Front are insignificant for Alternative A (**Table 3.1-20**). Since the emissions for the cumulative Alternative A are approximately 33 percent greater than the project-specific emissions for Alternative A at 75 years after full build out, then it can be inferred that the future impacts from the cumulative Alternative A would be moderately higher than project-specific impacts for Alternative A. Even with a moderate increase to impacts, the cumulative Alternative A impacts are anticipated to be insignificant at Clark County and the Wasatch Front and no further analyses are required for Clark County and the Wasatch Front since the project with RFFAs would not cause or contribute to an exceedance of applicable AAQS.

Model-predicted concentrations for Alternative A at 75 years after full build out are above the SILs at GBNP. Therefore, a more refined analysis was conducted to assess the total air quality impacts at GBNP. The model-predicted total concentrations at GBNP show compliance with applicable National and State AAQS (**Table 3.1-21**). Since the emissions for the cumulative Alternative A are approximately 33 percent greater than the project-specific emissions for Alternative A at 75 years after full build out, then it can be inferred that the future cumulative impacts from the Alternative A would be moderately higher than project-specific impacts for Alternative A. Even with a moderate increase , the cumulative Alternative A impacts would also be in compliance with applicable National and State AAQS at GBNP.

The modeled visibility impacts indicate that Alternative A has the potential to contribute to visibility impairment at GBNP (**Table 3.1-22**). Since the emissions for the cumulative Alternative A are approximately 33 percent greater than Alternative A at 75 years after full build out, then it can be inferred that the future visibility impacts from the cumulative Alternative A would be moderately higher than project-specific impacts for Alternative A. However, these results are conservatively high and further evaluation of visibility impacts would be required to definitively assess the potential visibility impacts to GBNP (see **Appendix F3.1.2** for more information regarding limitations of the modeling analysis).

Cumulative Effects

- Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably due to ROW and groundwater field development construction and maintenance activities.
- The level and extent of air impacts from groundwater drawdown of 10-feet and greater are highly uncertain and estimated impacts should be used for comparison purposes only. At full build out, windblown dust emissions due to the cumulative effects of groundwater drawdown are predicted to be 167 percent more than the project-specific windblown dust emissions. At full build out plus 75 years, emissions are predicted to be 33 percent more than project-specific emissions. At full build out plus 200 years, emissions are predicted to be 38 percent more than project-specific emissions. At these levels, air quality impacts are not anticipated to contribute to nearby PM_{10} or $PM_{2.5}$ nonattainment area such as Clark County or the Wasatch Front. Model-predicted impacts indicate that applicable AAQS at GBNP would be met. However, it is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at the GBNP. The extent of possible visibility impairment is highly uncertain.

3.1.3.7 Alternative B

Rights-of-way and Groundwater Development Area Construction and Maintenance

The cumulative impacts to air quality due to ROW and groundwater development construction and maintenance and known past and present actions and RFFAs are anticipated to be negligible. Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably. A formal cumulative air quality impact analysis to demonstrate compliance with applicable AAQS will be conducted with project-specific emissions as part of any required operation permits.

Groundwater Pumping Effects

Windblown Dust Emissions from Groundwater Drawdown

It is predicted that increased dust may be generated as the result of cumulative drawdown over different pumping time frames (**Table 3.1-41**). At full build out, emissions are predicted to be 123 percent more than project-specific emissions. At full build out plus 75 years, emissions are predicted to be 111 percent more than project-specific emissions. At full build out plus 200 years, windblown dust emissions due to the cumulative effects of groundwater drawdown are predicted to be 19 percent greater than the project-specific windblown dust emissions.

Table 3.1-41 Alternative B, Estimated Cumulative Increases in Windblown Dust from ET Units Affected by 10-foot or Greater Pumping Drawdown Over Different Time Periods

Cumulative ET Unit[1]	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	Total PM_{10} Emissions from Windblown Dust (tons per year)	PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 75 years)	PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 200 years)
Bare Soil/Sparse Vegetation	19,806	74,151	86,640	839	3,658	3,860
Phreatophyte/ Medium Vegetation	26,546	78,377	85,005	3,047	17,114	10,424
Wetland/Meadow	2,167	9,008	12,187	1,099	4,765	4,705
Total Cumulative (tons per year)				**4,984**	**25,537**	**18,988**
Percent Change Relative to Project-specific Emissions (%)				**123**	**111**	**19**

[1] ET units are defined based on vegetation cover type (see Section 3.5, Vegetation Resources).

Similar to the approach used in the assessment of project impacts from groundwater pumping (described in Section 3.1.2.7) the project-specific emissions associated with groundwater drawdown were modeled for Alternatives A, E, F and the No Action Alternative. The estimated cumulative impacts are assessed qualitatively relative to the alternatives explicitly modeled. The modeling analysis shows that the predicted concentrations of PM_{10} and $PM_{2.5}$ in Clark County and in the Wasatch Front are insignificant for all Alternatives (**Tables 3.1-20**, **3.1-27**, and **3.1-30**).Since the emissions for the cumulative Alternative B are approximately 116 percent greater than the project-specific impacts for Alternative A at 75 years after full build out, then it can be inferred that the future impacts from the cumulative Alternative B would be moderately higher the project-specific emissions for Alternative A. However, even with an increase in the emissions, it is anticipated that the cumulative Alternative B impacts would also be insignificant at Clark County and the Wasatch Front and no further analyses are required for Clark County and the Wasatch Front since the project with RFFAs would not cause or contribute to an exceedance of applicable AAQS.

Model-predicted concentrations for Alternative A at 75 years after full build out are above the SILs at GBNP. Therefore, a more refined analysis was conducted to assess the total air quality impacts at GBNP. The model-predicted total concentrations at GBNP show compliance with applicable National and State AAQS (**Table 3.1-21**). Since the emissions for the cumulative Alternative B are approximately 116 percent greater than the project-specific emissions for Alternative A at 75 years after full build out, then it can be inferred that the future cumulative impacts from the Alternative B would be moderately higher than the project-specific impacts for Alternative A. Even with an increase in impacts, the cumulative Alternative B impacts would also be in compliance with applicable National and State AAQS at GBNP.

The modeled visibility impacts indicate that Alternative A has the potential to contribute to visibility impairment at GBNP (**Table 3.1-22**). Since the emissions for the cumulative Alternative B are approximately 116 percent greater than the project-specific emissions for Alternative A at 75 years after full build out, then it can be inferred that the future visibility impacts from the cumulative Alternative B would be moderately higher than project-specific impacts for Alternative A. However, these results are conservatively high and further evaluation of visibility impacts would be required to definitively assess the potential visibility impacts to GBNP (see **Appendix F3.1.2** for more information regarding limitations of the modeling analysis).

Cumulative Effects

- Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably due to ROW and groundwater field development construction and maintenance activities.
- The level and extent of air impacts from groundwater drawdown of 10-feet and greater are highly uncertain and estimated impacts should be used for comparison purposes only. At full build out, emissions are predicted to be 123 percent more than project-specific emissions. At full build out plus 75 years, emissions are predicted to be 111 percent more than project-specific emissions. At full build out plus 200 years, windblown dust emissions due to the cumulative effects of groundwater drawdown are predicted to be 19 percent greater than the project-specific windblown dust emissions. At these levels, air quality impacts are not anticipated to contribute to nearby PM_{10} or $PM_{2.5}$ nonattainment area such as Clark County or the Wasatch Front. Model-predicted impacts indicate that applicable AAQS at GBNP would be met. However, it is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at the GBNP. The extent of possible visibility impairment is highly uncertain.

3.1.3.8 Alternative C

Rights-of-way and Groundwater Development Area Construction and Maintenance

The cumulative impacts to air quality due to ROW and groundwater development construction and maintenance and known past and present actions and RFFAs are anticipated to be negligible. Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably. A formal cumulative air quality impact analysis to demonstrate compliance with applicable AAQS will be conducted with project-specific emissions as part of any required operation permits.

Groundwater Pumping Effects

Windblown Dust Emissions from Groundwater Drawdown

It is predicted that increased dust may be generated as the result of cumulative drawdown over different pumping time frames (**Table 3.1-42**). After full build out, cumulative emissions are predicted to be 174 percent more than project-specific emissions. At full build out plus 75 years, cumulative emissions are predicted to be 88 percent more than project-specific emissions. At full build out plus 200 years, windblown dust emissions due to the cumulative effects of groundwater drawdown are predicted to be 99 percent the project-specific windblown dust emissions.

Table 3.1-42 Alternative C, Estimated Cumulative Increases in Windblown Dust from Evapotranspiration Affected by 10-foot or Greater Pumping Drawdown Over Different Time Periods

Cumulative ET Unit[1]	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	Total PM_{10} Emissions from Windblown (tons per year)	PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 75 years)	PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 200 years)
Bare Soil/Sparse Vegetation	17,808	49,665	63,009	785	2,423	2,970
Phreatophyte/ Medium Vegetation	21,707	47,246	58,774	2,577	5,800	7,175
Wetland/Meadow	1,525	4,718	8,123	790	1,961	3,192
Total Cumulative (tons per year)				**4,152**	**10,185**	**13,337**
Percent Change Relative to Project-specific Emissions (%)				**174**	**88**	**99**

[1] ET units are defined based on vegetation cover type (see Section 3.5, Vegetation Resources).

Similar to the approach used in the assessment of project impacts from groundwater pumping (described in Section 3.1.2.7) the project-specific emissions associated with groundwater drawdown were modeled for Alternatives A, E, F and the No Action Alternative. The estimated cumulative impacts are assessed qualitatively relative to the alternatives explicitly modeled. The modeling analysis shows that the predicted concentrations of PM_{10} and $PM_{2.5}$ in Clark County and in the Wasatch Front are insignificant for all Alternatives (**Tables 3.1-20, 3.1-27**, and **3.1-30**). Since the emissions for the cumulative Alternative C are approximately 14 percent less than the project-specific impacts for Alternative A at 75 years after full build out, then it can be inferred that the future impacts from the cumulative Alternative C would be somewhat less than the project-specific emissions for Alternative A. With a decrease in the emissions, it is anticipated that the cumulative Alternative C impacts would also be insignificant at Clark County and the Wasatch Front and no further analyses are required for Clark County and the Wasatch Front since the project and RFFAs would not cause or contribute to an exceedance of applicable AAQS.

Model-predicted concentrations for Alternative A at 75 years after full build out are above the SILs at GBNP. Therefore, a more refined analysis was conducted to assess the total air quality impacts at GBNP. The model-predicted total concentrations at GBNP show compliance with applicable National and State AAQS (**Table 3.1-21**). Since the emissions for the cumulative Alternative C are approximately 14 percent less than the project-specific emissions for Alternative A at 75 years after full build out, then it can be inferred that the future cumulative impacts from the Alternative C would be somewhat less than the project-specific impacts for Alternative A. Even with an increase in impacts, the cumulative Alternative C impacts are anticipated to be in compliance with applicable National and State AAQS at GBNP.

The modeled visibility impacts indicate that Alternative A has the potential to contribute to visibility impairment at GBNP (**Table 3.1-22**). Since the emissions for the cumulative Alternative C are approximately 14 percent less than Alternative A at 75 years after full build out, then it can be inferred that the future visibility impacts from the cumulative Alternative C would be somewhat less than the project-specific impacts for Alternative A. However, these results are conservatively high and further evaluation of visibility impacts would be required to definitively assess the potential visibility impacts to GBNP (see **Appendix F3.1.2** for more information regarding limitations of the modeling analysis).

Cumulative Effects

- Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably due to ROW and groundwater field development construction and maintenance activities.
- The level and extent of air impacts from groundwater drawdown of 10-feet and greater are highly uncertain and estimated impacts should be used for comparison purposes only. After full build out, cumulative emissions are predicted to be 174 percent more than project-specific emissions. At full build out plus 75 years, cumulative emissions are predicted to be 88 percent more than project-specific emissions. At full build out plus 200 years, windblown dust emissions due to the cumulative effects of groundwater drawdown are predicted to be 99 percent more than project-specific windblown dust emissions. At these levels, air quality impacts are not anticipated to contribute to nearby PM_{10} or $PM_{2.5}$ nonattainment area such as Clark County or the Wasatch Front. Model-predicted impacts indicate that applicable AAQS at GBNP would be met. However, it is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at the GBNP. The extent of possible visibility impairment is highly uncertain.

3.1.3.9 Alternative D

Rights-of-way and Groundwater Development Area Construction and Maintenance

The cumulative impacts to air quality due to ROW and groundwater development construction and maintenance and known past and present actions and RFFAs are anticipated to be negligible. Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably. A formal cumulative air quality impact analysis to demonstrate compliance with applicable AAQS will be conducted with project-specific emissions as part of any required operation permits.

Groundwater Pumping Effects

Windblown Dust Emissions from Groundwater Drawdown

It is predicted that increased dust may be generated as the result of cumulative drawdown over different pumping time frames (**Table 3.1-43**). At full build out, cumulative emissions are predicted to be approximately the same as project-specific emissions. At full build out plus 75 years, cumulative emissions are predicted to be 189 percent more than project-specific emissions. At full build out plus 200 years, windblown dust emissions due to the cumulative effects of groundwater drawdown are predicted to be approximately 50 percent more than the project-specific windblown dust emissions.

Similar to the approach used in the assessment of project impacts from groundwater pumping (described in Section 3.1.2.7) the project-specific emissions associated with groundwater drawdown were modeled for Alternatives A, E, F and the No Action Alternative. The estimated cumulative impacts are assessed qualitatively relative to the alternatives explicitly modeled. The modeling analysis shows that the predicted concentrations of PM_{10} and $PM_{2.5}$ in Clark County and in the Wasatch Front are insignificant for all Alternatives (**Tables 3.1-20, 3.1-27**, and **3.1-30**). Since the emissions for the cumulative Alternative D are approximately 4 percent less than the project-specific emissions for Alternative E at 75 years after full build out, then it can be inferred that the future impacts from the cumulative Alternative D are approximately the same as the project-specific impacts for Alternative E. Therefore, it is anticipated that the cumulative Alternative D impacts would also be insignificant at Clark County, GBNP, and the Wasatch Front and no further air quality analyses are required since the project with RFFAs would not cause or contribute to an exceedance of applicable AAQS.

The modeled visibility impacts for Alternative E (**Table 3.1-28**) indicate that the eighth highest day would have less than a 5 percent change in light extinction and visibility at GBNP would be unlikely to be impaired. The eighth highest percent change in visibility is a threshold used by the FLMs (FLAG 2010).Since the emissions for the cumulative Alternative D are approximately 4 percent less than the project-specific emissions for Alternative E at 75 years after full build out, then it can be inferred that the future visibility impacts from the cumulative Alternative D would be approximately the same as the project-specific impacts for Alternative E (see **Appendix F3.1.2** for more information regarding limitations of the modeling analysis).

Table 3.1-43 Alternative D, Estimated Cumulative Increases in Windblown Dust from ET Units Affected by 10-foot or Greater Pumping Drawdown Over Different Time Periods

Cumulative ET Unit[1]	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	Total PM_{10} Emissions from Windblown (tons per year)	Total PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 75 years)	Total PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 200 years)
Bare Soil/Sparse Vegetation	10,322	36,131	51,043	427	1,420	2,132
Phreatophyte/Medium Vegetation	6,147	35,406	61,272	569	3,969	7,089
Wetland/Meadow	1,157	4,067	7,584	654	1,763	3,084
Total Cumulative (tons per year)				**1,651**	**7,151**	**12,305**
Percent Change Relative to Project-specific Emissions (%)				**--**	**189**	**49**

[1] ET units are defined based on vegetation cover type (see Section 3.5, Vegetation Resources).

Cumulative Effects

- Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably due to ROW and groundwater field development construction and maintenance activities.
- The level and extent of air impacts from groundwater drawdown of 10-feeet and greater are highly uncertain and estimated impacts should be used for comparison purposes only. At full build out, cumulative emissions are predicted to be approximately the same as project-specific emissions. At full build out plus 75 years, cumulative emissions are predicted to be 189 percent more than project-specific emissions. At full build out plus 200 years, windblown dust emissions due to the cumulative effects of groundwater drawdown are predicted to be approximately 50 percent more than the project-specific windblown dust emissions. At these levels, air quality impacts are not anticipated to contribute to nearby PM_{10} or $PM_{2.5}$ nonattainment area such as Clark County or the Wasatch Front. Model-predicted impacts indicate that applicable AAQS at GBNP would be met visibility conditions at the GBNP are unlikely to be impaired. The extent of possible visibility impairment is highly uncertain.

3.1.3.10 Alternative E

Rights-of-way and Groundwater Development Area Construction and Maintenance

The cumulative impacts to air quality due to ROW and groundwater development construction and maintenance and known past and present actions and RFFAs are anticipated to be negligible. Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably. A formal cumulative air quality impact analysis to demonstrate compliance with applicable AAQS will be conducted with project-specific emissions as part of any required operation permits.

Groundwater Pumping Effects

Windblown Dust Emissions from Groundwater Drawdown

It is predicted that increased dust may be generated as the result of cumulative drawdown over different pumping time frames (**Table 3.1-44**). At full build out, cumulative emissions are predicted to be 178 percent more than project-specific emissions. At full build out plus 75 years, cumulative emissions are predicted to be 55 percent more than project-specific emissions. At full build out plus 200 years, windblown dust emissions due to the cumulative effects of groundwater drawdown are predicted to be 61 percent more than the project-specific windblown dust emissions.

Table 3.1-44 Alternative E, Estimated Cumulative Increases in Windblown Dust from ET Units Affected by 10-foot or Greater Pumping Drawdown Over Different Time Periods

Cumulative ET Unit[1]	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	Total PM_{10} Emissions from Windblown Dust (tons per year)	Total PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 75 years)	Total PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 200 years)
Bare Soil/Sparse Vegetation	17,808	63,455	73,554	785	2,673	3,022
Phreatophyte/ Medium Vegetation	21,707	59,349	68,013	2,577	6,882	7,756
Wetland/Meadow	1,525	4,805	7,492	854	2,033	3,004
Total Cumulative (tons per year)				**4,217**	**11,588**	**13,783**
Percent Change Relative to Project-specific Emissions (%)				**178**	**55**	**61**

[1] ET units are defined based on vegetation cover type (see Section 3.5, Vegetation Resources).

Similar to the approach used during the assessment of project impacts from groundwater pumping (described in Section 3.1.2.7), the project-specific emissions associated with groundwater drawdown were modeled for Alternative E and the estimated cumulative impacts for are assessed qualitatively. The modeling analysis shows that the predicted concentrations of PM_{10} and $PM_{2.5}$ in are insignificant for Alternative E for all areas analyzed (**Table 3.1-27**). Since the emissions for the cumulative Alternative E are approximately 55 percent greater than the project-specific emissions for Alternative E at 75 years after full build out, then it can be inferred that the future impacts from the cumulative Alternative E would be moderately higher than project-specific impacts for Alternative E. Even with a moderate increase to impacts, the cumulative Alternative E impacts are anticipated to be insignificant at Clark County, GBNP, and the Wasatch Front and no further air quality analyses are required since the project with RFFAs would not cause or contribute to an exceedance of applicable AAQS.

The modeled visibility impacts for Alternative E (**Table 3.1-28**) indicate that the eighth highest day would have less than a 5 percent change in light extinction and visibility at GBNP would be unlikely to be impaired. The eighth highest percent change in visibility is a threshold used by the FLMs (FLAG 2010). Since the emissions for the cumulative Alternative E are approximately 55 percent greater than the project-specific impacts for Alternative E at 75 years after full build out, then it can be inferred that the future visibility impacts from the cumulative Alternative E would be moderately higher than project-specific impacts for Alternative E and cumulative impacts could cause some small level of visibility impairment. However, these results are conservatively high and further evaluation of visibility impacts would be required to definitively assess the potential visibility impacts to GBNP (see **Appendix F3.1.2** for more information regarding limitations of the modeling analysis).

Cumulative Effects

- Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably due to ROW and groundwater field development construction and maintenance activities.
- The level and extent of air impacts from groundwater drawdown of 10-feet and greater are highly uncertain and estimated impacts should be used for comparison purposes only. At full build out, cumulative emissions are predicted to be 178 percent more than project-specific emissions. At full build out plus 75 years, cumulative emissions are predicted to be 55 percent more than project-specific emissions. At full build out plus 200 years, windblown dust emissions due to the cumulative effects of groundwater drawdown are predicted to be 61 percent more than the project-specific windblown dust emissions. At these levels, air quality impacts are not anticipated to

contribute to nearby PM_{10} or $PM_{2.5}$ nonattainment area such as Clark County or the Wasatch Front. Model-predicted impacts indicate that applicable AAQS at GBNP would be met. However, it is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at the GBNP. The extent of possible visibility impairment is highly uncertain.

3.1.3.11 Alternative F

Rights-of-way and Groundwater Development Area Construction and Maintenance

The cumulative impacts to air quality due to ROW and groundwater development construction and maintenance and known past and present actions and RFFAs are anticipated to be negligible. Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably. A formal cumulative air quality impact analysis to demonstrate compliance with applicable AAQS will be conducted with project-specific emissions as part of any required operation permits.

Groundwater Pumping Effects

Windblown Dust Emissions from Groundwater Drawdown

It is predicted that increased dust may be generated as the result of cumulative drawdown over different pumping time frames (**Table 3.1-45**). At full build out, cumulative emissions are predicted to be 245 percent more than project-specific emissions. At full build out plus 75 years, cumulative emissions are predicted to be 46 percent more than project-specific emissions. At full build out plus 200 years, windblown dust emissions due to the cumulative effects of groundwater drawdown are predicted to be 33 percent more than the project-specific windblown dust emissions.

Table 3.1-45 Alternative F, Estimated Cumulative Increases in Windblown Dust from ET Units Affected by 10-foot or Greater Pumping Drawdown Over Different Time Periods

Cumulative ET Unit[1]	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	Total PM_{10} Emissions from Windblown Dust (tons per year)	Total PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 75 years)	Total PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 200 years)
Bare Soil/Sparse Vegetation	16,263	75,011	88,552	738	3,259	3,820
Phreatophyte/Medium Vegetation	19,381	64,772	74,168	2,199	7,482	8,464
Wetland/Meadow	1,509	5,278	8,447	753	2,013	3,150
Total Cumulative (tons per year)				**3,689**	**12,754**	**15,434**
Percent Change Relative to Project-specific Emissions (%)				**245**	**46**	**33**

[1] ET units are defined based on vegetation cover type (see Section 3.5, Vegetation Resources).

Similar to the approach used during the assessment of project impacts from groundwater pumping (described in Section 3.1.2.7), the project-specific emissions associated with groundwater drawdown were modeled for Alternative F and the estimated cumulative impacts for are assessed qualitatively. The modeling analysis shows that the predicted concentrations of PM_{10} and $PM_{2.5}$ in are insignificant for Alternative F for all areas analyzed (**Table 3.1-30**). Since the emissions for the cumulative Alternative F are approximately 46 percent greater than the project-specific emissions for Alternative F at 75 years after full build out, then it can be inferred that the future impacts from the cumulative Alternative F would be moderately higher than project-specific impacts for Alternative F. Even with a moderate increase to impacts, the cumulative Alternative F impacts are anticipated to be insignificant at Clark County, GBNP, and the Wasatch Front and no further air quality analyses are required since the project with RFFAs would not cause or contribute to an exceedance of applicable AAQS.

The modeled visibility impacts for Alternative F (**Table 3.1-31**) indicate that the eighth highest day would have less than a 5 percent change in light extinction and visibility at GBNP would be unlikely to be impaired. The eighth highest percent change in visibility is a threshold used by the FLMs (FLAG 2010). Since the emissions for the cumulative Alternative F are approximately 46 percent greater than the project-specific impacts for Alternative F at 75 years after full build out, then it can be inferred that the future visibility impacts from the cumulative Alternative F would be moderately higher than project-specific impacts for Alternative F and cumulative impacts could cause some small level of visibility impairment. However, these results are conservatively high and further evaluation of visibility impacts would be required to definitively assess the potential visibility impacts to GBNP (see **Appendix F3.1.2** for more information regarding limitations of the modeling analysis).

Cumulative Effects

- Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably due to ROW and groundwater field development construction and maintenance activities.
- The level and extent of air impacts from groundwater drawdown of 10-feet and greater are highly uncertain and estimated impacts should be used for comparison purposes only. At full build out, cumulative emissions are predicted to be 245 percent more than project-specific emissions. At full build out plus 75 years, cumulative emissions are predicted to be 46 percent more than project-specific emissions. At full build out plus 200 years, windblown dust emissions due to the cumulative effects of groundwater drawdown are predicted to be 33 percent more than the project-specific windblown dust emissions. At these levels, air quality impacts are not anticipated to contribute to nearby PM_{10} or $PM_{2.5}$ nonattainment area such as Clark County or the Wasatch Front. Model-predicted impacts indicate that applicable AAQS at GBNP would be met. However, it is possible that windblown dust emissions from groundwater drawdown could impair visibility conditions at the GBNP. The extent of possible visibility impairment is highly uncertain.

3.1.3.12 No Action

Groundwater Development Area

The cumulative impacts to air quality due to already authorized activities, and known past and present actions and RFFAs are anticipated to be negligible. Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably.

Groundwater Pumping Effects

Windblown Dust Emissions from Groundwater Drawdown

It is predicted that increased dust may be generated as the result of cumulative drawdown over different pumping time frames (**Table 3.1-46**). This table shows that approximately 2,027 tons of PM_{10} per year, 3,827 tons of PM_{10} per year, and 5,291 tons of PM_{10} per year are due to non-project impacts at the full build out timeframe, full build out plus 75 years timeframe and at full build out plus 200 years timeframe, respectively. In 200 years, windblown dust emissions due to the cumulative effects of groundwater drawdown without the project are predicted to be 64 percent more than the No Action alternative, shown in Section 3.1.2.6, which doesn't include past and present actions and RFFAs, but does include authorized pumping quantities.

Similar to the approach used during the assessment of project impacts from groundwater pumping (described in Section 3.1.2.7), the project-specific emissions associated with groundwater drawdown were modeled for the No Action Alternative and the estimated cumulative impacts for are assessed qualitatively. The modeling analysis shows that the predicted concentrations of PM_{10} and $PM_{2.5}$ in are insignificant for Alternative E for all areas analyzed (**Table 3.1-33**). Since the emissions for the cumulative No Action Alternative are approximately 105 percent greater than the project-specific emissions for No Action Alternative at 75 years after full build out, then it can be inferred that the future impacts from the cumulative No Action Alternative would be moderately higher than project-specific impacts for No Action Alternative. Even with a moderate increase to impacts, the cumulative No Action Alternative impacts are anticipated to be insignificant at Clark County, GBNP, and the Wasatch Front and no further air quality analyses are required since the project with RFFAs would not cause or contribute to an exceedance of applicable AAQS.

Table 3.1-46 No Action, Estimated Cumulative Increases in Windblown Dust from ET Units Affected by 10-foot or Greater Pumping Drawdown Over Different Time Periods

Cumulative ET Unit[1]	Acres Affected (full build out)	Acres Affected (full build out plus 75 years)	Acres Affected (full build out plus 200 years)	Total PM_{10} Emissions from Windblown Dust (tons per year)	Total PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 75 years)	Total PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 200 years)
Bare Soil/Sparse Vegetation	13,047	26,802	31,913	510	959	1,129
Phreatophyte/ Medium Vegetation	9,174	20,556	26,579	814	1,856	2,435
Wetland/Meadow	1,240	1,840	3,801	703	1,013	1,727
Total Cumulative without Project (tons per year)				**2,027**	**3,827**	**5,291**
Percent Change Relative to No Action (%)				**284**	**105**	**64**

[1] ET units are defined based on vegetation cover type (see Section 3.5, Vegetation Resources).

The modeled visibility impacts for No Action Alternative (**Table 3.1-34**) indicate that the eighth highest day would have less than a 5 percent change in light extinction and visibility at GBNP would be unlikely to be impaired. The eighth highest percent change in visibility is a threshold used by the FLMs (FLAG 2010). Since the emissions for the cumulative No Action Alternative are approximately 105 percent greater than the project-specific impacts for No Action Alternative at 75 years after full build out, then it can be inferred that the future visibility impacts from the cumulative No Action Alternative would be moderately higher than project-specific impacts for No Action Alternative. Even with a moderate increase in impacts, it is unlikely that visibility at GBNP would be impaired under the No Action Alternative (see **Appendix F3.1.2** for more information regarding limitations of the modeling analysis).

Cumulative Effects

- Current air quality conditions, as presented in Section 3.1.1.1, are not expected to change appreciably in the future with cumulative impacts from other projects.
- Current groundwater pumping for agricultural and municipal purposes would continue. At current levels of groundwater pumping and the addition of other projects, there would be an increase in current levels of windblown dust generation due to changes in vegetation and groundcover. Air quality impacts are not anticipated to contribute to nearby PM_{10} or $PM_{2.5}$ nonattainment area such as Clark County or the Wasatch Front. Model-predicted impacts indicate that applicable AAQS at GBNP would be met and visibility conditions would be unlikely to be impaired. The level and extent of these impacts are highly uncertain and estimated impacts should be used for comparison purposes only.
- Under the No Action Alternative, no monitoring or mitigation measures would be enacted.

3.1.3.13 Alternatives Comparison

Generally, the cumulative impacts to air quality vary considerably between the alternatives. The Proposed Action is predicted to have the highest cumulative, long-term impact to air quality. The cumulative air quality impacts due to the Proposed Action may be as much as approximately 20 percent more than any other alternative. Alternative D is predicted to have the lowest cumulative impacts out of the project alternatives; however, the impacts for full build out plus 200 years could still be approximately 250 percent more than the No Action Alternative. **Table 3.1-47** shows the estimated cumulative windblown dust emissions that would result from groundwater drawdown for each alternative combined with currently approved activities, past and present actions, and RFFAs.

Table 3.1-47 **Estimated Cumulative Windblown Dust Emissions from Cumulative Groundwater Drawdown for the Proposed Action and Alternatives A through F**

Alternative	PM_{10} Emissions from Windblown Dust (tons per year) (full build out)	PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 75 years)	PM_{10} Emissions from Windblown Dust (tons per year) (full build out plus 200 years)	$PM_{2.5}$ Emissions from Windblown Dust (tons per year) (full build out)	$PM_{2.5}$ Emissions from Windblown Dust (tons per year) (full build out plus 75 years)	$PM_{2.5}$ Emissions from Windblown Dust (tons per year) (full build out plus 200 years)
No Action	2,027	3,827	5,291	203	383	529
Proposed Action[1]	4,876	18,173	21,518	488	1,817	2,152
Alternative A[1]	4,058	15,784	18,426	406	1,578	1,843
Alternative B[1]	4,984	25,537	18,988	498	2,554	1,899
Alternative C[1]	4,152	10,185	13,337	415	1,018	1,334
Alternative D[1]	1,651	7,151	12,305	165	715	1,231
Alternative E[1]	4,217	11,588	13,783	422	1,159	1,378
Alternative F[1]	3,689	12,754	15,434	369	1,275	1,543

[1] Project-alone impacts are shown for each alternative. Total impacts for each alternative are the No Action impacts plus the Alternative's impact.

For comparison purposes, the estimated potential impacts to PM_{10} and $PM_{2.5}$ are presented for each alternative in **Figures 3.1-7** and **3.1-8**, respectively. **Figures 3.1-7** and **3.1-8** show the impacts estimated to occur at full build out (FBO), after full build out plus 75 years (FBO+75), and after full build out plus 200 years (FBO+200) for each alternative. The impacts in blue are the estimated impacts due to the currently approved activities (i.e., No Action Alternative) with all past and present actions and RFFAs. The estimated incremental impact due to the project alternatives are shown in red, and the green bars represent the total cumulative impact with all approved activities, past and present actions, RFFAs and the project alternative.

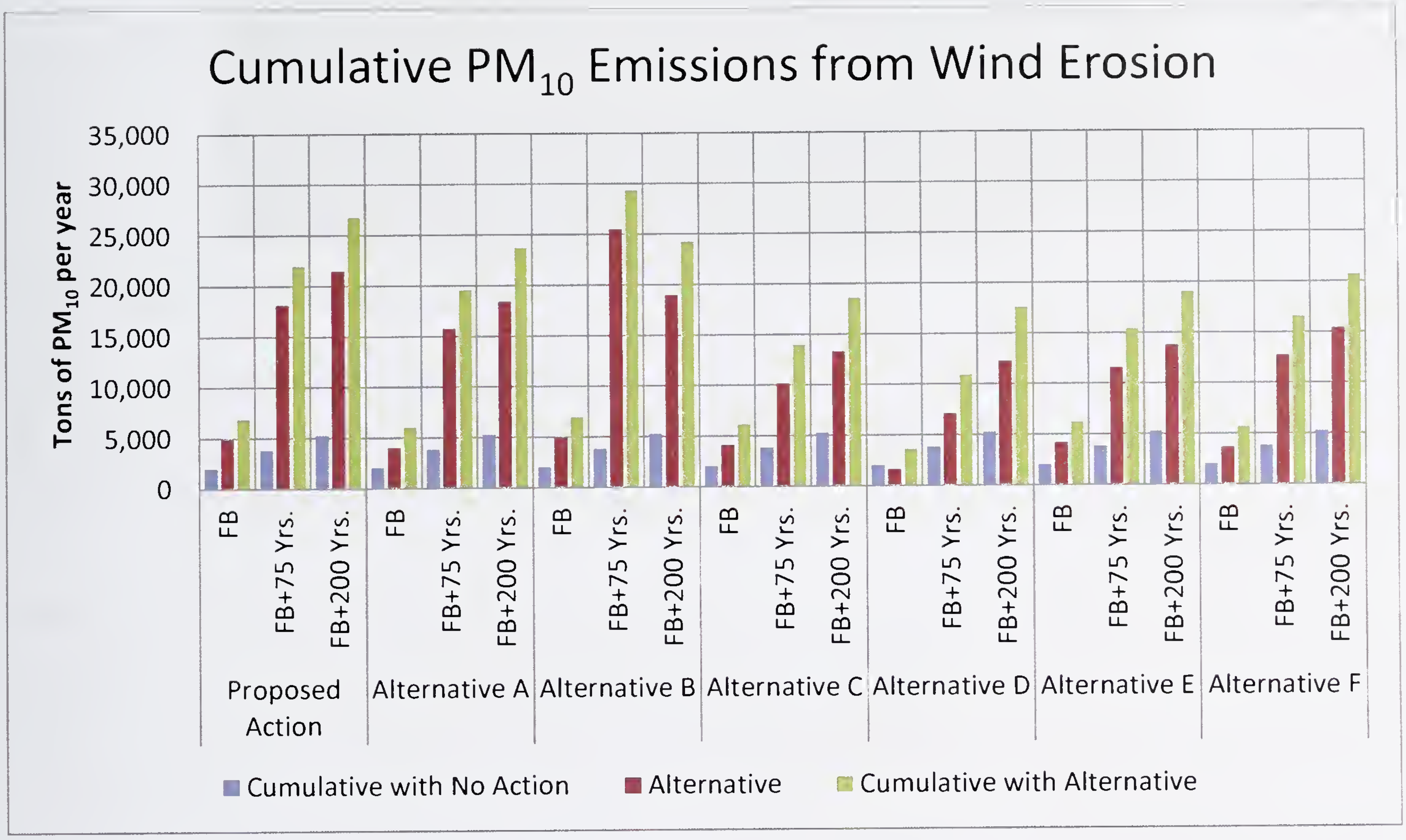


Figure 3.1-7 **Comparison of Estimated PM_{10} Emissions from Cumulative Groundwater Drawdown Windblown Dust for the Proposed Action and Alternatives A through F for Three Timeframes**

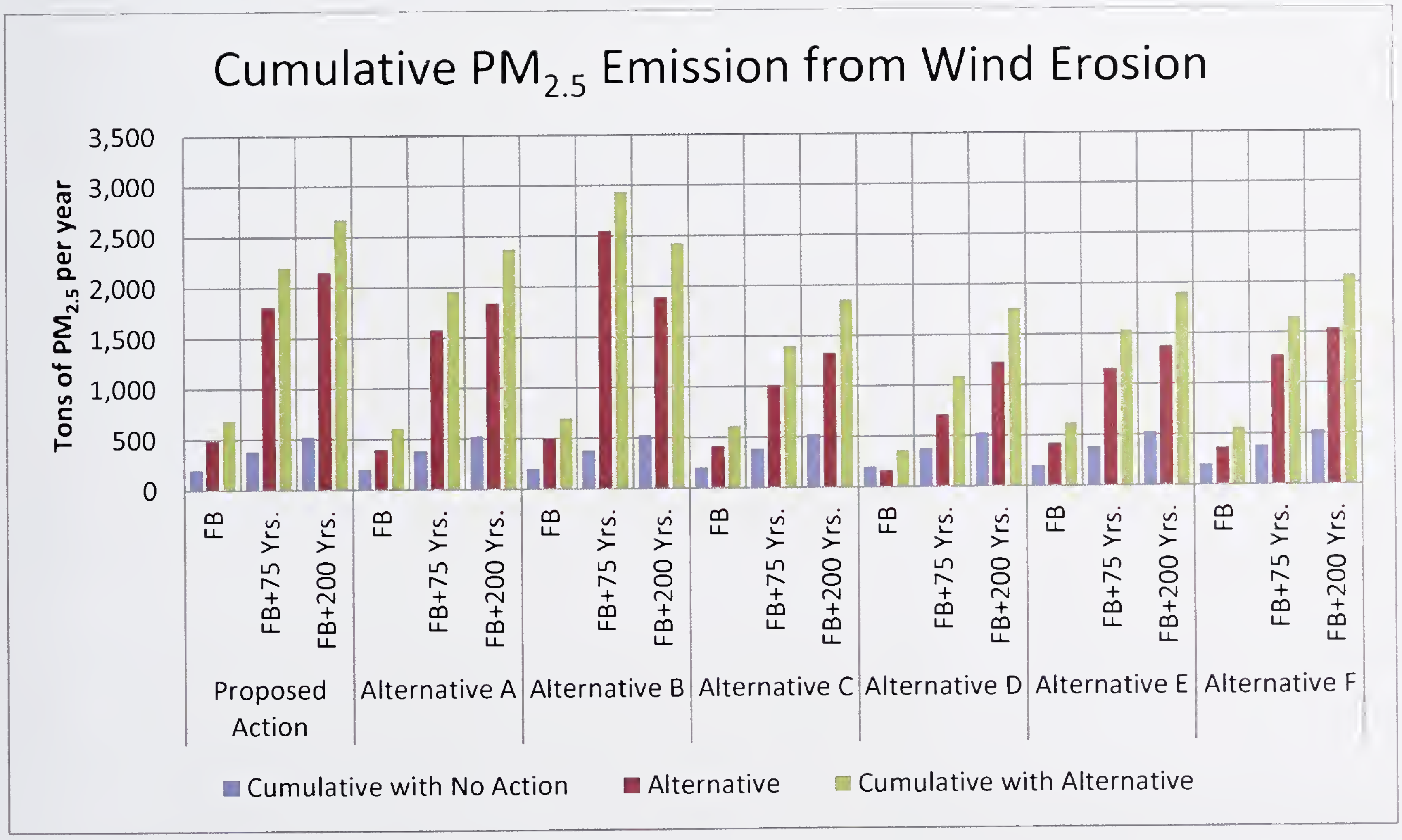
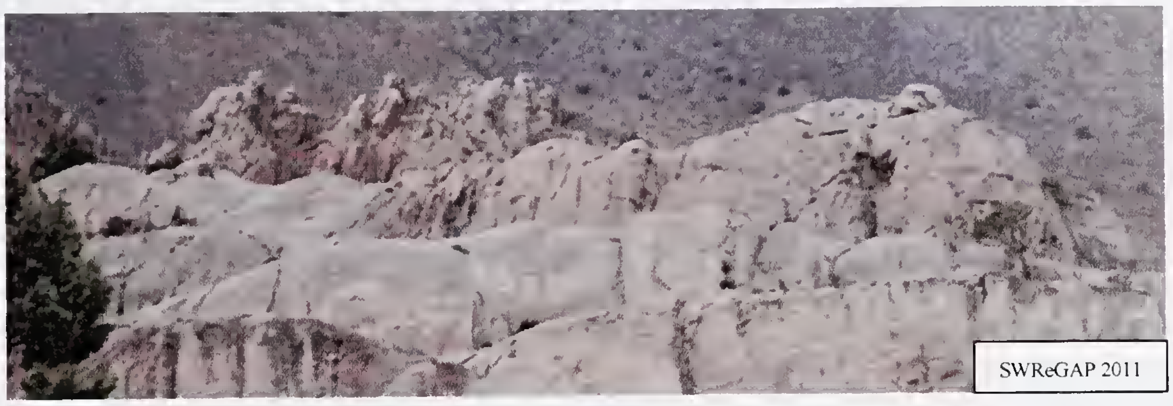


Figure 3.1-8 **Comparison of Estimated $PM_{2.5}$ Emissions from Cumulative Groundwater Drawdown Windblown Dust for the Proposed Action and Alternatives A through F for Three Timeframes**



3.2 Geologic Resources

3.2.1 Affected Environment

The study area for geology includes the proposed ROWs and groundwater development areas and the broader geographical area referred to as the natural resources region of study (**Figure 3.0-3**).

3.2.1.1 Overview

Regional Geology

The study area is located in the Basin and Range physiographic province and the sub-province called the Great Basin (Eaton 1979). The Basin and Range province is characterized by generally north-south trending mountain ranges and valleys and encompasses portions of a number of states including Arizona, California, Idaho, Nevada, New Mexico, Oregon, Utah, and Texas.

In the study area, the mountains and valleys follow the Basin and Range north-south pattern and are about 5 to 15 miles wide and 20 to 100 miles long. Elevations range from less than 2,000 feet above mean sea level (amsl) in the valleys in the Las Vegas area to Wheeler Peak at 13,063 feet amsl, the second highest point in Nevada. Generally, the valley floors in the northern part of the study area are higher than in the southern areas with elevations ranging from 6,000 to 6,500 feet amsl. Elevations in the mountain ranges generally are from 7,500 to 10,000 feet with the higher peaks often above 11,000 feet amsl. The highest mountain ranges are in the northern part of the study area, with the Snake and Schell Creek ranges containing several peaks above 11,000 feet amsl.

The mountain ranges in the study area generally consist of volcanic and sedimentary rocks (Stewart and Carlson 1978), and intrusives are scattered in mountain ranges throughout the study area. Erosion has created rugged terrain in the mountains and some areas show evidence of past glaciation (Price 2004). The valleys contain valley-fill material eroded from the mountains. The valley fill can be thousands of feet thick with deposits consisting of poorly sorted alluvial fans adjacent to the mountain ranges and fine grained playa deposits and sand dunes in the valley floors. Most of the area is internally drained and surface runoff is confined to the basins. A few drainages in the southern part of the study area drain into the Virgin or Colorado rivers. See Section 3.3, Water Resources, for information regarding surface water drainages.

The region of study in the eastern Great Basin presents a complex geologic setting. Deformed Paleozoic and Mesozoic rock units were overlain by thick Tertiary volcanic ash-flow tuffs, intruded by igneous stocks of considerable size and depth, and then rifted apart during middle to late Cenozoic Basin and Range extensional faulting. See **Appendix F**, **Table F3.2-1** (Geologic History Summary), **Figure F3.2-2** (Geologic Map), and **Figures F3.2-1**, **F3.2-3**, **F3.2-4**, and **F3.2-5** (composite stratigraphic columns). Today the project area is dominated by alluvial basins with thick accumulations of clastic sediments separated by mountain ranges that contain some of the most complex geology on the North American continent. Most

QUICK REFERENCE

amsl – above mean sea level

FLPMA – Federal Land Policy and Management Act of 1976

GPS – global positioning system

NBMG – Nevada Bureau of Mines and Geology

ROW – right-of-way

USGS – U.S. Geological Survey

Volcanic – Rocks formed from an opening in the crust that allows molten rock to reach the surface.

Sedimentary – Rocks formed by rocks accumulation and cementation of minerals transported by wind or water, or chemically precipitated.

Intrusives – Igneous rock bodies that have forced their way in a molten state into surrounding rock.

Alluvial – Water-deposited terrestrial.

Fans – sediment composed of sorted or unsorted sand, gravel, and clay.

Playa – Dry lake.

current groundwater sources come from wells developed in the aquifers that are contained within the alluvial sediments of the basins. However, the Paleozoic carbonate rocks found in the mountain ranges and in the bedrock beneath the alluvial basins are believed to constitute a major regional aquifer system that contains many different flow regimes. Groundwater flow in these rocks is controlled by secondary permeability created by faults and fractures.

Additional information regarding the potential effects of these structural features on groundwater flow is provided in Section 3.3, Water Resources.

Paleontology

The study area for paleontological resources includes the proposed ROWs and groundwater development areas that would be directly disturbed by the Proposed Action and other alternatives (**Figure 3.0-1**). No additional region of study is relevant for paleontological resources because the indirect effect of groundwater drawdown is not an issue for this resource.

Paleontology – The study of prehistoric life, including organisms evolution and interactions with each other and their environments.

Pleistocene Deposits – Of or belonging to the geologic time, rock series, or sedimentary deposits of the earlier of the two epochs of the Quaternary Period (2.6 million to 10,000 years ago), characterized by the alternate appearance and recession of northern glaciation, the appearance and worldwide spread of hominids, and the extinction of numerous land mammals, such as the mammoths, mastodons, and saber-toothed tigers.

Paleontological resources or fossils are the imprints or remains of once-living plants and animals preserved in rocks and sediments. Paleontological resources on public lands are considered nonrenewable records of the history of life on earth; hence, they represent important and critical components of America's natural history. Once damaged, destroyed, or improperly collected, their scientific value could be greatly reduced or lost forever. Paleontological resources also can be used to provide information about interrelationships between biological and geological components of ecological systems over long periods of time.

The BLM manages paleontological resources under a number of federal laws including the Paleontological Resources Preservation Act of 2009, FLPMA Sections 302(b) and 310, which direct the BLM to manage public lands to protect the quality of scientific and other values. Management direction also is provided in 43 CFR 8365.1-5, which prohibits the willful disturbance, removal, and destruction of scientific resources or natural objects; and 43 CFR 3622, which regulates the amount of petrified wood that can be collected for personal, noncommercial purposes without a permit. In addition, the BLM provides management direction for the identification, evaluation, protection, and use of fossils in the Potential Fossil Yield Classification System for Paleontological Resources on Public Lands (BLM 2007). In addition to the BLM fossil classification system, the BLM Manual 8270 and BLM Handbook H-8270-1 provide guidance for managing paleontological resources on federally owned and managed lands.

Fossils occur in sedimentary rocks and also in deposits found in caves, lake bottoms, and older alluvial surfaces. The BLM Potential Fossil Yield Classification System for Paleontological Resources on Public Lands describes a classification system for ranking rock units according to their potential for scientifically important occurrences of fossils. The Potential Fossil Yield Classification System indicates unlikely occurrence of paleontological resources in areas with igneous and metamorphic rocks; extremely young alluvium, colluvium, or aeolian deposits; or deep soils. The classes listed below are assigned to rock units that have the potential to contain important paleontological resources:

- Class 3a (Moderate) – Units are known to contain vertebrate fossils or scientifically significant non-vertebrate fossils, but these occurrences are widely scattered. Common invertebrate and plant fossils may be found in the area.
- Class 4 (High) – Geologic units are known to contain a high occurrence of significant fossils. Vertebrate fossils or scientifically significant invertebrate or plant fossils are known to occur and have been documented, but may vary in occurrences and predictability.
- Class 5 (Very High) – Highly fossiliferous geologic units that consistently and predictably produce vertebrate fossils or scientifically significant invertebrate or plant fossils, and that are at risk of human-caused adverse impacts or natural degradation.

The BLM (1998; 2008) has not categorized specific geologic formations in the project area according to the Potential Fossil Yield Classification System. However, there are deposits and sedimentary rocks that have potential to contain important fossils. The following is a general list of formations or deposits that have a high sensitivity rating for fossil potential occurrence.

- Pleistocene deposits in caves or fissures have a potential to contain woodrat/packrat (*Neotoma* sp.) middens (i.e., concentrations of bone and fecal waste from woodrats [Scott 2003]). Material in these middens is partially fossilized and contains a wealth of data on climatic and faunal biogeographical changes over the past 40,000 years. Pleistocene deposits found in caves would be considered highly sensitive for paleontological resources.
- Tertiary formations that contain abundant vertebrate fossils. These formations, while not often yielding fossils of scientific importance, are given a high sensitivity rating because of the abundance of vertebrate fossil material. An example of a highly sensitive Tertiary formation is the Muddy Creek formation (Scott 2003).
- Cambrian-aged sedimentary rocks (for example, the Pioche Shale) may contain abundant trilobites, ancient segmented arthropods that lived 550 to 250 million years ago (Alles 2006). Trilobites are important fossils for documenting the profusion of life that occurred during the Cambrian Period. Areas where Cambrian rocks are exposed may be considered moderate to high sensitivity for paleontological resources.

An important information source for paleontological resources for the area was a literature review and records search conducted by the San Bernardino County Museum (Scott 2008). This study identified known records of paleontological resources within the project area, as well as areas considered to contain high potential for occurrence fossils. The study referenced a variety of paleontological surveys that have been conducted in the vicinity of the project area.

3.2.1.2 Right-of-way Areas and Groundwater Development Areas

Geologic Features and Hazards

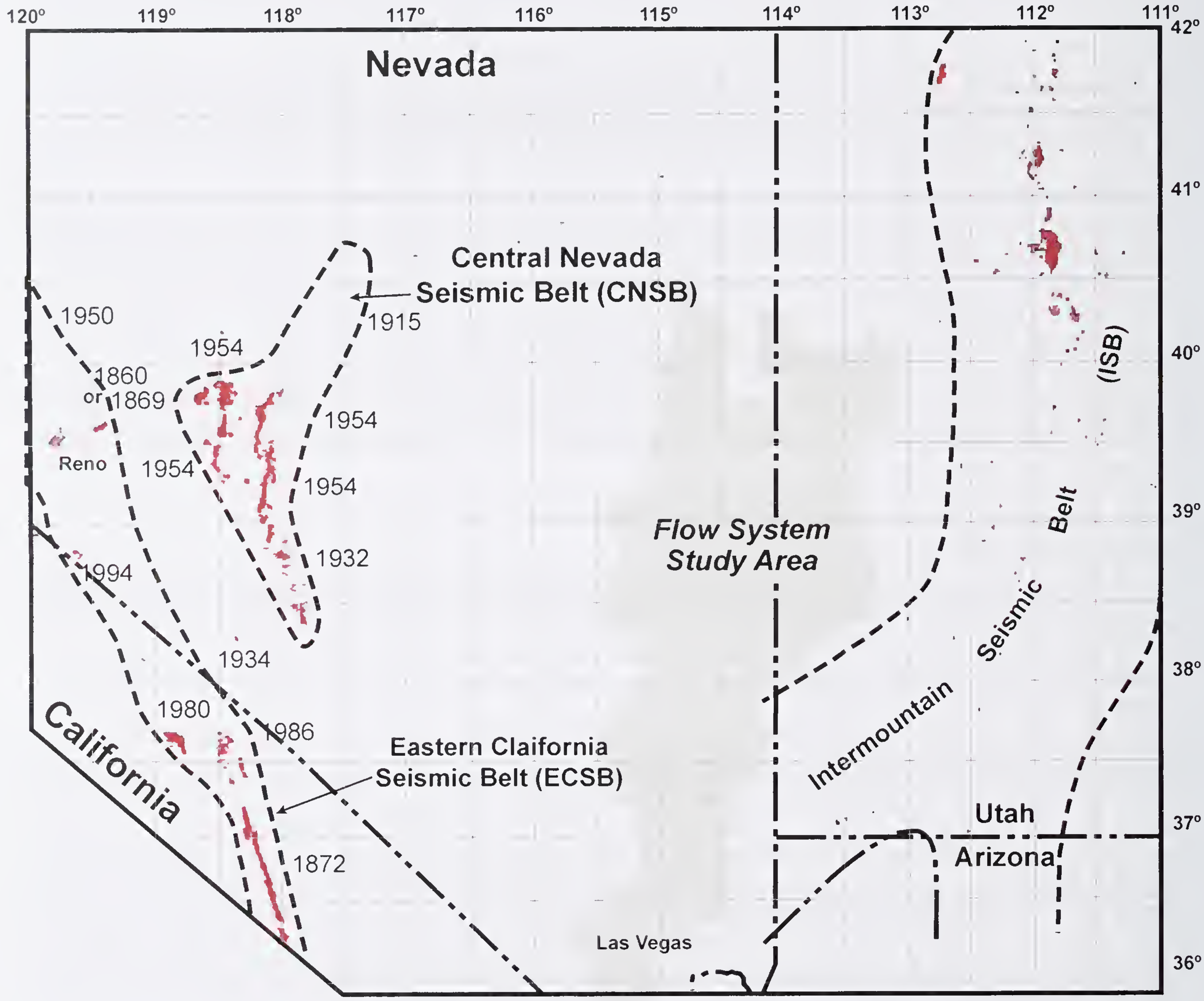
Characterization of geologic hazards within the project area is described in terms of seismicity, landslides, subsidence, and karst topography. These hazards represent risks to pipeline and project facility integrity. Karst geology also is considered an important aspect of cave formation.

Seismicity

Nevada is a very seismically active state and ranks third behind Alaska and California in numbers of 7.0 magnitude earthquakes from 1789 to 2005 (Nevada Seismological Laboratory 2006). However, most of the earthquake events recorded in the state are concentrated in the western and central part of the state in two areas designated as the Central Nevada Seismic Belt and the Eastern California Seismic Belt (**Figure 3.2-1**). The project area in the central Great Basin has relatively few earthquakes in comparison to the rest of the state (Machette et al. 2004). The Central Nevada Seismic Belt and Eastern California Seismic Belt are characterized by numerous historic events (during last 150 years) where ground rupture has been documented along the faults. Seismic activity in Utah occurs along a line north to south in the center of the state from Salt Lake City to the southwest corner of the state (**Figure 3.2-1**). The line corresponds to the Wasatch Mountain front in the northern part of the state and along the hingeline that marks the boundary between the Great Basin and Colorado Plateau. This area of earthquake activity along the Wasatch Mountains is referred to as the Intermountain Seismic Belt (Machette et al. 2004).

There are numerous faults of Quaternary-age in the project area (**Figure 3.2-2**). Quaternary faults have been classified according to age of movement (Nevada Earthquake Safety Council 1998):

- Historic Active Fault – a fault that has moved within the last 150 years;
- Holocene Active Fault – a fault that has moved within the last 15,000 years;
- Late Quaternary Active Fault – a fault that has moved within the last 130,000 years;
- Mid-Late Quaternary Active Fault – a fault that has moved within the last 750,000 years; and
- Quaternary Active Fault – a fault that has moved within the last 1.6 million years.



Surface Ruptures
Historic

Source: Machette, et al (2004).

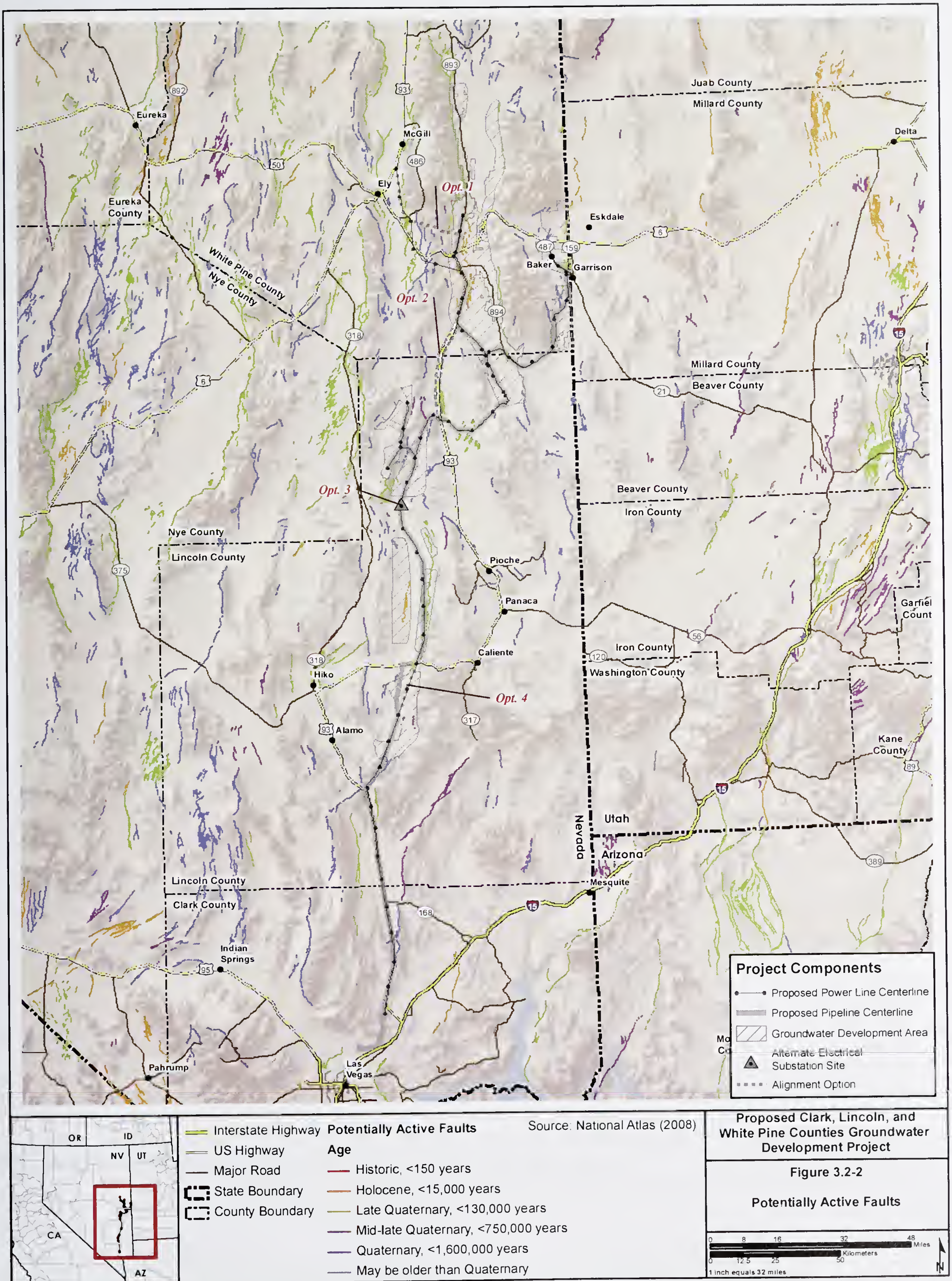
N

0 km 50 km 100 km
Scale in Kilometers

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.2-1

Regional Seismicity



No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

Global positioning system (GPS) data indicate that extension is occurring along the aforementioned seismic belts. The central part of the Great Basin, which encompasses the project area, shows a much lower level of potential activity. Most of the faults in this area are late Quaternary (130,000 years ago) or older. The project exploration areas would be located over an area of normal Holocene faults (activity less than 15,000 years ago) in central and southern Spring Valley, in the central Dry Lake Valley, and the west side of the Snake Valley. A several-mile discontinuous, generally north-south surface fissure is located in Dry Lake Valley (Swadley 1995). It is unknown whether this fissure was caused by subsidence or tectonics. Additional fissures are located in Delamar Valley oriented northeast, parallel to the Pahranagat shear zone, approximately north-south, or northwest (Swadley 1995). The latter directions are also parallel to known fault zones.

Landslides

Because of the infrequency of rainfall, precipitation events are characterized by brief heavy storm events that result in mainly debris flows rather than landslides (Radbruch-Hall et al. 1982). Debris flows are a major mode of deposition for alluvial fans. Landsides in the Great Basin are less frequent and occur more often in the higher latitudes at higher elevations where precipitation is more frequent. Shale and sediments derived from volcanic deposits are prevalent in landslides in the Basin and Range area. Massive carbonate rocks that have been sheared and fractured are also prone to landslides. Most of the project area has a low recorded landslide incidence and susceptibility, areas with less than 1.5 percent of the area involved (National Atlas 2008). However, a few areas of medium (1.5 to 15 percent of area involved) to high (greater than 15 percent of area involved) susceptibility and incidence are present in the southern Snake Range located north of the White Pine-Lincoln county line, and in the Schell Creek Range south of Ely, Nevada (**Figure 3.2-3**). In the Snake Range, large blocks of displaced Paleozoic rocks have been observed (Elliott et al. 2006; Whitebread 1969).

Subsidence

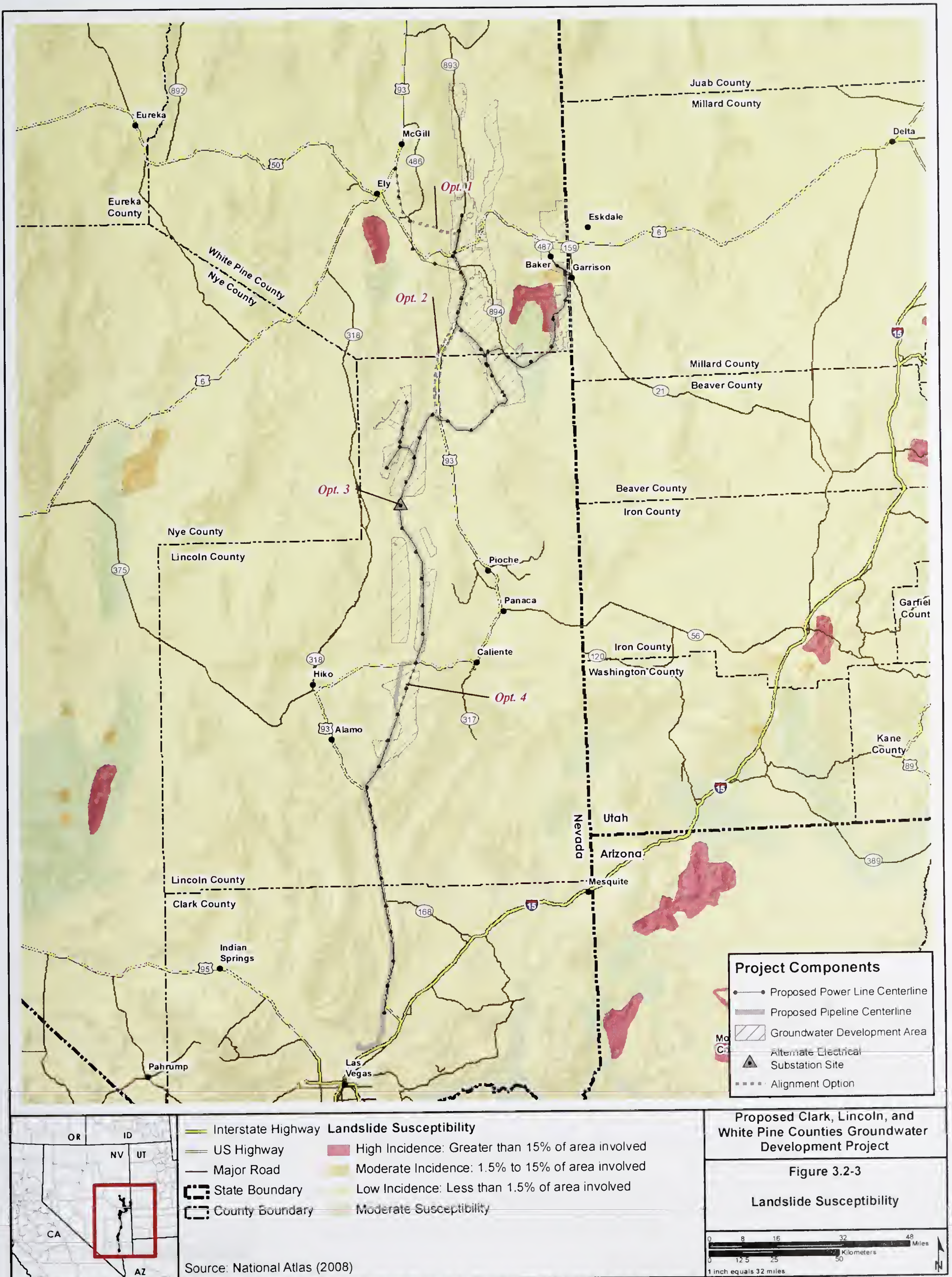
Subsidence is a decrease of surface elevation of the ground and may be caused by a variety of phenomena including, but not limited to, solution of subsurface strata, compaction, removal of groundwater, and earthquake ground motion. The surface expression from subsidence can range from localized precipitous collapses (sinkholes) to broad regional lowering of the earth's surface.

Subsidence in the Las Vegas Valley is well documented and has been primarily caused by withdrawal of groundwater (Bell 1981; 2003). Subsidence has been monitored since 1935 and localized depressions have developed where the changes in elevation range from 2.5 to 5 feet. One of the depressions is located just north of the McCarran Airport.

When the ground subsides, the Las Vegas faults can be sites for fissuring to occur, especially in the more fine-grained deposits (Bell 1981, 2003). Subsidence due to groundwater withdrawal has not been documented in other basins in the project area.

Karst Topography and Caves

Another potential cause of subsidence is the solution of carbonate rocks resulting in karst terrain (sinkholes and depressions). Some areas of karst potential are present in the project area (**Figure 3.2-4**) (National Atlas 2008). These areas of karst potential are broadly defined in areas that are shallowly underlain by carbonate rocks, but subsidence has not been documented. The greater the depth of fill over carbonate rocks, the lower the probability for surface effects occurring from subsurface voids created by solutions. Caves may form in thick layers of limestone where there is sufficient water to dissolve rock and create fissures, tubes, and caves. The Federal Cave Resources Protection Act of 1988 provided for the protection of cave resources on federally managed lands. Included in the act were provisions charging the DOI to issue regulations that define what constitutes significant caves, identify and list significant caves on federally managed lands. The legislation also defined prohibited acts and criminal penalties for violation of the law. All the caves in the GBNP would be considered significant caves. The primary areas where the pipeline crosses limestone outcrops where caves may potentially be present include the south end of Spring Valley and the divide between Cave and Dry Lake valleys. Lehman Caves and other known caves in the GBNP, and caves in Cave Valley are located in project hydrologic basins. Cave information generally is not publicized by the caving community or the land management agencies to prevent vandalism and disturbance of cave fauna, such as bats.

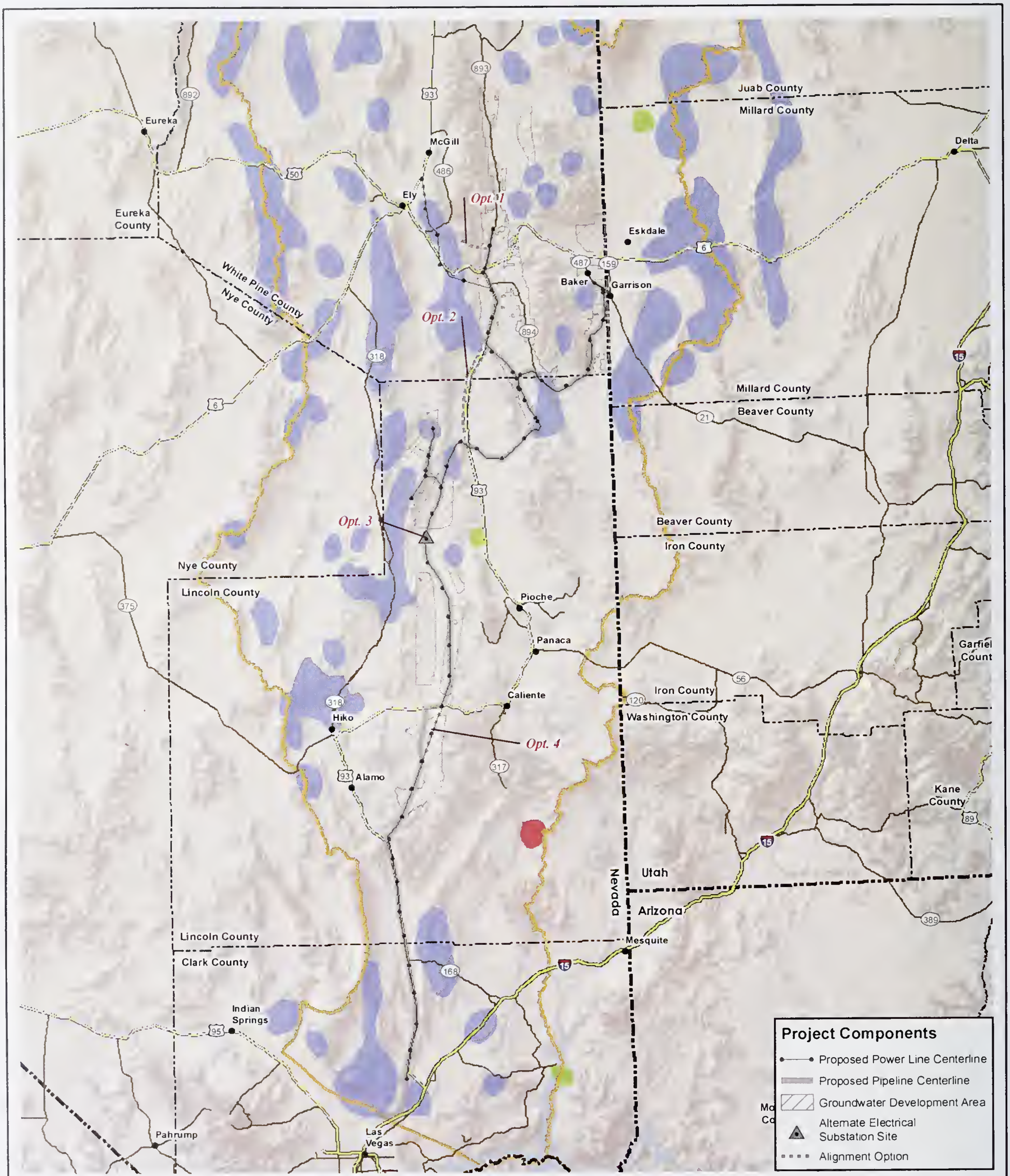


Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.2-3

Landslide Susceptibility

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.2-4

Karsts

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

Erionite

Potential public exposure to airborne particles of erionite, a zeolite mineral that occurs in some volcanic tuff deposits may be a public health hazard if inhaled. Erionite deposits have been identified in Nevada and Utah, but the primary localities are in the western and central part of Nevada and are associated with upper Cenozoic tuffaceous rocks (Sheppard 1996). No erionite occurrences have been identified in the project area. Volcanic tuff is present south of Baker, Nevada, but erionite has not been identified in these deposits (Sweetkind 2009). In addition, the volcanic origin and depositional environment of the tuff deposits near Baker have not been characterized. This issue is addressed in this Geologic Resources section, since the risk of exposure must be evaluated before considering health hazards.

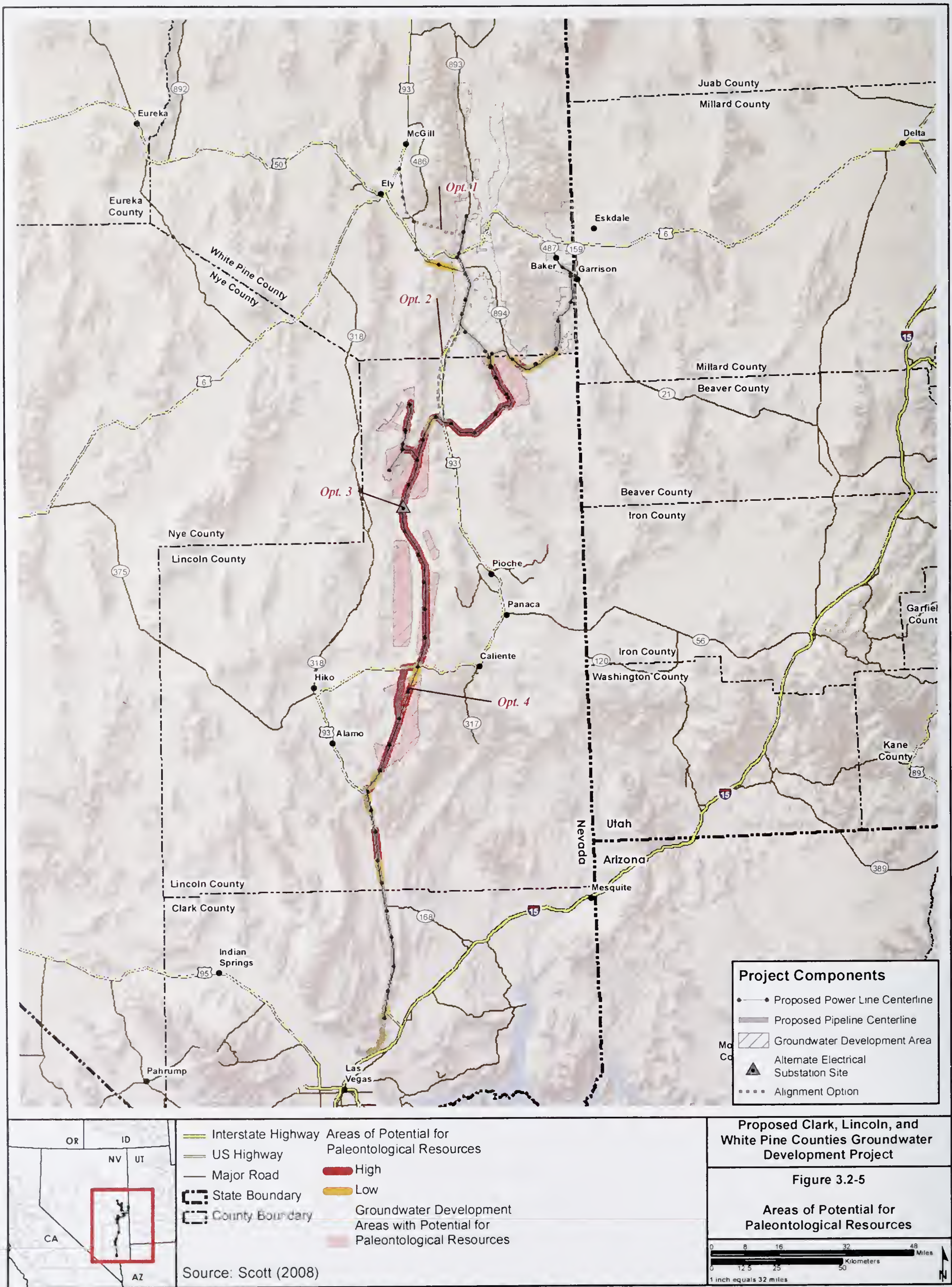
Paleontological Resources

Based on a records search by San Bernardino County Museum (Scott 2008), no paleontological resource locations were identified for the project ROWs. However, this study identified areas of high potential occurrence of paleontological resources along portions of the ROWs based on geological formations and previous paleontology studies (**Figure 3.2-5**). These high potential occurrence areas are located in Lincoln County. The following information provides a summary of geologic formations and their associated fossils.

- Paleozoic Rocks – The Guilmette and Simonson Dolomite formations located north of the Limestone Hills and the western Schell Creek Range are known to contain marine invertebrate fossils. Caves also may be present in the limestone formations that could contain vertebrate fossils.
- Lacustrine (lake) Deposits in Valley Alluvium – Lacustrine deposits in Cave, Coyote Spring, Delamar, Dry Lake, and Spring valleys are considered ancient lakes such as Bristol or Dry Lake, Cave Lake, Lake Carpenter, Delamar Lake, and Spring Lake. Fluvial (river) and lacustrine sediments of late Pliocene and Pleistocene age have high potential to contain scientifically important paleontological resources. An example is the Sunshine locality in Long Valley, White Pine County. The locality has yielded vertebrate fossils in lacustrine, fluvial, and eolian Pleistocene and Holocene deposits (Huckleberry et al. 2001). Older alluvium and its associated sediments are not considered conducive to the preservation of vertebrate fossils.

Specific fossil sites also have been identified at locations adjacent to the ROWs for the Proposed Action and Alternatives in Clark, Lincoln, and White Pine counties (**Table 3.2-1**). Wildcat Wash is within of the Muddy Creek formation, while the Snake Creek Indian Burial Site is located within late Pleistocene deposits. The closest known sites are Hidden Valley and Seven Oaks Springs (1 to 2 miles east of alternatives A through C), and the Snake Creek Indian Burial Site (1 to 2 miles west of Alternatives A through C).

The highest potential for paleontological resources is lacustrine formations in valley alluvium in Delamar, Dry Lake, Cave, and southern Spring Valley. These deposits may contain invertebrate fossils and lesser occurrences of vertebrates (see ROWs above) (**Figure 3.2-5**).



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.2-5

Areas of Potential for Paleontological Resources

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

Table 3.2-1 Known Fossil Sites Near the Right-of-way/Groundwater Exploratory Areas

Site/Location	Description	Source of Information
Clark		
Wildcat Wash, eastern portion of Pahranagat Wash, approximately 4 miles east of the ROW for Alternatives A through E and Alignment Options 1 through 4	Collection site is part of Muddy Creek formation. Fossils occasionally are locally abundant but usually are infrequent and isolated fragments. Recovered fossils included fish, mammal, and rodent bones.	Scott (2003)
Joanna and Monte Cristo Limestone formation	Marine invertebrates.	Scott (2008)
Lincoln County		
Kane Springs Wash/Highway 93 in Coyote Spring Valley, 2 to 3 miles east of the ROW for Alternatives A through C and Alignment Option 3	Late Mississippian limestone outcrop coral fossils. Most of the fossil-bearing outcrops of early Permian and late Mississippian beds of limestone, dolomite, and sandstone are buried up to 33 feet in Quaternary alluvium.	Duncan and Gordon (no date) as cited in Tschanz and Pampeyan (1970).
Hidden Valley and Seven Oaks Springs approximately 1 to 2 miles east of the ROW for Alternatives A through C	Collection sites contain trilobites from the late Lower Cambrian and early Middle Cambrian periods.	Palmer (1998)
White Pine County		
Snake Creek Indian Burial Site, approximately 7 miles southeast of Baker, 1 to 2 miles west of the Snake Lateral ROW for Alternatives A through C	Pleistocene-aged camel, horse, rodent, and reptile fossils were recovered from a cave.	BLM (2008); Bell and Mead (1998); and Mead and Bell (1994)
Southern Schell Creek Range, limestone formations	Marine invertebrate fossils and vertebrate fossils in cave deposits.	Hose et al. (1976)

3.2.2 Environmental Consequences

3.2.2.1 Rights-of-Way

Issues

The following issues for paleontological resources and geological hazards are evaluated for ROW construction and maintenance.

Geological Hazards

- Risk of potential damage to pipelines and ancillary facilities from earthquake ground motion and permanent ground displacement along faults or ground fissures of undetermined origin.
- Risk of landslides or mass wasting (large movements of earth materials) to pose risks of damage to pipelines and related facilities.
- Areas underlain by carbonate formations may have the potential for ground subsidence due to karst features. Ground subsidence due to karst can create loss of support and damage to pipelines and related facilities.
- Potential health risks to workers and public due to exposure to erionite.

Caves

Unique geological features in the region are caves that have formed in bedrock carbonate formations. Caves provide habitat for flora and fauna as well as localities for scientifically important fossil resources. Caves may be adversely affected by ROW construction and maintenance activities.

Paleontological Resources

- Potential damage and loss of scientifically important fossils could occur from ROW clearing, grading, trench excavation, construction of other pipeline-related facilities, operational maintenance activities that would require disturbance of previously unaffected areas within the established ROW.
- Loss of scientifically valuable fossils also may occur because of vandalism or unauthorized collection.

Assumptions

The following assumptions were used in the impact analysis for geological and paleontological resources for ROW construction and maintenance.

Geological Hazards

- The location of active faults is based on information available from the USGS and Nevada Bureau of Mines and Geology (NBMG) (2006). The ground motion estimate is based on recent updates of the USGS seismic hazard mapping by the USGS (2010). There are numerous Quaternary faults in the project area which may rupture at any time, however, only those faults with movement documented by the USGS and NBMG (2006) in the last 15,000 years are considered to be active.
- Movement across ground fissures in the Dry Lake and Delamar valleys may result in ground deformation similar to that caused by movement on active faults.
- Landslide risk information is based on data provided in the National Atlas (2008). The data for landslide incident and susceptibility areas is based on Radbruch-Hall et al. (1982), Landslide Overview map of the Contiguous U.S. Because of the scale of the map, it overstates the landslide risk in the southern Snake Range. Landslide risk was assessed using large-scale mapping, where available, that showed mapped landslides in relation to proposed project elements (NPS 2009).
- Nevada does not have a state-wide database for sinkholes (NBMG 2010), therefore potential karst areas were identified by review of the national karst hazards mapping by Davies et al. (1984) which used for the karst layer in the National Atlas (2008). As with the national landslide risk mapping, the karst hazards map of the U.S. at a

1:7,500,000 scale may overstate the potential for karst development. However, the presence of caves in areas underlain by limestone may indicate the potential presence for other karst features.

- The greatest exposure risk to erionite would occur during active ground disturbance and excavation.

Caves

- In the analysis of ROW construction and maintenance effects, caves are considered to be unique geological features.

Paleontological Resources

- Areas of medium to high potential for valuable fossil resources were defined on the basis of literature review and assessment conducted by the San Bernardino Museum (Scott 2008). No field surveys were conducted. The fossil yield potential areas identified for this analysis were used to define areas where detailed on-site surveys would be needed.

Methodology for Analysis

The methodology for impact analysis for geological and paleontological resources for ROW construction and maintenance:

Geologic Resources

- SNWA would be required to implement a comprehensive COM Plan that would include all future hydrographic basins and all facilities associated with the SNWA GWD Project. The COM Plan includes a requirement for comprehensive monitoring and mitigation program for the entire project that would integrate the various required monitoring and mitigation actions. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary, along with measures to protect geologic resources from ROW construction and operation activities.

Geologic Hazards

- Seismicity and Active Faults. Based on seismic hazard mapping and Quaternary fault maps (USGS 2010; USGS and NBMG 2006), assess the risk of the proposed pipeline and related facilities being affected by permanent ground displacement resulting from movement on faults or fissures and potential ground motion. Pipelines can be susceptible to two major types of seismic hazards: permanent ground deformation and wave propagation hazards (O'Rourke and Liu 1999). Permanent ground deformation hazards include displacement of ground across a fault, soil liquefaction, and landslides. Wave propagation hazards result from the ground waves that are set in motion from an earthquake event. The ground waves can cause stress on pipe, resulting in rupture. There is potential for permanent displacement of the ground across active faults (O'Rourke and Liu 1999). A pipeline crossing an active fault is susceptible to bending or rupture if ground displacement is severe. An earthquake generates waves of energy that cause the ground to shake. Surface structures are susceptible to ground motion, but buried pipelines also may be at risk (Pelmulder 1995). Soil liquefaction occurs when ground shaking from an earthquake causes soil to lose its ability to support a load. Soils that are especially susceptible to liquefaction are saturated unconsolidated sand and sandy soil. Liquefaction causes the soil to compact and settle allowing buried pipelines to become buoyant. Liquefaction on a slope may cause earth materials to flow downhill. Lateral spreading is another liquefaction hazard in which blocks of competent soil are displaced horizontally over liquefied strata (Pelmulder 1995). Earthquake induced liquefaction can cause loss of pipeline support resulting in bending or rupture. Soil liquefaction has been documented in valley areas in the Mojave Desert in California (Wills 2001). Liquefaction may occur where soil and shallow groundwater create susceptibility. The mass movement of ground because of seismic energy can cause bending or rupture of buried pipelines due to loss of support or movement of pipe.

Seismicity – The world-wide and local distribution of earthquakes in space and time; a general term for the number of earthquakes in a unit of time.

Subsidence – The movement or sinking of the land surface.

Karst – Landscape shaped by the dissolving of soluble bedrock (usually limestone or dolomite).

- Landslides. Through the use of available geological information and landslide incidence and susceptibility maps, qualitatively estimate the risk of landslide movement affecting the construction zone via destabilization of existing active landslides or creation of instability based on undercutting of slopes. Landslides can occur in a number of different ways in different geological settings. Large masses of earth become unstable and by gravity begin to move downhill. Another form of mass wasting, debris flows, are common where mountain drainages cross onto mountain pediments formed by alluvial fans. Debris flows occur during heavy precipitation events and are slurries of materials that may consist of large boulders to clay-size particles (USGS 2004). Because debris flows have high water content, they can be very destructive. However, the power of debris flows is rapidly reduced as flows discharge over the upper reaches of the alluvial fans.
- Karst. Based on available geological information and karst potential maps, qualitatively estimate the risk of installing project components over shallow caves and potential sinkholes in karst terrain.
- Erionite. The potential for the occurrence of eronite-containing surficial materials in areas to be disturbed and excavated was evaluated to assess the risks of inhalation of erionite by construction workers and the public.

Caves

- Based on available geological information (geologic maps and karst potential maps), assess the risk associated with project construction and maintenance on caves and cave resources.

Paleontological Resources

Conduct an analysis using the available paleontological information from publically available sources and information provided by Scott (2008) to determine the potential for the existence of scientifically important paleontological resources. Based on review of the information, provide an estimate of risk and identify measures that would be used to protect the resources.

3.2.2.2 Proposed Action, Alternatives A through C

Construction and Facility Maintenance

Geologic Hazards

Seismicity and Active Faults. During construction activities, potential effects due to seismicity and permanent ground displacement are not expected to pose a concern. Seismicity and active fault hazards present risks to long-term maintenance of the proposed pipeline and facilities. Permanent ground deformation across faults or fissures could result in damage to pipelines and facilities. There are two active fault zones (last movement demonstrated to be less than 15,000 years ago) that are present in the proposed ROW areas: the Southern Spring Valley and Snake Valley fault zones (**Figure 3.2-2**) (Sawyer and Redsteer 2000; Black et al. 2005). The Southern Spring Valley fault zone is a series of scarps along the west side of the southern Spring Valley. The proposed ROW in the Spring Valley crosses two mapped faults in the fault zone. The south end of the Snake Valley fault zone parallel the groundwater development area along the Utah-Nevada state line. There are also fissures that have been described in Dry Lake and Delamar valleys of undetermined origin, but are possibly seismic (Swadley 1995). The proposed ROW crosses fissures in the north end of Dry Lake Valley and southern Delamar Valley.

Ground motions from a maximum earthquake in the project area are expected to range from 10 to 27 percent of the acceleration of gravity (9.80 meters per second squared), with a 2 percent probability of exceedance in 50 years (USGS 2010). The highest ground accelerations would be expected to occur in central Lincoln County and the least in southeastern White Pine County. Ground accelerations of 27 percent of g may result in slight damage to well-built structures, but damage may be considerable in poorly built or badly designed structures. Such ground accelerations would probably not affect high-grade steel pipe in good condition (McDonough 1995; Wald et al. 1999). Ground motion risk will be lessened by design and construction of the proposed ROW facilities according to applicable and appropriate seismic standards.

Soil liquefaction has the greatest probability of occurring along the edges of alluvial fans where the deposits are saturated at shallow depths (Wills 2001). However, the overall potential for liquefaction would be low because of the expected low-magnitude of ground motions in the project area from a maximum earthquake.

Earthquake induced landslides do not appear to present to a risk to the project since the project ROWs are located in areas of low to medium landslide risk and susceptibility (see landslide discussion below).

The Ely and Las Vegas RMPs (BLM 2008, 1998) provide no management direction or BMPs regarding the siting of facilities with regard to active faults. Therefore if active faults or fissures cannot be avoided, then the ACMs (**Appendix E**) provide for the following protection measures for active faults and fissures:

- ACM A.3.1: If fault crossings of the pipeline are identified during detailed geotechnical investigations, additional design features will be added to ensure pipeline integrity (e.g., flexible couplings, increased pipe wall thickness, pipe sleeves).
- ACM A.3.2: In the "fissures" area of Dry Lake Valley, in addition to design features, over-excavation of existing soils and replacement with engineered fill, grouting of fissures, and/or use of geo-textile fabric will be utilized as needed to ensure pipeline stability.

Landslide is a term used for various processes involving the movement of earth material down slopes (USGS 2004).

Landslides. Hazards of concern from landslides during construction of the pipeline would be from unintentional undercutting of slopes or construction on steep slopes resulting in instability that would lead to landslides. When selecting the final pipeline route, steep slopes crossed by the pipeline should be kept to a minimum.

In the project vicinity, there is an area of high landslide susceptibility and incidence in the southern Snake Range, southwest of Baker. This area of landslide risk is restricted to the slopes of the range. Since the project ROW in that area is located on the valley areas east and south sides of the range, where landslide risk is low to moderate, landslides are not expected to be a concern for facility maintenance. Other portions of the proposed ROWs are located in areas of low landslide incidence and susceptibility and therefore landslides would pose low-risk to the proposed project.

During facility maintenance, debris flows have the potential to damage pipelines, roads, and associated facilities. The power of debris flows is such that backfill could be eroded and the pipeline exposed and damaged. Also culverts and roads are commonly washed away during heavy precipitation events.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on geologic resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

- ACM A.1.67: Desert washes and ephemeral drainages will be restored to pre-existing conditions. Soils will be compacted, and additional stabilization measures such as rip-rap may be required to protect the facilities and prevent increased erosion in the wash.

Karst. Although there is potential for karst development in the project area (National Atlas 2008), karst terrain has not been documented along ROWs. While the inferred presence of caves and other karst features from **Figure 3.2-4** has not been conclusively documented in many areas, it also doesn't preclude the existence of karst potential and hazards related to sinkhole subsidence during construction and maintenance of ROW facilities. Erionite is not likely to pose a concern because no erionite deposits have been identified in the project area.

Caves. No caves have been identified in ROW areas. Construction and maintenance of pipelines ROW facilities are not likely to pose risks to caves and their unique habitats.

Conclusion. Geologic hazards are not likely to pose risks during construction of ROW facilities. During facility maintenance, seismic hazards, active faults, fissures, and debris flows pose the greatest concern. The proposed pipeline and facilities are not likely to be at risk from expected ground motion and karst. There is a low potential for disturbance or damage to caves from construction activities and cave resources would not be affected by maintenance of the facilities.

Proposed mitigation measures:

None.

Residual impacts include:

- A very small risk of facility damage would remain after implementation of geotechnical studies and design measures for fault movement and seismicity.

Paleontological Resources

Figure 3.2-5 displays project elements with respect to paleontological resource sensitivity. ROWs in the Coyote Springs, Delamar, Dry Lake, Cave, Lake, and Snake valleys cross deposits that have high potential for important fossils. Potential impacts to fossil localities during construction would be both direct and indirect. Direct impacts to or destruction of fossils would occur from trenching or facility construction activities conducted through important fossil beds. Indirect impacts during construction would include erosion of fossil beds due to slope re-grading and vegetation clearing or the unauthorized collection of scientifically important fossils by construction workers or the public due to increased access to fossil localities along the ROW.

Any potential effects to fossils from facility maintenance (non-pumping) activities would be isolated due to the probable dispersed nature of maintenance activities. Also, potential impact during maintenance would be minimal since activity would generally occur on previously disturbed ROW. Routine operation of the proposed pipeline and related facilities would not disturb paleontological resources. Maintenance activities that would result in surface disturbance typically would occur within the ROW that was previously disturbed during construction. Since new disturbances would not be anticipated from routine maintenance activities (i.e., maintenance activities would occur within the ROW), impacts to paleontological resources would be negligible. If maintenance or new construction requires disturbance of previously undisturbed areas, the protection measures as described in **Appendix E** would be implemented.

To provide protection for potential paleontological resources, protection measures would be followed as provided in **Appendix E** would be implemented.

- ACM A.6.1: A field survey will be conducted of areas within the ROWs identified as having a high potential for paleontological resources, based upon a paleontological records search using the Potential Fossil Yield Classification System. The field surveys will identify if there are surface exposures containing visible fossils and if there is a potential for buried fossils within the construction footprint. If any important fossils or middens are found during the field survey, a program will be developed and implemented to remove any exposed fossils prior to construction.
- ACM A.6.2: Areas identified as having a high potential for buried paleontological resources based upon the field survey will be monitored by a qualified paleontologist during construction activities involving ground disturbance, including grading, excavation, and trenching.
- ACM A.6.3: Any fossils recovered during the field survey or construction monitoring will be prepared in accordance with standard professional paleontological techniques. The fossils will be curated in a BLM-approved facility. A report on the findings and significance of the salvage program, including a list of the recovered fossils, will be prepared following completion of the program. A copy of this report will accompany the fossils, and a copy will be submitted to the Nevada State Museum.

Ely RMP (BLM 2008) provides management direction for protection of paleontological resources including BMPs for wind energy development and stipulations and notices for fluid minerals leasing. The ACMs listed for paleontological resources below are in conformance with those BMPs and stipulations. The Las Vegas RMP (BLM 2008) does not provide management direction or BMPs with regard to paleontological resources.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on paleontological resources. The COM Plan would integrate protective measures from the following: BLM

RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

Conclusion. Portions of proposed ROWs may contain areas of medium to high potential for scientifically important fossil resources. The BLM BMPs and ACMs would ensure that important fossils are properly documented and curated, and therefore lessen potential impacts during construction of the pipeline and related facilities. Facility maintenance is not expected to pose risks to paleontological resources.

Proposed mitigation measures:

None.

Residual impacts include:

- Even if construction monitoring is implemented, some scientifically valuable fossils may be disturbed and lost during excavation and ROW grading over thousands of acres. As a consequence, there would be a small incremental loss of fossil material that would be offset by the material that is recovered, and curated for scientific study purposes. Since public access to the ROW and surrounding areas would not be prohibited by the BLM, the risk of unauthorized collection of fossil material would remain.

3.2.2.3 Alternative D

Construction and Facility Maintenance

Geological Hazards

Hazards due to fault movement seismic-induced ground motion are not expected to pose a risk during construction of the facilities. Seismicity and active fault hazards present risks to long-term maintenance of the proposed pipeline and facilities. No active faults zones are crossed by the proposed ROWs in Alternative D. However, the proposed ROWs cross fissures of unknown origin in Dry Lake and Delamar valleys. ACM A3.2 would be used to lessen the risk from movement along faults or fissures. Ground motion is not expected to pose a risk to proposed pipelines and facilities. Landslides due to slope failure may present concerns during construction, but not during maintenance. Debris flows pose a concern for facilities adjacent to mountain fronts. The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on geologic resources. ACM A1.67 provides for special construction methods to lessen the risk of damage to facilities from high runoff events or debris flows.

Subsidence from karst is not expected to have impacts on operational and maintenance activities in ROW areas.

Erionite is not likely to pose a concern because erionite-containing deposits have not been identified in the project area.

Caves

Caves would not be affected during construction or maintenance of ROW facilities.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on geologic resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

Conclusion. Geologic hazards are not likely to pose risks during construction of ROW facilities. During facility maintenance, seismic hazards, active faults, fissures, and debris flows pose the greatest concern. The proposed pipeline and facilities are not likely to be at risk from expected ground motion and karst. There is a low potential for disturbance or damage to caves from construction activities and cave resources would not be affected by maintenance of the facilities.

Proposed mitigation measures:

None.

Residual impacts include:

- A very small risk of facility damage would remain after implementation of geotechnical studies, and design measures for fault movement and seismicity.

Paleontological Resources

Potential impacts to fossil resource during construction would be both direct and indirect. Direct impacts to or destruction of fossils would occur from trenching or facility construction activities conducted through important fossil beds. Indirect impacts during construction would include erosion of fossil beds due to slope re-grading and vegetation clearing or the unauthorized collection of scientifically important fossils by construction workers or the public due to increased access to fossil localities along the ROW. Routine facility maintenance of the proposed pipeline and related facilities would not disturb paleontological resources. Maintenance activities that would result in surface disturbance typically would occur within the ROW that was previously disturbed during construction. Since new disturbances would not be anticipated from routine maintenance activities (i.e., maintenance activities would occur within the ROW), impacts to paleontological resources would be negligible.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on paleontological resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

Conclusion. Portions of proposed ROWs may contain areas of medium to high potential for scientifically important fossil resources. The BLM BMPs and ACMs would ensure that important fossils are properly documented and curated, and therefore lessen potential impacts during construction of the pipeline and related facilities. Facility maintenance is not expected to pose risks to paleontological resources.

Proposed mitigation measures:

None.

Residual impacts include:

- Paleontological Resources – Some paleontological resources may be disturbed or lost during excavation of the pipeline ROW. There could be a small incremental loss of fossil material that would be offset by recovered material and curated for scientific study. There is a risk of unauthorized collection of fossil materials.
- Geologic Hazards – There is a small risk of facility damage after implementation of geological studies and design measures for fault movement and seismicity.

3.2.2.4 Alternatives E and F

Construction and Facility Maintenance

Geological Hazards

Hazards due to fault movement seismic-induced ground motion are not expected to pose a risk during construction of the facilities. Seismicity and active fault hazards present risks to long-term maintenance of the proposed pipeline and facilities. There is 1 active fault zone (last movement demonstrated to be less than 15,000 years ago) that is present in the proposed ROW areas: the Southern Spring Valley fault zone (**Figure 3.2-2**) (Sawyer and Redsteer 2000). The Southern Spring Valley fault zone is a series of scarps along the west side of the southern Spring Valley. The proposed ROWs cross fissures of unknown origin in Dry Lake and Delamar valleys (Swadley 1995). ACM A3.2 would be used to lessen the risk from movement along faults or fissures. Ground motion is not expected to pose a risk to proposed pipelines and facilities. Landslides due to slope failure may present concerns during construction, but not during maintenance. Debris flows pose a concern for facilities adjacent to mountain fronts. The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on geologic resources. ACM A1.67 provides for special construction methods to lessen the risk of damage to facilities from high runoff events or debris flows.

Subsidence from karst is not expected to have impacts on operational and maintenance activities in the ROW areas and caves would not be affected during construction or maintenance of the ROW facilities.

Erionite is not likely to pose a concern because erionite-containing deposits have not been identified in the project area.

Caves

Caves would not be affected during construction or maintenance of the ROW facilities.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on geologic resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

Conclusion. Geologic hazards are not likely to pose risks during construction of the ROW facilities. During facility maintenance, seismic hazards, active faults, fissures, and debris flows pose the greatest concern. The proposed pipeline and facilities are not likely to be at risk from expected ground motion and karst. There is a low potential for disturbance or damage to caves from construction activities and cave resources would not be affected by maintenance of the facilities.

Proposed mitigation measures:

None.

Residual impacts include:

- A very small risk of facility damage would remain after implementation of geotechnical studies and design measures for fault movement and seismicity.

Paleontological Resources

Potential impacts to fossil resources during construction would be both direct and indirect. Direct impacts to or destruction of fossils would occur from trenching or facility construction activities conducted through important fossil beds. Indirect impacts during construction would include erosion of fossil beds due to slope re-grading and vegetation clearing or the unauthorized collection of scientifically important fossils by construction workers or the public due to increased access to fossil localities along the ROW. Routine facility maintenance of the proposed pipeline and related facilities would not disturb paleontological resources. Maintenance activities that would result in surface disturbance typically would occur within the ROW that was previously disturbed during construction. Since new disturbances would not be anticipated from routine maintenance activities (i.e., maintenance activities would occur within the ROW), impacts to paleontological resources would be negligible.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on paleontological resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

Conclusion. Portions of the proposed ROWs may contain areas of medium to high potential for scientifically important fossil resources. The BLM BMPs and ACMs would ensure that important fossils are properly documented and curated, and therefore lessen potential impacts during construction of the pipeline and related facilities. Facility maintenance is not expected to pose risks to paleontological resources.

Proposed mitigation measures:

None.

Residual impacts include:

- Paleontological Resources – Some paleontological resources may be disturbed or lost during excavation of the pipeline ROW. There could be a small incremental loss of fossil material that would be offset by recovered material and curated for scientific study. There is a risk of unauthorized collection of fossil materials.

3.2.2.5 Alignment Options 1 through 4

Table 3.2-2 presents impacts for the Alignment Options (1 through 4) in relation to the relevant underground or aboveground facility segment(s) of the Proposed Action.

Table 3.2-2 Paleontological and Geological Resources Impact Summary for Alignment Options 1 through 4 as Compared to Proposed Action

Option	Analysis
Alignment Option 1 (The potential effects on paleontological and geological resources of changing the locations of a portion of the 230 kV power line from Gonder Substation near Ely to Spring Valley)	Alignment Option 1 would result in no changes in potential impacts to paleontological resources and geological hazards compared to the relevant segment of the Proposed Action.
Alignment Option 2 (The potential effects on paleontological and geological resources of changing the locations of portions of the mainline pipeline and electrical transmission line in north Lake Valley)	Alignment Option 2 would result in no changes in potential impacts to paleontological resources and geological hazards compared to the relevant segment of the Proposed Action.
Alignment Option 3 (The potential effects on paleontological and geological resources of eliminating the Gonder to Spring Valley transmission line, and constructing a substation with an interconnection with an interstate, high voltage power line in Muleshoe Valley).	Alignment Option 3 would result in no changes in potential impacts to paleontological resources and geological hazards compared to the relevant segment of the Proposed Action.
Alignment Option 4 (The potential effects on paleontological and geological resources of changing the location of a short section of mainline pipeline in Delamar Valley to follow an existing transmission line).	Alignment Option 4 would result in no changes in potential impacts to paleontological resources and geological hazards compared to the relevant segment of the Proposed Action.

3.2.2.6 No Action

If the proposed project did not occur, then there would be no impacts to paleontological resources and geological hazards. No project-related surface disturbance would occur. Paleontological and geological resources would continue to be affected by natural events such as wildfires and land use activities such as mining.

3.2.2.7 Comparison of Alternatives

Table 3.2-3 summarizes the major differences between the alternatives.

Table 3.2-3 Comparison of Alternatives

Parameter	Proposed Action, Alternatives A through C	Alternative D	Alternative E	Alternative F
Active Faults	There are two active fault zones present in proposed project areas: the Southern Spring Valley and Snake Valley fault zones. The proposed ROWs cross fissures of unknown origin in Dry Lake Valley.	No active fault zones are crossed, but ROWs do cross fissures in Dry Lake Valley.	There is one active fault zone present in proposed project areas: the Southern Spring Valley fault zone. The proposed ROWs cross fissures of unknown origin in Dry Lake Valley.	There is one active fault zone present in proposed project areas: the Southern Spring Valley fault zone. The proposed ROWs cross fissures of unknown origin in Dry Lake Valley.

3.2.2.8 Groundwater Development and Groundwater Pumping

Issues

Groundwater Development Construction and Facility Maintenance

The following issues for paleontological resources and geological hazards are evaluated for groundwater development construction and facility maintenance.

Geological Hazards

- Risk of potential damage to groundwater development facilities from earthquake ground motion and permanent ground displacement along faults or ground fissures of undetermined origin.
- Areas underlain by carbonate formations may have the potential for ground subsidence due to karst features (see Caves below). Ground subsidence due to karst can create loss of support and damage to groundwater development facilities.
- Potential health risks to workers and public due to exposure to erionite.

Caves

- Unique geological features in the region are caves that have formed in bedrock carbonate formations. Caves provide habitat for flora and fauna as well as localities for scientifically important fossil resources. Caves may be adversely affected by groundwater development and maintenance activities.
- Caves are the natural result of dissolution processes on susceptible rock layers. Caves and naturally-occurring voids that have not manifested to the surface also present hazards. Also, the caves themselves constitute unique geological features that are potentially at risk. However, there are other concerns related to caves with regard to groundwater hydrology, wildlife, and cultural resources. Concerns related to those resources are discussed in the appropriate sections of this document.

Paleontological Resources

- Potential damage and loss of scientifically important fossils could occur during groundwater development including clearing, grading, trench excavation, construction of other pipeline-related facilities, development of production well sites, and operational maintenance activities that would require disturbance of previously unaffected areas. Loss of scientifically valuable fossils also may occur because of vandalism or unauthorized collection.

Groundwater Pumping

Geological Hazards

- The major geologic hazard associated with groundwater pumping would be the risk of subsidence of the ground surface associated with withdrawal of subsurface fluids from valley fill deposits.
- Landslides and seismic hazards are not considered for analysis under groundwater pumping.
- Erionite is not a concern with groundwater pumping.

Caves

- The unique habitats supported by caves and associated water resources could be adversely affected by drawdown of potentiometric heads during groundwater pumping. Impacts related to groundwater pumping drawdown are discussed in Section 3.3, Water Resources and Section 3.6, Terrestrial Wildlife, respectively.

Paleontological Resources.

- Groundwater pumping is not expected to have effects on paleontological resources. Therefore there are no issues concerning potential impacts to paleontological resources with regard to groundwater pumping.

Assumptions

Groundwater Development Construction and Facility Maintenance

The following assumptions were used in the impact analysis for geological and paleontological resources for groundwater development construction and facility maintenance:

Geological Hazards

- The location of active faults is based on information available from the USGS and NBMG (2006). The ground motion estimate is based on recent updates of the USGS seismic hazard mapping by the USGS (2010). There are numerous Quaternary faults in the project area which may rupture at any time, however, only those faults with movement documented by the USGS and NBMG (2006) in the last 15,000 years are considered to be active.
- Movement across ground fissures in the Dry Lake and Delamar Valleys may result in ground deformation similar to that caused by movement on active faults.
- Landslide risk information is based on data provided in the National Atlas (2008). The data for landslide incident and susceptibility areas is based on Radbruch-Hall et al. (1982), Landslide Overview Map of the Conterminous U.S. Because of the scale of the map, it overstates the landslide risk in the southern Snake Range. Landslide risk was assessed using large-scale mapping, where available, that showed mapped landslides in relation to proposed project elements (NPS 2009).
- Nevada does not a have a state-wide database for sinkholes (NBMG 2010), therefore potential karst areas were identified by review of the national karst hazards mapping by Davies et al. (1984) which used for the karst layer in the National Atlas (2008). As with the national landslide risk mapping, the karst hazards map of the U.S. at a 1:7,500,000 scale may overstate the potential for karst development. However, the presence of caves in areas underlain by limestone may indicate the potential presence for other karst features such as sinkholes.
- The greatest exposure risk to erionite would occur during active ground disturbance and excavation.

Caves

- In the analysis of ROW construction and maintenance effects, caves are considered to be unique geological features.
- Underground voids derived from natural processes could be present, but have yet to be manifested on the surface, posing hazards to activities on the surface.

Paleontological Resources

- Areas of medium to high potential for valuable fossil resources were defined on the basis of literature review and assessment conducted by the San Bernardino Museum (Scott 2008). No field surveys were conducted. The fossil yield potential areas identified for this analysis were used to define areas where detailed on-site surveys would be needed.

Groundwater Pumping

The following assumptions were used in the impact analysis for geological hazards and cave resources for groundwater pumping.

Geological Hazards

- Hazards from seismicity, active faults, landslides, karst, and erionite are not considered risks associated with groundwater pumping. Rather, the geologic hazard of subsidence due to withdrawal of subsurface fluids result is the only geologic hazard considered in analyzing groundwater pumping effects.
- Drawdown of potentiometric heads from groundwater pumping may cause subsidence of unconsolidated valley fill materials.
- The fissures identified in the Delamar and Dry Lake valleys have the potential to be affected by groundwater pumping.
- In the absence of modeling it is assumed that 20 feet of drawdown could result in 1 foot of subsidence (Bell 1981).

- The magnitude of potential subsidence coincides with the magnitude of groundwater drawdown, but actual subsidence also is highly dependent on other conditions such as composition and physical properties of the aquifers that would be pumped. Pumping from well-cemented or solid grain-supported rocks is not likely to cause subsidence; whereas pumping from unconsolidated deposits with a high proportion of fine-grained materials would be more prone to compaction from fluid withdrawal that would result in subsidence. The analysis of subsidence assumes that aquifer materials would be prone to a degree of compaction because of groundwater withdrawal.
- Assumptions about the potential changes in future groundwater availability from groundwater pumping do not incorporate additional assumptions about the effects of climate change because specific long-term effects of climate change are not presently known, and the incremental contribution of climate change effects to project effects cannot be reasonably estimated. A general discussion of climate change effects is provided in Section 3.2.3.1.

Methodology for Analysis

Groundwater Development Construction and Facility Maintenance

The methodology for impact analysis for geological and paleontological resources for groundwater development construction and facility maintenance is the same as that described for ROWs:

- Mitigation measures discussed in this resource section focus on new measures. Where applicable, some of the ROW mitigation measures may apply to surface disturbance activities associated with groundwater development. These ROW mitigation measures also would be considered in subsequent NEPA tiers.

Geologic Resources

- SNWA would be required to implement a comprehensive COM Plan that would include all future hydrographic basins and all facilities associated with the SNWA GWD Project. The COM Plan includes a requirement for comprehensive monitoring and mitigation program for the entire project that would integrate the various required monitoring and mitigation actions. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary, along with measures to protect geologic resources from ROW construction and operation activities.

Groundwater Pumping

The impact analysis methodology for geological hazards for groundwater pumping are listed below. Groundwater pumping effects on caves are discussed in Section 3.3, Water Resources.

<u>Geological Hazards</u>

- Provide a relative magnitude of subsidence that could occur due to the proposed groundwater pumping by looking at subsidence due to groundwater withdrawal in analogous basins that are similar in character to the basins proposed for extraction.
- Use documented subsidence from groundwater withdrawal in other Great Basin or southwestern U.S. valleys as analogs to provide a qualitative estimate of drawdown risk of subsidence from the proposed groundwater pumping scenarios.
- The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on geologic resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

3.2.2.9 Proposed Action

Groundwater Development Area

Geologic Hazards

Seismicity and Active Faults. During construction activities, potential effects due to seismicity and permanent ground displacement are not expected to pose a concern. Seismicity and active fault hazards present risks to long-term maintenance of the proposed pipeline and facilities. Permanent ground deformation across faults or fissures could result in damage to pipelines and facilities. There are two potentially active fault zones (last movement demonstrated to be less than 15,000 years ago) present in the proposed in groundwater development areas: the Southern Spring Valley fault zone and the West Dry Lake fault zone (**Figure 3.2-2**) (Anderson 1999; Sawyer and Redsteer 2000). The Southern Spring Valley fault zone is a series of scarps along the west side of Southern Spring Valley. The West Dry Lake Valley fault zone is marked by a series of northeast trending scarps in the central part of the valley. There are also fissures that have been described in Dry Lake and Delamar valleys of undetermined origin, but are possibly seismic (Swadley 1995). Fissures are present in proposed groundwater development areas in the center and east side of Dry Lake Valley.

Ground motion from a maximum earthquake in the project area are expected to range from 10 to 27 percent of the acceleration of gravity, with a 2 percent probability of exceedance in 50 years (USGS 2010). The highest ground accelerations would be expected to occur in central Lincoln County and the least in southeastern White Pine County. Ground accelerations of 27 percent of g may result in slight damage to well-built structures, but damage may be considerable in poorly built or badly designed structures. Such ground accelerations would probably not affect high-grade steel pipe in good condition (McDonough 1995; Wald et al. 1999). Ground motion risk will be lessened by design and construction of the proposed groundwater development facilities according to applicable and appropriate seismic standards.

Soil liquefaction has the greatest probability of occurring along the edges of alluvial fans where the deposits are saturated at shallow depths (Wills 2001). However, the overall potential for liquefaction would be low because of the expected ground motions in the project area from a maximum earthquake.

Earthquake induced landslides do not appear to present risks since the groundwater development areas are located where there is low landslide risk and susceptibility (see landslide discussion below).

Landslides. During the construction phase, there is a very low risk of landslides in the groundwater development areas since the development areas are located where there is low to medium risk and susceptibility for landslides (National Atlas 2008). An area of high landslide susceptibility and incidence is indicted in the southern Snake Range, southwest of Baker. This area of landslide risk is restricted to the slopes of the range (NPS 2009). Since the groundwater development areas are on the west and east sides of the Snake Range in the valley floors, landslides are not expected to be a concern for construction or facility maintenance.

During facility maintenance, debris flows have the potential to damage groundwater development facilities. The power of debris flows is such that backfill could be eroded and the pipelines exposed and damaged and culverts and roads can be washed away during heavy precipitation events.

Karst. Although there is potential for karst development in the groundwater development areas (National Atlas 2008), karst terrain has not been documented. However, the circumstantial presence of nearby caves may be indicative of the existence of karst potential and hazards related to sinkhole subsidence during construction and maintenance of groundwater development areas. Other hazards in karst terrain would include lost circulation of drilling fluids.

Erionite. Erionite is not likely to pose a concern because no erionite deposits have been identified in the in areas of proposed disturbance.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on geologic resources. The Ely and Las Vegas RMPs (BLM 2008, 1998) provide no management direction or BMPs regarding the siting of facilities with regard to active faults. Therefore, if active faults or fissures cannot be avoided, then the ACMs (**Appendix E**) provide for the following protection measures for active faults and fissures:

- ACM A.3.1: If fault crossings of the pipeline are identified during detailed geotechnical investigations, additional design features will be added to ensure pipeline integrity (e.g., flexible couplings, increased pipe wall thickness, pipe sleeves).
- ACM A.3.2: In the "fissures" area of Dry Lake Valley, in addition to design features, over-excavation of existing soils and replacement with engineered fill, grouting of fissures, and/or use of geo-textile fabric will be utilized as needed to ensure pipeline stability.

The Ely and Las Vegas RMPs (BLM 2008, 1998) provide no management direction or BMPs regarding the siting of facilities with regard landslides and debris flows. To reduce risk due to debris flows, ROW facilities should be located as far as practically allowable from the mouths of drainages at the mountain range-alluvial fan interface. Additional measures are included in the ACMs (**Appendix E**):

- ACM A.1.67: Desert washes and ephemeral drainages will be restored to pre-existing conditions. Soils will be compacted, and additional stabilization measures such as rip rap may be required to protect the facilities and prevent increased erosion in the wash.

Conclusion. Except for potential karst, geologic hazards are not likely to pose risks during drilling and construction of groundwater development facilities. See discussion on caves below for analysis of potential hazards from karst since caves and karst are related topics. During facility maintenance, active faults, fissures, and karst pose potential concerns. The proposed pipeline and facilities are not likely to be at risk from earthquake ground motion. The ACMs would provide protection for facilities with regard to active faults and fissures.

Proposed mitigation measures:

None.

Caves

Caves have been identified in areas close to, but not within groundwater development areas. The development areas are located in Cave and Snake valleys. The presence of caves may be indicative of karst systems that cover larger areas than the caves themselves, but are not obvious on the surface. Construction and maintenance activities in groundwater development areas are likely to pose risks to caves and their unique habitats:

- Increased opportunity for unauthorized entry and disturbance or damage to cave resources.
- Drilling into cave/karst features and providing a pathway for contamination of groundwater.
- Blasting may cause cave instability and collapse.

In addition to the potential impacts listed above, the cave openings and undiscovered underground voids pose risks to health and safety, roads, structures, and runoff.

The Ely and Las Vegas RMPs (BLM 1998; 2008) do not provide general management direction for protection of cave resources; however, there are instances of ACEC and lease stipulations that provide for cave protection in specific locations. The RMPs do not provide management direction for dealing with karst hazards.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on geologic resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

Conclusion. There is a potential for disturbance or damage to caves from construction and drilling activities. Mitigation measures are proposed to lessen potential impacts to caves during groundwater development construction and drilling activities. Cave resources would not be affected by maintenance of the groundwater facilities. Karst features may have impacts on construction and maintenance of groundwater facilities. Mitigation measures are proposed to lessen the potential impact of karst features during construction, drilling, and maintenance of groundwater development facilities.

Proposed mitigation measures:

GW-G-1: Cave Protection. Prior to ground disturbing or drilling activities in areas close to identified cave resources, the conditions of approval will require appropriate site specific measures for the protection of caves that may be at risk such as, but not limited to, the following:

- Reasonable and appropriate setbacks and buffers around caves.
- Limitations on blasting.
- Requirements for the storage and handling of hazardous materials such as fuels.
- Other measures that may be appropriate for wells including procedures when encountering subsurface voids while drilling, closed drilling fluid (mud) systems (no earthen mud pits), use of freshwater mud, directional drilling, and special casing programs.

Effectiveness: This measure would be effective in avoiding impacts to caves and to provide a margin of safety for construction and maintenance activities with respect to caves and possible underground voids that may be associated with caves. Effects on other resources: Effects on other resources would be minimal.

GW-G-2: Underground Voids. If underground voids are unexpectedly encountered during facility construction or drilling, the following measures would apply:

- Work will be halted and the BLM will be notified immediately.
- The BLM, in consultation with the permittee, shall assess the risk of further drilling or siting of surface facilities in the area where the voids are encountered.
- Risk assessment may require the use of appropriate geotechnical methods to gather relevant data on the extent of karst features.

Effectiveness: This measure would be effective in avoiding impacts to caves and to provide a margin of safety for construction and maintenance activities with respect to caves and possible underground voids that may be associated with caves. Effects on other resources: Effects on other resources would be minimal.

Paleontological Resources

Figure 3.2-5 displays project elements with respect to paleontological resource sensitivity. Proposed groundwater development areas in the Coyote Springs, Delamar, Dry Lake, Cave, Lake, and Snake valleys are located in areas with deposits that have high potential for important fossils. Potential impacts to fossil localities during construction would be both direct and indirect. Direct impacts to or destruction of fossils would occur from trenching or facility construction activities conducted through important fossil beds. Indirect impacts during construction would include erosion of fossil beds due to slope re-grading and vegetation clearing or the unauthorized collection of scientifically important fossils by construction workers or the public due to increased access to fossil localities in the proposed groundwater development areas.

Any potential effects to fossils from facility maintenance (non-pumping) activities would be isolated due to the probable dispersed nature of maintenance activities. Also, potential impact during operations and maintenance would be minimal since activity would generally occur in previously disturbed areas. Routine operation of the proposed pipeline and related facilities would not disturb paleontological resources. Maintenance activities that would result in surface disturbance typically would occur within areas previously disturbed during construction. Since new disturbances would not be anticipated from routine maintenance activities, impacts to paleontological resources would be negligible. If maintenance or new construction requires disturbance of previously undisturbed areas, the protection measures as described in **Appendix E** would be implemented.

Ely RMP (BLM 2008) provides management direction for dealing with paleontological resources including BMPs for wind energy development and stipulations and notices for fluid minerals leasing. The ACMs listed for paleontological resources below are in conformance with those BMPs and stipulations.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on paleontological resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

To provide protection for potential paleontological resources, protection measures would be followed as provided in **Appendix E**. The protection measures are applicable to ROWs and groundwater development areas. These protection measures include the following:

- ACM A.6.1: A field survey will be conducted of areas within the ROWs identified as having a high potential for paleontological resources, based upon a paleontological records search using the Potential Fossil Yield Classification System. The field surveys will identify if there are surface exposures containing visible fossils and if there is a potential for buried fossils within the construction footprint. If any important fossils or middens are found during the field survey, a program will be developed and implemented to remove any exposed fossils prior to construction.
- ACM A.6.2: Areas identified as having a high potential for buried paleontological resources based upon the field survey will be monitored by a qualified paleontologist during construction activities involving ground disturbance, including grading, excavation, and trenching.
- ACM A.6.3: Any fossils recovered during the field survey or construction monitoring will be prepared in accordance with standard professional paleontological techniques. The fossils will be curated in a BLM-approved facility. A report on the findings and significance of the salvage program, including a list of the recovered fossils, will be prepared following completion of the program. A copy of this report will accompany the fossils, and a copy will be submitted to the Nevada State Museum.

Conclusion. Portions of proposed groundwater development areas may contain deposits of medium to high potential for scientifically important fossil resources. The BLM BMPs and ACMs would ensure that important fossils are properly documented and curated, and therefore lessen potential impacts during construction of the pipeline and related facilities. Facility maintenance is not expected to pose risks to paleontological resources.

Proposed mitigation measures:

None.

Potential residual impacts include:

- Even if construction monitoring is implemented, some scientifically valuable fossils would be disturbed and lost during excavation and grading over underdetermined distances. As a consequence, there would be a small incremental loss of fossil material that would be offset by the material that is recovered, and curated for scientific study purposes.
- Since public access to the groundwater development and surrounding areas would not be prohibited by the BLM, the risk of unauthorized collection of fossil material would remain.

Table 3.2-4 **Summary of Geologic Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Proposed Action Groundwater Development**

Effects/Conclusion
• Except for potential karst, geologic hazards are not likely to pose risks during drilling and construction of groundwater development facilities. During facility maintenance, active faults, fissures, and potential karst pose potential concerns. The proposed pipeline and facilities are not likely to be at risk from expected ground motion. The ACMs would provide protection for facilities with regard to active faults and fissures. Proposed mitigation measures would lessen the risk of karst hazards. • Mitigation measures are proposed to lessen potential impacts to caves during groundwater development construction and drilling activities. Cave resources would not be affected by maintenance of the groundwater facilities. Karst features may have impacts on construction and maintenance of groundwater facilities. Mitigation measures are proposed to lessen the potential impact of karst features during construction, drilling, and maintenance of groundwater development facilities. • Portions of proposed groundwater development areas may contain deposits of medium to high potential for scientifically important fossil resources. Facility maintenance is not expected to pose risks to paleontological resources.
COM Plan
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for geologic resources are summarized below for ACMs and mitigation recommendations.
ACMs
• ACM A.6.1: A field survey will be conducted of areas within the ROWs identified as having a high potential for paleontological resources, based upon a paleontological records search using the Potential Fossil Yield Classification System. The field surveys will identify if there are surface exposures containing visible fossils and if there is a potential for buried fossils within the construction footprint. If any important fossils or middens are found during the field survey, a program will be developed and implemented to remove any exposed fossils prior to construction. • ACM A.6.2: Areas identified as having a high potential for buried paleontological resources based upon the field survey will be monitored by a qualified paleontologist during construction activities involving ground disturbance, including grading, excavation, and trenching. • ACM A.6.3: Any fossils recovered during the field survey or construction monitoring will be prepared in accordance with standard professional paleontological techniques. The fossils will be curated in a BLM-approved facility. A report on the findings and significance of the salvage program, including a list of the recovered fossils, will be prepared following completion of the program. A copy of this report will accompany the fossils, and a copy will be submitted to the Nevada State Museum.
Proposed Mitigation
GW-G-1 (Cave Protection). Prior to ground disturbing or drilling activities in areas close to identified cave resources, the conditions of approval will require appropriate site specific measures for the protection of caves that may be at risk such as , but not limited to, the following: • Reasonable and appropriate setbacks and buffers around caves. • Limitations on blasting. • Requirements for the storage and handling of hazardous materials such as fuels. • Other measures that may be appropriate for wells including procedures when encountering subsurface voids while drilling, closed drilling fluid (mud) systems (no earthen mud pits), use of freshwater mud, directional drilling, and special casing programs. This measure would be effective in avoiding impacts to caves and to provide a margin of safety for construction and maintenance activities with respect to caves and possible underground voids that may be associated with caves. **GW-G-2 (Underground Voids).** If underground voids are unexpectedly encountered during facility construction or drilling, the following measures would apply: • Work will be halted and the BLM will be notified immediately. • The BLM, in consultation with the permittee, shall assess the risk of further drilling or siting of surface facilities in the area where the voids are encountered. • Risk assessment may require the use of appropriate geotechnical methods to gather relevant data on the extent of karst features. This measure would be effective in avoiding impacts to caves and to provide a margin of safety for construction and maintenance activities with respect to caves and possible underground voids that may be associated with caves.

Table 3.2-4 Summary of Geologic Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Proposed Action Groundwater Development (Continued)

Potential Residual Impacts
• Even if construction monitoring is implemented, some scientifically valuable fossils would be disturbed and lost during excavation and grading over underdetermined distances. As a consequence, there would be a small incremental loss of fossil material that would be offset by the material that is recovered, and curated for scientific study purposes. • Since public access to the groundwater development and surrounding areas would not be prohibited by the BLM, the risk of unauthorized collection of fossil material would remain. • A very small risk of facility damage would remain after implementation of geotechnical studies and design measures for fault movement, seismicity, and karst.

Groundwater Pumping

The following issues for paleontological resources and geological hazards are evaluated for groundwater pumping.

Geological Hazards

The major geologic hazard associated with groundwater pumping would be the risk of subsidence of the ground surface associated with withdrawal of subsurface fluids from valley fill deposits. The subsidence due to groundwater withdrawal is a very different phenomenon from subsidence resulting from dissolution of subsurface strata as in karst environments discussed in the ROW and groundwater development impact sections.

There are many variables in this process and no one aquifer is going to react in the same way as other aquifers. Instead of modeling the potential subsidence that might occur due to the withdrawal of groundwater, the purpose here is to provide a relative magnitude of subsidence that could occur due to the proposed action by looking at subsidence due to groundwater withdrawal in analogous basins that are similar in character to the basins proposed for extraction.

Subsidence caused by groundwater withdrawal occurs as a result of a decrease in pore volume of the aquifer as fluids are removed (Holzer and Galloway 2005). The compaction of beds within the aquifer can result in the lowering of the ground surface around the point or points of withdrawal (wells). The subsidence can be from less than a foot to tens of feet depending on the amount of fluid withdrawal and the composition of the aquifer. Finer-grained materials are more susceptible to compaction than coarse-grained materials. Subsidence due to groundwater withdrawal may include the following effects: damage to well casings, roads, structures, utilities, and pipelines. In addition, subsidence would also affect surface drainage flow resulting in undesirable diversion and impoundment of water. Permanent irreversible subsurface compaction causing subsidence could result in decreased well productivity over the lifetime of the well.

If materials prone to compaction are encountered, there is a high likelihood that subsidence would occur. The crucial questions are how much would occur and what are the consequences. There are two simple ways to estimate the amount of subsidence that would occur. One way is to look at documented subsidence rates in similar basins and assign a reasonably comparable rate of subsidence regardless of amount of water withdrawal and extrapolate that rate over time. Another way is to use documented data from an analogous basin and compare the amount of ground subsidence to have occurred for an estimated amount of decline in *potentiometric head* or water table.

For the first case, **Table 3.2-5** provides data on documented subsidence rates and water table declines for similar basins located mainly in the southwestern U.S.

Using the average subsidence rate of 0.17 feet per year, for 200 years of pumping, the maximum subsidence would be 34 feet. However, to assume a linear relationship between subsidence and pumping time may overstate the amount of subsidence because of complex interactions of the aquifer materials and rates of recharge in response to groundwater withdrawal (Poland 1984).

Table 3.2-5 Rates of Subsidence and Water Table Declines for Selected Southwestern U.S. Basins

Location	Maximum Subsidence (feet)	Dates	Subsidence Rate (feet per year)	Maximum Water Table Decline (feet)	Ratio of Subsidence to Water Table (Head) Decline
Central Arizona[1]	9	1915-1971	0.16	374	1:42
Tulare-Wasco, California[1]	14	1926-1970	0.32	100	1:7
Antelope Valley, California[2]	6	1930-1992	0.10	150	1:25
Las Vegas, Nevada[3]	5	1935-2000	0.08	300	1:61
			Average 0.17		Average 1:34

[1] Holzer 1976.

[2] Sneed and Galloway 2000.

[3] Bell et al. 2002.

Under the second approach, if it is assumed that the maximum drawdown over 200 years would be an estimated 100 feet, then the amount of subsidence based on the average ratio of subsidence to drawdown as shown in **Table 3.2-5** would be approximately 3 feet based on a ratio of 1 foot of subsidence to 34 feet of drawdown. However, this may underestimate the amount of subsidence that may occur. According to Bell (1981), a ratio of 1:20 may be "the most representative value for areas underlain by fine-grained deposits." Areas underlain by coarse materials may have subsidence-to-drawdown ratios of 1:40 to 1:60 because the coarser materials would undergo less compaction than fine-grained materials (Mindling 1974 as cited by Bell 1981). Moreover, observations in the Las Vegas Valley from 1939 to 1962 indicated that the subsidence to drawdown ratio varied over time at a bench mark measuring station from 1:8 to 1:30, but the cause for change in ratio was not explained (Malmberg 1964). Because the subsidence-to-drawdown ratio appears to vary over time and type of subsurface materials, the 1:20 ratio was chosen as a reasonable factor to use for potential subsidence analysis.

From the above data, it is worth noting that pumping in the Las Vegas Valley over the period of 1953 to 1978 was about 61,000 afy (Bell 1981). Also, to use as a comparison, peak water withdrawal from the Antelope Valley in California ranged from 350,000 to 400,000 afy and has declined since then to about 75,000 afy by 1999 (Sneed and Galloway 2000). Pumping in the Tulare-Wasco area from 1950 to 1962 averaged over 1,036,000 afy (Lofgren and Klausing 1969).

A measure of potential subsidence was estimated based on the assumption that every 20 feet of drawdown would result in 1 foot of surface subsidence. Using the drawdown values calculated in the groundwater withdrawal model, the amount of subsidence over the withdrawal areas can be estimated by using the drawdown contour maps. For example, **Figure 3.3.2-5** depicts the drawdown for the Proposed Action at full build out plus 200 years. The groundwater drawdown contours of 10 feet, 50 feet, 100 feet, and 200 feet enclose areas potentially subject to varying degrees of subsidence. **Table 3.2-6** lists the areas by basin that may be subjected to subsidence for the Proposed Action at full build out plus 200 years. The drawdown and associated potential subsidence magnitude categories shown on **Table 3.2-6** generally follow the drawdown contour intervals so that the regions of varying drawdown on the map correlate with the data in the table, but the acreages on the **Table 3.2-6** and tables in subsequent sections have been adjusted to exclude bedrock areas that are within the influence of drawdown, but would not be subject to compaction subsidence as would valley fill deposits. As can be seen on **Table 3.2-6**, about 525 square miles may be at risk for 5 feet of subsidence of greater. It is assumed that subsidence would occur within the defined drawdown areas.

On **Table 3.2-6** it can be seen that the areas at highest risk for subsidence greater than 5 feet are Spring Valley, Snake Valley, Dry Lake Valley, Delamar Valley, and Cave Valley basins.

The groundwater development valleys with predicted drawdown effects are located in sparsely populated areas in comparison to the Las Vegas Valley. Subsidence could damage roads, buried utilities (including the proposed project utilities), and isolated structures where subsidence fissures become manifest. Also, changes in surface topography could affect runoff and fissures may become conduits for diverting surface flows. Subsidence impacts would be considered unavoidable adverse impacts and in some cases irreversible. Baseline measurements (Bell and Arai 2009) indicate there is little to no subsidence in basins to be developed under the Proposed Action and other alternatives, but the amounts of water being pumped from these basins is much less than the proposed groundwater development project.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on geologic resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

Table 3.2-6 Potential Subsidence, Proposed Action at Full Build Out Plus 200 Years

Drawdown (feet)	**10 to 20**	**20-50**	**50 to 100**	**100 to 200**	**>200**
Potential Subsidence (feet)	**<1 to 1**	**1 to 2.5**	**2.5 to 5**	**5 to 10**	**>10**
Subsidence Area (square miles)					
Cave Valley	16	22	14	40	59
Coyote Spring Valley	2	<1	0	0	0
Delamar Valley	<1	22	108	86	1
Dry Lake Valley	52	143	361	1	0
Hamlin Valley	62	112	166	<1	0
Kane Springs Valley	5	1	0	0	0
Lake Valley	193	70	2	0	0
Lower Meadow Valley Wash	8	<1	3	0	0
Pahranagat Valley	11	33	5	0	0
Pahroc Valley	10	14	<1	0	0
Panaca Valley	18	3	<1	0	0
Patterson Valley	7	0	0	0	0
Pine Valley	0	<1	0	0	0
Snake Valley	102	148	187	110	0
Spring Valley	0	0	0	0	0
Spring Valley	96	319	223	230	0
Steptoe Valley	14	16	0	0	0
Tippett Valley	48	<1	0	0	0
White River Valley	4	1	0	0	0
Total	**647**	**905**	**1,070**	**465**	**60**

Monitoring Recommendations:

GW-G-3: Subsidence Monitoring. Subsidence monitoring is recommended in current and proposed water withdrawal areas in order to provide baseline data before build out begins. As groundwater extraction occurs in full production, monitoring would be needed to assess the magnitude and extent of subsidence in order to take actions that would mitigate subsidence where necessary. Potential monitoring could include:

- Baseline Subsidence Monitoring.
- Initial Subsidence Modeling, Exploratory Phase.
- Monitoring During Pumping.

- Establish a periodic and systematic inspection of water development areas to observe the development and documentation of ground fissures that may develop.

The following is a conceptual subsidence monitoring plan. The purpose is to provide a general framework for a subsidence monitoring plan and is not intended to be rigorous in scope. Geotechnical engineering design and best practices will provide the details of a monitoring plan that will be sufficient to assess the development of subsidence to aid in planning and mitigation of potential subsidence impacts. The following would be considered during the development of the COM Plan.

<u>Baseline Data Acquisition</u>. Baseline data should be collected in the groundwater development areas prior to development. There may already be effects from pumping that, without proper documentation, could be attributed to the proposed groundwater development program. Baseline information would include surveys to precisely determine present elevations in the development areas and collection of evidence of existing subsidence (fissures, displacement of surface features such as roads, structures, and water well damage). If subsidence is already present, then an attempt should be made to estimate how much has occurred up to the present time.

Areas such as the Dry Lake and Delamar valleys have documented fissures and faults (Swadley 1995). Although the origin of these features is not well understood, they could be readily activated by groundwater pumping and provide zones of weakness allowing for preferential development of subsidence along fissures, even if they are presently inactive. If groundwater development is contemplated in any area with known faults regardless of age in valley fill sediments, then accurate baseline data are of critical importance.

<u>Initial Subsidence Modeling, Exploratory Phase</u>. Prior to the drilling of development wells, subsidence models should be developed in groundwater development areas with data taken from exploratory wells. Such an effort may provide sufficient information on subsurface conditions and well productivity that would allow for predictive modeling of subsidence. As wells are drilled and constructed, subsurface and well test information would be obtained that would allow preparation of predictive models. Such information would include subsurface boring logs, core descriptions, geotechnical test results on core materials, and extended pump tests of sufficient volume and duration to provide accurate estimates of potential drawdown and storage coefficients.

<u>Monitoring During Pumping</u>. During the operational phase, subsidence monitoring would be conducted by the following activities.

- Construction of subsidence monitoring monuments along transects or arrays in groundwater development areas to accurately survey changes in land surface with the use of GPS technology. The exact layout of monument transects or arrays would be determined when the location of pumping wells is known, but also should be located to provide information along major roads (e.g., State Highway [SH] 93), county roads, residences, and utilities. Monitoring transects may also be placed across faults in valley fill. In addition to survey monuments and GPS, Interferometric Synthetic Aperture Radar, a remote sensing technique, could be used to monitor changes in ground elevation (Haynes 2009).
- Monitor and document drawdown or declines in head according to best management practices for water production wells. Monitoring during pumping will be carried out in conjunction with stipulated agreements and other adaptive management plans.

Establish a periodic and systematic inspection of water development areas to observe the development and documentation of ground fissures that may develop. The inspection would include observation and documentation of damage to surface structures, roads, utilities, and wells.

As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).

Proposed mitigation measures:

As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7).

Potential residual impacts include:

- The COM Plan and water resources monitoring and mitigation measures could be effective in reducing subsidence impacts. One relevant objective of the COM Plan to private agricultural lands is to identify triggers for early warning of potential adverse impacts that would act as indicators for groundwater drawdown thresholds. Subsidence impacts due to groundwater drawdown could occur and would likely be permanent, depending on the composition of aquifer deposits and recharge conditions. Even if rebound were to occur, it is unlikely that the land surface would return to its original condition. It is not possible to determine the level of impact at this time. Residual subsidence effects could exist considering the potential long recovery period for recharge that could occur. Some unavoidable adverse subsidence impacts to could occur at some locations.

Caves

Groundwater pumping effects on caves are discussed in Section 3.3, Water Resources.

Paleontological Resources

Groundwater pumping is not expected to have effects on paleontological resources.

Summary of Impacts, Proposed Action Pumping

A summary of impact information, including ACMs (where applicable) and mitigation recommendations is provided for the Proposed Action, groundwater pumping, in **Table 3.2-7**.

Table 3.2-7 Summary of Geologic Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Proposed Action Pumping

Effects/Conclusion			
• Areas within the 100-foot drawdown contour are at risk over the lifetime of the project for greater than 5 feet of subsidence and include areas in Spring Valley, Snake Valley, Cave Valley, Dry Lake Valley, and Delamar Valley basins. A risk of lesser subsidence could occur outside the 100-foot contour to the 10-foot contour (from 0.5 to 5 feet). The effects of subsidence may be permanent even if pumping ceases. Potential subsidence effects include damage to roads, buried utilities (including the proposed project utilities), and isolated structures. Also, changes in surface topography could affect runoff and fissures may become conduits for diverting surface flows. Subsidence impacts would be considered unavoidable adverse impacts and in some cases irreversible. • Groundwater pumping is not expected to have effects on paleontological resources.			
Impact Indicators By Model Timeframe	**Full Build Out**	**Full Build Out Plus 75 Years**	**Full Build Out Plus 200 Years**
Subsidence greater than 5 feet (square miles)	<1	147	525
COM Plan			
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the			

Table 3.2-7 Summary of Geologic Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Proposed Action Pumping

BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for geologic resources are summarized below for ACMs and mitigation recommendations.

ACMs

- None.

Monitoring Recommendations

GW-G-3: Subsidence Monitoring. Subsidence monitoring is recommended in current and proposed water withdrawal areas in order to provide baseline data before build out begins. As groundwater extraction occurs in full production, monitoring would be needed to assess the magnitude and extent of subsidence in order to take actions that could mitigate subsidence where necessary.

As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).

Mitigation Recommendations

- Mitigation measures as appropriate for subsidence and caves would be developed through adaptive management as described in **Appendix A**.

GW-WR-7: Groundwater Development & Drawdown Effects to Federal Resources and Federal Water Rights. If the results of the monitoring or modeling information provided in accordance with GW-WR-3a indicate that impacts to federal resources or federal water rights from groundwater withdrawal are occurring or are likely to occur, and the groundwater development project is the likely cause of or contributor to the impacts, the following measures would be initiated:

1. The BLM would evaluate the available information and determine if emergency action and/or a mitigation plan is required.
2. If the BLM determines that emergency action is required to avoid, minimize, or offset the impact, the BLM would serve an immediate "Cease and Desist" order identifying the actions to be taken, including whether SNWA would be required to concurrently develop a mitigation plan as required in bullet 3 below.
3. If the BLM determines that a mitigation plan is required, the SNWA would prepare a detailed, site- specific plan that (a) identifies the magnitude and timing of the drawdown or associated impacts to federal resources or federal water rights; and (b) provides detailed site-specific measures that would be used to avoid, minimize the magnitude of, or offset the identified impacts. The mitigation plan would be submitted to BLM for approval within 30 days of BLM's determination that a site-specific mitigation plan is required (unless a longer timeframe is approved by BLM).
4. The BLM-approved, site-specific mitigation plan would be implemented by the SNWA. The BLM could require that specific measures be implemented per the schedule specified in the mitigation plan to avoid, minimize, or offset the impacts to federal resources or federal water rights. The specific mitigation measures may include but are not limited to the following:
   - Reduction or cessation in groundwater withdrawals;
   - Geographic redistribution of groundwater withdrawals;
   - Recharge projects to offset local groundwater drawdown;
   - Flow augmentation to maintain flow in specific water sources; or
   - Other on-site or off-site improvements.

- Monitoring of the surface water resources and groundwater elevations required under Mitigation Measure GW-WR3a would be used in addition to other specified monitoring in the approved mitigation plan to document the effectiveness of the implemented measures. If the initial implementation of the mitigation plan does not provide the desired results within the time frame specified by the BLM, the BLM may require implementation of additional measures.

Potential Residual Impacts

- As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7).

3.2.2.10 Alternative A

Groundwater Development Area

Geological Hazards

Except for potential karst, geologic hazards are not likely to pose risks during drilling and construction of groundwater development facilities. During facility maintenance, active faults, fissures, and potential karst pose potential concerns. The proposed pipeline and facilities are not likely to be at risk from expected ground motion.

Caves

There is a potential for disturbance or damage to caves from construction and drilling activities. Mitigation measures are proposed to lessen potential impacts to caves during groundwater development construction and drilling activities. Cave resources would not be affected by maintenance of the groundwater facilities. Karst features may have impacts on construction and maintenance of groundwater facilities.

Paleontological Resources

Portions of proposed groundwater development areas may contain deposits of medium to high potential for scientifically important fossil resources. The COM Plan, BLM BMPs, and ACMs would ensure that important fossils are properly documented and curated, and therefore lessen potential impacts during construction of the pipeline and related facilities. Facility maintenance is not expected to pose risks to paleontological resources.

Summary of Impacts, Alternative A Groundwater Development

A summary of impact information, including ACMs (where applicable) and mitigation recommendations is provided for Alternative A, groundwater development, in **Table 3.2-8**.

Table 3.2-8 Summary of Geologic Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative A Groundwater Development

Effects/Conclusion
• Except for potential karst, geologic hazards are not likely to pose risks during drilling and construction of groundwater development facilities. During facility maintenance, active faults, fissures, and potential karst pose potential concerns. The proposed pipeline and facilities are not likely to be at risk from expected ground motion. The ACMs would provide protection for facilities with regard to active faults and fissures. Proposed mitigation measures would lessen the risk of karst hazards. • Mitigation measures are proposed to lessen potential impacts to caves during groundwater development construction and drilling activities. Cave resources would not be affected by maintenance of the groundwater facilities. Karst features may have impacts on construction and maintenance of groundwater facilities. Mitigation measures are proposed to lessen the potential impact of karst features during construction, drilling, and maintenance of groundwater development facilities. • Portions of proposed groundwater development areas may contain deposits of medium to high potential for scientifically important fossil resources. Facility maintenance is not expected to pose risks to paleontological resources.
COM Plan
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for geologic resources are summarized below for ACMs and mitigation recommendations.

Table 3.2-8 Summary of Geologic Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative A Groundwater Development (Continued)

ACMs
• ACM A.6.1: A field survey will be conducted of areas within the ROWs identified as having a high potential for paleontological resources, based upon a paleontological records search using the Potential Fossil Yield Classification System. The field surveys will identify if there are surface exposures containing visible fossils and if there is a potential for buried fossils within the construction footprint. If any important fossils or middens are found during the field survey, a program will be developed and implemented to remove any exposed fossils prior to construction. • ACM A.6.2: Areas identified as having a high potential for buried paleontological resources based upon the field survey will be monitored by a qualified paleontologist during construction activities involving ground disturbance, including grading, excavation, and trenching. • ACM A.6.3: Any fossils recovered during the field survey or construction monitoring will be prepared in accordance with standard professional paleontological techniques. The fossils will be curated in a BLM-approved facility. A report on the findings and significance of the salvage program, including a list of the recovered fossils, will be prepared following completion of the program. A copy of this report will accompany the fossils, and a copy will be submitted to the Nevada State Museum.
Proposed Mitigation
GW-G-1: Cave Protection. Prior to ground disturbing or drilling activities in areas close to identified cave resources, the conditions of approval would require appropriate site specific measures for the protection of caves that may be at risk such as, but not limited to, the following: • Reasonable and appropriate setbacks and buffers around caves. • Limitations on blasting. • Requirements for the storage and handling of hazardous materials such as fuels. Other measures that may be appropriate for wells including procedures when encountering subsurface voids while drilling, closed drilling fluid (mud) systems (no earthen mud pits), use of freshwater mud, directional drilling, and special casing programs. **GW-G-2: Underground Voids**. If underground voids are unexpectedly encountered during facility construction or drilling, the following measures would apply: • Work would be halted and the BLM would be notified immediately. • The BLM, in consultation with the permittee, would assess the risk of further drilling or siting of surface facilities in the area where the voids are encountered. Risk assessment may require the use of appropriate geotechnical methods to gather relevant data on the extent of karst features.
Potential Residual Impacts
• Even if construction monitoring is implemented, some scientifically valuable fossils would be disturbed and lost during excavation and grading over underdetermined distances. As a consequence, there would be a small incremental loss of fossil material that would be offset by the material that is recovered, and curated for scientific study purposes. • Since public access to the groundwater development and surrounding areas would not be prohibited by the BLM, the risk of unauthorized collection of fossil material would remain. • A very small risk of facility damage would remain after implementation of geotechnical studies, and design measures for fault movement, seismicity, and karst.

Groundwater Pumping

Geological Hazards

The major geologic hazard associated with groundwater pumping would be the risk of subsidence of the ground surface associated with withdrawal of subsurface fluids from valley fill deposits. The areas at highest risk for subsidence greater than 5 feet are Spring Valley and Cave Valley basins. Potential subsidence effects include impacts to roads, buried utilities (including the proposed project utilities), and isolated structures where subsidence fissures become manifest. Also, changes in surface topography could affect runoff and fissures may become conduits for diverting surface flows. Subsidence impacts would be considered unavoidable adverse impacts and in some cases irreversible.

Summary of Impacts Alternative A Pumping

A summary of impact information, including ACMs (where applicable) and mitigation recommendations is provided for Alternative A, groundwater pumping, in **Table 3.2-9**.

Caves

Groundwater pumping effects on caves are discussed in Section 3.3, Water Resources.

Paleontological Resources

Groundwater pumping is not expected to have effects on paleontological resources.

Table 3.2-9 Summary of Geologic Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative A Pumping

<table>
<tr><td colspan="4">Effects/Conclusion</td></tr>
<tr><td colspan="4">• The areas at highest risk for subsidence greater than 5 feet are Spring Valley and Cave Valley basins. A risk of lesser subsidence could occur outside the 100-foot contour to the 10-foot contour (from 0.5 to 5 feet). The effects of subsidence may be permanent even if pumping ceases. Potential subsidence effects include damage to roads, buried utilities (including the proposed project utilities), and isolated structures. Also, changes in surface topography could affect runoff and fissures may become conduits for diverting surface flows. Subsidence impacts would be considered unavoidable adverse impacts and in some cases irreversible.
• Groundwater pumping is not expected to have effects on paleontological resources.</td></tr>
<tr><td>Impact Indicators By Model Timeframe</td><td>Full Build Out</td><td>Full Build Out Plus 75 Years</td><td>Full Build Out Plus 200 Years</td></tr>
<tr><td>Subsidence greater than 5 feet (square miles)</td><td>0</td><td>5</td><td>159</td></tr>
<tr><td colspan="4">COM Plan</td></tr>
<tr><td colspan="4">• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for geologic resources are summarized below for ACMs and mitigation recommendations.</td></tr>
<tr><td colspan="4">ACMs</td></tr>
<tr><td colspan="4">• None.</td></tr>
<tr><td colspan="4">Monitoring Recommendations</td></tr>
<tr><td colspan="4">GW-G-3: Subsidence Monitoring. Subsidence monitoring is recommended in current and proposed water withdrawal areas in order to provide baseline data before build out begins. As groundwater extraction occurs in full production, monitoring would be needed to assess the magnitude and extent of subsidence in order to take actions that could mitigate subsidence where necessary.
As described in Water Resources, Section 3.3, GW-WR-3a (Comprehensive Water Resources Monitoring Plan) would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).</td></tr>
<tr><td colspan="4">Mitigation Recommendations</td></tr>
<tr><td colspan="4">• Mitigation measures as appropriate for subsidence and caves would be developed through adaptive management as described in Appendix A.
• As described in Water Resources, Section 3.3, GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights) would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7).</td></tr>
</table>

Table3.2-9 **Summary of Geologic Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative A Pumping (Continued)**

Potential Residual Impacts
• The COM Plan and water resources monitoring and mitigation measures could be effective in reducing subsidence impacts. One relevant objective of the COM Plan to private agricultural lands is to identify triggers for early warning of potential adverse impacts that would act as indicators for groundwater drawdown thresholds. Subsidence impacts due to groundwater drawdown could occur and would likely be permanent, depending on the composition of aquifer deposits and recharge conditions. Even if rebound were to occur, it is unlikely that the land surface would return to its original condition. It is not possible to determine the level of impact at this time. Residual subsidence effects could exist considering the potential long recovery period for recharge that could occur. Some unavoidable adverse subsidence impacts to could occur at some locations.

3.2.2.11 Alternative B

Groundwater Development Area

Geological Hazards

Except for potential karst, geologic hazards are not likely to pose risks during drilling and construction of groundwater development facilities. During facility maintenance, active faults, fissures, and potential karst pose potential concerns. The proposed pipeline and facilities are not likely to be at risk from expected ground motion. The ACMs would provide protection for facilities with regard to active faults and fissures.

Caves

There is a potential for disturbance or damage to caves from construction and drilling activities. Mitigation measures are proposed to lessen potential impacts to caves during groundwater development construction and drilling activities. Cave resources would not be affected by maintenance of the groundwater facilities. Karst features may have impacts on construction and maintenance of groundwater facilities. Mitigation measures are proposed to lessen the potential impact of karst features during construction, drilling, and maintenance of groundwater development facilities.

Paleontological Resources

Portions of proposed groundwater development areas may contain deposits of medium to high potential for scientifically important fossil resources. The COM Plan, BLM BMPs, and ACMs would ensure that important fossils are properly documented and curated, and therefore lessen potential impacts during construction of the pipeline and related facilities. Facility maintenance is not expected to pose risks to paleontological resources.

Summary of Impacts Alternative B Groundwater Development

A summary of impact information, including ACMs (where applicable) and mitigation recommendations is provided for Alternative B, groundwater development, in **Table 3.2-10**.

Table 3.2-10 **Summary of Geologic Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative B Groundwater Development**

Effects/Conclusion
• Except for potential karst, geologic hazards are not likely to pose risks during drilling and construction of groundwater development facilities. During facility maintenance, active faults, fissures, and potential karst pose potential concerns. The proposed pipeline and facilities are not likely to be at risk from expected ground motion. The ACMs would provide protection for facilities with regard to active faults and fissures. Proposed mitigation measures would lessen the risk of karst hazards.
• Mitigation measures are proposed to lessen potential impacts to caves during groundwater development construction and drilling activities. Cave resources would not be affected by maintenance of the groundwater facilities. Karst features may have impacts on construction and maintenance of groundwater facilities. Mitigation measures are proposed to lessen the potential impact of karst features during construction, drilling, and maintenance of groundwater development facilities.
• Portions of proposed groundwater development areas may contain deposits of medium to high potential for scientifically important fossil resources. Facility maintenance is not expected to pose risks to paleontological resources.

Table 3.2-10 Summary of Geologic Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative B Groundwater Development (Continued)

COM Plan

- The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for geologic resources are summarized below for ACMs and mitigation recommendations.

ACMs

- ACM A.6.1: A field survey will be conducted of areas within the ROWs identified as having a high potential for paleontological resources, based upon a paleontological records search using the Potential Fossil Yield Classification System. The field surveys will identify if there are surface exposures containing visible fossils and if there is a potential for buried fossils within the construction footprint. If any important fossils or middens are found during the field survey, a program will be developed and implemented to remove any exposed fossils prior to construction.
- ACM A.6.2: Areas identified as having a high potential for buried paleontological resources based upon the field survey will be monitored by a qualified paleontologist during construction activities involving ground disturbance, including grading, excavation, and trenching.
- ACM A.6.3: Any fossils recovered during the field survey or construction monitoring will be prepared in accordance with standard professional paleontological techniques. The fossils will be curated in a BLM-approved facility. A report on the findings and significance of the salvage program, including a list of the recovered fossils, will be prepared following completion of the program. A copy of this report will accompany the fossils, and a copy will be submitted to the Nevada State Museum.

Proposed Mitigation

GW-G-1 (Cave Protection). Prior to ground disturbing or drilling activities in areas close to identified cave resources, the conditions of approval will require appropriate site specific measures for the protection of caves that may be at risk such as, but not limited to, the following:

- Reasonable and appropriate setbacks and buffers around caves.
- Limitations on blasting.
- Requirements for the storage and handling of hazardous materials such as fuels.
- Other measures that may be appropriate for wells including procedures when encountering subsurface voids while drilling, closed drilling fluid (mud) systems (no earthen mud pits), use of freshwater mud, directional drilling, and special casing programs.

This measure would be effective in avoiding impacts to caves and to provide a margin of safety for construction and maintenance activities with respect to caves and possible underground voids that may be associated with caves.

GW-G-2 (Underground Voids). If underground voids are unexpectedly encountered during facility construction or drilling, the following measures would apply:

- Work will be halted and the BLM will be notified immediately.
- The BLM, in consultation with the permittee, shall assess the risk of further drilling or siting of surface facilities in the area where the voids are encountered.
- Risk assessment may require the use of appropriate geotechnical methods to gather relevant data on the extent of karst features.

This measure would be effective in avoiding impacts to caves and to provide a margin of safety for construction and maintenance activities with respect to caves and possible underground voids that may be associated with caves.

Potential Residual Impacts

- Even if construction monitoring is implemented, some scientifically valuable fossils would be disturbed and lost during excavation and grading over underdetermined distances. As a consequence, there would be a small incremental loss of fossil material that would be offset by the material that is recovered, and curated for scientific study purposes.
- Since public access to the groundwater development and surrounding areas would not be prohibited by the BLM, the risk of unauthorized collection of fossil material would remain.
- A very small risk of facility damage would remain after implementation of geotechnical studies, and design measures for fault movement, seismicity, and karst.

Groundwater Pumping

Geological Hazards

The major geologic hazard associated with groundwater pumping would be the risk of subsidence of the ground surface associated with withdrawal of subsurface fluids from valley fill deposits. Simply stated, subsidence occurs in unconsolidated aquifers when compaction occurs in response to withdrawal of water. **Figure 3.3.2-18** depicts the drawdown for Alternative B full build out plus 200 years. The groundwater drawdown contours of 10 feet, 50 feet, 100 feet, and 200 feet enclose areas potentially subject to varying degrees of subsidence. For Alternative B at full build out plus 200 years, it is estimated that about 669 square miles would be at high risk for subsidence greater than 5 feet.

The areas at highest risk for subsidence greater than 5 feet are Dry Lake Valley, Delamar Valley, Lake Valley, Snake Valley, Spring Valley, and Cave Valley basins. Potential subsidence effects include impacts to roads, buried utilities (including the proposed project utilities), and isolated structures where subsidence fissures become manifest. Also, changes in surface topography could affect runoff and fissures may become conduits for diverting surface flows. Subsidence impacts would be considered unavoidable adverse impacts and in some cases irreversible.

Caves

Groundwater pumping effects on caves are discussed in Section 3.3, Water Resources.

Paleontological Resources

Groundwater pumping is not expected to have effects on paleontological resources.

Summary of Impacts Alternative B Pumping

A summary of impact information, including ACMs (where applicable) and mitigation recommendations is provided for Alternative B, groundwater pumping, in **Table 3.2-11**.

Table 3.2-11 Summary of Geologic Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative B Pumping

Effects/Conclusion			
• The areas at highest risk for subsidence greater than 5 feet are Dry Lake Valley, Delamar Valley, Lake Valley, Snake Valley, Spring Valley, and Cave Valley basins. A risk of lesser subsidence could occur outside the 100-foot contour to the 10-foot contour (from 0.5 to 5 feet). The effects of subsidence may be permanent even if pumping ceases. Potential subsidence effects includes damage to roads, buried utilities (including the proposed project utilities), and isolated structures. Also, changes in surface topography could affect runoff and fissures may become conduits for diverting surface flows. Subsidence impacts would be considered unavoidable adverse impacts and in some cases irreversible. • Groundwater pumping is not expected to have effects on paleontological resources.			
Impact Indicators By Model Timeframe	**Full Build Out**	**Full Build Out Plus 75 Years**	**Full Build Out Plus 200 Years**
Subsidence greater than 5 feet (square miles)	3	172	669
COM Plan			
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for geologic resources are summarized below for ACMs and mitigation recommendations.			
ACMs			
• None.			

Table 3.2-11 Summary of Geologic Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative B Pumping (Continued)

Monitoring Recommendations
GW-G-3: Subsidence Monitoring. Subsidence monitoring is recommended in current and proposed water withdrawal areas in order to provide baseline data before build out begins. As groundwater extraction occurs in full production, monitoring would be needed to assess the magnitude and extent of subsidence in order to take actions that would mitigate subsidence where necessary. As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).
Mitigation Recommendations
• Mitigation measures as appropriate for subsidence and caves would be developed through adaptive management as described in **Appendix A**. • As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7).
Potential Residual Impacts
• The COM Plan and water resources monitoring and mitigation measures could be effective in reducing subsidence impacts. One relevant objective of the COM Plan to private agricultural lands is to identify triggers for early warning of potential adverse impacts that would act as indicators for groundwater drawdown thresholds. Subsidence impacts due to groundwater drawdown could occur and would likely be permanent, depending on the composition of aquifer deposits and recharge conditions. Even if rebound were to occur, it is unlikely that the land surface would return to its original condition. It is not possible to determine the level of impact at this time. Residual subsidence effects could exist considering the potential long recovery period for recharge that could occur. Some unavoidable adverse subsidence impacts to could occur at some locations.

3.2.2.12 Alternative C

Groundwater Development Area

Geological Hazards

Except for potential karst, geologic hazards are not likely to pose risks during drilling and construction of groundwater development facilities. During facility maintenance, active faults, fissures, and potential karst pose potential concerns. The proposed pipeline and facilities are not likely to be at risk from expected ground motion.

Caves

There is a potential for disturbance or damage to caves from construction and drilling activities. Mitigation measures are proposed to lessen potential impacts to caves during groundwater development construction and drilling activities. Cave resources would not be affected by maintenance of the groundwater facilities. Karst features may have impacts on construction and maintenance of groundwater facilities.

Paleontological Resources

Portions of proposed groundwater development areas may contain deposits of medium to high potential for scientifically important fossil resources. The COM Plan, BLM BMPs, and ACMs would ensure that important fossils are properly documented and curated, and therefore lessen potential impacts during construction of the pipeline and related facilities. Facility maintenance is not expected to pose risks to paleontological resources.

Summary of Impacts Alternative C Groundwater Development

A summary of impact information, including ACMs (where applicable) and mitigation recommendations is provided for Alternative C, groundwater development, in **Table 3.2-12**.

Table 3.2-12 Summary of Geologic Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative C Groundwater Development

Effects/Conclusion
• Except for potential karst, geologic hazards are not likely to pose risks during drilling and construction of groundwater development facilities. During facility maintenance, active faults, fissures, and potential karst pose potential concerns. The proposed pipeline and facilities are not likely to be at risk from expected ground motion. The ACMs would provide protection for facilities with regard to active faults and fissures. Proposed mitigation measures would lessen the risk of karst hazards. • Mitigation measures are proposed to lessen potential impacts to caves during groundwater development construction and drilling activities. Cave resources would not be affected by maintenance of the groundwater facilities. Karst features may have impacts on construction and maintenance of groundwater facilities. Mitigation measures are proposed to lessen the potential impact of karst features during construction, drilling, and maintenance of groundwater development facilities. • Portions of proposed groundwater development areas may contain deposits of medium to high potential for scientifically important fossil resources. Facility maintenance is not expected to pose risks to paleontological resources.
COM Plan
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for geologic resources are summarized below for ACMs and mitigation recommendations.
ACMs
• ACM A.6.1: A field survey will be conducted of areas within the ROWs identified as having a high potential for paleontological resources, based upon a paleontological records search using the Potential Fossil Yield Classification System. The field surveys will identify if there are surface exposures containing visible fossils and if there is a potential for buried fossils within the construction footprint. If any important fossils or middens are found during the field survey, a program will be developed and implemented to remove any exposed fossils prior to construction. • ACM A.6.2: Areas identified as having a high potential for buried paleontological resources based upon the field survey will be monitored by a qualified paleontologist during construction activities involving ground disturbance, including grading, excavation, and trenching. • ACM A.6.3: Any fossils recovered during the field survey or construction monitoring will be prepared in accordance with standard professional paleontological techniques. The fossils will be curated in a BLM-approved facility. A report on the findings and significance of the salvage program, including a list of the recovered fossils, will be prepared following completion of the program. A copy of this report will accompany the fossils, and a copy will be submitted to the Nevada State Museum.
Proposed Mitigation
GW-G-1 (Cave Protection). Prior to ground disturbing or drilling activities in areas close to identified cave resources, the conditions of approval will require appropriate site specific measures for the protection of caves that may be at risk such as, but not limited to, the following: • Reasonable and appropriate setbacks and buffers around caves. • Limitations on blasting. • Requirements for the storage and handling of hazardous materials such as fuels. • Other measures that may be appropriate for wells including procedures when encountering subsurface voids while drilling, closed drilling fluid (mud) systems (no earthen mud pits), use of freshwater mud, directional drilling, and special casing programs.

Table 3.2-12 Summary of Geologic Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative C Groundwater Development (Continued)

Proposed Mitigation
This measure would be effective in avoiding impacts to caves and to provide a margin of safety for construction and maintenance activities with respect to caves and possible underground voids that may be associated with caves. **GW-G-2 (Underground Voids)**. If underground voids are unexpectedly encountered during facility construction or drilling, the following measures would apply: • Work will be halted and the BLM will be notified immediately. • The BLM, in consultation with the permittee, shall assess the risk of further drilling or siting of surface facilities in the area where the voids are encountered. • Risk assessment may require the use of appropriate geotechnical methods to gather relevant data on the extent of karst features. This measure would be effective in avoiding impacts to caves and to provide a margin of safety for construction and maintenance activities with respect to caves and possible underground voids that may be associated with caves.
Potential Residual Impacts
• Even if construction monitoring is implemented, some scientifically valuable fossils would be disturbed and lost during excavation and grading over underdetermined distances. As a consequence, there would be a small incremental loss of fossil material that would be offset by the material that is recovered, and curated for scientific study purposes. • Since public access to the groundwater development and surrounding areas would not be prohibited by the BLM, the risk of unauthorized collection of fossil material would remain. • A very small risk of facility damage would remain after implementation of geotechnical studies, and design measures for fault movement, seismicity, and karst.

Groundwater Pumping

Geological Hazards

The major geologic hazard associated with groundwater pumping would be the risk of subsidence of the ground surface associated with withdrawal of subsurface fluids from valley fill deposits. Simply stated, subsidence occurs in unconsolidated aquifers when compaction occurs in response to withdrawal of water. A measure of potential subsidence was estimated based on the assumption that every 20 feet of drawdown would result in 1 foot of surface subsidence. Using the drawdown values calculated in the groundwater withdrawal model, the amount of subsidence and risk of severe subsidence over the withdrawal areas can be estimated by using the drawdown contour maps. For example, **Figure 3.3.2-21** depicts the drawdown for Alternative C full build out plus 200 years. The groundwater drawdown contours of 10 feet, 50 feet, 100 feet, and 200 feet enclose areas potentially subject to varying degrees of subsidence. For Alternative C at full build out plus 200 years, it is estimated that about 1 square mile would be at high risk for subsidence greater than 5 feet in the Cave Valley basin. The lack of subsidence as compared with other alternatives due to the fact that Alternative C calls for the least amount of water pumped over time.

Potential subsidence effects include impacts to roads, buried utilities (including the proposed project utilities), and isolated structures where subsidence fissures become manifest. Also, changes in surface topography could affect runoff and fissures may become conduits for diverting surface flows. Subsidence impacts would be considered unavoidable adverse impacts and in some cases irreversible.

Subsidence monitoring as described in Section 3.2.2.9, Proposed Action, is recommended to assess the magnitude and extent of subsidence.

Caves

Groundwater pumping effects on caves are discussed in Section 3.3, Water Resources.

Paleontological Resources

Groundwater pumping is not expected to have effects on paleontological resources

Summary of Impacts Alternative C Pumping

A summary of impact information, including ACMs (where applicable) and mitigation recommendations is provided for Alternative C, groundwater pumping, in **Table 3.2-13**.

Table 3.2-13 Summary of Geologic Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative C Pumping

Effects/Conclusion

- The areas at highest risk for subsidence greater than 5 feet are Spring Valley and Cave Valley basins. A risk of lesser subsidence could occur outside the 100-foot contour to the 10-foot contour (from 0.5 to 5 feet). The effects of subsidence may be permanent even if pumping ceases. Potential subsidence effects includes damage to roads, buried utilities (including the proposed project utilities), and isolated structures. Also, changes in surface topography could affect runoff and fissures may become conduits for diverting surface flows.
- Groundwater pumping is not expected to have effects on paleontological resources.

Impact Indicators By Model Timeframe	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Subsidence greater than 5 feet (square miles)	0	<1	1

COM Plan

- The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for geologic resources are summarized below for ACMs and mitigation recommendations.

ACMs

- None.

Monitoring Recommendations

GW-G-3: Subsidence Monitoring. Subsidence monitoring is recommended in current and proposed water withdrawal areas in order to provide baseline data before build out begins. As groundwater extraction occurs in full production, monitoring would be needed to assess the magnitude and extent of subsidence in order to take actions that would mitigate subsidence where necessary. As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).

Mitigation Recommendations

- Mitigation measures as appropriate for subsidence and caves would be developed through adaptive management as described in **Appendix A**.
- As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7).

Potential Residual Impacts

- The COM Plan and water resources monitoring and mitigation measures could be effective in reducing subsidence impacts. One relevant objective of the COM Plan to private agricultural lands is to identify triggers for early warning of potential adverse impacts that would act as indicators for groundwater drawdown thresholds. Subsidence impacts due to groundwater drawdown could occur and would likely be permanent, depending on the composition of aquifer deposits and recharge conditions. Even if rebound were to occur, it is unlikely that the land surface would return to its original condition. It is not possible to determine the level of impact at this time. Residual subsidence effects could exist considering the potential long recovery period for recharge that could occur. Some unavoidable adverse subsidence impacts to could occur at some locations.

3.2.2.13 Alternative D

Groundwater Development Area

Geological Hazards

Except for potential karst, geologic hazards are not likely to pose risks during drilling and construction of groundwater development facilities. During facility maintenance, active faults, fissures, and potential karst pose potential concerns. The proposed pipeline and facilities are not likely to be at risk from expected ground motion.

Caves

There is a potential for disturbance or damage to caves from construction and drilling activities. Mitigation measures are proposed to lessen potential impacts to caves during groundwater development construction and drilling activities. Cave resources would not be affected by maintenance of the groundwater facilities. Karst features may have impacts on construction and maintenance of groundwater facilities.

Paleontological Resources

Portions of proposed groundwater development areas may contain deposits of medium to high potential for scientifically important fossil resources. The COM Plan, BLM BMPs, and ACMs would ensure that important fossils are properly documented and curated, and therefore lessen potential impacts during construction of the pipeline and related facilities. Facility maintenance is not expected to pose risks to paleontological resources.

Summary of Impacts Alternative C Groundwater Development

A summary of impact information, including ACMs (where applicable) and mitigation recommendations is provided for Alternative D, groundwater development, in **Table 3.2-14.**

Table 3.2-14 Summary of Geologic Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative D Groundwater Development

Effects/Conclusion
• Except for potential karst, geologic hazards are not likely to pose risks during drilling and construction of groundwater development facilities. During facility maintenance, active faults, fissures, and potential karst pose potential concerns. The proposed pipeline and facilities are not likely to be at risk from expected ground motion. The ACMs would provide protection for facilities with regard to active faults and fissures. Proposed mitigation measures would lessen the risk of karst hazards. • Mitigation measures are proposed to lessen potential impacts to caves during groundwater development construction and drilling activities. Cave resources would not be affected by maintenance of the groundwater facilities. Karst features may have impacts on construction and maintenance of groundwater facilities. Mitigation measures are proposed to lessen the potential impact of karst features during construction, drilling, and maintenance of groundwater development facilities. • Portions of proposed groundwater development areas may contain deposits of medium to high potential for scientifically important fossil resources. Facility maintenance is not expected to pose risks to paleontological resources.
COM Plan
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for geologic resources are summarized below for ACMs and mitigation recommendations.
ACMs
• ACM A.6.1: A field survey will be conducted of areas within the ROWs identified as having a high potential for paleontological resources, based upon a paleontological records search using the Potential Fossil Yield Classification System. The field surveys will identify if there are surface exposures containing visible fossils and if there is a potential for buried fossils within the construction footprint. If any important fossils or middens are found during the field survey, a program will be developed and implemented to remove any exposed fossils prior to construction. • ACM A.6.2: Areas identified as having a high potential for buried paleontological resources based upon the field survey will be monitored by a qualified paleontologist during construction activities involving ground disturbance, including grading, excavation, and trenching. • ACM A.6.3: Any fossils recovered during the field survey or construction monitoring will be prepared in accordance with standard professional paleontological techniques. The fossils will be curated in a BLM-approved facility. A report on the findings and significance of the salvage program, including a list of the recovered fossils, will be prepared following completion of the program. A copy of this report will accompany the fossils, and a copy will be submitted to the Nevada State Museum.

Table 3.2-14 **Summary of Geologic Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative D Groundwater Development (Continued)**

Proposed Mitigation
GW-G-1 (Cave Protection). Prior to ground disturbing or drilling activities in areas close to identified cave resources, the conditions of approval will require appropriate site specific measures for the protection of caves that may be at risk such as, but not limited to, the following: • Reasonable and appropriate setbacks and buffers around caves. • Limitations on blasting. • Requirements for the storage and handling of hazardous materials such as fuels. • Other measures that may be appropriate for wells including procedures when encountering subsurface voids while drilling, closed drilling fluid (mud) systems (no earthen mud pits), use of freshwater mud, directional drilling, and special casing programs.
This measure would be effective in avoiding impacts to caves and to provide a margin of safety for construction and maintenance activities with respect to caves and possible underground voids that may be associated with caves. **GW-G-2 (Underground Void).** If underground voids are unexpectedly encountered during facility construction or drilling, the following measures would apply: • Work will be halted and the BLM will be notified immediately. • The BLM, in consultation with the permittee, shall assess the risk of further drilling or siting of surface facilities in the area where the voids are encountered. • Risk assessment may require the use of appropriate geotechnical methods to gather relevant data on the extent of karst features. This measure would be effective in avoiding impacts to caves and to provide a margin of safety for construction and maintenance activities with respect to caves and possible underground voids that may be associated with caves.
Potential Residual Impacts
• Even if construction monitoring is implemented, some scientifically valuable fossils would be disturbed and lost during excavation and grading over underdetermined distances. As a consequence, there would be a small incremental loss of fossil material that would be offset by the material that is recovered, and curated for scientific study purposes. • Since public access to the groundwater development and surrounding areas would not be prohibited by the BLM, the risk of unauthorized collection of fossil material would remain. • A very small risk of facility damage would remain after implementation of geotechnical studies, and design measures for fault movement, seismicity, and karst.

Groundwater Pumping

Geological Hazards

The major geologic hazard associated with groundwater pumping would be the risk of subsidence of the ground surface associated with withdrawal of subsurface fluids from valley fill deposits. Simply stated, subsidence occurs in unconsolidated aquifers when compaction occurs in response to withdrawal of water. A measure of potential subsidence was estimated based on the assumption that every 20 feet of drawdown would result in 1 foot of surface subsidence. Using the drawdown values calculated in the groundwater withdrawal model, the amount of subsidence and risk of severe subsidence over the withdrawal areas can be estimated by using the drawdown contour maps. For example, **Figure 3.3.2-25** depicts the drawdown for Alternative D full build out plus 200 years. The groundwater drawdown contours of 10 feet, 50 feet, 100 feet, and 200 feet enclose areas potentially subject to varying degrees of subsidence.

The areas at highest risk for subsidence greater than 5 feet are Lake Valley, southern Spring Valley and Cave Valley basins.

Of note in exception to the other alternatives, there is a risk of subsidence greater than 5 feet beginning at full build out. Potential subsidence would occur in south Spring Valley, the portion within Lincoln County. As pumping continues through time, subsidence risk would remain concentrated in the south Spring Valley, but by full build out plus 200 years, the aforementioned valleys would also be at risk for subsidence greater than 5 feet. Potential subsidence effects include impacts to roads, buried utilities (including the proposed project utilities), and isolated structures where subsidence fissures become manifest. Also, changes in surface topography could affect runoff and fissures may become conduits for diverting surface flows. Subsidence impacts would be considered unavoidable adverse impacts and in some cases irreversible.

Subsidence monitoring as described in Section 3.2.2.9, Proposed Action, is recommended to assess the magnitude and extent of subsidence.

Caves

Groundwater pumping effects on caves are discussed in Section 3.3, Water Resources.

Paleontological Resources

Groundwater pumping is not expected to have effects on paleontological resources.

Summary of Impacts Alternative D Pumping

A summary of impact information, including ACMs (where applicable) and mitigation recommendations is provided for Alternative D, groundwater pumping, in **Table 3.2-15**.

Table 3.2-15 Summary of Geologic Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative D Pumping

Effects/Conclusion			
• The areas at highest risk for subsidence greater than 5 feet are Lake Valley, southern Spring Valley and Cave Valley basins. A risk of lesser subsidence could occur outside the 100-foot contour to the 10 foot contour (from 0.5 to 5 feet). The effects of subsidence may be permanent even if pumping ceases. Potential subsidence effects includes damage to roads, buried utilities (including the proposed project utilities), and isolated structures. Also, changes in surface topography could affect runoff and fissures may become conduits for diverting surface flows. Subsidence impacts would be considered unavoidable adverse impacts and in some cases irreversible. • Groundwater pumping is not expected to have effects on paleontological resources.			
Impact Indicators By Model Timeframe	**Full Build Out**	**Full Build Out Plus 75 Years**	**Full Build Out Plus 200 Years**
Subsidence greater than 5 feet (square miles)	25	152	269
COM Plan			
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for geologic resources are summarized below for ACMs and mitigation recommendations.			
ACMs			
• Mitigation measures as appropriate for subsidence and caves would be developed through adaptive management as described in **Appendix A**.			
Monitoring Recommendations			
GW-G-3: Subsidence Monitoring. Subsidence monitoring is recommended in current and proposed water withdrawal areas in order to provide baseline data before build out begins. As groundwater extraction occurs in full production, monitoring would be needed to assess the magnitude and extent of subsidence in order to take actions that would mitigate subsidence where necessary. As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).			

Table 3.2-15 Summary of Geologic Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative D Pumping (Continued)

Mitigation Recommendations
• Mitigation measures as appropriate for subsidence and caves would be developed through adaptive management as described in **Appendix A**. • As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7).
Potential Residual Impacts
• The COM Plan and water resources monitoring and mitigation measures could be effective in reducing subsidence impacts. One relevant objective of the COM Plan to private agricultural lands is to identify triggers for early warning of potential adverse impacts that would act as indicators for groundwater drawdown thresholds. Subsidence impacts due to groundwater drawdown could occur and would likely be permanent, depending on the composition of aquifer deposits and recharge conditions. Even if rebound were to occur, it is unlikely that the land surface would return to its original condition. It is not possible to determine the level of impact at this time. Residual subsidence effects could exist considering the potential long recovery period for recharge that could occur. Some unavoidable adverse subsidence impacts to could occur at some locations.

3.2.2.14 Alternative E

Groundwater Development Area

Geological Hazards

Except for potential karst, geologic hazards are not likely to pose risks during drilling and construction of groundwater development facilities. During facility maintenance, active faults, fissures, and potential karst pose potential concerns. The proposed pipeline and facilities are not likely to be at risk from expected ground motion. The ACMs would provide protection for facilities with regard to active faults and fissures. Proposed mitigation measures would lessen the risk of karst hazards.

Caves

There is a potential for disturbance or damage to caves from construction and drilling activities. Mitigation measures are proposed to lessen potential impacts to caves during groundwater development construction and drilling activities. Cave resources would not be affected by maintenance of the groundwater facilities. Karst features may have impacts on construction and maintenance of groundwater facilities. Mitigation measures are proposed to lessen the potential impact of karst features during construction, drilling, and maintenance of groundwater development facilities.

Paleontological Resources

Portions of proposed groundwater development areas may contain deposits of medium to high potential for scientifically important fossil resources. The COM Plan, BLM BMPs, and ACMs would ensure that important fossils are properly documented and curated, and therefore lessen potential impacts during construction of the pipeline and related facilities. Facility maintenance is not expected to pose risks to paleontological resources.

Summary of Impacts Alternative E Groundwater Development

A summary of impact information, including ACMs (where applicable) and mitigation recommendations is provided for Alternative E, groundwater development, in **Table 3.2-16**.

Table 3.2-16 Summary of Geologic Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative E Groundwater Development

Effects/Conclusion
• Except for potential karst, geologic hazards are not likely to pose risks during drilling and construction of groundwater development facilities. During facility maintenance, active faults, fissures, and potential karst pose potential concerns. The proposed pipeline and facilities are not likely to be at risk from expected ground motion. The ACMs would provide protection for facilities with regard to active faults and fissures. Proposed mitigation measures would lessen the risk of karst hazards. • Mitigation measures are proposed to lessen potential impacts to caves during groundwater development construction and drilling activities. Cave resources would not be affected by maintenance of the groundwater facilities. Karst features may have impacts on construction and maintenance of groundwater facilities. Mitigation measures are proposed to lessen the potential impact of karst features during construction, drilling, and maintenance of groundwater development facilities. • Portions of proposed groundwater development areas may contain deposits of medium to high potential for scientifically important fossil resources. Facility maintenance is not expected to pose risks to paleontological resources.
COM Plan
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for geologic resources are summarized below for ACMs and mitigation recommendations.
ACMs
• ACM A.6.1: A field survey will be conducted of areas within the ROWs identified as having a high potential for paleontological resources, based upon a paleontological records search using the Potential Fossil Yield Classification System. The field surveys will identify if there are surface exposures containing visible fossils and if there is a potential for buried fossils within the construction footprint. If any important fossils or middens are found during the field survey, a program will be developed and implemented to remove any exposed fossils prior to construction. • ACM A.6.2: Areas identified as having a high potential for buried paleontological resources based upon the field survey will be monitored by a qualified paleontologist during construction activities involving ground disturbance, including grading, excavation, and trenching. • ACM A.6.3: Any fossils recovered during the field survey or construction monitoring will be prepared in accordance with standard professional paleontological techniques. The fossils will be curated in a BLM-approved facility. A report on the findings and significance of the salvage program, including a list of the recovered fossils, will be prepared following completion of the program. A copy of this report will accompany the fossils, and a copy will be submitted to the Nevada State Museum.
Proposed Mitigation
GW-G-1 (Cave Protection). Prior to ground disturbing or drilling activities in areas close to identified cave resources, the conditions of approval will require appropriate site specific measures for the protection of caves that may be at risk such as, but not limited to, the following: • Reasonable and appropriate setbacks and buffers around caves. • Limitations on blasting. • Requirements for the storage and handling of hazardous materials such as fuels. • Other measures that may be appropriate for wells including procedures when encountering subsurface voids while drilling, closed drilling fluid (mud) systems (no earthen mud pits), use of freshwater mud, directional drilling, and special casing programs. This measure would be effective in avoiding impacts to caves and to provide a margin of safety for construction and maintenance activities with respect to caves and possible underground voids that may be associated with caves.

Table 3.2-16 Summary of Geologic Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative E Groundwater Development (Continued)

Proposed Mitigation
This measure would be effective in avoiding impacts to caves and to provide a margin of safety for construction and maintenance activities with respect to caves and possible underground voids that may be associated with caves. **GW-G-2 (Underground Voids).** If underground voids are unexpectedly encountered during facility construction or drilling, the following measures would apply: • Work will be halted and the BLM will be notified immediately. • The BLM, in consultation with the permittee, shall assess the risk of further drilling or siting of surface facilities in the area where the voids are encountered. • Risk assessment may require the use of appropriate geotechnical methods to gather relevant data on the extent of karst features. This measure would be effective in avoiding impacts to caves and to provide a margin of safety for construction and maintenance activities with respect to caves and possible underground voids that may be associated with caves.
Potential Residual Impacts
• Even if construction monitoring is implemented, some scientifically valuable fossils would be disturbed and lost during excavation and grading over underdetermined distances. As a consequence, there would be a small incremental loss of fossil material that would be offset by the material that is recovered, and curated for scientific study purposes. • Since public access to the groundwater development and surrounding areas would not be prohibited by the BLM, the risk of unauthorized collection of fossil material would remain. • A very small risk of facility damage would remain after implementation of geotechnical studies, and design measures for fault movement, seismicity, and karst.

Groundwater Pumping

Geological Hazards

The major geologic hazard associated with groundwater pumping would be the risk of subsidence of the ground surface associated with withdrawal of subsurface fluids from valley fill deposits. Simply stated, subsidence occurs in unconsolidated aquifers when compaction occurs in response to withdrawal of water.

A measure of subsidence risk was estimated based on the assumption that every 20 feet of drawdown would result in 1 foot of surface subsidence. Using the drawdown values calculated in the groundwater withdrawal model, the amount of potential subsidence over the withdrawal areas can be estimated by using the drawdown contour maps. For example, **Figure 3.3.2-29** depicts the drawdown for Alternative E full build out plus 200 years. The groundwater drawdown contours of 10 feet, 50 feet, 100 feet, and 200 feet enclose areas potentially subject to varying degrees of subsidence. For Alternative E at full build out plus 200 years, it is estimated that about 161 square miles would be at high risk for subsidence greater than 5 feet.

The areas at highest risk for subsidence greater than 5 feet are Spring Valley and Cave Valley basins. The reduction in areas at risk for subsidence greater than 5 feet suggests that the reduced pumping proposed in Alternative E is responsible. Potential subsidence effects include impacts to roads, buried utilities (including the proposed project utilities), and isolated structures where subsidence fissures become manifest. Also, changes in surface topography could affect runoff and fissures may become conduits for diverting surface flows. Subsidence impacts would be considered unavoidable adverse impacts and in some cases irreversible.

Caves

Groundwater pumping effects on caves are discussed in Section 3.3, Water Resources.

Paleontological Resources

Groundwater pumping is not expected to have effects on paleontological resources.

Summary of Impacts Alternative E Groundwater Pumping

A summary of impact information, including ACMs (where applicable) and mitigation recommendations is provided for Alternative E, groundwater pumping, in **Table 3.2-17**.

Table 3.2-17 Summary of Geologic Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative E Pumping

Effects/Conclusion

- The areas at highest risk for subsidence greater than 5 feet are Spring Valley and Cave Valley basins. A risk of lesser subsidence could occur outside the 100-foot contour to the 10-foot contour (from 0.5 to 5 feet). The effects of subsidence may be permanent even if pumping ceases. Potential subsidence effects includes damage to roads, buried utilities (including the proposed project utilities), and isolated structures. Also, changes in surface topography could affect runoff and fissures may become conduits for diverting surface flows. Subsidence impacts would be considered unavoidable adverse impacts and in some cases irreversible.
- Groundwater pumping is not expected to have effects on paleontological resources.

Impact Indicators By Model Timeframe	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Subsidence greater than 5 feet (square miles)	0	5	153

COM Plan

- The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for geologic resources are summarized below for ACMs and mitigation recommendations.

ACMs

- Mitigation measures as appropriate for subsidence and caves would be developed through adaptive management as described in **Appendix A**.

Monitoring Recommendations

GW-G-3: Subsidence Monitoring. Subsidence monitoring is recommended in current and proposed water withdrawal areas in order to provide baseline data before build out begins. As groundwater extraction occurs in full production, monitoring would be needed to assess the magnitude and extent of subsidence in order to take actions that would mitigate subsidence where necessary. As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).

Mitigation Recommendations

- Mitigation measures as appropriate for subsidence and caves would be developed through adaptive management as described in **Appendix A**.
- As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7).

Potential Residual Impacts

- The COM Plan and water resources monitoring and mitigation measures could be effective in reducing subsidence impacts. One relevant objective of the COM Plan to private agricultural lands is to identify triggers for early warning of potential adverse impacts that would act as indicators for groundwater drawdown thresholds. Subsidence impacts due to groundwater drawdown could occur and would likely be permanent, depending on the composition of aquifer deposits and recharge conditions. Even if rebound were to occur, it is unlikely that the land surface would return to its original condition. It is not possible to determine the level of impact at this time. Residual subsidence effects could exist considering the potential long recovery period for recharge that could occur. Some unavoidable adverse subsidence impacts to could occur at some locations.

3.2.2.15 Alternative F

Groundwater Development Area

Geological Hazards

Except for potential karst, geologic hazards are not likely to pose risks during drilling and construction of groundwater development facilities. During facility maintenance, active faults, fissures, and potential karst pose potential concerns. The proposed pipeline and facilities are not likely to be at risk from expected ground motion. The ACMs would provide protection for facilities with regard to active faults and fissures. Proposed mitigation measures would lessen the risk of karst hazards.

Caves

There is a potential for disturbance or damage to caves from construction and drilling activities. Mitigation measures are proposed to lessen potential impacts to caves during groundwater development construction and drilling activities. Cave resources would not be affected by maintenance of the groundwater facilities. Karst features may have impacts on construction and maintenance of groundwater facilities. Mitigation measures are proposed to lessen the potential impact of karst features during construction, drilling, and maintenance of groundwater development facilities.

Paleontological Resources

Portions of proposed groundwater development areas may contain deposits of medium to high potential for scientifically important fossil resources. The COM Plan, BLM BMPs, and ACMs would ensure that important fossils are properly documented and curated, and therefore lessen potential impacts during construction of the pipeline and related facilities. Facility maintenance is not expected to pose risks to paleontological resources.

Summary of Impacts Alternative F Groundwater Development

A summary of impact information, including ACMs (where applicable) and mitigation recommendations is provided for Alternative F, groundwater development, in **Table 3.2-18**.

Table 3.2-18 Summary of Geologic Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative F Groundwater Development

Effects/Conclusion
• Except for potential karst, geologic hazards are not likely to pose risks during drilling and construction of groundwater development facilities. During facility maintenance, active faults, fissures, and potential karst pose potential concerns. The proposed pipeline and facilities are not likely to be at risk from expected ground motion. The ACMs would provide protection for facilities with regard to active faults and fissures. Proposed mitigation measures would lessen the risk of karst hazards. • Mitigation measures are proposed to lessen potential impacts to caves during groundwater development construction and drilling activities. Cave resources would not be affected by maintenance of the groundwater facilities. Karst features may have impacts on construction and maintenance of groundwater facilities. Mitigation measures are proposed to lessen the potential impact of karst features during construction, drilling, and maintenance of groundwater development facilities. • Portions of proposed groundwater development areas may contain deposits of medium to high potential for scientifically important fossil resources. Facility maintenance is not expected to pose risks to paleontological resources.
COM Plan
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for geologic resources are summarized below for ACMs and mitigation recommendations.

Table 3.2-18 Summary of Geologic Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative F Groundwater Development (Continued)

ACMs

- ACM A.6.1: A field survey will be conducted of areas within the ROWs identified as having a high potential for paleontological resources, based upon a paleontological records search using the Potential Fossil Yield Classification System. The field surveys will identify if there are surface exposures containing visible fossils and if there is a potential for buried fossils within the construction footprint. If any important fossils or middens are found during the field survey, a program will be developed and implemented to remove any exposed fossils prior to construction.
- ACM A.6.2: Areas identified as having a high potential for buried paleontological resources based upon the field survey will be monitored by a qualified paleontologist during construction activities involving ground disturbance, including grading, excavation, and trenching.
- ACM A.6.3: Any fossils recovered during the field survey or construction monitoring will be prepared in accordance with standard professional paleontological techniques. The fossils will be curated in a BLM-approved facility. A report on the findings and significance of the salvage program, including a list of the recovered fossils, will be prepared following completion of the program. A copy of this report will accompany the fossils, and a copy will be submitted to the Nevada State Museum.

Proposed Mitigation

GW-G-1 (Cave Protection). Prior to ground disturbing or drilling activities in areas close to identified cave resources, the conditions of approval will require appropriate site specific measures for the protection of caves that may be at risk such as , but not limited to, the following:

- Reasonable and appropriate setbacks and buffers around caves.
- Limitations on blasting.
- Requirements for the storage and handling of hazardous materials such as fuels.
- Other measures that may be appropriate for wells including procedures when encountering subsurface voids while drilling, closed drilling fluid (mud) systems (no earthen mud pits), use of freshwater mud, directional drilling, and special casing programs.

This measure would be effective in avoiding impacts to caves and to provide a margin of safety for construction and maintenance activities with respect to caves and possible underground voids that may be associated with caves.

Proposed Mitigation

This measure would be effective in avoiding impacts to caves and to provide a margin of safety for construction and maintenance activities with respect to caves and possible underground voids that may be associated with caves.

GW-G-2 (Underground Void). If underground voids are unexpectedly encountered during facility construction or drilling, the following measures would apply:

- Work will be halted and the BLM will be notified immediately.
- The BLM, in consultation with the permittee, shall assess the risk of further drilling or siting of surface facilities in the area where the voids are encountered.
- Risk assessment may require the use of appropriate geotechnical methods to gather relevant data on the extent of karst features.

This measure would be effective in avoiding impacts to caves and to provide a margin of safety for construction and maintenance activities with respect to caves and possible underground voids that may be associated with caves.

Potential Residual Impacts

- Even if construction monitoring is implemented, some scientifically valuable fossils would be disturbed and lost during excavation and grading over underdetermined distances. As a consequence, there would be a small incremental loss of fossil material that would be offset by the material that is recovered, and curated for scientific study purposes.
- Since public access to the groundwater development and surrounding areas would not be prohibited by the BLM, the risk of unauthorized collection of fossil material would remain.
- A very small risk of facility damage would remain after implementation of geotechnical studies, and design measures for fault movement, seismicity, and karst.

Groundwater Pumping

Geological Hazards

The major geologic hazard associated with groundwater pumping would be the risk of subsidence of the ground surface associated with withdrawal of subsurface fluids from valley fill deposits. Simply stated, subsidence occurs in unconsolidated aquifers when compaction occurs in response to withdrawal of water.

A measure of subsidence risk was estimated based on the assumption that every 20 feet of drawdown would result in 1 foot of surface subsidence. Using the drawdown values calculated in the groundwater withdrawal model, the amount of potential subsidence over the withdrawal areas can be estimated by using the drawdown contour maps. For example, **Figure 3.3.2-33** depicts the drawdown for Alternative F full build out plus 200 years. The groundwater drawdown contours of 10 feet, 50 feet, 100 feet, and 200 feet enclose areas potentially subject to varying degrees of subsidence. For Alternative F at full build out plus 200 years, it is estimated that about 242 square miles would be at high risk for subsidence greater than 5 feet.

The areas at highest risk for subsidence greater than 5 feet are Spring Valley, Dry Lake, and Cave Valley basins. The reduction in areas at risk for subsidence greater than 5 feet as compared to the Proposed Action suggests that the reduced pumping overall and no pumping in Snake Valley proposed in Alternative F is responsible. Potential subsidence effects include impacts to roads, buried utilities (including the proposed project utilities), and isolated structures where subsidence fissures become manifest. Also, changes in surface topography could affect runoff and fissures may become conduits for diverting surface flows. Subsidence impacts would be considered unavoidable adverse impacts and in some cases irreversible.

Caves

Groundwater pumping effects on caves are discussed in Section 3.3, Water Resources.

Paleontological Resources

Groundwater pumping is not expected to have effects on paleontological resources.

Summary of Impacts Alternative F Groundwater Pumping

A summary of impact information, including ACMs (where applicable) and mitigation recommendations is provided for Alternative F, groundwater pumping, in **Table 3.2-19**.

Table 3.2-19 Summary of Geologic Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative F Pumping

Effects/Conclusion			
• The areas at highest risk for subsidence greater than 5 feet are Spring Valley, Dry Lake, and Cave Valley basins. A risk of lesser subsidence could occur outside the 100-foot contour to the 10-foot contour (from 0.5 to 5 feet). The effects of subsidence may be permanent even if pumping ceases. Potential subsidence effects includes damage to roads, buried utilities (including the proposed project utilities), and isolated structures. Also, changes in surface topography could affect runoff and fissures may become conduits for diverting surface flows. Subsidence impacts would be considered unavoidable adverse impacts and in some cases irreversible. • Groundwater pumping is not expected to have effects on paleontological resources.			
Impact Indicators By Model Timeframe	**Full Build Out**	**Full Build Out Plus 75 Years**	**Full Build Out Plus 200 Years**
Subsidence greater than 5 feet (square miles)	0	71	242
COM Plan			
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for geologic resources are summarized below for ACMs and mitigation recommendations.			

Table 3.2-19 Summary of Geologic Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative F Pumping (Continued)

ACMs
• Mitigation measures as appropriate for subsidence and caves would be developed through adaptive management as described in **Appendix A**.
Monitoring Recommendations
This measure would be effective in avoiding impacts to caves and to provide a margin of safety for construction and maintenance activities with respect to caves. **GW-G-3: Subsidence Monitoring**. Subsidence monitoring is recommended in current and proposed water withdrawal areas in order to provide baseline data before build out begins. As groundwater extraction occurs in full production, monitoring would be needed to assess the magnitude and extent of subsidence in order to take actions that would mitigate subsidence where necessary. As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).
Mitigation Recommendations
• Mitigation measures as appropriate for subsidence and caves would be developed through adaptive management as described in **Appendix A**. • As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7).
Potential Residual Impacts
• The COM Plan and water resources monitoring and mitigation measures could be effective in reducing subsidence impacts. One relevant objective of the COM Plan to private agricultural lands is to identify triggers for early warning of potential adverse impacts that would act as indicators for groundwater drawdown thresholds. Subsidence impacts due to groundwater drawdown could occur and would likely be permanent, depending on the composition of aquifer deposits and recharge conditions. Even if rebound were to occur, it is unlikely that the land surface would return to its original condition. It is not possible to determine the level of impact at this time. Residual subsidence effects could exist considering the potential long recovery period for recharge that could occur. Some unavoidable adverse subsidence impacts to could occur at some locations.

3.2.2.16 No Action

Groundwater Development Area

Under the No Action, groundwater development activities pursuant to the proposed project would not occur and there would be no impacts.

Groundwater Pumping

Under the No Action, groundwater pumping would continue under status quo condition as described in Chapter 2, Section 2.2, No Action.

Geological Hazards

The major geologic hazard associated with groundwater pumping would be the risk of subsidence of the ground surface associated with withdrawal of subsurface fluids from valley fill deposits. As the project would not be pumping groundwater, no subsidence could be attributed to the project.

For the No Action Alternative at full build out plus 200 years, there would be no areas at risk for subsidence greater than 5. However, there is risk of 2.5 to 5 feet of subsidence in 369 square miles, mainly Patterson Valley and Lake Valley basins.

Paleontological Resources

Groundwater pumping is not expected to have effects on paleontological resources.

3.2.2.17 Alternatives Comparison

Groundwater Development Area

Impacts to paleontological resources would be the same across the alternatives, even with the reduction in footprint of Alternatives D and E, since high potential areas would not change. Similarly, there are no differences between alternatives in regard to risk from the geologic hazards from active faults or fissures.

Groundwater Pumping

Major differences in subsidence risk potential are highlighted in **Table 3.2-20**. Alternative B has the largest area that is at risk for subsidence 5 feet or greater. The No Action Alternative has no areas at risk of 5 feet or greater subsidence. The variable and distributed pumping scenarios proposed in Alternative C appear to reduce the potential of subsidence greater than 5 feet.

Table 3.2-20 Comparison by Alternative of Areas (Square Miles) of Potential Subsidence Greater than 5 Feet

Scenario	Proposed Action	No Action	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E	Alternative F
Full Build Out	<1	0	0	3	0	25	0	0
Full Build Out Plus 75 Years	147	0	5	172	<1	152	5	71
Full Build Out Plus 200 Years	525	0	159	669	1	269	153	242

3.2.3 Cumulative Impacts

3.2.3.1 Impacts Common to All Alternatives

Climate Change Effects

Climate change already appears to be influencing both natural and managed ecosystems of the American Southwest (Breshears et al. 2005, Westerling et al. 2006, Seager et al. 2007) and models indicate the likelihood of the Southwest being a climate change "hotspot" in the coming decades (Diffenbaugh et al. 2008). Recent warming in the Southwest is among the most rapid in the nation, significantly more than the global average in some areas (USGCRP 2009). Projections suggest continued strong warming in the region, with significant increases in temperature (USGCRP 2009) and decreases in precipitation (Seager et al. 2007). A warmer atmosphere and an intensified water cycle are likely to mean not only a greater likelihood of drought for the Southwest, but also an increased risk of flooding (USGCRP 2009). Greater variability in patterns of precipitation can be anticipated in the future. In the coming century, mean global temperature could increase significantly, with an associated increase in both the frequency of extreme events (heat waves, droughts, storms) and the frequency and extent of wildfire (IPCC 2007; Westerling & Bryant 2008; Krawchuk et al. 2009). Under such conditions, future impacts could be substantial for some resources, impacting biodiversity, protected areas, and agricultural lands.

Climate Change Effects to Geological Resources

Climate change effects were not evaluated for this resource because potential effects to geological resources as a result of climate change cannot be directly quantified.

3.2.3.2 Issues

Rights-of-way and Groundwater Development Area Construction and Maintenance

Geological Hazards

- Risk of potential damage to PPAs from geologic hazards including earthquake ground motion, movement of active faults, landslides, karst, and erionite.
- The proposed ROW and groundwater development would add infrastructure in areas that may already be at risk.
- The RFFAs would also add infrastructure in areas at risk for geological hazards.

Caves

- Adverse impacts may have occurred to caves from PPAs.
- The proposed ROW and groundwater development potentially creates additional risk to caves.
- The RFFAs may present an additional potential risk to caves.

Paleontological Resources

- Potential damage and loss of scientifically important fossils may have already occurred from PPAs.
- The proposed ROW and groundwater development construction may result in incremental loss of fossil resources in addition to PPAs.
- The RFFAs have the potential to cause loss of fossil resources.

Groundwater Pumping

Geological Hazards

- The major geologic hazard associated with groundwater pumping for cumulative effects would be the risk of subsidence of the ground surface associated with withdrawal of subsurface fluids from valley fill deposits.

- Landslides and seismic hazards are not considered for analysis under cumulative effects for groundwater pumping.
- Erionite is not a considered for analysis for cumulative effects for groundwater pumping.

Caves

The unique habitats supported by caves and associated water resources could be adversely affected by the cumulative drawdown of potentiometric heads during groundwater pumping. Impacts related to groundwater pumping drawdown are discussed in Section 3.3, Water Resources and Section 3.6, Terrestrial Wildlife, respectively.

Paleontological Resources

- Cumulative effects to paleontological resources are not expected from groundwater pumping.

3.2.3.3 Assumptions

Rights-of-way and Groundwater Development Area Construction and Maintenance

Geological Hazards

- The geographic scope of the analysis for geological hazards is limited to the basins in which actual ground disturbing activities would occur and include Cave Valley, Coyote Springs Valley, Delamar Valley, Dry Lake Valley, Garnet Valley, Hamlin Valley, Hidden Valley, Lake Valley, Las Vegas Valley, Snake Valley, and Spring Valley basins. These areas were chosen for cumulative analysis because they are where direct and indirect effects would be expected to occur.
- There may be hazards in these valleys that were not identified because they did not pose a risk to the proposed project, but may constitute risks to other projects.

Caves

- The geographic scope of the analysis for caves is limited to the basins in which actual ground disturbing activities would occur and include Cave Valley, Coyote Springs Valley, Delamar Valley, Dry Lake Valley, Garnet Valley, Hamlin Valley, Hidden, Lake Valley, Las Vegas Valley, Snake Valley, and Spring Valley basins. This analysis area was chosen for cumulative analysis because they are where direct and indirect effects would be expected to occur.

Paleontological Resources

- The geographic scope of the analysis for paleontological resources is limited to the basins in which actual ground disturbing activities would occur and include Cave Valley, Coyote Springs Valley, Delamar Valley, Dry Lake Valley, Garnet Valley, Hamlin Valley, Hidden Valley, Lake Valley, Las Vegas Valley, Snake Valley, and Spring Valley basins. These areas were chosen for cumulative analysis because they are where direct and indirect effects would be expected to occur.
- There may be areas of high fossil potential in these valleys, but not identified by this study.

Groundwater Pumping

Geological Hazards

- The cumulative analysis area for geological hazards (subsidence due to groundwater withdrawal) is within the 10-foot drawdown contour as shown on **Figures 3.3.3-4** and **3.3.3-5**. This area was chosen for cumulative analysis because it is where direct and indirect effects would be expected to occur from PPAs and RFFAs.
- There may be areas where groundwater withdrawal has occurred in the past and into the present where subsidence has already occurred, but has not been identified or documented.

3.2.3.4 Methodology of Analysis

Rights-of-way and Groundwater Development Area Construction and Maintenance

Mitigation measures discussed in this resource section focus on new measures. Where applicable, some of the ROW mitigation measures may apply to surface disturbance activities associated with groundwater development. These ROW mitigation measures also would be considered in subsequent NEPA tiers.

Geological Hazards

Review the PPAs and RFFAs and assess the level of incremental risk exposure posed by the proposed project within the defined cumulative impact assessment area.

Caves

Review the PPAs and RFFAs and assess the level of incremental risk to caves by the proposed project within the defined cumulative impact assessment areas.

Paleontological Resources

Review the PPAs and RFFAs and assess the level of incremental impact that the proposed project is likely to incur on paleontological resources in the defined cumulative impact assessment area.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on geologic resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

Groundwater Pumping

Mitigation measures discussed in this resource section focus on new measures. Where applicable, some of the ROW mitigation measures may apply to surface disturbance activities associated with groundwater development. These ROW mitigation measures also would be considered in subsequent NEPA tiers.

Geological Hazards

Review the PPAs and RFFAs and assess the level of incremental risk of subsidence due to groundwater pumping posed by the proposed project within the defined cumulative impact assessment area.

Caves

Groundwater pumping effects on caves are discussed in Section 3.3, Water Resources.

Paleontological Resources

No analysis methodology is proposed.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on geologic resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

3.2.3.5 No Action

Groundwater Development Area

Because the project would not be constructed, there would be no surface impacts to paleontological resources from construction and operation (see Section 3.3, Water Resources **Figure 3.3.1-1**).

Groundwater Pumping Effects

Geological Hazards

Existing groundwater pumping would continue, and may result in areas of subsidence within hydrographic basins that are currently experiencing pumping, and where pumping from foreseeable projects may occur in the future. The areas where risk of subsidence is greater than 5 feet include Clover Valley, Lower Meadow Valley Wash, and Panaca Valley. Other valleys potentially at risk for lesser subsidence include Spring Valley, Lake Valley, Patterson Valley, Kane Springs, Coyote Springs Valley, Muddy River Springs Area, Garnet Valley, Hidden Valley (North), Las Vegas Valley and the Black Mountain Area (**Table 3.2-21**).

Table 3.2-21 Summary of Cumulative Potential Subsidence for No Action Pumping

Impact Indicators By Model Timeframe	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Subsidence greater than 5 feet (square miles)	76	126	163

3.2.3.6 Proposed Action

Groundwater Development Area

Geological Hazards

All RFFAs (**Table 2.9-1** and **Figures 2.9-1** and **3.2-2** through **3.2-4**) that involve ground disturbing activities could potentially be at risk to geological hazards of active faults, fissure, landsides, and karst. Protection measures including BMPs and ACMs applied to this project would cause a small decrease in risk from geological hazards.

Caves

There is a RFFA (Wilson Creek Wind Project) that involves ground disturbing activities above limestone bedrock where caves and voids could occur. This area is geographically separate from the GWD Project pipeline, and no cumulative effects caused by both projects are expected. Recommended mitigation measures include GW-G-1, GW-G-2, and G-3.

Paleontological Resources

The RFFAs that share the same utility corridors (TransWest Express, Zephyr, ON Transmission Line, and Wilson Creek Wind) that involve ground disturbing activities potentially could disturb paleontological resources (**Figures 2.9-1** and **3.2-5**). Protection measures including BMPs and ACMs applied to this project would provide for the documentation and preservation of scientifically important paleontological resources. As a result, the Proposed Action and the RFFAs would cause a small reduction in paleontological resources.

Groundwater Pumping Effects

Geological Hazards

Figure 3.2-6 illustrates the estimated subsidence effects in hydrologic basins affected by Proposed Action operations. Cave and Spring valleys are predicted to experience subsidence in excess of 5 feet over 50 square miles at full build out plus 75 years from cumulative project operations. Cave, Spring and Snake valleys are predicted to experience subsidence in excess of 5 feet over 100 square miles at full build out plus 200 years. In the near term, the cumulative effects of subsidence are nearly identical to those identified for the individual alternatives because there is limited existing or foreseeable pumping in the basins affected by the GWD Project. At full build out plus 200 years, there is some contribution from other groundwater pumping sources in addition to the GWD Project in Spring Valley.

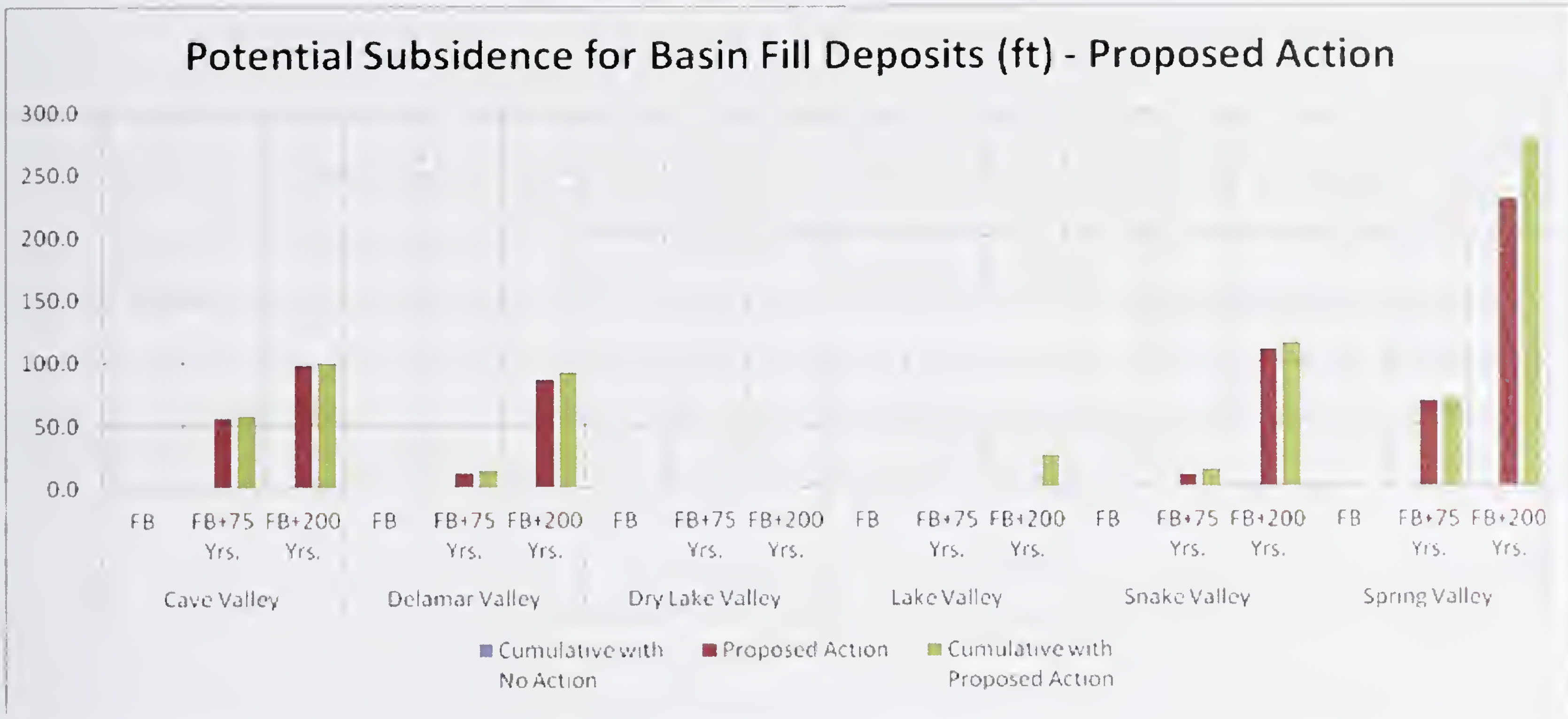


Figure 3.2-6 Square Miles of Potential Subsidence Greater Than 5 Feet for Basin Fill Deposits – Proposed Action

It is possible that subsidence caused by groundwater pumping could damage roadways and structures, and could cause local alterations in drainage flow patterns. Because of the long time frames, there would be a long-term opportunity to monitor subsidence as it begins to appear, and to potentially alter pumping regimes to reduce the rate of subsidence. As discussed in Section 3.2.2.9, any subsidence measured at the soil surface is probably irreversible.

Table 3.2-22 summarizes the potential subsidence area resulting from groundwater pumping from the Proposed Action and other cumulative sources over three time frames.

Table 3.2-22 Summary of Cumulative Potential Subsidence Impacts for Proposed Action Pumping

Impact Indicators By Model Timeframe	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Subsidence greater than 5 feet (square miles)	76	283	781

3.2.3.7 Alternative A

Rights-of-way and Groundwater Development Area Construction and Maintenance

Geological Hazards

All RFFAs (**Table 2.9-1** and **Figures 2.9-1** and **3.2-2** through **3.2-4**) that involve ground disturbing activities could potentially be at risk to geological hazards of active faults, fissure, landsides, and karst. Protection measures including BMPs, ACMs, and recommended mitigation measures GW-G-1 and GW-G-2 applied to this project would cause a small decrease in risk from geological hazards.

Caves

There is a RFFA (Wilson Creek Wind Project) that involves ground disturbing activities above limestone bedrock where caves and voids could occur. This area is geographically separate from the GWD Project pipeline, and no cumulative effects caused by both projects are expected. Recommended mitigation measures include GW-G-1, GW-G-2, and GW-G-3.

Paleontological Resources

The RFFAs that share the same utility corridor (TransWest Express, Zephyr, ON Transmission Line, and Wilson Creek Wind) that involve ground disturbing activities that could potentially impact paleontological resources (**Figures 2.9-1** and **3.2-5**). Protection measures including BMPs and ACMs applied to this project would provide for the documentation and preservation of scientifically important paleontological resources. As a result, Alternative A would cause a small increase in overall impacts to paleontological resources.

Groundwater Pumping Effects

Geological Hazards

It is possible that there would be effects of subsidence by water withdrawal by reasonably foreseeable projects. At this time, it is not possible to precisely predict the amount of additional incremental subsidence as a result of groundwater withdrawal by other projects.

Figure 3.2-7 illustrates the estimated subsidence effects in hydrologic basins affected by Alternative A. Very little subsidence in excess of 5 feet is expected in any of the valleys through full build out plus 75 years. Spring Valley would experience subsidence in excess of 5 feet over 100 square miles at full build out plus 200 years. At full build out plus 200 years, there is a small contribution from other groundwater pumping sources in addition to the GWD Project in Spring Valley.

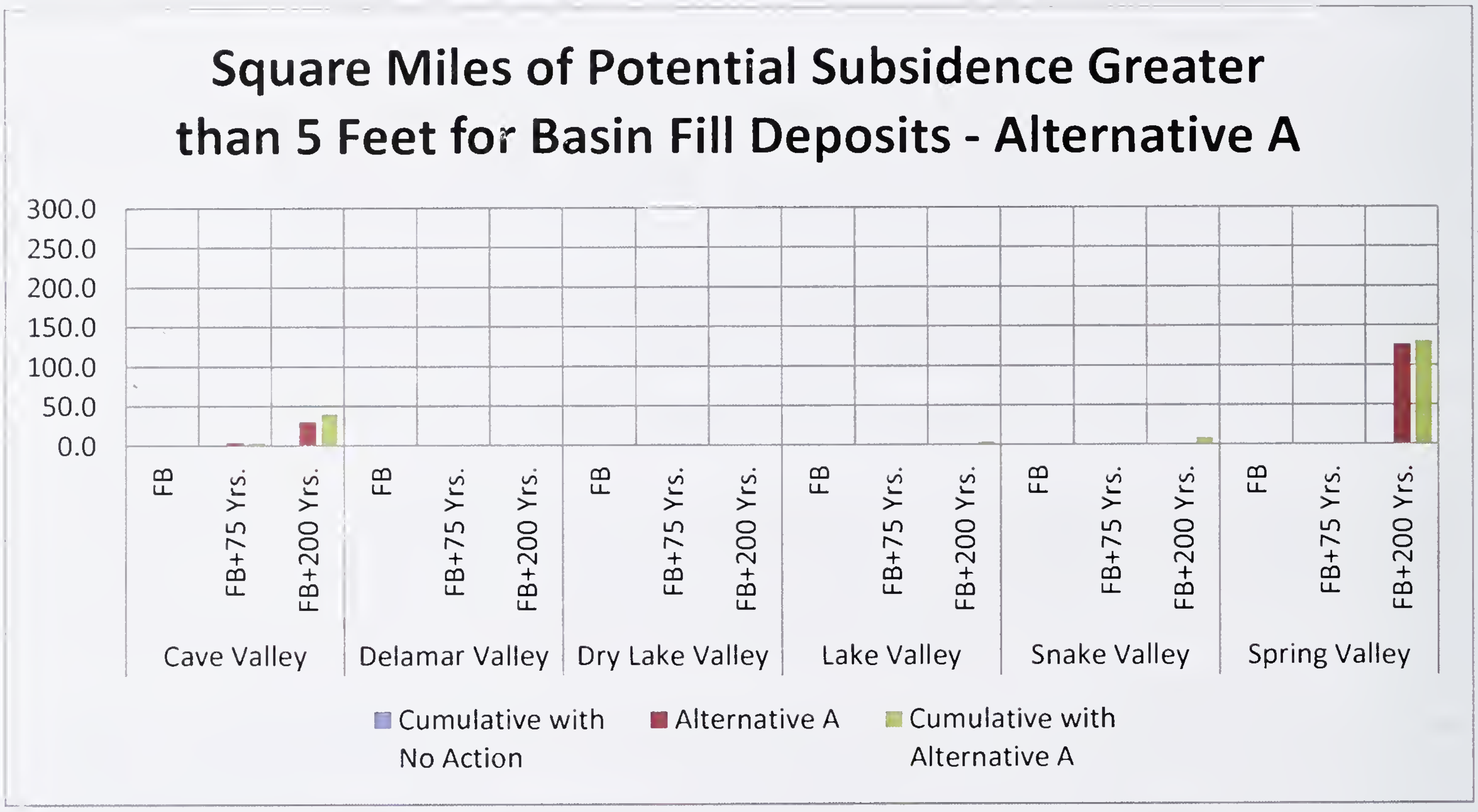


Figure 3.2-7 Square Miles of Potential Subsidence Greater Than 5 Feet for Basin Fill Deposits – Alternative A

Potential subsidence effects to natural and human resources are those described for the Proposed Action.

Table 3.2-23 summarizes the potential subsidence area resulting from groundwater pumping from Alternative A and other cumulative sources over three time frames.

Table 3.2-23 Summary of Cumulative Subsidence Impacts for Alternative A Pumping

Impact Indicators By Model Timeframe	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Subsidence greater than 5 feet (square miles)	76	131	349

3.2.3.8 Alternative B

Rights-of-way and Groundwater Development Area Construction and Maintenance

Geological Hazards

All RFFAs (**Table 2.9-1** and **Figures 2.9-1** and **3.2-2** through **3.2-4**) that involve ground disturbing activities that could potentially be at risk to geological hazards of active faults, fissure, landsides, and karst. Protection measures including BMPs, ACMs, and recommended mitigation measures GW-G-1 and GW-G-2 applied to this project would cause a small decrease in risk from geological hazards.

Caves

There is a RFFA (Wilson Creek Wind Project) that involves ground disturbing activities above limestone bedrock where caves and voids could occur. This area is geographically separate from the GWD Project pipeline, and no cumulative effects caused by both projects are expected. Recommended mitigation measures include GW-G-1, GW-G-2, and GW-G-3.

Paleontological Resources

The RFFAs that share the same utility corridors (TransWest Express, Zephyr, ON Transmission Line, and Wilson Creek Wind) that involve ground disturbing activities potentially could disturb paleontological resources (**Figures 2.9-1** and **3.2-5**). Protection measures including BMPs and ACMs applied to this project would provide for the documentation and preservation of scientifically important paleontological resources. As a result, the Proposed Action and the RFFAs would cause a small reduction in paleontological resources.

Groundwater Pumping Effects

Geological Hazards

Figure 3.2-8 illustrates the estimated subsidence effects in hydrologic basins affected by Alternative B. Snake and Spring valleys are predicted to experience subsidence in excess of 5 feet over 50 square miles at full build out plus 75 years from GWD Project operations. Delamar, Spring, and Snake valleys are predicted to experience subsidence in excess of 5 feet over 100 square miles at full build out plus 200 years. Spring Valley is predicted to experience as much as 300 square miles of subsidence greater than 5 feet, likely caused by very large drawdowns by pumping at a small number of diversion points.

Potential subsidence effects to natural and human resources are those described for the Proposed Action.

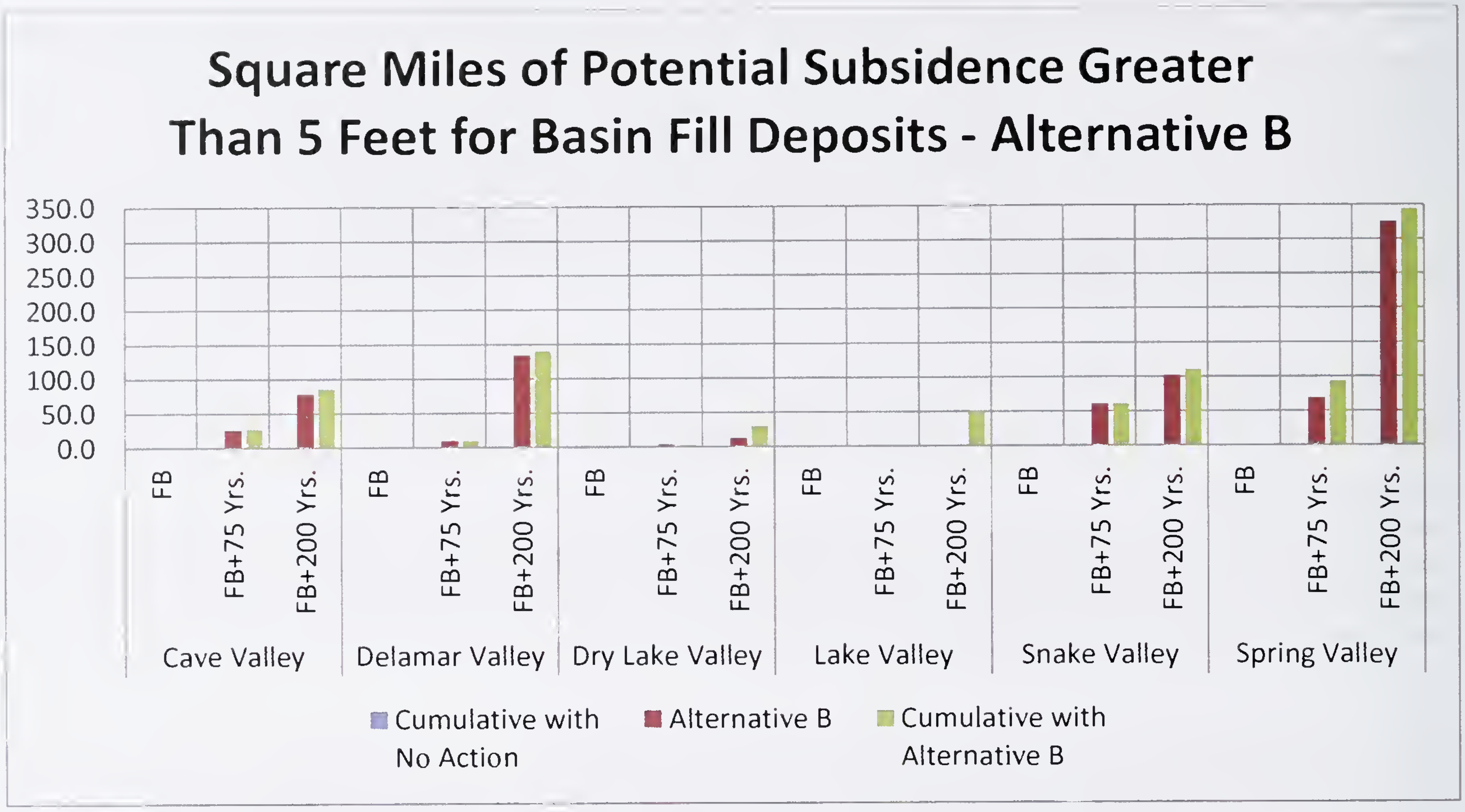


Figure 3.2-8 Square Miles of Potential Subsidence Greater Than 5 Feet for Basin Fill Deposits – Alternative B

Table 3.2-24 summarizes the potential subsidence area resulting from groundwater pumping from Alternative B and other cumulative sources over three time frames.

Table 3.2-24 Summary of Cumulative Subsidence Impacts for Alternative B Pumping

Impact Indicators By Model Timeframe	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Subsidence greater than 5 feet (square miles)	78	323	956

3.2.3.9 Alternative C

Rights-of-way and Groundwater Development Area Construction and Maintenance

Geological Hazards

All RFFAs (**Table 2.9-1** and **Figures 2.9-1** and **3.2-2** through **3.2-4**) that involve ground disturbing activities that could potentially be at risk to geological hazards of active faults, fissure, landsides, and karst. Protection measures including BMPs and ACMs applied to this project would cause a small decrease in risk from geological hazards.

Caves

There is a RFFA (Wilson Creek Wind Project) that involves ground disturbing activities above limestone bedrock where caves and voids could occur. This area is geographically separate from the GWD Project pipeline, and no cumulative effects caused by both projects are expected. Recommended mitigation measures include GW-G-1, GW-G-2, and GW-G-3.

Paleontological Resources

The RFFAs that share the same utility corridors (TransWest Express, Zephyr, ON Transmission Line, and Wilson Creek Wind) that involve ground disturbing activities potentially could disturb paleontological resources (**Figures 2.9-1** and **3.2-5**). Protection measures including BMPs and ACMs applied to this project would provide for the documentation and preservation of scientifically important paleontological resources. As a result, the Proposed Action and the RFFAs would cause a small reduction in paleontological resources.

Groundwater Pumping Effects

Geological Hazards

Figure 3.2-9 illustrates the estimated subsidence effects in hydrologic basins affected by Alternative C. Very little subsidence greater than 5 feet is expected in any valley at any time period because groundwater would be pumped on an intermittent basis and generally lesser volumes of water as compared to the other alternatives.

Potential subsidence effects to natural and human resources are those described for the Proposed Action.

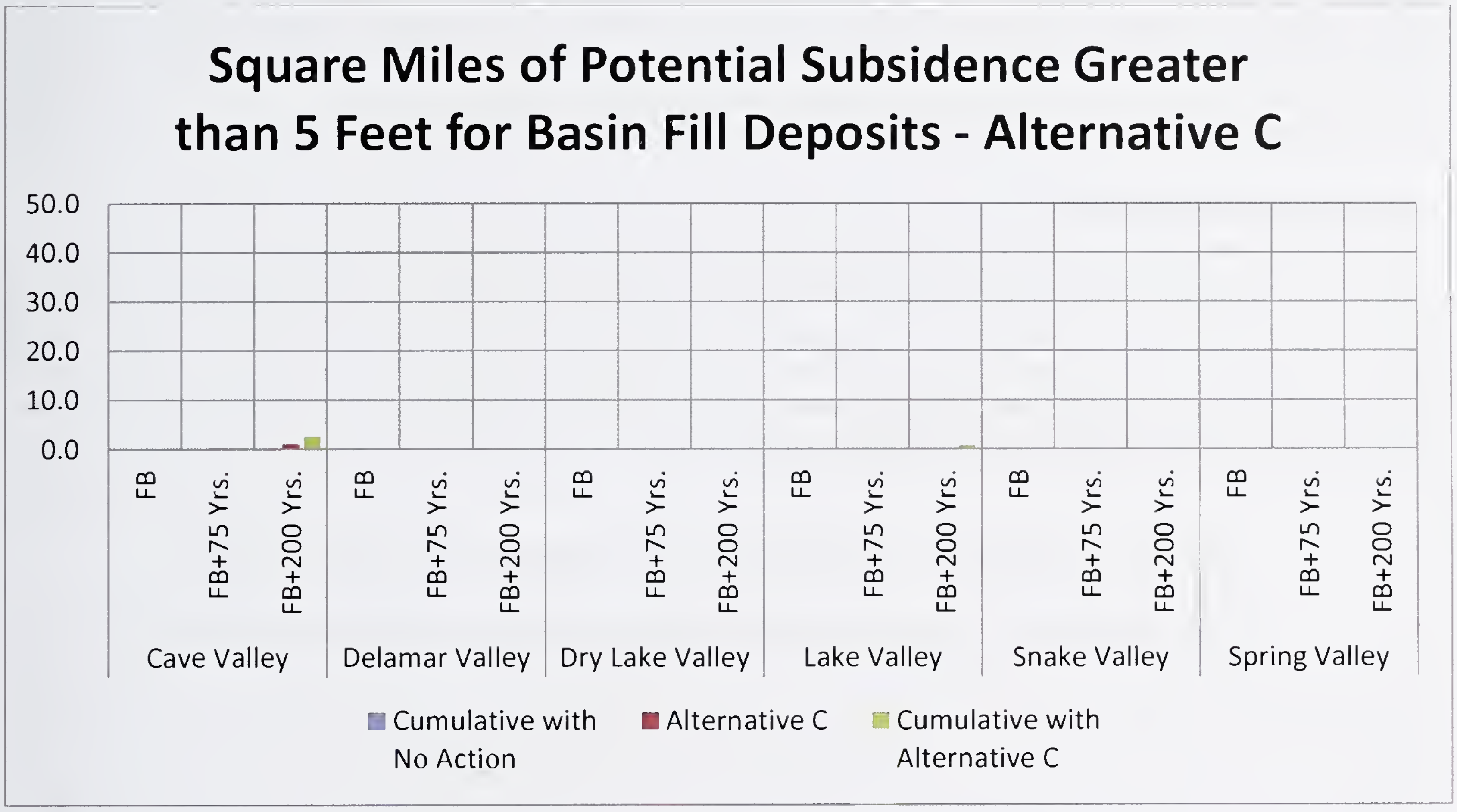


Figure 3.2-9 Square Miles of Potential Subsidence Greater Than 5 Feet for Basin Fill Deposits – Alternative C

Table 3.2-25 summarizes the potential subsidence area resulting from groundwater pumping from Alternative C and other cumulative sources over three time frames.

Table 3.2-25 Summary of Cumulative Subsidence Impacts for Alternative C Pumping

Impact Indicators By Model Timeframe	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Subsidence greater than 5 feet (square miles)	76	126	167

3.2.3.10 Alternative D

Rights-of-way and Groundwater Development Area Construction and Maintenance

Geological Hazards

All RFFAs (**Table 2.9-1** and **Figures 2.9-1** and **3.2-2** through **3.2-4**) that involve ground disturbing activities that could potentially be at risk to geological hazards of active faults, fissure, landsides, and karst. Protection measures including BMPs, ACMs, and recommended mitigation measures GW-G-1 and GW-G-2 applied to this project would cause a small decrease in risk from geological hazards.

Caves

There is a RFFA (Wilson Creek Wind Project) that involves ground disturbing activities above limestone bedrock where caves and voids could occur. This area is geographically separate from the GWD Project pipeline, and no cumulative effects caused by both projects are expected. Recommended mitigation measures include GW-G-1, GW-G-2, and GW-G-3.

Paleontological Resources

The RFFAs that share the same utility corridors (TransWest Express, Zephyr, ON Transmission Line, and Wilson Creek Wind) that involve ground disturbing activities potentially could disturb paleontological resources (**Figures 2.9-1** and **3.2-5**). Protection measures including BMPs and ACMs applied to this project would provide for the documentation and preservation of scientifically important paleontological resources. As a result, the Proposed Action and the RFFAs would cause a small increase in overall impacts to paleontological resources.

Groundwater Pumping Effects

Geological Hazards

Figure 3.2-10 illustrates the estimated subsidence effects in hydrologic basins affected by Alternative D. Subsidence in excess of 5 feet over 50 square miles is estimated in Spring Valley through full build out plus 75 years. Spring Valley would experience subsidence in excess of 5 feet over 150 square miles at full build out plus 200 years, primarily from groundwater development pumping. Lake Valley could experience subsidence in excess of 100 feet, primarily from pumping from past, present, and foreseeable sources.

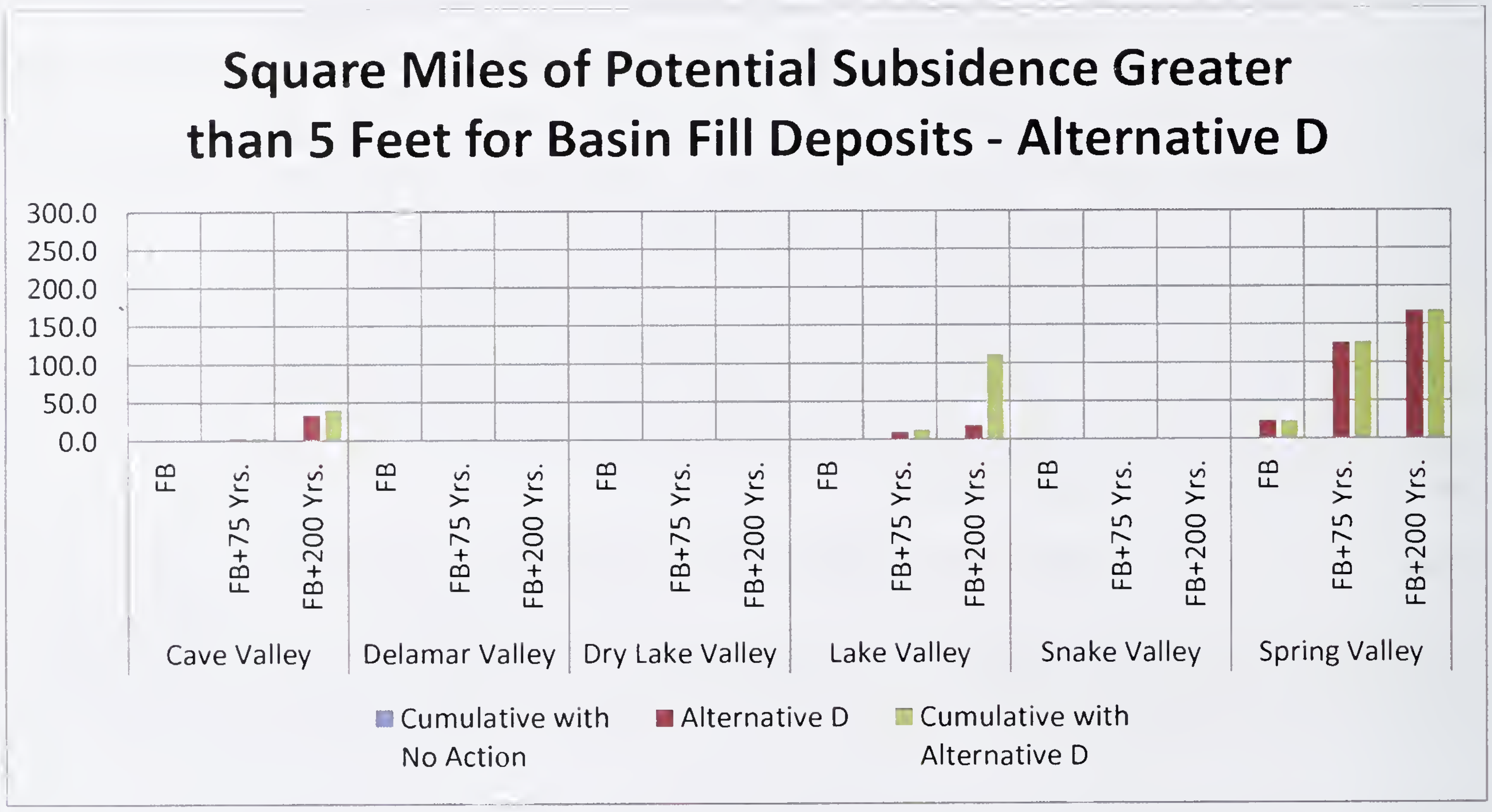


Figure 3.2-10 Square Miles of Potential Subsidence Greater Than 5 Feet for Basin Fill Deposits – Alternative D

Potential subsidence effects to natural and human resources are those described for the Proposed Action.

Table 3.2-26 summarizes the potential subsidence area resulting from groundwater pumping from Alternative D and other cumulative sources over three time frames.

Table 3.2-26 Summary of Cumulative Subsidence Impacts for Alternative D Pumping

Impact Indicators By Model Timeframe	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Subsidence greater than 5 feet (square miles)	88	281	560

3.2.3.11 Alternative E

Rights-of-way and Groundwater Development Area Construction and Maintenance

Geological Hazards

All RFFAs (**Table 2.9-1** and **Figures 2.9-1** and **3.2-2** through **3.2-4**) that involve ground disturbing activities that could potentially be at risk to geological hazards of active faults, fissure, landsides, and karst. Protection measures including BMPs and ACMs applied to this project would cause a small decrease in risk from geological hazards.

Caves

There is a RFFA (Wilson Creek Wind Project) that involves ground disturbing activities above limestone bedrock where lanes and voids could occur. This area is geographically separate from the GWD Project pipeline, and no cumulative effects caused by both projects are expected. Recommended mitigation measures include GW-G-1, GW-G-2, and GW-G-3.

Paleontological Resources

The RFFAs that share the same utility corridors (TransWest Express, Zephyr, ON Transmission Line, and Wilson Creek Wind) that involve ground disturbing activities could potentially disturb paleontological resources (**Figures 2.9-1** and **3.2-5**). Protection measures including BMPs and ACMs applied to this project would provide for the documentation and preservation of scientifically important paleontological resources. As a result, the Proposed Action and the RFFAs would cause a small reduction in paleontological resources.

Groundwater Pumping Effects

Geological Hazards

Figure 3.2-11 illustrates the estimated subsidence effects in hydrologic basins affected by Alternative E. No subsidence in excess of 5 feet is estimated in any valley through full build out plus 75 years. Spring Valley would experience subsidence in excess of 5 feet over 100 square miles at full build out plus 200 years, primarily from groundwater development pumping. No other valleys would experience subsidence in excess of 5 feet at the longest time frame.

Potential subsidence effects to natural and human resources are those described for the Proposed Action.

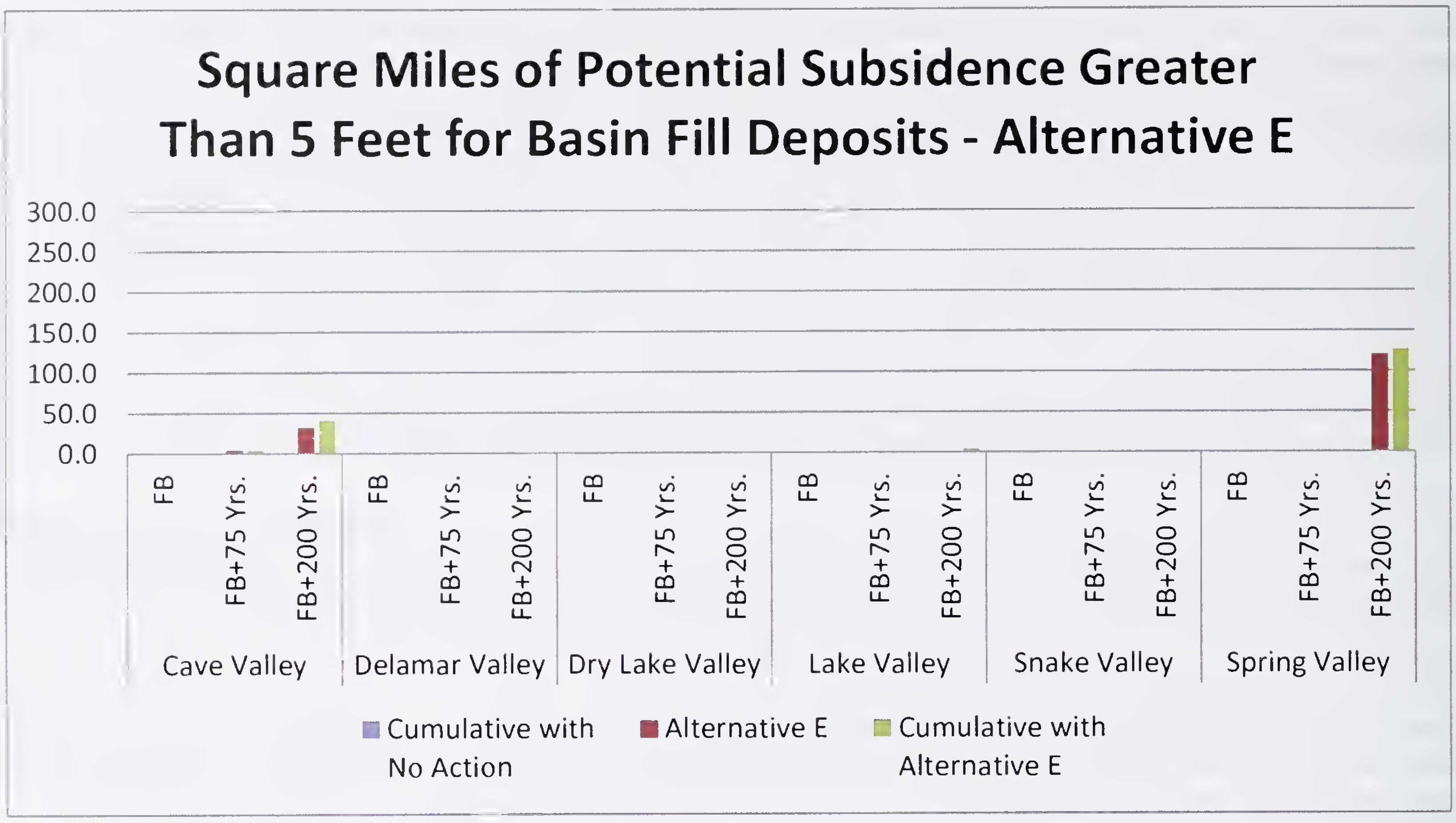


Figure 3.2-11 Square Miles of Potential Subsidence Greater Than 5 Feet for Basin Fill Deposits – Alternative E

Table 3.2-27 summarizes the potential subsidence area resulting from groundwater pumping from Alternative E and other cumulative sources over three time frames.

Table 3.2-27 Summary of Cumulative Subsidence Impacts for Alternative E Pumping

Impact Indicators By Model Timeframe	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Subsidence greater than 5 feet (square miles)	76	131	336

3.2.3.12 Alternative F

Rights-of-way and Groundwater Development Area Construction and Maintenance

Geological Hazards

All RFFAs (**Table 2.9-1** and **Figures 2.9-1** and **3.2-2** through **3.2-4**) that involve ground disturbing activities that could potentially be at risk to geological hazards of active faults, fissure, landsides, and karst. Protection measures including BMPs and ACMs applied to this project would cause a small decrease in risk from geological hazards.

Caves

There is a RFFA (Wilson Creek Wind Project) that involves ground-disturbing activities above limestone bedrock where lanes and voids could occur. This area is geographically separate from the GWD Project pipeline, and no cumulative effects caused by both projects are expected. Recommended mitigation measures include GW-G-1, GW-G-2, and GW-G-3.

Paleontological Resources

The RFFAs that share the same utility corridors (TransWest Express, Zephyr, ON Transmission Line, and Wilson Creek Wind) that involve ground disturbing activities could potentially disturb paleontological resources (**Figures 2.9-1** and **3.2-5**). Protection measures including BMPs and ACMs would be applied to this project and provide for the documentation and preservation of scientifically important paleontological resources. As a result, the Alternative F and the RFFAs would cause a small reduction in paleontological resources.

Groundwater Pumping Effects

Geological Hazards

Figure 3.2-12 illustrates the estimated subsidence effects in hydrologic basins affected by Alternative F. No subsidence in excess of 5 feet over 50 square miles is estimated in any valley through full build out plus 75 years. Cave and Spring valleys would experience subsidence in excess 5 feet over 100 square miles at full build out plus 200 years, primarily from groundwater pumping. No other valleys would experience subsidence in excess 5 feet over 50 square miles at the longest time frame.

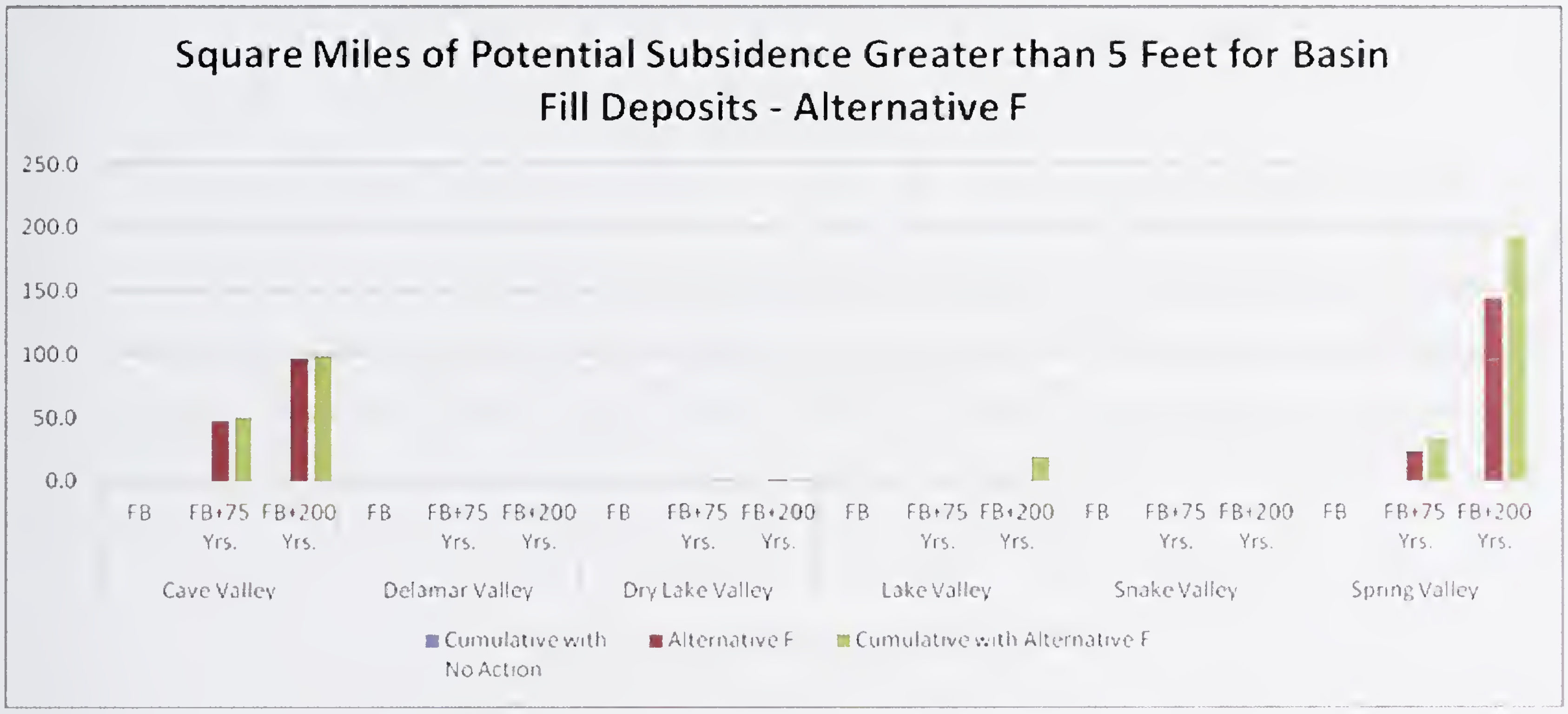


Figure 3.2-12 Square Miles of Potential Subsidence Greater Than 5 Feet for Basin Fill Deposits – Alternative F

Table 3.2-28 summarizes the potential subsidence area resulting from groundwater pumping from Alternative F and other cumulative activities at three model time frames.

Table 3.2-28 Summary of Cumulative Subsidence Impacts for Alternative F Pumping

Impact Indicators By Model Timeframe	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Subsidence greater than 5 feet (square miles)	76	208	477

3.2.3.13 Alternatives Comparison

Rights-of-way and Groundwater Development Area Construction and Maintenance

Geological Hazards

Project exposure to geological hazards risks occurs on an individual, not cumulative basis.

Paleontological Resources

Cumulative impacts to paleontological resources could occur when the GWD Project, TransWest Express, Zephyr, ON Transmission Line Project, and Wilson Creek Wind ROWs overlap.

Groundwater Pumping

Geological Hazards

At full build out plus 200 years, the Proposed Action and Alternatives B, D, and E pose a subsidence risk greater than the RFFAs and projected consumptive water uses. **Table 3.2-29** compares the alternatives with respect to potential cumulative effect of greater than 5 feet of subsidence. In the cumulative case, the No Action and Alternative C would result in the least area of risk greater than 5 feet of subsidence, while Alternative B potentially has the largest area at risk for greater than 5 feet of subsidence.

Table 3.2-29 Cumulative Impacts Comparison by Alternative of Areas of Potential Subsidence Greater than 5 Feet (square miles)

	Proposed Action		No Action		Alternative A		Alternative B		Alternative C		Alternative D		Alternative E		Alternative F	
Scenario	Project	Cumulative	Project	Cumulative	Project	Cumulative	Project	Cumulative	Project	Cumulative	Project	Cumulative	Project	Cumulative	Project	Cumulative
Full Build Out	<1	76	0	76	0	76	3	78	0	76	25	88	0	76	0	76
Project Build Out Plus 75 Years	147	283	0	126	5	131	172	323	<1	126	152	281	5	131	71	208
Project Build Out Plus 200 Years	525	781	0	163	159	349	669	956	1	167	269	560	153	336	242	477

3.3 Water Resources

3.3.1 Affected Environment

Figure 3.3.1-1 shows the region of study for water resources. This study area (or hydrologic study area) includes the ROWs and groundwater development areas and encompasses 35 hydrographic basins, as defined by the NDWR (2009). Most (but not all) boundaries between the hydrographic basins correspond to topographic divides.

QUICK REFERENCE

BARCAS – Basin and Range Carbonate-Rock Aquifer System study

ET – Evapotranspiration

GPM – Gallons per minute

NDWR – Nevada Division of Water Resources

NRA – National Recreation Area

NRCS – Natural Resources Conservation Service

3.3.1.1 Overview

The general topographic and physiographic features of the region are discussed in Section 3.2, Geologic Resources. In summary, the region of study is situated within the Basin and Range physiographic region, characterized by a series of generally north- to northeast-trending mountain ranges separated by broad valleys. The mountain ranges typically are 20 to 100 miles long and are spaced approximately 5 to 15 miles apart. Within this hydrologic study area, the land-surface elevations range from 13,063 feet amsl (at Wheeler Peak in the Snake Range) to approximately 1,111 feet amsl at Lake Mead in November 2007.

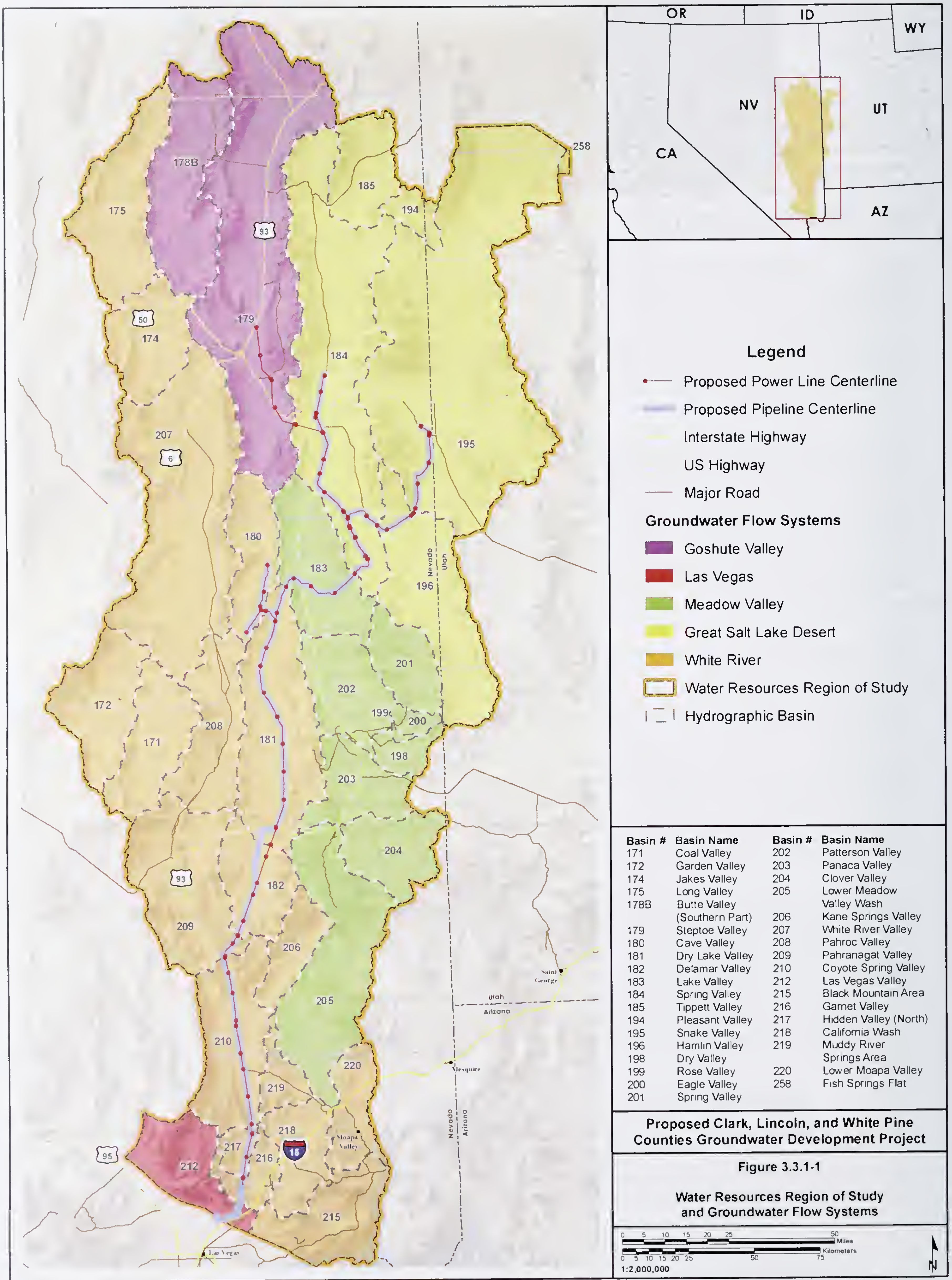
The climatic conditions across the hydrologic study area are highly variable and reflect wide elevation changes, the presence of numerous mountain ranges, and a wide range in latitude. Precipitation generally increases with elevation (see Figure 20 in Welch et al. 2007). In the Great Basin, the mean annual precipitation ranges from less than 5 to 16 inches in the valleys and approximately 16 to 60 inches in the mountains (Harrill and Prudic 1998). Elevation and precipitation generally decrease from north to south across the region. Specific information about climate (including precipitation, temperature variations and trends, and discussions of climate change) are provided in Section 3.1, Air and Atmospheric Values.

Hydrographic basins are local drainage basins within large multi-basin flow systems. Hydrographic basins (or areas) are defined by the State Engineer's Office, Department of Conservation and Natural Resources (DCNR), Division of Water Resources. The terms *hydrographic areas*, *hydrographic basins*, and *groundwater basins* often are used interchangeably to describe the same area in published literature and reports.

This section describes water resources within the hydrologic study area. In addition, the section provides a summary of more-detailed, site-specific information for the five hydrographic basins (Spring, Snake, Delamar, Dry Lake, and Cave valleys) where pumping is proposed as part of future activities associated with the Proposed Action and alternatives. The initial Affected Environment subsections provide an overview of the regional flow systems within the region of study. The remaining sections provide a baseline summary of the surface water, groundwater, water quality, and water rights relevant to the project.

3.3.1.2 Regional Flow Systems

The 35 hydrographic basins within the hydrologic study area can be grouped into regional flow systems, and each can be defined as a set of hydraulically connected basins. As **Figure 3.3.1-1** shows, the hydrologic study area encompasses all or portions of five flow systems and includes, from north to south: 1) Goshute Valley flow system; 2) Great Salt Lake Desert flow system; 3) White River flow system; 4) Meadow Valley flow system; and 5) Las Vegas flow system.



Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.1-1

Water Resources Region of Study and Groundwater Flow Systems

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

The north-central section of the hydrologic study area includes a portion of the Goshute Valley flow system. The Goshute Valley flow system includes Steptoe and Southern Butte valleys (in the north-central portion of the study area), and Goshute Valley (immediately north of the hydrologic study area). Groundwater flow in this system generally is north, toward Goshute Valley.

The northeastern section of the hydrologic study area includes a portion of the Great Salt Lake Desert flow system. Hydrographic basins in the Great Salt Desert flow system in the study area include Tippet, Pleasant, Spring, Hamlin, Snake, and a small portion of Fish Springs Flat that encompasses Fish Springs. The overall direction of flow in this region is toward the northeast. This flow system terminates at the Great Salt Lake (northeast of the study area), with intermediate discharge at Fish Springs in Juab County, Utah.

The western and southern portions of the hydrologic study area encompass the White River and Meadow Valley Wash flow systems. These systems are tributary to the Colorado River regional flow system. Both the entire White River and Meadow Valley flow systems are included within the hydrologic study area. The White River flow system consists of 19 hydraulically-interconnected basins, which flow from north to south over a distance of approximately 250 miles. The Meadow Valley flow system essentially is parallel to the White River flow system and includes nine basins. The flow direction in the Meadow Valley flow system also is north to south, and the system merges into the White River flow system in the southern portion of the hydrologic study area. Major surface discharge features in the lower end of the White River flow system include Muddy River Springs, which forms the headwaters of the Muddy River, and Rogers and Blue Point springs. The Muddy River is a tributary to the Colorado River and its current stream course terminates at Lake Mead. Rogers and Blue Point springs are located within the Lake Mead National Recreation Area.

The southwest corner of the study area includes a segment of the Las Vegas Valley hydrographic area (HA) that is part of the Las Vegas flow system.

3.3.1.3 Hydrologic Cycle and Conceptual Groundwater Flow

Surface water and groundwater discharged in the region originate from precipitation. Precipitation that falls to the land surface might infiltrate the soil or bedrock and recharge the groundwater system, evaporate, be transpired by plants, or flow as runoff through drainages. Surface water runoff that originates at higher mountain elevations generally flows in well-defined channels cut into bedrock in the mountain blocks; the runoff then discharges onto alluvial fans at the valley margin. Several potential outcomes exist for runoff that flows from the mountain blocks and into the valley bottom. As surface water moves from the mountains into the valley setting, it is continually removed from the surface-water system by a variety of processes including: 1) infiltration as recharge to groundwater (as seepage into fractures in bedrock or permeable sediments in the drainage channel, into alluvial fans at the margins of the mountain fronts, or into basin-fill sediments in the central portions of the valley); 2) removed from the system by evaporation or transpired by plants (both in the channel, in ponds or lakes, and at playas in the valley bottom); and 3) diversion for irrigation or other beneficial uses.

Perennial surface water is supported by groundwater discharge in this region. Springs that discharge groundwater at the land surface can collect into channels to form perennial streams. Periodic rain storms and snow melt generate runoff that contributes to temporary stream-flow increases. However, a consistent base flow for streams and springs in the region observed even after prolonged dry periods is maintained by the discharge from the groundwater system.

The downward movement of water, through the soil to groundwater, is known as *infiltration*. Water infiltration that reaches a groundwater source is called *recharge*.

The movement of water from soil or groundwater into plants and then released into the atmosphere is known as *transpiration*.

An *alluvial fan* is a fan-shaped deposit of generally coarse material (sand, gravel, rocks) that is created where a stream flows out of the mountains and onto the valley floor.

A *perennial* stream (or stream reach) flows throughout the year.

A conceptual diagram of the groundwater flow system for the region is illustrated in **Figure 3.3.1-2**. This conceptual groundwater flow system is described in the BARCAS report (Welch et al. 2007), as follows:

> "Ground water in the study area is influenced by a combination of topography, climate, and geology. Ground water moves through permeable zones under the influence of hydraulic gradients from areas of recharge to areas of discharge, and this movement can be discussed in terms of local, intermediate, and regional flow systems.
>
> Local flow systems are characterized by relatively shallow and localized flow paths that terminate at upland springs. Local springs are low volume, tend to have temperatures similar to annual average ambient atmospheric conditions and have discharge that fluctuates according to the local precipitation. Intermediate flow systems include flow from upland recharge areas to discharge areas along the floor of the intermontane valley. Within intermediate flow systems, springs typically discharge near the intersection of the alluvial fan and the valley floor near the range front. Intermediate flow system springs often are of moderate volume and tend to have less variable flow relative to local springs.
>
> Regional ground-water flow follows large-scale (tens to hundreds of miles) topographic gradients as water moves toward low altitudes in the region. Discharge from these regional flow systems manifests as large springs and, in some areas, extensive wetlands."

Hydraulic gradient is the gradient or slope of a water table or potentiometric surface measured in the direction of the steepest change.

Intermontane refers to a feature that lies between mountains.

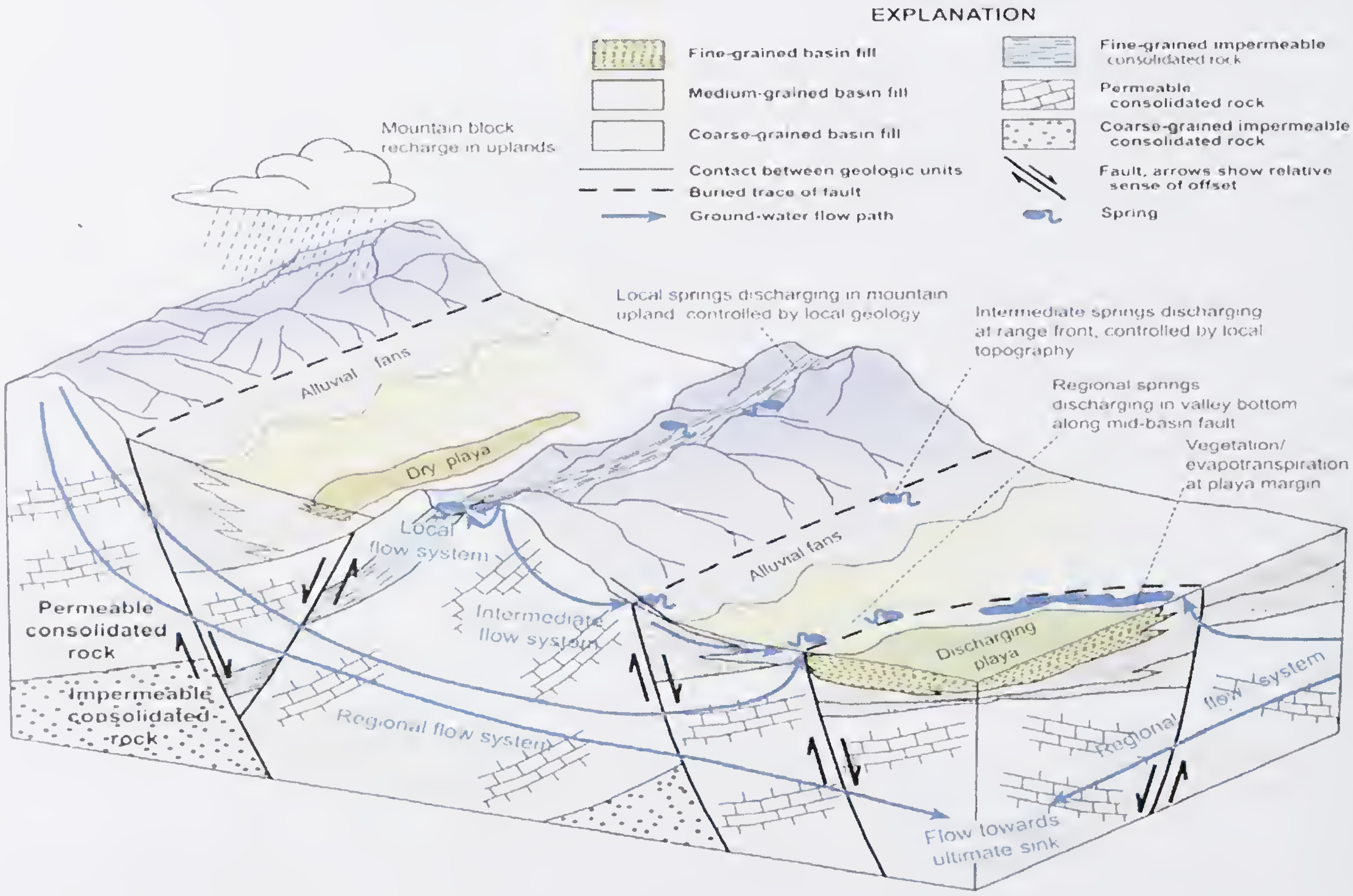


Figure 3.3.1-2 Conceptual Groundwater Flow System (From Welch et al. 2007)

Numerous springs occur in high-elevation areas in the mountains throughout much of the region. These springs generally are controlled by discharge from localized or perched groundwater systems that are not hydraulically connected to the regional groundwater system (Prudic et al. 1995). Many small springs also occur in the valleys or along the margins of the valleys. The occurrence and discharge of these springs generally is controlled by flow along intermediate flow paths (as described previously) that originate in the adjacent mountain ranges or alluvial fans.

Perched (localized) groundwater systems are not hydraulically connected to the regional groundwater system.

Large springs (greater than 100 gpm) with relatively constant discharge rates are present in several valleys within the hydrologic study area. These springs typically discharge from carbonate rock or from basin-fill that overlies or that is adjacent to carbonate rocks (Prudic et al. 1995). Discharge at these large springs is presumed to be controlled by groundwater that moves through a deep, regional groundwater flow system; this system is made up of interconnected basin-fill and carbonate-rock aquifers and is unconstrained by local topographic or drainage features (Plume 1996; Welch et al. 2007). As illustrated in the conceptual flow diagram (**Figure 3.3.1-2**), water enters the regional groundwater flow system primarily as recharge in the mountains and can flow through several basins and beneath mountain ranges before finally discharging at a regional spring.

Basin-fill and *carbonate-rock* aquifers are described in Section 3.3.3.1.

3.3.1.4 Surface Water Resources

Rights-of-way/Groundwater Exploratory Areas

Figure 3.3.1-3 shows perennial stream reaches and springs that have been identified near the ROWs and groundwater development areas for the Proposed Action and alternatives.

The ROW for the Proposed Action (and Alternatives A through C) for the Snake Valley lateral would cross one perennial stream, Snake Creek, in the southern portion of the Snake Valley hydrographic basin. The ROWs for the main pipeline and laterals into Spring Valley and Cave Valley would not cross perennial streams. The ROW for the power line for the Proposed Action would cross Steptoe Creek (a perennial stream in Steptoe Valley).

The ROWs for the Proposed Action and alternatives would cross numerous ephemeral stream channels. Most of these channels are local drainage features on alluvial fans. Rainfall from severe storms poses a risk of flash flooding in these ephemeral channels. Two of the larger ephemeral or intermittent stream crossings include Lexington Creek in Snake Valley and Pahranagat Wash in Coyote Spring Valley. Lexington Creek is an incised, intermittent stream that is approximately 2 miles south of Big Wash in southern Snake Valley. Pahranagat Wash drains the northern half of Coyote Spring Valley. The wash is an ephemeral drainage up to approximately 0.5-mile wide, where flash flooding is possible. The proposed ROWs would cross and parallel Pahranagat Wash for approximately 13 miles.

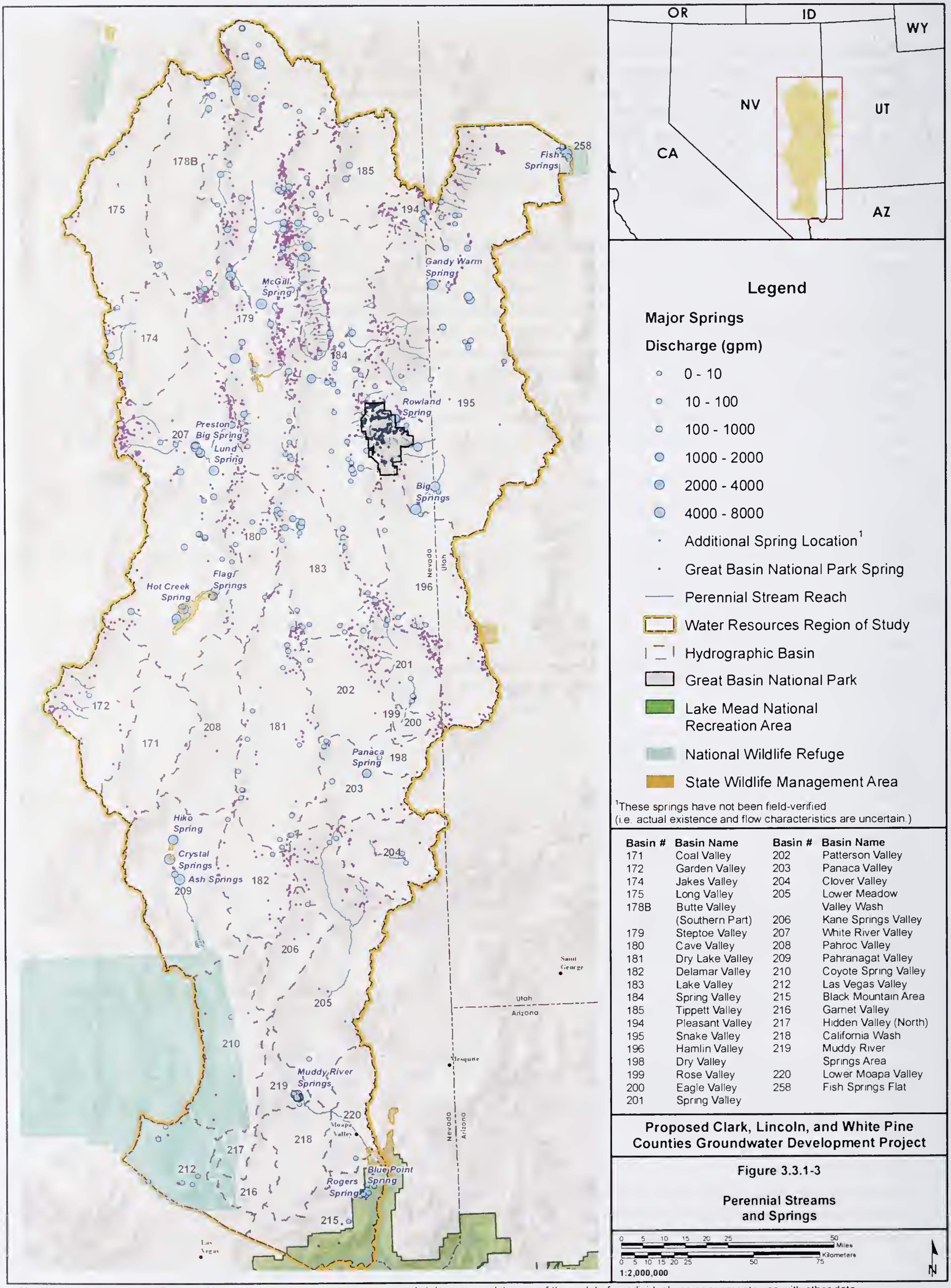
An *ephemeral* stream is a stream or portion of a stream that flows briefly in direct response to precipitation.

The proposed ROW would cross numerous small ephemeral washes through Las Vegas Valley. These washes typically drain runoff across alluvial fans that slope gently from the Las Vegas Range. Alluvial fan flooding is likely to occur in these areas.

Information that relates to perennial streams and springs within or near the groundwater exploratory areas is provided in subsequent sections that describe water resources within the region of study and in the proposed groundwater development basins.

Floodplains

Floodplains are areas where water overflows onto an area of typically dry land. Floodplains often occur adjacent to existing waterways and help to moderate flood flow, recharge groundwater, spread silt to replenish soils, and provide habitat for numerous plant and animal species. Executive Order (EO) 11988, Floodplain Management, requires federal



No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

agencies to ensure that their actions minimize the impacts of floods on human health and safety and to restore the natural and beneficial values of floodplains. USDOE regulation 10 CFR Part 1022 requires public notification of floodplain involvement.

Federal Emergency Management Agency (FEMA) delineates 100-year floodplains. FEMA maps are available for Clark County; however, maps are only available for the local unincorporated areas of White Pine and Lincoln counties. In two areas within Clark County, the proposed pipeline and power lines cross FEMA-designated 100-year floodplain boundaries. A playa in Hidden Valley (within the Hidden Valley North hydrographic basin southwest of Moapa, Nevada) is designated as a 100-year floodplain. The pipeline and transmission lines parallel U.S. 93, which also crosses the Hidden Valley floodplain. The total pipeline and power line distance that crosses the floodplain is 4.6 miles. Immediately north of the Hidden Valley playa is an unnamed stream with a designated floodplain area. The span across this floodplain is approximately 0.2 miles.

Region of Study

Figure 3.3.1-1 shows the region of study for water resources. This section provides an overview of the perennial water sources (streams, springs, and seeps) within the region of study. Groundwater pumping under the Proposed Action and alternatives would occur in five hydrographic basins within the Great Salt Lake Desert flow system (Spring Valley and Snake Valley) and the White River flow system (Delamar, Dry Lake, and Cave valleys). Major surface-water discharge features within these two flow systems are described, followed by a description of surface-water resources in each of the five proposed groundwater pumping basins.

Surface-water resources within the region of study include intermittent washes, perennial streams, ponds or reservoirs, playas, and springs. In terms of streams, ephemeral drainages represent the predominant feature type. Perennial stream locations are shown in **Figure 3.3.1-3**; estimated miles of perennial stream, by basin, are provided in **Table 3.3.1-1**. Perennial stream reaches were defined by compiling available published and unpublished information that identified perennial streams (BLM 2007; NPS 2007; Elliott et al. 2006; SNWA 2006; Crookshanks 2011; USGS 2011; Eakin 1966, 1963). The length of the individual stream reaches were further evaluated using available aerial photo imagery.

Hydrographic basins with more than 100 miles of estimated perennial stream length include Steptoe Valley (162 miles), Spring Valley (207 miles), and Snake Valley (218 miles). All of the other basins have total estimated perennial stream lengths of less than 100 miles. Major perennial streams of interest controlled by discharge from the groundwater flow system include Big Spring Creek, in Snake Valley; White River, in White River Valley; Pahranagat Creek, in Pahranagat Valley; Meadow Valley Wash, in Lower Meadow Valley Wash; and Muddy River, which originates in the Muddy River Springs area.

Other perennial streams, ponds, and reservoirs are discussed in Section 3.7, Aquatic Biological Resources.

There are a total of 316 inventoried springs that have been identified in the region of study. For the purposes of this analysis, inventoried springs are springs that have been field-verified and typically include flow measurements. A list of the inventoried springs, including the spring names, location, average flow rate, and data source is provided in **Appendix F3.3.1**, **Table F3.3.1-1A**. Other data, such as temperature and water-quality, also are available for many of these springs. The inventoried springs compilation includes information from the following sources: 1) USGS spring data provided in the BARCAS study (Welch et al. 2007), and National Water Information System (USGS 2009a); 2) SNWA's spring inventory for the project (SNWA 2007); 3) spring data collected by BIO-WEST (BIO-WEST 2008, 2007); and 4) spring data included in the Desert Research Institute (DRI) spring database.

The SNWA inventory documents baseline hydrologic conditions for selected springs in 13 hydrographic basins in the study area. The SNWA spring inventory includes existing data, photographic documentation, discharge measurements, water-chemistry sampling, and physical and geologic descriptions of the spring source area. BIO-WEST (2007) collected flow and temperature data of selected springs at 105 locations in 13 hydrographic basins (located inside and outside the study area boundary) as part of a baseline inventory of aquatic resources in the region.

Table 3.3.1-1 Perennial Stream Reaches Within the Region of Study

Groundwater Flow System	Basin Number (Upgradient to Downgradient)	Basin Name	Total Estimate Miles
White River	175	Long Valley	0.8
	174	Jakes Valley	21.8
	207	White River Valley	76.8
	180	Cave Valley	2.1
	172	Garden Valley	27.7
	171	Coal Valley	0.0
	208	Pahroc Valley	0.0
	181	Dry Lake Valley	0.9
	209	Pahranagat Valley	22.0
	182	Delamar Valley	0.0
	206	Kane Springs Valley	0.0
	210	Coyote Spring Valley	0.0
	219	Muddy River Springs Area	6.2
	218	California Wash	8.0
	220	Lower Moapa Valley	15.8
	217	Hidden Valley	0.0
	216	Garnet Valley	0.0
	215	Black Mountains Area	0.0
Goshute Valley	179	Steptoe Valley	161.8
	178B	Butte Valley (Southern Part)	19.1
Great Salt Lake Desert	196	Hamlin Valley	5.1
	185	Tippett Valley	2.2
	184	Spring Valley (184)	207.4
	194	Pleasant Valley	0.0
	195	Snake Valley	217.8
Meadow Valley	183	Lake Valley	8.3
	201	Spring Valley (201)	43.1
	202	Patterson Valley	1.6
	200	Eagle Valley	3.2
	199	Rose Valley	0.0
	198	Dry Valley	3.1
	203	Panaca Valley	7.4
	204	Clover Valley	17.9
	205	Lower Meadow Valley Wash	67.7
Las Vegas	212	Las Vegas Valley	0.0
Total			**947.8**

An additional 427 springs have been identified by the NPS in the GBNP (NPS 2007). Information on these springs includes location, an estimate of discharge (predominantly using a visual estimate rather than a measured value), and results for several field water quality parameters. Additional information on these springs is presented in the surface water discussions for Spring Valley and Snake Valley later in this section.

Numerous other spring locations have been mapped in the area but do not have documented flow, temperature, or water-quality data. These additional (or "other") spring locations also are shown on **Figure 3.3.1-3**. These spring locations were compiled from the National Hydrography Dataset (USGS 2009b), digitized from 7.5 minute topographic maps for selected basins (i.e., Spring, Snake, Dry Lake, Delamar, and Coyote Spring valleys) (SNWA 2008), or identified from other sources. These springs have not been field-verified, so their actual existence and status as a perennial or ephemeral surface water feature has not been determined.

The locations of springs with flow data and their relative flow magnitudes are shown on **Figure 3.3.1-3**. Springs with reported average discharges of 200 gpm or greater are listed in **Table 3.3.1-2**. The largest spring discharge areas in the Great Salt Lake Desert and the White River regional flow systems area are briefly summarized in the following subsections.

Table 3.3.1-2 Springs with Average Discharges of 200 gpm or Greater in the Region of Study

Groundwater Flow System	Basin Number	Basin Name	Spring Name	Average Flow (gpm)
White River	174	Jakes Valley	Illipah Spring	900
	207	White River Valley	Hot Creek Spring	5,032
			Arnoldson Spring	1,608
			Cold Spring	582
			Preston Big Spring	3,572
			Lund Spring	3,594
			Moorman Spring	405
			Flag Springs 3	969
			Flag Springs 2	1,287
			Flag Springs 1	1,019
			Butterfield Spring	1,225
			Hardy Springs	200
			Nicholas Spring	1,185
			Moon River Spring	1,707
			Emigrant Springs	797
			Forest Home Spring	221
			Water Canyon Spring	320
			Indian Ranch Spring	236
			Sunnyside Creek Spring (Upper)	2,553
			Sunnyside Creek Spring (Lower)	5,284
	180	Cave Valley	Cave Spring	211
	209	Pahranagat Valley	Hiko Spring	2,735
			Crystal Springs	4,235
			Ash Springs	6,909
			Brownie Spring	224
			Cottonwood Spring	1,760

Table 3.3.1-2 Springs with Average Discharges of 200 gpm or Greater in the Region of Study (Continued)

Groundwater Flow System	Basin Number	Basin Name	Spring Name	Average Flow (gpm)
White River (Continued)	219	Muddy River Springs Area	Jones Spring	455
			Baldwin Spring	1,065
			Muddy Spring	3,148
			Iverson Flume	3,912
			M-11	515
			M-13	287
			M-15	702
			M-19	414
			M-20	363
			Warm Springs East	1,000
			Warm Springs West	2,431
			M-10	278
			Apear Springs (Moapa)	264
	215	Black Mountains Area	Rogers Spring	771
			Blue Point Spring	223
Goshute Valley	179	Steptoe Valley	Murry Springs	3,179
			McGill Spring	4,782
			Monte Neva Hot Springs	649
			Indian Ranch Spring	215
			Big Spring	300
			Willow Creek Springs	624
			Big Indian Creek Spring	426
			Wilson Creek Springs	265
			Comins Lake Spring	334
			Nelson Spring	973
			Schoolhouse Spring	450
			Currie Springs	2,181
			Twin Springs	661
			Campbells Embayment Spring	2,746
			Egan Creek Springs	803
			Currie Gardens	225
			Borchert Spring	610
			Cave Springs	300
			McGill Spring	450
			Lower Schellbourne Warm Spring	450
			Lower Schellbourne Pass Spring	314
			Willow Creek Springs	685
			Shallenberger Spring	450
			Bird Creek Spring	720
			McDermitt Ranch Springs	2,697
	178B	Butte Valley (Southern Part)	Stratton Springs	350

Table 3.3.1-2 Springs with Average Discharges of 200 gpm or Greater in the Region of Study (Continued)

Groundwater Flow System	Basin Number	Basin Name	Spring Name	Average Flow (gpm)
Great Salt Lake Desert	184	Spring Valley (184)	Kalamazoo Spring	869
			North Millick Spring	284
			South Millick Spring	506
			Swallow Springs	391
			Keegan Spring	234
			Minerva Spring	258
			Bastian Spring	1,150
			North Creek Spring	1,000
			Muncy Creek Spring	1,005
			West Spring Valley Complex # 1	438
			Keegan Spring Complex (North)	221
			West Spring Valley Complex # 5	756
			Swallow Spring	318
			Schellbourne Springs	242
			Kalamazoo Creek Spring	1,112
	195	Snake Valley	Rowland Spring	1,088
			Big Springs	4,289
			Gandy Warm Springs	7,426
			Foote Reservoir Spring	1,300
			Twin Springs	1,423
			Spring Creek Spring	1,205
			Miller Spring	206
			Outhouse Springs	500
			Stateline Spring/Lake Creek	3,663
	258	Fish Springs Flat	North Springs	3,140
Meadow Valley	183	Lake Valley	Geyser Springs	471
			North Creek Springs	397
			Unnamed spring flowing north	431
			Unnamed spring flowing south	974
			Dupont Spring	970
			Burnt Knoll Spring	972
			North Big Spring	1,400
	203	Panaca Valley	Panaca Spring	1,256

Great Salt Lake Desert Regional Flow System

The largest spring discharge area for the Great Salt Lake Desert flow system is at Fish Springs, along the extreme northeast edge of the region of study (**Figure 3.3.1-3**). The Fish Creek Range forms a surface-water divide between the Snake Valley and Fish Springs Flat hydrographic basins. Springs in the Fish Springs discharge area occur along a north-northwest trending zone that extends for approximately 10 miles and is coincident with the eastern margin of the Fish Springs Range in the Fish Springs Flat hydrographic basin. The discharge locations for most of these springs are assumed to be controlled by an inferred north-northwest trending fault (Bolke and Sumison 1978). Numerous springs discharge in the Fish Springs area. Specific springs that have been identified as the Fish Springs Group include North Spring, Deadman Spring, Walter Spring, and Fish Spring complex (including House, Mirror, Thomas, Middle, Lost, Crater, South, and Percy springs). The USFWS estimated that the total discharge at Fish Spring Group was approximately 21,000 afy, or 28.69 cubic feet per second (cfs) (USFWS 2004). An earlier water resources reconnaissance report for the Fish Flats hydrographic basin estimated that the Fish Springs had a combined discharge of approximately 24,000 afy, or 33.5 cfs (Bolke and Sumison 1978).

Several major springs are identified in Spring Valley and Snake Valley. The largest discharges occur at Gandy Warm Springs (approximately 15 cfs) and Big Springs (approximately 10 cfs) in Snake Valley. Discharge at Big Springs sustains perennial flows in Big Spring Creek. The springs in Spring Valley and Snake Valley are discussed in more detail under separate hydrographic basin headings.

White River Regional Flow System

Major perennial surface-water discharge occurs within the White River flow system in White River Valley, Pahranagat Valley, and the Muddy River Springs area. The White River Valley is located in the upper portion of the flow system and is characterized by numerous perennial surface-water features, which include approximately 13 major spring discharge areas. Major springs identified in White River Valley include (from north to south) Preston Big Springs, Moorman Spring, Hot Creek Spring, and Moon River Spring. The average annual discharge from these springs is approximately 17,000 afy (24 cfs). Lund Spring is another major spring that occurs in the northern portion of White River Valley and has an average discharge of approximately 5,700 afy (8 cfs). Other major springs in the valley include Cold Spring, Nicholas Spring, Arnoldson Spring, Hardy Springs, Emigrant Spring, Butterfield Spring, and Flag Springs. Spring discharge contributes flow to localized perennial reaches of the White River and to several surface-water features (e.g., ponds, reservoirs, marshes, wetlands) in the basin, including extensive surface-water features in the Kirch Wildlife Management Area in the southern portion of the basin.

Pahranagat Valley is located near the middle of the White River flow system. Major surface-water resources in Pahranagat Valley include groundwater discharge at Hiko, Crystal, and Ash springs, along with Brownie Spring, and other smaller springs and seeps in the southern portion of the discharge area. Eakin (1963) indicated that Hiko, Crystal, and Ash springs have the largest discharge, with an estimated combined total discharge of approximately 25,000 afy (35 cfs). Discharge from the springs supports perennial flows and riparian vegetation along Pahranagat Wash in the Pahranagat hydrographic basin. Spring discharge likely also contributes to flow in lakes and wetlands, including flow to the Upper Lake, Middle Pond, and Lower Lake in the Pahranagat National Wildlife Refuge.

Muddy River Springs consists of numerous springs that discharge over approximately 3 square miles in the eastern portion of the Muddy River Springs hydrographic basin. These springs represent the largest groundwater discharge at the lower end of the White River flow system. Discharge from the springs forms the headwaters of the Muddy River and sustains perennial flow along portions of the Muddy River. The Moapa flow gauge on the Muddy River measures the total discharge from the Muddy River Springs area, minus diversions for municipal and industrial uses (SNWA 2009a). Eakin (1966) indicates that from 1914 to 1962, the average mean annual flow at the Moapa gauge was 33,700 afy (approximately 47 cfs). Between 1963 and 2004, the mean annual flow at the Moapa gauge exhibited a long-term trend of reduced flows. From 2004 to 2010, flows at the gauge generally increased (ranging from approximately 24,000 to 25,900 afy) but were still reduced compared to the 1914 to 1962 conditions. As of 2010, the mean annual flow at the Moapa gauge was approximately 25,900 afy (approximately 36 cfs) or approximately 23 percent less than the average mean annual flow for the 1914 to 1962 period. Flow rates in the river are affected by diversions for agriculture and power generation. Spring discharge rates into Muddy River are controlled by water levels in the carbonate aquifer system that vary in response to climate conditions and groundwater pumping (Mayer and Congdon 2007).

Rogers and Blue Point springs are located in the extreme southeastern margin of the study area, within the White River flow system. These springs occur in the Black Mountain hydrographic basin and are within the Lake Mead National Recreation Area. The spring discharge represents a mixture of local and regional water sources (Pohlmann et al. 1988). The combined discharge of these springs is approximately 1,600 afy (2.2 cfs).

Springs that support special status aquatic species are discussed in Section 3.7, Aquatic Biological Resources.

Surface Water Resources within the Proposed Pumping Basins

The following subsections provide an overview of the surface-water resources for the five basins proposed for groundwater development under the Proposed Action and alternatives.

Spring Valley

The Spring Valley hydrographic basin is a topographically closed basin that is bounded by the Schell Creek and Fortification ranges on the west and the Snake Range on the east. Both Schell Creek and Snake ranges have extensive high-elevation areas (greater than 10,000 feet amsl). The lowest elevation of the valley floor is approximately 5,545 feet amsl and occurs in a playa area (Yelland Dry Lake) in the north-central segment of the valley north of Highway 50. The elevation of the valley floor increases to approximately 6,500 feet amsl along both the north and south margins of the valley floor. A substantial band of irrigated fields, marshes, and open-water ponds occurs along the valley floor, south from Piermont Creek approximately 20 miles to Cleve Creek. In addition to stream flows, these features are maintained by irrigation ditches and numerous springs that discharge along the lower margin of the alluvial fans between elevations of approximately 5,570 to 5,600 feet, just above the valley floor.

Streams

Spring Valley Creek is an ephemeral stream with a north-to-south gradient and is the main channel along the valley axis. Spring Creek also is an ephemeral stream that occupies a similar position, with a south-to-north gradient from the southern end of the valley. Dry lakes and other smaller playa features occur in the valley bottom. Along the west side of the basin, stream flows originate in the Schell Creek Range. Runoff from the Fortification Range enters the basin from the southwest and flows originating in the Snake Range enter from the east.

Rush and Kazmi (1965) described the general-surface water resources in Spring Valley. In addition, SNWA identified 22 streams with perennial stream reaches (SNWA 2006, Table 4-1). **Figure 3.3.1-4** shows the locations of perennial stream reaches in the Spring Valley hydrographic basin. SNWA collected instantaneous discharge measurements between 1990 and 2006 at selected stream sites and compiled and evaluated miscellaneous discharge measurements from other sources for perennial streams in Spring Valley (SNWA 2006). Elliott et al. (2006) also conducted field investigations and flow monitoring to define surface water within and near the GBNP. The Elliott et al. (2006) study includes continuous stream-discharge data for Shingle Creek (also known as Willard Creek) and Williams Canyon, which drain the southern Snake Range.

Table 3.3.1-3 lists selected streams that drain from the Schell Creek and Snake ranges onto the alluvial fans of the basin. Perennial streams generally originate in channels in higher-elevation mountain settings and these flows tend to rapidly dissipate into the valley fill sediments after leaving the mountain front. A large number of other smaller canyons and channels also exit the surrounding ranges onto the valley floor. Physical descriptions of the streams in **Table 3.3.1-3** are provided in SNWA (2008) and Elliott et al. (2006).

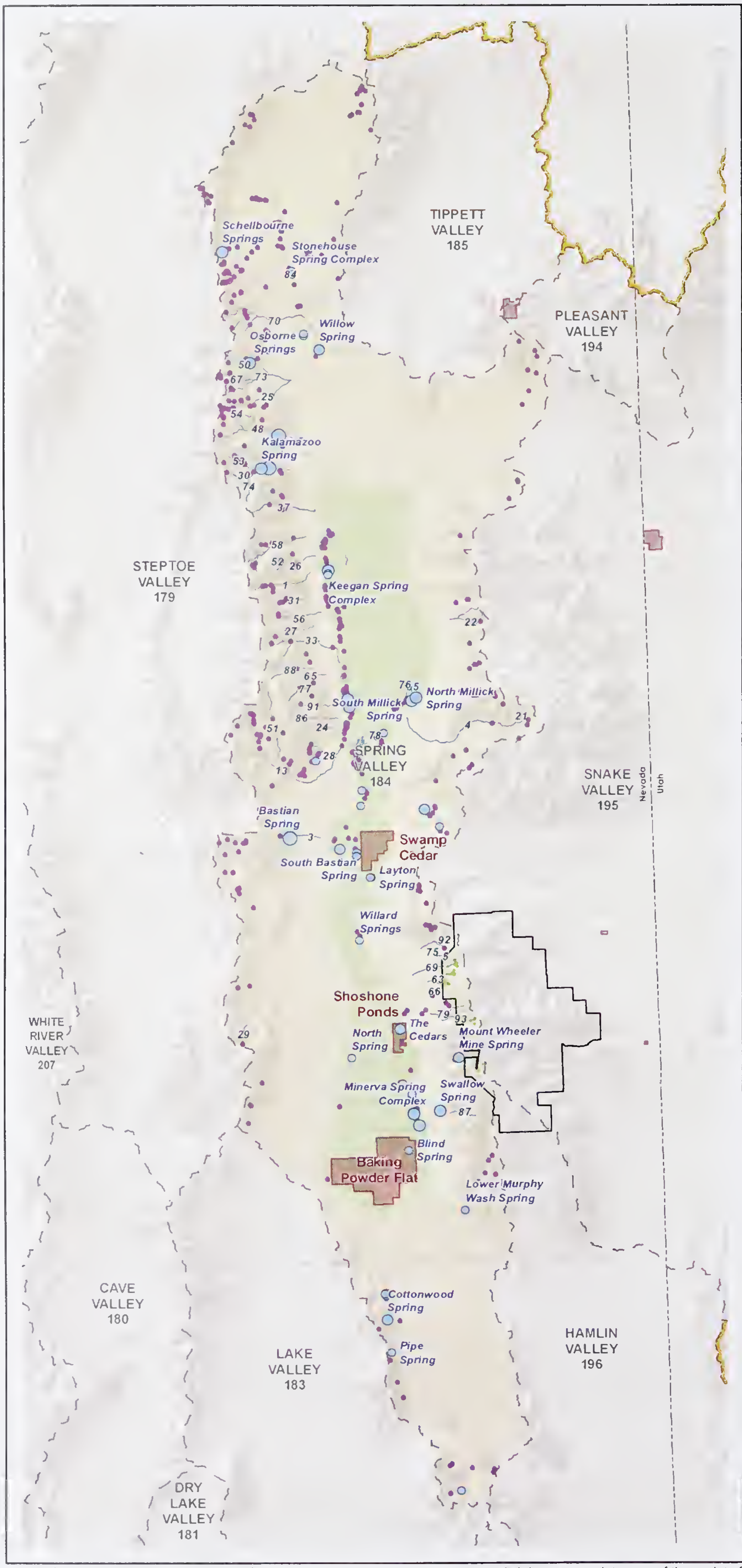
Cleve Creek is a prominent surface-water feature and has the largest drainage area in Spring Valley. The USGS has intermittently operated several gauging stations on Cleve Creek since 1914. Cleve Creek has the longest period of record for streams in Spring Valley. The long-term mean annual discharge is 10.5 cfs, and the second highest mean annual discharge was reported as 21.6 cfs in 2005 (USGS 2007). Stream flow in this region fluctuates, depending on annual and seasonal precipitation variations.

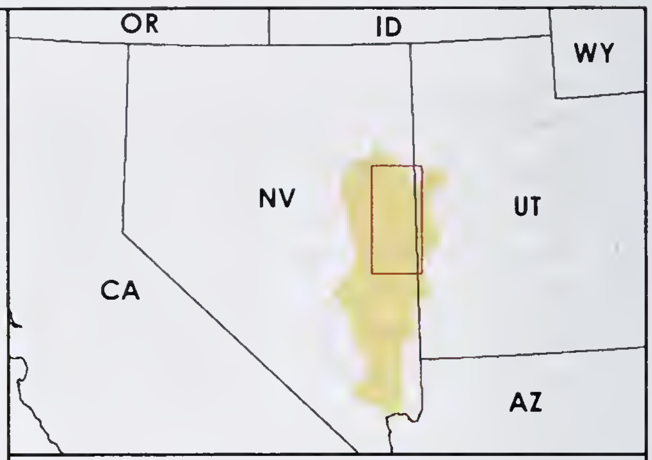
Springs

Springs identified within the Spring Valley hydrographic basin are shown in **Figure 3.3.1-4**. This includes 52 inventoried springs (i.e., springs that have been field-verified and that have flow measurements) and 621 other springs (i.e., springs with map locations that have not been field verified) have been identified in the basin. The location, name, average flow, and data source for the inventoried springs are listed in **Table F3.3.1-1A** in **Appendix F3.3.1**.

A large number of springs occur in the Schell Creek, Snake, and Fortification ranges. Approximately 50 unnamed springs are shown on USGS maps for this area, paralleling the western margin of the valley at elevations of approximately 5,550 to 5,800 feet amsl. These lower-elevation springs contribute to surface-water uses and features on the valley floor.

Thirty-seven springs have been identified in GBNP within Spring Valley by the NPS (2007). These springs occur in the Lincoln Canyon (2 springs), Pine Creek and Ridge Creek (15 springs), Shingle Creek (9 springs) and Williams Canyon Creek (11 springs) watershed areas. Available field information for all the springs identified in GBNP is summarized under the Snake Valley subheading below.





Legend

Inventoried Springs

Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location[1]
- Perennial Stream Reach
- Evapotranspiration Area
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- BLM Areas of Critical Environmental Concern

[1]These springs have not been field-verified (i.e. actual existence and flow characteristics are uncertain.)

#	Stream Name	#	Stream Name
1	Bassett Creek	55	North Millick Spring Creek
3	Bastian Creek	56	Odgers Creek
4	Big Negro Creek	58	Piermont Creek
5	Board Creek	63	Pine Creek
13	Cleve Creek	65	Ranger Creek
21	Deer Head Canyon Creek	66	Ridge Creek
22	Eightmile Creek	67	Ruby Creek
24	Freehill Creek	69	Shingle Creek
25	Frenchman Creek	70	Siegel Creek
26	Garden Creek	73	Snow Bank Creek
27	Gordon Creek	74	South Fork Kalamazoo Creek
28	Indian Creek	75	South Fork Willard Creek
29	John Henry Wash	76	South Millick Spring Creek
30	Kalamazoo Creek	77	South Taft Creek
31	Little Negro Creek	78	Spring Creek
33	McCoy Creek	79	Spring Creek (GBNP)
37	Meadow Creek	84	Spring Valley Creek
48	Muncy Creek	86	Stephens Creek
50	North Creek	87	Swallow Canyon Creek
51	North Fork Cleve Creek	88	Taft Creek
52	North Fork Garden Creek	91	Vipont Creek
53	North Fork Kalamazoo Creek	92	Willard Creek
54	North Fork Muncy Creek	93	Williams Canyon Creek

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.1-4

Spring Valley Perennial Streams and Springs

0 5 10 15 20 25 Miles
0 5 10 15 20 25 Kilometers
1:800,000

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

Table 3.3.1-3 General Characteristics of Perennial Streams In Spring Valley

Stream	Location	Estimated Mean Annual Stream Flow (gpm)[1]	Stream with Perennial Reaches
Muncy Creek	Schell Creek Range	853	Yes[3]
Kalamazoo Creek	Schell Creek Range	2,693	Yes[3]
Meadow Creek	Schell Creek Range	350	No
Siegel Creek	Schell Creek Range	462	Yes[3]
North Creek (station 1840401)	Schell Creek Range	557	Yes[6]
North Creek (station 1843401)	Schell Creek Range	4	Yes[1,5]
Frenchman Creek	Schell Creek Range	242	Yes[3]
Piermont Creek	Schell Creek Range	754	Yes[3]
Garden Creek	Schell Creek Range	175	Yes[3]
Bassett Creek	Schell Creek Range	2,240	Yes[3]
Little Negro Creek	Schell Creek Range	386	Yes[3]
Negro Creek	Snake Range	1,176	Yes[3]
Odgers Creek	Schell Creek Range	1,064	Yes[3]
McCoy Creek	Schell Creek Range	3,025	Yes[3]
Taft Creek	Schell Creek Range	1,176	Yes[3]
Stephens Creek	Schell Creek Range	467	Yes[3]
Cleve Creek	Schell Creek Range	4,713 [2]	Yes[3]
Bastian Creek	Schell Creek Range	1,234	Yes[3]
Board Creek	Snake Range	13	Yes[1,5]
Eight Mile Creek	Snake Range	440	Yes[3]
Swallow Creek	Snake Range	3,434	Yes[3]
Dry Canyon and Williams Canyon	Snake Range	458	Yes[3,4]
Pine and Ridge Creeks	Snake Range	530	Yes[3,4]
Willard Creek	Snake Range	413	Yes[3]
Shingle Creek	Snake Range	431	Yes[4]
Ranger Creek	Schell Creek Range	27	Yes
South Taft Creek	Schell Creek Range	310	Yes[6]

[1]SNWA (2008), estimated mean annual stream flow for ungauged perennial streams and the gauge at Cleve Creek.
[2]USGS (2007).
[3]SNWA (2006).
[4]Elliott et al. (2006).
[5]Perennial stream reach not mapped.
[6]Crookshanks (2011).

SNWA has conducted detailed field investigations at 10 representative springs in Spring Valley (SNWA 2008). SNWA selected these springs based on aerial distribution, discharge, and lithologic setting. The general characteristics of these springs are summarized in **Table 3.3.1-4** and discussed in the following paragraphs.

Willow Spring. Willow Spring is in northern Spring Valley. The spring has two distinct orifices that discharge into a small, man-made impoundment that forms a small pond used by livestock and wildlife.

The spring discharges from Quaternary alluvium and is one of several springs that surface along a northeast trending lineation, suggesting the presence of a concealed fault (SNWA 2008).

Table 3.3.1-4 General Characteristics of Selected Springs in Spring Valley[1]

Spring Name	Location	Landscape Position	Elevation (feet)	Source Geology	Measured Discharge Range in gpm (Number of Measurements)	Water Temperature (Number of Measurements) °C[2]
Willow Spring	Schell Creek Range	Mountain upland	5,982	Carbonate bedrock	1.8–35.9 (5)	10.4–14.9 (3)
North Millick Spring	Snake Range	Valley margin	5,590	Unconsolidated sediment	196–328 (10)	10.9–15.5 (7)
South Millick Spring	Snake Range	Valley margin	5,592	Unconsolidated sediment	200–727 (13)	10.2–15.8.(10)
South Bastian Spring	Snake Range	Valley floor	5,660	Unconsolidated sediment	0.5–4.76 (3)	12–12.9 (2)
Willard Spring	Snake Range	Valley floor	5,755	Unconsolidated sediment	NMD–3 (2)	7.9 (1)
Layton Spring	Snake Range	Valley floor	5,698	Unconsolidated sediment	NMD–1.0 (7)	8.6–22 (5)
North Spring	Schell Creek Range	Valley floor	5,763	Unconsolidated sediment	10.0 (1)	22.7
The Cedars[3]	Snake Range	Valley floor	5,783	Alluvium	20.6–74.5 (6)	23.7–24.5 (6)
Swallow Springs	Snake Range	Valley floor	6,080	Alluvium	275–511 (13)	9.4–13.8 (10)
Blind Spring	Snake Range	Valley floor	5,773	Unconsolidated sediment	NMD (5)	2.2–25.3

NMD = No measurable discharge (dry or stagnant pond).

[1] Source: SNWA (2008) unless otherwise noted.

[2] Range of available temperature measurements; SNWA (2008), USGS (2007), BIO-WEST (2007).

[3] The area referred to as "The Cedars" contains surface discharges from two artesian wells that provide water to a wetland area (see text for additional description).

North and South Millick Springs. North and South Millick springs are approximately 3.5 miles southeast of the center of Yelland Dry Lake and approximately 6 miles east of the West Spring Valley Highway (State Route [SR] 893). They are in north-central Spring Valley on the west flank of the Snake Range, about 6 miles north of U.S. Highway 50. South Millick Spring is approximately 0.5 mile to the southwest of North Millick Spring. Several small orifices contribute flow to form large spring pools at each spring (SNWA 2008).

Both North and South Millick springs discharge from alluvium and are located on a northeast-southwest trending normal fault. Mean discharge was recorded at the South Millick Spring as approximately 506 gpm. The mean discharge of North Millick Spring was recorded as approximately 284 gpm. Water from the North and South Millick springs is used to water livestock (SNWA 2008).

Layton Spring. Layton Spring is approximately 2.5 miles north of U.S. Highway 50, along the eastern flank of Spring Valley. During a field visit on July 15, 2004, the spring was observed to be dry (SNWA 2008). When flowing, the spring discharges from a 2-inch-diameter pipe into a watering trough and then overflows into a shallow reservoir (SNWA 2008).

South Bastian Spring. South Bastian Spring is located approximately 2.8 miles southeast of Bastian Creek Ranch and approximately 2.3 miles northwest of Layton Spring. The spring discharges along the western edge of an extensive marshy area with large cedar trees. Two other springs with similar conditions, including discharge from the Quaternary alluvium and diversion structures, also were observed in the area (SNWA 2008). Discharge at South Bastian Spring was measured at approximately 4 gpm during a July 15, 2004, field visit. Livestock and wildlife use the water (SNWA 2008).

Willard Spring. Willard Spring is located in the valley bottom near the central axis of the valley, approximately 1.5 miles south of U. S. Highway 50. The spring discharges from unconsolidated sediments. The spring was described as stagnant with no measured discharge on July 15, 2004; and had a measurable flow of 3 gpm on March 27, 2007 (SNWA 2008).

North Spring. North Spring is 10 miles north of Lake Valley Summit and 2 miles east of U.S. Highway 93. North Spring discharges along a north-south-trending fault and is flanked on the east and west by additional north-south-trending faults. Another small spring approximately 900 to 1,200 feet north of North Spring appears to discharge from the same fault (SNWA 2008).

Discharge was estimated to be 10 gpm during a June 22, 2004, field visit (SNWA 2008). The spring flow travels only 150 yards before it is lost to infiltration and ET. The water is used for livestock watering and supports a small grassy area downstream of the spring (SNWA 2008).

Swallow Springs. Swallow Springs is in a grove of large cottonwood trees, 1.5 miles north of Shoshone, Nevada, and 1.5 miles east of SR 894. Swallow Springs is in the middle of a large alluvial fan, approximately 0.25 mile from an outcrop of middle Cambrian limestone (Hose et al. 1976). The combined discharge of the two orifices on November 29, 2007, was approximately 337 gpm. There are several historic water diversions in the area, and water currently discharges in the natural channel (SNWA 2008).

Blind Spring. Blind Spring is in southern Spring Valley, approximately 7 miles east of U.S. Highway 93 and 2 miles southwest of Minerva, Nevada. A raised rim surrounds Blind Spring and it appears to be manmade. The SNWA (2008) reports that the pool level might represent the potentiometric surface or groundwater table. At the time of the field visit, Blind Spring was discharging into a stagnant pool, so no discharge measurements were possible. Water from Blind Spring is used for wildlife and livestock (SNWA 2008).

A *potentiometric surface* is one that represents the static head of groundwater in tightly cased wells that tap a water-bearing unit (i.e., aquifer).

Other Major Ponds and Wetland Areas Fed by Groundwater Discharge

Shoshone Ponds Area. The Shoshone Ponds area is located in the southern portion of the Spring Valley approximately 10 miles south of U.S. Highway 6/50. The area consists of wet meadow/wetlands complex situated along the eastern margin of the valley floor that also is named "The Cedars" on topographic maps of the area. The source of water for the wet meadow/wetland complex is discharge from six artesian wells located along the eastern margin of the area. Five of the wells were constructed in the 1930s to supply water to a Civilian Conservation Corps Camp located in the area; the sixth well was constructed in the early 1970s for the NDOW to provide a water source for three ponds (known as the Shoshone Ponds) used as refugia for Nevada native fish (BLM 2010). (The management of the ponds as refugia for federally endangered fish is discussed in Section 3.7, Aquatic Biological Resources.) The SNWA conducted field investigations of the discharge characteristics at two of the artesian wells (SNWA 2008). The two wells are described as being situated at the toe of an alluvial fan that consists mainly of carbonate clasts. Discharge volume was measured for both wells on July 28, 2004. Total discharge from the two wells was estimated at 75 gpm.

Artesian well: A well in which the water pressure is so great that the water level in the well stands above the ground surface and may discharge at the surface without pumping (i.e., "flowing artesian well").

Snake Valley

Snake Valley is a western tributary to the Great Salt Lake drainage basin. The western margin of the valley is bounded by the Deep Creek and Snake ranges, which have extensive high-elevation areas (greater than 10,000 feet amsl). The eastern margin of the valley is bounded by the Fish Springs and Confusion ranges; neither exceeds 9,000 feet amsl. The elevation of the valley surface gently slopes toward the north, although it does not contain a well-defined continuous stream channel that extends the length of the valley (Hood and Rush 1965).

A gentle land surface separates the Snake Valley hydrographic basin from the Hamlin Valley hydrographic basin. Hamlin Valley Wash dissipates northward on the valley floor toward Snake Valley and Big Springs Creek and Lake Creek closely parallel the wash, also flowing north. Because of the subdued topography and surface drainage, some investigators include Hamlin Valley as the southernmost part of Snake Valley (Hood and Rush 1965; Welch et al. 2007).

Streams

Perennial stream reaches identified in the Snake Valley hydrographic basin are shown on **Figure 3.3.1-5**. These stream reaches were defined based on available information in the BLM Ely Proposed RMP/Final EIS (BLM 2007), in the GBNP Bio-Physical Report (NPS 2007), and in Elliott et al. (2006). From north to south, the perennial stream reaches include Trout Creek and several other perennial reaches that drain the Deep Creek Range; Deadman Creek, Deep Canyon Creek, Hampton Creek, Hendry's Creek, and Silver Creek in the Snake Range north of Highway 50; and Weaver Creek, Strawberry Creek, Mill Creek, Lehman Creek, Baker Creek, Snake Creek, Spring Creek, and Big Wash within or near the GBNP, as described by Elliott et al. (2006). Big Springs Creek/Lake Creek is a perennial stream in the southwest portion of Snake Valley that originates at Big Springs and terminates at Pruess Lake, with an estimated surface area of about 200 acres.

Hood and Rush (1965) identified 14 perennial streams in Snake Valley, including streams that discharge from Gandy Warm Springs and Big Spring and 12 others that originate in the high mountains of the Deep Creek and Snake ranges. Discharge measurement and observations included in Hood and Rush (1965) are summarized in **Table 3.3.1-5**.

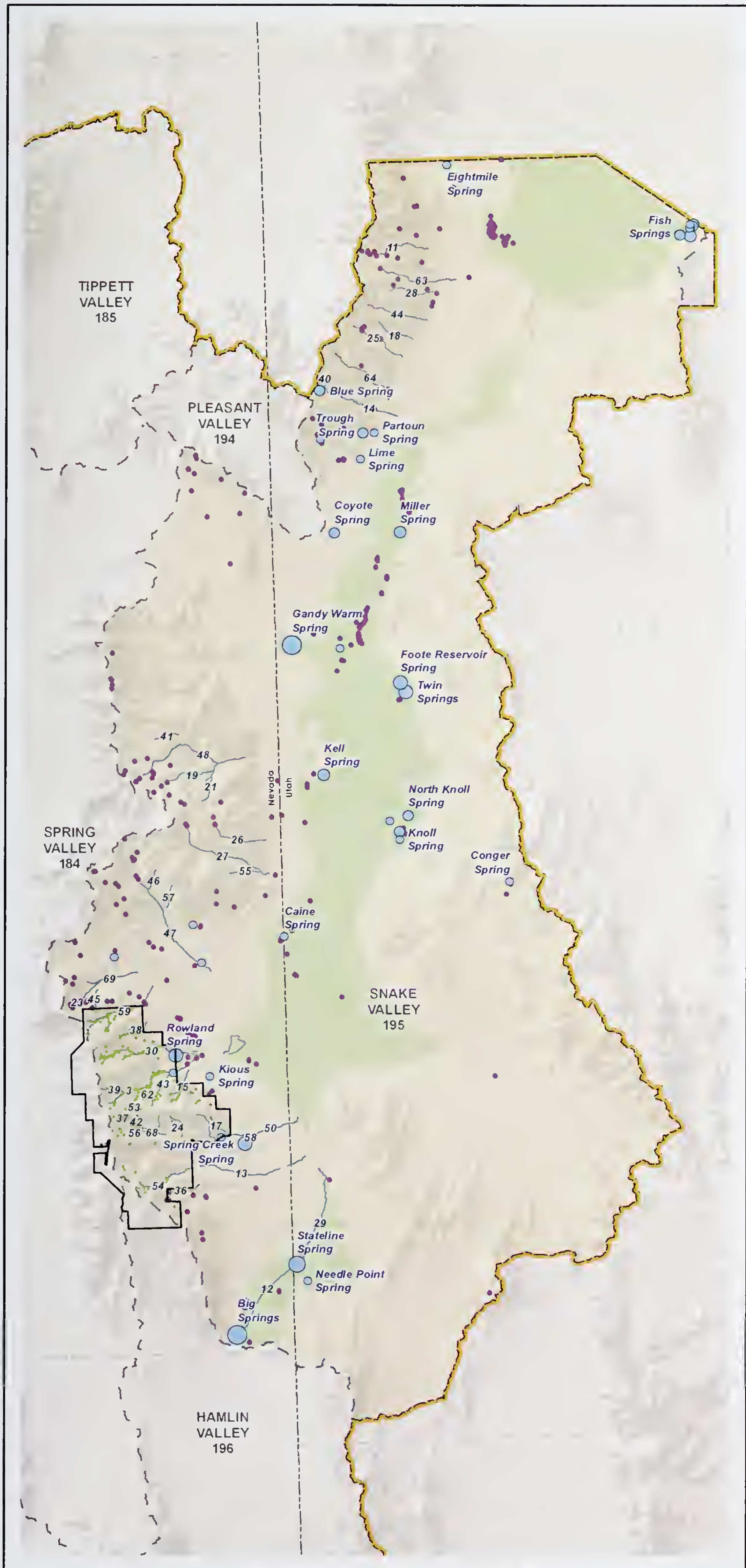
Mean annual discharge was estimated by the SNWA for 11 inventoried streams, and these results are presented in **Table 3.3.1-5** (SNWA 2008). Variation in mean annual discharge estimates on the same stream for different studies might be caused in part by differences in measurement location.

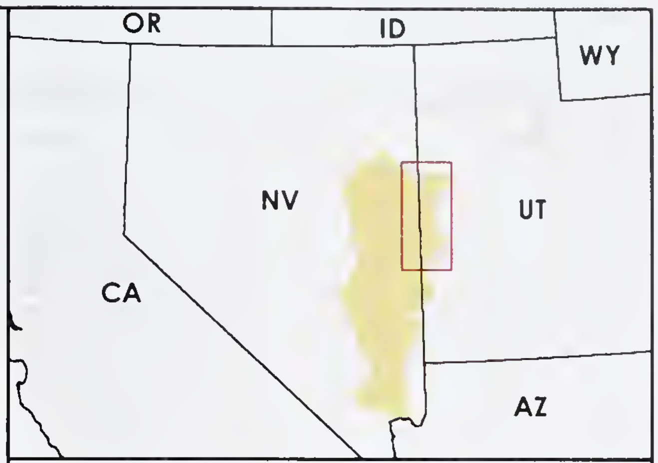
Great Basin National Park. Perennial streams identified within the GBNP are shown on **Figure 3.3.1-6**. The USGS and the NPS investigated streams originating in the GBNP and flowing into Snake Valley (Elliott et al. 2006; NPS 2007). The study characterized surface-water resources in the GBNP and included measuring the discharge of streams and springs and assessing the natural variability of their flow. Mean annual discharge was estimated for six stream gauges and Rowland Spring in Snake Valley. Snake Creek has four gauge sites and two of these sites had sufficient data to estimate a mean annual discharge.

Stream discharge characteristics reported in Elliott et al. (2006) are summarized in **Table 3.3.1-6**. This investigation included miscellaneous discharge measurements at different locations along the streams to further characterize variations and potential water sources along the channels. The results of the study indicated that substantial differences in discharge occur along the stream lengths and at different times of year. Multiple discharge measurements over short periods of time along Baker, Lehman, and Snake creeks indicate that these streams gain and lose water over relatively short stream reaches. These discharge fluctuations are attributed to the distribution of permeable and impermeable consolidated rocks that form the stream channels. Typically, higher values of discharge occur in the spring and summer months (June or July), and lower values occur in the fall (October). Lower flows in the fall typically are associated with higher specific conductance and lower temperatures (Elliott et al. 2006).

Water Resources in Caves. Elliott et al. (2006) identified an area within the GBNP where surface water resources likely are susceptible to groundwater withdrawal. Baker (2009) has identified 6 caves in these susceptibility areas that are in direct contact with the water table or surface water. These include Model Cave, Ice Cave, Wheeler's Deep Cave, and Systems Key Cave in the Baker Creek watershed. There is limited information to define the hydrology of these caves or determine the source of water that occurs within these caves.

Trip reports from spelunkers published during the 1950s and 1960s reported explorations of the Baker Creek Cave System. Bridgemon (1967) describes the Baker Creek Cave System as 15 caves that occur within the Pole Canyon Limestone. Wheeler's Deep Cave also is reported to have a perennial stream (Baker 2009). Model Cave is reported to be the most important cave within the Baker Creek Cave System and is reported to have one or more perennial streams (McLean 1965; Bridgemon 1967; Baker 2009). Lange (1954) describes slots in the floor of Model Cave that he states were formed by upward (or artesian) flow. However, he does not provide data to determine if these features were formed in the geologic past (i.e., under different hydrologic conditions) or were formed recently under present hydrologic conditions. If the latter were true, these features would suggest that artesian flow in the limestone is the





Legend

Inventoried Springs Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location[1]
- Perennial Stream Reach
- Evapotranspiration Area
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park

[1]These springs have not been field-verified (i.e. actual existence and flow characteristics are uncertain.)

#	Stream Name	#	Stream Name
3	Baker Creek	41	North Fork Smith Creek
11	Basin Creek	42	North Fork Snake Creek
12	Big Springs Creek	43	Pole Creek
13	Big Wash	44	Red Cedar Creek
14	Birch Creek	45	Sage Creek
15	Can Young Canyon	46	Second Fork Silver Creek
17	Cave Canyon Creek	47	Silver Creek
18	Cottonwood Creek	48	Smith Creek
19	Deadman Creek	50	Snake Creek
21	Deep Canyon Creek	53	South Fork Baker Creek
23	Grace Creek	54	South Fork Big Wash
24	Granite Basin Creek	55	South Fork Hendry's Creek
25	Granite Creek	56	South Fork Snake Creek
26	Hampton Creek	57	Spring Creek (Trib. to Silver Creek)
27	Hendry's Creek		
28	Indian Farm Creek	58	Spring Creek (Trib. to Snake Creek)
29	Lake Creek		
30	Lehman Creek	59	Strawberry Creek
36	Lexington Creek	62	Timber Creek
37	Middle Fork Snake Creek	63	Tom's Creek
38	Mill Creek	64	Trout Creek
39	North Fork Baker Creek	68	Upper Snake Creek
40	North Fork Birch Creek	69	Weaver Creek

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.1-5

Snake Valley Perennial Streams and Springs

0 5 10 15 20 25 Miles
0 5 10 15 20 25 Kilometers
1:800,000
N

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

Table 3.3.1-5 Mean Annual Stream Discharge Estimates for Selected Perennial Streams In Snake Valley

Stream	Location	Hood and Rush (1965)[1] cfs	Elliott et al. (2006) cfs	USGS (2007) cfs	SNWA (2008) cfs
Baker Creek	Southern Snake Range	8.53	9.08	NS	NS
Lehman Creek	Southern Snake Range	7.49	5.13	5.67	NS
Trout Creek	Deep Creek Range	4.34	NS	5.51	NS
Warm Creek	West Central Snake Valley	Inventory	NS	NS	NS
Big Springs Creek	Southern Snake Range	Inventory	NS	NS	NS
Big Wash	Southern Snake Range	Inventory	NS	NS	1.44
Snake Creek	Southern Snake Range	Inventory	2.70	NS	9.50
Silver Creek	Northern Snake Range	Inventory	NS	NS	5.10
Hendry's Creek	Northern Snake Range	Inventory	NS	NS	2.62
Birch Creek	Deep Creek Range	Inventory	NS	NS	4.39
Granite Creek	Deep Creek Range	Inventory	NS	5.12	NS
Cedar Creek	Deep Creek Range	Inventory	NS	NS	NS
Thomas Creek	Deep Creek Range	Inventory	NS	NS	NS
Basin Creek	Deep Creek Range	Inventory	NS	NS	NS
Indian Farm Creek	Deep Creek Range	NS	NS	NS	4.24
Smith Creek	Northern Snake Range	NS	NS	NS	4.66
Hampton Creek	Northern Snake Range	NS	NS	NS	0.728
Weaver Creek	Southern Snake Range	NS	NS	NS	0.383
Strawberry Creek	Southern Snake Range	NS	0.58	NS	1.46
Lexington Creek	Southern Snake Range	NS	NS	NS	0.226

[1]Inventory = Discharge measurement used for basin estimate provided in Hood and Rush (1965), but no mean annual discharge estimate was reported.
NS = Mean annual stream discharge estimates not surveyed by this study.

source of water in this cave. Preliminary results from ongoing hydrogeologic and water resource investigations at GBNP suggest that water resources in Model Cave may be interconnected with the alluvial basin-fill in Snake Valley (Prudic and Sweetkind 2012).

Ice Cave is reported to have a stream that is controlled by flow through a surface culvert directing water into the cave entrance (Baker 2009). Systems Key Cave is partially located beneath Baker Creek and has a small stream that originates in the ceiling, flows along the floor, and then disappears down a tight passage (Baker 2009). These descriptions suggest that water within Ice Cave and Systems Key Cave likely is due to the infiltration of surface runoff and not upward flow from the regional groundwater flow system. Uncertainty exists regarding the degree of hydraulic connection, if any, among water in these caves, the local aquifer, and aquifer(s) beneath Snake Valley, including how their degree of connection might vary seasonally and through wet and dry years.

Squirrel Springs Cave extends below the water table. The water table is reported to fluctuate and the cave experiences seasonal flooding (Baker 2009). These descriptions suggest that the water table observed in the cave likely is controlled in part by groundwater fluxuation and in part by seasonal precipitation patterns. Water Trough Cave is described as containing ponded water. Information regarding the likely source of water in Water Trough Cave is not available.

Overall, much uncertainty exists regarding hydraulic interconnection between these caves in the Pole Canyon limestone and the regional aquifer system that would be targeted for groundwater development in Snake Valley. As described in Section 3.0.3, Incomplete and Unavailable Information, USGS in conjunction with the NPS are conducting additional studies to address cave hydrology within GBNP.

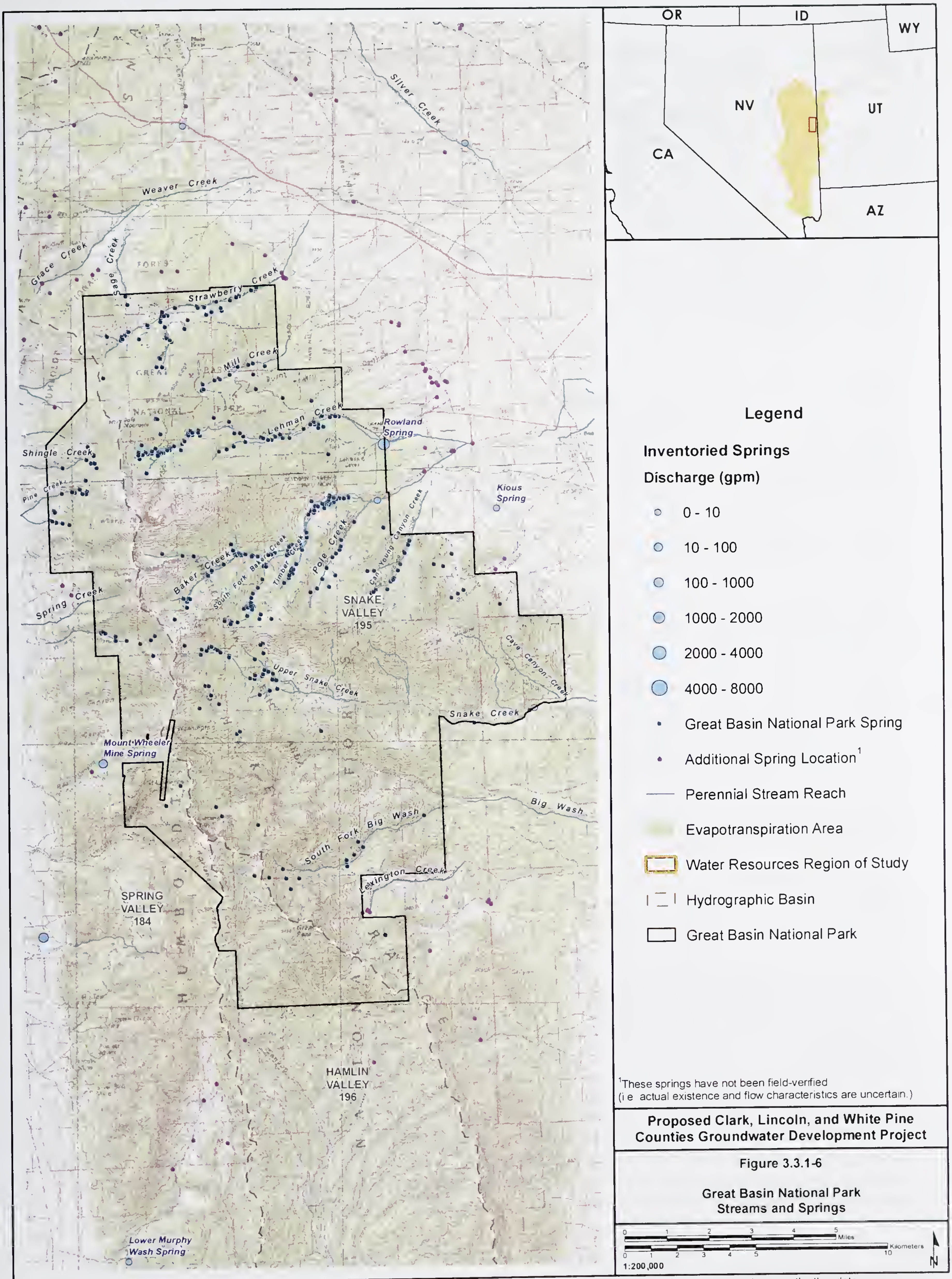


Figure 3.3.1-6

Great Basin National Park Streams and Springs

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

Table 3.3.1-6 Summary of Stream Characteristics in and near GBNP

Basin	Stream Name	Discharge Range (cfs)	Water Temperature Range (°F)	Specific Conductance Range (µS/cm)
Snake Valley	Strawberry Creek	0.12 to 3.18	45 to 63	52 to 153
Spring Valley	Shingle Creek	0.59 to 2.02	45 to 55	60 to 80
Snake Valley	Lehman Creek	0.49 to 11.7	45 to 68	30 to 152
Snake Valley	Baker Creek	0 to 8.07	43 to 65	28 to 107
Snake Valley	Snake Creek	0 to 15.5	45 to 59	76 to 375
Snake Valley	Big Wash	0 to 5.05	45 to 57	341 to 475

µS/cm = microSiemens per centimeter.
Source: Elliott et al. 2006.

Springs

Springs that were identified in Snake Valley are shown on **Figure 3.3.1-5**.

Available spring data include: 1) inventoried springs with flow measurements; 2) additional springs identified in GBNP; and 3) other unverified spring locations identified on topographic maps or included in the National Hydrographic Dataset.

Thirty-eight inventoried springs that have flow measurement data have been identified. The location, name, average flow, and data source for the inventoried springs are listed in **Table F3.3.1-1A** in **Appendix F3.3.1**.

GBNP Springs. The NPS has identified an additional 427 springs located in the GBNP (NPS 2007). Of these, 390 springs occur in Snake Valley in 13 watershed areas. The identified spring locations within the GBNP are shown in **Figure 3.3.1-6**. Information on these springs is summarized in **Table 3.3.1-7**, including the ranges of estimated discharge and the minimum and maximum reported field water quality results by watershed area. The location, watershed area, discharge method used, and estimated discharge range for the springs are listed in **Table F3.3.1-1B** in **Appendix F3.3.1**. The estimated spring discharge for springs is reported as a range in flow. The flow estimates were based on visual observations (305 springs), volumetric measurements (109 springs), and flow meter measurements (1 spring). No flow measurements were reported for 15 of these springs. The discharge and field water quality parameters were collected over a period from April through October 2003, April through October 2004, and July 2005.

Available information for Big Springs, Caine Springs, Gandy Warm Springs, Cave Springs, Rowland Springs, Spring Creek Spring, and Needle Point Springs is presented in **Table 3.3.1-8** and summarized in the following paragraphs.

Big Springs. Big Springs provides water for irrigation at Big Springs Ranch and then flows northeast into Big Springs Creek, which becomes Lake Creek east of the Utah-Nevada border, and finally flows into Pruess Lake 3 miles southeast of Garrison, Utah (SNWA 2008).

There are several springs emanating from the alluvium in the area and Big Springs has the largest discharge. Two unnamed spring complexes are located northeast of Big Springs, possibly along the same north-northeast trending fault that controls Big Springs. North and South Little Springs complexes are to the southeast of Big Springs. These springs are located along separate, but sub-parallel, north-northeast trending faults with varying vertical and horizontal surface displacement.

Discharge measurement location in the Big Springs area is important because of a number of diversions and because Big Spring Creek gains water before flowing into Lake Creek. The diversions at Big Springs include several portable pumps that divert water and a splitter box consisting of two weirs. The discharge for Big Springs (approximately 9 cfs [4,086 gpm]) is defined as the total measured below each of the two weirs (SNWA 2008). Additional springs that contribute flow downstream of the weirs increased the discharge to between 15 and 19 cfs (6,730 and 8,530 gpm) from June through November 1972 (Walker 1972).

Table 3.3.1-7 Summary of Springs Identified in GBNP

Hydrographic Basin	Watershed	Springs Inventoried	Number of Springs by Range of Estimated discharge (gpm)[1]			Water Temp °F		Specific Conductance (µS/cm)		pH (units)	
			0-10	10-100	100-1000	min	max	min	max	min	max
Snake Valley	Baker Creek	148	103	31	10	34	65	12.7	303	3	8.4
	Burnt Mill Creek	4	4			45	50	89.9	161.2	6.4	7.3
	Can Young Canyon	19	12	5		37	55	40.1	426.4	6.1	7.62
	Decathon Creek	1				63	63	399	399	7.1	7.1
	Lehman Creek	79	46	26	3	36	61	15.4	241.6	4.97	7.59
	Lexington Creek	1				56	56	630	630	7.67	7.67
	Mill Creek	13	9	3		40	52	19.1	290.8	6.2	7.5
	North Fork Big Wash	6	2	2	2	37	50	193	420.7	7.5	8
	Snake Creek	38	24	11	3	33	59	30.9	280.6	5.7	7.8
	South Fork Big Wash	12	6	3	3	43	47	169	414.4	7.47	8.5
	Strawberry Creek	59	39	11	9	39	54	38.4	324.5	6	7.8
	Weaver Creek	2	2			45	54	180	185.6	6.96	7.06
	Young Canyon	8	6	2		45	55	31.3	457.2	6.41	7.3
Spring Valley	Lincoln Canyon	2				37	37	281	362.5	7.7	8
	Pine Creek/Ridge Creek	15	13	2		39	52	25.7	101.5	6.4	10.2
	Shingle Creek	9	5	3	1	39	48	25.7	94.8	6.5	9.43
	Williams Canyon Creek	11	3	3	2	35	45	17	38.3	6.28	7.3
Total springs		427	274	102	33						

[1] Flow estimates based on visual observations (305 springs), volumetric measurements (109 springs), and flow meter measurements (1 spring).

[2] Temperature converted from °C and rounded to whole number.

Table 3.3.1-8 Selected Spring Discharge Measurements in Snake Valley

Spring Name	UTM[1] Easting (m)	UTM[1] Northing (m)	Elevation (feet amsl)	Mean Discharge (gpm) (Number of measurements)	Mean Discharge (cfs) (Number of measurements)	Temperature Range (°F) (Number of measurements)
Big Springs	749,476	4,287,141	5,572	4,267 (23)	9.5 (23)	61–64 (2)
Caine Spring	755,138	4,336,186	5,032	5.0 (1)	0.010 (1)	58 (1)
Gandy Warm Springs	756,007	4,371,984	5,156	7,252 (28)	16.2 (28)	76–82 (10)
Rowland Spring	741,778	4,321,448	6,580	1,032 (continuous)	2.2 (continuous)	48–50 (3)
Cave Springs	739,312	4,322,110	7,270	45 (daily 2004-2006)	0.1 (daily 2004-2006)	56 (356)
Spring Creek Spring	750,345	4,310,673	6,123	1,205 (2)	2.7 (2)	55 (1)
Needle Point Springs	758,117	4,293,839	5,460	see text	see text	Not available

[1]Coordinates are in UTM Zone 11 and North American Datum of 1983.

[2] Temperature converted from °C and rounded to whole number.

UTM = Universal Transverse Mercator; m = meter.

Sources: SNWA 2008; Elliott et al. 2006; Summers 2012; NPS 2007.

Caine Spring. Caine Spring is approximately 10 miles north of Baker, Nevada. The spring discharges from two seeps. One of the seeps is enhanced by artesian flow from a 3-inch-diameter well. The total discharge was estimated at 0.011 cfs, or 5 gpm (SNWA 2008).

Gandy Warm Springs. Gandy Warm Springs is a major surface-water feature and a popular recreation area with local Snake Valley residents. Swimmers are able to swim in the main discharge channel and into the large solution cavern where the spring discharges from Paleozoic carbonate rocks (SNWA 2008). The spring is located approximately 0.5 mile east of the Nevada state line and 3 miles west of Gandy, Utah. Spring flow is diverted to the south and the east towards Gandy, where it supports agriculture.

Water discharges from several orifices, which coincide with the intersection of fault and fracture zones perpendicular to a major northeast-southwest trending, normal fault. Discharge measurements of 8.0 cfs in November 1964 (Hood and Rush 1965) and 8.42 cfs (3,780 gpm) in June 2004 are anomalously low (SNWA 2008). These measurements appear to have missed a large volume of flow and are not included in the mean discharge estimates (16.8 cfs [7,562 gpm]) in **Table 3.3.1-8**.

Rowland Spring. Rowland Spring is located at the eastern boundary of the park. The spring discharges from alluvium and glacial sediments (Elliott et al. 2006). Discharge was monitored at Rowland Spring, a tributary to Lehman Creek, as part of the USGS study at GBNP. Rowland Spring is one of the major springs of the South Snake Range. Average annual discharge of Rowland Spring is 2.3 cfs based on 2 years of measurements (Elliott et al. 2006). The source of water for Rowland Springs is uncertain. Elliott et al. (2006) suggest that two possible sources for the discharge are eastward groundwater flow through the Pole Canyon Limestone in the Lehman Creek Drainage or northeastward groundwater flow through carbonate rocks in the Baker Creek Drainage.

Cave Springs. Cave Springs is the water supply for the GBNP operational facilities. Mean annual discharge for 2004 through 2006 was 0.1 cfs (NPS 2007). Cave Springs consists of several small springs that discharge from alluvial and glacial deposits near the contact between quartzite and granite. A recent USGS investigation of Cave Springs (Prudic and Glancy 2009) investigated the source of water to the spring to evaluate the potential for depletion from groundwater development in Snake Valley. The results of the study indicate that the source of the water in the spring is primarily from winter precipitation that discharges from quartzite on the upstream contact between quartzite and granite. The study also indicated the potential for spring depletion from groundwater pumping in Snake Valley is less than if carbonate rocks were present beneath the springs, as carbonate rocks would provide a better connection with alluvial aquifers in the valley.

Spring Creek Spring. Spring Creek Spring is located near the eastern boundary of the GBNP and is a tributary to Snake Creek. Spring Creek Spring discharges from the Fishtown and Lakehaven Dolomites at a fault contact with alluvial and glacial tertiary age sediments (Elliott et al. 2006). The spring discharge sustains perennial flows in Spring Creek, a tributary to Snake Creek. Most of the flow in Spring Creek is diverted into the NDOW's Spring Creek Rearing Station, a fish culture facility, with return flows entering Snake Creek downstream of the rearing station. Discharge of Spring Creek just upstream of the fish-rearing ponds was 2.02 cfs (906.6 gpm) in June 2003 and 1.78 cfs (798.9 gpm) in October 2003 (Elliott et al. 2006), indicating a small (approximately 12 percent) reduction in flow between June and October.

Needle Point Springs. Needle Point Springs is located near the southeast margin of Snake Valley Utah near the Utah-Nevada state line, approximately 5 miles northeast of Big Springs in Nevada. The spring occurs in an area of basin alluvium, which is inferred to be underlain by fractured dolomite that outcrops at the surface in the Needle Point Mountain south of the spring (Summers 2012). The following summary is based on information compiled in an unpublished BLM report on Needle Point Springs, prepared by BLM Senior Hydrogeologist Paul Summers (Summers 2012).

Spring discharge has been documented as early as 1939 by the Civilian Conservation Corps work crew who performed improvements at the spring. The Civilian Conservation Corps camp engineers documented flow from the spring at 6 gpm on September 22, 1939. The spring was developed by digging approximately 10 feet into the alluvium and installing a 6-foot-diameter circular steel tank, which was perforated to allow water to flow into the tank. An outlet pipe feeds water to a nearby trough and a surface pond, for easy access by stock and wild horses. Water at the spring has been used continuously since 1939 for watering stock and wild horses. Prior to 1939, anecdotal reports of spring use suggest that water at this spring was used for several years by sheep and cattle operations in the area.

The following flow measurements were recorded by BLM staff between 1992 and 2001:

- Sept. 24, 1992, 6 gpm;
- Feb. 16, 1994, 7 gpm;
- July 11, 1997, 7 gpm;
- June 6, 2001, 2.4 gpm;
- Late June, 2001: water level dropped below outlet pipe of the spring box and the flow to the watering trough and surface pond ceased; and
- July 2001 to March 2012: the water level has remained below the spring outlet; no flow to watering troughs.

After flow ceased in June 2001, the BLM installed a 2-inch-diameter monitoring well (piezometers) to measure the elevation of the water table next to the spring. The water level in the spring head-box and the monitoring well coincide with each other so that the monitoring well accurately represents the water level at the spring. The depth to water has been monitored by the BLM staff on a regular basis since August 28, 2001. The results of the monitoring indicate that there has been no observable flow at the spring between the periods of record (available at the time of this evaluation) that extends from June 6, 2001, to December 1, 2010. The water table has declined by as much as 7.74 feet, which occurred on September 30, 2010. The water table exhibits rapid and steep seasonal declines, corresponding to irrigation season cycles, when center pivot irrigation pumps located approximately 1.25 to 1.5 miles away are turned on. Water levels decline for 5 to 6 months each year during the irrigation season (typically starting in late March to early May and ending in late October), and partially recover over the remainder of the annual cycle, when irrigation pumps are shut off. The water level recovery after each cycle of pumping does not return to the pre-pumping water level prior to the start of the previous year's pumping cycle. Thus, the water levels at the end of each irrigation season have continuously trended downward, resulting in a continuously lowered water level year over year (Summers 2012).

Cave Valley

Figure 3.3.1-7 shows the perennial water resources in Cave Valley. This valley is a comparatively small basin, with a topographically closed, surface-drainage system. This system is defined by the southern Egan Range on the west and the southern Schell Creek Range on the east and is bounded in the south where these two ranges merge. The wash varies down-valley from ephemeral to intermittent because of runoff from tributaries such as Haggerty Wash and Big Springs Wash. Ditches, small embankments, and several small stock ponds are located along Cave Valley Wash. Cave Valley Wash dissipates southward into the valley floor sediments. No discharge measurements are known to exist for these streams.

<u>Springs</u>

Springs that were identified within the Cave Valley hydrographic basin are shown in **Figure 3.3.1-7**. Four inventoried springs (**Table F3.3.1-1A** located in **Appendix F3.3.1**) and 44 other springs were identified in the basin.

The two inventoried springs (Cave and Sidehill springs) investigated by SNWA personnel (SNWA 2008) are described below. Most of the other mapped springs occur in higher elevation areas in the northern part of the valley.

Discharge and temperature data for Cave and Sidehill springs are presented in **Table 3.3.1-9**. Cave Spring is located on the eastern side of the valley and discharges from Cambrian Pole Canyon limestone. The spring discharge flows into a small creek incised 3 to 4 feet into the alluvium. Discharge at Cave Spring was measured three times during separate field sessions in June, July, and September of 2004 (SNWA 2008). Spring discharge was observed to decrease during the summer months and the spring was observed to be dry in September. This variable discharge and the cold temperature of the water suggest that this spring is fed solely by local precipitation (SNWA 2008).

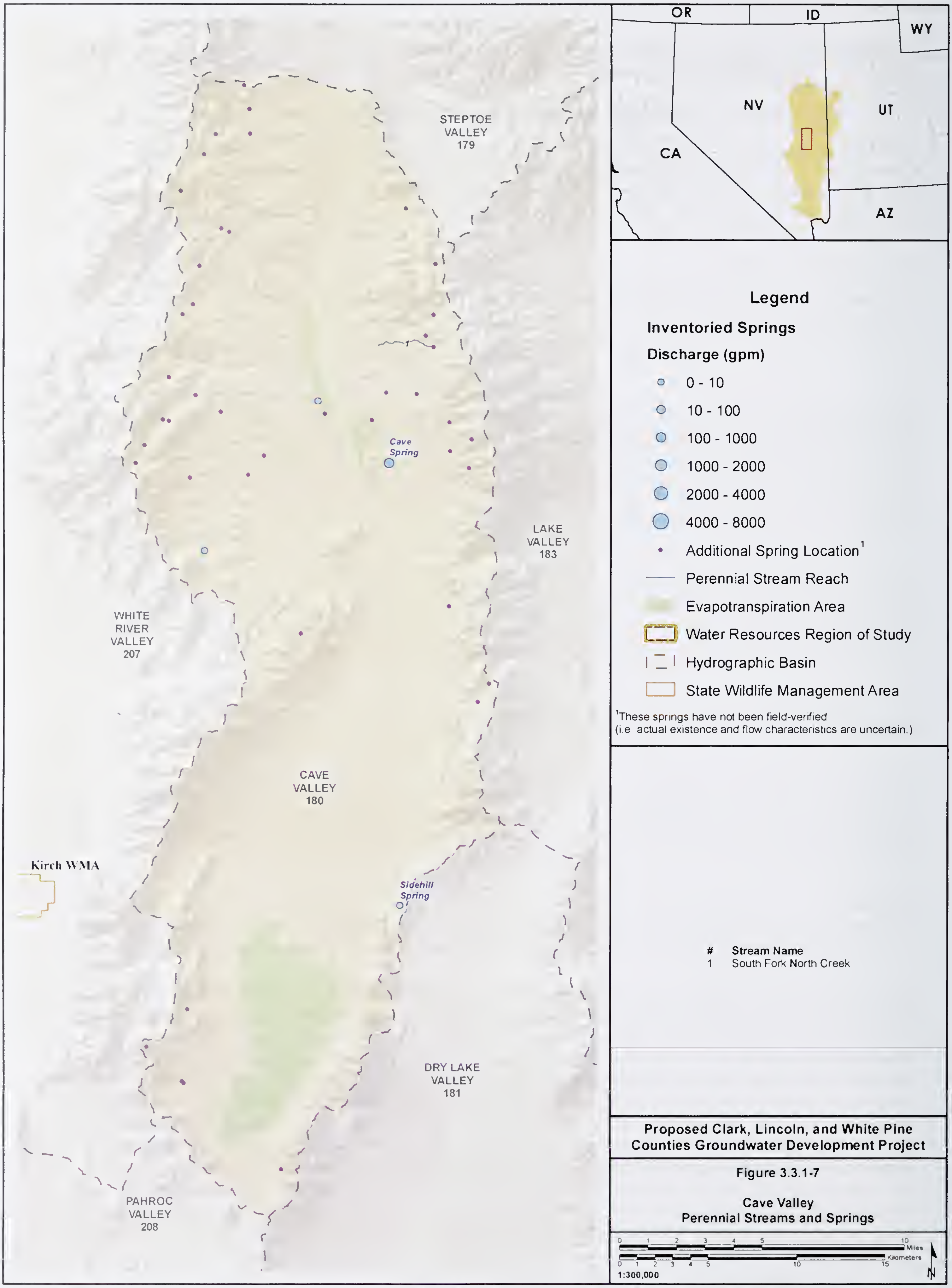


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Figure 3.3.1-7

Cave Valley
Perennial Streams and Springs

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

Table 3.3.1-9 Springs with Discharge Measurements in Cave Valley

Spring Name	UTM Easting[1] (m)	UTM Northing[1] (m)	Elevation[2] (feet amsl)	Mean Discharge, (gpm) (Number of Measurements)	Mean Discharge (cfs) (Number of Measurements)	Temperature Range (°C) (Number of Measurements)
Cave Spring	691,760	4,279,249	6,488	211 (11)	0.47 (11)	11.6 - 13 (5)
Sidehill Spring	692,407	4,254,280	6,527	1.84 (2)	0.003 (2)	15 - 17 (2)

[1] Coordinates are in UTM Zone 11 and North American Datum of 1983.
[2] Elevations are in North American Vertical Datum of 1988.
Source: SNWA 2008.

Sidehill Spring is located on the east side of Cave Valley and discharges from volcanic tuffs. Two reliable discharge measurements are available; they indicate an average flow of 0.006 cfs, or 1.8 gpm (SNWA 2008). The area around the spring has reportedly been disturbed by heavy equipment and other surface disturbances are present (SNWA 2008). The spring discharge is conveyed to a large livestock tank on the valley floor.

Dry Lake Valley

Figure 3.3.1-8 shows perennial water resources in Dry Lake Valley. Dry Lake Valley is bounded on the west by the North Pahroc Range and on the east by several smaller or more-localized low-elevation ranges, including the Fly Springs and Burnt Springs ranges. Dry Lake merges to the south with Delamar Valley and forms a single structural trough (Eakin 1963). Coyote Wash is the main south-trending channel in the basin. It is ephemeral and forms the axis of the valley floor. Coyote Wash has a large number of smaller, ephemeral tributaries that drain dissected fan piedmonts on either side of the valley. There are no perennial streams in Dry Lake Valley and no discharge measurements are known to exist.

Springs

Springs identified within the Dry Lake Valley hydrographic basin are shown in **Figure 3.3.1-8**. Seventeen inventoried springs and 95 other springs were identified in the basin. The location, name, average flow, and data source for the inventoried springs are listed in **Table F3.3.1-1A** in **Appendix F3.3.1**. A majority of these springs are at higher elevations.

Meloy, Bailey, Littlefield, and Coyote springs were investigated by the SNWA as summarized in **Table 3.3.1-10** and described in the following paragraphs.

Table 3.3.1-10 Springs with Discharge Measurements in Dry Lake Valley

Spring Name	UTM Easting[1] (m)	UTM Northing[1] (m)	Elevation[2] (feet amsl)	Mean Discharge (gpm) (Number of Measurements)	Mean Discharge (cfs) (Number of Measurements)	Temperature Range (°C) (Number of Measurements)
Meloy Spring	700,888	4,236,201	6,174	49.0 (3)	0.11 (3)	19.3 (1)
Bailey Spring	699,080	4,227,795	6,086	1.80 (3)	0.004 (3)	13.0 (1)
Littlefield Spring	701,112	4,233,949	6,146	27.1 (3)	0.06 (3)	15 - 17.9 (2)
Coyote Spring	687,693	4,211,513	5,220	1.32 (5)	0.003 (5)	18.0 (2)

[1] Coordinates are in UTM Zone 11 and North American Datum of 1983.
[2] Elevations are in North American Vertical Datum of 1988.
Source: SNWA 2008.

Meloy Spring discharges from the base of small scarp in Tertiary volcanic rocks. During a 2004 field visit, the spring was inaccessible because of wild rose bushes, so no measurement was taken. In May 1980, the spring's discharge was measured at 82 gpm. In 1997, the discharge was estimated at 0.1 cfs (45 gpm) (SNWA 2008). Livestock and wildlife currently use the spring.

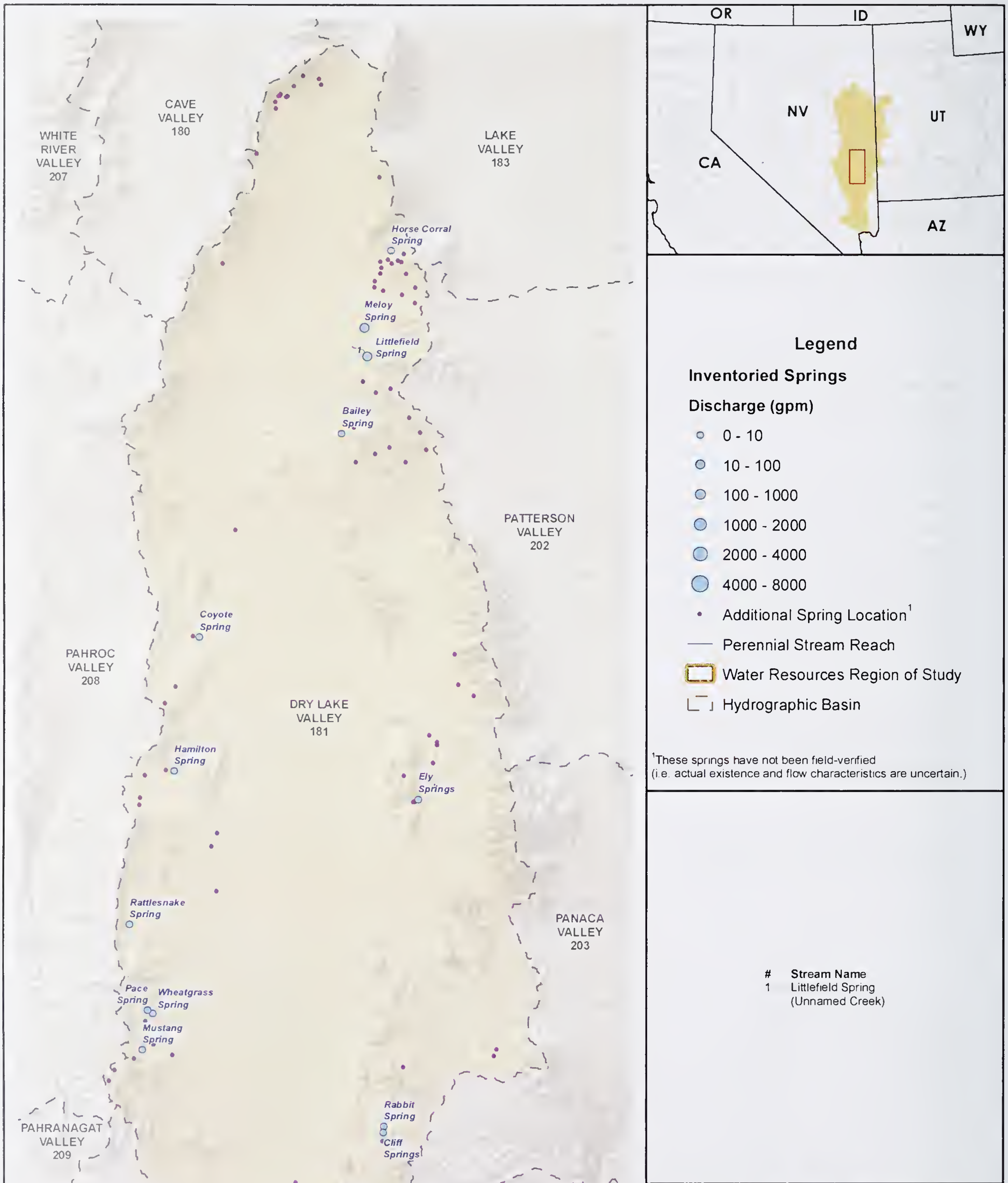

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Figure 3.3.1-8

Dry Lake Valley
Perennial Streams and Springs

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Bailey Spring is located near a small abandoned homestead and the spring area has been excavated. The spring discharges from Tertiary volcanic rocks along a small fault. At the time of a field visit in June 2004, wildlife was the only observable water user (SNWA 2008). The three available discharge measurements were obtained in 1912, 1980, and 2004.

Littlefield Spring discharges from the alluvium near an outcrop of volcanic rock. The mean of three discharge measurements is 27.1 gpm; this value is skewed by an anomalously high discharge of 59.7 gpm measured on July 25, 2005 (SNWA 2008).

Coyote Spring discharges from the base of a scarp in volcanic rocks. Discharge measurements date to 1912 and the average measured flow is 1.33 gpm. Modifications, including a large concrete livestock tank, have been made to the spring, but the spring currently is not in use (SNWA 2008).

Delamar Valley

Figure 3.3.1-9 presents perennial water resources in Delamar Valley. This valley is a topographically-closed basin, bounded on the east by the Delamar Mountains and on the west by the Pahroc Range. The unnamed ephemeral wash that forms the valley axis generally ranges in width from 600 to 1,200 feet. The wash might be inundated during and shortly after severe storms. Knoll Pond Reservoir is a small ephemeral water body within the northern part of the exploratory area in the center of the valley. At the southern end of the valley, Delamar Lake and the associated wash along the valley floor form a much-larger playa area subject to shallow flooding during and shortly after severe storms. The playa elevation is about 4,538 feet. Several ephemeral washes, including Cottonwood Wash, Monkey Wrench Wash, Delamar Wash, Jumbo Wash, and Big Lime Wash, drain westward from the mountains into the basin. All of these distribute runoff across alluvial fans. There are no perennial streams in Delamar Valley and no discharge measurements are known to exist.

Springs

Springs that were identified within the Delamar Valley hydrographic basin are shown in **Figure 3.3.1-9**. One spring (Grassy Spring) was investigated and documented by SNWA (**Table 3.3.1-11**); 2 springs were identified in the USGS National Water Information System and DRI databases, and the remaining 28 springs were identified from additional location only datasets and topographic maps. The majority of the springs occur at higher elevations on the eastern side of the valley.

Table 3.3.1-11 Springs with Discharge Measurements in Delamar Valley

Spring Name	UTM Easting[1] (m)	UTM Northing[1] (m)	Elevation[2] (feet amsl)	Mean Discharge (gpm) (Number of Measurements)	Mean Discharge (cfs) (Number of Measurements)	Temperature Range (°C) (Number of Measurements)
Grassy Spring	695,124	4,157,193	5,786	4.62 (4)	0.26 (4)	11–21.2 (3)

[1] Coordinates are in UTM Zone 11 and North American Datum of 1983.

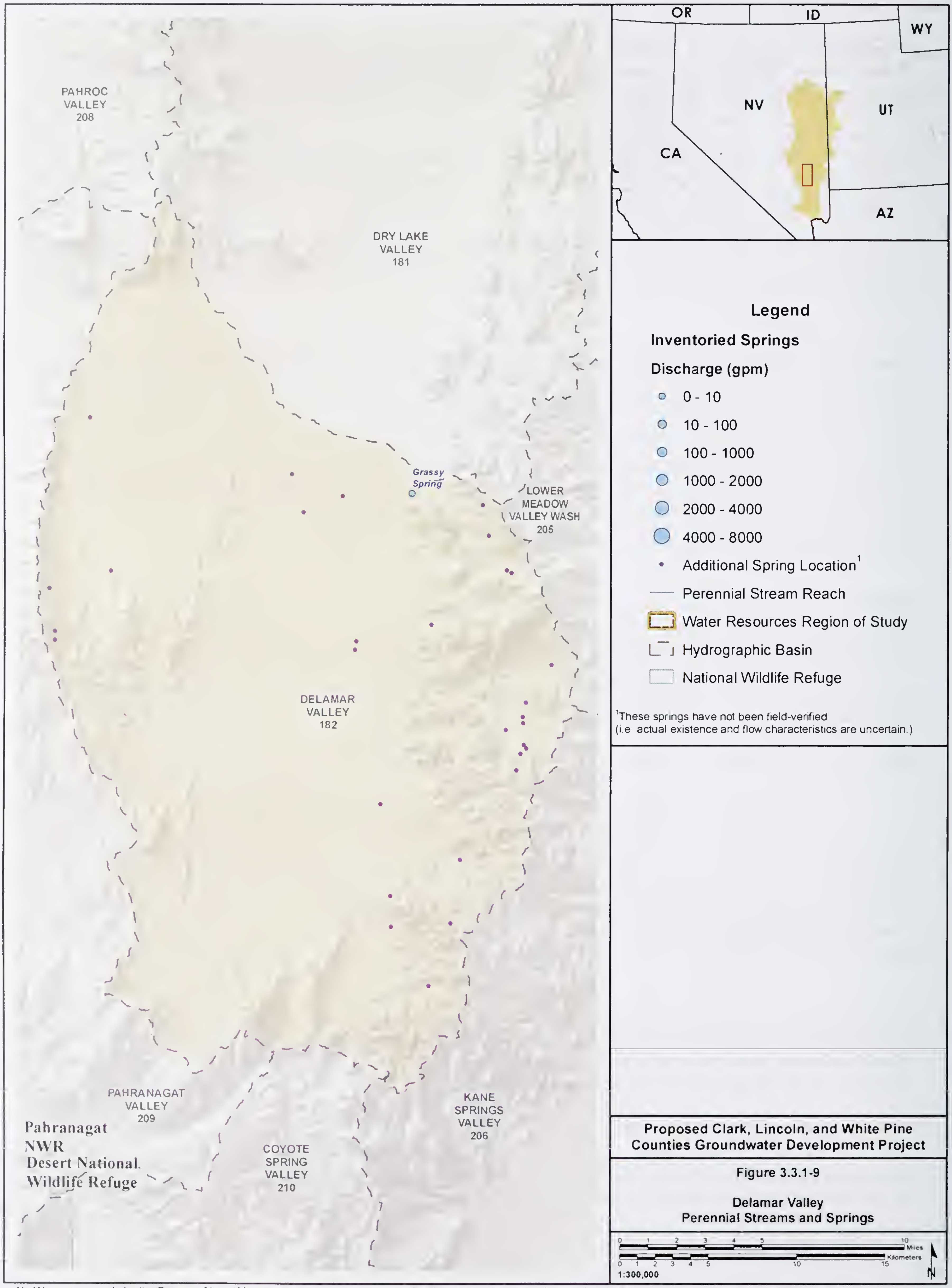
[2] Elevations are in North American Vertical Datum of 1988.

Source: SNWA 2008.

Information on Grassy Spring documented by the SNWA (2008) is summarized in **Table 3.3.1-11**. Grassy Spring is located along the western flank of the Delamar Mountains and supplies water to livestock. The spring discharges from alluvial sediments, near contact between the sediments and volcanic rocks (SNWA 2008). The mean discharge of four measurements is 4.62 gpm and the lowest flow recorded was 0.5 gpm on June 2, 2004.

3.3.1.5 Groundwater Resources

This section includes a description of the hydrogeologic conditions, groundwater elevations, and water balance components for the region of study. Baseline information for the groundwater resources and hydrogeologic conditions in the region of study is derived in part from the project baseline characterization report (SNWA 2008). Other



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.1-9

Delamar Valley Perennial Streams and Springs

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

important information that was used to define these baseline conditions includes the recently completed the USGS BARCAS report (Welch et al. 2007) and various other USGS reports completed as part of the Regional Aquifer System Analysis Program for the Great Basin Region (including Harrill et al. 1988; Harrill and Prudic 1998; Plume and Carlton 1988; Prudic et al. 1995; Thomas and Dettinger 1996; Plume 1996).

Hydrogeologic Conditions

Lithologic refers to the composition of rock formations.

Recharge, storage, movement, and discharge of groundwater are dependent in part on the regional geologic conditions and the topography. The general stratigraphic and structural framework of the region of study is described in Section 3.2, Geologic Resources. As described in that section, the geology across the region of study is both stratigraphically and structurally complex. To characterize the groundwater conditions in the area, the geologic formations are grouped into 12 hydrogeologic units (HGUs) (SNWA 2008). The HGUs were developed by grouping geologic map units with similar lithologic properties and inferred ability to transmit water. The HGUs range from Precambrian to Holocene in age. The general distribution of these units is presented in the generalized hydrogeologic map (**Figure 3.3.1-10**), and their physical characteristics are summarized in **Table 3.3.1-12**. Major structural features in the region are illustrated on **Figure 3.3.1-11**; generalized cross-sections at representative locations are presented in **Appendix F3.3.3**.

The 12 HGUs include two distinct types of materials: fractured rock (carbonate, siliceous, intrusive, volcanic, and metamorphic), and unconsolidated to poorly-consolidated sediments (alluvial and basin-fill deposits). In the bedrock units, recharge, storage, flow, and discharge of groundwater primarily are controlled by the secondary features (fractures, faults, and solution cavities) that have enhanced the porosity and permeability of the rock. In the unconsolidated to poorly-consolidated sediments, the groundwater is stored and transmitted through interconnected pores within the sediments.

Regional Aquifer Systems

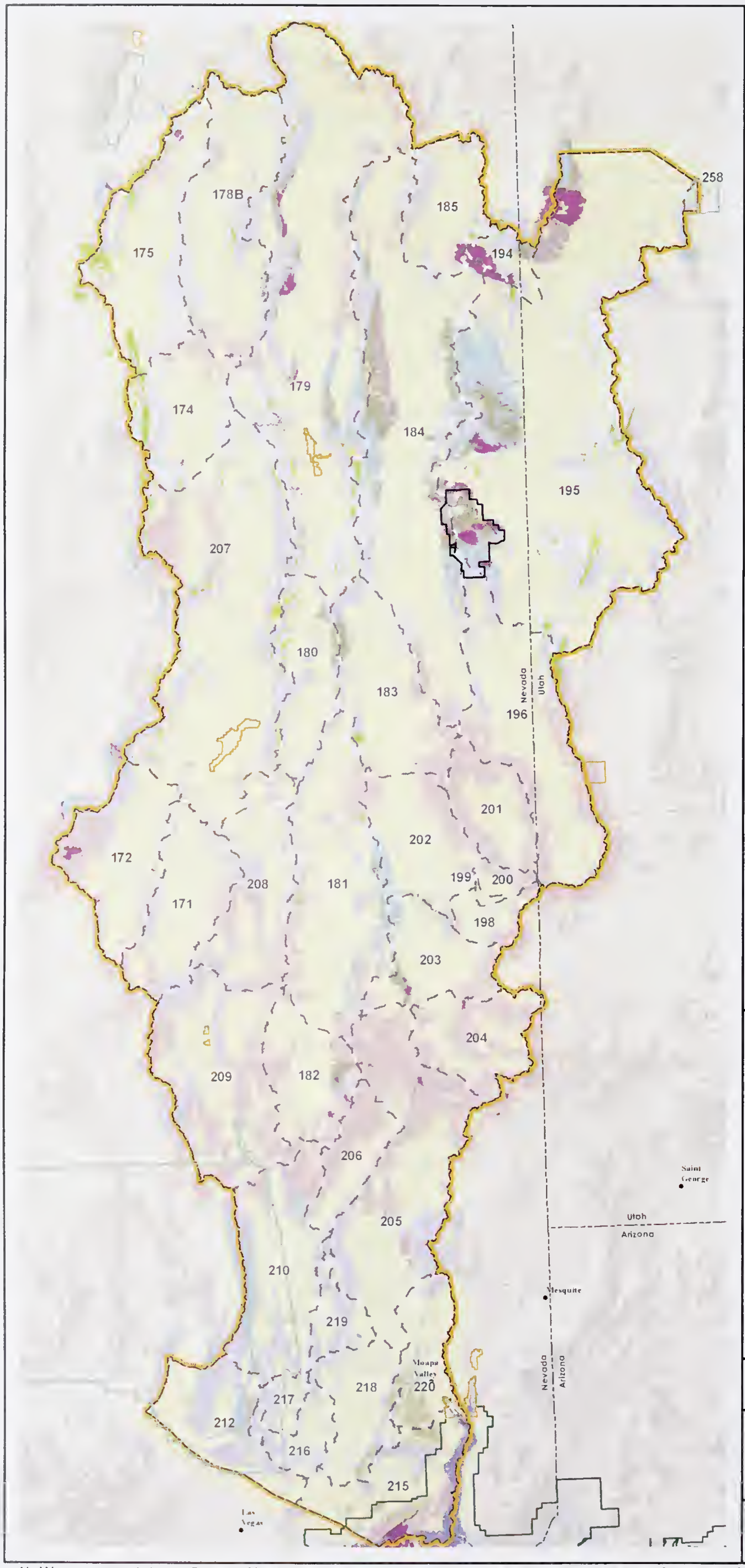
Aquitards are geologic strata (i.e., beds) that act as impediments to flow between aquifers.

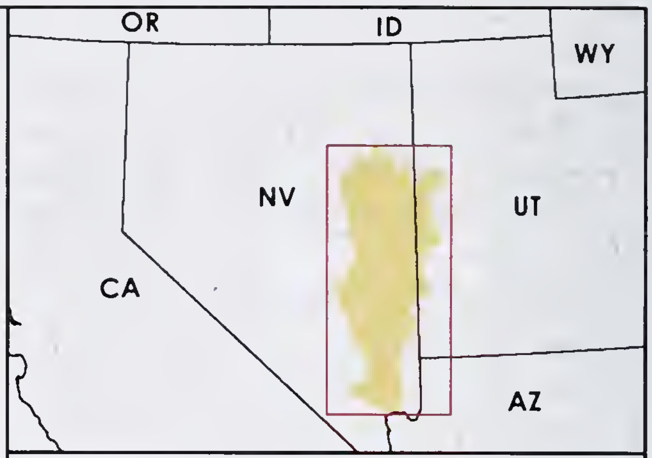
Two principal aquifer systems—the carbonate-rock aquifer system and basin-fill aquifer system—occur in the region of study. The volcanic rock unit might be an important aquifer in particular areas, depending on actual rock types and fracture characteristics. The volcanic rocks also might be regional conduits for flow, where they have sufficient permeability and are in contact with the carbonate or basin-fill aquifer systems. The other rocks are believed to act as impediments (i.e., aquitards) to flow. These aquitards divide the carbonate rocks into an upper and lower flow system and serve as boundaries to flow.

Carbonate-Rock Aquifer System

Clastic pertains to rock or sediment that is composed primarily of broken fragments that have been transported some distance from their origin.

The carbonate-rock aquifer system is regionally extensive and underlies the eastern two-thirds of the Great Basin (Plume 1996). This system is an important conduit for recharge and interbasin groundwater flow (Welch et al. 2007). The carbonate-rock aquifer system consists of lower and upper carbonate-rock aquifers that are stratigraphically separated by low-permeability, fine-grained clastic rocks that restrict vertical flow between the two aquifers (Plume and Carlton 1988; Winograd and Thordarson 1975; Welch et al. 2007). The lower carbonate-rock aquifer consists of the Cambrian carbonate rocks and Mississippian to Ordovician carbonate rock HGUs (SNWA 2008). The lower carbonate-rock aquifer generally is present over most of the region of study, except within caldera complexes or areas underlain by igneous plutons. The Mississippian Siliciclastic Unit includes abundant, shaley, predominantly fine-grained rocks (including the Chainman Shale) with low permeability; these rocks act as a confining bed for vertical flow between the lower and upper carbonate-rock aquifer. The upper carbonate-rock aquifer is composed of a sequence of Pennsylvanian to Permian age carbonate rocks with minor clastic rocks. Both the Mississippian Siliciclastic Unit and upper carbonate-rock aquifer occur over broad areas in the northern and central regions of the region of study. However, these units have been removed by erosion and generally are not present in the southern portion of the region of study (i.e., south of Pahroc Valley).





Legend

Hydro-Geologic Formations

- QTs, Quaternary-Tertiary sediments
- QTb, Quaternary and Tertiary basalts
- Tv, Tertiary volcanic rocks
- Tos, Tertiary older sediments
- TJi, Tertiary-Jurassic intrusive rocks
- KTRs, Cretaceous-Triassic clastic rocks
- PPPc, Permian-Pennsylvanian carbonate rocks
- Ms, Mississippian clastic rocks
- MOc, Mississippian-Ordovician carbonate rocks
- Cc, Cambrian carbonate rocks
- CpCs, Cambrian-Precambrian clastic rocks
- pCm, Precambrian metamorphic rocks
- Open Water
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.1-10

Hydro-Geologic Formations

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
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Table 3.3.1-12 HGUs in the Study Area

HGU	Map Symbol	Geologic Map Units[1] (Geologic Age)	Equivalent HGU in BARCAS (Welch et al. 2007)	General Occurrence and Range of Thickness	Major Lithologic Characteristics	Generalized Aquifer Characteristics
Quaternary and Tertiary Sediments	QTs	Ts2, Ts3, Ts4, QTa	Fine-grained Younger Sedimentary HGU; Coarse-grained Younger Sedimentary HGU; Older Sedimentary HGU	Occurs below the valley bottoms in the hydrographic basins. Average thickness in basins ranges from 1,000 to 13,000 feet.	Predominantly basin-fill deposits (QTa) consisting gravel, sand, silt, and clay; unconsolidated near surface and becomes moderately consolidated at depth. Locally tuffaceous and contains minor limestone. Unit also includes Tertiary sedimentary rocks (Ts2, Ts3, and Ts4) that underlie basin-fill sediments that consist of sandstone, conglomerate, and minor limestone and tuff beds.	Basin-fill sediments are considered significant aquifers in hydrographic basins; unit includes beds of less permeable finer-grained sediment and volcanic ash that act as local confining beds within the sequence. Older consolidated rocks (Ts2, Ts3, and Ts4) have significantly lower permeabilities than the overlying basin-fill sediments.
Quaternary and Tertiary Basalt	QTb	QTb	Volcanic Flow Unit	Localized, typically less than 200 feet thick.	Basalt flows; generally thin and localized.	Basalt flows typically contain closely spaced joints and breccia zones that are highly permeable; however, because of limited thickness and distribution in the region of study, this unit is not a significant regional aquifer.
Tertiary Volcanic Rocks	Tv	Tmb, Ta1, Ta2, Ta3, Ta4, Tr1, Tr2, Tr3, Tr4, Tt1, Tt2, Tt3 and Tt4	Volcanic Flow Unit; Volcanic Tuff Unit	Outside caldera complexes the unit typically ranges from 1,000 to 4,000; within the calderas the unit generally is greater than 10,000 thick.	Volcanic rock units that include poorly to densely welded ash flow tuffs with interbedded air fall tuffs; rhyolite, andesite, and dacitic lava flows, with flow breccias and mudflow breccias, and megabreccia associated with caldera development.	Volcanic rocks generally are moderately permeable; depending upon jointing and fracture characteristics, the rocks may be significant aquifers.
Older Tertiary Sediments	Tos	Ts1	Older Sedimentary HGU	Localized occurrence; thickness ranges from 600 to 3,000 feet.	Mostly nonresistant sandstone, mudstone, conglomerate and minor lacustrine limestone that locally underlies Tv.	Overall permeability probably similar to the consolidated rocks included in the QTs unit. Not a significant regional aquifer due to limited lateral extent and porosity and permeability.

Table 3.3.1-12 HGUs in the Study Area (Continued)

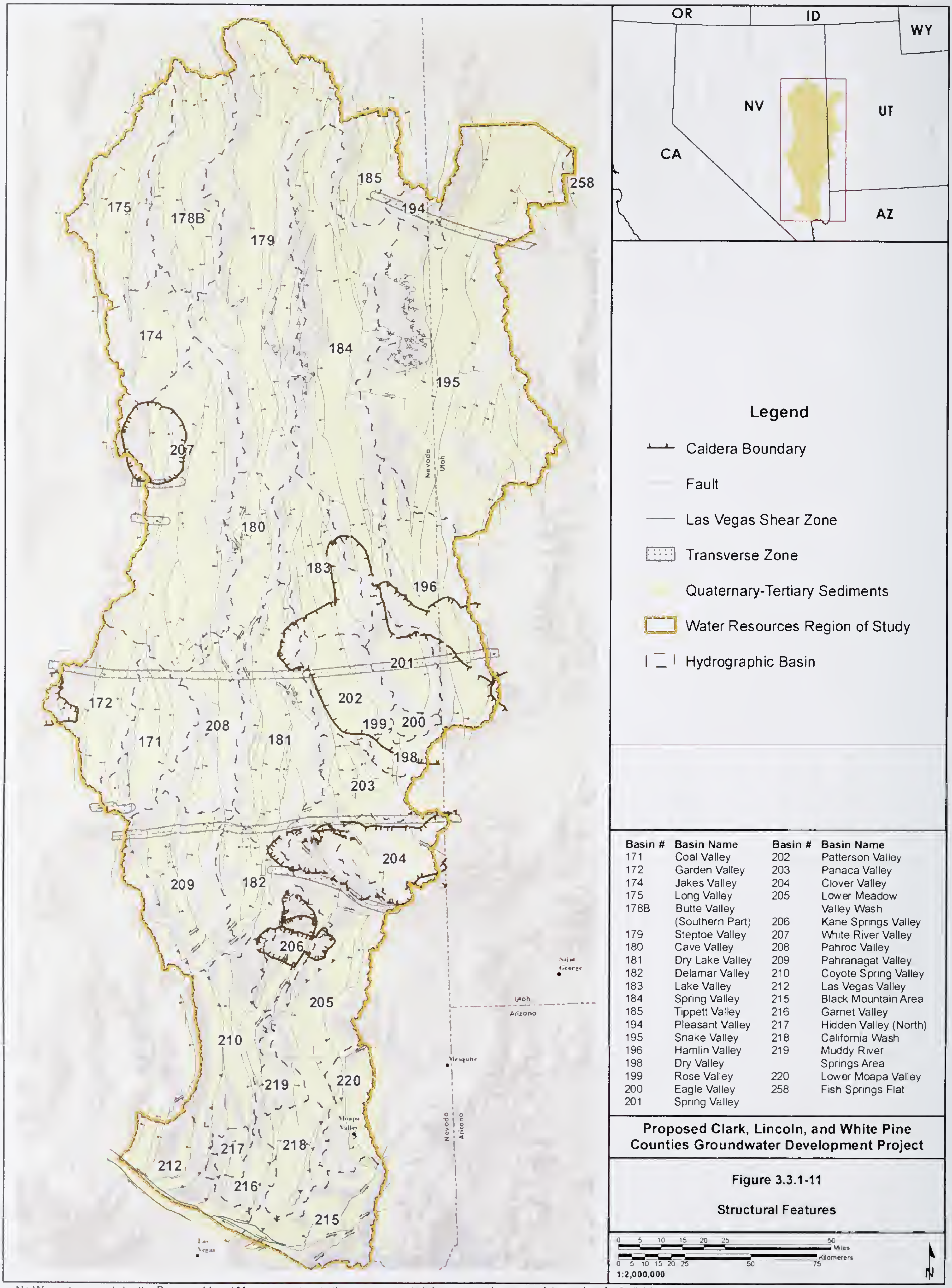
HGU	Map Symbol	Geologic Map Units[1] (Geologic Age)	Equivalent HGU in BARCAS (Welch et al. 2007)	General Occurrence and Range of Thickness	Major Lithologic Characteristics	Generalized Aquifer Characteristics
Tertiary to Jurassic Intrusive Rocks	TJi	Ji, Ki, TKi, Ti	Intrusive Unit	Occurs as large plutons that form a significant portion of the Snake, Schell Creek, Egan and Kern ranges, and beneath caldera complexes.	Predominantly quartz monzonite, granodiorite, and diabase composition.	Plutonic rocks typically act as impediments to groundwater flow. Relatively small quantities of water move through these rocks where sufficiently fractured or weathered.
Cretaceous to Triassic Siliciclastic Rocks	KTrs	Trs, Js, Ks	Mesozoic Sedimentary HGU	Occurs in the southeast portion of the region of study and in a few isolated areas in other portions of the region of study. Average thickness ranges from less than 1,000 to ~10,000 feet.	Includes a broad range of rock types from massive to soft variegated mudstones and siltstone and gypsiferous beds ("red beds"). Also includes siltstone, limestone, claystone, shale, and conglomerate.	The aquifer characteristics depend on the actual rock types present in specific areas. For example, thick sandstone beds likely have moderate permeability, particularly where fractured and are potential aquifers. Fine-grained rocks such as the shales, soft mudstones, and siltstones are potential aquitards. However, the unit has restricted occurrence and only locally affects groundwater flow patterns.
Permian and Pennsylvanian Carbonate Rocks	PPc	P, PP, Pr, Pa, Par, Pp, Pz	Upper Carbonate HGU	Occurs over broad regions in the central and northern portion of the region of study. Ranges from less than 1,000 to 9,000 feet thick.	Mostly carbonate rocks with minor clastic rocks.	Major regional aquifer. Movement and storage of groundwater primarily controlled by networks of fractures or solution openings (or vuggy zones along fractures). Unit contains zones of high transmissivity that can be controlled by structural deformation, solution openings, or karstic features. Unit potentially important as a conduit for interbasin groundwater flow.
Mississippian Siliciclastic Rocks	Ms	Mc, Md, MDd	Upper Siliciclastic HGU	Occurs over broad regions in the central and northern portion of the region of study. Ranges from 1,000 to 3,000 feet thick.	Predominantly fine-grained clastic rocks (i.e., shale).	Regional aquitard that impedes flow between the lower and upper Paleozoic carbonate rock units.

Table 3.3.1-12 HGUs in the Study Area (Continued)

HGU	Map Symbol	Geologic Map Units[1] (Geologic Age)	Equivalent HGU in BARCAS (Welch et al. 2007)	General Occurrence and Range of Thickness	Major Lithologic Characteristics	Generalized Aquifer Characteristics
Mississippian to Ordovician Carbonate Rocks	MOc	Ol, SOu, So, Ds, Dg, Dn, Dd, Du, DO, DS, MD	Lower Carbonate HGU	Occurs over broad regions throughout most of the region of study. Ranges from 1,000 to 12,000 feet thick.	Predominantly carbonate rock with interbedded clastic rocks (i.e., shale, quartzite).	Major regional aquifer. Similar characteristics to PPc; movement and storage of groundwater primarily controlled by networks of fractures, solution openings (particularly vuggy zones or solution cavities formed along fracture zones). Unit contains zones of high transmissivity typically controlled by structural deformation, solution openings, or karstic features. Unit potentially important as a conduit for interbasin groundwater flow.
Cambrian Carbonate Rocks	Cc	Cm, Cc	Lower Carbonate HGU	Occurs over broad regions throughout most of the region of study. Ranges from 2,000 to 6,000 feet thick.	Predominantly carbonate with limited clastic rocks.	Major regional aquifer with similar properties to the MOc unit.
Cambrian to Precambrian Siliciclastic Rocks	CpCs	CpCs	Lower Siliciclastic HGU	Occurs over broad regions throughout most of the region of study. Ranges from 4,000 to 9,000 feet thick.	Nonmetamorphosed to moderately metamorphosed siliciclastic rocks (predominantly shale and quartzite).	Regional aquitard with low permeability. Where it occurs at shallow depths, rocks are commonly highly fractured and can transmit relatively small flows.
Precambrian Metamorphic Rocks	PCm	PC	Lower Siliciclastic HGU	Basement rocks throughout region; exposed in the core of several mountain ranges.	Crystalline metamorphic rocks including metamorphosed quartzite, slate, and argillite.	Regional aquitard with very low permeability.

[1]See Section 3.2, Geologic Resources, and SNWA (2008) for description of geologic map units.

Source: SNWA (2008); Welch et al. (2007); additional references for aquifer properties provided in text.



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Where both the upper and lower carbonate units are present, extensive normal faulting throughout the region has juxtaposed these units such that they are commonly in fault contact and probably are hydraulically connected in most areas (Plume and Carlton 1988). In addition, the carbonate-rock aquifer system is locally bounded by relatively impermeable, intrusive rocks, truncated by major faults zones that juxtapose the carbonate sequence against low-permeability rocks that potentially compartmentalize the aquifer into different flow systems (Winograd and Thordarson 1975).

Groundwater in the carbonate rocks primarily is stored and transmitted within a network of fractures that may have been solution-widened to varying degrees. Solution channels typically develop by the dissolution of carbonate minerals along secondary openings (such as fractures and faults) in the rock mass. As a result, solution channels are appreciably wider than the original secondary opening. Solution channel widths can range from inches to tens of feet (Plume 1996).

Analyses of 10 aquifer-pumping tests in the Cambrian to Devonian age carbonate sequence at the Nevada Test Site, northwest of Las Vegas and outside of the region of study, indicate a hydraulic conductivity that ranges from 0.7 to 700 feet per day (Winograd and Thordarson 1975), with a mean value of 80 feet per day and median values of 6 feet per day. Estimates from four wells in Pennsylvanian and Permian limestone, drilled and tested as part of the MX missile-siting program, indicate hydraulic conductivity ranging from 0.1 feet per day to 900 feet per day, with a mean of 200 feet per day and a median of 9 feet per day (Bunch and Harrill 1984). Higher values are assumed to reflect fault or fracture zones with solution widening; lower values are assumed to reflect relatively unfractured rock.

The combined thickness of the carbonate-rock aquifer system typically is greater than 20,000 feet. There is uncertainty regarding the depth of the groundwater flow within the carbonate-rock aquifer system. Significant secondary permeability does not extend over the entire stratigraphic thickness (Plume 1996). The base of the groundwater system is either the underlying siliclastic rocks or impermeable carbonate rocks presumed to occur at great depth (Plume 1996).

Basin-Fill Aquifer System

The basin-fill aquifer system is the most important and most developed aquifer in the region (Welch et al. 2007). Each HA within the region of study is characterized by a structural basin, filled by thousands of feet of clastic sediments eroded from adjacent mountain ranges. These clastic sediments include older and younger basin-fill deposits. The older deposits consist of Tertiary age, consolidated deposits of conglomerate, sandstone, siltstone, claystone, freshwater limestone, and evaporite, with local interbeds of volcaniclastic rocks. The older basin-fill deposits are overlain by younger Pliocene to Holocene aged alluvium, colluvial, and lacustrine sediments that are predominantly uncemented and unconsolidated near the surface and are more indurated with increasing depth. These deposits include coarser-grained material (predominantly sandy gravel with interbedded gravelly sand and sand) and fine grained playa and lake deposits (Welch et al. 2007). In general, the younger basin-fill deposits are coarser near the valley margins and become progressively finer towards the central axis of the valley. However, valleys drained by perennial streams typically have associated channel and floodplain deposits that include coarse-grained materials. In summary, younger basin-fill deposits are inherently heterogeneous, characterized by complexly interfingered coarse- and fine-grained materials.

Lacustrine pertains to or is produced by a lake.

Colluvial material consists of alluvium and angular fragments of rocks that typically are found at the bottom or on lower slopes of hills.

The thickness of the basin-fill deposits ranges from zero at the valley margin to several thousands of feet along the axis of the valley. In some valleys in the region of study, the thickness of the basin-fill locally exceeds 10,000 feet (SNWA 2008). In some valleys, the basin-fill sediments are entirely enclosed by low-permeable bedrock. In other valleys, the basin fill extends laterally into one or more adjacent basins and is part of a multibasin flow system. Even where the basin-fill sediments are not laterally continuous between basins, they may be connected hydraulically by flow through permeable rocks.

The permeability and hydraulic conductivities of the basin-fill deposits are highly variable and reflect the heterogeneous characteristics of the unit. The hydraulic properties of the material in a specific area depend on the lithology of the material, degree of sorting, and amount of interfingering and interbedding of coarse- and fine-grained sediments (Plume 1996). Aquifer tests in basin-fill sediments were conducted for the MX missile-siting investigation in valleys in central and eastern Nevada and western Utah. Those tests indicate that the hydraulic conductivity (for 18 tests) from 14 basins ranges from 0.02 to 140 feet per day and averaged 78 feet per day (Bunch and Harrill 1984).

Permeability is the ability of a material, such as rocks, to allow the passage of a liquid, such as water.

Volcanic Rock Aquifer

Volcanic rocks have a wide range of physical and hydraulic properties and can behave as either aquifers or flow barriers (Plume 1996). Despite the fact that volcanic rocks are widely distributed throughout the Great Basin, volcanic rocks have been identified as aquifers in relatively few areas (Plume 1996). Prudic et al. (1995) noted that fractured, basalt, and welded tuffs can yield significant quantities of water to wells, over large areas. At the Nevada Test Site, measured hydraulic-conductivity values for volcanic rocks (lava flows and ash flow tuffs) range from approximately 1.5 to 17 feet per day (Winograd and Thordarson 1975). Plume (1996) reported that 54 drill-stem tests in volcanic rocks in the Railroad and White River valleys in eastern Nevada produced hydraulic-conductivity values that range from less than 0.001 to 0.3 feet per day, with a mean value of 0.02 feet per day.

Conductivity is the capacity of a rock or sedimentary deposit to transmit water (see the Glossary for additional description).

Potential Lithologic Barriers to Regional Groundwater Flow

Rocks with low permeability characteristics tend to confine, restrict, or impede groundwater flow in the regional aquifer systems. Although many of these rocks can yield or transmit small volumes of water if sufficiently fractured, in a regional framework, these rocks are not considered regional aquifers. Depending on their stratigraphic position and structural juxtaposition, these rocks have the potential to restrict both vertical and horizontal flow paths. Identifying the spatial distribution of these low-permeability rocks is important to understanding potential barriers to flow between basins or boundaries that segregate flow systems within the carbonate-rock aquifer system (Prudic et al. 1995).

From oldest to youngest, the following HGUs are considered as potential barriers to regional flow: 1) Precambrian metamorphic rocks and Cambrian to Precambrian siliciclastic rocks (also collectively referred to as the Lower Siliciclastic Unit); 2) Mississippian siliciclastic rocks (also referred to as the Upper Siliciclastic Unit); 3) Cretaceous to Triassic siliciclastic rocks (also referred to as the Mesozoic Sedimentary Unit); and 4) Tertiary to Jurassic intrusive rocks (also referred to as the Intrusive Unit) (Welch et al. 2007).

The two lowermost units—the Precambrian Metamorphic HGU and Cambrian to Precambrian Siliciclastic HGU—are believed to have very low permeability characteristics throughout the eastern Great Basin (Winograd and Thordarson 1975; Plume 1996). Regionally, the top of this unit represents the base of the groundwater flow system (Welch et al. 2007).

The Mississippian Siliciclastic HGU consists predominantly of shaley, fine-grained, low-permeability rocks. The water-bearing properties of this unit are not well known, but it is assumed to behave as a local barrier to flow between the upper and lower carbonate-rock aquifers. A steeply dipping north-south oriented section of this unit acts as a barrier to eastward flow between southern Snake Valley and Pine, Wah Wah, and Tule valleys (Gardner et al. 2011).

The Cretaceous to Triassic Siliciclastic HGU occurs in local, isolated areas in the north and central portions of the region of study and along the margin of the Colorado Plateau in the southeastern portion of the region of study. This unit includes diverse lithologies, and its water-bearing properties are unknown (Plume and Carlton 1988). Because these rocks have only localized occurrences and are relatively thin, they are not considered to behave as important conduits for groundwater flow (Welch et al. 2007). However, in the southeastern portion of the region of study, these units are relatively thick and are likely to include lithologic zones with moderate permeability.

The Tertiary to Jurassic Intrusive HGU occurs as large plutons that form a large portion of the Snake, Schell Creek, Egan, and Kern ranges (SNWA 2008). Large intrusive bodies also are inferred to exist beneath ash flow tuff sequences within the White River, Indian Peaks, Central Nevada, and Caliente Caldera complexes. These intrusives primarily are composed of granodiorite and quartz monzonite. No aquifer tests have been performed on the intrusive rocks within the region of study. However, intrusive rocks generally have very low permeability and impede the movement of groundwater (Plume 1996). Belcher et al. (2001) report horizontal hydraulic conductivities from 0.002 feet per day to 3.3 feet per day for Jurassic- to Oligocene-age granodiorite, quartz monzonite, granite, and tonalite in Southern Nevada and parts of California. In some areas, plutons intrude the carbonate-rock aquifers and act as potential vertical barriers to groundwater flow.

Hydrostructural Conditions

In summary, the region of study is located within a region that has experienced various episodes of structural deformation, including compressional, extensional, and translational tectonics. As a result, the structural geology of the region of study is complex. Major fault or structural zones identified or mapped within the region of study include detachment faults, thrust faults, strike-slip faults, normal faults, and east-west lineaments, and caldera margins (SNWA 2008). The distribution of major fault zones and other structural discontinuities (i.e., lineaments) in the region of study are shown in **Figure 3.3.1-11**.

Slip refers to a planar feature where movement along a fault has occurred and resulted in the displacement of formerly adjacent points on either side of the fault.

Groundwater flow pathways may be influenced by major faults that offset and displace rock units and older alluvial deposits. A recent study completed by the USGS "Conceptual Model of the Great Basin Carbonate and Alluvial Aquifer System" (Heilweil and Brooks 2011; Sweetkind et al. 2011) describes how fault displacement disrupts HGUs and can affect groundwater flow in the Great Basin carbonate and alluvial aquifer system (GBCAAS):

Gouge is pulverized, clay-like material found along some faults; formed by the grinding of rock material during fault movement.

> "Given the complex geologic history of the GBCAAS study area, HGUs often are disrupted by large-magnitude offset thrust, strike-slip, and normal faults. These geologic structures disrupt bedrock continuity (figs. C–2 and C–3) and result in a complex distribution of rocks that affect the direction and rate of interbasin groundwater flow by altering flow paths. The juxtaposition of thick, low-permeability siliciclastic-rock strata against higher permeability carbonate-rock aquifers, caused by faulting, commonly forms barriers to groundwater flow and greatly influences the shape of the potentiometric surface (Winograd and Thordarson, 1975; McKee and others, 1998; Thomas and others, 1986)."

Breccia is rock made up of angular fragments of other rocks, held together by mineral cement or a fine-grained matrix. Fault breccia is made by breaking and grinding rocks along a fault.

Conversely, where fault movement results in the juxtaposition of HGUs with similar permeabilities, the juxtaposition of these materials would not behave as an impediment to cross-fault groundwater flow unless the fault zone had a lower permeability than the unfaulted material on either side of the fault zone.

Fault zones typically are lithologically heterogeneous (i.e., nonuniform) and structurally anisotropic (i.e., variable in different directions) (Caine et al. 1996). Depending on the physical properties of the rocks involved, the amount and type of structural deformation, and the alteration and mineralization history, fault zones may behave as barriers, conduits, or combined conduit/barrier systems that enhance or restrict groundwater flow (Caine et al. 1996). In addition, the hydraulic properties of the materials within individual fault zones can vary spatially along the fault zone.

For the purposes of discussion, fault zones can be subdivided into two zones: the principal fault zone and the damaged zone. Both zones can have distinct physical properties that control the storage and movement of groundwater. The principal fault zone is defined as the zone in which most of the displacement has occurred and can consist of a wide range of materials, including a single slip or multiple slip surfaces, unconsolidated clay-rich gouge, breccia zones, chemically altered zones, or mylonite zones. The generation of fine-grained materials and alteration and mineral precipitation tends to reduce the porosity and permeability of the primary fault zone, compared to the adjacent unfaulted bedrock materials (Caine et al. 1996). The principal fault zone can be bounded on one or both sides by a damaged zone, defined as a zone of fractured or highly fractured rock that is associated with the fault zone and that has not experienced large displacement. By definition, rocks within the damaged zone are more highly fractured than the bedrock outside of the fault zone. The fracture network within the damaged zone tends to have a higher or enhanced permeability, compared to both the principal fault zone and the less-fractured regional bedrock material outside of the fault zone (Caine et al. 1996). In this way, major regional fault zones have the potential to behave as both conduits and barriers to groundwater flow (Sweetkind et al. 2011).

Mylonite is a brecciated, metamorphic rock frequently found in a fault zone; formed by the crushing actions of fault movement.

Monitoring associated with dewatering activities related to open pit and underground mining activities in the Carlin Trend in north central Nevada have demonstrated that major basin- and range-type faults zones can restrict the propagation or spread of drawdown resulting from the groundwater pumping. One example is the effects of dewatering at the Barrick Goldstrike Mine located in the Carlin Trend. Dewatering required for mining at the Goldstrike Mine was initiated in 1990 and continued through 2011. Dewatering occurs in permeable carbonate rock that host the ore deposit. Dewatering rates peaked at approximately 70, 000 gpm in 1998 and gradually declined to approximately 15,000 gpm at the end of 2011. Dewatering activities at the mine have resulted in lowering the groundwater levels approximately 1,700 feet within the carbonate aquifer. Monitoring results indicate that the drawdown area resulting from groundwater pumping is an elongate northwest-trending zone that is approximately 2.5 miles wide and 8 miles long and is bounded by major fault zones. Long-term monitoring results indicate that major fault zones bounding the northeast and southwest boundaries of the carbonate block behave as barriers to groundwater flow between aquifers that have restricted the spread of aquifer drawdown (Zhan et al. 2011). The influence of these structures on the groundwater flow system generally is characterized by a noticeable change in gradient and water levels on either side of the faults. These hydrostructural features are described in BLM (2000) and in Zhan et al. (2011).

The major hydrostructural features that occur in the region, and their potential influence on groundwater flow patterns, are briefly summarized in the following paragraphs. In the region of study, the basin and range topography is defined by an extensive system of normal faults, which separate the basin and mountains ranges. The systems of north- to northwest-trending fault zones bound the mountain blocks and typically display vertical displacements of several thousand feet (or greater). These faults commonly juxtapose permeable basin-fill sediments against older consolidated rock as well as permeable rocks against low-permeability rocks. Fault displacement of aquifer units against materials with low permeabilities can result in fault compartmentalization of aquifers (Winograd and Thordarson 1975). However, as stated previously, where fault movement results in the juxtaposition of HGUs with similar permeabilities the juxtaposition of these materials would not behave as an impediment to cross-fault groundwater flow unless the fault zone had a lower permeability than the unfaulted material on either side of the fault zone. Where they are not cemented, the highly fractured rocks (or damaged zone) associated with these faults can behave as conduits for groundwater flow (Prudic et al. 1995; Sweetkind et al. 2011). Flow also can be restricted across these fault zones where they contain fault gouge or other fine-grained materials, alteration products, or mineral precipitation products. Overall, hydrologic significance of major normal fault structures in the region is presumed to be variable and dependant on both the relative permeability of the materials juxtaposed by the fault movement, and the hydraulic properties of the fault zone. It is likely that in some locations, major regional normal faults may impede groundwater flow across the fault, whereas in other locations, the fault may not restrict groundwater flow across the fault (Sweetkind et al. 2011).

Large-offset extensional detachment faults occur locally in some mountain ranges within the region of study. These fault zones are gently to moderately dipping and typically separate lower metamorphic rocks from overlying unmetamorphosed rocks. Seismic reflection data and interpretive cross-section suggest detachment fault dip beneath Snake Valley and the Confusion Range in the Snake Valley hydrographic basin (Welch et al. 2007). The hydrologic significance of these detachment faults on groundwater flow is generally unknown. Four east-west oriented transverse lineaments have been identified in the region of study (SNWA 2008). These lineaments generally are several tens of miles to hundreds of miles long and up to several miles wide and are oriented at nearly right angles to the basin and range normal faults. These lineaments are marked by alignment of such features as topographic breaks or terminations of mountain ranges, stratigraphic discontinuities, positioning of large volcanic fields and caldera boundaries, and in some instances, emplacement of large igneous intrusions. The influence of these large structural features on regional groundwater flow patterns is not well understood. Prudic et al. (1995) infer that these lineaments may behave as leaky barriers to groundwater flow or could act as barriers where they disrupt or truncate carbonate-rock aquifers.

Several shear zones, defined by either left-lateral or right-lateral movement, occur in the region of study (SNWA 2008). The identified shear zones primarily are restricted to the southern half of the region of study. The most notable shear zones are the Pahranagat shear zone and the Las Vegas shear zone. The Pahranagat shear zone consists of a series of roughly parallel left lateral faults that trend east-northeast in the southern portion of Pahranagat Valley, Delamar Valley, East Pahranagat Range, Hiko Range, and the southern Delamar Mountains and adjacent areas, as mapped by Ekren et al. (1976). Eakin (1966) inferred that the relatively large hydraulic gradient between Pahranagat Valley and Coyote Valley was likely the result of the Pahranagat shear zone acting as an impediment to flow. The Las Vegas shear zone is a west-northwest trending right-lateral shear zone that defines the southern boundary of the region of study in the Las Vegas Valley. Winograd and Thordarson (1975) inferred that a steep gradient between adjacent wells in Las Vegas Valley is evidence that the shear zone is a barrier to groundwater flow.

Several major thrust faults have been mapped in the southern part of the region of study but occur in only few isolated areas in the northern and central parts of the region of study (SNWA 2008). The SNWA (2008) suggest that gouge and mylonite zones associated with these thrust faults act as impediments to flow, most notably in the Sheep and Pahranagat ranges, Delamar Mountains, and several other ranges in the southern portion of the region of study. Prudic et al. (1995) suggest that because they could not correlate the locations of major thrust faults with changes to simulated water levels and transmissivities during regional modeling, these structures may only minimally influence regional groundwater flow patterns.

More detailed descriptions of these and other structural features in the region and their potential influence on groundwater flow paths are provided in Heilweil and Brooks 2011.

Potential for Interbasin Groundwater Flow

Interbasin flow of groundwater depends both on the geologic conditions between basins and groundwater gradients. SNWA (2008) and Welch et al. (2007) identified locations in which the known or inferred geologic conditions between the hydrographic basins could allow for significant movement of groundwater, without respect to groundwater gradient. Groundwater flow could occur wherever the consolidated rocks under the valleys and in the mountains that separate the valleys are permeable and interconnected and wherever the basins are connected by unconsolidated sediments (basin-fill). Groundwater flow between hydrographic basins is considered to be unlikely in areas where the hydrographic basins are separated by relatively impermeable bedrock. For additional information and discussion of potential locations for interbasin flow, see SNWA 2008, Welch et al. 2007, and Heilweil and Brooks 2011.

Groundwater Elevations, Gradients, and Potential Flow Directions

The following summary of groundwater elevations is based on the information in the report "Water Level Data Compilation and Evaluation for the Clark, Lincoln, and White Pine Counties Groundwater Development Project" (SNWA 2008). This report presents the results of a comprehensive compilation and evaluation of water-level data for the project basins and other hydrographic basins included within the region of study.

As described in this baseline report, water-level measurements were compiled from 1,976 wells and springs in the region of study, derived from published and unpublished reports and agency databases. The data evaluation included determining the effective open interval and the HGU for each well completion, calculating water-level elevations from depth-to-water data, and identifying outlier and non-steady state water-level measurements. The resulting data set was used to construct water-level contour maps for the basin-fill aquifer for each hydrographic basin. Additional maps that show areas of shallow groundwater also were developed for basins where there is significant groundwater discharge from ET. A water-level contour map also was constructed for the carbonate-rock aquifer system for the entire region of study (**Figure 3.3.1-12**).

Details regarding the data reduction and analysis methodologies and a complete set of water-level contour maps for all basins were provided in the report. The following section provides an overview of the water-level data for the five basins proposed for groundwater development under the Proposed Action and alternatives.

Additional information for the portion of the Great Salt Lake Desert Groundwater Flow System included within the study area is based on the recently completed regional potentiometric map prepared by Gardner et al. (2011).

Spring Valley

Basin-fill Aquifer

A water-level elevation map for the basin-fill aquifer in Spring Valley is presented in **Figure 3.3.1-13**. Water-level elevations for wells completed in the basin-fill aquifer range from 6,862 feet amsl (in the northern portion of the valley) to 5,537 feet amsl (in the central portion of valley). The water levels are higher in the north and south ends of the valley and lower in the center of the valley, indicating that the general direction of groundwater flow within the basin-fill material is toward the central portion of the valley. The hydraulic gradient is approximately 25 to 30 feet per mile in the northern part of the valley and approximately 5 feet per mile in the southern part of the valley (SNWA 2008).

In addition, the water-level data suggest that a groundwater divide in southern Spring Valley separates groundwater that flows toward the central portion of Spring Valley from groundwater that flows towards Hamlin Valley (SNWA 2008; Gardner et al. 2011).

As shown on the depth-to-water map (**Figure 3.3.1-14**), shallow groundwater conditions exist over large portions of the valley floor in Spring Valley. Depths to groundwater ranges from above ground surface (i.e., flowing wells and spring discharge areas) to greater than 400 feet below ground surface near the southern end of the valley. The central portion of the valley contains a number of springs, ponds, and small playa lakes; most of these features are presumably controlled by groundwater discharge.

Carbonate-Rock Aquifer

Water-level elevation data for the carbonate-rock aquifer system in Spring Valley are provided in the SNWA's baseline water resource report (SNWA 2008). The water-level data were derived from water-level measurements at six sites, which include three wells drilled prior to 2006 and three new locations drilled by SNWA in 2006 and 2007 (SNWA 2008). Each of the three SNWA locations includes a test well and a monitoring well.

The average water-level elevations for the carbonate-rock wells range from a high of 6,645 feet amsl located along the east central edge of the valley near Sacramento Pass to 5,706 feet amsl for the southernmost SNWA test well situated at the Hamlin Valley hydrographic basin boundary. The SNWA (2008) noted that the high water elevations in the well near Sacramento Pass might be influenced by the presence of clastic rocks that confine the carbonate-rock aquifer in this area. The water-level data for the wells completed in the carbonate-rock aquifer system suggest there is a potential for groundwater to flow from north to south in the southern half of Spring Valley. The water-level data for the region suggest that there is a potential for groundwater in the carbonate-rock aquifer to flow from the southern half of Spring Valley into Hamlin Valley and then into Snake Valley.

A water-level elevation map of the carbonate-rock aquifer recently was completed as part of the BARCAS study (Wilson 2007). That study suggested that some of the groundwater in the carbonate-rock aquifer in the northern half of the Spring Valley HA flows northward into the Tippett Valley HA; and some water flows east into Snake Valley along the northeast boundary of the HA.

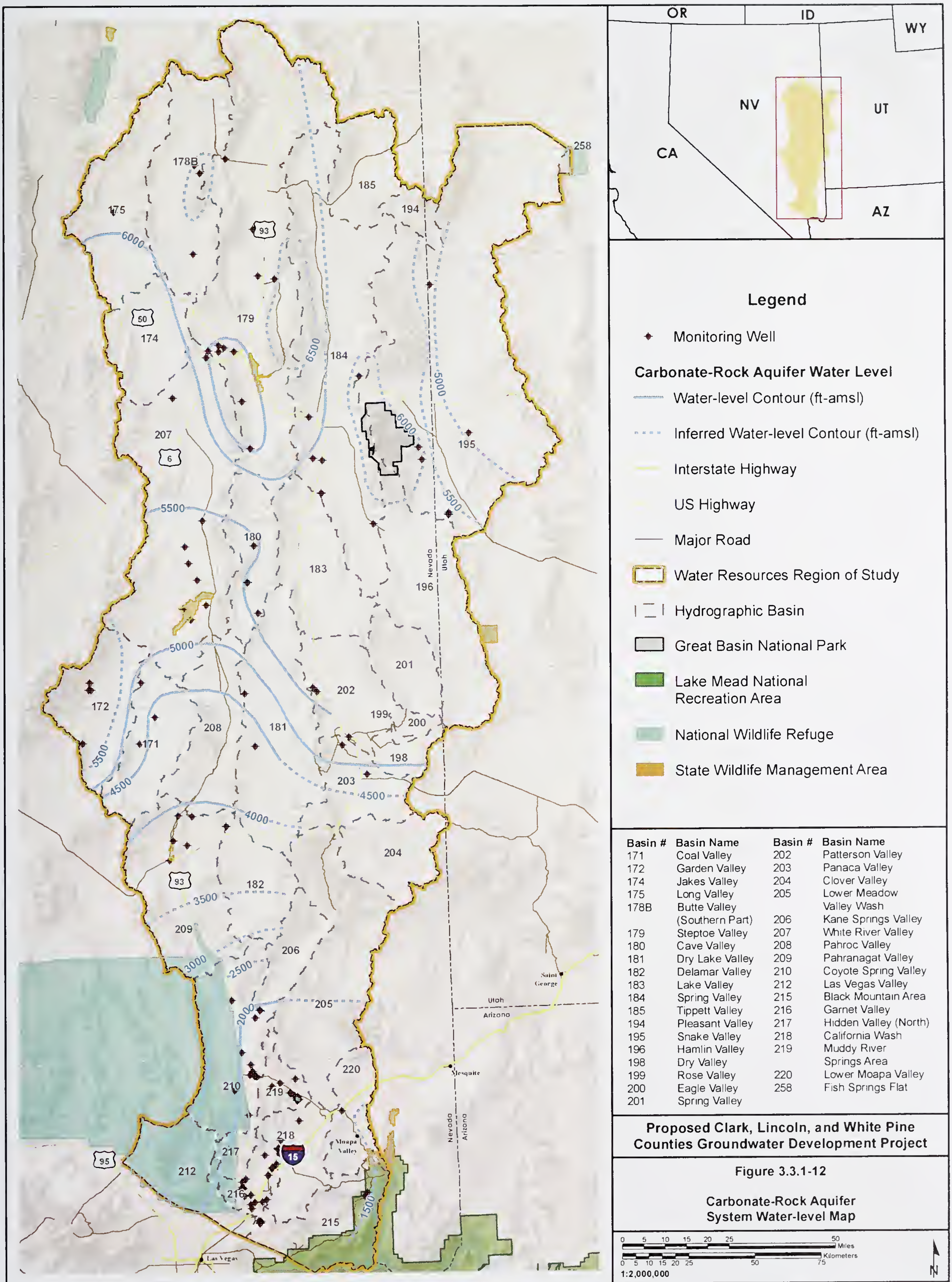
Trends

Hydrographs were constructed for wells that had 10 or more depth-to-water measurements (SNWA 2008). All of the wells that met the 10-or-more-measurement criterion are completed in the basin-fill aquifer. Review of the hydrographs indicates that most wells exhibit water-level variations of 1 to 10 feet in the basin-fill aquifer. Several wells display trends lasting several years of decreasing or increasing water levels. A USGS MX well near the center of the valley (N15 E67 26CA1) exhibits the maximum variation and indicates a long-term reduction of water levels of approximately 14.5 feet over the period of record (1981 and 2006). The SNWA (2008) suggests that some wells that show a reduction in water-level elevation occur in or near agricultural areas.

Snake Valley

Basin-fill Aquifer

Data has been compiled for more than 250 wells and springs in Snake Valley (SNWA 2008). **Figure 3.3.1-15** presents the average water levels for specific wells and springs and interpreted water-level elevation contours for the basin-fill aquifer system in Snake Valley. Water-level elevations for wells on the valley floor range from approximately 5,522 feet amsl (along the southern margin of the valley) to 4,324 amsl (in the northernmost portion of the valley). The



Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.1-12

Carbonate-Rock Aquifer System Water-level Map

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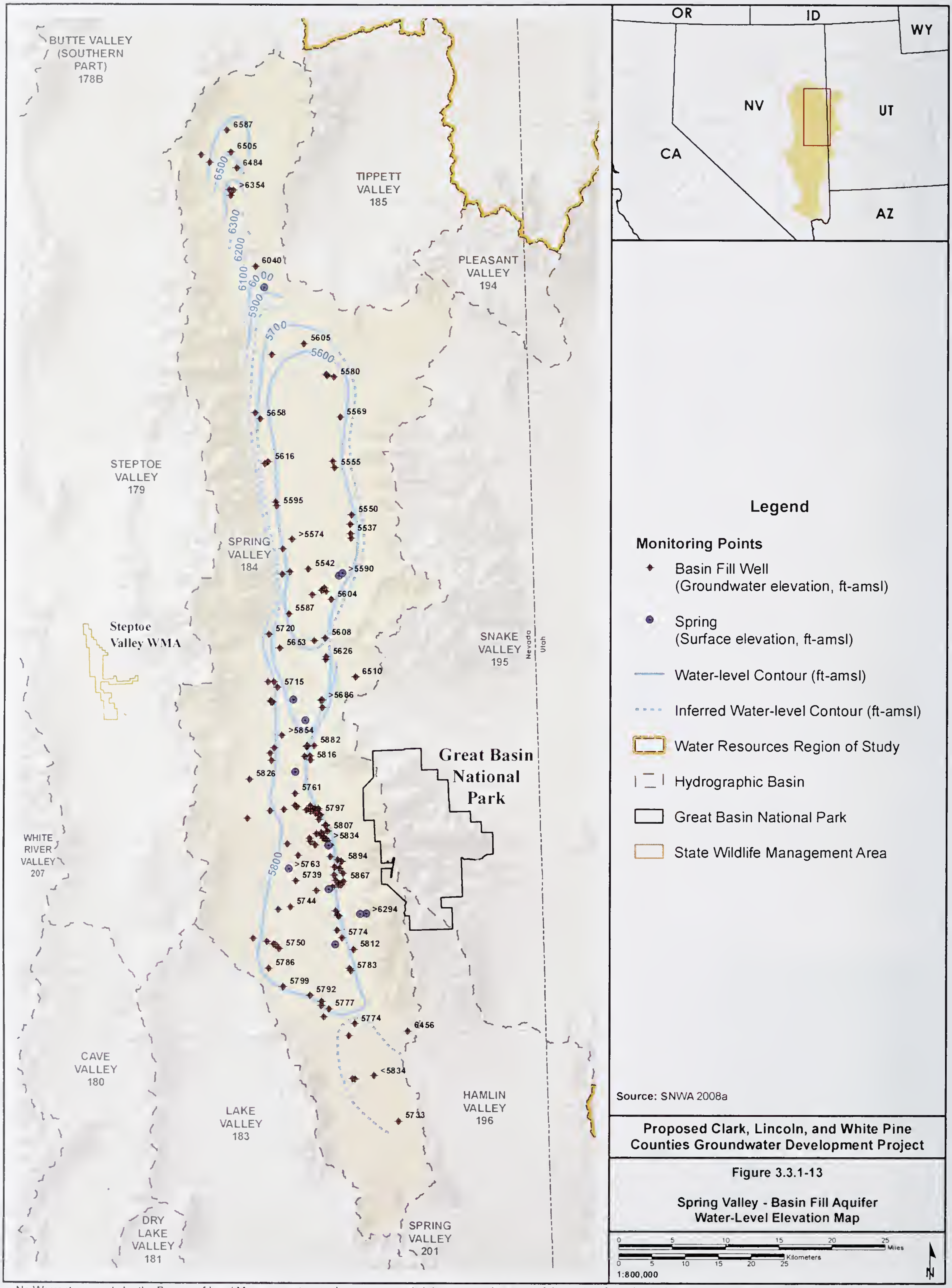

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.1-13

Spring Valley - Basin Fill Aquifer Water-Level Elevation Map

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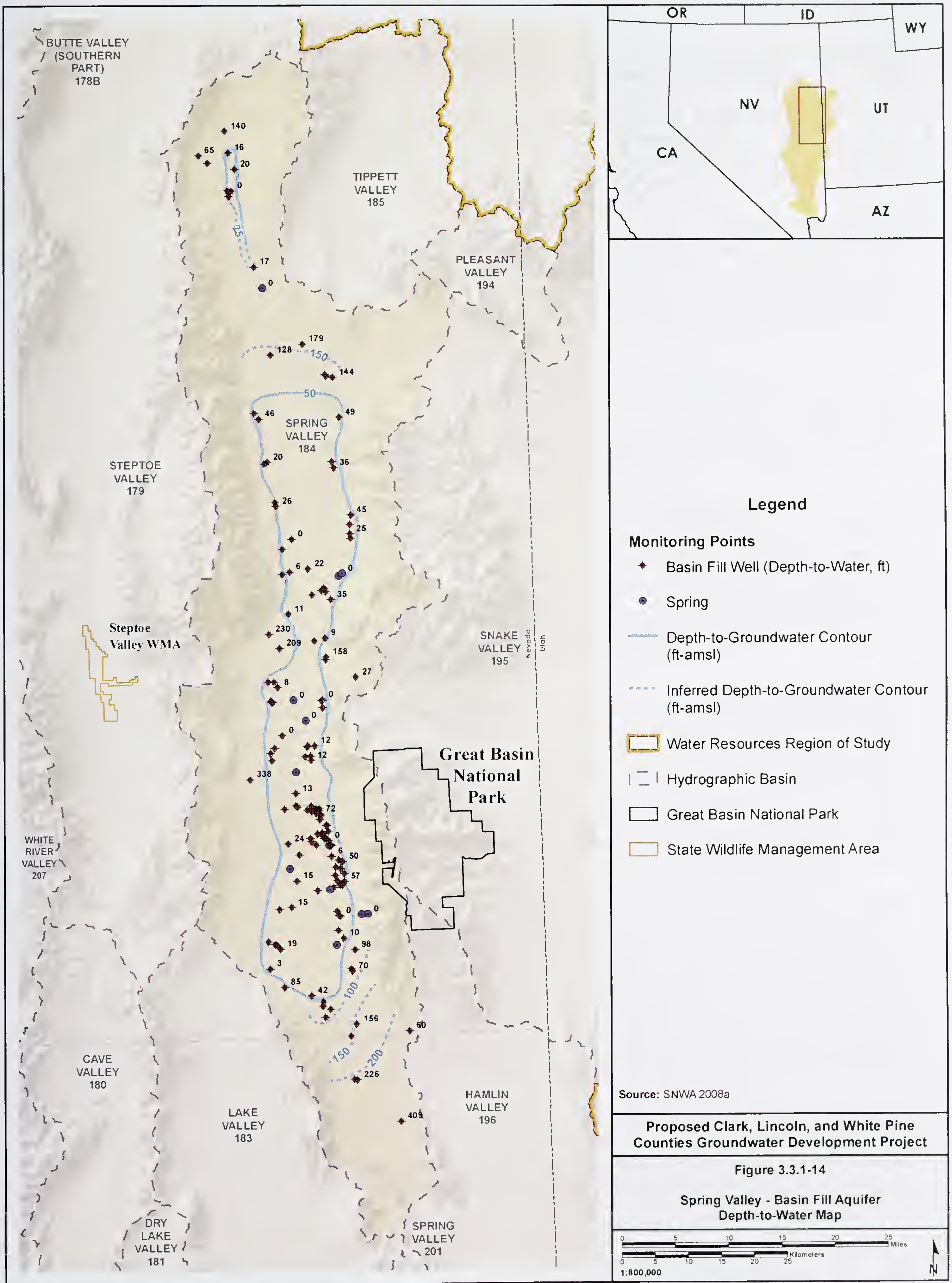

Figure 3.3.1-14

Spring Valley - Basin Fill Aquifer Depth-to-Water Map

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water-level contours indicate that groundwater in the basin-fill sediments generally flows toward the north (towards the Great Salt Lake Desert HA) with a north-to-south hydraulic gradient of approximately 11 feet per mile (SNWA 2008).

The depth to groundwater in Snake Valley ranges from above ground surface to greater than 500 feet below ground surface. As shown in **Figure 3.3.1-16**, the depth to groundwater is less than 50 feet over large areas in the central portion of the valley. The depth to groundwater generally increases toward the margins of the valley and is greatest in the southeast and south margins of the valley.

Carbonate-Rock Aquifer

Water-level elevation data for the carbonate-rock aquifer system in Snake Valley is presented in the SNWA's baseline water resources report (SNWA 2008). This data set identified five wells completed in the carbonate-rock aquifer system; three of these are oil wells along the southern boundary of the HA. The water levels for these monitoring wells range from 6,194 feet amsl to approximately 4,988 feet amsl. The regional water-level data indicate that the gradient for groundwater flow in the carbonate rocks in Snake Valley is generally from southwest to northeast, across the basin.

Water-level elevation contour maps prepared as part of the USGS BARCAS study (Wilson 2007) indicate that in the central portion of the Snake Valley HA, groundwater in the carbonate-rock aquifer system flows from west to east, with a potential for flow beneath the Confusion Range and toward the Tule Valley HA. The BARCAS study also indicates that groundwater in the carbonate rock system in the northern portion of the Snake Valley HA flows toward the northeast (toward the Great Salt Lake Desert HA).

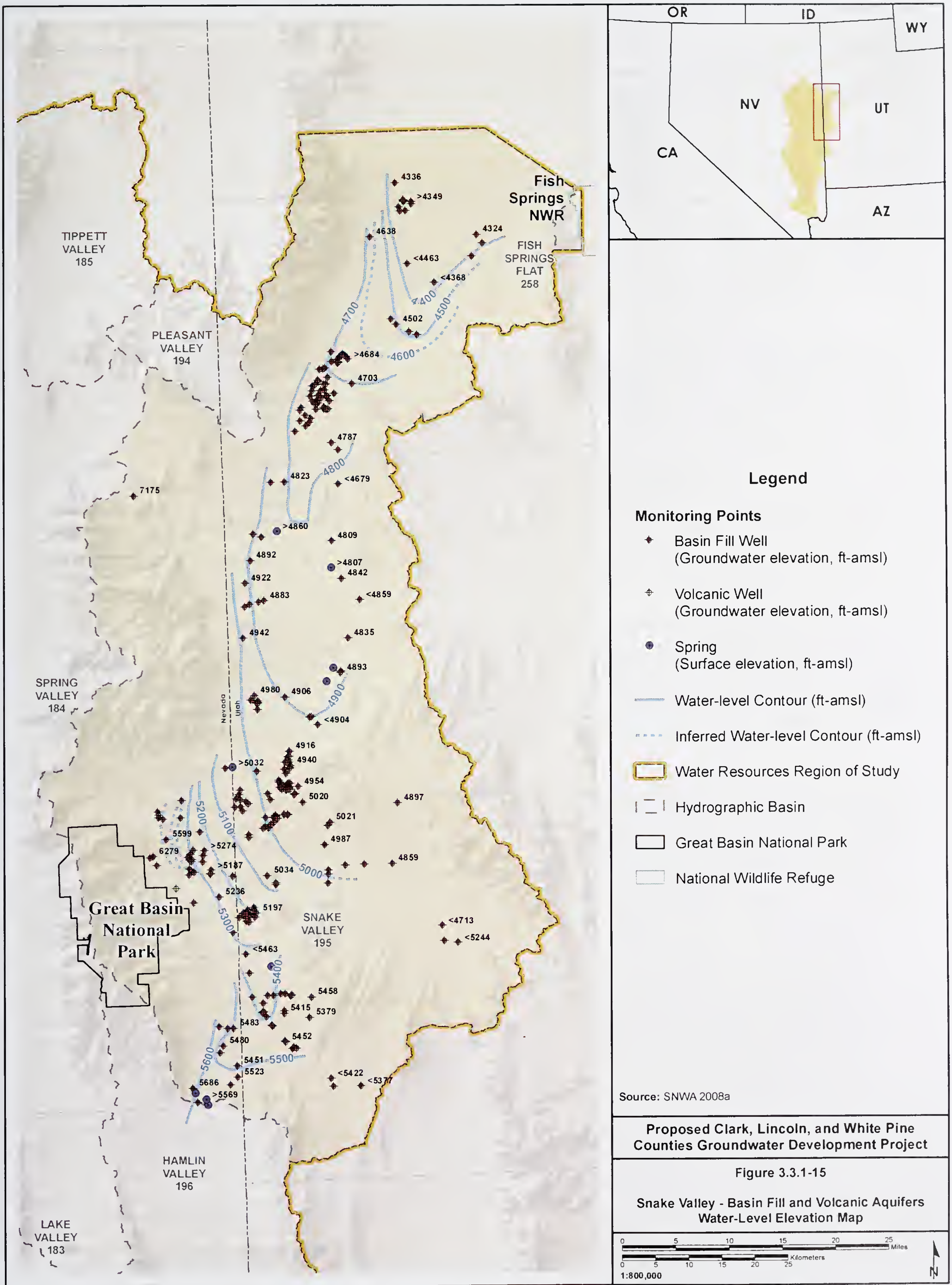
A recent (2011) potentiometric map prepared by the USGS for the Snake Valley and adjacent areas indicates that groundwater gradients and flow paths are controlled by a north-south oriented band of steeply dipping Chainman Shale that occurs along the east margin of Snake Valley (Gardner et al. 2011). The band of low permeability rocks extends for nearly 60 miles from Hamlin Valley on the south to near Highway 50 in Snake Valley on the north. This band of low permeability rocks act as a barrier to groundwater flow in this area between Snake Valley and Pine, Wah Wah, and the southern portion of Tule Valley. This report also indicates that north of this barrier, there is uncertainty regarding the existence of substantial interbasin flow between Snake Valley and Tule Valley (and subsequently, Fish Springs).

Trends

Hydrographs were constructed for wells with 10 or more depth-to-water measurements (SNWA 2008). All of the wells that met this criterion are completed in the basin-fill aquifer. Review of the hydrographs indicates that most wells exhibit variations of 10 feet or less; however, some wells show water-level fluctuations of as much as 50 feet. There is no consistent trend for water levels across the valley. Some wells exhibit relatively consistent water levels over their respective period of record, whereas many wells show increasing or decreasing water-level trends that continue over several years or several decades. Additional description of water-level trends and hydrographs for wells in Snake Valley are provided in the project baseline characterization report (SNWA 2008); and in the appendices to the transient groundwater model report (SNWA 2009b).

The USGS maintains a "groundwater watch" web site (USGS 2010) that provides up-to-date statistics on water-level measurements and trends for active wells monitored in Snake Valley and throughout the nation. Review of the data sets for the central and southern portions of Snake Valley indicate that there is a cluster of wells located in the area around Eskdale, Utah (extending south to Highway 50/6 and west to Gandy Road), where most wells in the network within this area exhibit a trend of declining water levels starting in the late 1980s or early 1990s and continuing to the present (March 2011). The non-artesian wells located in this area have experienced a reduction of water levels over this period ranging from approximately 3 to 10 feet. Two other wells in this area, including the BLM's Shell-Baker Creek Well located just south of Highway 50/6; and the USGS-MX (Snake Valley North) well located west of the Gandy Road in Nevada near the state line also show recent declining water-level trends.

Two artesian wells in this area are included in the groundwater watch monitoring well network—the West Buckskin Well (USGS location number C-20-19 1bcc-1) located about 2 miles south of Eskdale; and Flowing Well #2 (USGS location number C-20-19 8bcb-1) located about 5 miles southwest of Eskdale. Both artesian wells are reported to be completed in the basin-fill aquifer and have only limited head measurement data.



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.1-15

Snake Valley - Basin Fill and Volcanic Aquifers Water-Level Elevation Map

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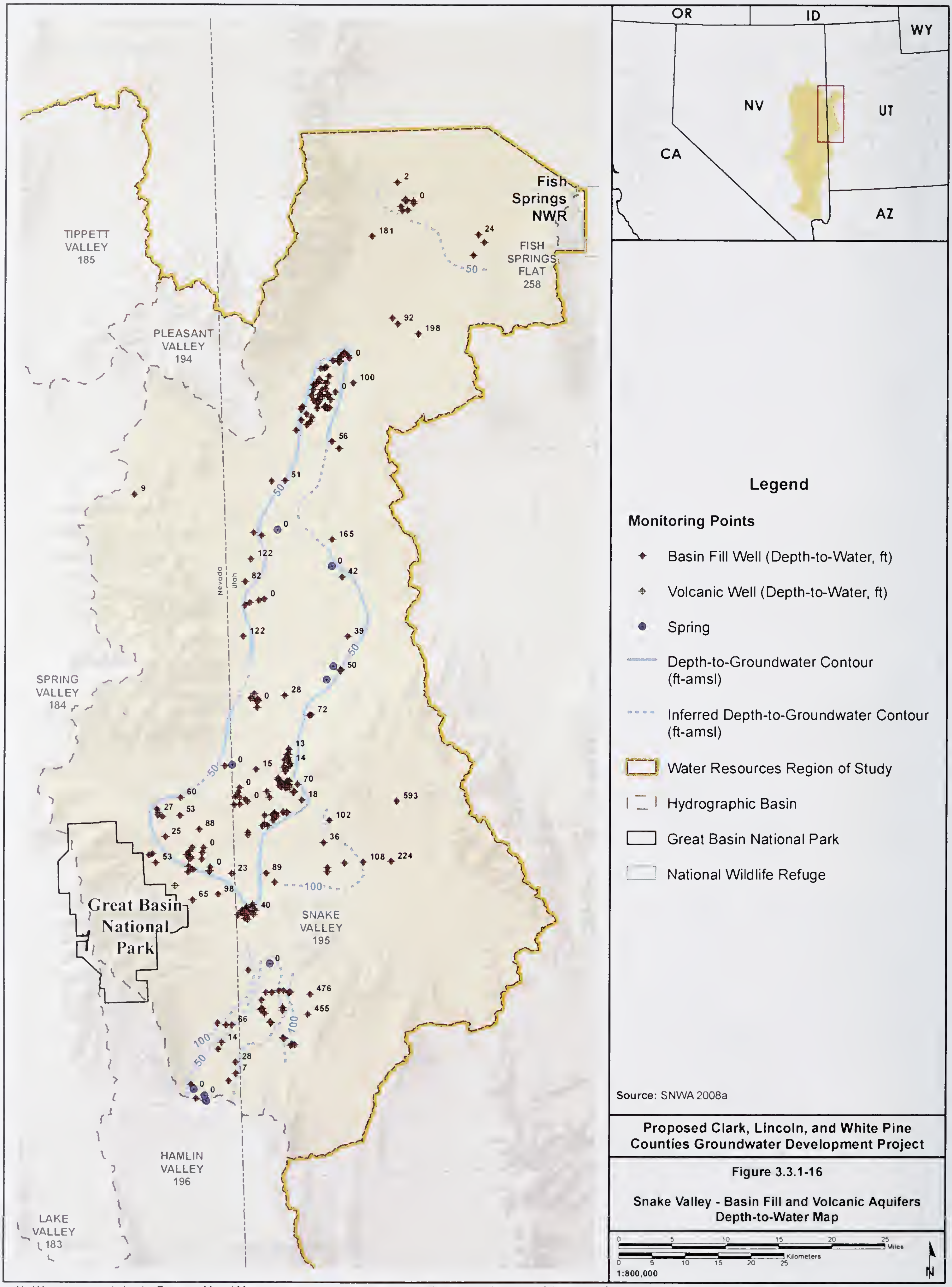

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The head measured at the West Buckskin Well was reported as 12.2 feet above ground surface in 1951. Quarterly monitoring initiated in September 2009 indicated a head of 4.41 feet above ground surface that has continued to decline to 2.44 feet above ground surface as of March 2011. This limited dataset indicates that the head in the West Buckskin Well has declined a total of 9.13 feet since the 1951 measurement.

For Flowing Well #2, 4 measurements have been taken between 1936 and 1948 and 8 measurements taken quarterly between June 2009 and March 2011. The older water-level data suggest that the head was relatively stable over the 1936 to 1948 period with measurements ranging from 7.4 to 8.6 feet above ground surface. All of the recent quarterly measurements indicate that the head in the well has dropped below surface with depth to water measurements fluctuating seasonally between 20.73 to 5.12 feet below ground surface. This limited dataset indicates that the head in Flowing Well #2 has declined a total of 13.12 to 28.73 feet depending on the season compared to the 1948 measurement. The limited water levels recorded during the recent quarterly monitoring are not sufficient to definitely identify any current trends in the well.

The Utah Geological Survey (UGS) has recently established a groundwater monitoring network in Utah's west desert that includes a series of wells installed at 27 sites in Snake Valley HA. The wells were installed between 2007 and 2009 and include: 1) paired wells competed in the carbonate rock and basin-fill aquifers; 2) wells located near agricultural areas; 3) water quality monitoring wells; 4) wells located near springs; and 5) shallow piezometers (less than 10 feet deep) in sensitive wetlands associated with spring discharge areas. Information on these monitoring locations, including water level hydrographs for the wells, is provided at the UGS web site (UGS 2010). Water levels have declined (as much as 7.74 feet since 2001) in the vicinity of Needle Point Springs as previously discussed in the surface water resources section for Snake Valley. The UGS groundwater monitoring network includes continuous water-level monitoring at Needle Point Springs and at a new well located approximately 1 mile south of Needle Point Springs.

Cave Valley

Basin-Fill Aquifer

A water-level elevation map for the basin-fill aquifer in Cave Valley is presented on **Figure 3.3.1-17**. Water-level elevations that were completed in the basin-fill aquifer range from 6,896 feet amsl (near the north end of the valley) to 5,790 feet amsl (in the southern portion of Cave Valley). The water-level data indicate that the general direction of groundwater flow within the basin-fill material is from north to south, with a gradient of approximately 48 feet per mile. The depth to groundwater ranges from near surface in the northern portion of the valley (**Figure 3.3.1-18**) to greater than 200 feet below ground surface in the southern portion of the valley.

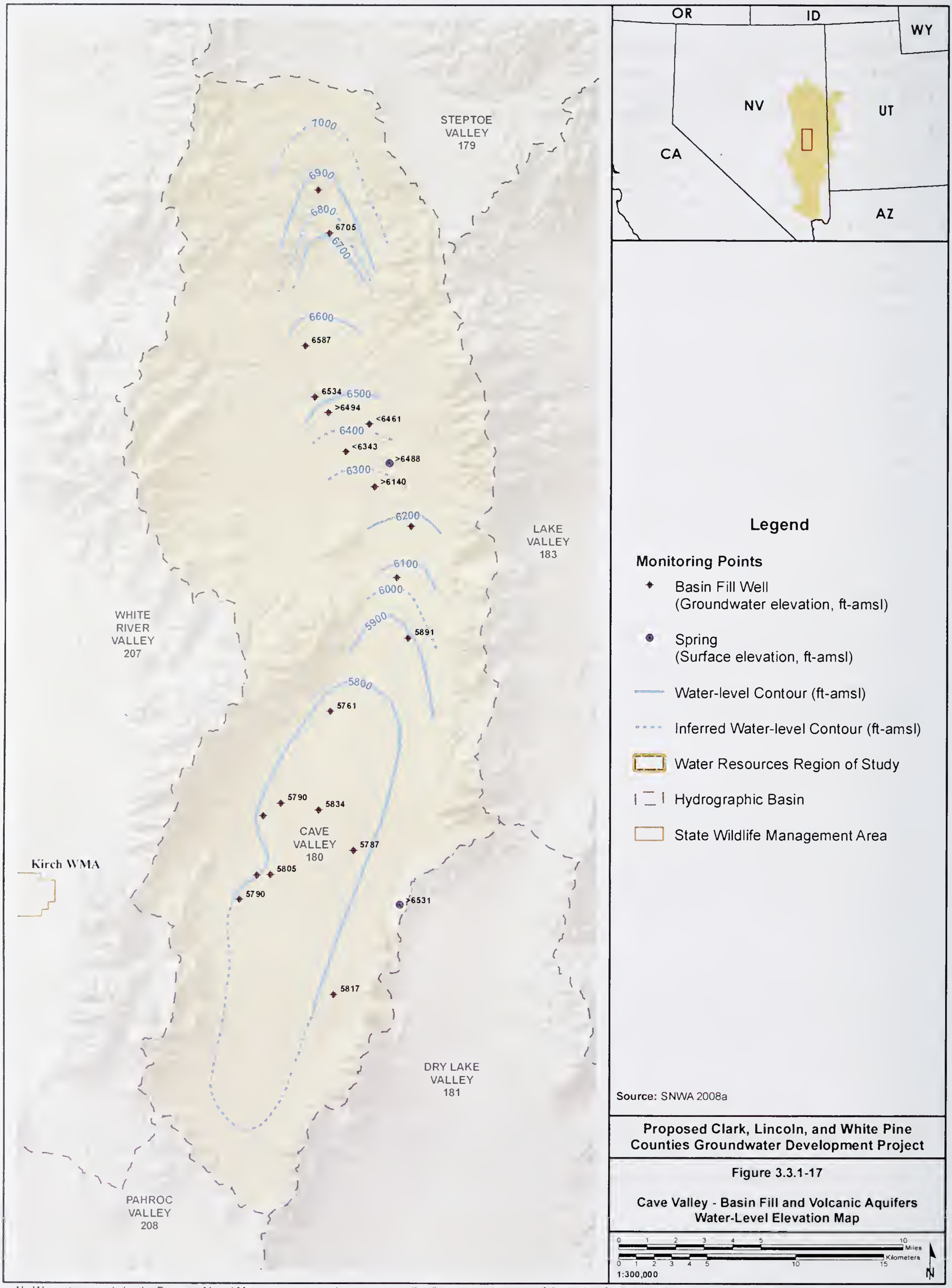
Carbonate-Rock Aquifer

Water-level elevations for five wells completed in the carbonate-rock aquifer system in Cave Valley are presented in SNWA's water resource baseline report (SNWA 2008). These limited data suggest that in Cave Valley, a potential exists for groundwater flow from south to north within the carbonate-rock aquifer. However, Cave Valley can be subdivided into a north and south subbasin with distinct structural characteristics that are separated by an oblique-slip fault (SNWA 2008) or normal fault (Welch et al. 2007). This fault and structural discontinuity between the two subbasins could disrupt or partition the groundwater flow system in the carbonate-rock aquifer in Cave Valley (SNWA 2008).

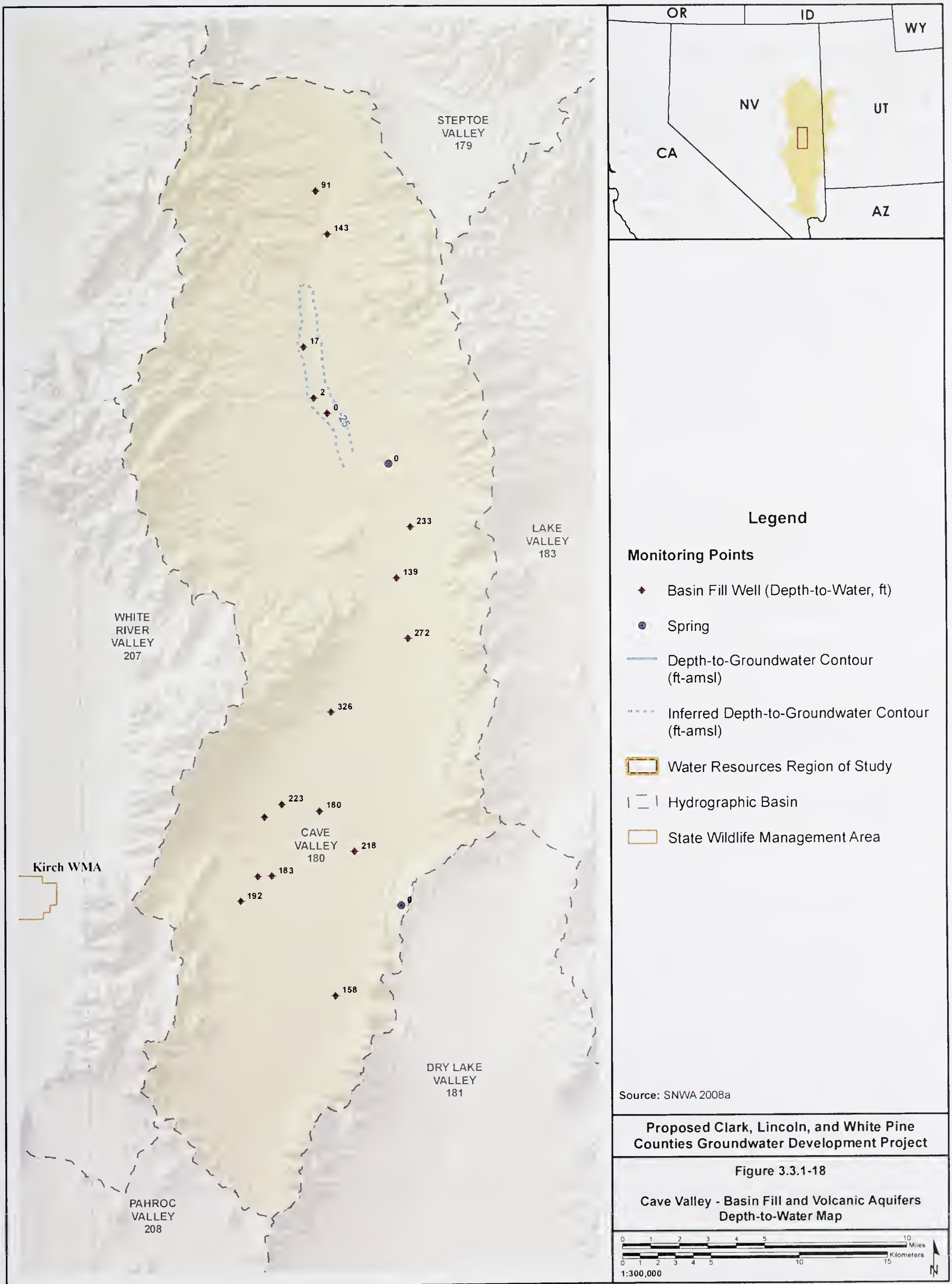
On a regional scale, the water levels in the carbonate wells in the central and southern portion of Cave Valley typically are several hundred feet higher than those in carbonate wells in White River Valley. The difference in water-level elevations between these two adjacent basins suggests the potential for groundwater in the carbonate-rock aquifer system in Cave Valley to flow towards the west or southwest into White River Valley (Harrill et al. 1988; Wilson 2007).

Trends

A well drilled during the MX missile program and completed in the carbonate-rock aquifer system in the south central portion of the region of study has shown a gradual increase in water levels of approximately 10 feet since 1980. There are no other wells with long-term (greater than 10 years) water-level recordings in Cave Valley (SNWA 2008).



No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.1-18

Cave Valley - Basin Fill and Volcanic Aquifers Depth-to-Water Map

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

Dry Lake and Delamar Valleys

Basin-Fill Aquifer

Water-level data for the basin-fill aquifer system in Dry Lake and Delamar valleys is presented on **Figures 3.3.1-19** and **3.3.1-20**, respectively. Water-level data for these two basins is limited. Water-level elevations for wells completed in the upper valley basin-fill sediments range from greater than 5,431 feet amsl (near the north end of Dry Lake Valley) to 3,845 feet amsl (near the center of Delamar Valley). The water-level data indicate that the general direction of groundwater flow within the basin-fill material is from north to south, with a gradient between the central portions of one valley to another of approximately 13 feet per mile. The depth to groundwater ranges from 200 to 500 feet below ground surface in Dry Lake Valley and exceeds 800 feet in Delamar Valley.

Carbonate-Rock Aquifer

Only two wells completed in the carbonate-rock aquifer have been identified in these hydrographic basins (SNWA 2008). Both wells are near the west margin of Dry Lake Valley. The average water levels for the two wells are 4,541 to 4,288 feet and suggest a general north-to-south flow direction in the carbonate-rock aquifer system in this region. These carbonate-rock water levels are more than 1,000 feet lower in elevation than water levels in Cave Valley that adjoin to the north and more than 2,000 feet higher than water levels in wells in Coyote Spring Valley that adjoin to the south. These numbers suggest a potential for groundwater in the carbonate-rock aquifer in southern Delamar Valley to flow toward the south into Coyote Spring Valley.

Trends

Only a few monitoring wells in these basins have been used for long-term water-level recordings. Five wells completed for the MX missile-siting program have reliable water-level data that extend back to the early 1980s. Water-level data for a well completed in the carbonate-rock aquifer system in Dry Lake Valley indicate that there has been a gradual increase in water levels of approximately 5 feet over the past 25 years. Hydrographs for wells completed in the basin-fill sediments also tend to show a gradual water-level increase of as much as several feet over the past 1 to 2 decades (SNWA 2008).

Additional Water Level Data for the Great Salt Lake Desert Regional Groundwater Flow System

The USGS recently published an updated regional potentiometric map of the Great Basin carbonate and alluvial aquifer system that includes Spring Valley, Snake Valley, and adjacent areas in eastern Nevada and western Utah (Gardner et al. 2011). This study included the results of recent (2007 to 2010) drilling by the UGS and USGS. At 20 sites, water levels were measured in "nested wells." Sites with nested wells include two or more monitoring wells designed and constructed to monitor water levels at different depths to evaluate vertical gradients. Several of the nested well sites include one or more wells with screened (or open zones) in the basin fill; and another well screened in the deeper carbonate bedrock. Water-level data from these particular nested well sites were used to evaluate the hydraulic connection between basin fill and consolidated bedrock. With respect to vertical gradients and hydraulic interconnection between the basin-fill and carbonate rock aquifers Gardner et al. (2011) state:

> *"Throughout the study area, water levels in neighboring consolidated-rock and basin-fill wells, and in nested observation wells, were found to be similar, indicating that consolidated-rock and basin-fill aquifers are hydraulically connected. The current map, therefore, is assumed to represent a single aquifer system. This assumption is consistent with the conceptualization of Sweetkind and others (2011b) in which water levels in shallow alluvium were considered to be in hydraulic connection with the underlying permeable bedrock."*

Groundwater Budget Estimates

A groundwater budget is a basic accounting of the inflows and outflows from an aquifer system in a specific area. Water budgets provide a means to quantitatively evaluate the availability and sustainability of a water resource (Healy et al. 2007). Under predevelopment conditions, the major components of inflow in a groundwater system include recharge from precipitation and groundwater inflow from adjacent basins. The principal groundwater outflow components include discharge of groundwater by ET and groundwater that leaves the area as subsurface flow in the aquifer system.

A *groundwater budget* is a basic accounting of the inflows and outflows from an aquifer system in a specific area.

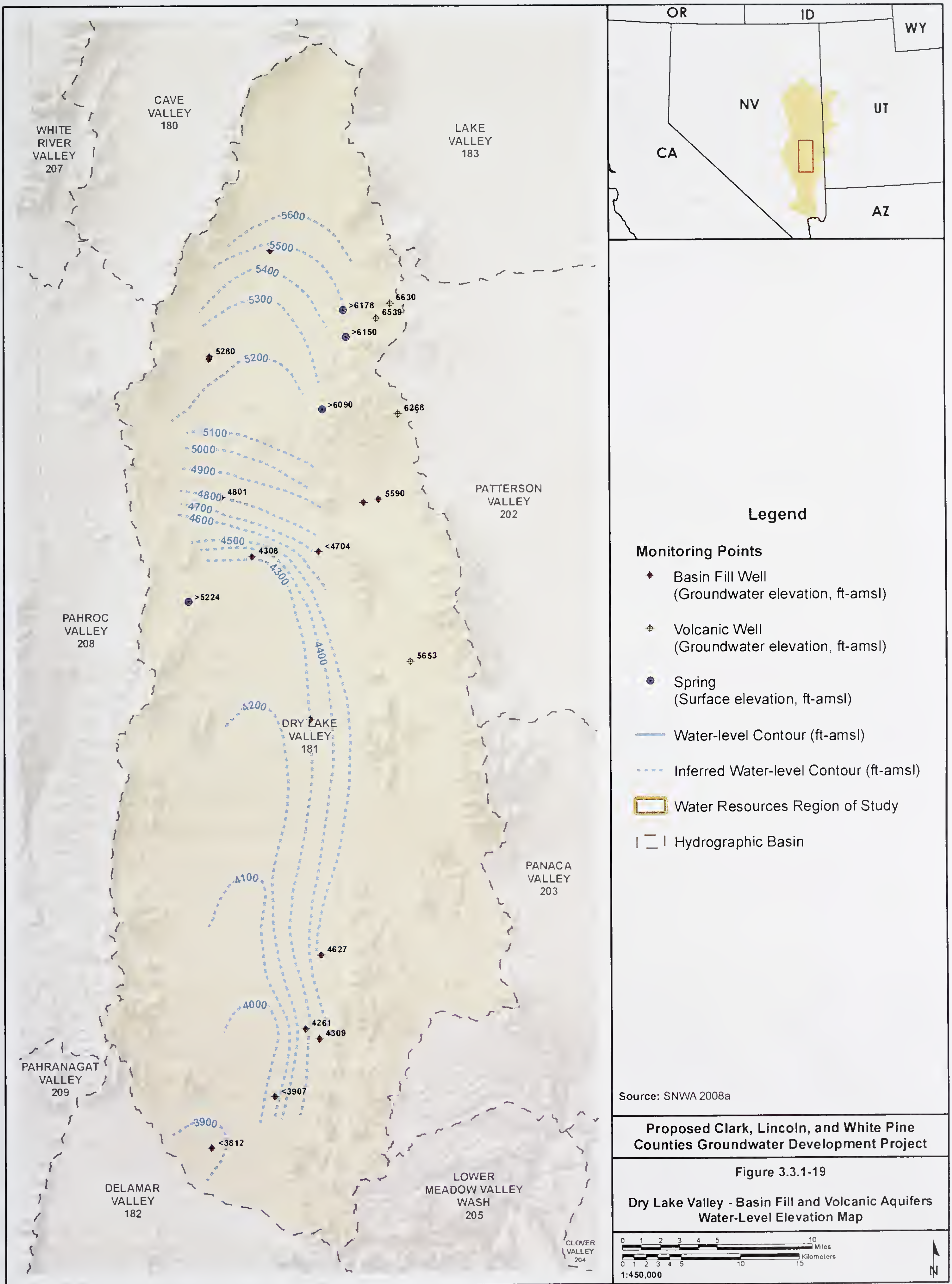
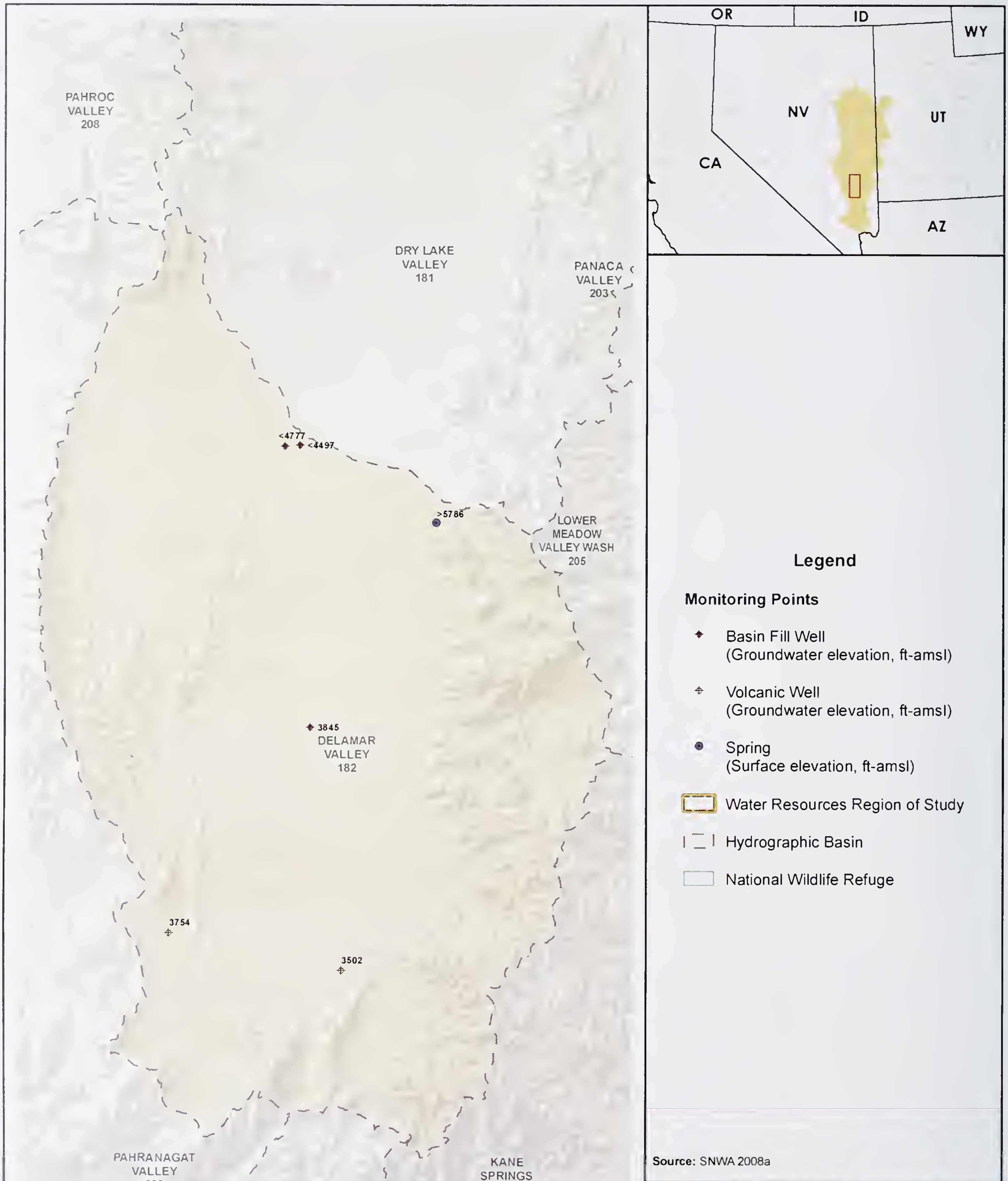


Figure 3.3.1-19

Dry Lake Valley - Basin Fill and Volcanic Aquifers Water-Level Elevation Map



Source: SNWA 2008a

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.1-20

Delamar Valley - Basin Fill and Volcanic Aquifers Water-Level Elevation Map

1:300,000

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

This section provides an overview of past and relatively recent water-balance estimates developed for the five basins identified for the Proposed Action and alternatives. In the 1960s and 1970s, the USGS, in cooperation with the State of Nevada, conducted water-resource reconnaissance studies throughout Nevada. These studies were intended to evaluate the availability of groundwater resources within specific hydrographic basins. These reports typically provide an estimate of recharge and ET and discuss groundwater subsurface flow into or out of the hydrographic basins. Recharge to the groundwater system from direct precipitation was estimated using an empirically derived relationship between precipitation and recharge developed by Maxey and Eakin (1949). Water resource reconnaissance reports are available for all of the basins within the region of study. The recently completed USGS BARCAS study (Welch et al. 2007) provides a re-evaluation of the recharge and groundwater discharge components for basins in the northern portion of the region of study, including three (i.e., Spring Valley, Snake Valley, and Cave Valley) of the five basins that would be developed under the Proposed Action. Precipitation recharge to groundwater was estimated using a mathematical model known as the Basin Characterization Model, which incorporates data sets for geology, soils, vegetation, air temperature, slope, aspect, potential ET, and precipitation (Flint and Flint 2007). Groundwater ET discharge was re-evaluated by using the Landsat Thematic Mapper (TM) to map ET units. The ET units were selected to correspond to different vegetation and soil conditions common to ET areas. The ET losses were estimated by determining the acreages of land cover types within each basin for each ET unit, multiplying the acreages by a coefficient to estimate ET losses, and summing the losses for each unit to estimate the total ET losses within each area.

The *Basin Characterization Model* (BCM) incorporates data sets for geology, soils, vegetation, air temperature, slope aspect, potential ET, and precipitation to create a mathematical estimate of the precipitation recharge to groundwater in a given basin.

The BARCAS study used a groundwater-accounting computer model to evaluate potential groundwater flow between the hydrographic basins. The computer model is described as a simplified, mass-balance mixing model that uses deuterium as a trace. The model was based on deuterium concentrations from sites distributed throughout the BARCAS region of study (Welch et al. 2007).

The SNWA has completed several studies in the past several years; these studies were submitted as exhibits to provide estimates of water availability for water rights hearings for Coyote Spring Valley (LVVWD 2001), Spring Valley (SNWA 2006), and Delamar, Dry Lake, and Cave valleys (SNWA 2008). Recharge to the groundwater system from precipitation was estimated by using an empirically derived relationship between precipitation, recharge, and altitude, similar to that developed by Maxey and Eakin (1949). The revised Maxey-Eakin relationship is based on a distribution of average annual precipitation, derived from the PRISM (Parameter-elevation Regressions on Independent Slopes Model) into zones where each zone is related to groundwater recharge via empirically derived recharge coefficients. Recent studies by the SNWA (SNWA 2008, 2006) also have used remote sensing imagery to map the ET units and have estimated ET by using methods similar to those used by the USGS for the BARCAS (Welch et al. 2007).

Recent compilations of published and unpublished water-balance estimates for the hydrographic basins within the region of study are discussed in the BARCAS study (Welch et al. 2007), SNWA documents (LVVWD 2001; SNWA 2009a, 2008, 2006), and Burbey (1997).

Spring Valley

Selected water-balance estimates for the Spring Valley HA are presented on **Table 3.3.1-13**. Rush and Kazmi (1965) conducted the first comprehensive evaluation of the water resources in Spring Valley. They estimated that the average annual groundwater recharge for the Spring Valley HA was 75,000 afy. Of this 75,000 afy of recharge, Rush and Kazmi (1965) estimated that an average of approximately 70,000 afy was consumed by ET on the valley floor; 4,000 afy was discharged from the southeastern boundary into Hamlin Valley; and (in 1964) less than 1,000 acre feet of groundwater was pumped for stock, domestic, and irrigation use.

The SNWA presented estimates of the water balance for Spring Valley at the hearings for their water rights applications in Spring Valley (SNWA 2006). At that time, SNWA estimated that the average annual groundwater inflow to Spring Valley consisted of 98,800 afy of precipitation recharge and 2,000 afy of groundwater subflow from

Table 3.3.1-13 Estimated Groundwater Inflow and Outflow for the Spring Valley Hydrologic Area (afy)[1]

Water Balance Component	Rush and Kazmi (1965)	SNWA (2006)	Welch et al. (2007)	SNWA (2009a)[2]
Groundwater Inflow				
Precipitation Recharge (Direct and Mountain Front Recharge)	75,000	98,800	93,100	81,300
Groundwater Inflow from Tippet Valley HA		2,000	0	
Groundwater Inflow from Steptoe Valley HA			4,000	
Groundwater Inflow from Lake Valley HA			29,000	
Total Inflow	**75,000**	**100,800**	**126,100**	**81,300**
Groundwater Outflow				
ET	70,000			75,600
Natural Vegetation and Dry Playa		90,000	72,000	
Irrigated Crops		5,800	4,000	
Other Groundwater Uses (mining and milling, stock water, quasi-municipal, wildlife)	<1,000	300	100	
Groundwater Outflow to Tippets Valley HA			2,000	
Groundwater Outflow to Snake Valley HA			16,000	
Groundwater Outflow to Hamlin/Snake HA	4,000	4,000	33,000	5,700
Total Outflow	**75,000**	**100,100**	**127,100**	**81,300**
Storage Estimates				
Estimated Groundwater Storage (upper 100 feet saturated basin fill)	4,200,000		3,788,000	

[1] Estimates rounded to the nearest hundred afy.

[2] Estimated predevelopment steady-state groundwater budget.

Tippets Valley HA (SNWA 2006). Groundwater outflow from Spring Valley included losses through ET from native vegetation and playas (90,000 afy), crop irrigation (5,800 afy), other uses (300 afy), and discharge to Hamlin Valley (4,000 afy).

The groundwater balance derived from estimates provided in the BARCAS study (Welch et al. 2007) suggests that there is substantially more groundwater moving through the Spring Valley HA than previously recognized. The BARCAS water budget estimates indicate that in addition to recharge (93,100 afy), groundwater flows from the west into the basin from Steptoe Valley (4,000 afy) and Lake Valley (29,000 afy). Although the ET estimates for natural vegetation and playa areas are similar to the estimates in the water resources reconnaissance report (Rush and Kazmi 1965), the BARCAS study indicates that a large percentage of the groundwater moving through the basin discharges as subsurface flow into the adjacent Snake and Hamlin valleys HAs (49,000 afy) to the west and the Tippet Valley HA (2,000 afy) to the north.

The SNWA provided new estimates of the steady-state predevelopment (i.e., prior to any groundwater development) groundwater budget for each basin within the hydrologic study area in the Conceptual Model Report (SNWA 2009a). These estimates indicate that groundwater inflow to the Spring Valley consists of 81,000 afy of precipitation recharge with no groundwater inflow from adjacent basins. Groundwater discharged from the basin was estimated at 76,000 afy to ET and 6,000 afy as groundwater outflow to the Hamlin Valley HA.

Snake Valley

Both the water resources reconnaissance report (Hood and Rush 1965) and the BARCAS study (Welch et al. 2007) define Snake Valley as the combination of the Snake Valley HA (Hydrographic Basin 195) and the Hamlin Valley HA (Hydrographic Basin 196), as designated by the NDWR (2009). Note that the NSE administers water rights individually for each of these basins. The baseline data reports for this project also address resources individually for each of these basins (SNWA 2008).

Selected water-balance estimates for groundwater inflow and outflow to the combined Snake Valley/Hamlin Valley HA are listed in **Table 3.3.1-14**. The water resources reconnaissance report estimates that the average groundwater inflow into this area (104,000 afy) is comprised of 100,000 afy of precipitation recharge and 4,000 afy of groundwater inflow from southern Spring Valley to Hamlin Valley (Hood and Rush 1965). The average annual groundwater outflow from this area is estimated to consist of 80,000 afy of ET from phreatophytes in the valley bottom; 7,000 afy pumped from wells used for irrigation and other uses; and 10,000 afy of groundwater that discharges through the alluvium across the north boundary of the Snake Valley HA into the Great Salt Lake Desert hydrographic basin (Hood and Rush 1965). Hood and Rush (1965) assumed that the difference between the estimated inflow and outflow components is groundwater that is discharged out of the area through the carbonate rock system. Using estimates provided in Hood and Rush (and accounting for losses from groundwater use for irrigation and other uses), the net difference is 7,000 afy.

Table 3.3.1-14 Estimated Groundwater Inflow and Outflow for the Combined Snake and Hamlin Valleys Hydrographic Basins (afy)[1]

Water Balance Component	Hood and Rush (1965)	Welch et al. (2007)	SNWA (2009a)[3]
Groundwater Inflow			
Precipitation Recharge (Direct and Mountain Front Recharge)	100,000	111,000	151,000
Groundwater Inflow from Spring Valley HA	4,000	49,000	5,700
Total Inflow	**104,000**	**160,000**	**156,700**
Groundwater Outflow			
ET (Natural Vegetation and Playa)	80,000	124,000	132,300
Irrigated Crops	7,000	8,000	
Other Groundwater Uses (mining and milling, stock water, quasi-municipal, wildlife)			
Groundwater Outflow to Great Salt Lake Desert HA to north	10,000	29,000	
Groundwater Outflow to Carbonate Rock System to east[2]	7,000	0	
Groundwater Outflow to Great Salt Lake Desert Flow System (to north and east)			24,400
Total Outflow	**104,000**	**161,000**	**156,700**
Storage Estimates			
Estimated Groundwater Storage (upper 100 feet saturated basin fill)	12,000,000	8,944,900	

[1]Estimates rounded to the nearest hundred afy.

[2]Estimated using the difference between inflow and outflow components provided in Hood and Rush (1965).

[3]Estimated predevelopment steady-state groundwater budget provided in Appendix I, SNWA 2009a.

The groundwater budget derived from recent estimates developed for the BARCAS study (Welch et al. 2007) is provided in **Table 3.3.1-14**. The results of the BARCAS study suggest that substantially more groundwater is moving through the Hamlin and Snake valleys hydrographic basins than was estimated in the water resources reconnaissance report (Hood and Rush 1965). The BARCAS water budget estimates that the total groundwater inflow to the area is 160,000 afy, comprising 111,100 afy of precipitation recharge and 49,000 afy of groundwater inflow from the Spring Valley HA. The BARCAS study results infer that groundwater inflow from the Spring Valley HA occurs in two general areas. The first area is between the Kern Mountains and Snake Range, along the northeast boundary of the Spring Valley HA, where estimated groundwater inflows of 16,000 afy flow into the northern portion of Snake Valley. The second area is along the southeast boundary of the Spring Valley HA, where an estimated 33,000 acre foot per year of water is inferred to flow into Hamlin Valley south of the Snake Range.

The BARCAS study estimates that groundwater outflow from the area occurs through ET (124,000 afy), pumping for crop irrigation (8,000 afy), and groundwater outflow (29,000 afy) (Welch et al. 2007). Most of the groundwater outflow is inferred to discharge across the northern boundary of Snake Valley into the Great Salt Lake Desert HA.

The SNWA estimates of the steady-state predevelopment quantities provided in the Conceptual Model Report (SNWA 2009a) indicates groundwater inflow to the combined Snake and Hamlin Valley HAs consists of 151,000 afy of precipitation recharge and 5,700 afy of groundwater inflow from the Spring Valley HA. Groundwater discharged from the basin was estimated at 132,300 afy to ET and 24,400 afy outflow to the Great Salt Lake Desert Flow System along the boundary of the study area. Compared to the BARCAS water balance estimates, the SNWA estimate assumes greater inflow from recharge, and substantially less groundwater inflow from Spring Valley. However, the total inflow estimates for the BARCAS study (160,000 afy) and SNWA conceptual model (156,700 afy) are similar.

Cave Valley

The water resource reconnaissance study (Eakin 1962) for the Cave Valley HA estimated the average annual recharge at 14,000 afy (**Table 3.3.1-15**). The reconnaissance study also indicates that ET is no more than a few hundred acre feet per year and estimates that most of the recharge leaves Cave Valley by subsurface flow toward the west and southwest. Harrill et al. (1988) interpret that the approximately 14,000 afy estimated by Eakin (1962) flows west into the White River HA.

Table 3.3.1-15 Estimates of Groundwater Inflow and Outflow for the Cave Valley Hydrologic Area (afy)[1]

Water Budget Component	Eakin (1962)	Welch et al. (2007)	SNWA (2007)	SNWA (2009a)
Groundwater Inflow				
Precipitation Reeharge	14,000	11,000	14,700	15,000
Groundwater Inflow from adjacent basins	0	0	0	0
Total Inflow	**14,000**	**11,000**	**14,700**	**15,000**
Groundwater Outflow				
ET	few 100	1,600	1,300	1,500
Groundwater Outflow:	about 14,000			
Outflow to White River Valley HA		9,000	4,000	13,500
Outflow to Pahroe Valley HA			9,400	
Total Outflow	**about 14,000**	**10,600**	**14,700**	**15,000**
Storage Estimates				
Estimated Groundwater Storage (upper 100 feet saturated basin fill)	1,000,000		805,200	

[1]Estimation rounded to the nearest hundred afy.

The BARCAS study estimates the average groundwater recharge for the Cave Valley at 11,000 afy. Under predevelopment conditions, the BARCAS study estimates that of the 11,000 afy recharge, 1,600 afy is discharged by ET and that the remaining balance (9,000 afy) leaves the hydrographic basin by subsurface flow out to the White River Valley (Welch et al. 2007).

The SNWA's water budget prepared for the 2008 water rights hearings for the Delamar, Dry Lake, and Cave HAs estimate that approximately 14,700 afy of recharge in the Cave Valley HA (SNWA 2007). Groundwater outflow from the Cave Valley HA was estimated to consists of 1,300 afy from ET, and groundwater outflow to the White River Valley HA (4,000 afy) and Pahroc Valley HA (9,400 afy). The SNWA's revised estimates provided in the Conceptual Model Report (SNWA 2009a) are similar to the 2007 estimates. The SNWA estimate for total inflow and outflow (15,000 afy) are similar to Eakin's (Eakin 1962) estimate (14,000 afy) and approximately 33 percent greater than those estimated in the BARCAS study (Welch et at. 2007) (11,000 afy).

Dry Lake Valley

Selected estimates of groundwater inflow and outflow to the Dry Lake Valley HA are listed in **Table 3.3.1-16**. The water resources reconnaissance report for Dry Lake Valley (Eakin 1963) estimates that the average recharge for Dry Lake Valley is 5,000 afy and that all or nearly all of the recharge discharges by subsurface flow into Delamar Valley.

Table 3.3.1-16 Estimates of Groundwater Inflow and Outflow for the Dry Lake Valley Hydrographic Basin (afy)[1]

Water Budget Component	Eakin (1963)	SNWA (2007)	SNWA (2009a)
Groundwater Inflow			
Precipitation Recharge	5,000	15,700	16,200
Groundwater Inflow from Pahroc Valley HA		2,000	2,000
Total Inflow	**5,000**	**17,700**	**18,200**
Groundwater Outflow			
ET	Minor	0	0
Groundwater Outflow to Delamar Valley HA	5,000	17,700	18,200
Total Outflow	**5,000**	**17,700**	**18,200**
Storage Estimates			
Estimated Groundwater Storage (upper 100 feet saturated basin fill)			

[1]Estimation rounded to the nearest hundred afy.

The SNWA's (2007) estimates (prepared for the 2008 water rights hearings for the Delamar, Dry Lake, and Cave HAs) indicate that the Dry Lake Valley hydrographic basin receives approximately 15,700 afy of recharge and 2,000 afy of subflow from the Pahroc Valley hydrographic basin. The total inflow of 17,700 afy discharges as subflow into Delamar Valley. The SNWA's revised estimates provided in the Conceptual Model Report (SNWA 2009a) are similar to their 2007 estimates. These estimates suggest there is approximately 3 times more recharge in this HA than originally estimated by Eakin (Eakin 1963).

Delamar Valley

The water resources reconnaissance report (Eakin 1963) estimates that the average recharge for Delamar Valley HA is 1,000 afy, and subsurface flow from the Delamar Valley HA is approximately 5,000 afy (**Table 3.3.1-17**). There is essentially no ET in the valley, and all of the inflow discharges as groundwater outflow. SNWA (2007) estimates a much higher recharge and subsurface flow from Delamar Valley HA and assumes the entire inflow (24,100 afy) discharges into Coyote Spring Valley HA. The recently revised groundwater budget provided in the Conceptual Model Report (SNWA 2009a) is very similar to the earlier 2007 estimate.

Table 3.3.1-17 Estimates of Groundwater Inflow and Outflow for the Delamar Valley Hydrographic Basin (afy)[1]

Water Balance Component	Eakin (1963)	SNWA (2007)	SNWA (2009a)
Groundwater Inflow			
Precipitation Recharge	1,000	6,400	6,600
Groundwater Inflow from Dry Lake Valley HA	5,000	17,700	18,200
Total Inflow	**6,000**	**24,100**	**24,800**
Groundwater Outflow			
ET	0	0	0
Groundwater Outflow (Coyote Spring Valley HA)	6,000	24,100	**24,800**
Total Outflow	**6,000**	**24,100**	**24,800**
Storage Estimates			
Estimated Groundwater Storage (upper 100 feet saturated basin fill)			

[1] Estimation rounded to the nearest hundred afy.

[2] Assumed to be equal to recharge.

3.3.1.6 Water Quality

Groundwater quality generally is controlled by the composition of the water that reaches an aquifer and its subsequent interactions with aquifer materials. Groundwater quality also is affected by the length of time that the groundwater is in contact with aquifer materials and can change with distance along a flow path. Some of the processes that influence groundwater quality that have been identified in the regional aquifer systems of the Great Basin include dedolomitization (gypsum and dolomite dissolution and calcite precipitation, which releases sulfate and magnesium ions), exchange of calcium and magnesium in the groundwater for sodium in clays, and dissolution of volcanic rock (which releases sodium to the groundwater). In some localized areas, calcium, sodium, sulfate, and chloride are released to groundwater by gypsum and halite dissolution.

Three aquifer types have been identified in the region of study: carbonate, volcanic, and basin-fill. The general baseline characteristics of groundwater associated with these three aquifer types have been described by SNWA (2008). Groundwater from carbonate-rock aquifers tends to have a calcium-bicarbonate composition with varying amounts of magnesium and sulfate; this water corresponds to the calcium-magnesium-bicarbonate groundwater facies described by Winograd and Thordarson (1975). Groundwater associated with volcanic rocks in the Great Basin generally has a sodium-potassium-bicarbonate composition with a lower pH than groundwater associated with carbonates. The composition of groundwater associated with valley fill generally is a function of the source of the valley fill. Calcium-magnesium-bicarbonate water occurs in basin-fill aquifers composed chiefly of carbonate-rock material (Winograd and Thordarson 1975; SNWA 2008). The SNWA (2008) identified sodium, chloride, and sulfate as the dominant constituents in basin-fill aquifers composed mainly of volcanic rocks. Valley-fill aquifer materials composed of a mixture of volcanic and carbonate rocks produce mixed-cation groundwater compositions (Winograd and Thordarson 1975; SNWA 2008).

The water quality in the region of study generally is good. The composition of the groundwater generally is controlled by its interaction with the deeper carbonate-rock aquifer material. Interaction between the groundwater and volcanic material and evaporites commonly results in increased sodium, sulfate, and chloride concentrations with groundwater transport distance in the White River Flow System. Concentrations of minor elements usually are low; all water samples from the Great Salt Lake Regional Flow System had minor element concentrations below the USEPA maximum contaminant levels (MCLs). However, the majority of the arsenic values from Coyote Spring Valley in the White River Flow System exceeded the USEPA MCL of 10 micrograms per liter. Some samples from both flow systems exceeded MCLs, including pH, chloride, and sulfate in the Great Salt Lake Desert Regional Flow System and aluminum, iron, manganese, and total dissolved solids (TDS) in the White River Flow System.

Characterization of the water quality and stable isotope concentrations in the Great Salt Lake Desert, and White River Flow Regional Flow Systems, including water-quality summary tables for each flow system, is provided in **Appendix F3.3.4**.

3.3.1.7 Water Rights and Water Use

Water law in both Nevada and Utah are based on the doctrine of prior appropriation, or first in time – first in right, and is administered by the respective State Engineer. Nevada's water law is contained in Nevada Revised Statutes, Chapters 532 through 538; Utah's water law is contained in Utah Code, Title 73. Both states' laws provide that water is the property of the state's public, and a water right is the right to put that water to beneficial use. The basis of a water right is the beneficial use. The process of obtaining a water right in both states begins with applying for an appropriation and ends with the right being "perfected" through filing proof of beneficial use or through final adjudication.

Adjudication is a state initiated finalization process for beneficial uses that existed prior to the law establishing a permit system of the respective states, and uses established through federal reserved water rights (discussed later in this section). Adjudication may be requested by the entity that manages the lands containing the right (e.g., private landowner, Tribe, or federal agency), or initiated by the state.

Active water rights within the hydrologic study area were inventoried to identify the location and status of water rights. The inventory was based on water rights records on file with the NDWR. Water rights on file with the Utah Division of Water Rights (UDWRi) also were inventoried for the Utah portion of the study area. The water rights are summarized in **Appendix F3.3.2**. The summary tables list the point of diversion, type of water rights permit, owner, water source (such as stream, spring, or underground), beneficial use, and annual duty (i.e., quantity of water use per year allocated by the water rights permit) for the each water right. The water source identified for water rights associated with water-well development in the water-rights databases for both states is referred to as "underground." For descriptive purposes in this EIS, water rights that are listed with an "underground" source designation are informally referred to as "groundwater rights."

The points of diversion for active surface water rights and groundwater rights within the region of study are shown on **Figures 3.3.1-21** and **3.3.1-22**, respectively. The surface water and groundwater rights for each of the basins within the study area are summarized in **Tables 3.3.1-18** and **3.3.1-19**, respectively.

State Water Rights held by Federal Bureaus

Federal bureaus have established state water rights in both states through the processes administered by the respective State Engineer. **Figure 3.3.1-23** depicts those water rights held by federal bureaus as returned by searches of NDWR and UDWRi water rights databases.

Nevada records both state-perfected water rights and state-adjudicated federal reserved water rights for federal bureaus.

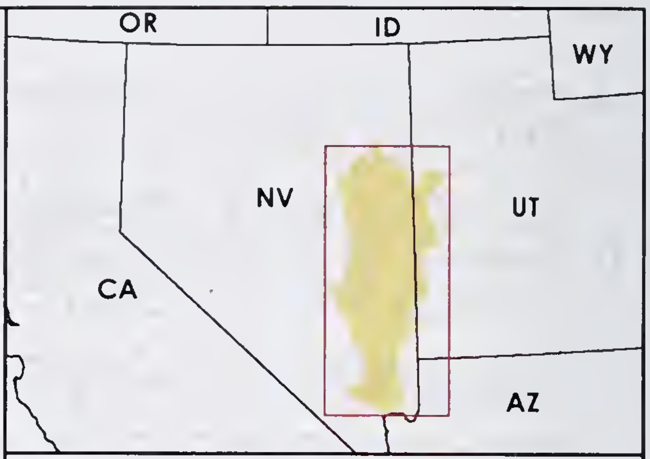
In Utah, "diligence claims" have been filed in the project area by the BLM for the establishment of multiple water rights. Diligence claims are Utah's vehicle for establishing and recording beneficial uses of surface water prior to 1903 or groundwater prior to 1935.

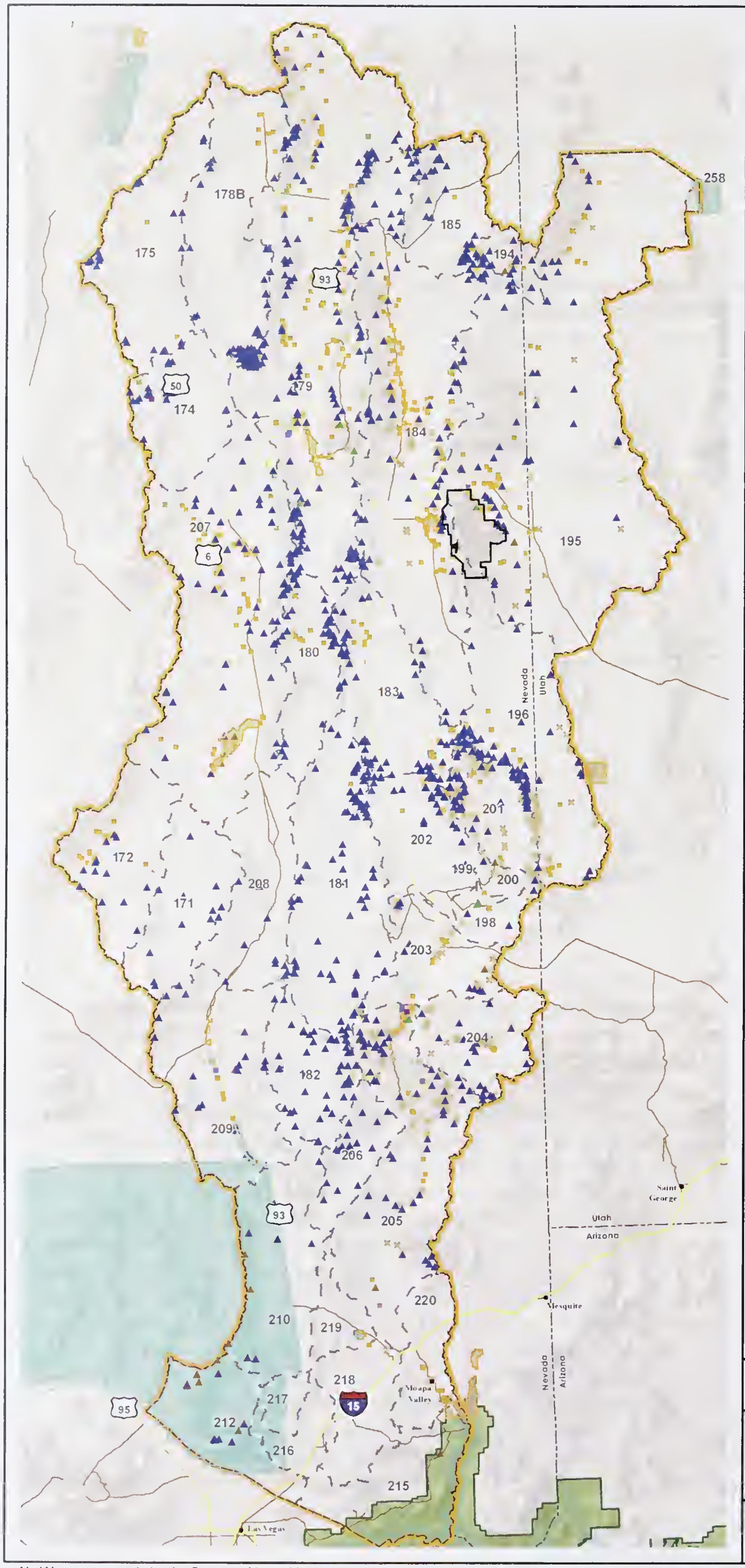
Federally Reserved Water Rights

The federally reserved water rights doctrine was originally established in 1908 by the U.S. Supreme Court in *Winters v. United States*, and is commonly known as the "Winters Doctrine." In a conflict over competing use of surface water between non-Indian settlers and Indians on the Fort Belknap Reservation in Montana, the U.S. Supreme Court held that when the Reservation lands were reserved by a 1888 agreement, water rights for the Indians also were reserved by necessary implication for farming and pastoral purposes. The Winters Doctrine was upheld and further defined by the U.S. Supreme Court in *Arizona v. California* (1964). The U.S. Supreme Court held that the doctrine applied to the establishment of a Reservation by treaty, statute or EO; that the water rights are reserved as of the date of creation of the Reservation; that the quantity of water reserved for Indian use is that amount sufficient to irrigate all the practicably irrigable acreage of the Reservation; and that the rights are not lost by non-use. The doctrine has been defined further in the state general stream adjudication process authorized by the McCarren Amendment (43 U.S.C. 666). In: *In Re the General Adjudication of All Rights To Use Water In The Gila River System and Source, W-1 (Salt), W-2 (Verde), W-3 (Upper Gila), W-4 (San Pedro) (Consolidated)*, the Arizona Supreme Court ruled that the homeland purpose is a valid Reservation purpose and that there is a reserved right to groundwater. The Homeland purpose has been interpreted to include a variety of water uses, including recreation, agriculture, domestic use, stock watering, commercial, and industrial uses.

The federally reserved water rights doctrine also applies to Reservations for non-Indian purposes, such as for National Parks (NPs), National Wildlife Refuges, certain BLM lands, and National Forests, although the U.S. Supreme Court has interpreted the uses of reserved water rights for non-Indian purposes more narrowly than the Indian reserved water rights. See *United States v. New Mexico* (1978) and *Cappaert v. United States* (1976). These rights, similar to the Indian reserved rights discussed previously, include the amount of water necessary to fulfill the primary purposes of the federal Reservation, with a priority date of the establishment of the Reservation. Water is taken from the unappropriated water at the time of creation of the Reservation. The right does not arise by use nor can it be lost by nonuse. Water is reserved for both present and future needs. The most common type of federal reserved water rights on BLM lands in the project area are Public Water Reserves (PWR), which set aside certain quantities of water from public water holes and springs for human and animal consumption. PWR were originally established on an individual basis; the earliest being PWR No. 1 established in 1912, which included wetland areas in Snake Valley. President Coolidge issued the EO of April 17, 1926, that created PWR No. 107 that reserved water yields from springs and natural water holes for human and animal consumption over vast tracks of public lands. Because of this, the vast majority of state-recognized PWRs hold the priority date of the EO.

The locations of federal reserved water rights included in the NDWR water rights database within the region of study, along with state-adjudicated water rights held by federal bureaus in both Nevada and Utah are shown on **Figure 3.3.1-23**. No federal reserved water rights were returned through searches of the UDWRi database, potentially because such rights in Utah have been established through "diligence claims" as discussed above. The federal reserved





Legend

Water Rights (Manner of Use)

- Commercial
- Industrial
- Mining and Milling
- Municipal
- Storage
- Domestic
- Irrigation
- Stockwatering
- Recreational
- Wildlife
- Other
- Interstate Highway
- US Highway
- Major Road
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Source: Nevada Division of Water Resources and Utah Division of Water Rights

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.1-21

Surface Water Rights

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000

N

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

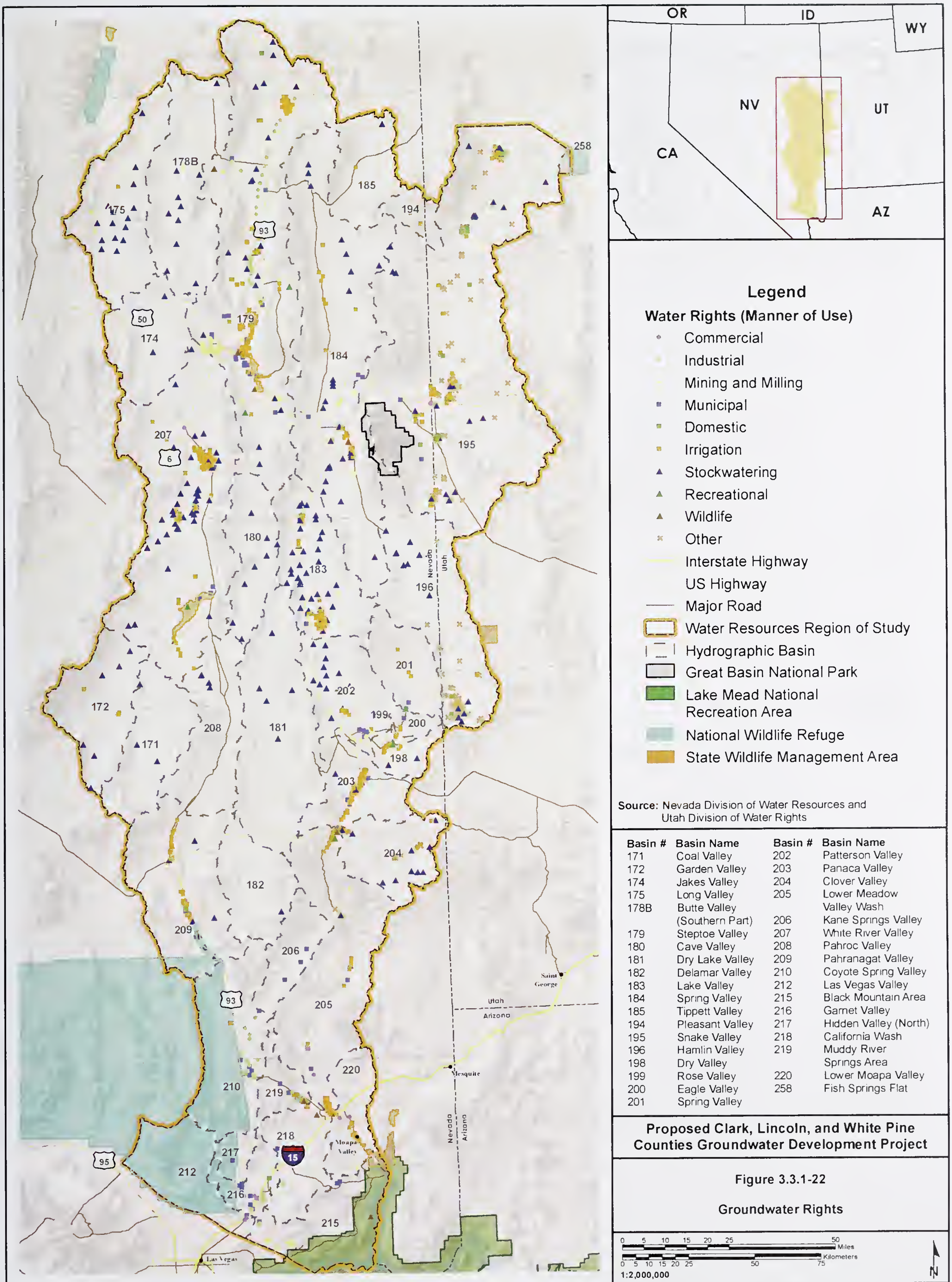


Figure 3.3.1-22

Groundwater Rights

Table 3.3.1-18 Surface Water Rights Summary Table (Number of Surface Water Rights)

GW Flow System	Basin Number	Basin Name (Upgradient to Downgradient)	Commercial	Industrial	Mining and Milling	Municipal	Domestic	Irrigation	Stockwatering	Storage	Recreational	Wildlife	Other	Total
White River	175	Long Valley						2	20					22
	174	Jakes Valley				2	1	3	27	4				37
	207	White River Valley		7	1	3	2	74	59			4	2	152
	180	Cave Valley					1	11	47				2	61
	172	Garden Valley					1	16	14					31
	171	Coal Valley							13					13
	208	Pahroc Valley							10				1	11
	181	Dry Lake Valley						3	88				1	92
	209	Pahranagat Valley				1		11	20				3	35
	182	Delamar Valley			1	2		1	46				2	52
	206	Kane Springs Valley							18					18
	210	Coyote Spring Valley							8			3		11
	219	Muddy River Springs Area		4		2	1	8				1		16
	218	California Wash											1	1
	220	Lower Moapa Valley						11				2	2	15
	215	Black Mountains Area										1		1
Goshute Valley	179	Steptoe Valley		10	8	7	2	100	179	1	3	9	10	329
	178B	Butte Valley (Southern Part)						11	38					49
Salt Lake Desert	196	Hamlin Valley					2	20	57				20	99
	185	Tippett Valley						5	34					39
	184	Spring Valley (184)		1	16		1	115	90				30	253
	194	Pleasant Valley						7	19			1		27
	195	Snake Valley		2		1	1	58	61		1	2	24	150
	258	Fish Springs Flat											2	2
Meadow Valley	183	Lake Valley			1	3		22	49				1	76
	201	Spring Valley (201)						7	62			1	47	117
	202	Patterson Valley			1			5	37				2	45
	200	Eagle Valley						1	2				6	9
	198	Dry Valley						4	3		1		3	11
	203	Panaca Valley	1			3		8	8			1	17	38
	204	Clover Valley						2	20				29	51
	205	Lower Meadow Valley Wash	1		2	3		21	48	1	3	2	60	141
Las Vegas	212	Las Vegas Valley							7			13		20
Total			**2**	**24**	**30**	**27**	**12**	**526**	**1084**	**6**	**8**	**40**	**265**	**2024**

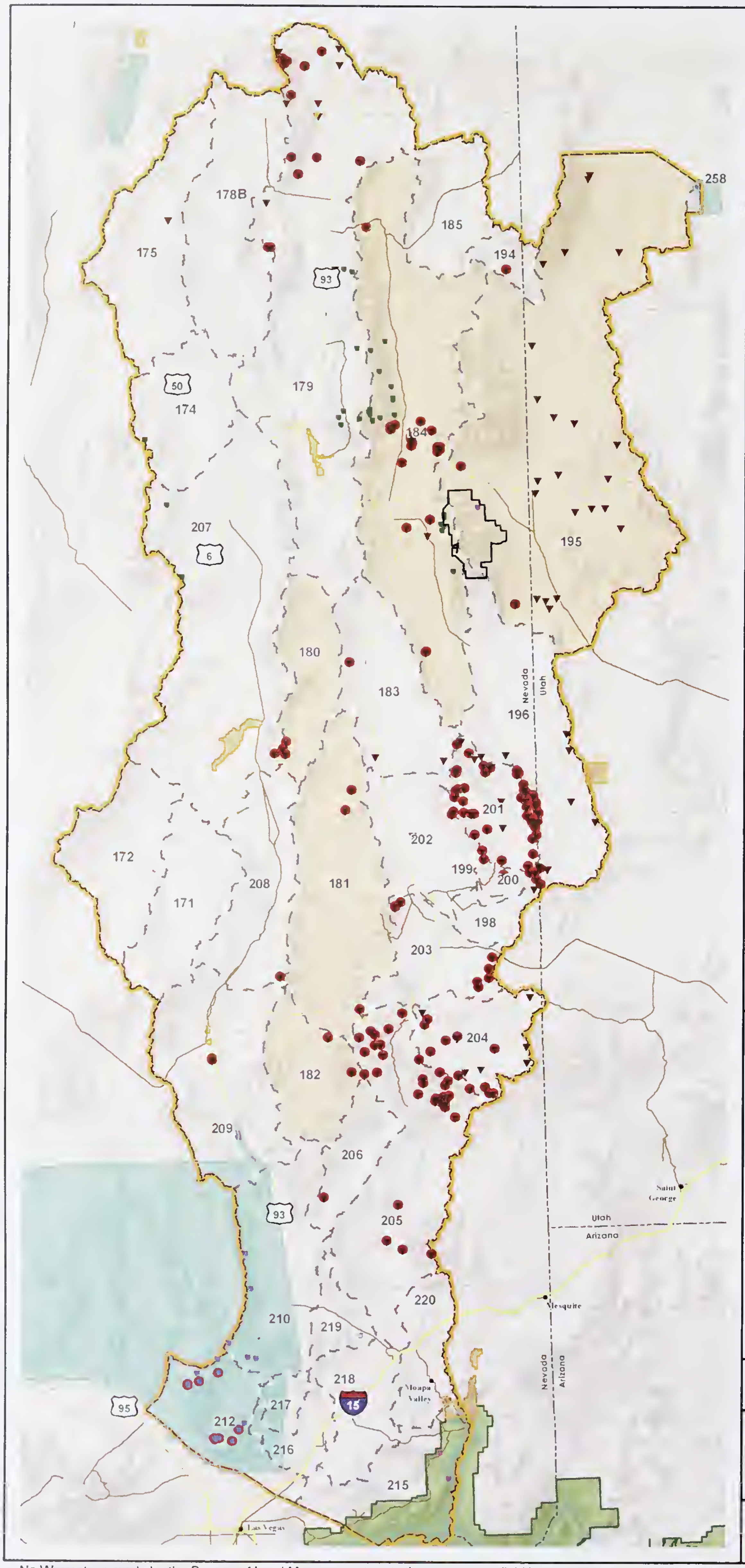
[1]The "other" category applies to water rights in Nevada or Utah where the use is not specified (see Water Rights Inventory, Appendix F3.3.2).
[2]Does not include water rights in the Fish Springs Flat HA since most of this HA is located outside of the study area boundary.

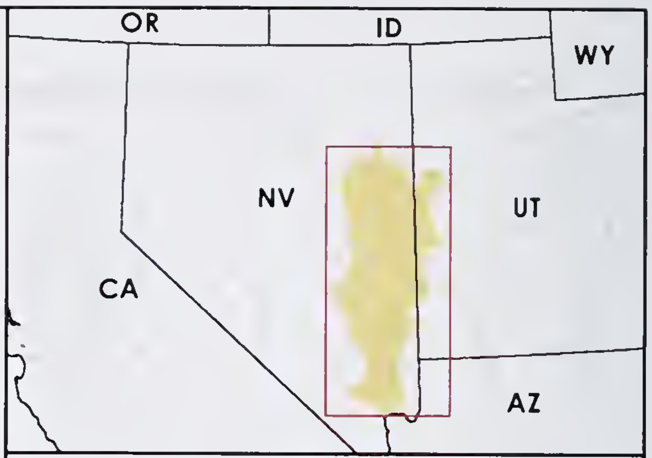
Table 3.3.1-19 Groundwater Rights Summary Table (Number of Groundwater Rights)

GW Flow System	Basin Number	Basin Name (Upgradient to Downgradient)	Commercial	Industrial	Mining and Milling	Municipal	Domestic	Irrigation	Stockwatering	Recreational	Wildlife	Other	Total
White River	175	Long Valley			5			1	15				21
	174	Jakes Valley							2				2
	207	White River Valley	2		6	8		83	44	1		1	145
	180	Cave Valley							8				8
	172	Garden Valley		1				3	6				10
	171	Coal Valley							3				3
	208	Pahroc Valley							4				4
	181	Dry Lake Valley			1				5				6
	209	Pahranagat Valley	4			7	1	34	8		2		56
	182	Delamar Valley							1				1
	206	Kane Springs Valley				4							4
	210	Coyote Spring Valley		16		4		1					21
	219	Muddy River Springs Area	3	30		5		17			1		56
	218	California Wash		2		4		5			3		14
	220	Lower Moapa Valley	2		2	2		17					23
	217	Hidden Valley (North)				1							1
	216	Garnet Valley	3	11	1	10	1						26
	215	Black Mountains Area		3	9	7					2		21
Goshute Valley	179	Steptoe Valley	3	31	35	54	2	148	23	3	4		303
	178B	Butte Valley (Southern Part)			1				10				11
Salt Lake Desert	196	Hamlin Valley					2	4	14			44	64
	185	Tippett Valley						1	1				2
	184	Spring Valley (184)			5	3		36	28		2		74
	194	Pleasant Valley						2					2
	195	Snake Valley	3			3	21	73	37			119	256
	258	Fish Springs Flat										1	1
Meadow Valley	183	Lake Valley			1	3		69	39				112
	201	Spring Valley (201)				3		3		1			7
	202	Patterson Valley			3	8		11	14		1		37
	200	Eagle Valley				2		3					5
	199	Rose Valley						4					4
	198	Dry Valley						21	3	2			26
	203	Panaca Valley	4			8	1	73	3			7	96
	204	Clover Valley		1		4		14	12			6	37
	205	Lower Meadow Valley Wash	8	8	1	7	1	56	2	2	1	5	91
Las Vegas	212	Las Vegas Valley	2			2							4
Total			**34**	**103**	**70**	**149**	**29**	**679**	**282**	**9**	**16**	**183**	**1554**

[1] The "other" category applies to water rights in Nevada or Utah where the use is not specified (see Water Rights Inventory, Appendix F3.3.2).

[2] Does not include water rights in the Fish Springs Flat HA since most of this HA is located outside of the study area boundary.





Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
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198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.1-23

Federal Agency Water Rights within the Region of Study

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

water rights returned by the NDWR water rights database include 161 water rights owned by the BLM and 9 water rights owned by the USFWS. All of these water rights are surface water rights at springs. The manner of use listed for the BLM's water rights includes "other" (143), stockwatering (15), wildlife (2), and irrigation (1). The BLM federal reserved water rights are distributed within 20 hydrographic basins, with the largest number occurring in Spring Valley (HA 184).

The USFWS federal reserved water rights returned though searches of the NDWR water rights database are all used for wildlife at locations within the Las Vegas Valley hydrographic basin. Unless the state has initiated a McCarran Amendment adjudication, federal reserved water rights would not necessarily be included in that state's database.

The unknown nature of unadjudicated federal reserved water rights, regarding both locations and quantities of water, limit the ability to further describe water use of this type in the hydrologic study area. Although the rights exist, without further judicial action there have been no details provided beyond what has been recorded by the state water administrations and what has been generally described here. The water resources in a particular flow system within the hydrologic study area would provide the source for federal reserved water rights located within that specific flow system. Even though the exact nature of these federal reserved water rights is unknown, the potential effects to water resource that supports these rights, whether surface or ground water, is described in Sections 3.3.2 and 3.3.3 in this chapter.

Proposed Pumping Basins Water Rights

The groundwater rights for each of the proposed groundwater development basins are summarized in **Table 3.3.1-20**. For Nevada, this summary is based on the data in the NDWR "Hydrographic Basin Summary by Manner of Use," downloaded from the NDWR on April 21, 2011 (NDWR 2011), and data provided by UDWRi (as summarized in SNWA 2008). **Table 3.3.1-20** includes "perennial yield" estimates for each of the hydrographic basins provided in recent NSE's water rights rulings for Spring, Delamar, Dry Lake, and Cave valleys (NDWR 2012a,b,c,d). The perennial yield is the estimated amount of groundwater available for appropriation in each basin. NDWR defines perennial yield as follows:

> "The perennial yield of a ground-water reservoir may be defined as the maximum amount of ground water that can be salvaged each year over the long term without depleting the ground-water reservoir. Perennial yield is ultimately limited to the maximum amount of natural discharge that can be salvaged for beneficial use. The perennial yield cannot be more than the natural recharge to a ground-water basin and in some cases is less. If the perennial yield is exceeded, ground-water levels will decline and steady-state conditions will not be achieved, a situation commonly referred to as ground-water mining" (NDWR 2012a).

Table 3.3.1-20 Summary of Active Groundwater Rights by Beneficial Use (afy) for the Proposed Pumping Basins

	Hydrographic Basin					
	Spring Valley[6]	Snake Valley		Cave Valley[6]	Dry Lake Valley[6]	Delamar Valley[6]
Manner of Use		Nevada	Utah			
Commercial	35	12	0	0	0	0
Domestic	0	2	111	0	0	0
Industrial	0	0	0	0	0	0
Irrigation	19,805	10,611	37,942	0	1,009	0
Mining and Milling	1,356	0	0	0	18	0
Municipal[6]	0	0	0	0	0	0
Quasi-municipal	79	56	0	0	0	0
Stockwatering	404	35	824	47	38	7
Wildlife	58	0	0	0	0	0

Table 3.3.1-20 Summary of Active Groundwater Rights by Beneficial Use (afy) for the Proposed Pumping Basins (Continued)

Manner of Use	Hydrographic Basin					
	Spring Valley[6]	Snake Valley		Cave Valley[6]	Dry Lake Valley[6]	Delamar Valley[6]
		Nevada	Utah			
Other [1]	NA	NA	1,563	NA	NA	NA
Total[2]	**21,736**	**10,715**	**40,440**	**47**	**1,066**	**7**
Perennial Yield Estimate[3]	**84,000**	**25,000[4]**		**5,600**	**15,000**	**6,100**
		80,000[5]				
Perennial Yield Reference Source:	State Engineers Ruling 6164 (NDWR 2012a)	USGS Open File Report 78-768 (Nolin 1986)	USGS Recon. 34 (Hood and Rush 1965)	State Engineer Ruling 6165 (NDWR 2012b)	State Engineer Ruling 6166 (NDWR 2012e)	State Engineer Ruling 6167 (NDWR 2012d)

[1]The "other" category applies to water rights in Utah where the use is not specified.

[2] Totals may differ from the sum of the individual numbers due to rounding.

[3] Perennial yield estimates contained in the State Engineer Rulings 6164, 6165, 6166, and 6167 dated March 22, 2012.

[4,5] For Snake Valley, the 25,000 afy (Nolin 1986) represents the Nevada fraction of total basin yield of 80,000 AFY (Hood and Rush 1965) and is the estimate provided by the NDWR for Hydrographic Basin 195.

[6] Summary of active water rights by manner of use was based on the NDWR hydrographic basin summaries by manner of use dated April 21, 2011; and, do not include the March 22, 2012, water rights appropriated for municipal and domestic use to the Las Vegas Valley Water District in Spring, Delamar, Dry Lake, and Cave valleys (NDWR 2012a,b,c,d).

Sources: NDWR (2011) for Nevada; SNWA (2008) for Utah.

The sources of information used to estimate perennial yields referenced by NDWR are included in **Table 3.3.1-20**. Note that the State Engineer can modify estimates of perennial yield as new data and analyses becomes available or as necessary when considering all available hydrologic studies as part of a water rights hearings process.

The following subsection briefly summarizes the active water rights and their designated beneficial uses in Nevada and Utah within the five groundwater development basins included under the Proposed Action and alternatives prior to the March 22, 2012, water rights appropriation for municipal and domestic use to the Las Vegas Valley Water District in Spring, Delamar, Dry Lake, and Cave valleys (NDWR 2012a,b,c,d). The locations of the points of diversion for active water rights in these basins are shown in **Figures 3.3.1-21** and **3.3.1-22**. Additional information on water rights in these basins and other basins in the region is available at the NDWR and UDWRi web sites and in the project baseline characterization report (SNWA 2008).

Spring Valley

Based on the NDWR database, there are a total of 327 active water rights in the inventoried area, which includes 253 surface water rights and 74 groundwater rights. The surface water rights include 24 reserved rights filed by the BLM and 16 claims of vested rights by the USFS (SNWA 2008). The primary uses for surface water are irrigation, stock watering, mining and milling, and domestic use.

The designated use for active groundwater rights is presented in **Table 3.3.1-20**. According to the NDWR records (2011), as of April 21, 2011, the total groundwater appropriated in Spring Valley was 21,736 afy. The current estimate for perennial yield for the basin is 84,000 afy (NDWR 2012a).

Snake Valley

Snake Valley includes land in both Nevada and Utah. Water development in Snake Valley supports crop irrigation on the valley floor and the communities of Garrison, Callao, Eskdale, Gandy, and Trout Creek. Water rights are associated with most of the perennial streams and major springs in the basin. The majority of the perennial streams originate on the east slope of the Snake Range. The estimated total of 406 active water rights includes 150 surface water rights and 256 groundwater rights.

NDWR indicates that there are 10,715 afy of active underground (groundwater) rights in Snake Valley within Nevada (**Table 3.3.1-20**). Irrigation accounts for 99 percent of the total groundwater use; the remainder of the water is designated for quasi-municipal use and stock watering. The total groundwater use permitted on the Utah side of the basin is 40,440 afy with 98 percent of this water being used for irrigation (SNWA 2008). Other uses of groundwater include stock watering and domestic supply.

Cave Valley

Based on the NDWR database, there are a total of 69 active water rights in Cave Valley, which includes 61 surface water rights and 8 groundwater rights. Most of the water rights are associated with springs used for stock watering. As of April 21, 2011, the total groundwater appropriated was 47 afy (**Table 3.3.1-20**,) and all of this water is designated for stock watering. The current estimate for perennial yield for the basin is 5,600 afy (NDWR 2012b).

Dry Lake Valley

The majority of the water rights in Dry Lake Valley are springs, although there are surface water rights on ephemeral drainages on the eastern side of the basin (SNWA 2008). According to the NDWR database, there are a total of 98 active water rights in the inventoried area, which includes 92 surface water rights and 6 groundwater rights. As of April 21, 2011, the total groundwater appropriated in the basin was 1,066 afy and this water was designated for irrigation, stock watering, and mining and milling (**Table 3.3.1-20**). The current estimate for perennial yield for the basin is 15,000 afy (NDWR 2012c).

Delamar Valley

Most of the active water rights in Delamar Valley are associated with springs used for stock watering in the mountains above the valley floor. According to the NDWR database, there are a total of 53 active water rights in the inventoried area, which includes 52 surface water rights and 1 groundwater right. As of April 21, 2011, the total groundwater appropriated (**Table 3.3.1-20)** was 7 afy and all of this water was designated for stock watering. The current estimate for perennial yield for the basin is 6,100 afy (NDWR 2012d).

Irrigated Acres

The USGS has recently completed studies as part of BARCAS that included an estimate of irrigated acreages in Spring Valley, Snake Valley, and Cave Valley hydrographic basins (Welch et al. 2007). The USGS mapped irrigated acreages using imagery processed from the TM sensor onboard the Landsat 4 and 5 satellites. These satellites have acquired images of the Earth nearly continuously since 1982, with a 16-day repeat cycle. Irrigated fields were mapped for 2000, 2002, and 2005. The analysis indicates that the estimated irrigated acres increased in both Spring and Snake valleys over these time intervals; however, there was no active irrigation in Cave Valley during the period. In 2005, the USGS conducted field work during the growing season to evaluate the TM data for accuracy. The field verification studies indicated that less than 5 percent of the fields identified on the TM images as active were determined to be inactive, and the estimates for 2005 were adjusted accordingly. The USGS estimated irrigated acreages for Spring and Snake valleys for 2005 are listed in **Table 3.3.1-21**.

Table 3.3.1-21 Estimated Irrigated Acreages for the Proposed Groundwater Development Basins

Hydrographic Basin	Irrigated Acreage (acres)	
	BARCAS[1] (2005 Imagery)	SNWA[2] (2002 Imagery)
Spring Valley	4,888	4,101
Snake Valley	9,200	12,594
Cave Valley	0	0
Dry Lake Valley	NA	0
Delamar Valley	NA	0

[1] Welch et al. (2007).
[2] SNWA (2008).

The SNWA estimated irrigated acres by using satellite imagery from June 2002 for all of the basins within the region of study (SNWA 2008). The SNWA irrigated acreage estimates for the five proposed groundwater development basins is summarized in **Table 3.3.1-21**. The SNWA estimates indicate that at the time of the imagery, there was essentially no active irrigation occurring in Delamar, Dry Lake, and Cave valleys. Both the USGS and SNWA estimates indicate that the largest areas of irrigated land occur in Snake Valley, and considerably fewer acres occur in Spring Valley. As shown on **Table 3.3.1-21**, the SNWA estimate for irrigated acreages for Spring Valley and Snake Valley are approximately 16 percent less and 37 percent greater, respectively, than the USGS estimate.

3.3.2 Environmental Consequences

3.3.2.1 Rights-of-way

Issues

Project development would require surface disturbance for construction of the pipelines, power lines, and ancillary facilities. The following water resource issues were evaluated as part of the impact analysis for construction and operation of the groundwater development project within the primary pipeline and power line ROWs.

- Surface disturbance to springs, seeps, and streams.
- Erosion and release of sediment from disturbed areas.
- Impacts to surface water quality from project construction-related activities.
- Damage to pipeline and ancillary facilities from flooding or scour.

Other potential impacts to wetlands and riparian areas are discussed in the Section 3.5, Vegetation Resources; and Section 3.7, Aquatic Biological Resources. Potential impacts to water resources resulting from the transportation, storage, and use of hazardous substances are addressed in Section 3.19, Public Safety and Health.

Methodology

Surface disturbance-related impacts to water resources were evaluated according to the following steps:

- Identify water resources (springs and seeps) located within the construction ROWs;
- Identify perennial, intermittent, and ephemeral streams that would be crossed or disturbed by the proposed facilities;
- Evaluate erosion and sedimentation impacts associated with construction and operation-related activities;
- Identify known flood zones and flood hazards that would be crossed or disturbed by the proposed facilities;
- Evaluate the existing BLM RMP management actions and BMPs, and ACMs to limit the extent and duration of predicted impacts;
- Recommend additional mitigation measures if warranted, to avoid, reduce, or offset impacts;
- Evaluate the effectiveness of the proposed mitigation measures; and
- Estimate residual impacts after the BLM management actions and BMPs, ACMs, and recommended mitigation measures are applied.

The applicant has committed to measures to minimize potential impacts. These ACMs are presented in **Appendix E**. The assessment of potential impacts to water resources assumes that these ACMs would be implemented as part of construction and operation of the project. SNWA also would be required to fund a comprehensive Construction, Operation, Monitoring, Maintenance, Management, and Mitigation Plan (COM Plan) that would include all facilities and hydrographic basins associated with the SNWA GWD Project. The plan would be approved and managed by the BLM in accordance with the FLPMA. A framework for development of the COM Plan is provided in Section 3.20, Monitoring and Mitigation Summary, and includes a description of the development process; plan components; roles and responsibilities for BLM, SNWA, and other federal and state agencies; enforcement; and description of the effectiveness of the plan to mitigate potential adverse impacts associated with the project.

3.3.2.2 Proposed Action, Alternatives A through C

The development associated with the primary pipeline and power line ROWs would be the same for the Proposed Action and Alternatives A through C. The proposed development within the ROW areas is described in detail in Chapter 2. Chapter 2 also provides estimates of surface disturbance from construction-related activities. In summary, the development would include construction of 306 miles of pipeline, 323 miles of overhead power lines, and two primary and five secondary electrical substations. Ancillary facilities that would be developed include five pumping stations, six regulating tanks, three pressure reducing stations, a water treatment facility, buried storage reservoir, access roads, and communication facilities.

Surface Disturbance of Water Sources

No known springs are located within the boundaries of the disturbance area for the ROWs and ancillary facilities. There are 4 known or suspected springs located downgradient near (i.e., within 1,000 feet) the proposed ROW. These include one inventoried spring (Big Springs located in Snake Valley) and 3 other non-inventoried springs (located in Snake Valley and Dry Lake Valley) identified from the National Hydrography Database or topographic maps. The actual existence and flow characteristics of these non-inventoried springs have not been confirmed by field investigation. Springs located downgradient and in the near vicinity of the ROW could be impacted by erosion and sedimentation from construction disturbance. However, implementation of the Storm Water Pollution Prevention Plan (SWPP Plan) and erosion control ACMs discussed below should protect these resources from construction-related impacts.

The proposed pipeline ROW would cross one perennial stream reach (Snake Creek) and two intermittent stream reaches (Big Wash and Lexington Creek), all located in Snake Valley. The intermittent stream reaches may be flowing during the period when the pipeline is constructed across the creeks. Construction across live (flowing) stream crossings would be accomplished using one of two methods: an open cut method with temporary diversions of stream flow, or a jack and bore method to tunnel under the stream. All construction across live streams would be accomplished in accordance with USACE and State of Nevada permit requirements.

The open cut method for live streams would consists of constructing a temporary diversion to divert flows around the stream crossing, excavating a trench across the stream bed from one or both banks, installing the pipe and cover, reconstructing the stream channel, and finally, diverting flows back into the reclaimed stream channel. Applying open cut methods to construct the pipeline across live streams would result in short-term (up to 2 years) impacts to the stream reach; and depending on the stream bed and stream bank characteristics and site-specific construction methods, could result in longer-term (greater than 2-year) impacts to the stream channel and downstream stream reach.

The jack and bore method requires the construction of a pit on either side of the stream. From these pits, the tunnel is created under the stream using a bore machine. The main advantage of the jack and bore method is that it generally does not result in alteration of the stream bed or flow conditions in the stream reach. Therefore, impacts to the stream channel using the jack and bore method should be minimal; however, there is a potential for erosion and sedimentation at the entrance and exit points for the bore.

Ground disturbance associated with the construction of the 306 miles of pipeline (including main and lateral pipelines) and ancillary facilities would result in direct impacts to an estimated 720 ephemeral stream reaches intersected along the ROWs. These ephemeral stream reaches predominantly are dry washes that only flow for short periods in response to infrequent runoff events. Construction across dry washes would use standard cut and cover methods with implementation of erosion control measures in accordance with an approved SWPP Plan required by the NDEP as part of the General Permit for Stormwater Discharges that will be required prior to any surface disturbance.

ACM A.1.52 also requires that construction across perennial, intermittent, and ephemeral drainages follow industry standards, permit requirements, and the BLM's guidance practices (DOI 2007). The BLM RMP guidance recommends an analysis of channel degradation and scour be completed to determine the depth of burial at all stream crossings that would prevent exposure or damage of the pipeline during extreme runoff events. Therefore, with implementation of ACM A.1.52, impacts associated with channel degradation and scour are not anticipated.

Other ACMs (including A.1.53 through A.1.68) include measures to control stormwater and minimize erosion and channel degradation. ACM A.4.1 requires that BMPs be used for the pipeline crossing of Snake Creek and Big Wash (if flowing).

The proposed overhead power line would span two perennial stream reaches (Snake Creek in Snake Valley and Steptoe Creek in Steptoe Valley) and two intermittent streams (Big Wash and Lexington Creek in Snake Valley). The 323-mile length of proposed power line also would span an estimated 642 ephemeral drainages. Transmission towers would not be located within active channels of these streams. The location of roads required for access and maintenance of the power system and tower locations would be determined in the final POD. Depending on location, construction of access roads associated with the power line and transmission tower could result in localized disturbance of the identified perennial and intermittent streams located within the corridor.

Other ancillary facilities associated with construction of the pipeline are located to avoid perennial water sources, intermittent and ephemeral drainages, and springs and seeps. Therefore, impacts to water resources associated with construction of these facilities are not anticipated.

Pipeline construction dewatering trenches are not anticipated to be necessary. However, if detailed geotechnical investigations indicate that dewatering is needed, a dewatering plan would be developed. That plan would specify that discharge waters be directed to prevent flow from entering streams, wetlands, or sensitive environmental areas (ACM A.1.51).

Hazardous and toxic materials (e.g., fuels, solvents, lubricants, acids) used during construction would be controlled to prevent accidental spills. Refueling of vehicles or equipment would be prohibited within 100 feet of any wash or stream (ACM A.1.43). Spill cleanup kits would be available on equipment so that accidental spills can be cleaned up quickly (ACM A.1.44). Therefore, the risk of spills into live streams or springs would be low, and impacts are not anticipated.

Conclusions. There are no springs that would be crossed by the pipeline ROW; and impacts to springs located downgradient and in the near vicinity of the ROW are unlikely due to implementation of required stormwater and erosion controls and ACMs.

The proposed pipeline ROW would cross one perennial stream reach (Snake Creek) and two intermittent stream reaches (Big Wash and Lexington Creek) all located in Snake Valley. Construction across live (flowing) stream crossings would include either an open cut method or a jack or bore method. Typically, open cut methods would result in short-term (up to 2 years) impacts to the stream reach; however, longer-term (greater than 2-year) impacts to these stream reaches could occur.

Ground disturbance associated with the pipeline ROW also would impact an estimated 720 ephemeral streams (i.e., dry washes). Implementation of required erosion control measures and ACMs are expected to generally limit these to short-term (up to 2 years) effects.

Overhead power lines would span two perennial streams, two intermittent streams, and 642 ephemeral drainages. Depending on location, construction of access roads associated with the power line and transmission tower could result in localized disturbance of the two perennial streams located within the corridor. Additional mitigation measures could be required in some situations, depending on the proximity of the streams and drainages and site-specific conditions at the time of construction.

Proposed mitigation measures:

ROW-WR-1: Stream Crossing Construction Plan. A site-specific plan would be developed to detail the construction procedures, erosion control measures, and reclamation that would occur for pipeline construction across live (flowing) stream reaches. The plan would include site-specific designs using either open cut or jack and bore techniques and site-specific measures to minimize disturbance of the stream bed, and release of sediment from the construction area into the downstream stream reach. The plan would be reviewed and approved by the BLM and NDOW prior to initiation of any construction activities within the stream corridor. Effectiveness: This mitigation measure would be moderately effective at reducing construction-related impacts to the streambed. Implementation of this additional mitigation measure, combined with other federal and state requirements, likely would result in a reduction of short-term impacts and minimize or eliminate long-term impacts at live stream crossings. Effects on other resources: This measure would not adversely affect other environmental resources.

ROW-WR-2: Avoid Power Line Structures in Streams. Power line structures would be designed to span all perennial streams and other ephemeral/intermittent streams or washes. No power line structures or ancillary facilities would be located within the active channels of these streams. Access roads constructed for the power line would be located to avoid or minimize disturbance to perennial and intermittent streams. Effectiveness: This measure would be highly effective in mitigating potential erosion and ground disturbance-related impacts to perennial streams associated with the power line construction. This avoidance measure is not currently included in the SNWA ACMs. Effects on other resources: This measure would not adversely affect other environmental resources.

Residual impacts include:

- Implementation of the federal and state requirements, ACMs, and additional mitigation measures should effectively mitigate construction-related impacts to water sources including perennial springs and streams and intermittent and ephemeral stream channels. Therefore, long-term adverse residual impacts to these water resources are not anticipated.

Erosion and Sedimentation

Erosion would occur in the disturbance areas for pipelines, power lines, and ancillary facility construction. Stormwater and erosion control measures include the preparation of site-specific SWPP Plans (ACM A.1.54) to identify and develop methods to control all potential sources of pollution affecting the quality of stormwater discharges from the construction site. Other ACMs to control erosion include developing construction plans to minimize the construction time frame, and implementing erosion and sediment control measures using both non-structural and structural construction BMPs (ACMs A.1.53-A.1.68). Examples of these measures include siltation or filter berms, filter or silt fencing, sediment barriers, rock or gravel mulches, and jute and synthetic netting. After construction, all temporary erosion and sediment controls not required for the protection of facilities would be removed and the drainages restored to their original form. Soils used for erosion control and soils captured by sedimentation control structures during construction would either be used in the ROW for construction or disposed of in approved borrow pits (ACM A.1.66).

Ground surface would be graded to match the surrounding topography and slopes as closely as possible. Perennial streams, washes, or ephemeral/intermittent drainages would be restored to pre-existing conditions as closely as possible. Permanent erosion control measures would be installed where necessary and could include vegetation restoration, placing matting on steep slopes to maintain stability, berming, and placement of rip-rap (ACMS A.1.67 and A.1.68).

Construction of the pipeline would require permanent disposal of excess soil generated during pipeline excavation. This includes soil volume displaced by the volume of the pipe and bedding material not generated from the excavation, and anticipated expansion of the soil material after excavation. Excess soil material generated from the trench operation would be spread evenly over the ROW disturbance corridor. The estimated volume of excess soil to be disposed of during construction and potential erosion impacts are discussed in Section 3.4, Soils.

Hydrostatic Testing. Hydrostatic testing would be required during construction to test the integrity of the pipeline. Discharge of these waters would be subject to conditions defined in a Hydrostatic Discharge Plan submitted to the BLM for approval (ACM A.1.64). The discharge plan would include energy dissipaters to minimize impacts from sedimentation and erosion. It currently is anticipated that discharge flow rates and volumes would not be allowed to exceed the 2- to 5-year storm event for the individual drainages (ACM A.1.62). If flows exceed these rates, the potential for erosion and scour would increase, resulting in deposition of sediment downstream. Water used for hydrostatic testing and for other construction activities would be tested and treated if necessary prior to discharge or disposal in accordance with the National Pollutant Discharge Elimination System (NPDES) permit requirements. Water not discharged locally would be hauled offsite for disposal (ACM A.1.65).

Emergency Drains. Construction of the water pipeline system would include drain valves located at low points along the pipeline. The location of the drains and design of the discharge points and erosion control measures would be determined prior to final BLM approval. Conceptually, the drains would discharge through energy dissipating devices and then would flow to dry washes lined with rip rap to control erosion. A detailed hydrologic analysis would be conducted during facility design for each discharge point to provide sufficient erosion control and prevent scouring. It currently is anticipated that discharge flow rates and volumes would not be allowed to exceed the 2- to 5-year storm event for the individual drainages (ACM A.1.62).

Conclusions. Surface disturbance from construction activities could affect water quality from sediment input on a short- and long-term basis. The development of construction plans, implementation of ACMs referenced above, and development of SWPP Plan and a Hydrostatic Discharge Plan would define methods to control runoff from construction activities.

Application of the ACMs to control erosion and sedimentation outside of the disturbed areas should minimize the potential impacts to perennial water sources and ephemeral and intermittent drainages. Although the ACMs would minimize erosion and sedimentation from construction activities, there is potential for erosion and sedimentation to occur locally until reclamation is completed, particularly after large storm events. These storm events could release sediment into drainages downgradient of the disturbance area.

Proposed mitigation measures:

None.

Residual impacts include:

- Disturbance areas in the ROW, particularly soils disturbed for pipeline excavation, likely would experience localized erosion in both the short- and long-term periods. Erosion likely would increase sedimentation to some water resources located downgradient from the disturbance areas. Resulting sedimentation would predominantly affect ephemeral drainages that terminate on the valley floors within closed basins.
- The amount of long-term erosion and sedimentation would depend on reclamation success and would be expected to diminish over time.

Flooding

The ROW project components would be subject to periodic localized flooding during the life of the project. Flooding risks include areas where facilities are located in a designated floodplain. The water pipelines and associated power line transmission structures cross two FEMA-designated 100-year floodplain areas in Clark County, Nevada. For discussion purposes, the northernmost floodplain is referred to as the "Unnamed Stream Floodplain Crossing," and the southernmost floodplain is referred to as the "Hidden Valley Floodplain."

The unnamed stream drainage floodplain crossing would require a span of approximately 894 feet. The proposed power line crossing the floodplain has above-ground structures with a maximum span between structures of approximately 800 feet. Therefore, at least one power line structure would need to be placed in that floodplain. The power line alignment also would cross approximately 4.6 miles of the Hidden Valley floodplain, requiring approximately 31 structures to be located within the floodplain. Long-term disturbance would be limited to the footprint of the structures and access roads for maintenance activities. The structures located within the floodplains would not impede the natural action or function of the floodplains. Considering the slope gradient within the floodplain areas, the potential for the structures to be damaged by flooding would be low.

The water pipeline located along the same alignment would be buried underground with a minimum of 6 feet of cover. Because the pipeline is underground, it would not impede the natural action or function of the floodplains. Both floodplains occur in areas with relatively gentle slopes (less than 5 percent), and it is unlikely that flooding in these areas would result in erosion that could expose the pipeline. Therefore, potential damage to the buried pipeline from flooding in these areas is low.

The water treatment facility, buried storage reservoir, and a secondary electrical substation are located within the boundaries of FEMA mapping in Clark County (FEMA 2009); however, none of these facilities are located within the 100-year floodplain. Therefore, potential impacts associated with flooding are not anticipated for these facilities.

A substantial portion of the project area is not covered by the FEMA 100-year floodplain delineation. Without specific delineation, it is assumed that construction of the pipeline and power lines, as well as pumping stations, electrical substations, staging areas, and borrow pits and access roads located near stream and playa crossings could be subject to localized flooding.

The ROW construction also would cross drainages that are subject to flash flooding. As discussed above, perennial, intermittent, and ephemeral stream crossings by the pipelines would be constructed according to the BLM design guidelines incorporated into ACM A.1.52 such that the final pipeline is constructed at sufficient depth to minimize the risk associated with scour and channel degradation. Even with appropriate design and construction practices, there is a risk of impact to project facilities from localized flooding. These types of impacts likely would be short-term and would be addressed as part of maintenance of the project components.

Conclusions. Construction and maintenance of project components within the ROW areas would be subject to periodic localized flooding during the life of the project. Even with appropriate design and construction practices, there is a risk of impact to project facilities from localized flooding.

Proposed mitigation measures:

None.

Residual impacts include:

- Portions of the ROW would be subject to flooding and flash-flood risks. Any resulting impacts would be managed as part of ongoing maintenance activities.

Construction Water Supply

Construction of the pipeline and ancillary facilities would require a water supply for dust suppression, hydrostatic testing, pipe bedding, and trench backfill compaction. It is estimated that between 5.5 and 8.7 million gallons of construction water would be needed for every mile of pipeline, with less water needed for dust control in wet winter conditions. Approximately one water supply well would be needed every 10 miles along the pipeline alignment, and would need to be capable of delivering up to 800 gallons per minute. The construction water supply would be obtained from existing wells or constructing new wells at the time of construction. Additional temporary construction water wells would be drilled within the construction staging areas; therefore, no additional surface disturbance is anticipated for the construction water supply. The temporary water supply would likely be derived by pumping from wells completed in the basin-fill aquifer located near the ROW. Temporary pumping for the construction water supply is anticipated to result in temporary (minor) drawdown effects that likely would be localized in the vicinity of the ROW well sites. Once the project has been completed these wells would be plugged and abandoned and the site would be reclaimed. This would restrict the possibility of these wells being used for multiple use management (i.e., wildlife, wild horses or grazing management).

Conclusions. Impacts associated with the construction of water supply wells could result in localized drawdown effects. Identification of volumes and source of water required during construction needs to be completed prior to construction for the ROW areas and additional mitigation may be needed on a case-by-case basis.

Proposed mitigation measures:

The following proposed mitigation measure is intended to minimize and control potential impacts associated with the development of water required during construction. A specific construction water supply plan and agency coordination to approve such a plan are not included in the SNWA ACMs.

ROW-WR-3: Construction Water Supply Plan. A Construction Water Supply Plan would be provided to the BLM for approval prior to construction. The plan would identify the specific locations of water supply wells that would be used to supply water for construction of the water pipeline and ancillary facilities; identify specific groundwater aquifers that would be used; estimate effects to surface water and groundwater resources resulting from the groundwater withdrawal; define the methods of transport and delivery of the water to the construction areas; and identify reasonable measures to reuse or conserve water. The BLM would review and approve the plan and, if necessary, include any monitoring or mitigation requirements required to minimize impacts prior to construction approval. SNWA would provide the drilling logs and water chemistry reports on water wells drilled for pipeline construction. BLM in consultation with State agencies and grazing permittee will review the location of construction water wells and determine if any would be needed for multiple use management goals. If specific wells slated to be plugged and abandoned are determined to be a benefit to the BLM for multiple use management, the BLM would work with the SNWA to procure the rights to the wells and obtain appropriate water rights for the beneficial use(s).

Effectiveness: This measure would be highly effective in identifying specific local impacts to water resources and provide for mitigation measures if necessary to avoid, reduce, or offset the identified localized effects. Effects on other resources: The BLM procurement of selected construction water supply wells (that would have been plugged and abandoned) would allow BLM to provide water for wildlife, wild horses, or grazing management as appropriate.

Residual impacts include:

- Residual impacts from development of construction water supply could include localized drawdown related impacts associated with groundwater pumping. The residual impacts would be quantified during subsequent BLM review following plan submittal.

3.3.2.3 Alternative D

Development in Snake Valley and the White County portion of Spring Valley would be eliminated under Alternative D. The same ROW construction and operational maintenance issues discussed for the Proposed Action and Alternatives A through C would apply to Alternative D, which would require 225 miles of pipeline, and 208 miles of power lines in Clark and Lincoln counties, Nevada. In addition, the BMPs and ACMs described for the Proposed Action, and Alternatives A through C would be applied to construction and operation to minimize impacts to water resources.

Surface Disturbance of Water Sources

Conclusions. No known springs are located within the boundaries of the disturbance area for the ROWs and ancillary facilities. There is one spring located downgradient near (i.e., within 1,000 feet) the proposed ROW. This is an unnamed spring located in Dry Lake Valley that has not been field verified. There are no springs that are crossed by the pipeline ROW; and impacts to springs located downgradient and in the near vicinity of the ROW are unlikely due to required stormwater and erosion controls and ACMs.

The proposed pipeline and power line ROWs would not cross any perennial stream reach and or intermittent stream reaches. Ground disturbance associated with the pipeline ROW would impact an estimated 504 ephemeral streams (i.e., dry washes); overhead power lines also would span 380 ephemeral drainages. Implementation of required erosion control measures and ACMs are expected to generally limit these to short-term (up to 2 years) effects.

Proposed mitigation measures:

None.

Residual impacts include:

- Implementation of the federal and state requirements, and ACMs should effectively mitigate construction-related impacts to water sources. Therefore, long-term, adverse residual impacts to these water resources are not anticipated.

Erosion and Sedimentation

Conclusions. Surface disturbance from construction activities could affect water quality from sediment input on a short- and long-term basis. The development of construction plans, implantation of ACMs referenced above, and development of SWPP Plan and a Hydrostatic Discharge Plan would define methods to control runoff from construction activities.

Application of the ACMs to control erosion and sedimentation outside of the disturbed areas should minimize the potential impacts to water resources located downslope from the ROWs. Although the ACMs would minimize erosion and sedimentation from construction activities, there is potential for erosion and sedimentation to occur locally until reclamation is completed, particularly after large storm events. These storm events could release sediment into drainages downgradient of the disturbance area.

Proposed mitigation measures:

None.

Residual impacts include:

- Disturbance areas in the ROW, particularly soils disturbed for pipeline excavation, likely would experience localized erosion in both the short- and long-term periods. Erosion from disturbed areas likely would increase sedimentation to some water resources located downgradient from the disturbance areas. The resulting sedimentation would predominantly affect ephemeral drainages that terminate on the valley floors within closed basins. The amount of long-term erosion and sedimentation would depend on reclamation success and would be expected to diminish over time.

Flooding

Conclusions. Construction and maintenance of project components within the ROW areas would cross delineated flood zones as discussed previously for the Proposed Action, and Alternative A through C. The ROW construction also would cross drainages that are subject to flash flooding. As a result, project components within the ROW areas would be subject to periodic localized flooding during the life of the project. Even with appropriate design and construction practices, there is a risk of impact to project facilities from localized flooding.

Proposed mitigation measures:

Mitigation measure ROW-WR-2 previously described under the Proposed Action also would apply to Alternative D. This would avoid placement of power lines or ancillary facilities in active stream channels. This measure would be highly effective in mitigating potential erosion and ground disturbance-related impacts to streams associated with the power line construction.

Residual impacts include:

- Portions of the ROW would be subject to flooding and flash flood risks. Any resulting impacts would be managed as part of ongoing maintenance activities.

Construction Water Supply

Construction of the pipeline and ancillary facilities would require a water supply for dust suppression, hydrostatic testing, pipe bedding, and trench backfill compaction. The construction water supply would be obtained from existing wells or constructing new wells at the time of construction. Additional temporary construction water wells would be drilled within the construction staging areas; therefore, no additional surface disturbance is anticipated for the construction water supply. Groundwater withdrawal for the construction water supply could result in localized drawdown effects.

Conclusions. Impacts associated with the construction of water supply wells could result in localized drawdown effects.

Proposed mitigation measures:

Mitigation measure ROW-WR-3 previously described under the Proposed Action also would apply to Alternative D. This would require that a Construction Water Supply Plan be approved by the BLM prior to construction. This measure would be effective in identifying specific local impacts to water resources and provided for mitigation measures if necessary to avoid, reduce, or offset the identified effects.

Residual impacts include:

- Residual impacts from development of construction water supply could include localized drawdown related impacts associated with groundwater pumping. The residual impacts would be quantified during subsequent BLM review following plan submittal.

3.3.2.4 Alternatives E and F

Development in Snake Valley would be eliminated under Alternatives E and F. The same ROW construction and operational maintenance issues discussed for the Proposed Action, and Alternatives A through C would apply to Alternatives E and F, which would require 263 miles of pipeline, and 280 miles of power lines in Clark and Lincoln counties, Nevada. In addition, the BMPs and ACMs described for the Proposed Action, and Alternatives A through C would be applied to construction and operation to minimize impacts to water resources.

Surface Disturbance of Water Sources

Conclusions. No known springs are located within the boundaries of the disturbance area for the ROWs and ancillary facilities. There is one spring located downgradient near (i.e., within 1,000 feet) the proposed ROW. This is an unnamed spring located in Dry Lake Valley that has not been field verified. There are no springs that are crossed by the pipeline ROW; and impacts to springs located downgradient and in the near vicinity of the ROW are unlikely due to required stormwater and erosion controls and ACMs.

The proposed pipeline and power line ROWs would not cross any perennial stream reach and or intermittent stream reaches. Ground disturbance associated with the pipeline ROW would impact an estimated 581 ephemeral streams (i.e., dry washes); overhead power lines also would span 514 ephemeral drainages. Implementation of required erosion control measures and ACMs are expected to generally limit these to short-term (up to 2 years) effects.

Proposed mitigation measures:

Mitigation measure ROW-WR-2 previously described under the Proposed Action also would apply to Alternatives E and F. This would avoid placement of power lines or ancillary facilities in active stream channels. This measure would be highly effective in mitigating potential erosion and ground disturbance-related impacts to streams associated with the power line construction.

Residual impacts include:

- Implementation of the federal and state requirements, and ACMs should effectively mitigate construction-related impacts to water sources. Therefore, residual impacts to these water resources are not anticipated.

Erosion and Sedimentation

Conclusions. Surface disturbance from construction activities could affect water quality from sediment input on a short- and long-term basis. The development of construction plans, implementation of the ACMs referenced above, and development of SWPP Plan and a Hydrostatic Discharge Plan would define methods to control runoff from construction activities.

Application of the ACMs to control erosion and sedimentation outside of the disturbed areas should minimize the potential impacts to water resources located downslope from the ROWs. Although the ACMs would minimize erosion and sedimentation from construction activities, there is potential for erosion and sedimentation to occur locally until reclamation is completed, particularly after large storm events. These storm events could release sediment into drainages downgradient of the disturbance area.

Proposed mitigation measures:

None.

Residual impacts include:

- Disturbance areas in the ROW, particularly soils disturbed for pipeline excavation, likely would experience localized erosion in both the short- and long-term periods. Erosion from disturbed areas likely would increase sedimentation to some water resources located downgradient from the disturbance areas. The resulting sedimentation would predominantly affect ephemeral drainages that terminate on the valley floors within closed basins. The amount of long-term erosion and sedimentation would depend on reclamation success and would be expected to diminish over time.

Flooding

Conclusions. Construction and maintenance of project components within the ROW areas would cross delineated flood zones as discussed previously for the Proposed Action, and Alternatives A through C. The ROW construction also would cross drainages that are subject to flash flooding. As a result, project components within the ROW areas would be subject to periodic localized flooding during the life of the project. Even with appropriate design and construction practices, there is a risk of impact to project facilities from localized flooding.

Proposed mitigation measures:

None.

Residual impacts include:

- Portions of the ROW would be subject to flooding and flash flood risks. Any resulting impacts would be managed as part of ongoing maintenance activities.

Construction Water Supply

Construction of the pipeline and ancillary facilities would require a water supply for dust suppression, hydrostatic testing, pipe bedding, and trench backfill compaction. The construction water supply would be obtained from existing wells or constructing new wells at the time of construction. Additional temporary construction water wells would be drilled within the construction staging areas; therefore, no additional surface disturbance is anticipated for the construction water supply. Groundwater withdrawal for the construction water supply could result in localized drawdown effects.

Conclusions. Impacts associated with the construction of water supply wells could result in localized drawdown effects.

Proposed mitigation measures:

Mitigation measure ROW-WR-3 described under the Proposed Action previously also would apply to Alternatives E and F. This would require that a Construction Water Supply Plan be approved by the BLM prior to construction. This measure would be effective in identifying specific local impacts to water resources and provided for mitigation measures if necessary to avoid, reduce, or offset the identified effects.

Residual impacts include:

- Residual impacts from development of construction water supply could include localized drawdown related impacts associated with groundwater pumping. The residual impacts would be quantified during subsequent BLM review following plan submittal.

3.3.2.5 Alignment Options 1 through 4

Alignment Options 1 through 4 would adjust the location of specific segments of the Proposed Action ROWs, as described in Chapter 2. Potential effects to water resources associated with these alignment modifications are summarized in **Table 3.3.2-1**.

Table 3.3.2-1 Water Resources Impact Summary for Alignment Options 1 through 4

Alignment Option	Analysis
Alignment Option 1 – Humboldt-Toiyabe Power Line Alignment (Modifies a portion of the 230-kV power line from the Gonder Substation near Ely to Spring Valley)	Impacts associated with the Humboldt-Toiyabe Power Line Alignment would be similar to the comparable section of the Proposed Action alignment (similar number of ephemeral stream crossings but no perennial stream or spring crossings).
Alignment Option 2 – North Lake Valley Pipeline Alignment (Modifies the location of the mainline pipeline and electrical transmission line in North Lake Valley)	Potential impacts associated with the North Lake Valley Pipeline Alignment would be similar to the Proposed Action and Alternatives A through C segment except for the following: 1) Three springs (North Big Springs, Wambolt Springs, and an un-named spring) are located downslope and within 1,000 feet of the construction ROW. The reported flow at North Big Springs is 1,400 gpm. Flow rates have not been reported for Wambolt Springs; and the unnamed spring was located based on National Hydrography Database data and has not been field verified. In contrast, no springs are located downslope and within 1,000-feet of construction disturbance for the comparable section of the Proposed Action ROWs. 2) Geyser Creek, a perennial stream located in Lake Valley, would be crossed by the pipeline and spanned by the power line but would not be crossed by the comparable sections of the Proposed Action ROWs. Potential surface disturbance related impacts would be essentially the same as discussed for the Snake Creek crossing in Snake Valley under the Proposed Action. Therefore, mitigation measure ROW-WR-1 described under the Proposed Action also would apply to the Geyser Creek crossing.
Alignment Option 3 – Muleshoe Substation and Power Line Alternative (Eliminates the Gonder to Spring Valley transmission line, and constructs the Muleshoe Substation that would interconnect with an interstate power line in Muleshoe Valley)	Potential impacts for this option would be less than the comparable Proposed Action and Alternatives A through C segment because of the elimination of the Steptoe Creek crossing associated with the Humboldt-Toiyabe Power Line ROW.
Alignment Option 4 – North Delamar Valley Pipeline and Power Line Alignment (Modifies the location of a short section of mainline pipeline in Delamar Valley to follow an existing transmission line.)	Impacts associated with the North Delamar Valley Pipeline and Power Line Alignment would be similar to the comparable section of the Proposed Action alignment (same number of ephemeral stream crossings but no perennial stream or spring crossings).

3.3.2.6 No Action Alternative

As described in Chapter 2, the No Action Alternative assumes that the BLM would not grant ROWs for the proposed project. Under this scenario, the proposed pipelines, power lines, ancillary facilities, and well fields would not be developed. Therefore, construction or operational impacts to water resources associated with the proposed GWD Project would not occur.

3.3.2.7 Comparison of Alternatives

Impacts resulting from construction and operation and maintenance activities on water resources from the Proposed Action and Alternatives A through F are listed in **Table 3.3.2-2.**

Table 3.3.2-2 Comparison of Potential Effects to Water Resources Associated with Construction, Operation and Maintenance of the Primary Rights-of-way

Parameter	Proposed Action, Alternatives A through C	Alternative D	Alternatives E and F
Springs (Number of Springs)			
Within ROW	0	0	0
Downslope[1] of ROW	4	1	1

Table 3.3.2-2 Comparison of Potential Effects to Water Resources Associated with Construction, Operation and Maintenance of the Primary Rights-of-way

Parameter	Proposed Action, Alternatives A through C	Alternative D	Alternatives E and F
Perennial Stream Crossings			
Pipelines			
-Snake Creek	Yes	No	No
Power Lines			
-Snake Creek	Yes	No	No
-Steptoe Creek	Yes	No	No
Intermittent Stream Crossings			
Pipeline			
-Big Wash	Yes	No	No
-Lexington Creek	Yes	No	No
Power Lines			
-Big Wash	Yes	No	No
-Lexington Creek	Yes	No	No
Ephemeral Stream Crossings (number of crossings)			
Pipelines	720	504	581
Power Lines	642	380	514
Ground Disturbance (Acres)	12,288	8,828	10,681

[1] Within 1,000 feet of ROW disturbance.

3.3.2.8 Groundwater Development and Groundwater Pumping

Issues

The following water resource issues were evaluated as part of the programmatic impact analysis for construction and operation of the well fields within the groundwater development areas.

Groundwater Well Field Construction and Facility Maintenance

- Surface disturbance to springs, seeps, and streams.
- Erosion and release of sediment from disturbed areas.
- Impacts to surface water quality from project construction-related activities.
- Damage to pipeline and ancillary facilities from flooding or scour.

Groundwater Pumping

- Reduction of groundwater levels from pumping activities resulting in adverse effects on water supply.
- Potential drawdown impacts to perennial springs, seeps, and streams.
- Potential drawdown impacts to surface and groundwater rights.
- Potential water balance changes (including reduction in ET discharge) from the pumping basins and regional flow system from groundwater withdrawal.
- Potential degradation of surface water or groundwater quality attributed to groundwater pumping.
- Potential effects to caves resulting from groundwater drawdown.

Potential impacts to wetlands and riparian areas are discussed in Section 3.5, Vegetation Resources, and aquatic resources are discussed in Section 3.7, Aquatic Biological Resources. Potential effects to caves are discussed in Section 3.2, Geologic Resources, and Section 3.6, Terrestrial Wildlife. Potential impacts to water resources resulting from the transportation, storage, and use of hazardous substances are addressed in Section 3.19, Public Safety and Health.

Mitigation measures discussed in this resource section focus on new measures for impacts associated with groundwater development. Where applicable, ROW mitigation measures ROW-WR-1 and ROW-WR-2 may apply to surface disturbance activities associated with groundwater development. These ROW mitigation measures would be considered in subsequent NEPA tiers after plans for the groundwater development are provided to the BLM.

Methodology, Assumptions, and Limitations

This section describes the general methodology, assumptions, and limitations used to quantify potential effects to perennial water sources associated with groundwater withdrawal, including:

- A summary of the numerical groundwater flow modeling used to predict changes in groundwater levels and flow rates;
- A definition of the drawdown area used in the analysis;
- A description of the method used to identify springs and streams that could be affected within the drawdown area;
- A description of the method used to evaluate potential changes in flow in selected springs and spring-fed streams; and
- Methods used to evaluate impacts to water rights.

Groundwater Flow Modeling

A numerical groundwater flow model was developed for this EIS to evaluate the probable long-term effects of groundwater withdrawal on a regional scale. The model, known as the Central Carbonate-Rock Province (CCRP) Model was developed specifically for this EIS by the SNWA under the BLM's guidance (SNWA 2010a,b; 2009a,b).

The model was constructed by: 1) developing a conceptual model of the groundwater flow system including the definition of major HGUs across the region, and estimating groundwater budget components (i.e., recharge, groundwater discharge by ET, and interbasin inflow and outflow); 2) constructing a numerical model to represent the conceptual model; and 3) calibrating the model to transient conditions.

The final calibrated model was used to simulate groundwater withdrawal under the seven different pumping scenarios (i.e., six project pumping alternatives and the No Action pumping scenario) for a period extending to full build out plus 200 years. The model also was used to evaluate the combined effects associated with continuation of existing and historic pumping, project pumping, and reasonably foreseeable future pumping in the region over the same time period.

The following section provides a brief description of other important groundwater flow models for the region and a description of the construction, calibration, and uncertainty and limitations associated with the CCRP model.

Other Important Groundwater Flow Models for the Region

There currently are three other regional groundwater flow models that encompass two or more of the proposed groundwater development basins:

1. Great Basin Regional Aquifer Systems Analysis (RASA) Model previously developed by the USGS to evaluate the conceptual flow system in the carbonate-rock province (Prudic et al. 1995);
2. GBNP Model recently developed by the USGS for the NPS to evaluate the potential effects of pumping in Snake Valley on springs, streams, and water levels in and adjacent to GBNP (Halford and Plume 2011);
3. Eastern Nevada-Western Utah (ENWU) Regional Model in development (Durbin and Loy 2010; Loy and Durbin 2010) for the BLM (Utah State Office), NPS, USFWS, and BIA to evaluate potential impacts of groundwater pumping resulting from several water rights applications filed in Iron and Beaver counties, Utah. This model evaluated impacts to groundwater resources in White Pine and Lincoln counties, Nevada, and Iron and Beaver counties, Utah.
4. Groundwater models developed by Myers (2011a,b) as evidence for consideration by the NSE prior to ruling on SNWA's water right applications in Spring, Delamar, Dry Lake, and Cave valleys.

RASA Model. The RASA model was constructed as a steady-state, three-dimensional, finite-difference groundwater flow model using MODFLOW (McDonald and Harbaugh 1988). The model encompassed a very large region (approximately 92,000 square miles) with coarse discretization (individual cells of 5 miles by 7.5 miles in dimension). The model was constructed with two layers and was intended to be conceptual in nature for the purpose of evaluating the possible interconnection between the deep flow through the carbonate rocks and the shallow flow system (Prudic et al. 1995). The model was later modified to develop "first approximations" of the possible effects of groundwater withdrawal of 180,800 afy by the Las Vegas Valley Water District in 17 basins in Nevada (Schaefer and Harrill 1995). The RASA model was not used to predict effects associated with the proposed groundwater withdrawal for this EIS because of:

- The broad regional nature of the model and its coarse discretization;
- The highly generalized assumptions and simplifications used to construct the model;
- The fact that the model was not calibrated to transient conditions; and
- The lack of model set up to simulate the effects associated with existing pumping in the region.

In summary, the CCRP model used for this EIS was constructed to provide a more detailed representation of a portion of the regional carbonate-rock groundwater flow system that was conceptually evaluated by the earlier RASA model.

GBNP RASA Model. The GBNP RASA model was constructed by refinement of the RASA model (described above) in Spring and Snake valleys, which encompass the GBNP study area. Groundwater flow in the GBNP RASA study area was simulated with a 4-layer, finite-difference MODFLOW model that extends from the water table to 2,000 feet below the water table. The model incorporates a refined grid cell network that encompasses the park with cells measuring 1,620 feet by 1,620 feet. The refined model simulated local flow in mountain blocks that was not simulated in the original RASA model. The GBNP RASA model does not explicitly represent the hydraulic properties of major fault zones; but rather represents the contrasting hydraulic properties of geologic units that may result from fault displacement.

The model was calibrated to existing water-level data, simulated water levels from the original RASA model, depth-to water beneath ET areas, spring discharges, and changes in discharge on selected stream reaches in the vicinity of the GBNP. The final calibrated model was used to simulate the potential effects of groundwater withdrawals associated with pumping in Snake Valley at nine points of diversion identified on the SNWA's water rights applications. Model simulations were conducted for groundwater withdrawal rates of 10,000 afy; 25,000 afy; and 50,000 afy over a 200-year period. Separate simulations were conducted with and without the addition of existing irrigation pumping. The irrigation pumping was based on the estimated distribution and rate of pumping that occurred in 2002, and assumed that this rate of pumping would continue in the future over the 200-year simulation period. Results from the GBNP model scenarios are presented as maps of groundwater capture and drawdown, time series of drawdowns and discharges from selected wells, and time series of discharge reductions from selected springs and streams.

Since the model design currently is focused on the Spring Valley and Snake Valley area, and pumping only in Snake Valley, the model results cannot be used to evaluate the potential effects to water resources associated with pumping in Spring, Delamar, Dry Lake, and Cave valleys. Additionally, the GBNP model results for Snake Valley assume pumping occurs at SNWA's original points of diversion and therefore, it cannot be used to evaluate potential effects associated with the distributed pumping in Snake Valley included in the Proposed Action and Alternatives A and C. However, given the points of diversion used in the GBNP model were the same ones used to simulate Alternative B, a preliminary comparison of simulated reductions of spring and stream flow results in Snake Valley will be discussed for the 50,000-afy GBNP model simulation and the CCRP model simulation for Alternative B (50,000 afy). While the amounts of water pumped at each point of diversion differ between the two model simulations, the comparison is still informative in bracketing the potential range of impacts.

ENWU Model. The ENWU model was developed using FEMFLOW3D version 3.01. This is a modified version of an earlier USGS code originally developed in 1998 that employs a different computational method than MODFLOW. The ENWU model domain extends further east into Utah, but not as far west and southwest in Nevada as the CCRP model used for this EIS; it only includes two of the five pumping basins included in the SNWA's proposed groundwater development project. Specifically, the ENWU model was not designed to evaluate the SNWA's proposed pumping in Delamar, Dry Lake, and Cave valleys. As a result, many of the areas where drawdown related impacts are indicated by the SNWA simulations are not included in the ENWU model.

A preliminary review of the documentation for the ENWU model indicated that the model has not been peer reviewed and the documentation currently does not provide sufficient information to make a rigorous evaluation (Poeter 2010; Halford 2010). Halford (2010) also raised concerns regarding the assumed hydraulic properties used to represent non-carbonate rocks within mountain blocks and the distribution of recharge.

The ENWU model assumes that the average annual rate of discharge from the combined Snake and Hamlin valleys is 78,000 afy instead of the 132,000 afy estimated from the recent BARCAS study (Welch et al. 2007) used in the CCRP model. Compared to the CCRP model, the pumping scenarios used for the ENWU model simulations included additional future pumping in Snake Valley and pumping in Pine and Wah Wah valleys by the Central Iron County Water District, but does not include the proposed pumping in Delamar, Dry Lake, and Cave valleys. Since the two models used different assumptions for ET discharge in Snake Valley and different pumping scenarios, it is not possible to make a direct comparison of their respective simulation results. In consideration of the preliminary review of the model and simulation results, the BLM has determined that the CCRP model designed and developed specifically for this EIS analysis currently is the best available tool for evaluating the probable long-term effects of groundwater withdrawal from the project on a regional scale.

Myers' Models (Myers 2011a,b). Myers conducted two separate groundwater modeling efforts that were submitted to the NSE as evidence provided by protestants for consideration prior to ruling on SNWA's groundwater appropriation applications for Spring, Delamar, Dry Lake, and Cave valleys.

- The first was a groundwater flow model for Spring Valley and surrounding areas developed by Myers (2011a) using MODFLOW-2000 (Harbaugh et al. 2000). The Spring Valley model domain included five hydrographic basins: Spring, Snake, Tippett, Pleasant, and Hamlin valleys. The model grid size ranges from 4 square miles in outlying areas to 0.25 square mile near the simulated pumping well location. The model was constructed with seven layers and designed to simulate vertical flow in the basin-fill aquifer. Layer 1 was set up as an unconfined layer. Faults were simulated in the model using horizontal flow barriers (HFBs). The HFB parameters were adjusted during calibration to simulate known or suspected gradients across the fault zones. D'Agnese (2011) conducted a technical review of the Myers model for SNWA and concluded that the model included a series of features that are not adequately associated with known hydrogeologic units or structures; and the model documentation was insufficient.

The NSE reviewed the Myers' Spring Valley model and compared it to the CCRP model (referred to in the following quote as the "Applicant's model") and provided the following conclusion in the water rights ruling for Spring Valley (NDWR 2012a):

> *"There was considerable discussion and evidence presented by all parties regarding the construction, errors, capabilities and accuracy of both the Applicant's and Dr. Myers' models. After considering the models, the evidence and the testimony, the State Engineer finds that the Applicant's model generally provides a more reliable basis to predict regional-scale impacts resulting from the Applicant's proposed pumping. The Applicant's model relies on better data and techniques, was developed through a more rigorous collaborative process with the BLM and recognized modeling experts, and is accompanied by more thorough documentation. Dr. Myers' Spring and Snake Valley model did not have the same benefit of a time-intensive collaborative process and a diversity of expert input."*

- The second modeling exercise conducted by Myers consisted of using the RASA model (Prudic et al. 1995; Schaefer and Harrill 1995) to analyze the effects of SNWAs proposed pumping in Delamar, Dry Lake, and Cave valleys. The RASA model was not used to predict effects associated with the proposed groundwater withdrawal for this EIS because the CCRP model used for this EIS was constructed to provide a more detailed representation of a portion of the regional carbonate-rock groundwater flow system that was conceptually evaluated by the earlier RASA model.

CCRP Model Construction, Calibration, Uncertainty, and Limitations

Technical Review Team

The BLM established a technical review team of hydrology specialists from the BLM Nevada and Utah State Offices and National Operations Center in Denver, the USGS, and AECOM (BLM EIS Contractor) to review the CCRP model. The review team included two groundwater flow modeling experts: Dr. Keith Halford (USGS) and Dr. Eileen Poeter (Poeter Engineering). A technical specialist from the NSE's Office observed the review process. The technical review team was formed to assist the BLM by reviewing the model documentation reports and providing recommendations to the BLM for improvements to the model. The review team held periodic conference calls and meetings with the SNWA modeling team and the BLM EIS project management team at various stages of the model development. The review team reviewed early work products, modeling files, data compilations and draft reports, and the most recent updated reports used for this impact analysis. The technical team requested specific improvements to the model. Key issues identified by the review team and their resolution, or improvements made to the model to address these issues, are discussed in Section 3.0 of SNWA (2009a), and in SNWA (2010a).

Model Development

The following discussion provides an overview of the CCRP model that was developed for use in the water resource impact analysis. Detailed documentation of the model is provided in the following technical documents:

1. Conceptual Model of Groundwater Flow for the Central Carbonate-Rock Province: Clark, Lincoln, and White Pine Counties GWD Project, SNWA, November 2009 (SNWA 2009a);
2. Transient Numerical Model of Groundwater Flow for the Central Carbonate-Rock Province: Clark, Lincoln, and White Pine Counties GWD Project, SNWA, November 2009 (SNWA 2009b);

3. Addendum to the Groundwater Flow Model for the Central Carbonate-Rock Province: Clark, Lincoln, and White Pine Counties Groundwater Development Project, Draft, August 2010 (SNWA 2010a); and

4. Simulation of Groundwater Development Scenarios Using the Transient Numerical Model of Groundwater Flow for the Central Carbonate-Rock Province: Clark, Lincoln, and White Pine Counties GWD Project, SNWA, Draft September 2010 (SNWA 2010b).

Model Construction. The transient, three-dimensional, finite-difference numerical groundwater flow model was developed by the SNWA's modeling team using the USGS groundwater flow program, MODFLOW-2000 (Harbaugh et al. 2000). The parameter-estimation code UCODE_2005 (Poeter et al. 2006) was used to assist in the calibration process.

The model domain is the same area as the hydrologic study area depicted on **Figure 3.3.1-1**, encompassing approximately 35 hydrographic basins and 20,688 square miles. The model grid is oriented north and the cells are uniform in size with a side dimension of 3,281 feet (1 kilometer). The model includes 11 layers that vary in thickness from 328 to 6,252 feet. The model extends vertically from -10,000 feet amsl to the water table, which varies from approximately 1,148 feet to more than 9,022 feet amsl.

Hydrogeologic Framework. Available geologic information was compiled and simplified to develop a geologic map and representative cross-sections for the region. This geologic representation was further simplified by combining geologic units with similar hydraulic properties to delineate regional HGUs and major structural features that may control groundwater flow. Two of the regional HGUs are important regional aquifers: the basin-fill aquifer and the carbonate-rock aquifer. Other units include basement rock that comprises the base of the flow system, plutons, plateau sedimentary rocks, and an upper aquitard that separates the upper and lower carbonate aquifers throughout much of the northern study area. Available hydraulic parameter data was compiled and evaluated to establish a range of properties for each of the regional HGUs. The spatial distribution of the regional HGUs is represented in the numerical model as zones of variable hydraulic properties. A function was added to the model to account for the reduction of hydraulic conductivity with increasing depth resulting from increased compression under load.

Representation of Structural Features. Major structural features are believed to influence or control groundwater flow in the region (SNWA 2009a,b). Faults can behave as barriers or conduits to flow as described in Section 3.3.1.5. Major structural features in the region include: a) basin-bounding faults; b) faults that cause large juxtaposition of geologic units; c) faults that exhibit large disturbances to HGUs; and d) faults that are known to restrict or partition groundwater flow. Major structural features include normal basin and range faults, strike-slip (lateral) fault zones, caldera bounding structures, low angle detachment faults, and regional thrust faults (Welch et al. 2007; Heilweil and Brooks 2011). Fifty faults (or fault zones) have been represented in the numerical model (Figure 4-11, p. 4-20, SNWA 2009b). The hydraulic conductivities for these faults were treated as parameters and were estimated during the model calibration process.

Recharge. Recharge refers to infiltration of precipitation or stream flow into the groundwater system. Recharge is the primary mechanism for replenishment of groundwater supplies within the region. Groundwater recharge cannot be measured directly in the field for areas as large as the model area. Groundwater recharge is spatially and temporally variable and its distribution is affected by many factors, including the amount and type of precipitation, topography and the hydrogeology of the unsaturated zone as well as the saturated zone.

The spatial distribution of precipitation across the region was estimated based on an averaged 30-year historical record (PRISM normal precipitation grid). This precipitation grid was used because it is recognized as the best available spatial climate data for the region. Recharge from precipitation was estimated using the groundwater balance method whereby recharge was calculated as the difference between total volume of groundwater discharge (i.e., groundwater ET plus subsurface outflow) and the volume of subsurface inflow as described in SNWA 2009a. This methodology was used to estimate an annual potential recharge by basin. The potential recharge from precipitation for a given area was then proportioned using hydrogeologic factors into in-place recharge and runoff recharge (i.e., infiltration down gradient and along streams).

Groundwater recharge is input into the numerical model as an average annual rate that is held constant during the entire modeling period. The model is not set up to simulate wet and dry cycles, or seasonal fluctuations. The actual rates, distribution, and timing of recharge remain very uncertain and therefore, the current model cannot provide a realistic simulation of wet and dry cycles over the region of study.

Evapotranspiration and Spring Flow. Groundwater discharges to the surface in ET areas or as spring or stream flow. Groundwater ET estimates were derived by delineating different types of ET areas and applying appropriate ET rates to estimate ET flow (SNWA 2009a). The groundwater discharge to ET areas and selected springs was simulated as drains in the numerical model. Large springs and streams controlled by groundwater discharge in Pahranagat Valley, Muddy River Springs Area, and Big Springs were simulated as streams in the model where the springs may flow upward through a number of layers, gaining or losing water along the route, and the spring discharge to streams at the surface can infiltrate into the flow system downstream from the spring orifice.

Boundary Conditions. Potential locations where flow could occur initially were identified based on the three-dimensional hydrogeologic framework (SNWA 2008). Boundary segments where the geologic conditions were favorable for flow were further evaluated using available water-level data, interpretive hydrogeologic framework information, and estimates from previous studies. Estimates of flow across external model boundaries are presented in SNWA 2009a. These flow estimates were used as flow observation targets during steady-state calibration of the model. The length of the flow segments were modified in some locations based on testing during the model calibration process and additional evaluation of geologic data as described in the numerical modeling report (SNWA 2009b). Flow into and out of the perimeter of the model was simulated by constant head cells. The locations of the constant head boundaries used in the model are described by basin (SNWA 2009b). The initial constant-head values assigned in the model were derived from published information (SNWA 2009b). However, the constant-head values were treated as model parameters that were adjusted during the model calibration process.

Calibration Process. Calibration entails adjustment of input parameter values to identify a set of parameter values that agrees with field observations and causes hydraulic heads and flows calculated by the model to generally match hydraulic heads and flows measured in the field. Model calibration can provide estimates of parameters that cannot be measured directly.

The model was calibrated to both steady-state and transient stress periods. The initial steady-state period represents predevelopment conditions prior to 1945. The transient calibration period extends from 1945 to 2004.

During the model calibration, the conceptual model represented in the numerical model was modified (or refined) to yield a better fit to field observations. The calibration was accomplished primarily through a trial and error, iterative process. During the model calibration process, variations in the: 1) hydrogeologic framework; 2) external flow boundaries; 3) recharge processes; and 4) discharge areas were tested and major improvements in model fit were retained in the final calibrated model. Major model refinements that were developed during the calibration process are briefly described below and discussed in detail in SNWA 2009a and 2010a.

Two conceptual models were considered during early stages of model development. The first model consisted of assigning rocks in mountain blocks with very low hydraulic conductivities; the second model assigned rocks in mountain blocks with moderately low hydraulic conductivities, combined with faults with low cross-fault transmissivity (i.e., flow barriers). The second conceptual model was adopted for the final model because this model configuration generally improved the calibration by: 1) improving the simulation of hydraulic head elevations in the mountain blocks; 2) eliminating or substantially diminishing the overall size of areas where the earlier model-simulated water levels above the ground surface; and 3) allowing for the simulation of large spring discharges (that in many cases, could not be simulated without the fault barrier) (SNWA 2009b). Subsurface data, aquifer test data, and water-level monitoring data are not available in most areas to evaluate if the major regional faults act as barriers to flow. One example of where there is water-level data across a major normal fault zone is in Dry Lake Valley and Patterson Valley where substantial drops in groundwater elevations across two normal faults appear to be controlled by faulting rather than mountain block bedrock characteristics (SNWA 2009b). In addition, major fault zones typically consist of a wide range of characteristics, including a single slip or multiple slip surfaces, unconsolidated clay-rich gouge, breccia zones, chemically altered zones, or mylonite zones. The generation of fine-grained materials and alteration and mineral precipitation tends to reduce the porosity and permeability of the primary fault zone, compared to the adjacent unfaulted bedrock materials (Caine et al. 1996). Therefore, it is plausible that major regional fault structures could behave as impediments to groundwater flow. The hydraulic properties of the materials along the external flow boundaries are largely unknown. The external flow boundaries were adjusted during the model calibration process (SNWA 2009b) to improve the model representation of hydraulic heads (i.e., groundwater elevations) and ET and spring discharge to more closely match field observations. The modifications of the external flow boundaries were consistent with the current understanding of the hydrogeologic conditions in these areas (SNWA 2009b).

The amount of recharge was not modified during final calibration. However, the runoff distribution paths were adjusted manually to reduce unrealistic simulated mounds in the water table. Modifications during calibration typically consisted of extending the distribution path to resolve the mounding problem. Other refinements were made to better constrain the distribution of ET across valley bottom areas and improve spring discharge rates (SNWA 2009a).

Detailed comparisons between measured or estimated values and model-simulated values are provided in the numerical model report (SNWA 2009b). Overall, the model results indicate that the calibrated model is a reasonable representation of the regional groundwater flow system. The aquifer parameters incorporated into the model generally lie within the range of estimated values for the HGUs. The distributions of hydraulic conductivity values generally are consistent with the conceptual model. Transmissivities, while high in some areas, are reasonable overall.

<u>Model Uncertainty</u>

Major sources of uncertainty inherent in the regional model results are associated with incomplete or limited information for the region, or generalizations required for model construction including:

- Limitations regarding the current understanding of the hydrogeologic framework that controls groundwater flow throughout the region;
- Limitations resulting from the gross simplification of hydrogeologic conditions required for construction of a regional scale model;
- Limitations and generalizations imposed by the use of a 1-kilometer (3,281 feet) grid cell width;
- Assumption of homogeneity within a given regional model unit or parameter zone as a result of data limitations and generalizations;
- Uncertainty regarding the mean recharge and spatial distribution of recharge across the region; and
- Uncertainties regarding the hydraulic interconnection between the groundwater flow system throughout the region.

There is uncertainty regarding the final set of aquifer parameters used to represent the HGUs across the region. A sensitivity analysis was performed by adjusting the hydraulic conductivity and storage properties simultaneously and within a reasonable and plausible range, to evaluate how this adjustment in parameters could change the drawdown results. The results of this sensitivity analysis (using the Alternative A pumping scenario) are provided in Figure 5-2 in SNWA 2010b. The results indicate that shifting these aquifer parameters within a plausible range would expand the areal extent of the area encompassed within the 10-foot drawdown contour. The changes in parameter values used in this sensitivity analysis, however, reduced the model fit compared with the calibrated model (SNWA 2010b).

Groundwater model solutions are not unique. In other words, the choice of parameter values and boundary conditions is not unique and other combinations of parameter values and boundary conditions may provide an equally justified calibrated model that also approximates the groundwater flow system. However, predictions from that model may differ from the current predictions. In addition, it is well established that groundwater models cannot be validated (Konikow and Bredehoeft 1992). Konikow and Bredehoeft explain that calibration is "only a limited demonstration of the reliability of the model." The term "validation" has been used to describe the successful simulation of a post-calibration stress to the groundwater system. However, one such success does not assure that the model will reliably predict a different future stress. Konikow and Bredehoeft note that realistic expectations of models "will help to shift emphasis towards understanding complex hydrogeological systems and away from building false confidence into model predictions." Although false confidence cannot be placed in numerical models, it is more realistic that hydrologists build a reasonable model that uses field information to estimate future conditions than to ignore such capability in lieu of less rigorous estimates. The goal is for the numerical model to reasonably represent the system.

Additional uncertainties are associated with the observation data sets (such as hydraulic head measurements, ET discharge estimates, and historic groundwater pumping estimates) used for calibration. These and other model uncertainties are discussed in detail in the transient model report and model simulation reports (SNWA 2010a,b; 2009b,c).

Climate Change. Section 3.1.3.2, Climate Change Effects to All Other Resources, discusses the current research into climate change and predicted future trends for the Great Basin and provides a discussion of the range of potential effects on water resources. Current climate change models suggest that within the study area, mean temperatures are expected to rise and annual precipitation is likely to remain similar to present conditions as the century progresses (Redmond 2009). However, there is insufficient information available to predict how changes in climate would affect the rate of groundwater recharge in the region. Because of the uncertainties regarding potential effects of climate change on the groundwater flow system, it was not possible to provide a reasonable or meaningful simulation of the combined effects of pumping and climate change on water resources.

Model Limitations

All models have limitations and the CCRP model is no exception. A detailed discussion of the model limitations and accuracy of the model to reproduce measured groundwater levels and estimated groundwater budget components is provided in the numerical model report (SNWA 2009b). Although the model results provide valuable insight as to the general, long-term drawdown patterns and relative trends likely to occur from the various pumping scenarios, the model does not have the level of accuracy required to predict absolute values at specific points in time (especially decades or centuries into the future). Two major limitations of the model for predictive studies include: 1) a lack of reliable information regarding the hydraulic properties of faults included in the model; and 2) representation of future climate as discussed below.

Regional information suggests that the presence of faults throughout the region strongly influences the movement of groundwater. However, reliable estimates of hydraulic properties of faults included in the model are not available. Considering the size of the study area, number of faults, and the fact that these properties likely would vary both horizontally and vertically along these structures, it is not practical (and likely would be impossible) to collect reliable estimates of hydraulic parameters for all of the major faults in the region of study. It also is probable that other faults exist in the model area that have not been identified or incorporated into the model. This pervasive lack of information regarding fault hydraulic parameters is considered a major limitation of the model. As described previously, 50 faults (or fault zones) have been represented in the numerical model (Figure 4-11, p. 4-20, SNWA 2009b). The hydraulic conductivities for these faults were treated as model parameters and were estimated during the model calibration process. Most of the major regional faults included in the calibrated model are represented as low permeability structures that inhibit flow across the fault zones. The presence of these structures in the model tends to influence the pattern and magnitude of drawdown simulated by the model.

Another limitation is that the recharge estimates used as model input assumes that the same average precipitation rate and pattern observed over approximately the past 30-year period is representative of the average conditions that will occur over the 245-year future simulation period (i.e., assumption that the annual recharge rates do not vary over the 245-year future simulation period [2005 – 2250]). For this reason, the calibrated model should not be considered an accurate or precise predictor of future conditions because it does not account for variations in future climate conditions that cannot be accurately forecasted at this time.

Conclusion. Although there are inherent uncertainties and limitations associated with results of a regional groundwater flow model over a broad region with complex hydrogeologic conditions, the calibrated CCRP model is a reasonable tool for estimating probable regional-scale drawdown patterns and trends over time, resulting from the various pumping alternatives that were evaluated. When combined with the baseline information on water resources in the study area, the simulated drawdowns, flow estimates, and water budget estimates provide reasonable and relevant results for analyzing the probable regional-scale effects and comparing alternatives for this programmatic level analysis.

Defining the Drawdown Area

For this impact analysis, the model-simulated area where the water table would experience a change (decrease) in groundwater elevation of 10 feet or more is defined as the "drawdown area." The 10-foot drawdown contour is used as a frame of reference to identify water-dependent water resources within the drawdown area that may be at risk, and for comparison of the potential effects between the various pumping scenario alternatives. Drawdowns of less than 10 feet could reduce flows in perennial springs or streams that are controlled by discharge from the regional groundwater flow system, which in turn potentially could cause declines in the diversity and abundance of associated riparian flora and fauna that may only be able to tolerate water declines on the order of a few feet. However, considering the regional scale of the model and unavoidable uncertainty associated with the model predictions (summarized below), the BLM does not believe that it is reasonable or appropriate to use the regional model to quantify changes in groundwater elevation of less than 10 feet. In addition, in many areas within the study area, changes in groundwater levels of less than 10 feet can be difficult to distinguish from natural seasonal and annual fluctuations in groundwater levels. The BLM has used the 10-foot drawdown contour to define the drawdown area for quantification of impacts associated with groundwater pumping in many other EISs in Nevada over the past 10 to 15 years[1]. The BLM recognizes that refinements, such as the collection of additional site-specific hydrologic information and model refinement (such as the development of embedded models in specific areas of interest) would be necessary to improve the ability to predict drawdown impacts at a more localized scale.

The drawdowns used in the impact evaluation were calculated as follows:

- For the No Action pumping scenario, the drawdowns results are calculated as the difference between the initial hydraulic heads (those simulated at the end of 2004 by the calibrated numerical model) and the simulated hydraulic head for the specific time frame.
- The drawdowns presented for the Proposed Action and Alternatives A through F pumping scenarios represent the estimated incremental drawdown attributable to each specific pumping scenario without the effects of the No Action pumping. These were calculated as the difference between the total drawdown simulated by the combined No Action pumping scenario plus the specific groundwater development pumping scenario (included in the Proposed Action or Alternatives A through F) subtracted from the No Action drawdown results for the specific time frame.
- The results for the cumulative pumping scenarios represent the combined effects of: 1) continuation of the No Action pumping scenario in the future; 2) addition of identified reasonably foreseeable future pumping actions; and 3) pumping associated with groundwater development project (Proposed Action or Alternatives A through F pumping scenarios). All of the drawdown results for the cumulative analysis were calculated as the difference between the initial hydraulic heads (those simulated at the end of 2004 by the calibrated numerical model) and the simulated hydraulic head for the specific time frame.

Spring and Stream Impacts Evaluation

Potential impacts to springs and streams were evaluated by identifying and evaluating the potential risk to all known or suspected perennial water sources in the defined drawdown area using the methodology described below. Because of the regional nature of the groundwater flow model and model limitations discussed previously, it is not possible to accurately predict site-specific changes in flow for springs or streams. However, the model is viewed as a useful and relevant tool for predicting flow trends resulting from the various pumping scenarios at selected springs and streams, primarily those with large flows that likely represent discharge from the regional groundwater flow system. These flow predictions were used to evaluate: 1) if and when impacts to flow were likely to occur; and 2) the relative magnitude of change that could occur. The methodology used for each of these evaluations is summarized below.

<u>Identification of Springs and Streams Susceptible to Drawdown Impacts</u>

The springs and streams in the region can be characterized as either ephemeral, intermittent, or perennial. Ephemeral and intermittent springs and stream reaches flow only during or after wet periods in response to seasonal runoff. By definition, these surface waters are not controlled by discharge from the regional groundwater flow systems. During the low-flow period of the year, ephemeral and intermittent springs and stream reaches typically are dry. In contrast, perennial springs and stream reaches generally flow throughout the year. Flows observed during the high-flow periods

[1] A few Nevada BLM EIS examples include: Final EIS Cortez Hills Expansion Project, September 2008; Final EIS Phoenix Project, January 2002; Draft SEIS Barrick Goldstrike Mines Inc. Betze Project, September 2000; Draft EIS Leeville Project, March 2002; Final EIS Newmont Mining Corporation South Operation Area Project Amendment, April 2002.

in perennial springs and streams include a combination of surface runoff and groundwater baseflow discharge, whereas during the low-flow period, flows are sustained entirely by baseflow discharge from the groundwater system. If the flow from the perennial spring or stream is controlled by discharge from the aquifer used for the GWD Project, a reduction of groundwater levels from well field production could reduce the groundwater discharge to perennial springs or streams with a corresponding reduction in spring flows, lengths of perennial stream reaches, and their associated riparian/wetland areas.

The actual impacts to individual seeps, springs, or stream reaches would depend on the extent of drawdown that occurs in the area, and the interconnection between the surface water feature and the aquifers affected by drawdown. The interconnection (or lack of interconnection) between the perennial surface waters and deeper groundwater sources is controlled by the specific hydrogeologic conditions that occur at each site. Considering the complexity of the hydrogeologic conditions over this broad region, inherent uncertainty in numerical modeling predictions (discussed above) related to the exact areal extent and magnitude of drawdown, and uncertainty in the site-specific hydrogeologic conditions controlling flow at most of the springs within the model domain, it is not possible to conclusively identify specific springs and seeps that would show effects from future drawdown from the various pumping scenarios considered in this analysis. However, the regional model results, coupled with a generalized understanding of the groundwater flow system, provide the most reasonable means available at this time to identify areas where impacts associated with the proposed action (or alternative) pumping are likely to occur. This drawdown impact evaluation for springs and streams is limited to a prediction of areas of risk with the recognition that actual impacts to individual springs and streams distributed over this broad region cannot be determined precisely prior to pumping.

Potential impacts to all perennial streams and springs located within the defined drawdown area were evaluated by:

1. Identifying perennial streams and springs within the model-simulated drawdown area (defined by the 10-foot drawdown contour at various future points in time); and
2. Evaluating the likely source of the water to identify water resources that potentially are susceptible to groundwater development drawdown impacts.

Baseline information for perennial springs and streams in the study area is summarized in Section 3.3.2. The spring databases compiled for this project include two types of data: 1) inventoried springs, and 2) other springs. For the purposes of this study, "inventoried springs" are springs that have been field verified and include one or more flow measurements. "Other springs" are mapped spring locations that have not been field verified and therefore do not include flow measurements. The other springs were identified based on locations shown on topographic maps or included in the National Hydrography Database.

As described in Section 3.3.1.3, Hydrologic Cycle and Conceptual Groundwater Flow, the conceptual model indicates that springs are controlled by local, intermediate, or regional flow systems. For this impact analysis, it is assumed that the intermediate and regional groundwater flow systems are hydraulically connected within the drawdown areas. For the purposes of discussion, unless otherwise specified, the use of the term "regional groundwater flow system" in the remainder of this document refers to the combined intermediate and regional groundwater flow systems described in Section 3.3.1.3.

The water resource impact analysis uses the geomorphic setting (i.e., valley floor, valley margin, and upland areas) defined in **Table 3.3.2-3**, combined with water level data, to identify the general risk level for each perennial water source within the simulated drawdown areas. For this analysis, springs in upland areas (i.e., high elevation regions or mountain block settings) are assumed to be controlled by discharge from local or perched groundwater systems that are unlikely to be hydraulically connected to the regional groundwater flow system that would be affected by groundwater withdrawal. Therefore, the analysis assumes that the risk of impacts to springs and perennial stream reaches located in upland settings is considered low regardless of the drawdown in the regional groundwater flow system that may occur beneath these areas.

Springs located in valley floor settings are assumed to be controlled predominantly by discharge from the regional groundwater flow system. The impact analysis further assumes a high risk of impacts to most springs (and associated stream reaches fed by springs) that discharge on the valley floors within the drawdown area. It is important to recognize that perched aquifers may occur in localized valley floor settings; however, localized perched aquifers in valley floor settings are not identified or evaluated as part of this regional impact assessment.

Table 3.3.2-3 Assumptions Used to Evaluate Potential Impacts to Perennial Water Resources Located Within the Drawdown Area

Generalized Geomorphic Setting	Predominant Groundwater Flow System Assumed to Control Discharge to Perennial Springs and Streams	Relative Risk of Impacts to Perennial Water Resources within the Drawdown Area	Explanation
Upland Areas	Local or Perched	Low	Impacts are unlikely to occur regardless of predicted model drawdown.
Valley Margin Areas	Local and Intermediate[1]	Moderate[2]	Impacts to some perennial waters may occur in springs discharging from aquifers hydraulically connected to the regional flow system. Impacts are unlikely to occur to perennial waters discharging from local or perched groundwater flow systems that are not hydraulically connected to the regional flow system.
Valley Floor Areas	Regional	High[2]	Impacts are likely to occur to perennial water resources that depend on discharge from the regional groundwater flow system. Impacts are unlikely to occur in localized perched aquifers that occur in some areas.

[1] Intermediate flow system is assumed to be interconnected with the regional flow system.

[2] Except where available, water-level data indicates that surface water resources are likely perched or hydraulically isolated from the regional groundwater flow system (see text for further explanation).

Springs (and stream reaches fed by springs) located in valley margin settings may be controlled by discharge from local, intermediate, or in some instances, regional groundwater flow systems. The actual discharge source for each spring or stream reach in these areas is controlled by site-specific hydrogeologic conditions that typically are not well understood. Considering the uncertainty associated with the source of groundwater discharge for individual springs and hydraulic interconnection between the spring source and the aquifer systems that would be affected by groundwater pumping, the impact analysis assumes that there is a moderate risk of impacts to springs (and stream reaches fed by springs discharging in these areas) located within the valley margin setting in the drawdown area.

The geomorphic settings (i.e., valley floor, valley margin, and upland areas) were determined for each basin within the study area using slope, elevation, and geology (based on the simplified hydrogeologic framework used to construct the numerical flow model provided in SNWA 2009b). The valley floor area was defined as the flat valley bottoms with the lowest elevations within each basin. The valley floor areas are underlain by unconsolidated basin-fill deposits. The valley margin areas generally are characterized by the intermediate slope and intermediate elevation zones between the flat valley floor and steeper bedrock areas in the mountain block. The valley margin areas generally are underlain by alluvial fans but may locally include bedrock, including carbonate bedrock units, which extend beneath the valley floor areas and their associated basin-fill deposits. The upland areas are characterized as higher elevation areas with typically steeper terrain that is predominantly underlain by bedrock.

Site-specific water-level data is not available in all locations to evaluate if perennial water resources are likely or unlikely to be connected to the regional groundwater system. Available depth-to-water data for the region is provided in the baseline characterization report (SNWA 2008 Volume 4), supplemented in Snake Valley with new information collected by UGS (2010). The data points (i.e., wells) with water-level data are spatially variable between the different geomorphic settings. Depth-to-water information is scarce to nonexistent in most upland areas, available locally in some areas within the valley margin zone, and typically available in the valley floor areas in most basins. However, the number of data points within the valley floor areas varies greatly between basin and by area within each basin. In most areas, the depth-to water data correlates with the geomorphic setting in that shallow water levels (less than 100 feet) generally occur in valley floor settings, and deeper water levels (greater than 100 feet) generally occur in the valley margin and upland areas. The areas of potential high risk initially identified using the geomorphic setting (summarized in **Table 3.3.2-3**) were adjusted in some areas if there was sufficient water-level data to demonstrate that the depth to the regional water table was relatively deep for a particular region or hydrographic basin. Specifically, if there were sufficient data to demonstrate that the depth-to-water in the valley floor setting was greater than 100 feet, the level of risk was adjusted to "moderate risk"; if the water level data indicated that the depth-to-water was greater than 150 feet, the risk level for that area was adjusted to "low risk". For example, in Delamar Valley, the depth-to-water is greater than 800 feet below ground surface indicating that surface water resources in this basin are not controlled by discharge from (or are hydraulically connected to) the regional groundwater system in this basin that would be affected by the proposed groundwater withdrawal. Therefore, the potential risk to surface water resources in the Delamar Valley hydrographic basin are assumed to be low (i.e., impacts are unlikely to occur regardless of drawdown) even if these resources occur in a valley floor or valley margin setting.

<u>Identification of Springs and Streams Susceptible to Drawdown Impacts within and Adjacent to Great Basin National Park</u>

As described previously, this analysis uses the geomorphic setting (i.e., valley floor, valley margin, and upland areas) combined with site-specific water-level data to identify the general risk level for each perennial water source within the predicted drawdown areas. This analysis has identified springs and perennial stream reaches located in lower elevation areas along the valley margin area of the park where surface waters could be impacted. The USGS has conducted a more detailed, site-specific study within GBNP and adjacent areas in Spring Valley and Snake Valley to evaluate the susceptibility of surface water resources to groundwater pumping. This study is described below.

The NPS requested a study by the USGS to identify areas within the GBNP where surface water resources are susceptible to groundwater pumping in the valleys adjacent to the park. The results of this study were published in the USGS report "Characterization of Surface-Water Resources in the GBNP Area and Their Susceptibility to Ground-Water Withdrawals in Adjacent Valleys, White Pine County, Nevada" (Elliott et al. 2006). The study assessed surface water resources to identify areas vulnerable to groundwater pumping effects. The results of the study delineated specific areas within and near the park; these areas were defined as follows:

(1) "Areas where surface-water resources likely are susceptible to ground-water withdrawals;" and

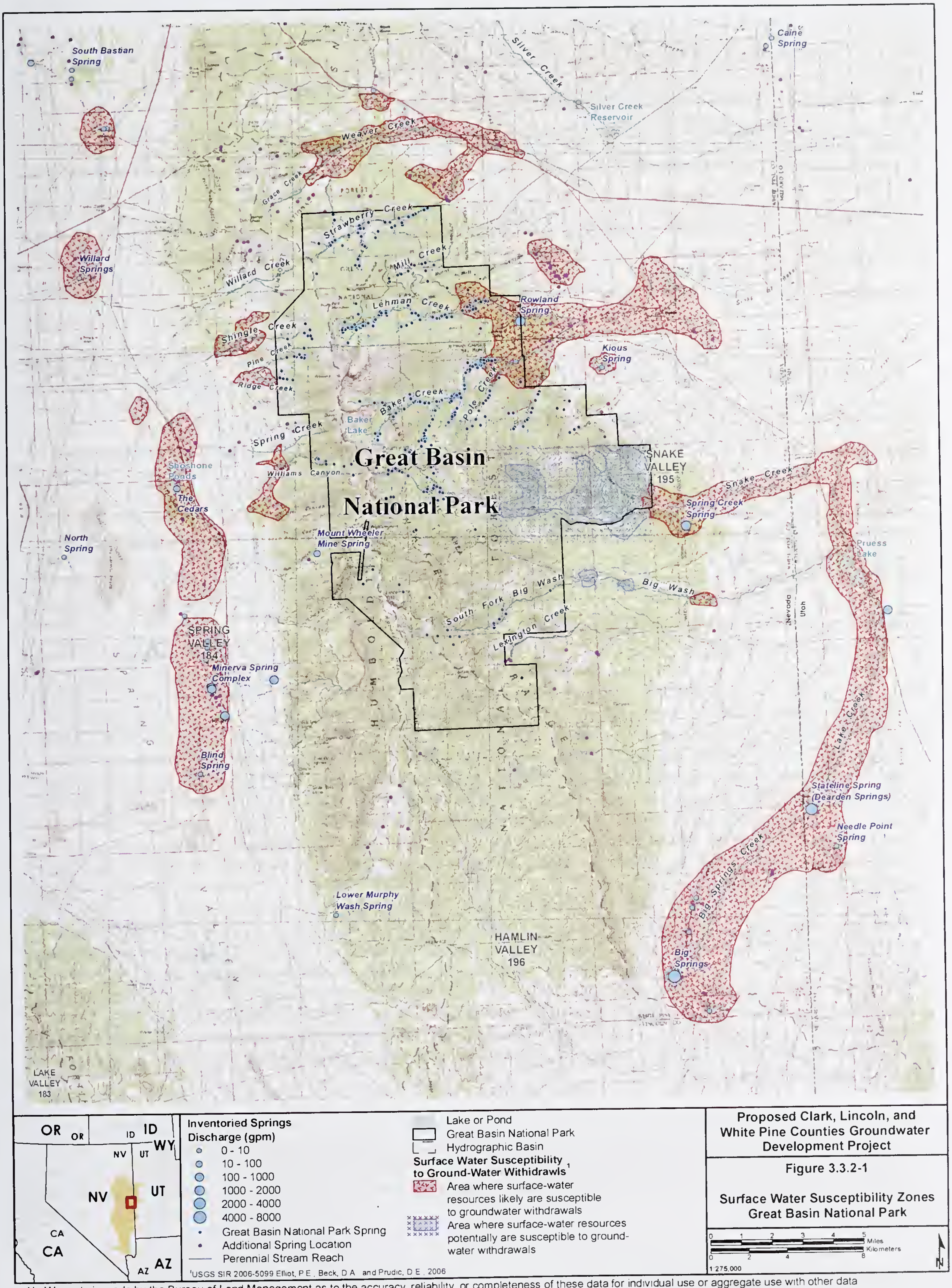
(2) "Areas where surface-water resources potentially are susceptible to ground-water withdrawal."

Prudic (2006), a coauthor of the susceptibility study, provided responses to comments on the susceptibility study that included an explanation of the difference between the two types of susceptibility areas identified on Plate 1. Prudic explained that the 'likely susceptible" areas are more vulnerable to groundwater pumping effects than the "potentially susceptible areas." He also states in the concluding summary of this document that "Results from the study indicate that surface-water resources in most of the Park are not susceptible to ground-water pumping in the adjacent valleys. However, we identify a few areas area within and near the Park's boundaries that are susceptible (potentially or likely); these warrant additional monitoring and study." As described in Section 3.0.3, Incomplete and Unavailable Information, the USGS and the University of Nevada, Reno (UNR) are in the process of completing a study entitled *A Study of the Connection Among Basin-Fill Aquifers, Carbonate-Rock Aquifers, and Surface-Water Resources in Southern Snake Valley, Nevada.* Additional studies also are ongoing to investigate the source of water in caves and interconnection between the caves and the groundwater flow system (Van Liew 2012; USGS 2008).

The areas identified in and adjacent to the park as "likely susceptible to groundwater withdrawal" (Elliott et al. 2006) are shown on **Figure 3.3.2-1** and include:

Spring Valley Hydrographic Basin:

- Shingle Creek (middle and lower reaches along the west boundary of the park)
- Pine and Ridge creeks (middle and lower reaches along the west boundary of the park)
- Williams Canyon (middle and lower reaches along the west boundary of the park) and adjacent Shoshone Ponds and Minerva spring complexes



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-1

Surface Water Susceptibility Zones Great Basin National Park

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

Snake Valley Hydrographic Basin:

- Weaver Creek (full reach along the north boundary of the park)
- Strawberry Creek (lower reaches) and adjacent springs (along the north boundary of the park)
- Lehman and Baker creeks (middle to lower reaches), and Rowland and Cave springs (along the northeast boundary of the park)
- Snake Creek and its tributary Spring Creek Tributary (lower reach along the eastern boundary of the park)
- Big Wash (lower reach east of the park boundary)
- Big Springs Creek/Lake Creek and associated springs (full reach from Nevada into Utah, southeast of the park boundary)

The areas identified in and adjacent to the park as "potentially susceptible" to groundwater withdrawal (Elliott et al. 2006) also are shown on **Figure 3.3.2-1** and include:

- Snake Creek and its tributaries (middle reach located upgradient of the likely susceptible lower reach)
- Big Wash (middle reach below confluence of North and South Forks of Big Wash, east of the park boundary)

The risk analysis used for this regional water resource impact evaluation has incorporated the results of the Elliot et al. (2006) study by assuming that there is a moderate risk of impacts to perennial water resources located within the susceptibility zones as defined on **Figure 3.3.2-1** within the boundaries of GBNP. For this analysis, the susceptibility zones delineated in **Figure 3.3.2-1** that occur outside park boundaries are defined as moderate or high risk depending on whether the perennial resources in these areas occur in the valley margin or valley floor setting, respectively.

Evaluation of Model-simulated Stream Flow Results

The numerical groundwater flow model was used to simulate changes in baseflow in a few selected springs and streams resulting from the Proposed Action and alternatives. The specific methods used to simulate spring and stream flow in the numerical model is provided in the model documentation (SNWA 2009b). Baseflow is the groundwater component of surface water flow and is distinct from the contributions to streamflow associated with runoff from precipitation or snowmelt. There is a high level of uncertainty associated with long-term simulations of changes in baseflow (or groundwater discharge) in streams and springs distributed over large regions. The numerical model encompasses over 20,000 square miles. As discussed previously, the groundwater flow model is based on a conceptual model that represents a simplified and generalized understanding of the hydrogeologic and hydrologic conditions over a very large region. A major source of uncertainty is the hydraulic interconnection between the regional groundwater flow system and the springs and streams represented in the model. Due to the simplified assumptions in the model and unknown or poorly-understood conditions that control flow in most of the springs and streams, the baseflow may not change as predicted by the model.

Considering the limitations of the regional model and inherent uncertainty associated with the flow predictions, the model-simulated spring flows are used in this analysis to identify major spring discharge areas outside of the identified drawdown area (including White River Valley, Pahranagat Valley, Muddy River, Big Springs, and Gandy Warm Springs in Snake Valley) where potential flow reductions could occur; they also are used to provide an indication of potential trends in flow that are likely to occur to springs located both within and outside the defined drawdown area. However, as explained previously, considerable uncertainty exists regarding the accuracy of these predictions. Therefore, it is not reasonable to use the results to predict the absolute change in flow over the long-term simulation period.

For the springs or streams with flow predictions, a simulated incremental change in flow of less than 5 percent was inferred to indicate that measureable impacts were unlikely to occur. A less than 5 percent reduction of flow would be difficult to accurately measure or distinguish from natural fluctuations and is presumed to be within the model uncertainty. The impact analysis further assumes that springs with model-simulated flow reductions of 5 percent or greater could be affected.

Big Springs Flow Predictions. An earlier version of the numerical model was set up such that a low permeability HFB was used to control the discharge at Big Springs (SNWA 2009b). The HFB was situated immediately east of Big Springs at the location of a local Quaternary fault. This model construction was able to closely approximate the discharge at Big Springs. However, the placement of the north-south fault barrier immediately east of the spring, and the assumed distribution of pumping wells on the east side of the fault restrict the drawdown impacts to Big Springs. The geologic map and cross-section provided in the baseline report indicate that the simulated fault is subparallel to a major range-bounding fault located approximately 0.75 mile to the west of Big Springs (SNWA 2008) that was not simulated in this version of the model. After review of the model construction, the BLM technical review team requested that the model be modified in southern Snake Valley that consisted of shifting the position of the HFB to essentially match the major range-bounding fault. In the final calibrated model used for the EIS, the HFB in the area of Big Springs was moved to the west to closely match the location of the range-bounding fault, as requested by the BLM (SNWA 2010a). As a result of this move, the local fault situated east of Big Springs on the valley floor was no longer represented in the regional model.

With this revised configuration, the model was only able to simulate discharge of about one-half of the observed discharge at Big Springs. It was not possible to simulate a larger spring discharge without drastic changes to the numerical model (SNWA 2010a). However, this fit to the observed discharge is similar to the quality of fit at other locations in the model. Because of this different representation of the spring in the earlier and final version of the models, the decrease in springflow caused by pumping is different. The spring discharge simulated by the original model decreases following a gentle slope. By the end of the simulation period, spring discharge has been reduced by less than a third of the rate in 2005. The spring discharge simulated by the modified numerical model decreases following approximately the same rate of decrease as the one simulated by the original model until about the year 2050 (when pumping is initiated in Snake Valley). After that time, the rate of decrease increases drastically causing the discharge at the spring to cease (SNWA 2010b). These alternative model configurations illustrate that there is considerable uncertainty regarding the hydrogeologic conditions that control the groundwater discharge at Big Springs. Therefore, the simulated reduction in flows should not be viewed as reliable predictions of future flows at specific points in time in the future. Rather, these flow predictions from the regional model should be viewed as indicators of the potential risk to the spring associated with pumping in southern Snake Valley and Spring Valley.

Water Rights Impact Evaluation

This impact evaluation is not intended to determine reasonable (or unreasonable) effects to water rights allowable under state law such as the Nevada Statue (NRS 534.110{4}) that allows for a reasonable lowering of the static water level at the points of diversion for existing water rights provided that the existing water rights can be satisfied. The water rights impacts evaluation is intended to provide a disclosure of potential effects to existing surface and groundwater rights resulting from the various proposed pumping alternatives.

Active water rights including their points of diversion and manner of use were identified within the hydrologic study area as described in Section 3.3.1.5, Groundwater Resources. The impact assessment was conducted by overlaying the predicted drawdown on the water right points of diversions to identify water rights that may be affected. For surface water rights, it was assumed that water rights located within the model-simulated drawdown area (defined by the 10-foot drawdown contour) and located within the identified high and moderate risk areas previously described for perennial water could be affected. It also was assumed that groundwater rights located within the same defined drawdown area could be affected. Groundwater rights were further evaluated by determining the magnitude and timing of the drawdown at the points of diversions. Potential impacts to surface water rights and groundwater rights were summarized by determining the number of water rights potentially affected in each hydrographic basin for each alternative. Additional information regarding uncertainty associated with the water rights impact assessment is presented under the Proposed Action drawdown effects analysis.

Presentation of Results

The results of the groundwater pumping analysis are summarized by alternative in the following section. Additional details and the supporting information used to develop the summaries and quantification of potential impacts to water resources are provided in the substantial material in **Appendices F3.3.7** through **F3.3.16**. This includes the following information provided for each pumping scenario and comparison time frame (i.e., full build out, full build out plus 75 years, and full build out plus 200 years).

- Drawdown maps for each pumping scenario at each time frame (**Appendix F3.3.7**);
- Maps delineating the risk to perennial surface water resources within the predicted drawdown areas (**Appendix F3.3.8**);
- Tables listing the number of springs by basin that occur within the high, moderate, and low risk areas for each pumping scenario and time frame (**Appendix F3.3.9**);
- Tables identifying the inventoried springs that occur within the moderate and high risk areas for each pumping scenario and time frame (**Appendix F3.3.10**);
- Tables listing the miles of perennial stream within areas where effects to surface waters could occur for each pumping scenario and time frame (**Appendix F3.3.11**);
- Maps illustrating the risks to surface water rights by manner of use within the drawdown areas for each pumping scenario and time frame (**Appendix F3.3.12**);
- Tables defining the risk to surface water rights by basin within the drawdown areas for each pumping scenario and time frame (**Appendix F3.3.13**);
- Maps illustrating the drawdown effects to groundwater rights by manner of use for each pumping scenario and time frame (**Appendix F3.3.14**);
- Tables defining the risk to groundwater rights by basin within the drawdown areas for each pumping scenario and time frame (**Appendix F3.3.15**); and
- Tables presenting the simulated groundwater budgets by basin and flow system for each pumping scenario and time frame (**Appendix F3.3.16**).

3.3.2.9 Proposed Action

Groundwater Development Areas

Groundwater development areas have been identified in the five groundwater development basins (i.e., Spring, Snake, Delamar, Dry Lake, and Cave valleys). Groundwater development areas are located in portions of the valley floor and valley margins within each basin. Development within the groundwater development areas would include groundwater production wells, collector pipelines, staging areas, power facilities, pumping stations, and access roads. The actual location of specific facilities within the groundwater development areas has not been identified at this stage of the project and will be subject to future site-specific NEPA analysis.

Construction and Operation

Springs identified within the groundwater development areas are summarized in **Table 3.3.2-4**. Under the Proposed Action, there are 60 springs located within the boundaries of the development areas. Of these 60 springs, 13 have been verified in the field and include flow data. The remaining 47 springs were identified based on locations shown on topographic maps or included in the National Hydrography Database. These springs occur within the groundwater development areas within Spring Valley (37 springs), Snake Valley (11 springs), Delamar Valley (7 springs), Dry Lake Valley (4 springs), and Cave Valley (1 spring).

There also are 28 separate perennial stream reaches with a total length of 29 miles that occur within the groundwater development areas (**Table 3.3.2-5**). This includes 23 perennial stream reaches (total length of 20.2 miles) located in Spring Valley and 5 (total length of 8.8 miles) located in Snake Valley.

The potential for impacts to springs and streams located within these groundwater development areas would depend on the location of facilities. For this programmatic analysis, it is assumed that the ACMs discussed for construction of the primary ROWs that address surface water resources, stream crossings, and erosion control measures would apply to these future ROWs. In addition, SNWA Programmatic Measures indicate that: 1) well pads would avoid riparian and wetland areas (ACM B.1.1); and 2) as feasible, collector pipeline, electrical service lines, and substations would avoid wetlands and stream crossings (ACM B.1.3). Implementation of these combined measures would minimize impacts to perennial water sources associated with the well field development.

Table 3.3.2-4 Number of Springs Located within the Groundwater Development Areas

Alternative				Proposed Action, A and C		B		D		E and F	
GW Flow System	Basin #	Basin Name	Name	Inv. Spg.[1]	Other Spgs.[2]	Inv. Spg.[1]	Other Spgs.[2]	Inv. Spg.[1]	Other Spgs.[2]	Inv. Spg.[1]	Other Spgs.[2]
White River	180	Cave Valley	381658114523300	–	1	–	–	–	1	–	1
	181	Dry Lake Valley	181 S01 E64 06DB 1	–	1	–	–	–	1	–	1
			Unnamed Springs		3	–	–	–	3	–	3
	182	Delamar Valley	Grassy Spring	1	–	–	–	1	–	1	
			Unnamed Springs	–	6	–	–	–	6	–	6
Salt Lake Desert	184	Spring Valley (184)	Blind Spring	1	–	–	–	–	–	1	–
			Four Wheel Drive Spring	1	–	–	–	–	–	1	–
			Indian Springs	1	4	–	–	–	–	1	4
			Kalcheck Springs	–	1	–	–	–	–		1
			Layton Spring	2	–	–	–	–	–	2	–
			N. Millick Spring	1	–	–	–	–	–	1	–
			S. Bastian Spring	1	–	–	–	–	–	1	–
			S. Bastian Spring 2	1	–	–	–	–	–	1	–
			S. Millick Spring	1	–	–	–	–	–	1	–
			The Seep	1	–	–	–	–	–	1	–
			Unnamed Springs	–	21	–	–	–	1	–	21
			Unnamed Springs east of Cleve Creek	1	–	–	–	–	–	1	–
	195	Snake Valley	363854114072701	–	1	–	–	–	–	–	–
			Kious Spring	–	–	1	–	–	–	–	–
			Unnamed Caine Spring	–	1	–	–	–	–	–	–
			Unnamed Caine Spring - South	–	1	–	–	–	–	–	–
			Unnamed Spring SW of Caine Spring	–	1	–	–	–	–	–	–
			Unnamed Springs	1	6	–	5	–	–	–	–
			Youn-Aquainv-003	–	–	1	–	–	–	–	–
Total				**13**	**47**	**2**	**5**	**1**	**12**	**12**	**37**
Total All Springs				**60**		**7**		**13**		**49**	

[1] Inventoried spring (field verified).

[2] Other springs (not field verified).

Table 3.3.2-5 Perennial Streams within the Proposed Groundwater Development Areas

GW Flow System	Basin #	Basin Name	Stream Name	Proposed Action, and A and C	B	D	E and F
Salt Lake Desert	184	Spring Valley (184)	Bassett Creek	0.8			0.8
			Bastian Creek	2.0			2.0
			Big Negro Creek	2.7			2.7
			Cleve Creek	2.3			2.3
			Freehill Creek	0.4			0.4
			Garden Creek	1.1			1.1
			Gordon Creek	0.1			0.1
			Indian Creek	1.7			1.7
			Kalamazoo Creek	0.1			0.1
			McCoy Creek	2.4			2.4
			McCoy Creek (Unnamed Wash)	0.5			0.5
			Meadow Creek	1.3			1.3
			Muncy Creek	0.2			0.2
			North Millick Spring Creek	0.6			0.6
			Odgers Creek	0.7			0.7
			Piermont Creek	0.7			0.7
			Ranger Creek	0.4			0.4
			Shingle Creek	0.5			0.5
			South Millick Spring Creek	0.1			0.1
			Spring Creek (GBNP)	0.1			0.1
			Spring Valley (Unnamed Creek 1)	0.4			0.4
			Stephens Creek	0.8			0.8
			Vipont Creek	0.4			0.4
	195	Snake Valley	Big Springs Creek	5.3	2.7		
			Big Wash	2.0			
			Lake Creek	0.1			
			Lehman Creek	0.2	1.0		
			Lehman Creek Diversion	1.2	2.1		
Total Miles				**29.0**	**5.8**		**20.3**

Although the SNWA Programmatic Measures commit to avoiding wetlands and stream crossing where feasible, the final facility likely would include some (unavoidable) perennial stream crossings. Potential construction related impacts to perennial streams generally would be minimized by the implementation of the BLM's BMPs and ACMs discussed previously for the primary pipeline and power line ROWs. These measures would minimize erosion and potential channel degradation and scour impacts. However, construction across perennial streams likely would result in short-term (2-year) impacts; depending on site-specific conditions and construction methods, construction also could result in long-term (greater than 2 years) impacts. Construction also would result in short-term disturbance of the stream beds in the other intermittent and ephemeral streams crossed by a pipeline or access road.

Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated maximum surface disturbance of approximately 8,400 acres within 5 hydrographic basins. This surface disturbance would result in an increase in erosion and sedimentation from construction of facilities in the groundwater development areas. Stormwater and erosion control measures including the preparation of site-specific SWPP Plans, implementation of the BLM Management Decisions and BMPs, and temporary and permanent erosion control measures included in the ACMs (previously discussed for the Primary ROWs) should minimize potential impacts to perennial water sources and ephemeral and intermittent drainages.

The development areas are not located within any mapped or delineated flood zone. However, the development areas incorporate drainage areas that are subject to periodic flooding, flash flooding, and associated erosion and sedimentation during extreme or prolonged runoff events. Potential periodic impacts from flooding likely would be localized and short-term and would be addressed as part of ongoing maintenance activities.

Monitoring and Mitigation Recommendation

SNWA would be required to develop and implement (and fund) a comprehensive COM Plan that would include all facilities and hydrographic basins associated with the SNWA GWD Project. The plan would be approved and managed by the BLM in accordance with the FLPMA. A framework for development of the COM Plan is provided in Section 3.20, Monitoring and Mitigation Summary, and includes a description of the development process; plan components; roles and responsibilities for BLM, SNWA, and other federal and state agencies; enforcement; and a description of the effectiveness of the plan to mitigate potential adverse impacts associated with the project.

In addition to all mitigation measures identified for ROW activities, the following monitoring and mitigation measures are recommended to supplement the ACMs and state and federal regulations to protect or reduce potential impacts to perennial water sources within the groundwater development areas.

Monitoring

GW-WR-1: Spring Inventories. A spring inventory would be conducted in all groundwater development areas to verify and map the location of all springs prior to construction. Construction and development of the groundwater development areas would avoid ground disturbance in the vicinity (i.e., 0.5 mile) of all verified spring locations. Effectiveness: This measure should effectively mitigate impacts to springs from ground disturbance and construction related activities.

Mitigation

GW-WR-2: Stream Crossing Plans. A site-specific plan would be developed to detail the construction procedures, erosion control measures, and reclamation that would occur for pipeline construction across live (flowing) stream reaches. The plan also would incorporate information from BLM Technical Reference 423, for hydraulic considerations in designing pipeline stream crossings (DOI 2007). The plan would include site-specific designs using either open cut or jack and bore techniques and site-specific measures to minimize disturbance of the stream bed, and release of sediment from the construction area into the downstream stream reach. The plan would be reviewed and approved by the BLM and NDOW prior to initiation of any construction activities within the stream corridor. Effectiveness. This measure would be effective in ensuring the use of best construction methods at all stream crossings.

Conclusion. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated maximum surface disturbance of approximately 8,400 acres within five hydrographic basins. There are 60 known or suspected springs identified within the groundwater development areas. These springs occur within the groundwater development areas within Spring Valley (37 springs), Snake Valley (11 springs), Delamar Valley

(7 springs), Dry Lake Valley (4 springs), and Cave Valley (1 spring). There also are 37 separate perennial stream reaches located in Spring Valley (32), Snake Valley (4), and Cave Valley (1) with a total length of 54.7 miles within the groundwater development areas. The potential for impacts to springs and streams located within these groundwater development areas would depend on the location of facilities. Implementation of the ACMs would minimize impacts to perennial water sources associated with the well field development. Additional mitigation recommendations include all previous, applicable ROW mitigation measures.

Groundwater Pumping

Groundwater Pumping Scenario

The groundwater pumping scenario for the Proposed Action assumes pumping at the full quantities (i.e., approximately 177,000 afy) listed on the pending water rights application for the 5 proposed project pumping basins (Spring, Snake, Delamar, Dry Lake, and Cave valleys). The well distribution developed by SNWA for this model scenario (**Figure 3.3.2-2)** distributes the simulated production wells spatially within the groundwater development areas in an effort to minimize pumping effects. For all pumping scenarios, pumping simulations were set up such that production wells associated with the SNWA groundwater development project were completed (depending on location) in either the Upper Valley Fill, Lower Valley Fill, or Lower Carbonate unit. Details regarding the assumed pumping schedule used for the model simulations are provided in the model simulation report (SNWA 2010a). The pumping schedule reflects the proposed staged general south-to-north sequence of basin development for the project.

Impacts to Water Levels

The predicted change in groundwater levels attributable to groundwater development under the Proposed Action at full build out, full build out plus 75 years, and full build out plus 200 years are provided in **Figures 3.3.2-3**, **3.3.2-4**, and **3.3.2-5** , respectively. These figures illustrate areas where the water levels are predicted to decrease in comparison to the simulated No Action water levels.

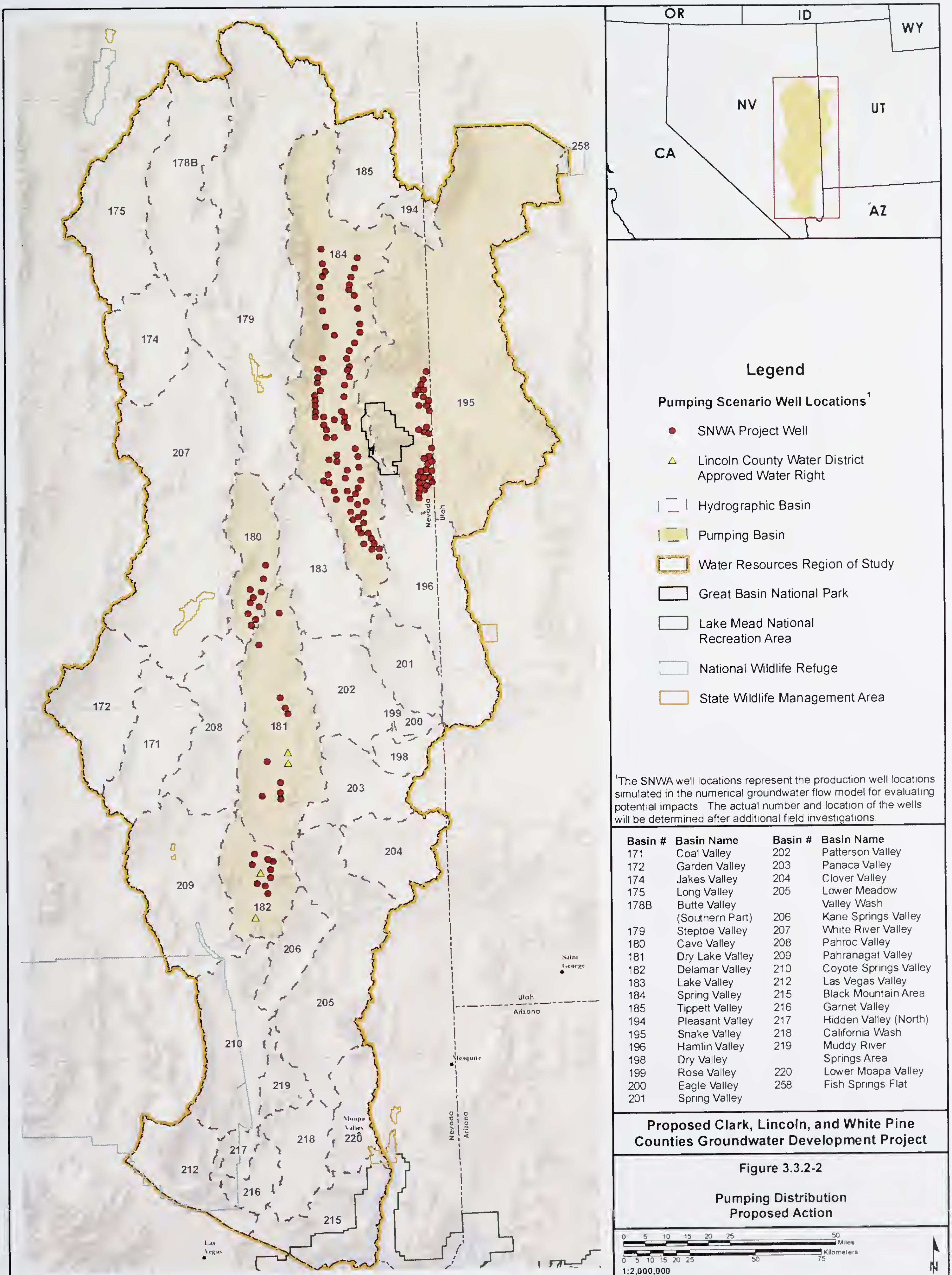
At full build out, the drawdown areas are localized in the vicinity of the pumping wells in Spring, Delamar, Dry Lake, and Cave valleys. Drawdown does not occur at this time period in Snake Valley. Comparison of the simulation results for the three representative points in time indicates that the drawdown area continues to progressively expand as pumping continues into the future.

At the full build out plus 75 years time frame, there are two distinct drawdown areas. The northern drawdown area encompasses most of valley floor in Spring Valley, southern Snake Valley, and northern Hamlin Valley. The southern drawdown area extends across the Delamar, Dry Lake, and Cave valleys in an elongate north-south direction and extends into the eastern margin of Pahranagat Valley and northwestern margin of Lower Meadow Valley Wash.

By the full build out plus 200 years time frame, the 2 drawdown areas merge into one that extends approximately 190 miles in a north-south direction and up to 55 miles in a east-west direction. At this time frame, the simulated drawdown area extends into Tippetts Valley, southeastern Steptoe Valley, the eastern margins of Pahroc and Pahranagat valleys, and the western margins of Panaca Valley and Lower Meadow Valley Wash.

The locations of six selected observation wells located within the proposed pumping basins are presented in **Figure 3.3.2-6**. Water level hydrographs for each of these observation wells within the pumping basins are provided in **Figures 3.3.2-7** and **3.3.2-8**. The hydrographs illustrate the predicted rate and magnitude of water-level decline at these representative locations over the simulation period. The hydrographs for the observation wells indicate that water levels are predicted to continue to decrease over the model simulation and are not predicted to reach a renewed equilibrium (or steady state condition) before the end of the simulation period. These results further suggest that with continued pumping beyond 200 years, additional drawdown is likely to occur after the model simulation period (i.e., after the full build out plus 200-year period).

The predicted drawdown associated with the Proposed Action pumping would lower water levels in basin-fill sediments particularly within the valley floor areas in the proposed pumping basins. Reduction of the water level in the unconsolidated sediments essentially would dewater the portion of the basin-fill aquifer situated within the drawdown cone. The portion of the unconsolidated basin-fill sediments that would be dewatered would undergo compaction as the water is removed from the material. The mechanics of compaction and the resultant changes in storage properties in



[1]The SNWA well locations represent the production well locations simulated in the numerical groundwater flow model for evaluating potential impacts. The actual number and location of the wells will be determined after additional field investigations.

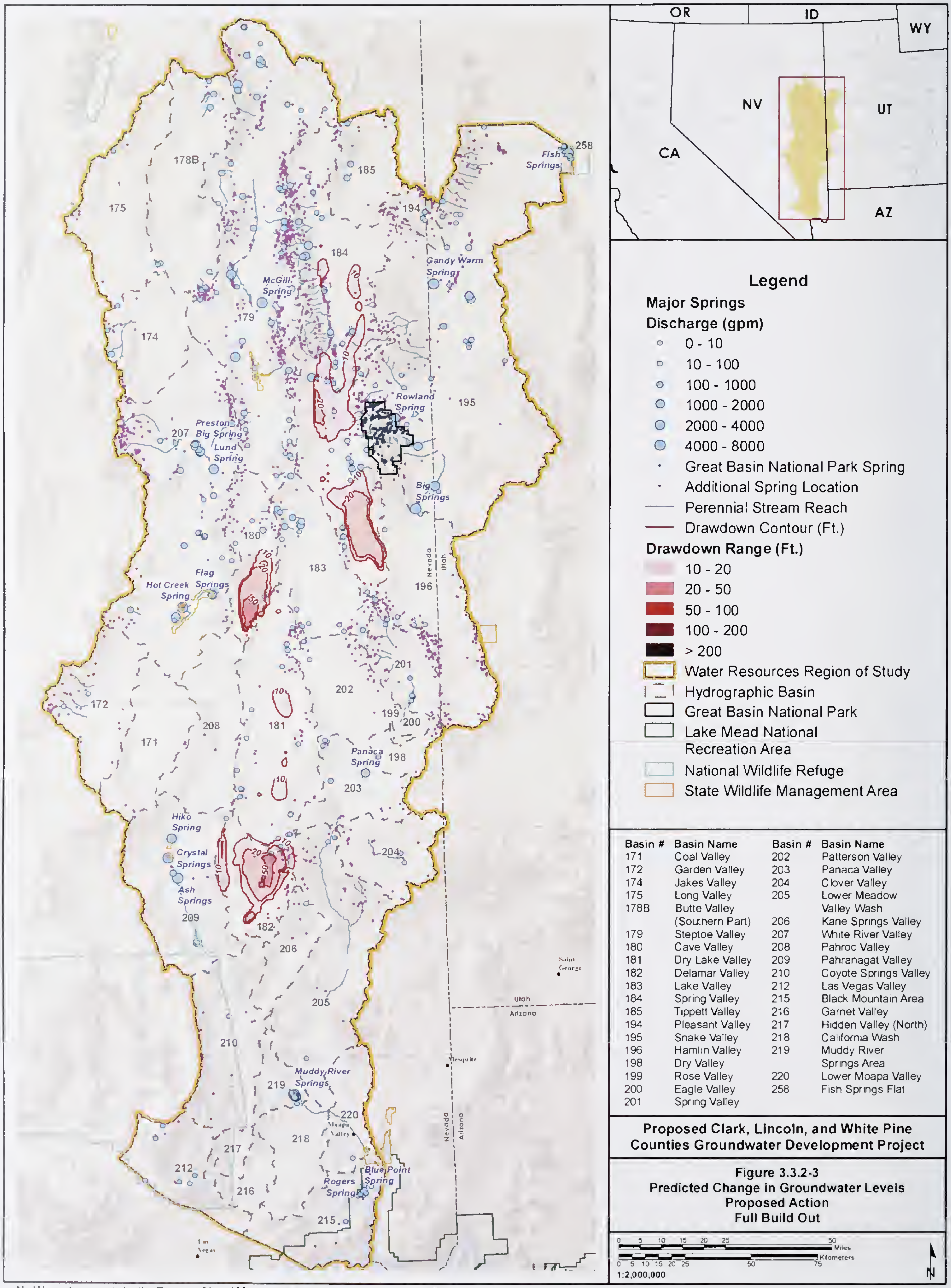
Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Springs Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-2

Pumping Distribution
Proposed Action

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

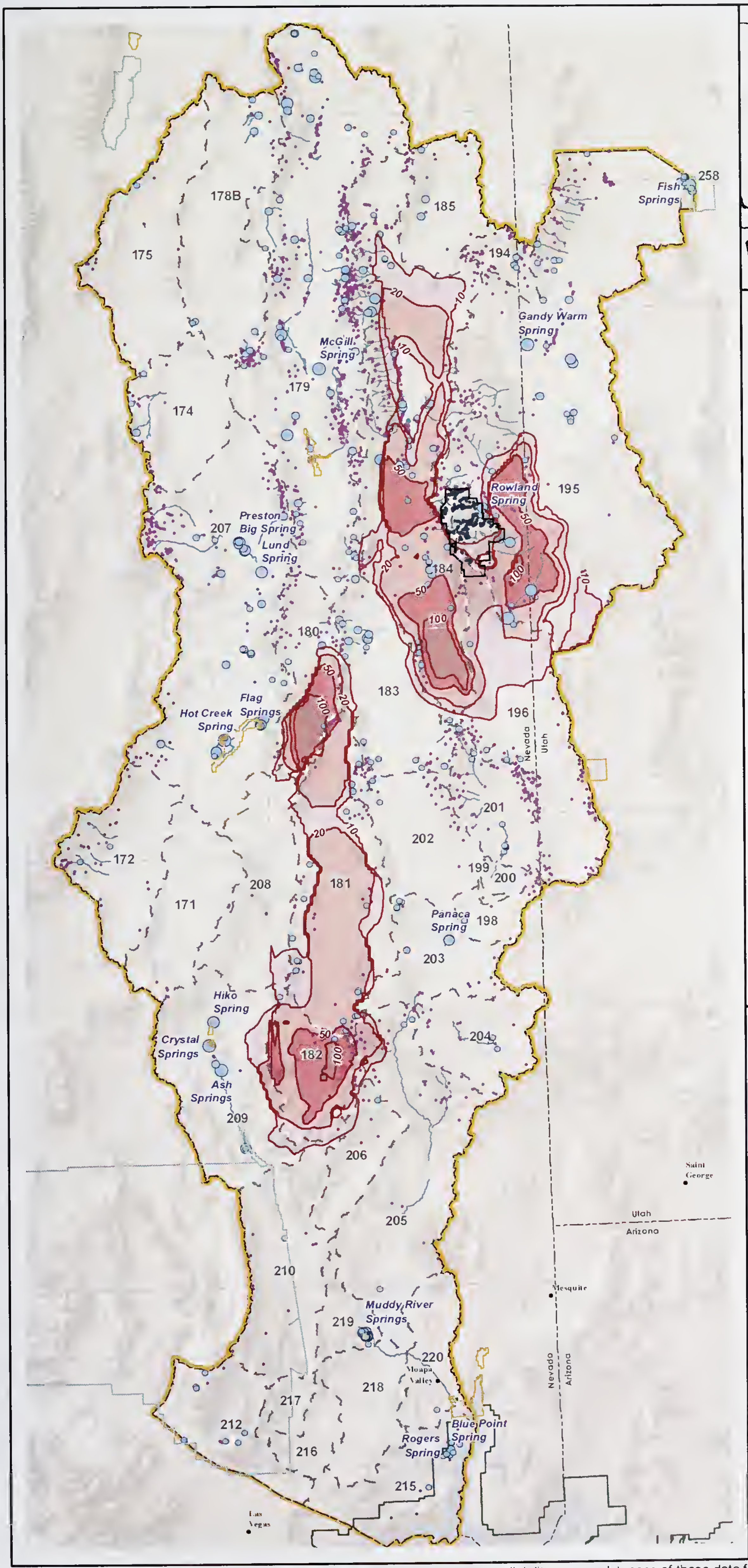


Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Springs Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-3
Predicted Change in Groundwater Levels
Proposed Action
Full Build Out

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.



Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
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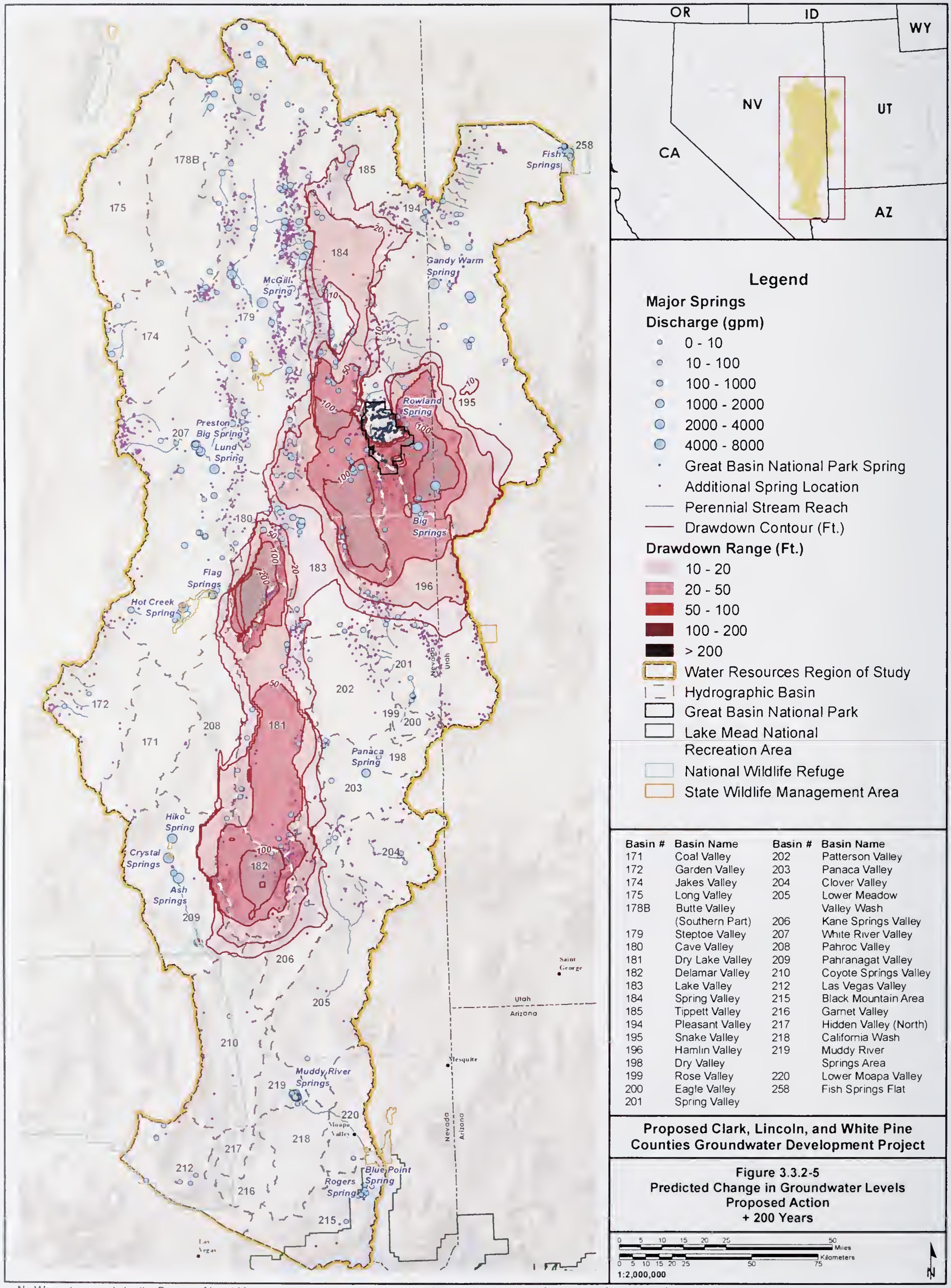
182	Delamar Valley	210	Coyote Springs Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-4
Predicted Change in Groundwater Levels
Proposed Action
+ 75 Years



Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
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181	Dry Lake Valley	209	Pahranagat Valley
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184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
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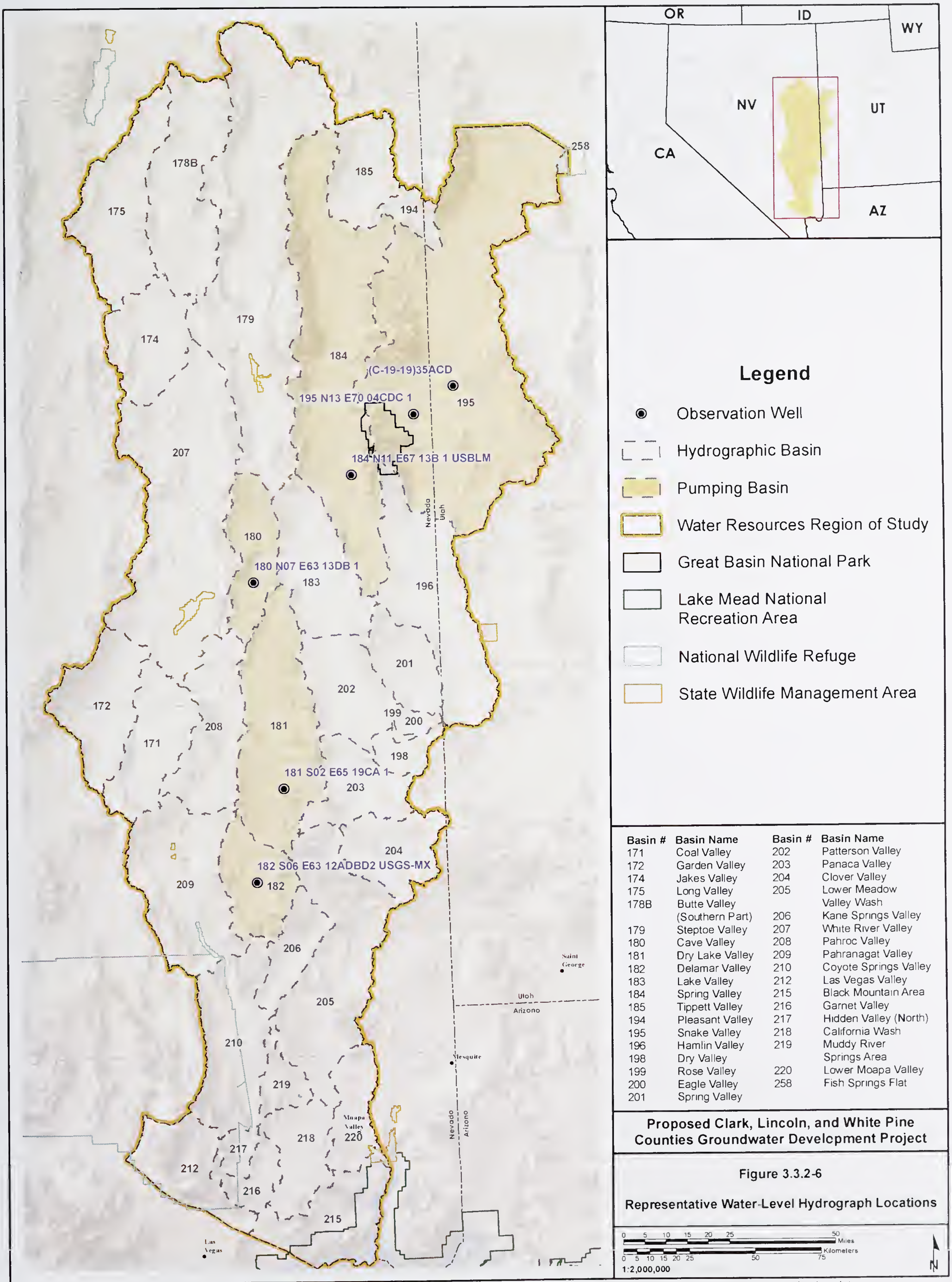
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-5
Predicted Change in Groundwater Levels
Proposed Action
+ 200 Years



Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
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196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-6

Representative Water-Level Hydrograph Locations

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

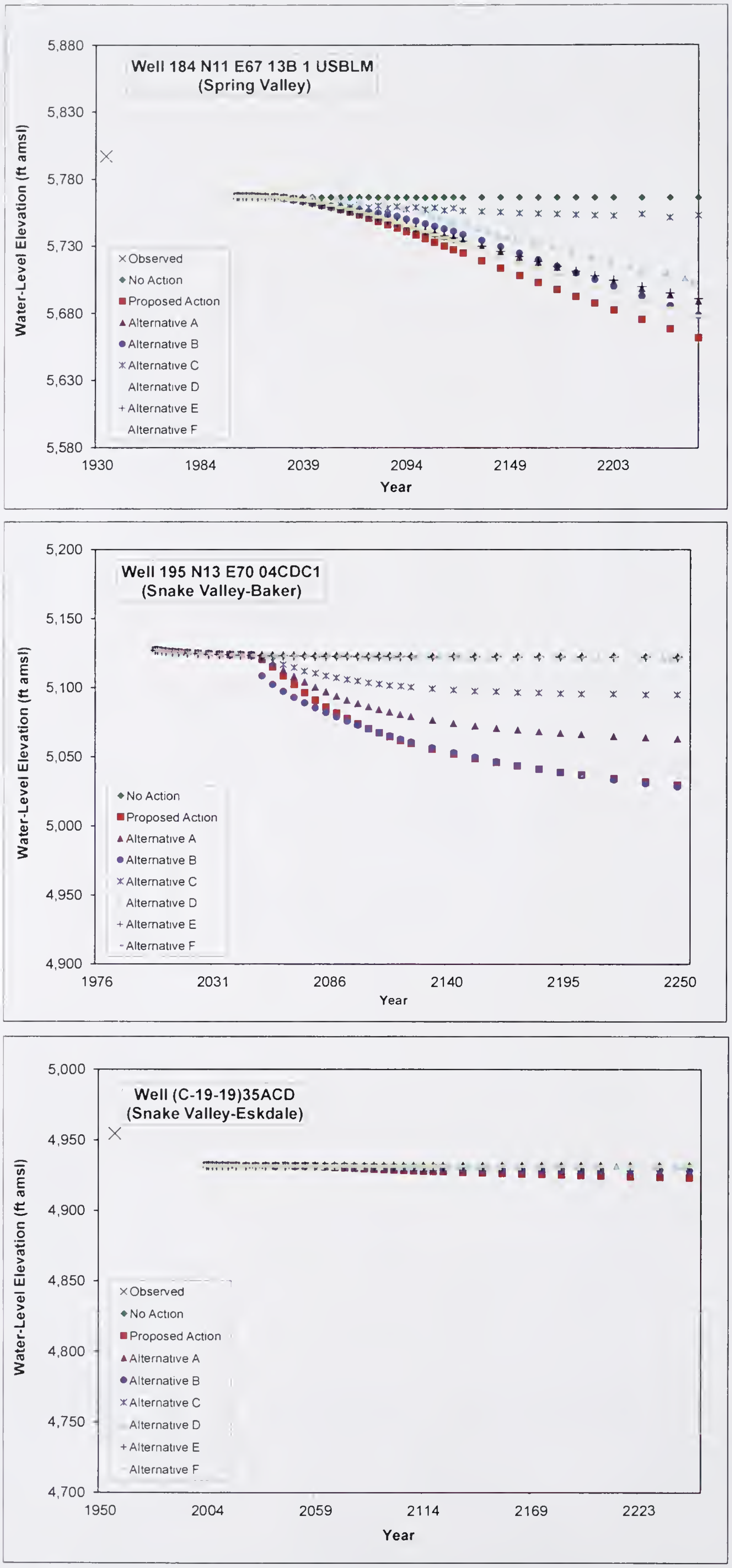


Figure 3.3.2-7 Representative Water-Level Hydrograph Locations for Spring and Snake Valleys

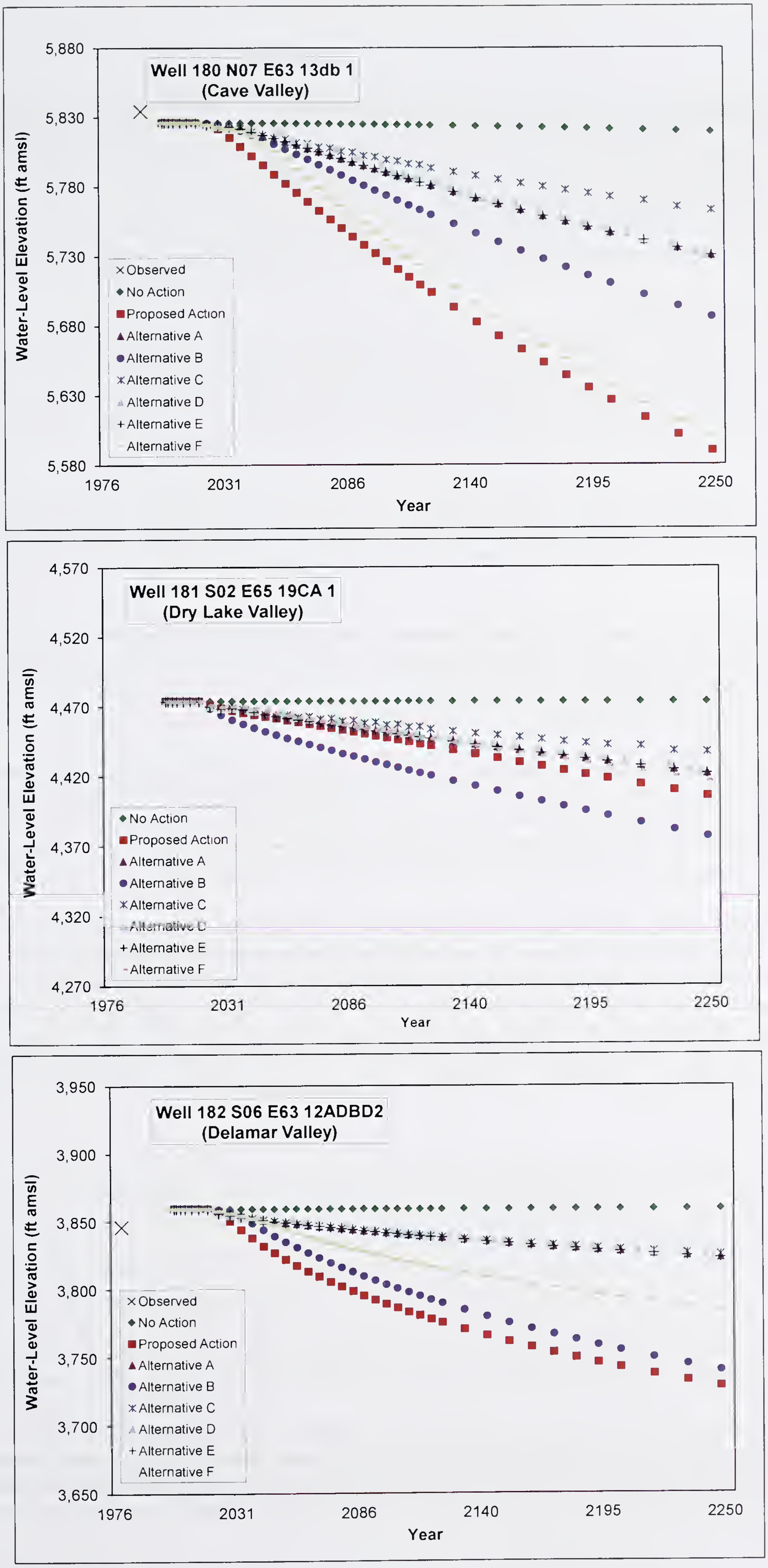


Figure 3.3.2-8 Representative Water-Level Hydrograph for Cave, Dry Lake, and Delamar Valleys

aquifer and aquitard materials and subsidence resulting from groundwater withdrawal are described in Poland (1984). Compaction of these sediments would result in a permanent reduction of the water storage properties of the aquifer. However, the amount of compaction and reduction in storage properties would depend on the grain-size and texture of the layers within the basin-fill sedimentary sequence. For example, the reduction in storage properties for the fine-grained materials (i.e., clays beds or aquitards) would be much greater than the reduction in storage for the coarse-grained materials (sands and gravel or high transmissive aquifers) in the sequence. The potential impacts associated with groundwater pumping-induced ground subsidence are described in Section 3.2, Geologic Resources.

Impacts to Springs and Streams

The estimated potential risks to springs located within the projected drawdown area at full build out, at full build out plus 75 years, and full build out plus 200 years are presented in **Figures F3.3.8A-1**, **F3.3.8A-2**, and **F3.3.8A-3**, respectively, in **Appendix F3.3.8**. The number of springs within the drawdown area and relative risk of impacts by hydrographic basin are summarized in **Table F3.3.9-1A** in **Appendix F3.3.9**. Specific inventoried springs located within the drawdown area at the representative points in time are listed in **Appendix F3.3.10**.

Potential effects to perennial springs and streams are summarized in **Table 3.3.2-6**. Comparison of the results of the model simulations and the resource impact evaluation for the three representative time periods indicated that the number of springs and miles of perennial streams that potentially could be affected increases at each successive time period.

For the predicted drawdown area at full build out plus 75 years, there are 44 inventoried springs and 168 "other" springs located within the high and moderate risk areas. At full build out plus 200 years, there are 57 inventoried springs and 248 "other" springs located within the high and moderate risk areas. These springs occur in Cave, Hamlin, Spring (HA 184), Snake, and Lake valleys.

The estimated total number of miles of perennial streams located in drawdown areas where surface waters could be affected is summarized in **Table 3.3.2-6**. The results indicate that the total estimated length of perennial streams located in areas where there is a high to moderate risk of impacts increases from approximately 80 miles at 75 years to 112 miles at full build out plus 200 years. This includes stream reaches located in Pahranagat, Steptoe, Spring (HA 184), Snake, and Lake valleys, and Lower Meadow Valley Wash.

Impacts to individual springs and streams would depend on the actual drawdown that occurs in these areas and the site-specific hydraulic connection between the groundwater systems impacted by pumping and the perennial water source. Perennial water sources that are hydraulically connected to the groundwater system impacted by pumping and within the drawdown area likely would experience a reduction in baseflow. Depending on the severity of these reductions in flow, this could result in drying up of springs or reducing the length of the perennial stream reaches and their associated riparian areas. Potential impacts to vegetation, wildlife, and aquatic resources resulting from these potential drawdown effects are addressed in Sections 3.5, Vegetation Resources; 3.6, Terrestrial Wildlife; and 3.7, Aquatic Biological Resources.

Model-simulated Spring and Stream Discharge Estimates. Model-simulated changes in spring flow for selected springs are presented in **Table 3.3.2-7**. Spring discharge was simulated at 11 springs within White River Valley. The model results indicate that two of these springs, Butterfield Spring and Flag Springs 3, are predicted to experience 7 percent flow reduction at the full build out plus 75 years time frame, and 18 percent and 17 percent flow reductions, respectively, at the full build out plus 200 years time frame. These results suggest that the groundwater development eventually could affect flows in springs located along the southeastern margin of the valley floor in White River Valley. This area is located near the drawdown boundary for these two time frames (see **Figures 3.3.2-4** and **3.3.2-5**). The model results indicate that other springs located in the northern portion of the valley floor in White River Valley are unlikely to experience impacts (greater than 5 percent reductions) attributable to the Proposed Action pumping.

The model results also indicate that the groundwater development is not predicted to reduce flows in the other major regional spring discharge areas within the White River Flow System, including Pahranagat Valley and the Muddy River Springs Area near Moapa. Impacts to flows in the major regional springs discharging in Steptoe Valley in the Goshute Valley Flow System and at Panaca Spring in Panaca Valley in the Meadow Valley Flow System are not anticipated.

Table 3.3.2-6 Summary of Potential Effects to Water Resources Resulting from the Proposed Action Pumping Scenario[1,2]

Water Resource Issue / Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Drawdown:			
• Number of hydrographic basins affected by drawdown	7	16	18
Drawdown effects on perennial springs:			
• Number of inventoried springs located in areas where impacts to flow could occur[3]	3	44	59
• Number of other springs located in areas where impacts to flow could occur[4]	5	168	248
• Model-simulated flow reduction at Big Springs (as percent flow reduction)	2%	100%	100%
Drawdown effects on perennial streams:			
• Number of basins with perennial stream reaches where impacts to flow could occur	1	2	6
• Miles of perennial stream located in areas where impacts to flow could occur	6	80	112
Drawdown effects on surface water rights:			
• Number of surface water rights located in areas where impacts to flow could occur	25	145	212
Drawdown effects on groundwater rights:			
• Number of groundwater rights located within the 10-50 foot drawdown area	28	129	96
• Number of groundwater rights located within the 50-100 foot drawdown area	0	68	134
• Number of groundwater rights located within the greater than 100-foot drawdown area	0	2	34
• (Total groundwater rights in drawdown area)	(28)	(199)	(264)
Percent reduction in ET and spring discharge:[5]			
• Spring Valley	45%	77%	84%
• Snake Valley	0%	28%	33%
• Great Salt Lake Desert Flow System[1]	18%	48%	54%
• White River Flow System	0%	1%	3%
Reduction in flow from Snake Valley to Pine, Wah Wah, and Tule valleys Hydrographic Basins:[5]			
• AFY	0	660	1,800
• Percent Reduction	0%	4%	10%

[1] Located within the groundwater flow model domain.
[2] Unless otherwise noted, supporting information for these estimates are provided in **Appendices F3.3.5** through **F3.3.16**.
[3] Specific inventoried springs identified in moderate or high risk areas are identified in **Table F3.3.10A** in **Appendix F3.3.10**.
[4] Other Springs" are springs identified in the National Hydrography Database or topographic maps that have not been field verified.
[5] Estimate derived from the model-simulated values provided in SNWA 2010b with comparison to No Action pumping results.

Table 3.3.2-7 Model-simulated Flow Changes (Proposed Action)

(Project Specific)					Proposed Action		
					Incremental Change in Flow % (from No-Action)		
Flow System	Hydrographic Basin	Spring	Average Flow (Actual) in gpm	Model-simulated Average Flow (2005) in gpm	Full Build Out	75 years after Full Build Out	200 years after Full Build Out
White River	White River Valley (207)	Arnoldson Spring	1,608	946	0	0	-1
		Butterfield Spring	1,225	471	-1	-7	-18
		Cold Spring	582	503	0	0	-1
		Flag Springs 3	969	560	-1	-7	-17
		Hardy Springs	200	73	0	0	-1
		Hot Creek Spring	5,032	6,899	0	-1	-3
		Lund Spring	3,594	3,314	0	0	-1
		Moon River Spring	1,707	1,457	0	0	-1
		Moorman Spring	405	353	0	-1	-3
		Nicolas Spring	1,185	872	0	0	-1
		Preston Big Spring	3,572	3,794	0	0	-1
	Pahranagat Valley (209)	Ash Springs	6,909	7,453	0	-1	-2
		Brownie Spring	224	277	0	0	0
		Crystal Springs	4,235	4,647	0	0	-1
		Hiko Spring	2,735	1,985	0	0	-2
	Muddy River Springs Area (219)	Muddy River near Moapa[1]	20,931	15,383	0	0	-1
	Lower Moapa Valley (220)	Muddy River near Glendale[1]	19,565	14,895	0	0	-1
	Black Mountains Area (215)	Blue Point Spring	223	393	0	0	0
		Rogers Spring	771	515	0	0	0
Goshute Valley	Steptoe Valley (179)	Campbel Ranch Springs	2,746	2,088	0	0	0
		Currie Spring	2,181	1,419	0	0	0
		McGill Spring	4,783	2,074	0	0	0
		Monte Neva Hot Springs	649	280	0	0	-1
Great Salt Lake Desert	Spring Valley (184)	Keegan Spring	234	63	-58	-100	-100
		North Millick Spring	284	98	-31	-62	-75
		South Millick Spring	506	278	-55	-94	-99
	Snake Valley (195)	Big Springs	4,289	1,977	-2	-100	-100
		Foote Res. Spring	1,300	211	0	-1	-2
		Kell Spring	120	59	0	-1	-2
		Warm Creek near Gandy, Utah	7,426	2,697	0	0	-1
Meadow Valley	Panaca Valley (203)	Panaca Spring	1,455	1,208	0	0	0

[1] Simulated using Stream Flow Routing 2 package for MODFLOW.

Source: SNWA 2010.

In the Great Salt Lake Desert Flow System, spring discharge was simulated at 3 springs in Spring Valley and 4 springs in Snake Valley. In Spring Valley, the model simulations indicate that by full build out plus 75 years, Keegan, North Millick, and South Millick springs all show reductions of flow. At full build out plus 200 years, these springs are predicted to experience flow reductions ranging from 75 to 100 percent. These three springs are all located near the margin of the valley floor in the north central portion of the valley. These results suggest that springs located in the southern portion of the valley that are hydraulically connected to the regional flow system are likely to experience some reduction in flow over the long term.

In Snake Valley, the model simulation results were used to evaluate potential changes in flow at Big Springs, Foote Reservoir Springs, Kell Spring, and Gandy Warm Springs. The model indicated that measurable flow reductions (greater than 5 percent) are not anticipated at Foote Reservoir Springs, Kell Springs, and Gandy Warm Springs located in the central portion of the basin. The results suggest that the springs located on the valley floor in the central and northern portion of the basin are unlikely to experience impacts (greater than 5 percent flow reduction). Big Springs, located in the southern portion of the basin, is predicted to experience a substantial reduction in flow by the full build out plus 75 years time frame. Reductions of flow at Big Springs would reduce flows in Big Springs Creek and reduce flows to Lake Creek and into Pruess Lake. The results suggest that the springs located on the valley floor in the southern portion of the valley likely would experience reductions in flow.

Water Resources Within or Adjacent to the GBNP. Surface water resources located within or adjacent to the GBNP that occur within both the model-simulated drawdown area and within the susceptibility zones identified by Elliot et al. (2006) are listed in **Table 3.3.2-8**. For the purpose of the EIS analysis, these areas are considered zones of moderate risk as defined in **Table 3.3.2-3** (i.e., impacts may occur to some perennial waters that are hydraulically connected to the regional flow system). At full build out plus 75 years, Outhouse Springs and Spring Creek Spring, both located outside the GBNP boundary, and 6.4 miles of Snake Creek are within the area of moderate risk. By full build out plus 200 years, three springs, Outhouse, Rowland (located along the park boundary), and Spring Creek Springs, along with 9.1 miles of Snake Creek and its tributaries, and 0.5 miles of Lehman Creek and its tributaries are within the area of moderate risk.

Table 3.3.2-8 GBNP Water Resources Risk Evaluation Summary by Alternative

	Proposed Action		Alt. A		Alt. B		Alt. C		Alt. D		Alt. E		Alt. F		No Action	
Years	**75**	**200**	**75**	**200**	**75**	**200**	**75**	**200**	**75**	**200**	**75**	**200**	**75**	**200**	**75**	**200**
Springs[1]																
Cave Spring					X	X										
Outhouse Springs	X	X	X	X	X	X		X		X						
Rowland Springs		X		X	X	X										
Spring Creek Spring	X	X	X	X	X	X		X		X						
Other springs[2]	0	0	0	0	15	25	0	0	0	0	0	0	0	0	0	0
Streams (Miles[3])																
Baker Creek and tributaries	0.0	0.0	0.0	0.0	1.7	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lehman Creek and tributaries	0.0	0.5	0.0	0.5	2.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Snake Creek and tributaries	6.4	9.1	5.6	8.3	9.1	10.2	0.0	8.0	0.0	8.0	0.0	2.1	0.0	4.2	0.0	0.0

[1] "X" indicates spring is located both within the simulated drawdown area and susceptibility zones as defined by Elliot et al. (2006).

[2] Other springs identified in GBNP are listed in **Appendix F3.3.1, Table F3.3.1-1B**.

[3] Miles of perennial stream identified in the GBNP located both within the simulated drawdown area and susceptibility zones as defined by Elliot et al. (2006).

Available information on water resources identified in caves within the GBNP is summarized in Section 3.3.1.4, Surface Water Resources. Baker (2009) has identified 6 caves in the susceptibility areas defined by Elliott et al. (2006) that are in direct contact with the water table or surface water. (Note that details regarding the locations and known subsurface extent of these cave systems were not available for BLM review at the time the EIS was written.) These include Model Cave, Ice Cave, Wheeler's Deep Cave, and Systems Key Cave in the Baker Creek watershed. Available information (summarized in Section 3.3.1.4) suggests that stream flow within Ice Cave and Systems Key Cave likely are controlled by the infiltration of surface runoff and not by upward flow from the regional groundwater flow system. Wheeler's Deep Cave also is reported to have a perennial stream (Baker 2009). Model Cave is reported to be the most important cave within the Baker Creek Cave System and is reported to have one or more perennial streams (McLean 1965; Bridgemon 1967; Baker 2009). Lange (1954) describes slots in the floor of Model Cave that he believes were formed by upward (or artesian) flow. However, he does not provide data to evaluate if these features likely were formed in the geologic past (i.e., under different hydrologic conditions) or were formed recently under present hydrologic conditions. If the latter were true, these features would suggest that artesian flow in the limestone is the source of water for the streams within this cave.

In summary, there is insufficient information to define the likely water source (i.e., local flow system or artesian flow through the carbonate aquifer system) that sustains the cave streams and uncertainty regarding hydraulic interconnection between the limestone and the regional aquifer system that would be the target for groundwater development in Snake Valley. Preliminary results from ongoing hydrogeologic and water resource investigations in and adjacent to GBNP provide some evidence that water resources in Model Cave may be interconnected with the alluvial basin fill in Snake Valley (Prudic and Sweetkind 2012). However, the model-simulated drawdown area under the Proposed Action pumping scenario is not projected to affect Baker Creek. Therefore, impacts to water resources in the Model Cave System in the Baker Creek drainage area are not anticipated under this alternative.

Utah Surface Water Resources

For the predicted drawdown area, there are three inventoried springs (Stateline, Caine, and Needle Point springs) and three perennial reaches (Big Wash, Lake Creek, and Snake Creek) in Snake Valley located within the high risk areas at the full build out plus 75 years and full build out plus 200 years time frames.

The Pine Valley hydrographic basin is located east of Snake Valley and east of the water resource region of study defined by the numerical groundwater flow model domain boundaries used in the EIS analysis. The model simulations indicate that drawdown could propagate into Pine Valley. At the full build out plus 75 years and full build out plus 200 years time frames, the maximum drawdown simulated at the boundary of the model between Snake and Pine valleys is approximately 17 feet and 51 feet, respectively. Therefore, the model simulations suggest that drawdown eventually could propagate into the Pine Valley hydrographic basin.

The potential for drawdown originating in Snake Valley to affect surface water resources in Pine Valley was evaluated by compiling available information to characterize the surface water and groundwater conditions in the basin to identify the likely source of water that controls perennial water sources and discharges in ET areas (see **Appendix F3.3.17** for baseline data) and potential interconnection to the regional groundwater system that would be affected by the groundwater development.

Stephens (1976) investigated the water resources in Pine Valley as part of a series of USGS investigations of water resources within western Utah. With respect to spring occurrence, Stephens reported that: 1) approximately 80 springs were identified from topographic maps; 2) that all springs in the basin discharge at elevations of 6,200 feet (amsl) along the base of the Needle Range and southern part of the Wah Wah Range; 3) many appear to only flow in response to runoff and are dry part of the year; 4) many of the springs that discharge from the volcanic rocks on the eastern flank of the Needle Range probably are perched; and 5) shallow water table conditions occur locally along Pine Grove Creek upstream of Pine Grove Spring.

Groundwater elevation data for eight wells located in the south, central, and northern portion of the valley can be found in **Appendix F3.3.17**. Seven of the 8 wells are generally located in the valley floor or near the toe of the alluvial fans in lower elevation areas within the basin; the eighth well appears to be situated in an alluvial fan. The average depth to water for the eight wells ranges from a low of 302 feet in the northern portion of the basin to 717 feet for a well located near the southern margin of the basin. These deep depths to groundwater suggest that the springs and other surface water features that occur in Pine Valley likely are controlled by local groundwater occurrences that are perched above the regional groundwater flow system. This depth-to-water data also suggest that drawdown of the regional aquifer system resulting from pumping in Snake Valley is unlikely to impact surface water resources in Pine Valley.

Drawdown could, however, eventually result in a reduction in water levels in water supply wells that exist now or may exist in the future. It also is important to note that the drawdown at the boundary is larger than it would be if the model was extended further east because the model boundary is set up as a no-flow boundary. In other words, if the model were extended to encompass Pine Valley, the drawdown at full build out plus 75 years would be less than the 17 feet currently simulated by the model. The actual maximum drawdown at the individual well locations would depend in part on the distance between the well and the northwest boundary between Pine and Snake valleys where the model simulates drawdown could occur. With these considerations, it seems reasonable to assume that the magnitude of the drawdowns at individual wells located in the Pine Valley would be less than the drawdowns simulated by the current model at the boundary between the Snake Valley and Pine Valley hydrographic basins. Therefore, potential reduction in water levels at production wells located within Pine Valley would be less than 17 feet at full build out plus 75 years and less than 51 feet at full build out plus 200 years.

Impacts to Surface Water Rights

For surface water rights, the actual impacts to individual water rights would depend on the site-specific hydrologic conditions that control surface water discharge. Only those waters sustained by discharge from the regional groundwater system targeted or intercepted by the groundwater pumping would be susceptible to impacts.

The locations and manner of use of the active surface water rights within the drawdown area at full build out, full build out plus 75 years, and full build out plus 200 years are presented in **Figures F3.3.12A-1**, **F3.3.12A-2**, and **F3.3.12A-3**, respectively, in **Appendix F3.3.12**. These maps also illustrate the relative risk to perennial surface water resources within the projected drawdown area. **Table F3.3.13-1A** lists the number of active surface water rights within the drawdown area that occur within the high-, moderate-, and low-risk areas at the three representative time frames.

These results indicate that the number of surface water rights that potentially could be affected increases over the model simulation period.

At full build out plus 75 years, there are a total of 145 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows. By the full build out plus 200 years time frame, there are 212 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows.

The predominant beneficial use for the surface-water rights within the high- and moderate-risk areas are irrigation, stockwatering, and municipal uses. Other beneficial uses associated with the water rights identified in these risk areas include commercial, industrial, mining and milling, domestic, recreational, wildlife, and other (not specified). It is important to note that some surface water rights only divert surface water runoff or groundwater discharge from local or perched groundwater systems that are not dependent on discharge from the regional or intermediate groundwater flow system. In these cases, impacts to surface water flows are not anticipated regardless of the predicted drawdown. For surface water rights that are dependent on groundwater discharge, a potential reduction in the water table at the point of diversion could reduce or eliminate the flow available at the point of diversion for the surface water right.

Impacts to Groundwater Rights

For the purposes of this evaluation, it is assumed that wells located within the areas affected by drawdown of 10 feet or greater could experience impacts. Specific impacts to individual wells would depend on the: 1) well completion, including pump setting, depth, yield, predevelopment static and pumping groundwater levels; 2) interconnection between the aquifer in which the well is completed in and the aquifer targeted by the GWD Project; and 3) the magnitude and timing of the drawdown that occurs at the specific location.

Figures F3.3.14A-1, **F3.3.14A-2**, and **F3.3.14A-3** in **Appendix F3.3.14** illustrate the location and manner of use of existing groundwater rights in relation to the magnitude of the model-simulated drawdown at full build out, full build out plus 75 years, and full build out plus 200 years. **Table F3.3.15-1A** lists the groundwater rights by hydrographic basin within the drawdown areas that are predicted to occur.

As summarized in the **Table 3.3.2-6**, the number of groundwater rights potentially impacted from drawdown is projected to increase over the model simulation period. At full build out plus 75 years, there are 199 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. One hundred and twenty-nine of these occur in areas with predicted drawdowns of 10 to 50 feet, 68 occur in areas with predicted drawdowns of 51 to 100 feet, and 2 occur in areas with predicted drawdowns of greater than 100 feet.

At full build out plus 200 years, there are 264 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. Ninety-six of these occur in areas with predicted drawdowns of 10 to 50 feet, 134 occur in areas with predicted drawdowns of 51 to 100 feet, and 34 occur in areas with predicted drawdowns of greater than 100 feet. However, considering the model uncertainty, the actual drawdown could be larger or smaller than predicted.

The predominant beneficial uses for the active groundwater rights within the drawdown area at full build out plus 200 years are irrigation and stockwatering. Additional beneficial uses associated with water rights that could be affected include commercial, mining and milling, municipal, domestic, and wildlife. Impacts to wells could include a reduction in yield, increased pumping cost, or if the water level were lowered below the pump setting or the bottom of the well, the well could be rendered unusable.

The Shoshone Ponds area is located in the drawdown area in the southern portion of the Spring Valley (described in Section 3.3.1.4). The source of water for three ponds (known as the Shoshone Ponds) used as refugia for Nevada native fish (BLM 2010) is artesian flow from a well. Actual impacts to the artesian flow would depend on the interconnection between the aquifer that sustains flow in the artesian well and the aquifers developed for production from proposed well field development. Considering the simulated drawdown and the hydrogeologic setting, there is a high risk that well field pumping eventually could result in reducing or drying up flows that sustain Shoshone Ponds. Potential impacts aquatic resources in Shoshone Ponds are discussed in Section 3.7, Aquatic Biological Resources.

Impacts to Water Balance

The model-simulated groundwater budget for current conditions is presented in **Appendix F3.3.16**, **Table F3.3.16-1A**. Under the current conditions, the principal groundwater outflow component for the groundwater flow systems is discharge of groundwater by ET. The ET estimate accounts for spring discharge that supports riparian and phreatophyte vegetation within delineated ET areas. Basins with large ET discharge rates (i.e., greater than 20,000 afy) that occur in the Great Salt Lake Desert and White River Groundwater Flow Systems include: Spring Valley (73,700 afy) and Snake Valley (105,800 afy) (the Great Salt Lake Desert Groundwater Flow System); and White River (65,600 afy), Pahranagat Valleys (21,800 afy), and Lower Moapa Valley (20,900 afy) (the White River Groundwater Flow System).

Potential changes in the water balance for the groundwater system within the region of study were estimated using the groundwater flow model (SNWA 2009c) results provided in **Appendix F3.3.16**, **Table F3.3.16-1B** with comparison to the simulated water balance under the No Action. The estimated reductions in ET and spring discharge for selected basins and flow systems are summarized in **Table 3.3.2-6**.

For Spring Valley, the pumping is estimated to result in reductions of groundwater discharge for ET that increase from a 77 percent reduction at full build out plus 75 years to 84 percent reduction at full build out plus 200 years. In Snake Valley, the pumping is estimated to result in reductions of groundwater discharge for ET of 28 percent at full build out plus 75 years and 33 percent at full build out plus 200 years, with most of this reduction occurring in the southern portion of the valley.

The proposed pumping is estimated to result in a total reduction of ET discharge from the portion of the Great Salt Lake Desert Flow System included within the study area of 48 percent at full build out plus 75 years and 54 percent at full build out plus 200 years. These predicted reductions in ET discharge rates indicate that spring discharge within and associated with these ET areas would be reduced. Estimates of the potential impacts to vegetation within ET areas are evaluated in Section 3.5, Vegetation Resources.

The pumping is estimated to have minimal impact on ET discharge within the other pumping basins and the White River Flow System.

Pine Valley, Wah Wah Valley, Tule Valley, and Fish Springs Flat hydrographic basins (identified in **Figure 3.0-2**) are located to the east of the northeast boundary of the region of study for the groundwater flow model. The model simulation results indicate that the drawdown area is projected to eventually intercept the model boundary that extends along the southeast margin of Snake Valley and eastern margin of Hamlin Valley. These model boundary areas are adjacent to the Pine Valley hydrographic basin located immediately east of the model domain. The results suggest that drawdown attributable to the Proposed Action pumping scenario eventually could extend into Pine Valley. The potential impacts to surface water resources in Pine Valley resulting from drawdown attributable to the proposed pumping in Snake Valley was discussed previously under the heading "*Utah Surface Water Resources.*"

The total predicted reduction of flow to Pine, Wah Wah, and Tule valleys is summarized in **Table 3.3.2-6**. This reduction corresponds to an approximate 4 percent and 10 percent reduction in flow to these basins at the full build out plus 75 years and full build out plus 200 years time frames. Pine, Wah Wah, and Tule valleys are part of the Great Salt Lake Desert groundwater flow system. A major discharge area located downgradient from Pine Valley is Fish Springs. As discussed in Section 3.3.1.4, estimates for the total discharge at Fish Springs range from 21,000 afy to 24,000 afy (USFWS 2004; Bolke and Sumison 1978; respectively). The actual groundwater flow paths and interconnection between Snake and Hamlin valleys and the valleys east of the model boundary (Pine Valley, Tule Valley, Fish Springs Flat, and Fish Springs) are not well understood. If the groundwater flow system is interconnected and regional flow from Snake Valley contributes to flow at Fish Springs, then a reduction of flow from Snake Valley to Pine, Wah Wah, and Tule valleys eventually could result in a reduction of discharge at Fish Springs. The model-estimated reduction of groundwater outflow from Snake Valley to these basins along the eastern boundary of Snake Valley is 1,800 afy at full build out plus 200 years, which represents approximately 7 to 9 percent of the surface discharge at Fish Springs. It important to understand that there is considerable uncertainty regarding the amount of subsurface flow that occurs between Hamlin and Snake valleys (within the model area) and Pine Valley, Wah Wah Valley, Tule Valley, and Fish Springs Flat (located east of the model boundary). For example, the estimates of interbasin flow from Snake Valley to Tule Valley range from 15,000 to 42,000 afy; for Snake Valley to Pine Valley, estimates range from -5,500 to 16,500 afy (SNWA 2009a). There also is uncertainty regarding the interconnection between underflow leaving from Snake Valley and the flow at Fish Springs. For these reasons, it is not possible to determine (using available data and the results from the CCRP) if the groundwater development is likely to produce a measurable reduction in discharge at Fish Springs.

The GBNP Model (Halford and Plume 2011) was set up to simulate flows at Fish Springs. The simulation results from the GBNP Model indicate that pumping in Snake Valley (at the points of diversion listed in the SNWA water rights applications), at the full application rate (50,000 afy) combined with continuation of existing agricultural pumping would not reduce flows in Fish Springs over the 200-year simulation period. These model results suggest that pumping associated with the groundwater development in Snake Valley is unlikely to result in a measureable reduction in flows at Fish Springs.

Impacts to Water Quality

As described above, the results of the numerical modeling and water resource impact assessment indicate that the GWD Project likely would result in flow reductions and drying up of some perennial water sources. Flow changes potentially could be accompanied by changes in water quality. Considering the complex hydrogeologic conditions over the hydrologic study area, it is not possible to predict the actual change in water quality that would occur from flow reductions at specific springs or streams. The actual changes in water quality would depend on the magnitude of the flow change and the source of the surface discharge. Depending on the origin of the groundwater that discharges at the surface as a seep, spring, or stream, a reduction of flow potentially could be accompanied by a change in water quality. For example, where the source of the surface discharge is a single hydrostratigraphic unit (or aquifer) with relatively constant water quality, lowering the water level within the unit, and thereby reducing the surface discharge rate, should not result in a substantial change in water quality. However, reductions in flow could affect temperatures and temperature-dependent water quality constituents. Conversely, where the source of surface groundwater discharge is a mixture of waters from two different sources, such as a deeper, older regional groundwater flow and a younger intermediate flow, a reduction in discharge from one of the sources potentially could skew the discharge water quality toward the less affected source. Additional discussion of potential localized changes to surface water quality related to aquatic habitat is provided in Section 3.7, Aquatic Biological Resources.

The baseline water quality in the region is summarized in Section 3.3.1.6, with additional details provided in **Appendix F3.3.4** and in the baseline characterization report (SNWA 2008). As described in Section 3.3.1.6, the water quality in the region is generally good. One exception is a zone of groundwater with elevated TDS and chloride concentrations situated in the Great Salt Lake Desert in the northernmost portion of Snake Valley (Hood and Rush 1965). The Great Salt Lake Desert area in Snake Valley is located approximately 50 miles north of the proposed groundwater development area in Snake Valley, and greater than 30 miles north of the projected drawdown area.

Therefore, drawdown associated with the groundwater pumping is not expected to capture or change the gradient or flow directions in the zone of high TDS and chloride concentrations associated with the Great Salt Lake Desert.

Stipulated Agreements, Applicant-committed Measures, and Monitoring and Mitigation Measures

Stipulated Agreements

Stipulation agreements between the DOI and SNWA exist for groundwater development in four (Spring, Delamar, Dry Lake, and Cave valleys) of the five proposed pumping basins. No stipulation agreement between the DOI and SNWA regarding SNWA's groundwater withdrawal permit applications currently exists for Snake Valley; however, approved monitoring plans (hydrologic and biologic) that are part of the Spring Valley stipulation agreement include certain portions of Snake Valley. The agreements are provided in **Appendix C**. The stipulations require that SNWA implement hydrologic monitoring, management, and mitigation plans. The current monitoring and mitigation plans for groundwater development in these four basins are as follows:

1. Spring Valley Hydrologic Monitoring and Mitigation Plan (Hydrographic Area 184) (SNWA 2009c); and
2. Hydrologic Monitoring and Mitigation Plan for Delamar, Dry Lake, and Cave Valleys (SNWA 2009d).

The current plans for locations of spring, stream, and groundwater monitoring sites included under these agreements in relation to the model-simulated drawdown areas are presented in **Figures 3.3.2-9** and **3.3.2-10**. Details regarding monitoring well completion, monitoring well data collection, baseline data collection, and modeling and reporting requirements are defined in the above referenced documents. A few of the key surface water and groundwater monitoring components included in the monitoring plans are the following:

- Monitoring groundwater levels in a network of monitoring wells distributed over the region. Individual wells will be monitored on either a quarterly, semiannual, or continuous basis;
- Monitoring groundwater levels in two new monitoring wells located in the vicinity of Shoshone Ponds in Spring Valley on a continuous basis;
- Monitoring groundwater levels in six new monitoring wells (i.e., four in the carbonate-rock aquifer and two in the basin-fill aquifer) in the "Interbasin Groundwater Monitoring Zone" in Spring and Hamlin valleys on a continuous basis.
- Monitoring wells in White River Valley and Pahranagat Valley;
- Monitoring groundwater levels continuously in shallow piezometers located adjacent to selected springs;
- Monitoring flow at Cleve Creek (Spring Valley) and Big Springs Creek (Snake Valley) using surface water gauges;
- Monitoring spring flow at other selected springs on a biannual basis; and
- Monitoring flow at Hot Creek Spring, Ash Springs, and Crystal Spring on a continuous basis.

The monitoring plans also include monitoring precipitation at various stations distributed across the area, water quality sampling, and baseline monitoring requirements.

Reporting and analysis requirements of the stipulated agreements would include the following:

- Annual reporting to the NSE presenting the results of the required monitoring and sampling and updated water-level drawdown maps for both the basin-fill and carbonate aquifer; and
- Updating an NSE approved groundwater flow model every 5 years after pumping begins and providing predictive results at 10-, 25-, and 100-year periods.

These stipulated agreements also would require the SNWA to modify or curtail pumping to mitigate impacts if required by the NSE.

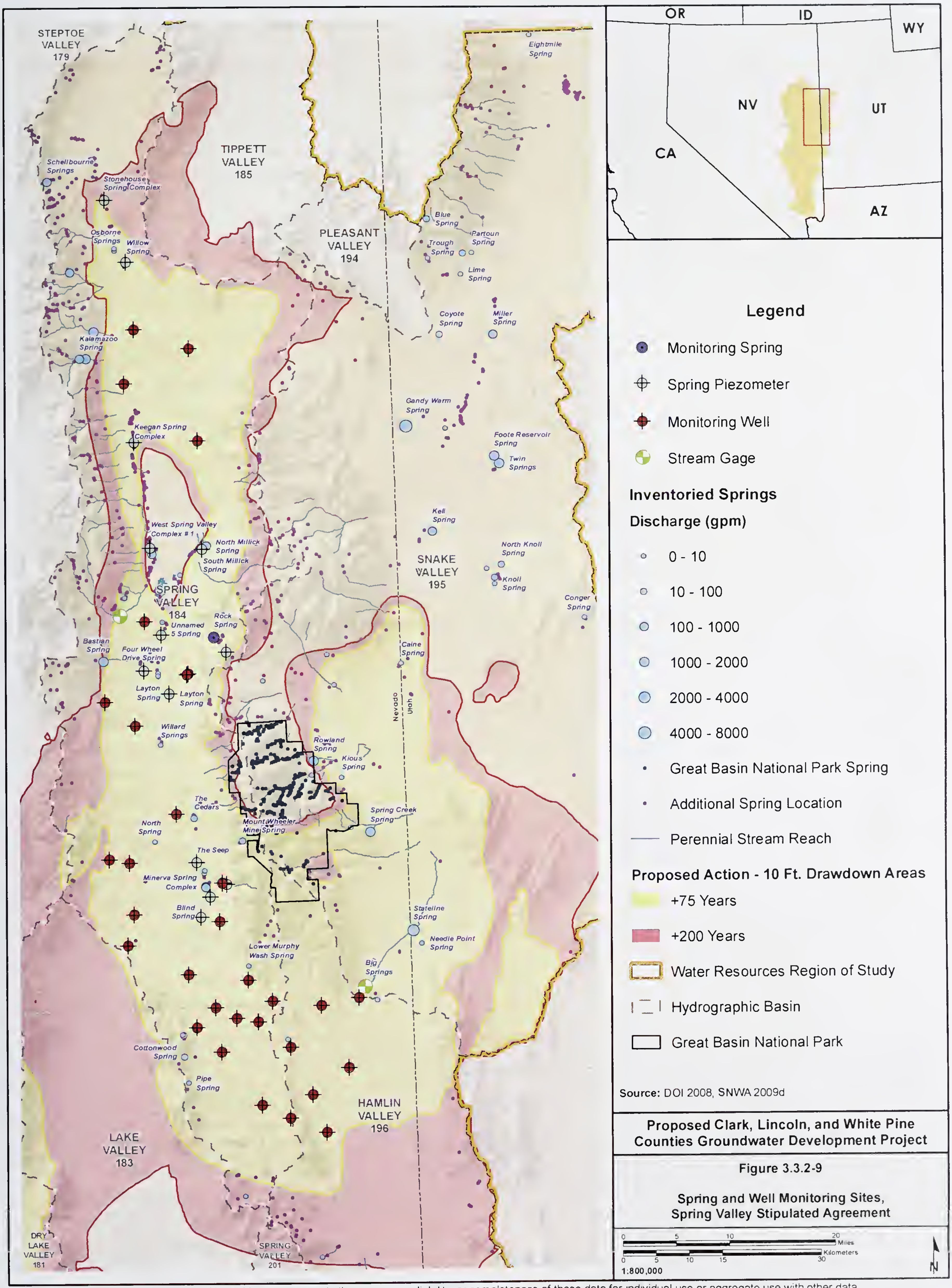
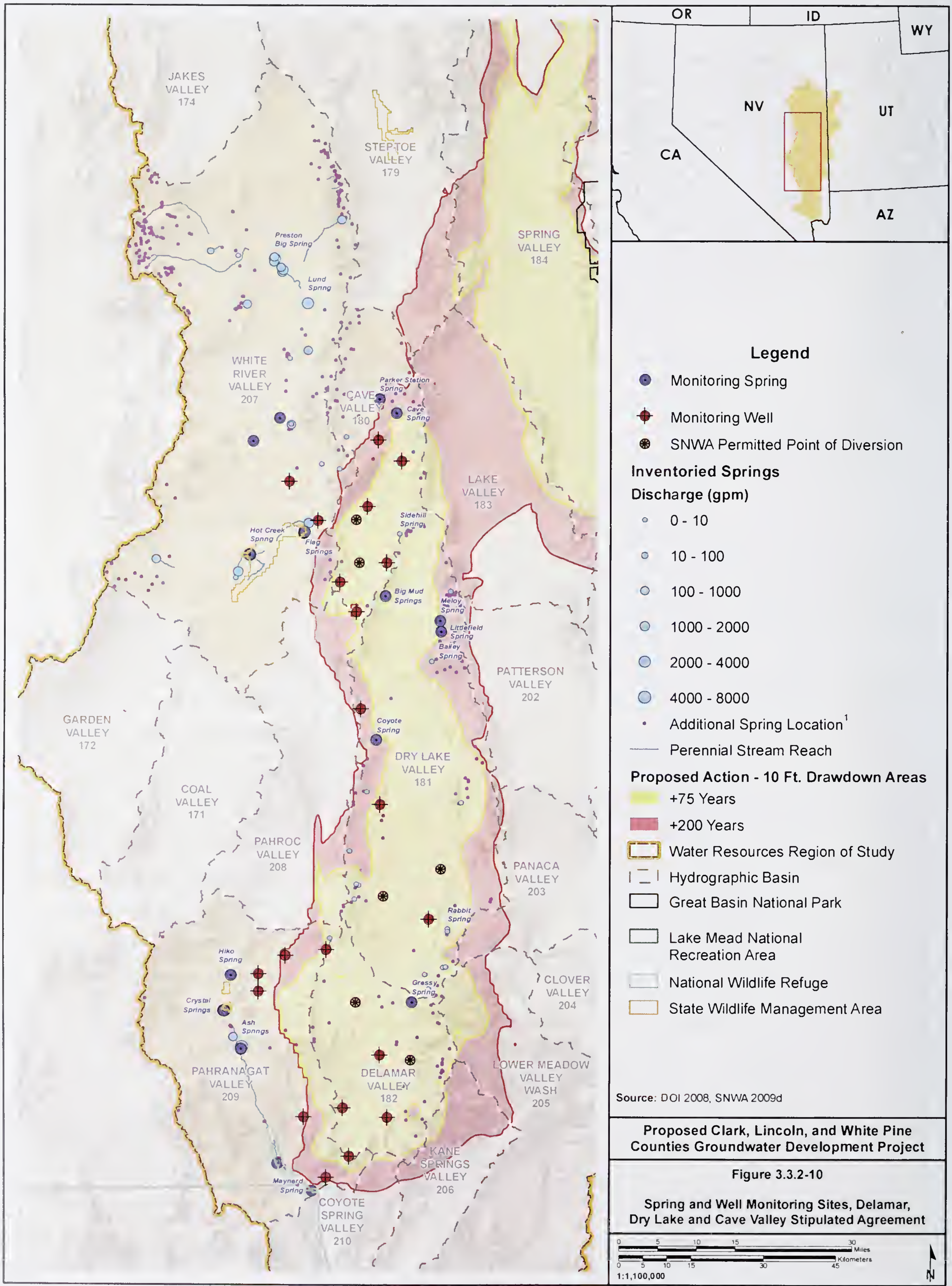


Figure 3.3.2-9

Spring and Well Monitoring Sites, Spring Valley Stipulated Agreement

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data



No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

Applicant-committed Adaptive Management Plan and Measures

In addition to the stipulated agreements, the SNWA has developed an adaptive management plan that was submitted as part of the Plan of Operations for the proposed project to address uncertainties in predicting potential effects of SNWA's groundwater production on water dependent resources and water rights holders. The adaptive management plan is intended to allow for the SNWA and the BLM to identify, avoid, minimize, and mitigate adverse effects associated with the proposed pumping in all five hydrographic basins and includes a framework for:

1. Monitoring baseline conditions;
2. Monitoring groundwater pumping effects;
3. Establishing groundwater-dependent, early warning thresholds to comply with the stipulated agreements, NSE Rulings, and the draft Snake Valley Agreement;
4. Implementation of adaptive mitigation measures designed to minimize or mitigate impacts to water dependent resources;
5. Monitoring the effects of implementation of adaptive management measures to meet environmental goals;
6. Implementing alternative adaptive mitigation measures if environmental goals are not met; and
7. Annual reporting requirements.

If the BLM determines those early warning thresholds have been reached as a result of the SNWA's groundwater withdrawal; one or more adaptive management measures may be implemented. These measures could include the following actions:

- Geographic redistribution of groundwater withdrawals (ACM C.2.1);
- Reduction or cessation in groundwater withdrawals (ACM C.2.1);
- Augmentation of water supply for federal and existing water rights and federal resources using surface and groundwater sources (ACM C.2.1);
- Conduct recharge projects to offset local groundwater drawdown (ACM C.2.21); and
- Implementation of cloud seeding programs to enhance groundwater recharge (ACM C.2.22).

Utah Geological Survey Monitoring

In addition to monitoring included in the stipulated agreements, the UGS recently established a groundwater monitoring network in Utah's west desert. The UGS groundwater monitoring network includes a series of wells installed in the Snake Valley HA and additional wells in adjacent basins in Utah to monitor: 1) groundwater elevations and water quality, and 2) shallow water levels at wetlands near selected springs. The UGS also established surface- and spring-flow gauges at selected springs. The UGS intends to use the monitoring network to establish baseline groundwater elevations, surface flow, and geochemical conditions, and to monitor for changes in these conditions after pumping begins. The UGS also intends to maintain and operate this monitoring network for at least the next 50 years (UGS 2010).

Monitoring and Mitigation Recommendations

SNWA would be required to implement a comprehensive COM Plan that would include all future hydrographic basins facilities associated with the SNWA GWD Project. The plan would be approved and managed by the BLM in accordance with the FLPMA. The COM Plan would integrate protective measure from the following: BLM RMP management actions and BMPs, BO, ACMs, stipulated agreements, and additional mitigation recommended in this EIS. A framework for development of the COM Plan is provided in Section 3.20, Monitoring and Mitigation Summary, and includes a description of the development process; plan components; roles and responsibilities for BLM, SNWA, and other federal and state agencies; enforcement; and description of the effectiveness of the plan to mitigate potential adverse impacts associated with the project.

The following proposed monitoring and mitigation measures are intended to supplement the existing monitoring and mitigation commitments included in the stipulation agreements and the ACMs described in **Appendix E**.

GW-WR-3a: Comprehensive Water Resources Monitoring Plan. Prior to any project pumping in Spring, Delamar, Dry Lake, or Cave valleys, the SNWA would develop a comprehensive water resources monitoring plan (WRMP). This plan would specify hydrologic monitoring requirements (i.e., meteorological and surface water and groundwater) to provide adequate baseline data to facilitate the creation of an early warning system designed to distinguish between the effects of project pumping, natural variations, and other non-project related groundwater pumping activities. The WRMP also would identify monitoring requirements to be used to improve the calibration and predictive abilities of the numerical groundwater flow models (GW-WR-3b) used to estimate future effects associated with the groundwater development project. The WRMP would specify the siting, installation, monitoring frequency, and monitoring and testing methodology (including quality control and quality assurance procedures). The WRMP would be implemented such that critical baseline data necessary to determine pumping effects would be collected for a period of at least 5 years prior to the initiation of pumping. The WRMP would be developed, implemented, and maintained by the SNWA with approval by the BLM in coordination with other federal and state agencies (as deemed appropriate by the BLM). The WRMP design would allow for reasonable modifications and adjustments to monitoring locations over the project life to account for the results of the monitoring, updated groundwater flow model predictions, and updated biological surveys and habitat/species monitoring.

The WRMP would include surface water and groundwater monitoring sites that have been identified as critical to providing an early warning system for potential effects to federal resources and federal water rights identified by the BLM. The monitoring would include water sources essential for threatened or endangered species, and other BLM-identified sensitive species and related habitat determined to be at risk from the project pumping or ground disturbance related activities. A list of springs and streams with sensitive species or game fish on public lands determined to be at risk from the project (where monitoring is likely to be required) under the various alternatives is provided in **Table 3.3.2-9**. Monitoring at specific surface water sites could include surface water flow monitoring and/or monitoring wells located near the surface water source designed to monitor changes in groundwater elevation.

Groundwater Elevation Monitoring Sites

The WRMP also would include a monitoring well network designed to track the magnitude and aerial extent of drawdown overtime resulting from the project pumping activities. It is anticipated that this monitoring well network would include monitoring wells located in the following areas.

- Wells sited in each pumping basin designed to monitor the magnitude and extent of the drawdown over time from project pumping. This would include wells designed to monitor the basin fill aquifer and carbonate aquifer systems; and in some areas, volcanic aquifers.
- Wells sited to monitor groundwater elevations (including wells both in the carbonate aquifer and basin fill aquifers) in the area between southern Spring Valley and southern Snake Valley and northern Hamlin Valleys.
- Wells sited in southern Snake Valley to monitor drawdown effects in southern Snake Valley due to pumping in Spring or Snake valleys.
- Wells sited to monitor for propagation of drawdown from project pumping in Spring or Snake valleys to major spring discharge areas in northern Snake Valley (e.g., Gandy Salt Marsh Complex, Bishop Spring Complex, Leland-Harris Spring Complex, and Twin Springs).
- Well(s) sited along the eastern margin of Steptoe Valley to monitor for the westward propagation of drawdown from project pumping in Spring Valley into Steptoe Valley beneath the Schell Creek Range.
- Well(s) sited in northeastern Lake Valley to monitor for the propagation of drawdown from project pumping in Spring Valley to the area of Geyser and Wambolt springs in Lake Valley.
- Well(s) sited on the west side of Lake Valley to monitor for the propagation of drawdown from project pumping in Cave Valley to the area of Geyser and Wambolt springs.

Table 3.3.2-9 Comparison of Springs and Streams on Public Lands with Sensitive Aquatic Species or Game Fish at Risk[1] by Alternative

Springs and Streams with Sensitive Species or Game Fish Project Specific[2]				Proposed Action			Alt. A - Distributed Pumping			Alt. B - PODs			Alt. C - Intermittent			Alt. D - LCCRDA			Alt. E - Spring/DDC Only			Alt. F - Spring DDC Only			
				Years After Full Build Out			Years After Full Build Out			Years After Full Build Out			Years After Full Build Out			Years After Full Build Out			Years After Full Build Out			Years After Full Build Out			
GW Flow System	Basin Name	Name	Land Owner	0	75	200	0	75	200	0	75	200	0	75	200	0	75	200	0	75	200	0	75	200	Sensitive Species or Game Fish[2]
White River	White River (207)	Flag Springs Complex[3]	State		X	X			X	X	X	X			X			X			X		X	X	White River spinedace, White River desert sucker, White River speckled dace, Flag pyrg
		Hot Creek Spring[3]	State								X	X													Moorman White River springfish, Pahranagat pebblesnail, grated tryonia
	Pahranagat Valley (209)	Pahranagat Creek	USFWS			X						X												X	Pahranagat speckled dace
Salt Lake Desert	Spring Valley (184)	Blind Spring	BLM		X	X		X	X		X	X			X		X	X		X	X		X	X	Northern leopard frog
		North Millick Spring[3]	BLM	X	X	X		X	X		X	X		X	X					X	X	X	X	X	Northern leopard frog
		South Millick Spring[3]	BLM	X	X	X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	X	Northern leopard frog
		Pine Creek	NPS, BLM		X	X		X	X		X	X		X	X			X		X	X		X	X	Bonneville cutthroat trout
		Ridge Creek	NPS, BLM		X	X		X	X		X	X		X	X			X		X	X		X	X	Bonneville cutthroat trout
		Spring Valley Creek	BLM		X	X															X			X	Relict dace
	Snake Valley (195)	Rowland Spring	NPS			X			X		X	X													Brook Trout
		Big Springs Creek	BLM		X	X		X	X		X	X		X	X		X	X		X	X		X	X	NDOW unique fish community
		Big Wash	BLM		X	X		X	X		X	X		X	X			X			X			X	Bonneville cutthroat trout
		Hendry's Creek	USFS, BLM		X	X																			Bonneville cutthroat trout
		Snake Creek	NPS, BLM		X	X		X	X		X	X		X	X			X			X			X	Bonneville cutthroat trout
		Strawberry Creek	NPS, BLM			X					X	X													Bonneville cutthroat trout
Meadow Valley	Spring Valley (201)	Camp Valley Creek	BLM														X	X							Meadow Valley Wash desert sucker, Meadow Valley Wash speckled dace
	Lower Meadow Valley Wash (205)	Meadow Valley Wash	BLM			X						X													Meadow Valley Wash desert sucker, Meadow Valley Wash speckled dace

[1] Includes springs and streams located within areas determined to have a moderate or high risk of effects, or springs with a model simulated flow reduction of 5 percent or greater.

[2] See description of risk to sensitive species and game species provided in Section 3.7, Aquatic Biological Resources.

[3] Risk based on model-simulated flow change of 5 percent or greater.

- Wells sited in Cave Valley and at the base of Shingle Pass in southern White River to monitor and track the westward propagation of drawdown from project pumping in Cave Valley towards the springs that discharge along the southeastern margin of White River Valley (i.e., Flag and Butterfield springs).
- Wells sited on the northern boundary between Delamar and Pahranagat valleys, and in northern Pahranagat Valley to monitor groundwater elevations between the project pumping in Dry Lake and Delamar valleys and the regional spring discharge in northern Pahranagat Valley (i.e., Hiko, Crystal and Ash springs).
- Well(s) sited in the Pahranagat Shear Zone at the boundary between southern Delamar and southern Pahranagat valleys to monitor groundwater elevations between the groundwater production well field in Delamar Valley and the perennial water resources in southern Pahranagat Valley (i.e., Pahranagat National Wildlife Refuge).

The WRMP would include other springs and streams sites, and groundwater monitoring areas as deemed appropriate by the BLM. In additional to the sites listed previously, monitoring sites would be included as necessary to: a) track the extent and magnitude of the drawdown; b) monitor flows in perennial springs and streams determined to be at risk of effects from the groundwater development; and c) provide early warning monitoring of groundwater levels between the production well fields and federal water rights and other water dependant resources identified as critical for management and protection of the BLM's water dependant resources.

Monitoring Results Reporting Requirements

The BLM-approved WRMP would specify the reporting requirements for the monitoring plan. At a minimum, the WRMP would require that SNWA provide the BLM with the following information upon implementation of the WRMP and over the life of the groundwater development project:

1. Quarterly reporting of the results of any meteorological, surface water, and groundwater monitoring required for the project (including all field and laboratory data and analysis).
2. An Annual Report that summarizes and evaluates all monitoring results. The report would minimally include:
    a. Drawdown maps identifying the change in groundwater levels from the previous year, and total drawdown since groundwater pumping was initiated;
    b. Hydrographs for groundwater monitoring wells indicating the change in groundwater levels since monitoring was initiated at each site;
    c. Hydrographys for surface water flow monitoring sites indicating changes in flow since monitoring was initiated at each site;
    d. Water quality sampling and testing results for each monitoring site (where water quality monitoring is required);
    e. Description of identified reductions in flow in any monitored surface water resources in the region;
    f. Evaluation of the likely causes for reductions in surface water flow identified in (e);
    g. Description of any significant changes in water quality identified in surface water or groundwater monitoring locations;
    h. Description of any deviations of the monitoring results from the current groundwater flow model predictions or anticipated from prior monitoring; and
    i. Proposed modifications to the monitoring plans based on the results of the monitoring or updated groundwater flow model predictions (i.e., changes to the monitoring well network, or network of springs and stream sites).
3. All data collected as part of the WRMP and quarterly and annual reports, would be accessible to the public and other federal and state agencies via an internet site. The design and maintenance of the internet site would be the responsibility of SNWA and would be approved by the BLM.

GW-WR-3b: Numerical Groundwater Flow Modeling Requirements. The regional model would be updated and recalibrated at least every 5 years (after pumping is initiated) or sooner if BLM identifies major differences between the model simulations and monitoring results (GW-WR-3a) and determines that model recalibration is necessary.

In addition to the regional groundwater flow model, the SNWA would develop more detailed (local scale) groundwater flow models designed to simulate the effects of pumping within each specific basin. These basin-specific models would be developed and approved by the BLM prior to BLM's NEPA review of specific groundwater development activities proposed by the SNWA. The basin-specific models would be coupled with the regional model by constructing separate models, whose boundary conditions are linked to the regional model; constructing an "embedded" model where the local model is coupled to the regional model; or using another method approved by the BLM. The BLM would utilize the basin-specific models and the regional groundwater model to conduct a more detailed NEPA evaluation of potential project-related pumping impacts once the location and pumping schedules for the production wells have been defined by SNWA. Additionally, the BLM would use the basin-specific models to critically evaluate the effectiveness of the proposed mitigation measures, ACMs, and other proposed adaptive management processes. The basin-specific models also would be recalibrated at least every 5 years (after pumping is initiated) or sooner if the BLM identifies major differences between the model simulations and monitoring results and determines that model recalibration is necessary.

The regional groundwater flow model and basin-specific models would be maintained through the life of the project. The BLM would establish a Technical Review Team to review the model on a periodic basis to provide recommendations to improve the calibration and predictive ability of the numerical groundwater flow model(s). The BLM, with input from their Technical Review Team, would determine if periodic updates of the groundwater flow model are no longer necessary or if other groundwater flow models or predictive tools should be used.

<u>Effectiveness</u>: It is anticipated that BLM's review of monitoring results combined with appropriate updated groundwater modeling predictions would provide early warning of potentially undesirable impacts to water-dependent resources. This early warning potentially would allow for implementation of appropriate management measures (identified in GW-WR-7) to mitigate effects on these resources. Implementation of these monitoring and mitigation measures likely would reduce potential impacts to critical areas but would not entirely eliminate impacts to water dependant resources; see the related discussion in *Potential Residual Impacts* (below).

GW-WR-4: Monitoring, Mitigation, and Management Plan for Snake Valley. Mitigation measure GW-WR-4 described below includes the water resource components of the draft documents prepared by BLM during preparation of the Draft EIS:

1) Monitoring, Mitigation, and Management Plan for Snake Valley, Utah-Nevada; and
2) Guidance to Technical Working Group for Development of Snake Valley Monitoring, Mitigation and Management Plan.

The complete Monitoring, Mitigation, and Management (3M Plan) documents are provided in **Appendix B**.

The SNWA, working in conjunction with the BLM and other DOI agencies, and with input from the States of Nevada and Utah, will develop and implement a long-term monitoring, management, and mitigation plan for Snake Valley (3M Plan) as outlined below. When the 3M Plan is fully developed, it will be comparable to the monitoring plans developed (or to be developed) under the existing stipulation agreements for other basins addressed in this EIS. The 3M Plan will reflect a staged approach to implementing monitoring, management, and mitigation activities because of the time period that may elapse between this EIS and construction and operation of groundwater infrastructure in Snake Valley. Building and implementing the various stages of the 3M Plan will be dependent upon triggers as the SNWA moves closer to implementing groundwater development in Snake Valley.

The purpose of the 3M Plan is to insure that: 1) implementation of the ROD protects water dependent resources and water-related resources on public lands, 2) protects federal water rights managed by federal agencies, and 3) provides a process for mitigating impacts. To accomplish this purpose, the 3M Plan will establish a network of groundwater and surface water monitoring sites to collect baseline data and monitor the effects of groundwater development on water resources. The intent of the 3M Plan is to provide early warning of potential adverse impacts to water rights and water-dependent sensitive resources, and provide time and flexibility to implement management measures and gauge their effectiveness. Following this intent, the highest priority actions in the Snake Valley 3M Plan will be tied to predicted impacts from groundwater development, as identified in this EIS.

The 3M Plan would be required to be implemented and updated as long as the SNWA maintains long-term plans to develop groundwater and remove it from Snake Valley. If the SNWA terminates plans to develop groundwater from Snake Valley and the 3M Plan adopted for Spring Valley shows no interbasin effects from pumping in Spring Valley, then the BLM may terminate the requirement for a Snake Valley 3M Plan.

Key Concepts of Proposed Snake Valley 3M Plan

Hydrologic Provisions – The Snake Valley 3M Plan will include sections to address hydrologic issues and would be similar to the plans developed with the BLM and other DOI agencies for the other groundwater development basins analyzed in this EIS. The 3M Plan will include:

- Development and implementation of baseline monitoring plans;
- Establishment of new monitoring sites and use of existing monitoring sites, including monitoring wells, piezometers, stream flow gages, and precipitation or meteorological stations;
- Collection of data on groundwater elevations, spring and stream flow rates, water quality, aquifer testing, vegetation communities, special status and water-dependent species and their habitats; and
- Updates or revisions to groundwater flow numerical modeling.

Management and Mitigation Actions – The initial 3M Plan generally will identify available management options and mitigation actions to address any adverse effects of SNWA pumping. These actions may include:

- Geographic redistribution of groundwater withdrawals;
- Reduction or cessation of groundwater withdrawals;
- If water supplies used for consumptive purposes, such as irrigation, domestic and livestock watering use were limited by the project, then the SNWA will provide alternate supplies of water;
- Acquisition of real property and/or water rights dedicated to management of special status species; and
- Augmentation of water supply and/or acquisition of existing water rights.

The initial 3M Plan will include triggers that will prompt the SNWA and the Technical Working Group (described below) to develop more detailed management response actions and specify conditions when those management actions will be implemented.

Staged Approach with Triggers for 3M Plan Activities – The SNWA and the Technical Working Group will develop an initial 3M Plan within 1 year of the ROD for this EIS. The initial 3M Plan will focus on:

- Identification of existing monitoring sites that would be useful in establishing baseline conditions;
- Identification of additional monitoring sites that will be needed to build full sets of baseline data;
- Processes for sharing monitoring data with interested parties;
- Description of other monitoring, management, and mitigation activities that will begin at later stages of project development; and
- Triggers, such as decisions by the NSE regarding water rights for Snake Valley or completion of the interstate agreement between Nevada and Utah regarding Snake Valley, which will initiate additional activities under the 3M Plan.

When these triggers occur, sections of the initial 3M Plan that were only generally described will be more fully developed to meet the objective of early detection of potential project impacts. Resources that must be committed by

SNWA to build and implement the 3M Plan are expected to gradually increase over time, commensurate with SNWA implementation of groundwater development in Snake Valley.

Management Committee and Technical Working Group – As part of the 3M Plan, a management committee and a Technical Working Group will be formed to implement the various aspects of the 3M Plan to achieve its purpose. SNWA, in conjunction with BLM, will develop appropriate guidelines for the management committee and Technical Working Group. The BLM Nevada State Director, or his designee, will chair the management committee. Members of the management committee and Technical Working Group may include representatives from the SNWA, federal agencies, and the States of Nevada and Utah. Final approval of the Snake Valley 3M Plan (or any interim plans) rests with the BLM.

SNWA Management and Reporting Responsibilities – The SNWA would be responsible for the development and implementation of management actions associated with the 3M Plan including all monitoring activities during the life of the project. In the initial phase of the 3M Plan, the SNWA will provide results of monitoring on a quarterly basis and provide a detailed analysis of monitoring in an annual report provided to the BLM. The report would include maps indicating drawdown extent and magnitude and hydrographs indicating water levels and spring discharge measurements over time. When subsequent phases of the 3M Plan implement additional activities, such as research, groundwater modeling, and groundwater testing, reporting requirements would be similar as specified in the Spring Valley Monitoring and Mitigation Plan (SNWA 2009c). These reports would be made available to the public on BLM's website.

Monitoring Area – The monitoring areas associated with the 3M Plan are to be located within the Great Salt Lake Desert Flow System. Subject to input from the management committee and the Technical Working Group, it is anticipated that the highest intensity area for monitoring efforts will occur between Miller Springs at the northern end of Snake Valley and the southern boundary of the Snake Valley hydrographic area. Lower intensity monitoring efforts will occur in adjacent hydrographic basins, including Fish Springs Flat, Tule Valley, Pine Valley, and Wah Wah Valley. The Technical Working Group will be tasked with coordinating operation of the Snake Valley and Spring Valley Plans.

Management of Monitoring Data – The Technical Working Group will be responsible for establishing data collection methodology and quality control procedures. The Technical Working Group also will be responsible for integrating and interpreting monitoring results from a variety of sources, including the USGS, UGS, and SNWA-operated monitoring well locations. SNWA will be responsible for constructing and maintaining a database to house the collected data and make it publicly available.

Hydrologic Monitoring Provisions – The 3M Plan will include the following provisions for hydrologic monitoring. The Technical Working Group will be tasked with prioritization and sequencing of monitoring tasks, so that increased monitoring obligations will be linked to accomplishment of significant milestones toward groundwater development. Accordingly, all of the monitoring tasks listed below may not be implemented immediately, and the recommended timing of each task below will be addressed in the initial 3M Plan.

- **Monitoring Wells** – The 3M Plan will rely upon existing groundwater monitoring networks established by the USGS and the UGS. The SNWA will construct and operate additional monitoring well sites at locations where the greatest impacts of groundwater diversions are expected to occur and in sites where geologic and aquifer properties are not well known. The monitoring plan and operation will be approved by the management committee and the Technical Working Group. The well monitoring network will collect both groundwater level data and water quality data, with the objective of establishing baseline conditions.
- **Spring Monitoring** –The 3M Plan also will include a program for monitoring spring discharge and groundwater levels associated with springs. Monitoring efforts will be focused on identification of early warning of groundwater declines that could impact springs. The SNWA, working with the Technical Working Group, will initially identify the springs to be monitored and this will be updated as the information indicates the need for additional or changed monitoring locations. The initial list of springs to be considered for monitoring will be derived from springs that may experience flow rate reductions, according to the groundwater modeling analysis for this EIS. Initially, the spring monitoring would be accomplished using continuous water-level monitoring in piezometers located near each spring and biannual monitoring of flow at the spring.

- **Stream Monitoring** – The SNWA may be required to construct and operate stream gauges on creeks within Snake Valley or adjacent valleys that currently are not monitored by the USGS gauges or by the State of Utah or State of Nevada. Emphasis will be placed on monitoring stream reaches that could be directly affected by the SNWA groundwater diversions and streams that make significant contributions to the Snake Valley groundwater budget.
- **Meteorological (Climate) Stations** – The SNWA will be required to construct and operate meteorological monitoring stations to provide information for geographic areas not covered by current stations operated by USGS, BLM, NOAA, State of Utah, or State of Nevada. Emphasis will be placed on locations that require better groundwater recharge estimates for use in groundwater modeling procedures. Data collected would include, at a minimum, precipitation, temperature, wind, soil moisture and temperature, and relative humidity (although not all stations may require all parameters).

Hydrologic Analysis Provisions – Hydrologic analysis activities that will be included in the 3M Plan are set forth below. These activities are not expected to be fully implemented until later stages of the 3M Plan, with timing based upon triggers established by the Technical Working Group.

- **Aquifer Characterization** – The regional groundwater model used to support the NEPA process identified areas of uncertainty with regard to geologic and hydraulic characteristics of Snake Valley and adjacent valleys. The Technical Working Group will determine whether the SNWA should conduct additional studies to determine lithology and structure (such as faulting) of geologic units and aquifers in Snake Valley. One area of research focus will be to better characterize inter-basin flow zones in valleys adjacent to Snake Valley. Results from these additional studies will be used to enhance groundwater modeling efforts.
- **Numerical Modeling of Snake Valley Groundwater Flow** – The SNWA will develop a groundwater flow system numerical model that is specific to Snake Valley, in cooperation with the Technical Working Group. The Technical Working Group will determine the characteristics of the Snake Valley flow model, such as grid size and representation of existing groundwater depletions. The SNWA will develop the flow model well in advance of any proposals for specific production well locations, so that model results can be used to identify areas of uncertainty that could be reduced by investigations that could be implemented by the Technical Working Group.

Effectiveness. It is anticipated that the 3M Plan would provide early warning of potentially undesirable impacts to water-dependent resources and provide time and flexibility to implement management measures to mitigate their effects. However, since groundwater development presumes some level of vegetation change and significant reduction in groundwater levels in some parts of Snake Valley, not all impacts would be avoided by this mitigation measure. The Snake Valley 3M Plan may include mitigation measures offered by the SNWA, in coordination with the State of Utah, to mitigate impacts that occur to lands, water rights, and water-dependent resources owned by private parties, local governments, and state governments. However, the BLM cannot enforce mitigation measures on lands owned by other parties and cannot insure that the funding and land access necessary to implement these measures will be made available.

GW-WR-5: Shoshone Ponds. Drawdown is likely to impact the source of water that supports important aquatic resources for Shoshone Ponds (as discussed in Section 3.7, Aquatic Biological Resources). The SNWA would develop a surface water and groundwater monitoring plan specific to providing an early warning system for effects to flow at Shoshone Ponds. The site specific monitoring plan would likely include monitoring discharge at the Shoshone ponds; and monitoring artesian pressures in the aquifer that controls discharge to the ponds. The general requirements for development, approval, implementation, and reporting for the Shoshone ponds monitoring plan would be the same as outlined in GW-WR-3a.

Impacts to Shoshone Ponds that are attributable to the SNWA's groundwater pumping would be mitigated by improving the existing well or drilling a new well, and installing a pump such that the well, pump, and water conveyance system are designed to maintain the flow to the ponds for the foreseeable future regardless of the groundwater drawdown. Any new well should be designed to pump groundwater from the same aquifer system to maintain the same general water quality and temperature characteristics currently used as the source of water for the ponds and sufficient to support the federally listed and special status species that inhabit the ponds, as described in Section 3.7, Aquatic Biological Resources. The SNWA would be responsible for all cost associated with the implementation, operation, and maintenance of the source of water required to offset the effects of SNWA's groundwater pumping activities.

Effectiveness: Pumping groundwater from the existing well or new well located within the same aquifer is a feasible mitigation measure that is expected to effectively mitigate the anticipated reductions of flow resulting from the groundwater development project. Pumping water to replace the existing water supply would result in an incremental increase in drawdown. Impacts to water quality are unlikely to occur if the water supply used for mitigation pumps water from the same aquifer that currently is used to supply water to the ponds.

GW-WR-6: Existing Water Rights, Domestic Water Supply Wells and Other Water-Dependent Resources. Impacts to existing water rights and domestic water supply wells would be mitigated, as required by the State of Nevada or Utah (presumably acting under authority of an interstate agreement between Utah and Nevada that would be developed prior to future development). The NSE would oversee the groundwater development and is required by law to take action to resolve groundwater withdrawal conflicts with existing water rights; to protect the water supply used by domestic water supply wells, or to determine the resolution of conflicts with other provisions of Nevada water law. The NSE also "*recognizes that existing rights must be protected, as well as concerns for the wildlife and maintenance of wetlands and fisheries*" (NDWR 2012a,b,c,d). Mitigation for impacts to existing water rights and domestic water supply wells, as well as water dependent resources, would depend on the site-specific conditions and impacts and could include a variety of measures. Methods to avoid or minimize impacts to existing water rights, water dependent resources and domestic water supply wells, may include such measures as alterations to the groundwater pumping activities (e.g., modifying the pumping regime, changing the location of pumping). The NSE could require the implementation of other proven and cost-effective mitigation measures at the water source locations. These measures may include but would not be limited to the following: 1) for wells, mitigation could include lowering the pump, deepening an existing well, drilling a new well, or providing a replacement water supply of equivalent yield and water quality; and 2) for surface water rights and water dependent resources, mitigation could require providing a replacement water supply of equivalent yield and water quality.

Effectiveness: Mitigation for impacts to existing water rights or domestic water supply wells would be mitigated on a case-by-case basis as determined by the NDWR or UDWRi using proven cost-effective strategies (NDWR 2012a,b,c,d). The NSE rulings regarding water rights permitting for the groundwater development project states that "*The State Engineer's water rights permitting requirements will ensure the Project's environmental soundness*" and that "*The State Engineer finds that the springs and streams upon which water rights exist and wildlife depends must be protected*" (NDWR 2012a,b,c,d). Inventoried springs and perennial streams within the areas at risk from the proposed development typically have existing water rights. The NSE rulings indicate that the NSE has committed to protect water dependant resources such as wildlife, wetlands, and fisheries that may be adversely affected by impacts to springs and streams. The NSE permitting requirements include provisions for comprehensive water resources monitoring, reporting, management, and mitigation for the project. Implementation of appropriate monitoring, management, and mitigation measures required by the NSE is anticipated to effectively protect existing water rights, and minimize the impacts to wildlife, fisheries, and other sensitive biological resources associated with springs and streams, and domestic water supply wells in accordance with applicable state laws.

GW-WR-7: Groundwater Development & Drawdown Effects to Federal Resources and Federal Water Rights. If the results of the monitoring or modeling information provided in accordance with GW-WR-3a indicate that impacts to federal resources or federal water rights from groundwater withdrawal are occurring or are likely to occur, and the groundwater development project is the likely cause of or contributor to the impacts, the following measures would be initiated:

1. The BLM would evaluate the available information and determine if emergency action and/or a mitigation plan is required.
2. If the BLM determines that emergency action is required to avoid, minimize, or offset the impact, the BLM would serve an immediate "Cease and Desist" order identifying the actions to be taken, including whether SNWA would be required to concurrently develop a mitigation plan as required in bullet 3 below.
3. If the BLM determines that a mitigation plan is required, the SNWA would prepare a detailed, site- specific plan that (a) identifies the magnitude and timing of the drawdown or associated impacts to federal resources or federal water rights; and (b) provides detailed site-specific measures that would be used to avoid, minimize the magnitude

of, or offset the identified impacts. The mitigation plan would be submitted to BLM for approval within 30 days of BLM's determination that a site-specific mitigation plan is required unless a longer time frame is approved by the BLM.

4. The BLM-approved, site-specific mitigation plan would be implemented by the SNWA. The BLM could require that specific measures be implemented per the schedule specified in the mitigation plan to avoid, minimize, or offset the impacts to federal resources or federal water rights. The specific mitigation measures may include but are not limited to the following:
   - Reduction or cessation in groundwater withdrawals;
   - Geographic redistribution of groundwater withdrawals;
   - Recharge projects to offset local groundwater drawdown;
   - Flow augmentation to maintain flow in specific water sources; or
   - Other on-site or off-site improvements.

5. Monitoring of the surface water resources and groundwater elevations required under Mitigation Measure GW-WR3a would be used in addition to other specified monitoring in the approved mitigation plan to document the effectiveness of the implemented measures. If the initial implementation of the mitigation plan does not provide the desired results within the time frame specified by the BLM, the BLM may require implementation of additional measures.

Effectiveness: The effectiveness would depend in part, on the capacity of the comprehensive WRMP (described in GW-WR-3a) and associated groundwater modeling to closely track the groundwater drawdown area resulting from the groundwater withdrawal and provide for an early warning system to identify potential effects to federal resources and federal water rights. The early warning monitoring system coupled with BLM authority to require that specific measures be implemented in a timely manner to avoid, minimize, or offset the impacts is expected to be effective at minimizing residual adverse effects to federal resources and federal water rights. However, reasonable or adequate mitigation measures for long-term reductions of groundwater discharge, or baseflow, may not be available for all locations as discussed in the *Potential Residual Impacts* section provided below. In addition, this mitigation measure also may be limited if actions required to offset, minimize or avoid the identified impact is not within BLM's authority or jurisdiction. See GW-WR-6.

Potential Residual Impacts

Potential residual impacts resulting from groundwater pumping for the Proposed Acton are discussed below.

Groundwater drawdown associated with groundwater development is predicted to expand for at least full build out plus 200 years and persist for the foreseeable future. Successful implementation of the stipulations and adaptive management plan likely would minimize residual adverse effects to water resources at selected locations. The feasibility and success of the mitigation would depend on the site-specific conditions and details of the mitigation plan. However, considering the regional scale of the predicted drawdown and number of perennial water sources identified that could be affected, it may not be feasible to effectively mitigate impacts to all of the potentially affected water sources. In addition, adequate mitigation measures for long-term reductions of groundwater discharge, or baseflow, may not be available for all locations.

The SNWA has identified several adaptive management measures that could be implemented to address adverse impacts. Two of these adaptive management measures would adjust groundwater withdrawal to minimize impacts, specifically: 1) geographic redistribution of groundwater withdrawal; or 2) reduction or cessation in groundwater withdrawal. Implementation of these adaptive management measures would reduce the magnitude of drawdown in specific areas. However, as described in **Appendix F3.3.5** (Pumping Cessation – Recovery Analysis), recovery of water levels in specific areas of interest to pre-project conditions could take several years or decades. Recovery would be dependent on location and implementation of specific adaptive management measures and may not successfully mitigate long-term impacts to surface water resources in some areas. Therefore, a long-term reduction in surface discharge at perennial surface water source areas is likely to occur in some areas even after implementation of the SNWA proposed adaptive management measures and proposed mitigation measures. This potential reduction in surface discharge at perennial surface water source areas is considered an unavoidable adverse impact associated with the proposed groundwater development.

The groundwater development is predicted to result in a long-term reduction in groundwater discharge to ET areas in Spring and Snake valleys. Some of these ET areas are sustained by spring discharge. It is not feasible to mitigate all impacts to ET areas resulting from the reduction in groundwater discharge. Long-term reductions in groundwater discharge to ET are considered unavoidable residual impacts associated with the proposed groundwater development.

3.3.2.10 Alternative A

Groundwater Development Areas

Groundwater development associated with the well fields would occur within the general areas identified within the five groundwater development basins (i.e., Spring, Snake, Cave, Delamar, and Dry Lake valleys). The groundwater development areas defined for Alternative A are the same as previously described for the Proposed Action. As with the Proposed Action, development within the groundwater development areas would include groundwater production wells, collector pipelines, staging areas, power facilities, pumping stations, and access roads. The actual location of specific facilities within the groundwater development areas has not been at this stage of the project and will be subject to future site-specific NEPA analysis.

Conclusion. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated maximum surface disturbance of approximately 4,800 acres within 5 hydrographic basins. As described under the Proposed Action, there are 60 known or suspected springs identified within the groundwater development areas (**Table 3.3.2-4**). These springs occur within the groundwater development areas within Spring Valley (37 springs), Snake Valley (11 springs), Delamar Valley (7 springs), Dry Lake Valley (4 springs), and Cave Valley (1 spring). There also are 28 separate perennial stream reaches located in Spring Valley (23 streams) and Snake Valley (5 streams) with a total length of 29 miles within the groundwater development areas (**Table 3.3.2-5**). The potential for impacts to springs and streams located within these groundwater development areas would depend on the final locations of facilities. Implementation of the ACMs would minimize impacts to perennial water sources associated with the well field development. Additional monitoring and mitigation recommendations (GW-WR-1, GW-WR-2) described under the Proposed Action also would apply to Alternative A and include identifying and establishing an avoidance buffer around all springs; and developing site-specific plans to minimize impacts at perennial stream crossings within the groundwater development areas.

Groundwater Pumping

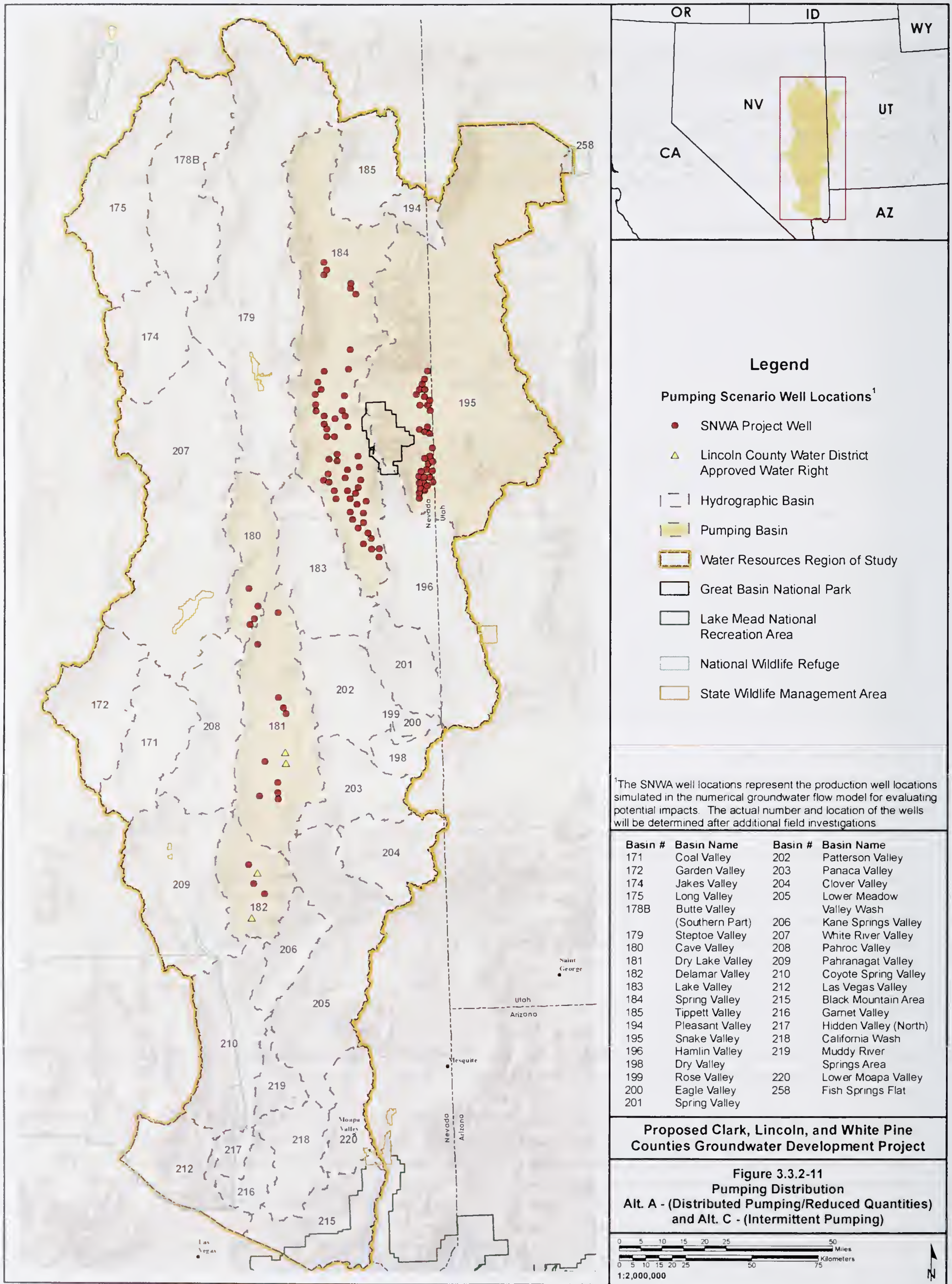
Groundwater Pumping Scenario

The groundwater pumping scenario for Alternative A assumes pumping at reduced quantities (approximately 115,000 afy) from those listed on the pending water rights application for the 5 proposed project pumping basins (Spring, Snake, Delamar, Dry Lake, and Cave valleys). The well distribution developed by SNWA for this model scenario (**Figure 3.3.2-11**) distributes the simulated production wells spatially within the groundwater development areas in an effort to minimize pumping effects. Details regarding the assumed pumping schedule used for the model simulations are provided in the model simulation report (SNWA 2010a). The pumping schedule reflects the proposed south to north sequence of basin development for the project.

Impacts to Water Levels

The predicted change in groundwater levels attributable to groundwater development under the Alternative A at full build out, full build out plus 75 years, and full build out plus 200 years are provided in **Figures 3.3.2-12**, **3.3.2-13**, and **3.3.2-14**, respectively. These figures illustrate areas where the water levels are predicted to decrease in comparison to the simulated No Action water levels.

At full build out, the drawdown areas are localized in the vicinity of the pumping wells in Spring, Delamar, Dry Lake, and Cave valleys. Drawdown does not occur at this time period in Snake Valley. Comparison of the simulation results for the three representative points in time indicates that the drawdown area continues to progressively expand as pumping continues into the future.



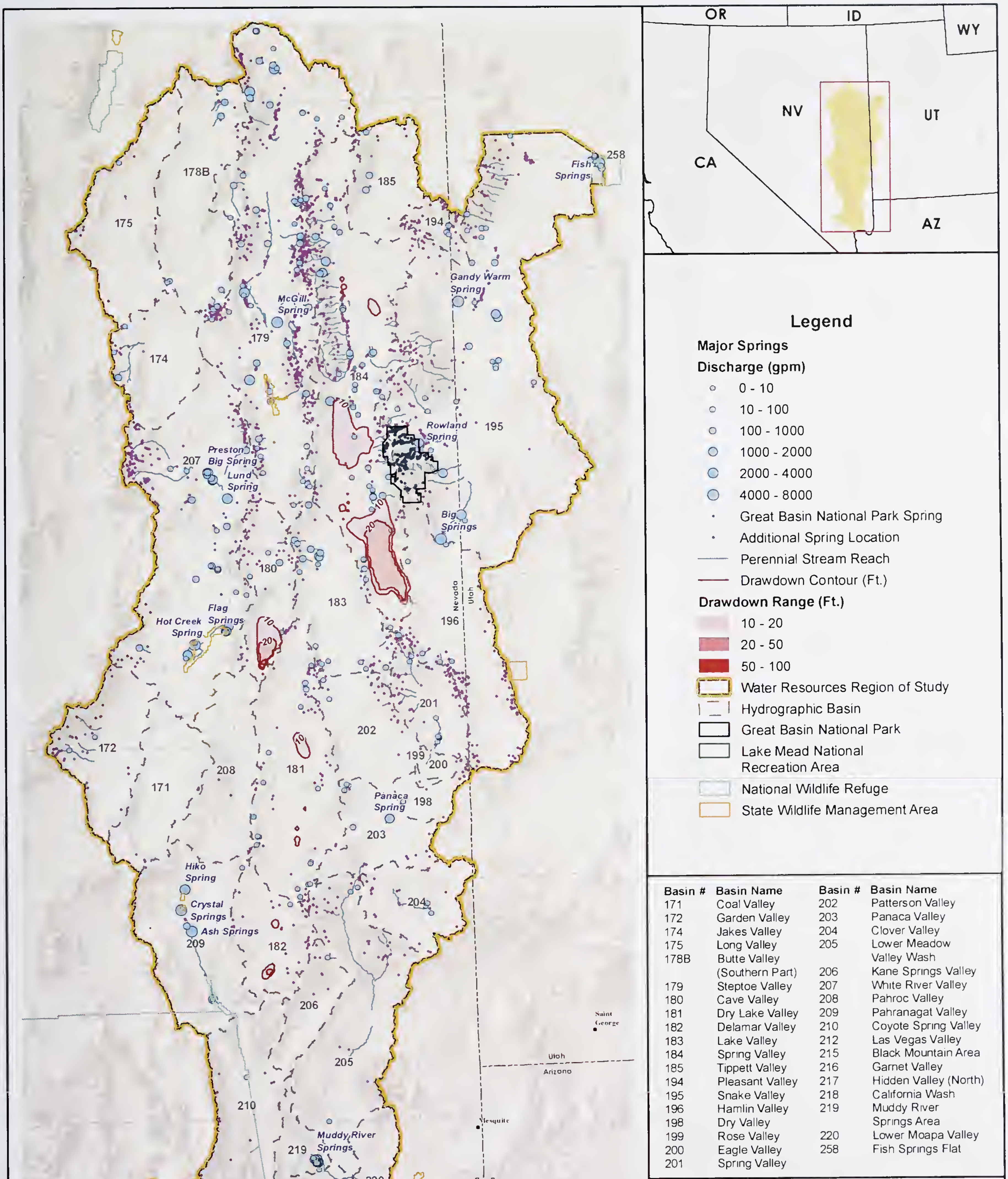
[1]The SNWA well locations represent the production well locations simulated in the numerical groundwater flow model for evaluating potential impacts. The actual number and location of the wells will be determined after additional field investigations.

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-11
Pumping Distribution
Alt. A - (Distributed Pumping/Reduced Quantities) and Alt. C - (Intermittent Pumping)

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data



Basin #	Basin Name	Basin #	Basin Name
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174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
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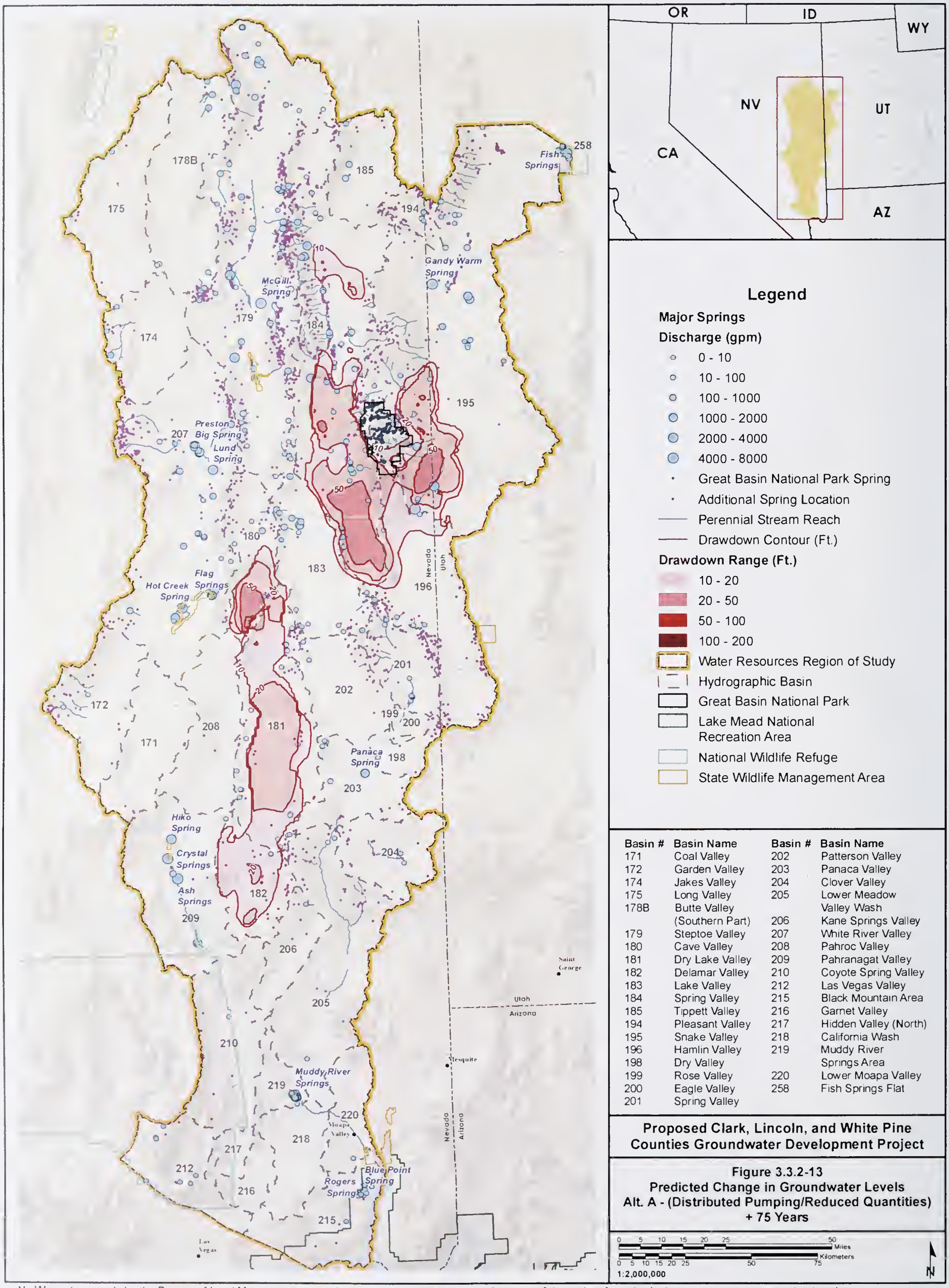
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-12
Predicted Change in Groundwater Levels
Alt. A - (Distributed Pumping/Reduced Quantities)
Full Build Out

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data



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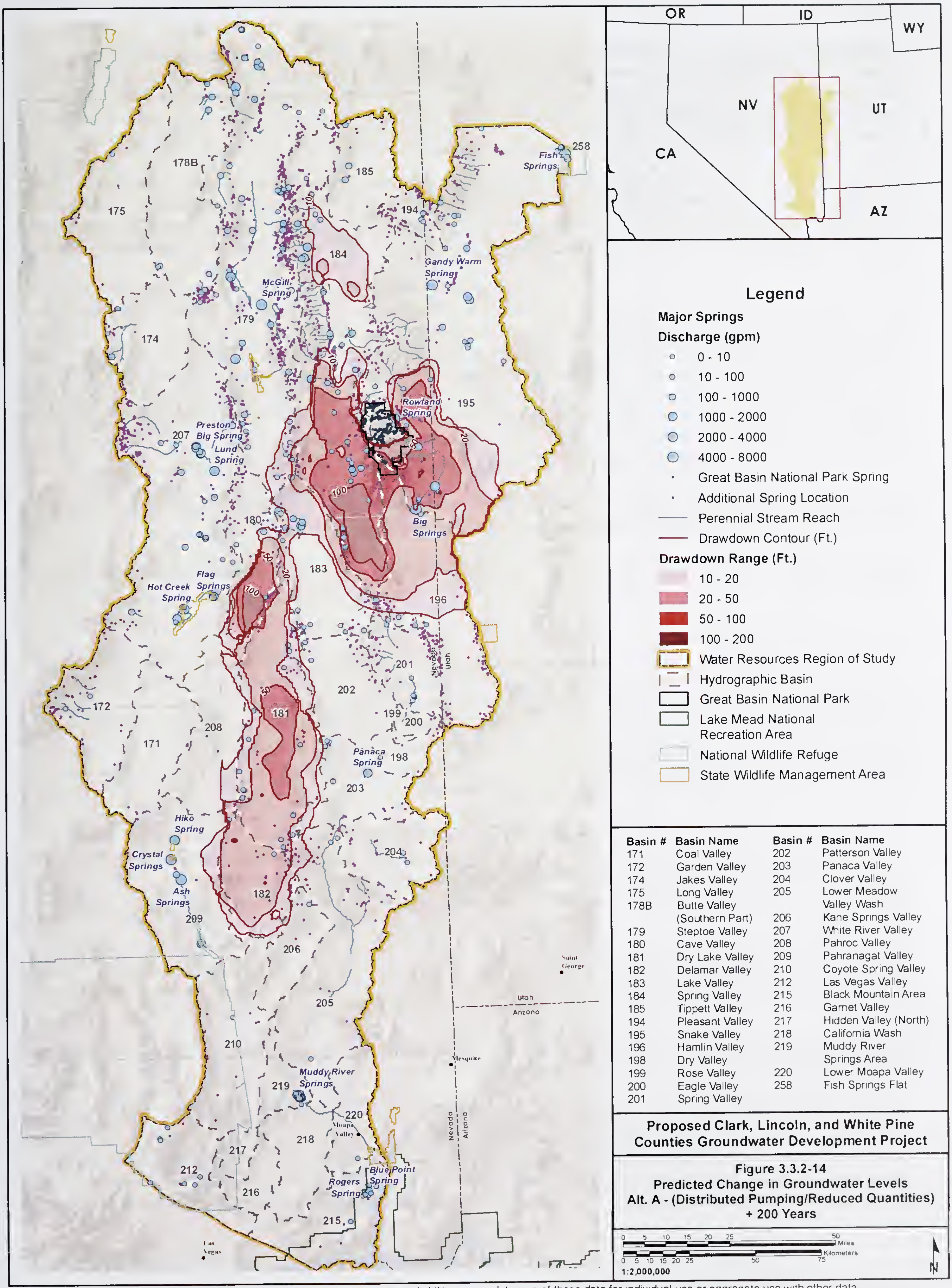
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-13
Predicted Change in Groundwater Levels
Alt. A - (Distributed Pumping/Reduced Quantities)
+ 75 Years



Basin #	Basin Name	Basin #	Basin Name
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196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-14
Predicted Change in Groundwater Levels
Alt. A - (Distributed Pumping/Reduced Quantities)
+ 200 Years

At full build out plus 75 years time frame, there are three distinct drawdown areas. The northernmost drawdown area is a relatively small localized drawdown area located in the northern portion of Spring Valley. The second drawdown area encompasses the southern Spring Valley, southern Snake Valley, and northern Hamlin Valley. The third drawdown area extends across Cave, Delamar, and Dry Lake valleys in an elongate north-south direction that primarily is confined in these three pumping basins.

By the full build out plus 200 years time frame, the two main drawdown areas are beginning to merge into one that extends approximately 170 miles in a north-south direction and up to 50 miles in a east-west direction. At this time frame, the simulated drawdown area extends into southeastern Steptoe Valley, and into eastern margins of Pahroc and Pahranagat Valleys, and extreme western margins of Panaca Valley and northwest margin of Lower Meadow Valley Wash.

The locations of six selected observation wells located within the proposed pumping basins are presented in **Figure 3.3.2-6**. Water-level hydrographs for each of these observation wells within the pumping basins are provided in **Figures 3.3.2-7** and **3.3.2-8.** The hydrographs illustrate the predicted rate and magnitude of water level decline at these representative locations over the simulation period. As with the Proposed Action, the hydrographs indicate that water levels are predicted to continue to decrease over the model simulation period; and not reach a renewed equilibrium (or steady state condition) before the end of the simulation period. The representative hydrographs illustrate that the reduced groundwater withdrawal under the Alternative A pumping scenario is predicted to result in a reduction in the amount of drawdown within the pumping basins as compared to the Proposed Action.

The potential for groundwater withdrawal to reduce the storage properties of the basin-fill sediments within the drawdown cone are the same as previously discussed for the Proposed Action (Section 3.3.2.9)

Potential effects to water resources resulting from the Alternative A pumping scenario are summarized in **Table 3.3.2-10**.

Impacts to Springs and Streams

The estimated potential risks to springs located within the projected drawdown area at full build out, full build out plus 75 years, and full build out plus 200 years are presented in **Figures F3.3.8A-4**, **F3.3.8A-5**, and **F3.3.8A-6**, respectively, in **Appendix F3.3.8**. The number of springs within the drawdown area and relative risk of impacts by hydrographic basin are summarized in **Table F3.3.9-2A** in **Appendix F3.3.9**. Specific inventoried springs located within the drawdown area at the representative points in time are listed in **Table F3.3.10-1A** in **Appendix F3.3.10**. The estimated miles of perennial streams (by hydrographic basin) located in the predicted drawdown areas where surface waters could be impacted are listed in **Table F3.3.11-2A** in **Appendix F3.3.11**.

Potential total effects to perennial springs and streams are summarized in **Table 3.3.2-10**. For the predicted drawdown area at full build out plus 75 years, there are 29 inventoried springs and 86 "other" springs located within the high and moderate risk areas. By full build out plus 200 years, this increased to 46 inventoried springs and 136 "other" springs located within the high and moderate risk areas. These springs occur in Cave, Steptoe, Hamlin, Spring (HA 184), Snake, and Lake valleys.

The total estimated length of perennial streams located in areas where there is a high to moderate risk of impacts resulting from the predicted drawdown increases from approximately 58 miles at 75 years to 81 miles at full build out plus 200 years. This includes stream reaches located in Steptoe, Spring (HA 184), Snake and Lake valleys.

Potential site-specific impacts to individual springs and streams affected by drawdown would be the same as discussed for the Proposed Action.

Model-simulated Spring and Stream Discharge Estimates. Model-simulated changes in spring flow for selected springs are presented in **Table 3.3.2-11**. The model results indicate that two of the modeled springs in White River Valley, Butterfield Spring and Flag Springs 3, are predicted to experience 8 percent flow reduction at the full build out plus 200 years time frame. These results suggest that the groundwater development eventually could affect flows in springs located along the south eastern margin of the valley floor in White River Valley. The model results also indicate that

Table 3.3.2-10 Summary of Potential Effects to Water Resources Resulting from the Alternative A Pumping Scenario[1,2]

Water Resource Issue / Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Drawdown:			
• Number of hydrographic basins affected by drawdown	5	10	16
Drawdown effects on perennial springs:			
• Number of inventoried springs located in areas where impacts to flow could occur[3]	1	29	46
• Number of other springs located in areas where impacts to flow could occur[4]	2	86	136
• Model-simulated flow reduction at Big Spring (as percent flow reduction)	2%	100%	100%
Drawdown effects on perennial streams:			
• Number of basins with perennial stream reaches where impacts to flow could occur	1	2	4
• Miles of perennial stream located in areas where impacts to flow could occur	1	58	81
Drawdown effects on surface water rights:			
• Number of surface water rights located in areas where impacts to flow could occur	14	109	151
Drawdown effects on groundwater rights:			
• Number of groundwater rights located within the 10-50 foot drawdown area	15	171	93
• Number of groundwater rights located within the 50-100 foot drawdown area	0	3	128
• Number of groundwater rights located within the greater than 100-foot drawdown area	0	0	2
• (Total groundwater rights in drawdown area)	(15)	(174)	(223)
Percent reduction in ET and spring discharge[5]:			
• Spring Valley	30%	51%	57%
• Snake Valley	0%	23%	27%
• Great Salt Lake Desert Flow System[1]	12%	34%	39%
• White River Flow System	0%	0%	1%
Reduction in flow from Snake Valley to Pine, Wah Wah, and Tule Valleys Hydrographic Basins[5]:			
• AFY	0	440	1,100
• Percent Reduction	0%	2%	6%

[1] Located within the groundwater flow model domain.

[2] Unless otherwise noted, supporting information used to develop these estimated effects are provided in **Appendices F3.3.5** through **F3.3.16**.

[3] Specific inventoried springs identified in moderate or high risk areas are identified in **Table F3.3.10-1A** in **Appendix F3.3.10**.

[4] "Other Springs" are springs identified in the National Hydrography Database or topographic maps that have not been field verified.

[5] Estimate derived from the model-simulated values provided in SNWA 2010a with comparison to No Action pumping results.

Table 3.3.2-11 Model-simulated Flow Changes (Alternative A Pumping)

(Project Specific)					Alternative A (Reduced Pumping)		
					Incremental Change in Flow % (from No-Action)		
Flow System	Hydrographic Basin	Spring	Average Flow (Actual) in gpm	Model-simulated Average Flow (2005) in gpm	Full Build Out	75 years after Full Build Out	200 years after Full Build Out
White River	White River Valley (207)	Arnoldson Spring	1,608	946	0	0	0
		Butterfield Spring	1,225	471	0	-3	-8
		Cold Spring	582	503	0	0	-1
		Flag Springs 3	969	560	-1	-3	-8
		Hardy Springs	200	73	0	0	-1
		Hot Creek Spring	5,032	6,899	0	-1	-2
		Lund Spring	3,594	3,314	0	0	-1
		Moon River Spring	1,707	1,457	0	0	-1
		Moorman Spring	405	353	0	0	-1
		Nicolas Spring	1,185	872	0	0	0
		Preston Big Spring	3,572	3,794	0	0	-1
	Pahranagat Valley (209)	Ash Springs	6,909	7,453	0	0	-1
		Brownie Spring	224	277	0	0	0
		Crystal Springs	4,235	4,647	0	0	-1
		Hiko Spring	2,735	1,985	0	0	-1
	Muddy River Springs Area (219)	Muddy River near Moapa[1]	20,931	15,383	0	0	0
	Lower Moapa Valley (220)	Muddy River near Glendale[1]	19,565	14,895	0	0	0
	Black Mountains Area (215)	Blue Point Spring	223	393	0	0	0
		Rogers Spring	771	515	0	0	0
Goshute Valley	Steptoe Valley (179)	Campbel Ranch Springs	2,746	2,088	0	0	0
		Currie Spring	2,181	1,419	0	0	0
		McGill Spring	4,783	2,074	0	0	0
		Monte Neva Hot Springs	649	280	0	0	0
Great Salt Lake Desert	Spring Valley (184)	Keegan Spring	234	63	-12	-28	-36
		North Millick Spring	284	98	-4	-9	-11
		South Millick Spring	506	278	-10	-21	-24
	Snake Valley (195)	Big Springs	4,289	1,977	-2	-100	-100
		Foote Res. Spring	1,300	211	0	-1	-1
		Kell Spring	120	59	0	-1	-1
		Warm Creek near Gandy, Utah	7,426	2,697	0	0	0
Meadow Valley	Panaca Valley (203)	Panaca Spring	1,455	1,208	0	0	0

[1] Simulated using Stream Flow Routing 2 package for MODFLOW.

Source: SNWA 2010b.

other springs located in the northern portion of the valley floor in White River Valley are unlikely to experience flow reductions (greater than 5 percent) attributable to the Alternative A pumping. The model results indicate that measurable flow reductions attributable to this alternative are not anticipated in major regional spring discharge areas within the White River Flow System including Pahranagat Valley, Muddy River Springs Area near Moapa.

In the Great Salt Lake Desert Flow System, spring discharge was simulated at 3 springs in Spring Valley, and 4 springs in Snake Valley. In Spring Valley, the model simulations indicate that by full build out plus 75 years, the flow at Keegan, North Millick, and South Millick springs all show reductions of flow. At full build out plus 200 years, these springs are predicted to experience flow reductions ranging from 11 to 36 percent. In Snake Valley, the model simulation results are essentially the same as those described for the Proposed Action.

Water Resources Within or Adjacent to GBNP. Surface water resources located within or adjacent to the GBNP that occur within both the model-simulated drawdown area and the susceptibility zones identified by Elliot et al. (2006) are listed in **Table 3.3.2-8**. For the purpose of the EIS analysis, these areas are considered zones of moderate risk as defined in **Table 3.3.2-3** (i.e., impacts may occur to some perennial waters that are hydraulically connected to the regional flow system). At the full build out plus 75 years time frame, Outhouse Springs and Spring Creek Springs (both located outside the GBNP boundary) and 5.6 miles of Snake Creek (located inside the GBNP boundary) are within the area of moderate risk. By the full build out plus 200 years time frame, three springs, Outhouse, Rowland (located along the park boundary), and Spring Creek Springs along with 8.8 miles of Snake Creek and its tributaries are within the area of moderate risk. Potential risk to streams in cave systems are uncertain as discussed under the Proposed Action. However, it important to note that the magnitude of drawdown simulated by the numerical model beneath the GBNP generally is less under Alternative A compared to the Proposed Action. Therefore, if any perennial waters or waters in cave systems are hydraulically connected to the regional aquifer system affected by groundwater withdrawal, potential impacts to these water sources would be anticipated to be less than those occurring under the Proposed Action.

Utah Surface Water Resources. There are three inventoried springs (Caine Spring, Stateline Springs, and Needle Point Springs in Snake Valley) and three perennial stream reaches (Big Wash, Lake Creek, and Snake Creek) in Snake Valley that could be impacted at either the full build out plus 75 years or full build out plus 200 years time frames. Flow reductions in Lake Creek would result in reduced flow to Pruess Lake.

The model simulations indicate that drawdown could propagate into Pine Valley. At the full build out plus 75 years and full build out plus 200 years time frames, the maximum drawdown simulated at the boundary of the model between Snake and Pine valleys is approximately 0 feet and 31 feet, respectively. Therefore, the model simulations suggest that drawdown eventually could propagate into the Pine Valley hydrographic basin. As described under the Proposed Action, available information suggest that drawdown from pumping in Snake Valley is unlikely to impact surface water resources in Pine Valley (see Proposed Action for further discussion).

Impacts to Surface Water Rights

The locations and manner of use of the active surface water rights within the drawdown area at full build out, full build out plus 75 years, and full build out plus 200 years are presented in **Figures F3.3.12A-4**, **F3.3.12A-5**, and **F3.3.12A-6**, respectively, in **Appendix F3.3.12**. **Table F3.3.13-2A** lists the number of active surface water rights within the drawdown area that occur within the high-, moderate-, and low-risk areas at the three representative time frames. At full build out plus 75 years, there are a total of 109 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows. By the full build out plus 200 years time frame, there are 151 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows. For surface water rights that are dependent on groundwater discharge, a potential reduction in the water table at the point of diversion could reduce or eliminate the flow available at the point of diversion for the surface water right.

Impacts to Groundwater Rights

Figures F3.3.14A-4, **F3.3.14A-5**, and **F3.3.14A-6** in **Appendix F3.3.14** illustrate the location and manner of use of existing groundwater rights in relation to the magnitude of the model-simulated drawdown at full build out, at full build out plus 75 years, and full build out plus 200 years. **Table F3.3.15-2A** (**Appendix F3.3.15**) lists the groundwater rights by hydrographic basin within the drawdown area. At full build out plus 75 years, there are 174 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. At full build out plus 200 years, the number increases to 223 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. The potential impacts to individual wells are the same as discussed under the Proposed Action.

Impacts to Water Balance

The model-simulated groundwater budget for the Alternative A pumping scenario is presented in **Appendix F3.3.16, Table F3.3.16-2B**. Compared to the simulated conditions under No Action, for Spring Valley, the Alternative A pumping is estimated to result in reductions of groundwater discharge for ET of 51 percent at full build out plus 75 years and 57 percent at full build out plus 200 years time frame. In Snake Valley, the pumping is estimated to result in reductions of groundwater discharge to support ET and spring discharge of 23 percent at full build out plus 75 years, and 27 percent at full build out plus 200 years with most of this reduction occurring in the southern portion of the valley. As with the Proposed Action, the Alternative A pumping is estimated to have minimal impact on ET discharge within the other pumping basins and the White River Flow System.

The total predicted reduction of flow to Pine, Wah Wah, and Tule valleys is summarized in **Table 3.3.2-10**. This reduction corresponds to an approximate 2 percent and 6 percent reduction in flow to these basins at the full build out plus 75 years and full build out plus 200 years time frame. If the groundwater flow system is interconnected and regional flow from Snake Valley contributes to flow at Fish Springs, then a reduction of flow from Snake Valley to Pine, Wah Wah, and Tule valleys eventually could result in a reduction of discharge at Fish Springs. The model estimated reduction of groundwater outflow from Snake Valley to downgradient basins in the Great Salt Lake Desert Flow System along the eastern boundary of Snake Valley is 1,100 afy at the full build out plus 200 years. This flow reduction represents approximately 5 percent of the surface discharge at Fish Springs. Flow reduction of this magnitude at Fish Springs likely would be difficult to measure and distinguish from natural flow variations.

The GBNP Model (Halford and Plume 2011) was set up to simulate flows at Fish Springs. The simulation results from the GBNP Model indicate that pumping in Snake Valley (at the points of diversion listed in the SNWA water rights applications), at the full application rate (50,000 afy) combined with continuation of existing agricultural pumping would not reduce flows in Fish Springs over the 200-year simulation period. These model results suggest that pumping associated with the groundwater development in Snake Valley is unlikely to result in a measureable reduction in flows at Fish Springs.

Water Quality

Potential impacts to water quality would be the same as described under the Proposed Action.

Monitoring and Mitigation Recommendations

Additional mitigation recommendations GW-WR-3a (Comprehensive Water Resources Monitoring Plan) and GW-3b (Numerical Groundwater Flow Modeling Requirements); GW-WR-4 (Monitoring, Mitigation and Management Plan for Snake Valley); GW-WR-5 (Shoshone Ponds Mitigation); GW-WR-6 (Water Rights Mitigation); and GW-WR-7 (Groundwater Development & Drawdown Effects to Federal Resources and Federal Water Rights) described under the Proposed Action, and the COM Plan described in Section 3.20, Monitoring and Mitigation Summary, would apply to Alternative A.

Potential Residual Impacts

Potential unavoidable residual impacts associated with the groundwater development are described under the Proposed Action. Because of the reduced maximum groundwater withdrawal rate (as compared to the Proposed Action), the magnitude of the potential unavoidable residual impacts to water resources associated with the Alternative A pumping scenario would be substantially less than the Proposed Action and Alternative B.

3.3.2.11 Alternative B

Groundwater Development Areas

For the purpose of analysis of surface disturbance related impacts, Alternative B (Points of Diversion) assumes that surface disturbance would be focused primarily near (i.e., within 1 mile radial distance) the points of diversion identified in the water rights applications in five basins (i.e., Spring, Snake, Delamar, Dry Lake, and Cave valleys). The development would include groundwater production wells, collector pipelines, staging areas, power facilities, pumping stations, and access roads. The actual location of specific facilities within the groundwater development areas has not been determined at this stage of the project and will be subject to future site-specific NEPA analysis.

Conclusion. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated maximum surface disturbance of approximately 4,660 acres within 5 hydrographic basins. As summarized in **Table 3.3.2-4**, there are 7 known or suspected springs identified within the potential disturbance areas, all located in Snake Valley. This includes two inventoried springs (Kious Spring and Youn-Aquainv-003) and five springs identified based on National Hydrography Database or topographic mapping data that have not been field verified. There are three perennial stream reaches (5.8 miles) in Snake Valley within the potential disturbance area (**Table 3.3.2-5**). The potential for impacts to springs and streams located within these groundwater development areas would depend on the actual location of facilities. Implementation of the ACMs would minimize impacts to perennial water sources associated with the well field development. Additional monitoring and mitigation recommendations (GW-WR-1, GW-WR-2) described under the Proposed Action also would apply to Alternative B and includes measures to identifying and establishing an avoidance buffer around all springs, and developing site-specific plans to minimize impacts at perennial stream crossings within the groundwater development areas.

Groundwater Pumping

Groundwater Pumping Scenario

The groundwater pumping scenario for Alternative B assumes pumping at the full diversion rates (i.e., approximately 177,000 afy) listed on the pending water rights application for the five proposed project pumping basins (Spring, Snake, Delamar, Dry Lake, and Cave valleys). The well distribution for this model scenario (**Figure 3.3.2-15**) assumes that wells would be developed at the actual points of diversion listed on the water rights applications. The pumping in each valley was distributed equally among the points of diversion based on the demand schedule up to the maximum diversion rate associated with each application. Details regarding the assumed pumping schedule used for the model simulations are provided in the model simulation report (SNWA 2010a). The pumping schedule reflects the proposed south to north sequence of basin development for the project.

Impacts to Water Levels

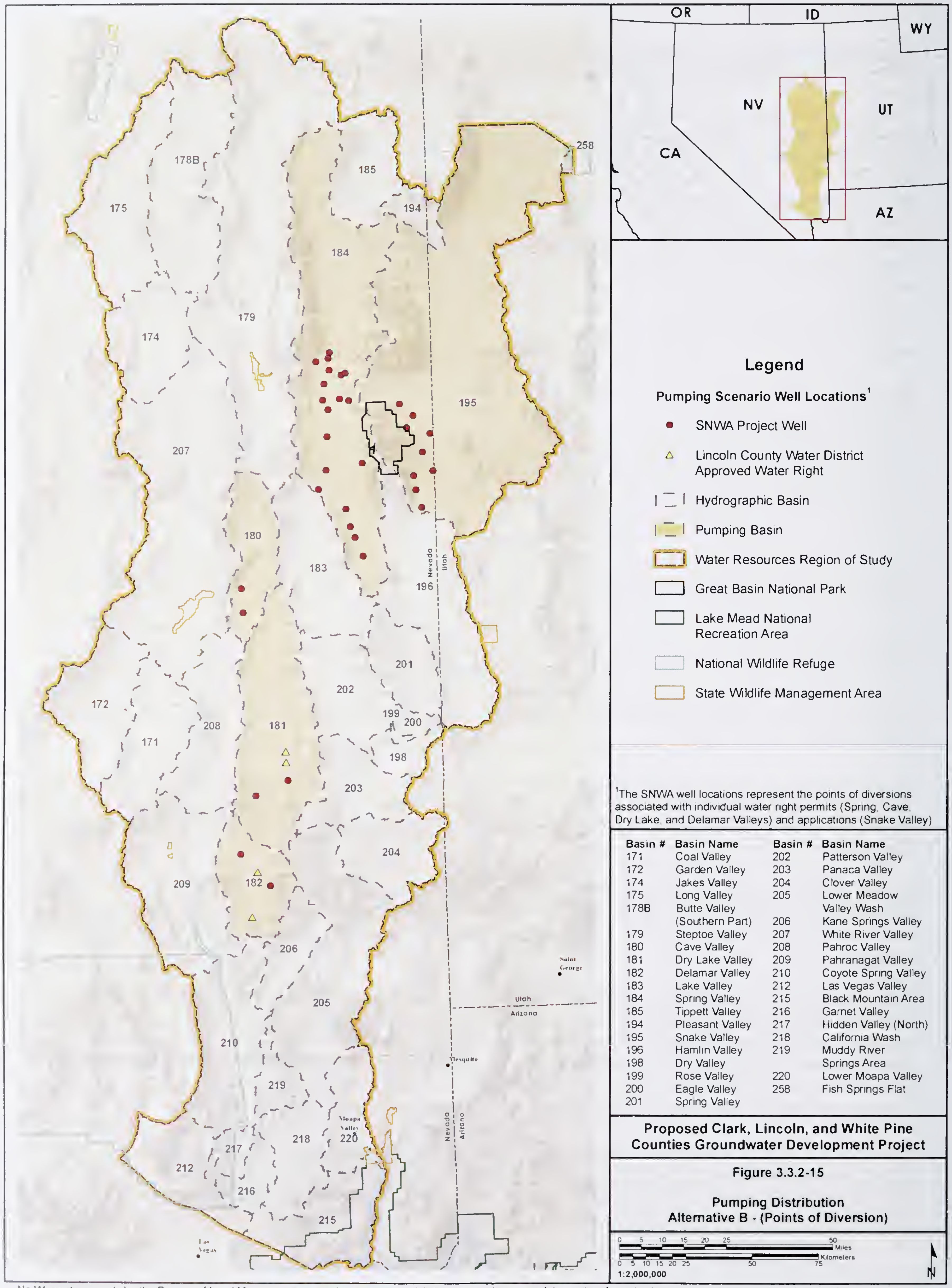
The predicted change in groundwater levels attributable to groundwater development under the Alternative B at full build out, full build out plus 75 years, and full build out plus 200 years is provided in **Figures 3.3.2-16**, **3.3.2-17**, and **3.3.2-18**, respectively. These figures illustrate areas where the water levels are predicted to decrease in comparison to the simulated No Action water levels.

At full build out, the drawdown areas are localized in the vicinity of the pumping wells in Spring, Delamar, Dry Lake, and Cave valleys. Drawdown does not occur at this time period in Snake Valley. Comparison of the simulation results for the three representative points in time indicates that the drawdown area continues to progressively expand as pumping continues into the future.

At full build out plus 75 years time frame, there are three drawdown areas: 1) northernmost drawdown area encompasses the southern Spring Valley, southern Snake Valley, and northern Hamlin Valley; 2) a smaller drawdown area extends across Cave Valley; and 3) southernmost drawdown area that extends across Dry Lake and Delamar valleys.

By the full build out plus 200 years time frame, the drawdown areas merge into one large drawdown area that extends approximately 150 miles in a north-south direction and up to 57 miles in an east-west direction. At this time frame, the simulated drawdown area extends into southeastern Steptoe Valley, the eastern margin of White River Valley, Pahroc and Pahranagat valleys, Lake Valley, and western margins of Panaca Valley, northwest margin of Lower Meadow Valley Wash, and northeast portion of Kane Springs Valley. Compared to the Proposed Action, the drawdown area for Alternative B does not extend into northern Spring Valley (HA 184) or Tippett Valley.

The locations of six selected observation wells located within the proposed pumping basins are presented in **Figure 3.3.2-6**. Water-level hydrographs for each of these observation wells within the pumping basins are provided in **Figures 3.3.2-7** and **3.3.2-8**. The hydrographs illustrate the predicted rate and magnitude of water level decline at these representative locations over the simulation period. As with the Proposed Action, the hydrographs illustrate that the



Legend

Pumping Scenario Well Locations[1]

- SNWA Project Well
- Lincoln County Water District Approved Water Right
- Hydrographic Basin
- Pumping Basin
- Water Resources Region of Study
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

[1]The SNWA well locations represent the points of diversions associated with individual water right permits (Spring, Cave, Dry Lake, and Delamar Valleys) and applications (Snake Valley)

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

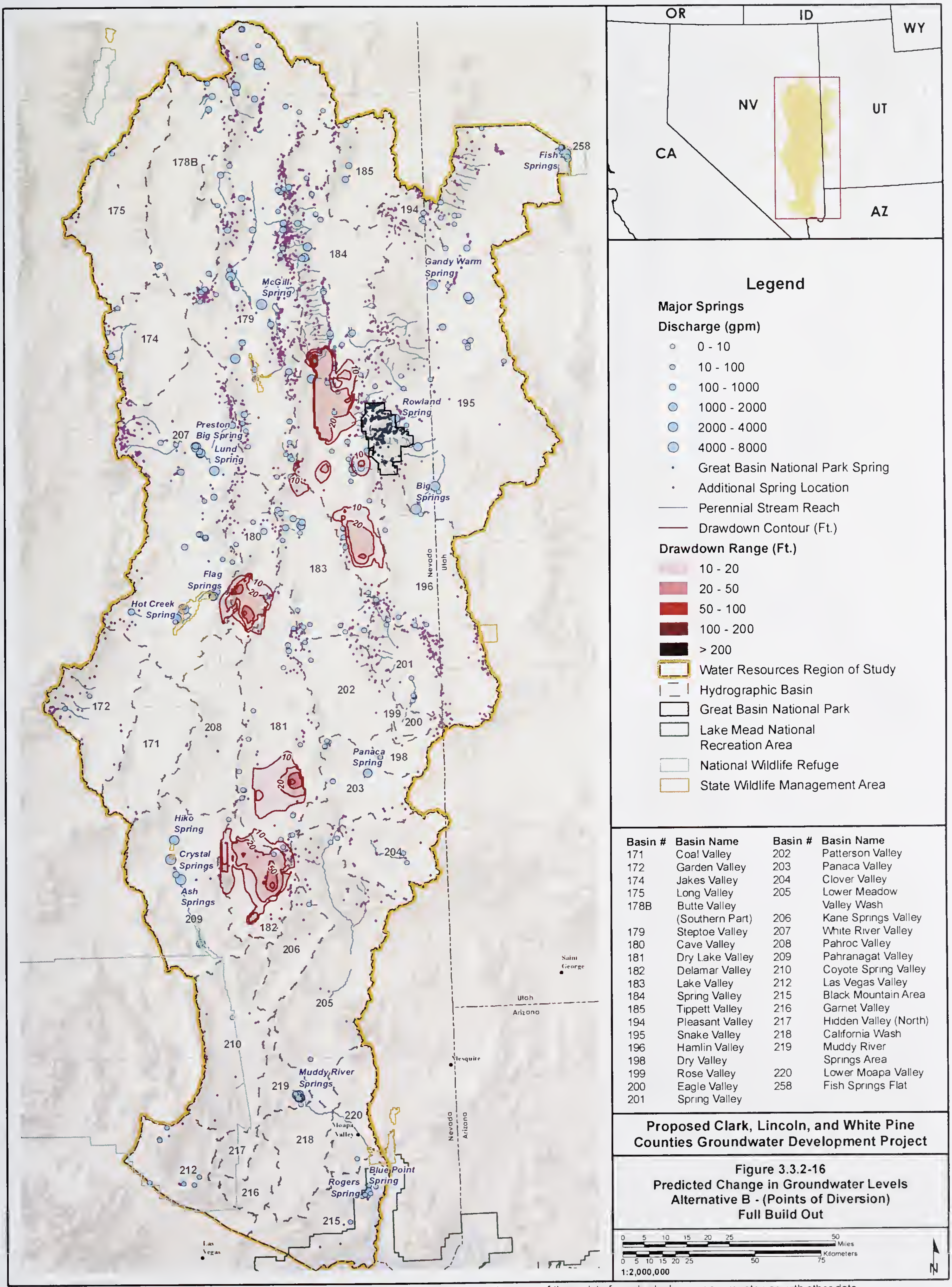
Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-15

Pumping Distribution Alternative B - (Points of Diversion)

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N

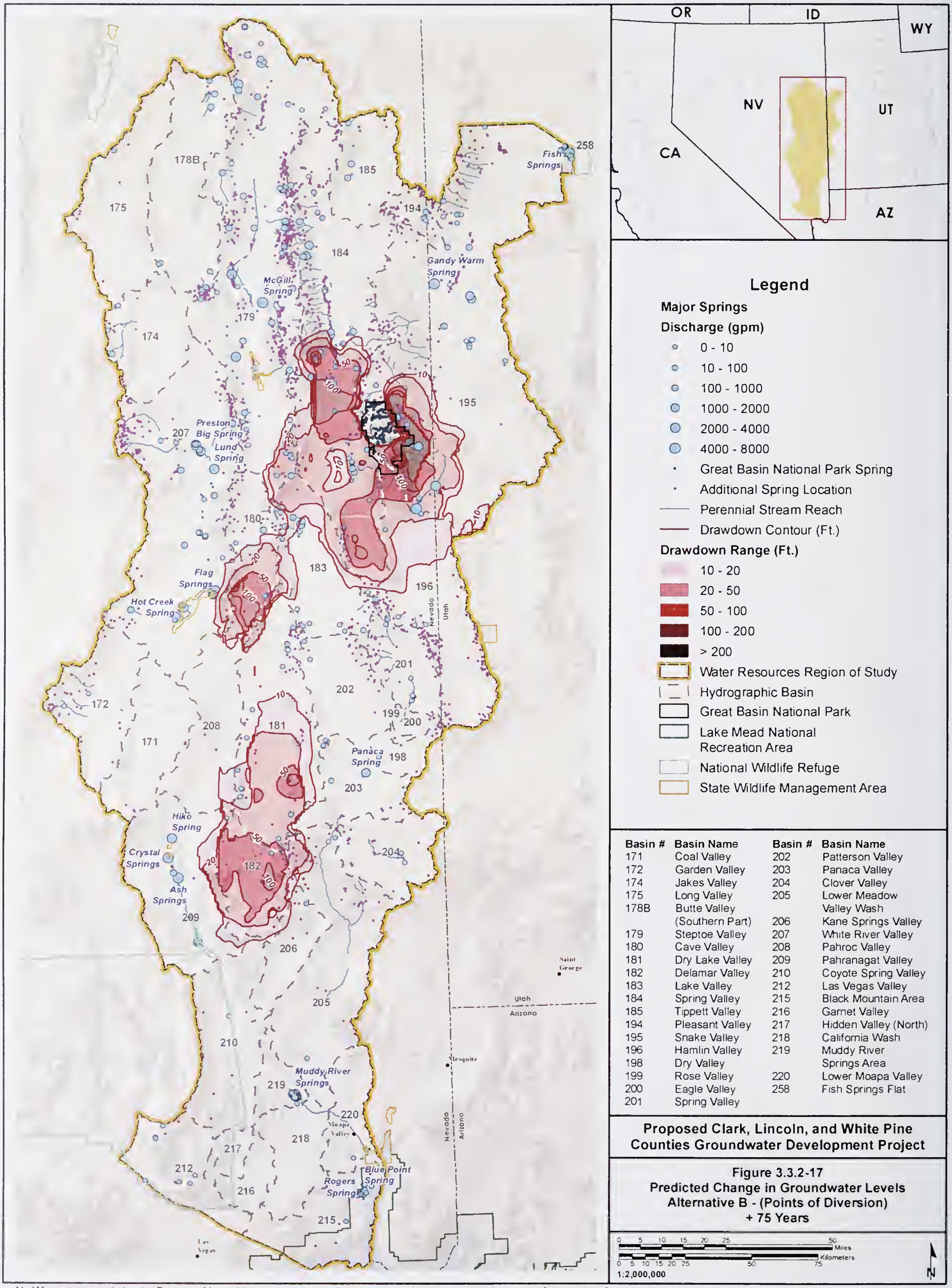
No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data



Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

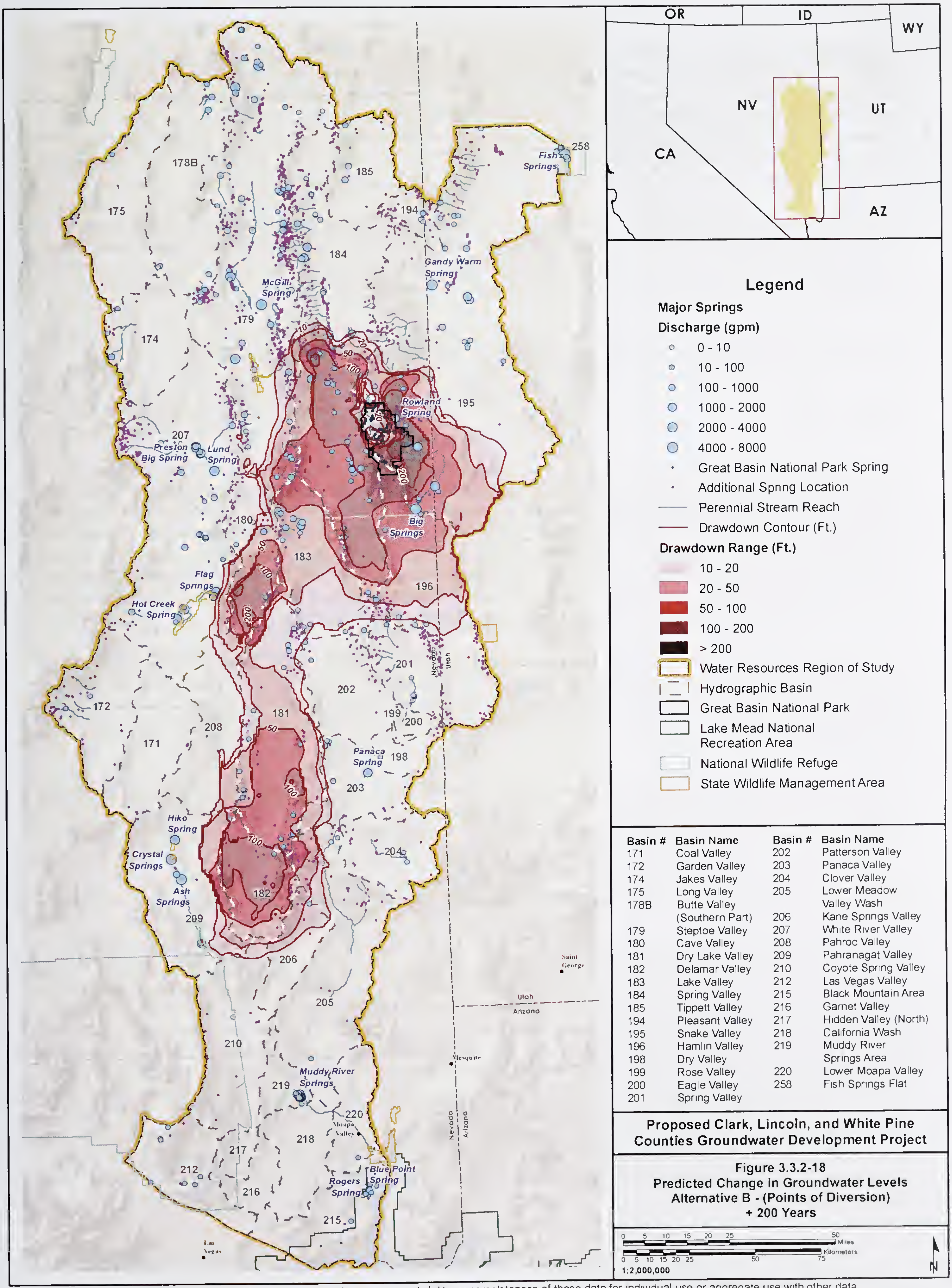
Figure 3.3.2-16
Predicted Change in Groundwater Levels
Alternative B - (Points of Diversion)
Full Build Out



Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-17
Predicted Change in Groundwater Levels Alternative B - (Points of Diversion) + 75 Years



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-18
Predicted Change in Groundwater Levels
Alternative B - (Points of Diversion)
+ 200 Years

water levels are predicted to continue to decrease over the model simulation period; and not reach a renewed equilibrium (or steady state condition) before the end of the simulation period. With the exception of Snake Valley where the drawdown at the observation wells is predicted to be essentially the same as the Proposed Action, the representative hydrographs illustrate that the groundwater withdrawal under the Alternative B pumping scenario is predicted to result in a reduction in the amount of drawdown within the pumping basins as compared to the Proposed Action at the selected observation wells for Spring, Delamar, and Cave valleys; and an increase in drawdown at the observation well in Dry Lake Valley.

In Snake Valley, the model simulation results indicate that under the Alternative B pumping scenario, the magnitude of drawdown would increase (compared to all other alternatives) along the eastern margin of the southern Snake Range. At the full build out plus 200 year time frame, the simulation results indicate that drawdown of greater than 200 feet would encroach along the eastern margin of GBNP.

The potential for groundwater withdrawal to reduce the storage properties of the basin-fill sediments within the drawdown cone are the same as previously discussed for the Proposed Action (Section 3.3.2.9)

Potential effects to water resources resulting from the Alternative B pumping scenario are summarized in **Table 3.3.2-12**.

Impacts to Springs and Streams

The estimated potential risks to springs located within the projected drawdown area at full build out, and at full build out plus 75 years and full build out plus 200 years are presented in **Figures F3.3.8A-7**, **F3.3.8A-8**, and **F3.3.8A-9**, respectively, in **Appendix F3.3.8**. The number of springs within the drawdown area and relative risk of impacts by hydrographic basin are summarized in **Table F3.3.9-3A** in **Appendix F3.3.9**. Specific inventoried springs located within the drawdown area at the representative points in time are listed in **Table F3.3.10-1A** in **Appendix F3.3.10**. The estimated miles of perennial streams (by hydrographic basin) located in the predicted drawdown areas where surface waters could be impacted are listed in **Table F3.3.11-3A** in **Appendix F3.3.11**.

Potential total effects to perennial springs and streams are summarized in **Table 3.3.2-12**. For the predicted drawdown area at full build out plus 75 years, there are 54 inventoried springs and 121 "other" springs located within the high and moderate risk areas. By full build out plus 200 years, this increased to 78 inventoried springs and 210 "other" springs located within the high and moderate risk areas. These springs occur in Cave, Steptoe, Hamlin, Spring (HA 184), Snake, and Lake valleys.

The total estimated length of perennial streams located in areas where there is a high to moderate risk of impacts resulting from the predicted drawdown increases from approximately 91 miles at full build out plus 75 years to 120 miles at full build out plus 200 years. This includes stream reaches located in Pahranagat, Steptoe, Spring (HA 184), Snake, Lake valleys, and Lower Meadow Valley Wash.

Potential site-specific impacts to individual springs and streams affected by drawdown would be the same as discussed for the Proposed Action.

<u>Model-simulated Spring and Stream Discharge Estimates</u>. Model-simulated changes in spring flow for selected springs are presented in **Table 3.3.2-13**. The model results indicate that two of the modeled springs in White River Valley, Butterfield Spring and Flag Springs 3, are predicted to experience flow reductions of 20 and 19 percent, respectively, by the full build out time frame increasing to flow reductions of 45 percent and 37 percent, respectively, at the full build out plus 200 years time frame. Hot Creek Spring and Moorman Spring also are predicted to experience flow reductions of 7 and 6 percent, respectively, at the full build out plus 200 years time frame. These results suggest that the groundwater development eventually could affect flows in springs located along the south eastern margin of the valley floor in White River Valley. The model results also indicate that other springs located in the northern portion of the valley floor in White River Valley are unlikely to experience measurable reductions (greater than 5 percent) attributable to the Alternative B pumping. Measurable flow reductions attributable to this alternative are not anticipated in major regional spring discharge areas within the White River Flow System including Pahranagat Valley, Muddy River Springs Area near Moapa.

Table 3.3.2-12 Summary of Potential Effects to Water Resources Resulting from the Alternative B Pumping Scenario[1,2]

Water Resource Issue / Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Drawdown:			
• Number of hydrographic basins affected by drawdown	10	15	17
Drawdown effects on perennial springs:			
• Number of inventoried springs located in areas where impacts to flow could occur[3]	13	54	78
• Number of other springs located in areas where impacts to flow could occur[4]	28	121	210
• Model-simulated flow reduction at Big Spring (as percent flow reduction)	7%	100%	100%
Drawdown effects on perennial streams:			
• Number of basins with perennial stream reaches where impacts to flow could occur	1	4	5
• Miles of perennial stream located in areas where impacts to flow could occur	3	91	120
Drawdown effects on surface water rights:			
• Number of surface water rights located in areas where impacts to flow could occur	34	141	186
Drawdown effects on groundwater rights:			
• Number of groundwater rights located within the 10-50 foot drawdown area	26	143	148
• Number of groundwater rights located within the 50-100 foot drawdown area	0	33	108
• Number of groundwater rights located within the greater than 100-foot drawdown area	0	8	45
• (Total groundwater rights in drawdown area)	(26)	(184)	(301)
Percent reduction in ET and spring discharge[5]:			
• Spring Valley	36%	66%	73%
• Snake Valley	0%	18%	24%
• Great Salt Lake Desert Flow System[1]	15%	37%	44%
• White River Flow System	0%	3%	5%
Reduction in flow from Snake Valley to Pine, Wah Wah, and Tule Valleys Hydrographic Basins[5]:			
• AFY	0	450	1,400
• Percent Reduction	0%	2%	7%

[1] Located within the groundwater flow model domain.

[2] Unless otherwise noted, supporting information used to develop these estimated effects are provided in **Appendices F3.3.5** through **F3.3.16**.

[3] Specific inventoried springs identified in moderate or high risk areas are identified in **Table F3.3.10-1A** in **Appendix F3.3.10**.

[4] "Other Springs" are springs identified in the National Hydrography Database or topographic maps that have not been field verified.

[5] Estimate derived from the model-simulated values provided in SNWA 2010a with comparison to No Action pumping results.

Table 3.3.2-13 Model-simulated Flow Changes (Alternative B Pumping)

(Project Specific)					Alternative B (Points of Diversion)		
					Incremental Change in Flow % (from No-Action)		
Flow System	Hydrographic Basin	Spring	Average Flow (Actual) in gpm	Model-simulated Average Flow (2005) in gpm	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
White River	White River Valley (207)	Arnoldson Spring	1,608	946	0	-1	-2
		Butterfield Spring	1,225	471	-20	-34	-45
		Cold Spring	582	503	0	-1	-2
		Flag Springs 3	969	560	-19	-29	-37
		Hardy Springs	200	73	-1	-2	-4
		Hot Creek Spring	5,032	6,899	-3	-5	-7
		Lund Spring	3,594	3,314	0	-1	-2
		Moon River Spring	1,707	1,457	-1	-2	-2
		Moorman Spring	405	353	-2	-4	-6
		Nieolas Spring	1,185	872	0	-1	-1
		Preston Big Spring	3,572	3,794	0	-1	-2
	Pahranagat Valley (209)	Ash Springs	6,909	7,453	0	-1	-2
		Brownie Spring	224	277	0	0	0
		Crystal Springs	4,235	4,647	0	0	-1
		Hiko Spring	2,735	1,985	0	-1	-2
	Muddy River Springs Area (219)	Muddy River near Moapa[1]	20,931	15,383	0	0	-1
	Lower Moapa Valley (220)	Muddy River near Glendale[1]	19,565	14,895	0	0	-1
	Blaek Mountains ` Area (215)	Blue Point Spring	223	393	0	0	0
		Rogers Spring	771	515	0	0	0
Goshute Valley	Steptoe Valley (179)	Campbel Ranch Springs	2,746	2,088	0	0	0
		Currie Spring	2,181	1,419	0	0	0
		McGill Spring	4,783	2,074	0	0	0
		Monte Ncva Hot Springs	649	280	0	0	0
Great Salt Lake Desert	Spring Valley (184)	Keegan Spring	234	63	0	-3	-5
		North Millick Spring	284	98	-2	-18	-42
		South Milliek Spring	506	278	-8	-47	-99
	Snake Valley (195)	Big Springs	4,289	1,977	-7	-100	-100
		Foote Res. Spring	1,300	211	0	0	-1
		Kell Spring	120	59	0	0	-1
		Warm Creek near Gandy, Utah	7,426	2,697	0	0	0
Meadow Valley	Panaea Valley (203)	Panaca Spring	1,455	1,208	0	0	0

[1] Simulated using Stream Flow Routing 2 package for MODFLOW.

Source: SNWA 2010b.

In the Great Salt Lake Desert Flow System, spring discharge was simulated at 3 springs in Spring Valley, and 4 springs in Snake Valley. In Spring Valley, the model simulations indicate that by full build out plus 75 years, the flow at Keegan, North Millick, and South Millick springs all show reductions of flow. At full build out plus 200 years these springs are predicted to experience flow reductions ranging from 5 to 99 percent.

In Snake Valley, the model simulation results are essentially the same as those described for the Proposed Action.

Water Resources Within or Adjacent to the GBNP. Surface water resources located within or adjacent to the GBNP that occur within both the model-simulated drawdown area and within the susceptibility zones identified by Elliot et al. (2006) are listed in **Table 3.3.2-8**. For the purpose of the EIS analysis, these areas are considered zones of moderate risk as defined in **Table 3.3.2-3** (i.e., impacts may occur to some perennial waters that are hydraulically connected to the regional flow system). At the full build out plus 75 years and full build out plus 200 years time frames, Cave, Outhouse, Rowland, and Spring Creek Spring are within the area of moderate risk. There also are 15 other springs (identified in NPS 2007) at the full build out plus 75 years time frame that increases to 25 springs at the full build out plus 200 years time frame located in moderate risk areas. Perennial segments on Baker, Lehman, and Snake creeks and their tributaries occur within the area of moderate risk at both the full build out plus 75 years and full build out plus 200 years time frame (see **Table 3.3.2-8** for stream miles at risk). Potential risk to streams in cave systems are uncertain as discussed under the Proposed Action. However, it is important to note that the magnitude of drawdown simulated by the numerical model beneath GBNP generally is greater under Alternative B compared to the Proposed Action and other alternatives. Preliminary results from ongoing hydrogeologic and water resource investigations in and adjacent to GBNP provide some evidence that water resources in Model Cave in the Baker Creek drainage may be interconnected with the alluvial basin fill in Snake Valley (Prudic and Sweetkind 2012). Because there is a moderate risk of impacts to the lower perennial segment of Baker Creek, there also is a moderate risk to water resource in the Model Cave under this alternative.

Model simulations have been performed using the GBNP RASA model developed by Halford and Plume (2011) to evaluate the potential effects of groundwater pumping in Snake Valley. These models simulate groundwater pumping in Snake Valley and only consider pumping at the points of diversions specified in the water right applications. The model-simulated flow reductions from pumping at the points of diversions are summarized in **Table 3.3.2-14**. These results indicate that after 200 years of pumping in Snake Valley at the points of diversions, this alternative would impact flows in Big Springs, Home Farm Springs, Kious Spring, Rowland Spring, Spring Creek Spring, and would not affect flows in Twin Spring located north of the proposed groundwater development area, and would not affect flows in Fish Springs located in the Fish Springs Flat hydrographic basin.

Cave Springs are used as the water supply for the Lehman Caves Visitor Center at the GBNP. Cave Springs was identified as “likely susceptible” in the Elliott et al. 2006 report. The model simulations summarized in **Table 3.3.2-14** indicate flow reductions of 5 percent or less. Prudic and Glancy (2009) conducted geochemical investigations of the Cave Springs to evaluate the potential for depletion resulting from groundwater pumping in Snake Valley. The results of their study conclude that the source of water to these springs is primarily from winter precipitation and the source area for the springs is the steep east slope of Jeff Davis Peak and not from alluvial and glacial deposits west of the springs. They also indicated that it is unlikely that the Pole Canyon Limestone occurs near the stream. The results of this study suggest that the source of flow to Cave Springs is derived from local precipitation, and limestone that could provide a potential hydraulic connection between the spring and the regional groundwater system is unlikely to occur at the stream. Therefore, the risk of impacts to flow is inferred to be low (i.e., unlikely to occur).

Utah Surface Water Resources. There are three inventoried springs (Caine, Stateline Springs, and Needle Point Springs in Snake Valley) and three perennial stream reaches (Big Wash, Lake Creek, and Snake Creek) in Snake Valley that could be impacted at either the full build out plus 75 years or full build out plus 200 years time frames. Flow reductions in Lake Creek would result in reduced flow to Pruess Lake.

The model simulations indicate that drawdown could propagate into Pine Valley. At the full build out plus 75 years and full build out plus 200 years time frames, the maximum drawdown simulated at the boundary of the model between Snake and Pine valleys is approximately 12 feet and 46 feet, respectively. As described under the Proposed Action, available information suggest that drawdown from pumping in Snake Valley is unlikely to impact surface water resources in Pine Valley (see Proposed Action for further discussion).

Table 3.3.2-14 Model-simulated Flow Reduction from Pumping at Points of Diversion in Snake Valley Only (GBNP-RASA Model)

I. SNWA Pumping (No Irrigation Pumping)											
Spring or Stream	Model-simulated Pre-development Flow (gpm)	25,000 afy Pumping Scenario					50,000 afy Pumping Scenario[1]				
		Years (After Pumping Initiated) (Percent)					Years (After Pumping Initiated) (Percent)				
		10	25	50	100	200	10	25	50	100	200
Big Springs	4,340	25	35	35	48	53	28	40	50	60	69
Cave Spring	62	0	0	0	0	0	0	0	1	3	5
Home Farm Spring 6	90	0	0	0	0	0	60	100	100	100	100
Kious Spring	224	0	0	1	2	3	2	12	24	35	43
Lehman Creek	1,364	0	0	0	0	0	0	1	3	6	8
Rowland Spring	434	0	0	0	0	0	0	1	4	10	16
Spring Creek Spring	898	48	87	100	100	100	53	100	100	100	100
Strawberry Creek	124	0	0	0	0	0	0	0	1	3	7
Twin Spring	2,480	0	0	0	0	0	0	0	0	0	0
Warm Spring	2,046	0	0	0	0	0	0	0	0	0	0
Fish Springs (3-8)	15,934	0	0	0	0	0	0	0	0	0	0
II. SNWA Pumping + Irrigation Pumping											
Spring or Stream	Model-simulated Pre-development Flow (gpm)	25,000 afy Pumping Scenario					50,000 afy Pumping Scenario[1]				
		Years (After Pumping Initiated) (Percent)					Years (After Pumping Initiated) (Percent)				
		10	25	50	100	200	10	25	50	100	200
Big Springs	4,340	31	42	51	59	67	34	47	59	72	84
Cave Spring	62	0	0	0	0	0	0	0	1	3	5
Home Farm Spring (6)	90	4	4	5	6	6	62	100	100	100	100
Kious Spring	224	1	1	2	4	6	4	15	30	44	55
Lehman Creek	1,364	0	0	0	0	0	0	1	3	5	7
Rowland Spring	434	0	0	0	0	0	0	1	4	10	17
Spring Creek Spring	898	50	90	100	100	100	50	100	100	100	100
Strawberry Creek	124	0	0	0	0	0	0	0	1	3	7
Twin Spring	2,480	0	0	0	0	1	0	0	0	0	1
Warm Spring	2,046	0	0	0	0	0	0	0	0	0	0
Fish Springs (3-8)	15,934	0	0	0	0	0	0	0	0	0	0

[1] Actual pumping was restricted to approx. 40,000 - 43,000 afy because drawdown was not allowed to exceed 1,000 at point of diversion.

Source: Derived from model results provided in Halford and Plume 2011.

Impacts to Surface Water Rights

The locations and manner of use of the active surface water rights within the drawdown area at full build out, full build out plus 75 years, and full build out plus 200 years are presented in **Figures F3.3.12A-7**, **F3.3.12A-8**, and **F3.3.12A-9**, respectively, in **Appendix F3.3.12**. **Table F3.3.13-3A** lists the number of active surface water rights within the drawdown area that occur within the high-, moderate-, and low-risk areas at the three representative time frames. These results indicated that the number of surface water rights potentially affected increases over the model simulation period. At full build out plus 75 years, there are a total of 141 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows. By the full build out plus 200 years time frame, there are 186 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows. For surface water rights that are dependent on groundwater discharge, a potential reduction in the water table at the point of diversion could reduce or eliminate the flow available at the point of diversion for the surface water right.

Impacts to Groundwater Rights

Figures F3.3.14A-7, **F3.3.14A-8**, and **F3.3.14A-9** in **Appendix F3.3.14** illustrate the location and manner of use of existing groundwater rights in relation to the magnitude of the model-simulated drawdown at full build out, full build out plus 75 years, and full build out plus 200 years. **Table F3.3.15-3A** (**Appendix F3.3.15**) lists the groundwater rights by hydrographic basin within the drawdown area. At full build out plus 75 years, there are 184 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. At full build out plus 200 years, the number increases to 301 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. The potential impacts to individual wells are the same as discussed under the Proposed Action.

Impacts to Water Balance

The model-simulated groundwater budget for the Alternative B pumping scenario is presented in **Appendix F3.3.16**, **Table F3.3.16-3B**. Compared to the simulated conditions under No Action, for Spring Valley, the pumping is estimated to result in reductions of groundwater discharge for ET of 66 percent at full build out plus 75 years and 73 percent at full build out plus 200 years. In Snake Valley, the pumping is estimated to result in reductions of groundwater discharge to support ET and spring discharge of 18 percent at full build out plus 75 years, and 24 percent at full build out plus 200 years with most of this reduction occurring in the southern portion of the valley. Alternative B pumping is estimated to have minimal impact (5 percent or less) on ET discharge within the White River Flow System.

The total predicted reduction of flow to Pine, Wah Wah, and Tule valleys is summarized in **Table 3.3.2-12**. This reduction corresponds to an approximate 2 percent and 7 percent reduction in flow to these basins at the full build out plus 75 years and full build out plus 200 years time frame. If the groundwater flow system is interconnected and regional flow from Snake Valley contributes to flow at Fish Springs, then a reduction of flow from Snake Valley to Pine, Wah Wah, and Tule valleys eventually could result in a reduction of discharge at Fish Springs. The model estimated reduction of groundwater outflow from Snake Valley to downgradient basins in the Great Salt Lake Desert Flow System along the eastern boundary of Snake Valley is 1,100 afy at the full build out plus 200 years. This flow reduction represents approximately 6 percent of the surface discharge at Fish Springs. Flow reduction of this magnitude at Fish Springs likely would be difficult to measure and distinguish from natural flow variations. (See Proposed Action for discussion of uncertainty regarding these flow reduction estimates using the results of the CCRP Model.)

The GBNP Model (Halford and Plume 2011) was set up to simulate flows at Fish Springs. The simulation results from the GBNP Model indicate that pumping in Snake Valley (at the points of diversion listed in the SNWA water rights applications), at the full application rate (50,000 afy) combined with continuation of existing agricultural pumping would not reduce flows in Fish Springs over the 200-year simulation period. These model results suggest that pumping associated with the groundwater development in Snake Valley is unlikely to result in a measureable reduction in flows at Fish Springs.

Water Quality

Potential impacts to water quality would be the same as described under the Proposed Action.

Monitoring and Mitigation Recommendations

Additional mitigation recommendations GW-WR-3a (Comprehensive Water Resources Monitoring Plan) and GW-3b (Numerical Groundwater Flow Modeling Requirements); GW-WR-4 (Monitoring, Mitigation and Management Plan for Snake Valley); GW-WR-5 (Shoshone Ponds Mitigation); GW-WR-6 (Water Rights Mitigation); and GW-WR-7 (Groundwater Development & Drawdown Effects to Federal Resources and Federal Water Rights) described under the Proposed Action, and the COM Plan described in Section 3.20, Monitoring and Mitigation Summary, would apply to Alternative B.

Potential Residual Impacts

Potential unavoidable residual impacts associated with the groundwater development are described under the Proposed Action. The potential magnitude of residual adverse impacts to water resources associated with the Alternative B pumping scenario would be similar to those described under the Proposed Action. However, the distributed pumping included in the Proposed Action likely would reduce impacts to springs and perennial streams with sensitive resources.

3.3.2.12 Alternative C

Groundwater Development Areas

For Alternative C (Intermittent Pumping), the infrastructure and therefore, ground disturbance effects would be identical to Alternative A. Groundwater development would occur within the areas identified in the five groundwater development basins (i.e., Spring, Snake, Delamar, Dry Lake, and Cave valleys). As with the Alternative A, development within the groundwater development areas would include groundwater production wells, collector pipelines, staging areas, power facilities, pumping stations, and access roads. The actual location of specific facilities within the groundwater development areas has not been determined at this stage of the project and will be subject to future site-specific NEPA analysis.

Conclusion. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated maximum surface disturbance of approximately 4,800 acres within five hydrographic basins. There are 60 known or suspected springs identified within the groundwater development areas (**Table 3.3.2-4**). These springs occur within the groundwater development areas within Spring Valley (37 springs), Snake Valley (11 springs), Delamar Valley (7 springs), Dry Lake Valley (4 springs), and Cave Valley (1 spring). There also are 28 separate perennial stream reaches with a total length of 29 miles that occur within the groundwater development areas (**Table 3.3.2-5**). This includes 23 perennial stream reaches (total length of 20.2 miles) located in Spring Valley, and 5reaches (total length of 8.8 miles) located in Snake Valley. The potential for impacts to springs and streams located within these groundwater development areas would depend on the location of facilities. Implementation of the ACMs would minimize impacts to perennial water sources associated with the well field development. Additional monitoring and mitigation recommendations (GW-WR-1, GW-WR-2) described under the Proposed Action would apply to Alternative C and include identifying and establishing an avoidance buffer around all springs, and developing site-specific plans for minimize impacts at perennial stream crossings within the groundwater development areas.

Groundwater Pumping

Groundwater Pumping Scenario

The groundwater pumping scenario for Alternative C assumed that the groundwater production wells would be developed and pumped using the distributed well locations shown in **Figure 3.3.2-11** and pumping schedule defined for Alternative A until the project reaches full build out in 2050. The pumping schedule reflects the same south to north sequence of basin development for the project included in the Alternative A pumping scenario. After full development, the pumping rates are assumed to cycle from minimum to maximum pumping rates every 5 years for the remainder of the simulation period. The minimum pumping rate is 9,000 afy and with minimal pumping in all five pumping basins. The maximum pumping rate under this scenario is the same as for Alternative A (approximately 115,000 afy). Details regarding the assumed pumping schedule used for the model simulations are provided in the model simulation report (SNWA 2010a).

Impacts to Water Levels

The predicted change in groundwater levels attributable to groundwater development under the Alternative C at full build out, full build out plus 75 years, and full build out plus 200 years are provided in **Figures 3.3.2-19**, **3.3.2-20**, and **3.3.2-21**, respectively. These figures illustrate areas where the water levels are predicted to decrease in comparison to the simulated No Action water levels.

At full build out, the drawdown areas are localized in the vicinity of the pumping wells in Spring, Delamar, Dry Lake, and Cave valleys. As with the Proposed Action, drawdown does not occur at this time period in Snake Valley. Comparison of the simulation results for the three representative points in time indicates that the drawdown area continues to progressively expand as pumping continues into the future.

At full build out plus 75 years and full build out plus 200 years time frames, there are two distinct drawdown areas. The northern drawdown area encompasses the southern Spring Valley, southern Snake Valley, and northern Hamlin Valley. The southern drawdown area extends across Delamar, Dry Lake, and Cave valleys in an elongate north-south direction

Water-level hydrographs for observation wells located within the pumping basins are provided in **Figures 3.3.2-7** and **3.3.2-8**. As with the Proposed Action, the hydrographs indicate that water levels are predicted to continue to decrease over the model simulation period; and not reach a renewed equilibrium (or steady state condition) before the end of the simulation period. The representative hydrographs illustrate that the reduced groundwater withdrawal under the Alternative C pumping scenario is predicted to result in a substantial reduction in the amount of drawdown within the pumping basins as compared to the Proposed Action.

The potential for groundwater withdrawal to reduce the storage properties of the basin-fill sediments within the drawdown cone are the same as previously discussed for the Proposed Action (Section 3.3.2.9).

Potential effects to water resources resulting from the Alternative C pumping scenario are summarized in **Table 3.3.2-15**.

Impacts to Springs and Streams

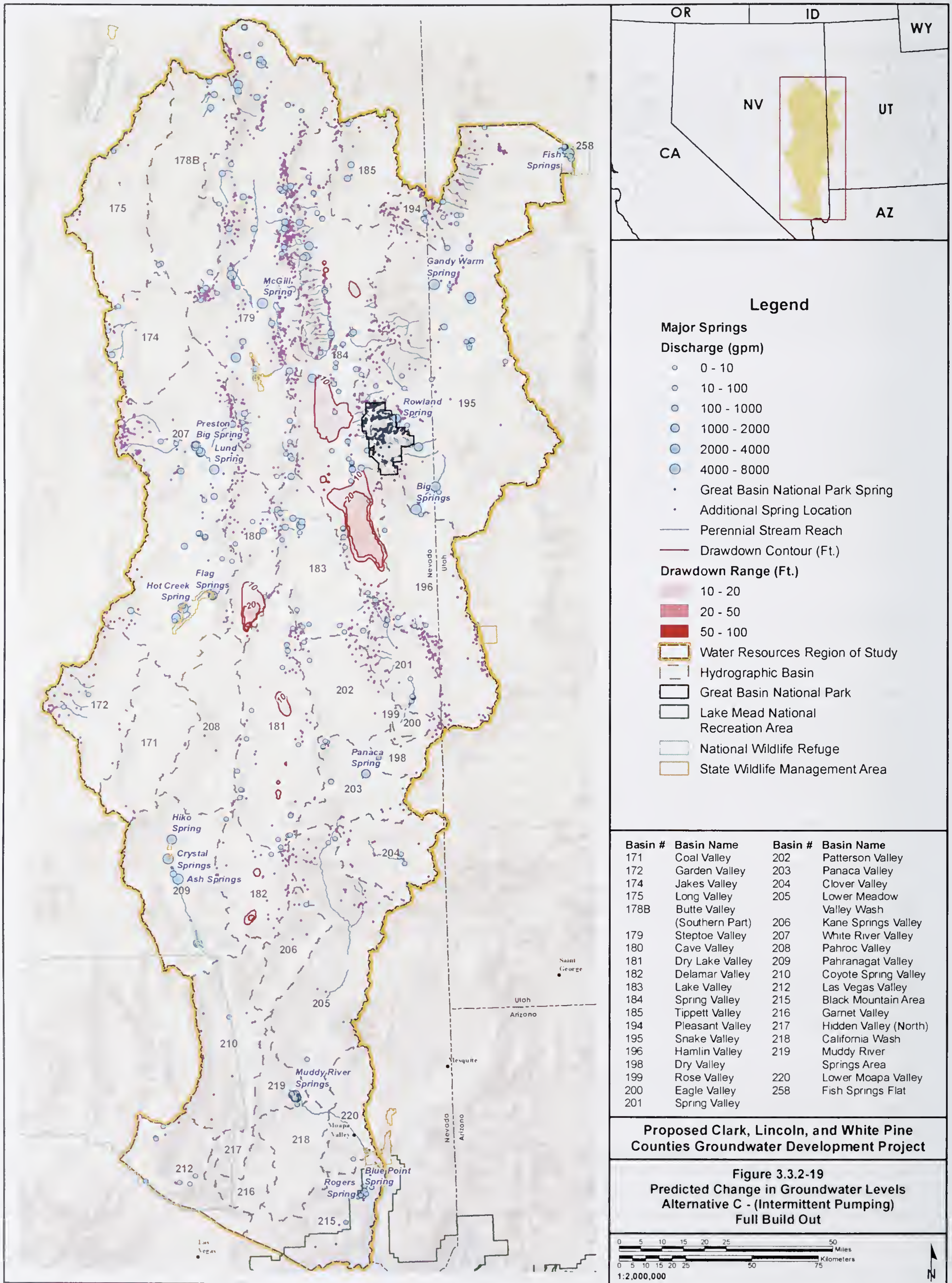
The estimated potential risks to springs located within the projected drawdown area at full build out, full build out plus 75 years, and full build out plus 200 years are presented in **Figures F3.3.8A-10**, **F3.3.8A-11**, and **F3.3.8A-12**, respectively, in **Appendix F3.3.8**. The number of springs within the drawdown area and relative risk of impacts by hydrographic basin are summarized in **Table F3.3.9-4A** in **Appendix F3.3.9**. Specific inventoried springs located within the cumulative drawdown area at the representative points in time are listed in **Table F3.3.10-1A** in **Appendix F3.3.10**. The estimated miles of perennial streams (by hydrographic basin) located in the predicted drawdown areas where surface waters could be impacted are listed in **Table F3.3.11-4A** in **Appendix F3.3.11**.

Potential total effects to perennial springs and streams are summarized in **Table 3.3.2-15**. For the predicted drawdown area at full build out plus 75 years, there are 19 inventoried springs and 44 "other" springs located within the high and moderate risk areas. By full build out plus 200 years, this increased to 26 inventoried springs and 70 "other" springs located within the high and moderate risk areas. These springs occur in Hamlin, Spring (HA 184), and Snake valleys.

The total estimated length of perennial streams located in areas where there is a high to moderate risk of impacts resulting from the predicted drawdown increases from approximately 37 miles at full build out plus 75 years to 59 miles at full build out plus 200 years. This includes stream reaches located in Spring (HA 184), Snake, and Lake valleys.

Potential site-specific impacts to individual springs and streams affected by drawdown would be the same as discussed for the Proposed Action.

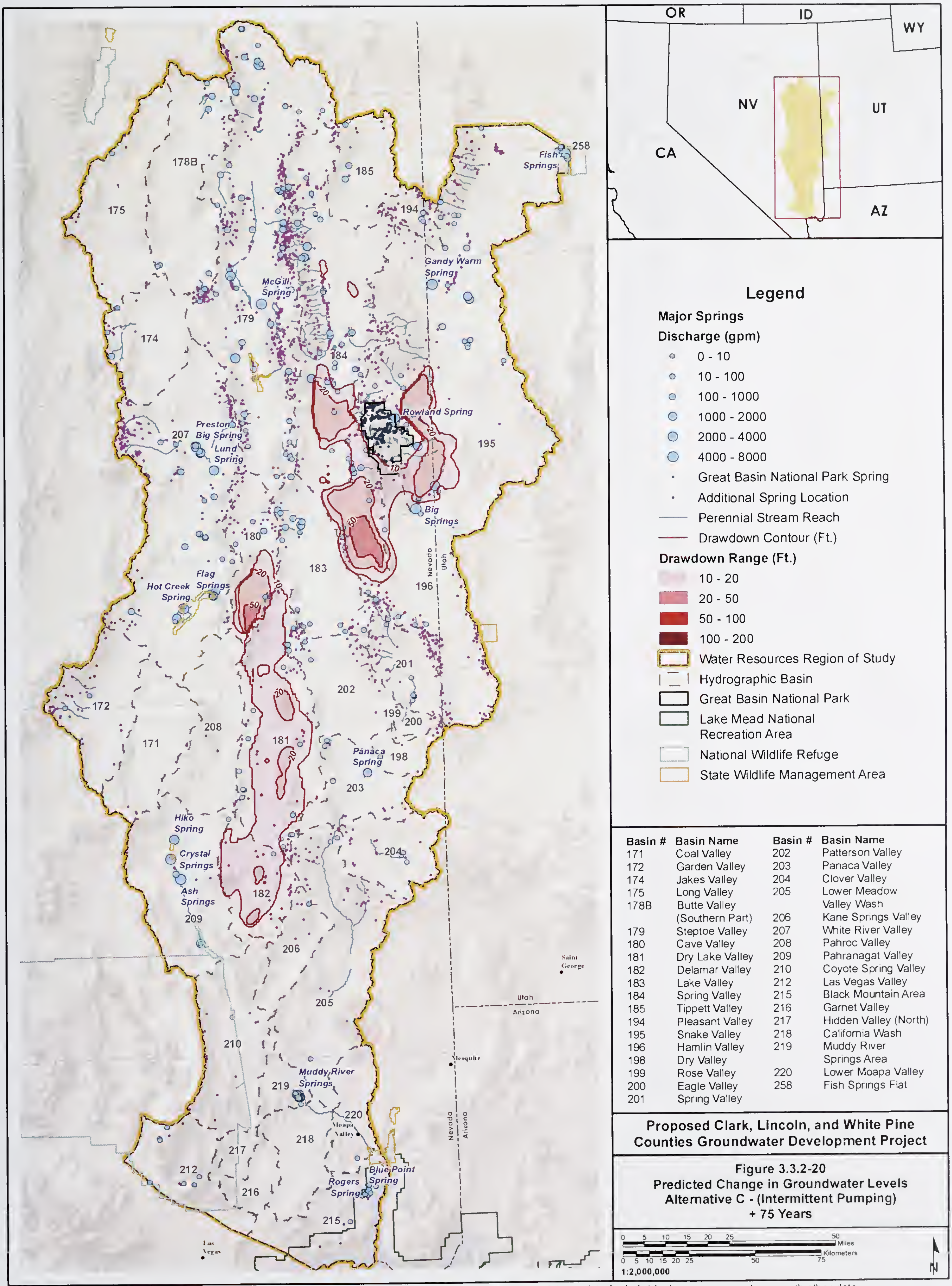
<u>Model-simulated Spring and Stream Discharge Estimates</u>. Model-simulated changes in spring flow for selected springs are presented in **Table 3.3.2-16**. The model results indicated that two of the modeled springs in White River Valley, Butterfield Spring and Flag Springs 3, are predicted to experience flow reductions of 5 percent, respectively, by the full build out plus 200 years time frame. These results suggest that the groundwater development eventually could affect



Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-19
Predicted Change in Groundwater Levels
Alternative C - (Intermittent Pumping)
Full Build Out



Basin #	Basin Name	Basin #	Basin Name
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174	Jakes Valley	204	Clover Valley
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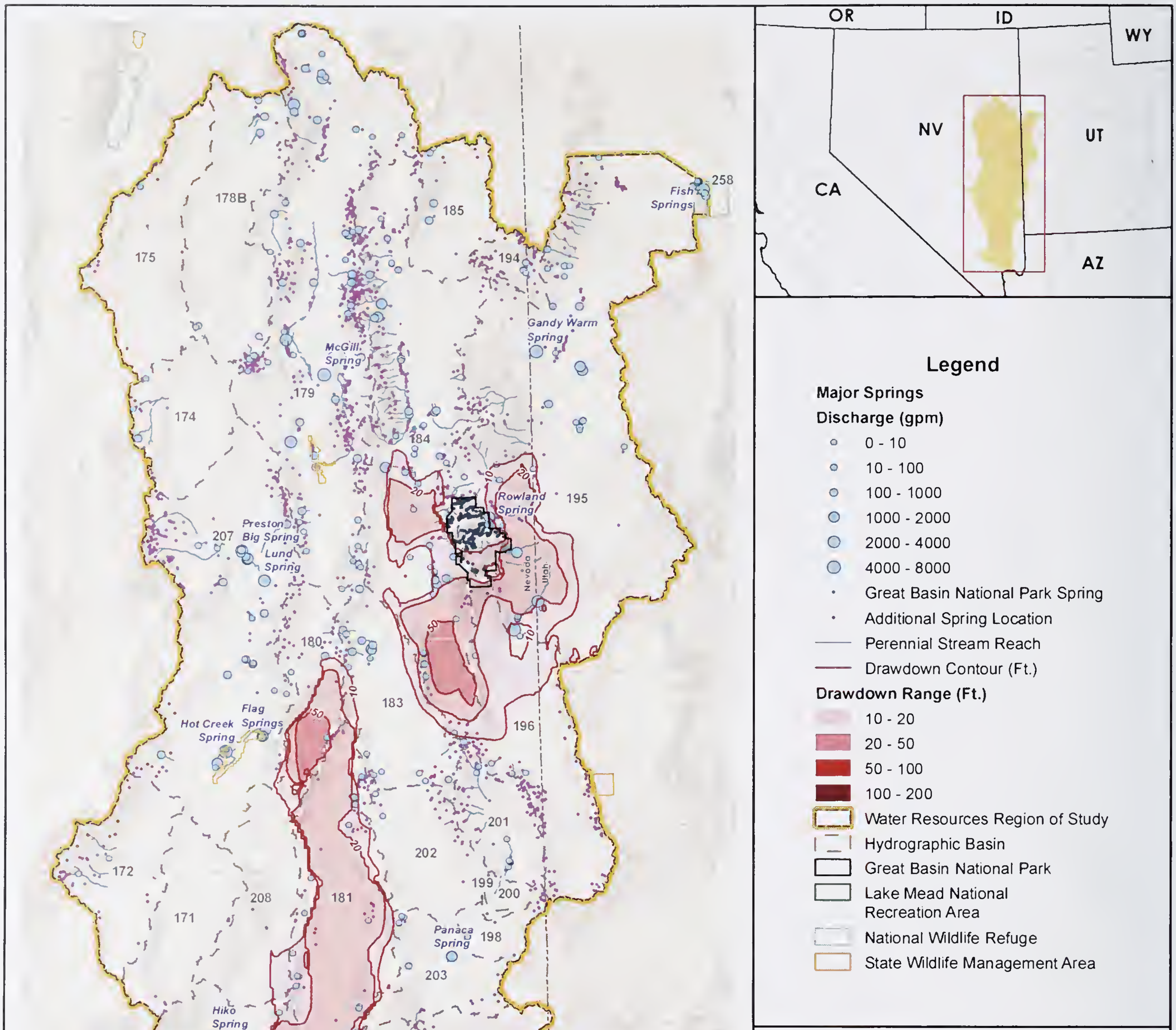
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-20
Predicted Change in Groundwater Levels Alternative C - (Intermittent Pumping) + 75 Years



Basin #	Basin Name	Basin #	Basin Name
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174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-21
Predicted Change in Groundwater Levels Alternative C - (Intermittent Pumping) + 200 Years

Table 3.3.2-15 Summary of Potential Effects to Water Resources Resulting from the Alternative C Pumping Scenario[1,2]

Water Resource Issue / Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Drawdown:			
• Number of hydrographic basins affected by drawdown	5	10	14
Drawdown effects on perennial springs:			
• Number of inventoried springs located in areas where impacts to flow could occur[3]	1	19	26
• Number of other springs located in areas where impacts to flow could occur[4]	2	44	70
• Model-simulated flow reduction at Big Spring (as percent flow reduction)	2%	87%	100%
Drawdown effects on perennial streams:			
• Number of basins with perennial stream reaches where impacts to flow could occur	1	2	2
• Miles of perennial stream located in areas where impacts to flow could occur	1	37	59
Drawdown effects on surface water rights:			
• Number of surface water rights located in areas where impacts to flow could occur	14	78	98
Drawdown effects on groundwater rights:			
• Number of groundwater rights located within the 10-50 foot drawdown area	15	132	169
• Number of groundwater rights located within the 50-100 foot drawdown area	0	1	2
• Number of groundwater rights located within the greater than 100-foot drawdown area	0	0	0
• (Total groundwater rights in drawdown area)	(15)	(133)	(171)
Percent reduction in ET and spring discharge[5]:			
• Spring Valley	30%	37%	37%
• Snake Valley	0%	15%	17%
• Great Salt Lake Desert Flow System[1]	12%	24%	25%
• White River Flow System	0%	0%	1%
Reduction in flow from Snake Valley to Pine, Wah Wah, and Tule Valleys Hydrographic Basins[5]:			
• AFY	0	200	400
• Percent Reduction	0%	1%	2%

[1] Located within the groundwater flow model domain.

[2] Unless otherwise noted, supporting information used to develop these estimated effects are provided in **Appendices F3.3.5** through **F3.3.16**.

[3] Specific inventoried springs identified in moderate or high risk areas are identified in **Table F3.3.10-1A** in **Appendix F3.3.10**.

[4] "Other Springs" are springs identified in the National Hydrography Database or topographic maps that have not been field verified.

[5] Estimate derived from the model-simulated values provided in SNWA 2010a with comparison to No Action pumping results.

Table 3.3.2-16 Model-simulated Flow Changes (Alternative C Pumping)

(Project Specific)					Alternative C (Intermittent Pumping)		
					Incremental Change in Flow % (from No-Action)		
Flow System	Hydrographic Basin	Spring	Average Flow (Actual) in gpm	Model-simulated Average Flow (2005) in gpm	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
White River	White River Valley (207)	Arnoldson Spring	1,608	946	0	0	0
		Butterfield Spring	1,225	471	0	-2	-5
		Cold Spring	582	503	0	0	0
		Flag Springs 3	969	560	-1	-2	-5
		Hardy Springs	200	73	0	0	0
		Hot Creek Spring	5,032	6,899	0	0	-1
		Lund Spring	3,594	3,314	0	0	0
		Moon River Spring	1,707	1,457	0	0	0
		Moorman Spring	405	353	0	0	-1
		Nieolas Spring	1,185	872	0	0	0
		Preston Big Spring	3,572	3,794	0	0	0
	Pahranagat Valley (209)	Ash Springs	6,909	7,453	0	0	-1
		Brownie Spring	224	277	0	0	0
		Crystal Springs	4,235	4,647	0	0	0
		Hiko Spring	2,735	1,985	0	0	-1
	Muddy River Springs Area (219)	Muddy River near Moapa[1]	20,931	15,383	0	0	0
	Lower Moapa Valley (220)	Muddy River near Glendale[1]	19,565	14,895	0	0	0
	Black Mountains Area (215)	Blue Point Spring	223	393	0	0	0
		Rogers Spring	771	515	0	0	0
Goshute Valley	Steptoe Valley (179)	Campbel Ranch Springs	2,746	2,088	0	0	0
		Currie Spring	2,181	1,419	0	0	0
		McGill Spring	4,783	2,074	0	0	0
		Monte Neva Hot Springs	649	280	0	0	0
Great Salt Lake Desert	Spring Valley (184)	Keegan Spring	234	63	-12	-14	-15
		North Milliek Spring	284	98	-4	-5	-5
		South Milliek Spring	506	278	-10	-12	-11
	Snake Valley (195)	Big Springs	4,289	1,977	-2	-87	-100
		Foote Res. Spring	1,300	211	0	0	-1
		Kell Spring	120	59	0	-1	-1
		Warm Creek near Gandy, Utah	7,426	2,697	0	0	0
Meadow Valley	Panaea Valley (203)	Panaea Spring	1,455	1,208	0	0	0

[1] Simulated using Stream Flow Routing 2 package for MODFLOW.

Source: SNWA 2010b.

flows in springs located along the south eastern margin of the valley floor in White River Valley. The model results also indicate that other springs located in the northern portion of the valley floor in White River Valley are unlikely to experience measurable reductions (greater than 5 percent) attributable to the Alternative C pumping. Measurable flow reductions attributable to this alternative are not anticipated in major regional spring discharge areas within the White River Flow System including Pahranagat Valley, Muddy River Springs Area near Moapa.

In the Great Salt Lake Desert Flow System, spring discharge was simulated at 3 springs in Spring Valley and 4 springs in Snake Valley. In Spring Valley, the model simulations indicate that by full build out plus 75 years, the flow at Keegan, North Millick, and South Millick springs all show reductions of flow. At full build out plus 200 years these springs are predicted to experience flow reductions ranging from 5 to 15 percent. In Snake Valley, the model simulation results are very similar to those described for the Proposed Action.

Water Resources Within or Adjacent to the GBNP. Surface water resources located within or adjacent to the GBNP that occur within both the model-simulated drawdown area and the susceptibility zones identified by Elliot et al. (2006) are listed in **Table 3.3.2-8**. For the purpose of the EIS analysis, these areas are considered zones of moderate risk as defined in **Table 3.3.2-3** (i.e., impacts may occur to some perennial waters that are hydraulically connected to the regional flow system). At the full build out plus 75 years time frame, there are no inventoried springs or perennial streams within the moderate risk zone. By the full build out plus 200 years time frame, Outhouse Spring (located approximately 2 miles outside the park boundary) and 8 miles of Snake Creek and its tributaries are within the area of moderate risk. Potential risk to streams in cave systems are uncertain as discussed under the Proposed Action. However, it is important to note that the magnitude of drawdown simulated by the numerical model beneath GBNP is less under Alternative C compared to the Proposed Action and Alternatives A and B. Therefore, if any perennial waters or waters in cave systems are hydraulically connected to the regional aquifer system affected by groundwater withdrawal, potential impacts to these water sources would be anticipated to be less than those occurring under these alternatives.

Utah Surface Water Resources. There are two inventoried springs (Caine and Stateline springs in Snake Valley) and three perennial stream reaches (Big Wash, Lake Creek, and Snake Creek) in Snake Valley located in an area that could be impacted at the full build out plus 75 years and full build out plus 200 years time frames. Flow reductions in Lake Creek would result in reduced flow to Pruess Lake.

The model simulations indicate that drawdown could propagate into Pine Valley. At the full build out plus 75 years and full build out plus 200 years time frames, the maximum drawdown simulated at the boundary of the model between Snake and Pine valleys is approximately 0 feet and 10 feet, respectively. As described under the Proposed Action, available information suggest that drawdown from pumping in Snake Valley is unlikely to impact surface water resources in Pine Valley (see Proposed Action for further discussion).

Impacts to Surface Water Rights

The locations and manner of use of the active surface water rights within the drawdown area at full build out, full build out plus 75 years, and full build out plus 200 years are presented in **Figures F3.3.12A-10**, **F3.3.12A-11**, and **F3.3.12A-12**, respectively, in **Appendix F3.3.12**. **Table F3.3.13-4A** lists the number of active surface water rights within the drawdown area that occur within the high-, moderate-, and low-risk areas at the three representative time frames. At full build out plus 75 years, there are a total of 78 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows. By the full build out plus 200 years time frame, there are 98 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows. For surface water rights that are dependent on groundwater discharge, a potential reduction in the water table at the point of diversion could reduce or eliminate the flow available at the point of diversion for the surface water right.

Impacts to Groundwater Rights

Figures F3.3.14A-10, **F3.3.14A-11**, and **F3.3.14A-12** in **Appendix F3.3.14** illustrate the location and manner of use of existing groundwater rights in relation to the magnitude of the model-simulated drawdown at full build out, full build out plus 75 years, and full build out plus 200 years. **Table F3.3.15-4A** (**Appendix F3.3.15**) lists the groundwater rights by hydrographic basin within the drawdown area. At full build out plus 75 years, there are 133 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. At full build out plus 200 years, the number increases to 171 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. The potential impacts to individual wells are the same as discussed under the Proposed Action.

Impacts to Water Balance

The model-simulated groundwater budget for the Alternative C pumping scenario is presented in **Appendix F3.3.16, Table F3.3.16-4B**. Compared to the simulated conditions under the No Action for Spring Valley, the pumping is estimated to result in a 37 percent reduction of groundwater discharge for ET at the full build out plus 75 years and full build out plus 200 years time frames. In Snake Valley, the pumping is estimated to result in reductions of groundwater discharge to support ET and spring discharge of 15 percent at full build out plus 75 years, and 17 percent at full build out plus 200 years with most of this reduction occurring in the southern portion of the valley. Alternative C pumping is estimated to have minimal impact (1 percent or less) on ET discharge within the White River Flow System.

The total predicted reduction of flow to Pine, Wah Wah, and Tule valleys is summarized in **Table 3.3.2-15**. This reduction corresponds to an approximate 1 percent and 2 percent reduction in flow to these basins at the 75- and 200-year time frames. If the groundwater flow system is interconnected and regional flow from Snake Valley contributes to flow at Fish Springs, then a reduction of flow from Snake Valley to Pine, Wah Wah, and Tule valleys eventually could result in a reduction of discharge at Fish Springs. The model estimated reduction of groundwater outflow from Snake Valley to downgradient basins in the Great Salt Lake Desert Flow System along the eastern boundary of Snake Valley is 400 afy at the 200 years after full build. This flow reduction represents approximately 2 percent of the surface discharge at Fish Springs. Flow reduction of this magnitude at Fish Springs likely would be difficult to measure and distinguish from natural flow variations.

The GBNP Model (Halford and Plume 2011) was set up to simulate flows at Fish Springs. The simulation results from the GBNP Model indicate that pumping in Snake Valley (at the points of diversion listed in the SNWA water rights applications), at the full application rate (50,000 afy) combined with continuation of existing agricultural pumping would not reduce flows in Fish Springs over the 200-year simulation period. These model results suggest that pumping associated with the groundwater development in Snake Valley is unlikely to result in a measureable reduction in flows at Fish Springs.

Water Quality

Potential impacts to water quality would be the same as described under the Proposed Action.

Monitoring and Mitigation Recommendations

Additional mitigation recommendations GW-WR-3a (Comprehensive Water Resources Monitoring Plan) and GW-3b (Numerical Groundwater Flow Modeling Requirements); GW-WR-4 (Monitoring, Mitigation and Management Plan for Snake Valley); GW-WR-5 (Shoshone Ponds Mitigation); GW-WR-6 (Water Rights Mitigation); and GW-WR-7 (Groundwater Development & Drawdown Effects to Federal Resources and Federal Water Rights) described under the Proposed Action, and the COM Plan described in Section 3.20, Monitoring and Mitigation Summary, would apply to Alternative C.

Potential Residual Impacts

Potential unavoidable residual impacts associated with the groundwater development are described under the Proposed Action. Because of the reduced maximum groundwater withdrawal rate (as compared to the Proposed Action) and intermittent pumping schedule, the magnitude of the potential unavoidable residual impacts to water resources associated with the Alternative C pumping scenario would be substantially less than the Proposed Action and Alternatives A and B.

3.3.2.13 Alternative D

Groundwater Development Areas

Development in Snake Valley and the White Pine County portion of Spring Valley would be eliminated under Alternative D (LCCRDA). As a result, groundwater development for Alternative D would be restricted to the southernmost portion of Spring, Delamar, Dry Lake, and Cave valleys. Development within the groundwater development areas would include groundwater production wells, collector pipelines, staging areas, power facilities, pumping stations, and access roads. The actual location of specific facilities within the groundwater development areas has not been determined at this stage of the project and will be subject to future site-specific NEPA analysis.

Conclusion. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated maximum surface disturbance of approximately 4,000 acres within four hydrographic basins. There are 13 known or suspected springs identified within the groundwater development areas (**Table 3.3.2-4**). These springs occur within the groundwater development areas within Spring Valley (1 spring), Delamar Valley (7 springs), Dry Lake Valley (4 springs), and Cave Valley (1 spring). There are no perennial stream reaches located within the assumed groundwater development areas (**Table 3.3.2-5**). The potential for impacts to springs located within these groundwater development areas would depend on the location of facilities. Implementation of the ACMs would minimize impacts to perennial water sources associated with the well field development. Additional monitoring and mitigation recommendations (GW-WR-1) described under the Proposed Action would apply to Alternative D and include identifying and establishing an avoidance buffer around all springs, and developing site-specific plans for minimize impacts at perennial stream crossings within the groundwater development areas.

Groundwater Pumping

Groundwater Pumping Scenario

The groundwater pumping scenario for Alternative D assumes that no pumping will occur in Snake Valley, and pumping in Spring Valley would be restricted to the southern portion of the valley within Lincoln County as shown in **Figure 3.3.2-22**. The maximum groundwater production rate under this scenario is approximately 79,000 afy for the four pumping basins (Spring, Delamar, Dry Lake, and Cave valleys), the same as the maximum pumping rate assumed for these basins under Alternative A, C, and E. The well distribution developed by SNWA for this model scenario includes the same spatial distribution of wells included in Alternative A for Delamar, Dry Lake, and Cave valleys. Details regarding the assumed pumping schedule used for the model simulations are provided in the model simulation report (SNWA 2010a). The pumping schedule reflects the proposed south to north sequence of basin development for the project.

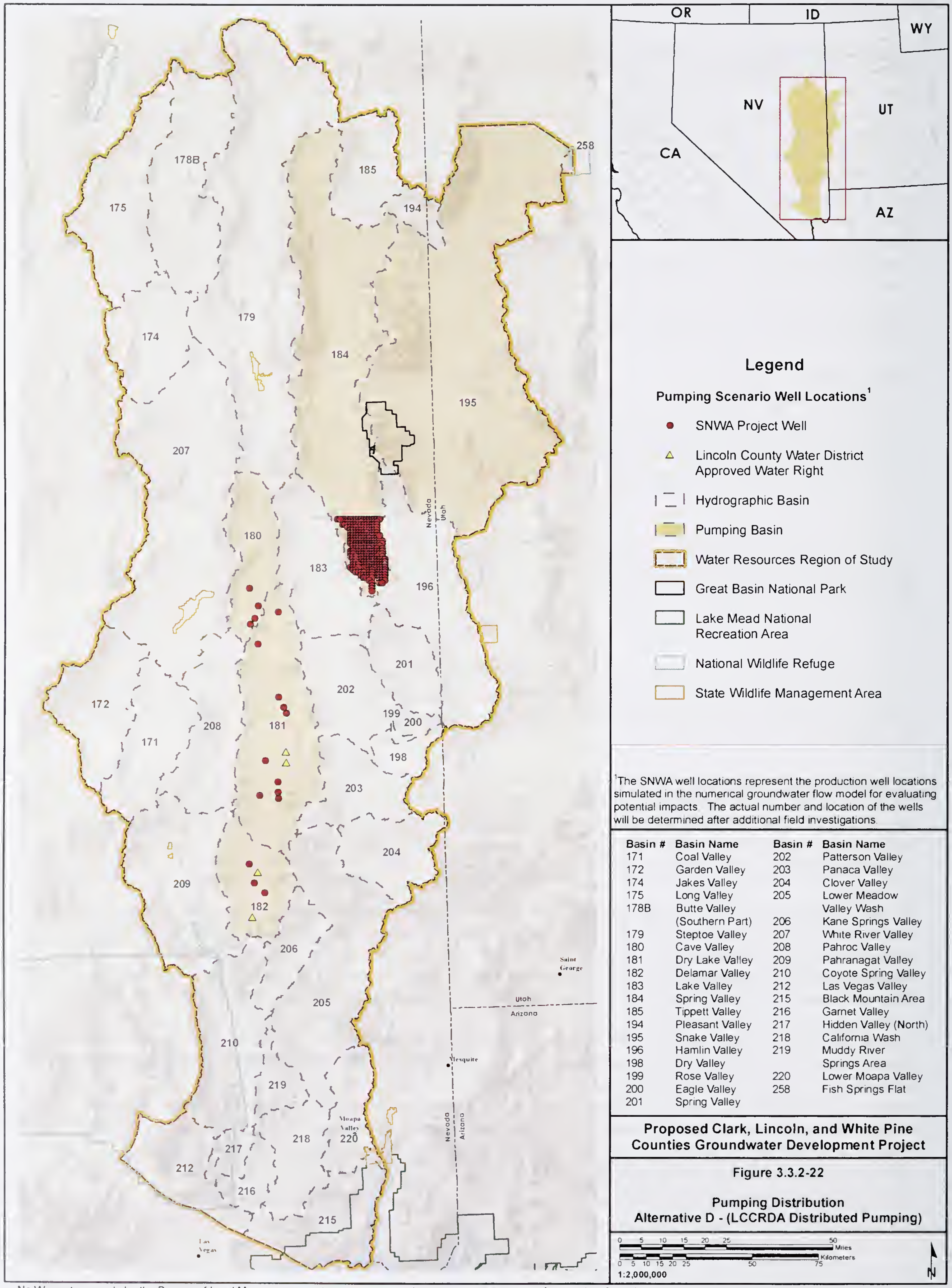
Impacts to Water Levels

The predicted change in groundwater levels attributable to groundwater development under the Alternative D at full build out, full build out plus 75 years, and full build out plus 200 years are provided in **Figures 3.3.2-23**, **3.3.2-24**, and **3.3.2-25**, respectively. These figures illustrate areas where the water levels are predicted to decrease in comparison to the simulated No Action water levels.

At full build out, the drawdown areas are localized in the vicinity of the pumping wells in Spring, Delamar, Dry Lake, and Cave valleys. At this time frame, a drawdown cone is predicted to develop in southern Spring Valley in response to the focused groundwater withdrawal in this area. As with all other pumping alternatives, the simulation results for the three representative points in time indicates that the drawdown area continues to progressively expand over the model simulation period.

At full build out plus 75 years time frame, there are two distinct drawdown areas. The northern drawdown area encompasses the approximate southern Spring Valley, northern Hamlin Valley, and overlaps along the south west margin of Snake Valley and north margin of Lake Valley. The central portion of this drawdown cone is predicted to result in drawdowns greater than 200 feet. The southern drawdown area extends across Delamar, Dry Lake, and Cave valleys in an elongate north-south direction that generally is restricted to these pumping basins.

By the full build out plus 200 years time frame, the two main drawdown areas have merged into one that extends approximately 120 miles in a north-south direction and up to 55 miles in a east-west direction. Compared to the Proposed Action, Alternative D limits drawdown in the central and northern portion of Spring Valley and southern portion of Snake Valley. At the full build out plus 200 years time frame, in addition to the pumping basins, the simulated drawdown area extends across Lake Valley and into the southeastern Steptoe Valley, eastern margins of Pahroc and Pahranagat valleys, and extreme western margins of Panaca Valley and northwest margin of Lower Meadow Valley Wash. The central portion of this drawdown cone predicts drawdowns greater than 200 feet across the entire southern portion of Spring Valley.

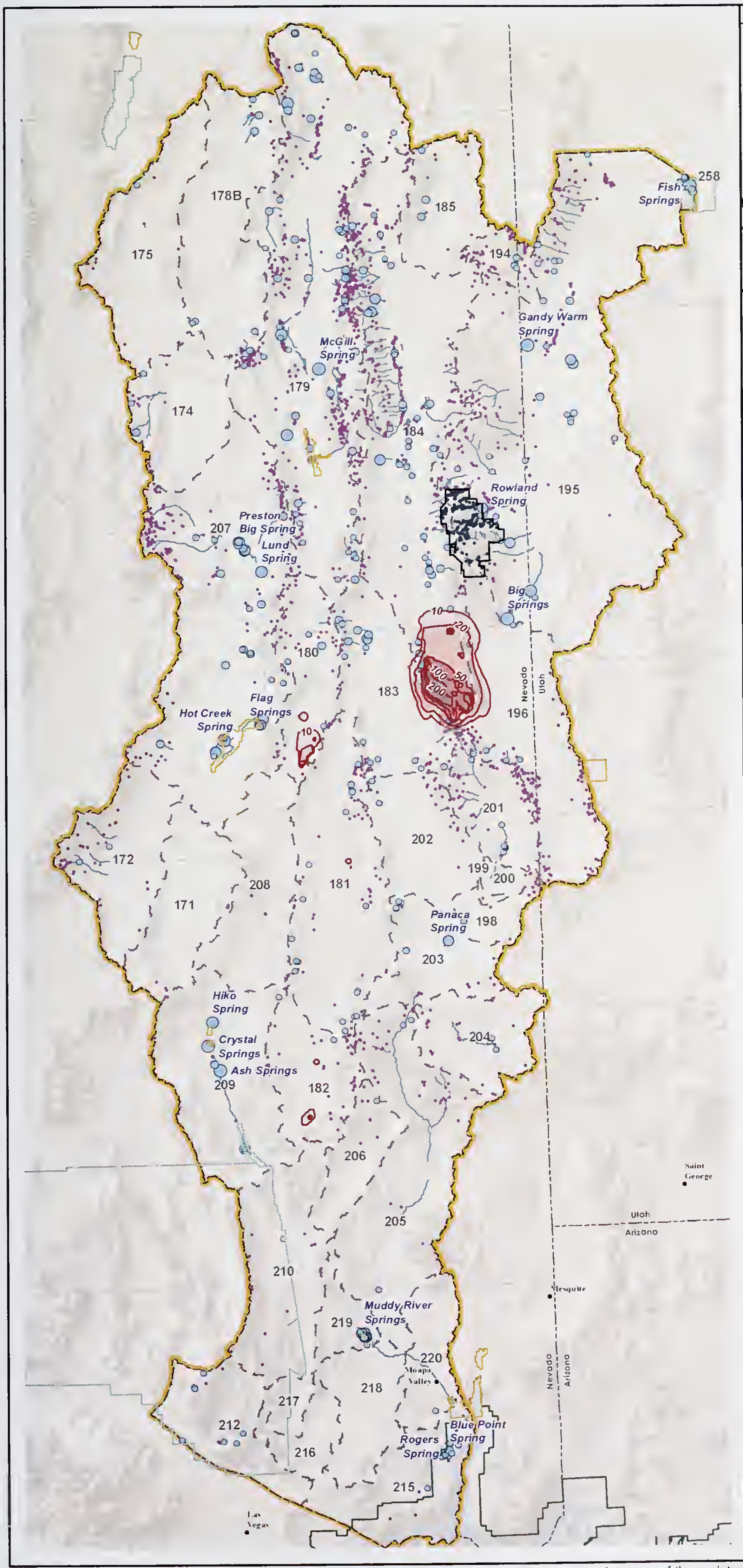


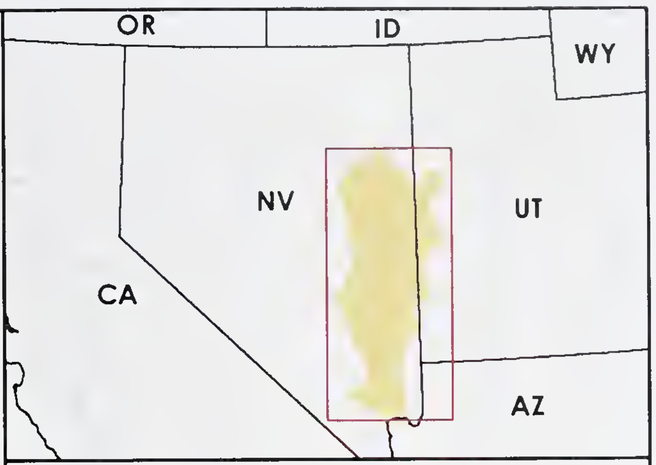
Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-22

Pumping Distribution
Alternative D - (LCCRDA Distributed Pumping)





Legend

Major Springs

Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location
- Perennial Stream Reach
- Drawdown Contour (Ft.)

Drawdown Range (Ft.)

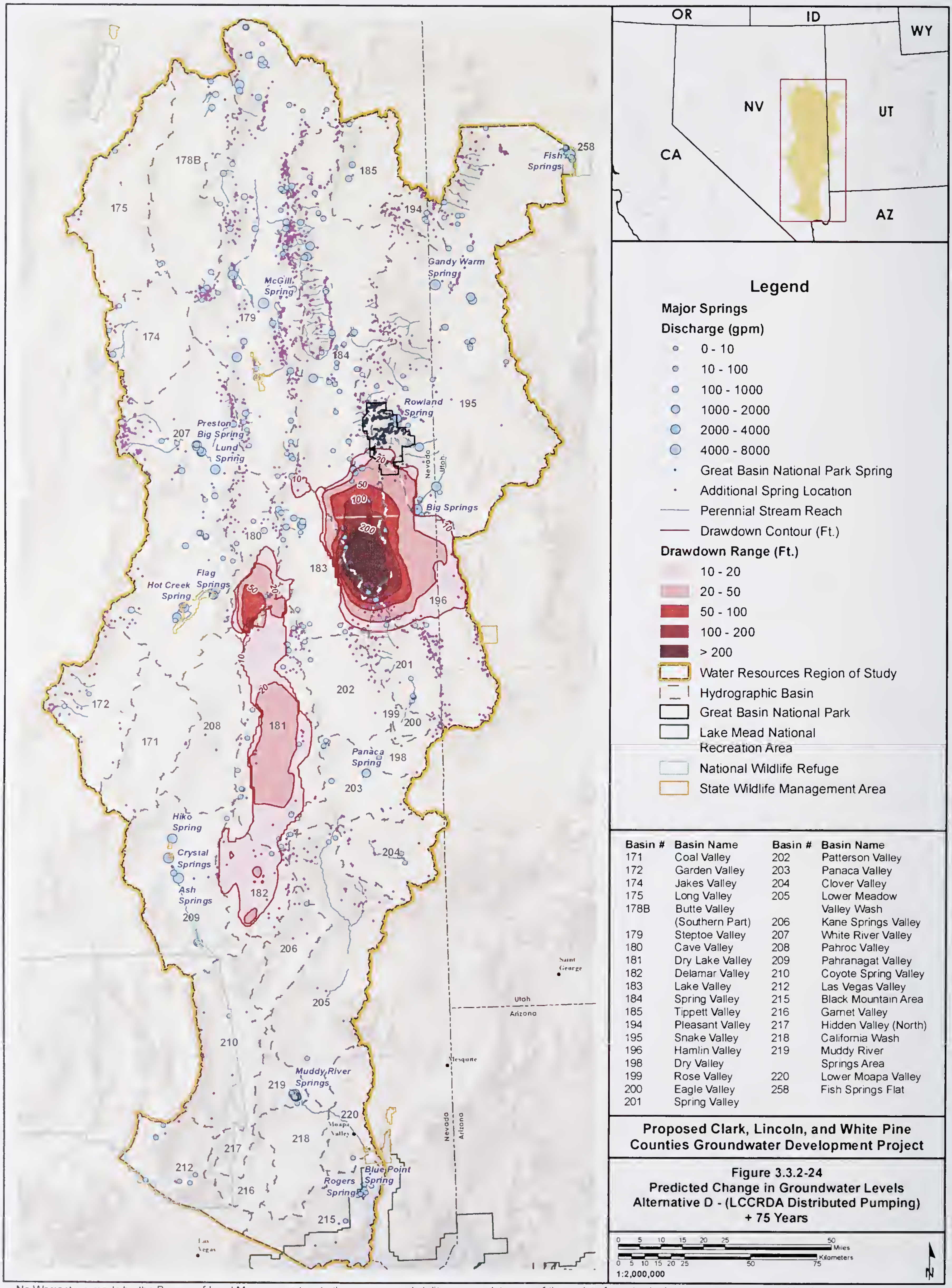
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- > 200
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-23
Predicted Change in Groundwater Levels Alternative D - (LCCRDA Distributed Pumping) Full Build Out

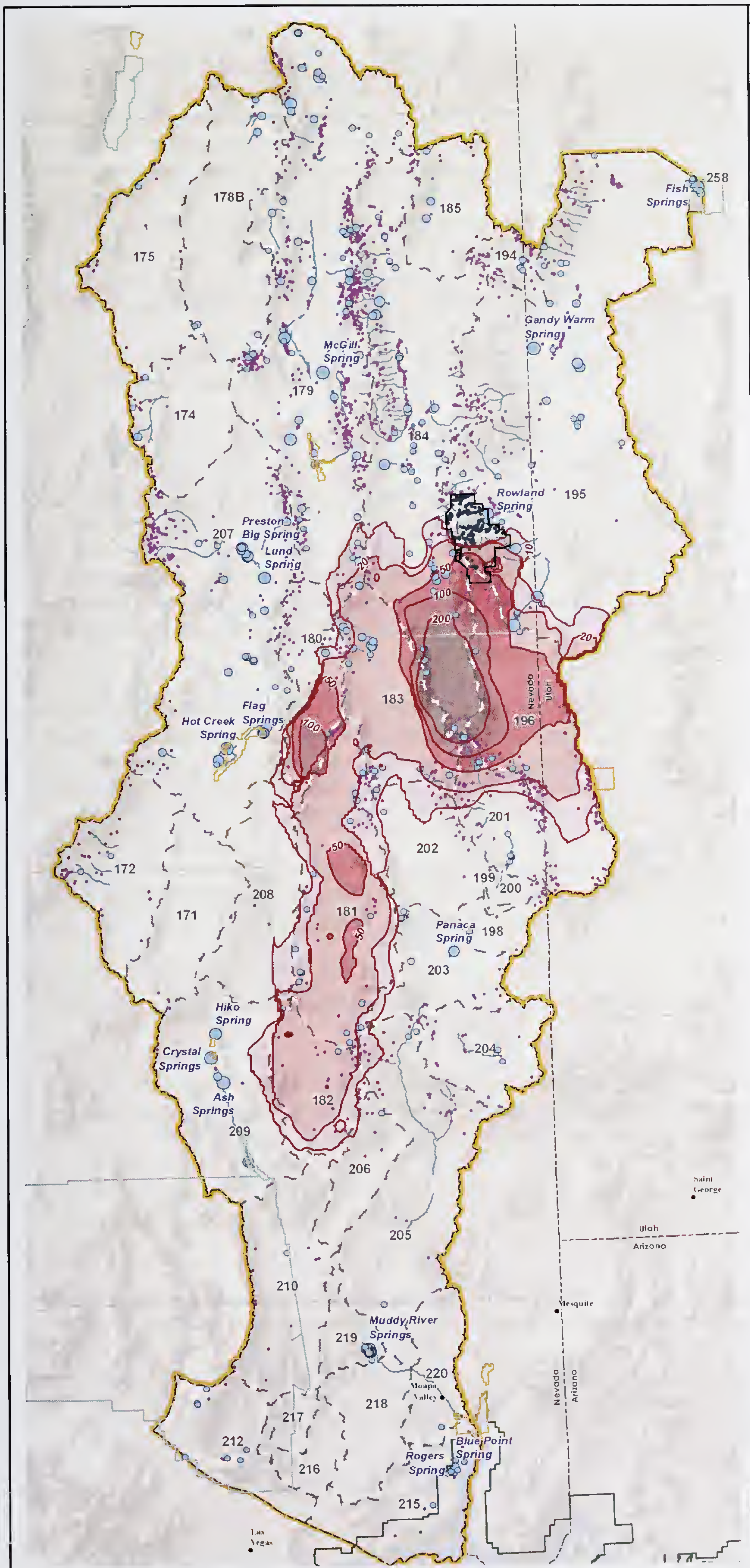
0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000

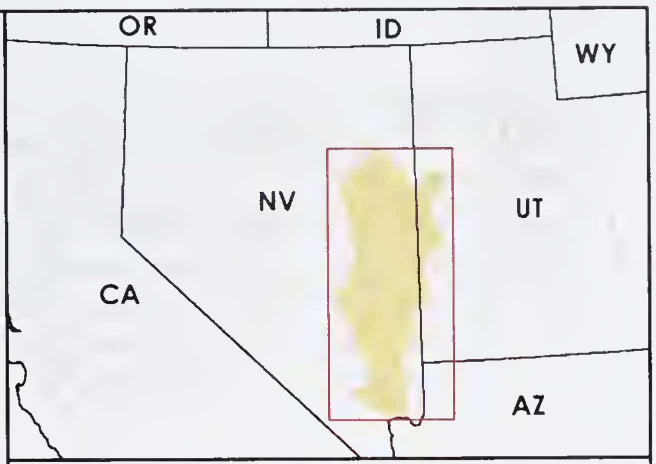


Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-24
Predicted Change in Groundwater Levels Alternative D - (LCCRDA Distributed Pumping) + 75 Years

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data





Legend

Major Springs

Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location
- Perennial Stream Reach
- Drawdown Contour (Ft.)

Drawdown Range (Ft.)

- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- > 200
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-25
Predicted Change in Groundwater Levels
Alternative D - (LCCRDA Distributed Pumping) + 200 Years

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000

N

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

Water-level hydrographs for each of these observation wells within the pumping basins provided in **Figures 3.3.2-7** and **3.3.2-8** show the predicted rate and magnitude of water level decline at these representative locations over the simulation period. As with the Proposed Action, the hydrographs indicate that water levels are predicted to continue to decrease over the model simulation period, and not reach a renewed equilibrium (or steady state condition) before the end of the simulation period. The hydrographs illustrate that because the same pumping schedule is the same for Alternative A and Alternative D for Delamar, Dry Lake, and Cave valleys, the rate and magnitude of drawdown are the same in those valleys. As shown on **Figure 3.3.2-7**, this alternative would reduce the drawdown area in Snake Valley in the vicinity of Baker compared to the Proposed Action and Alternatives A, B, and C.

The potential for groundwater withdrawal to reduce the storage properties of the basin-fill sediments within the drawdown cone are the same as previously discussed for the Proposed Action (Section 3.3.2.9).

Potential effects to water resources resulting from the Alternative D pumping scenario are summarized in **Table 3.3.2-17**.

Impacts to Springs and Streams

The estimated potential risks to springs located within the projected drawdown area at full build out, full build out plus 75 years, and full build out plus 200 years are presented in **Figures F3.3.8A-13**, **F3.3.8A-14**, and **F3.3.8A-15**, respectively, in **Appendix F3.3.8**. The number of springs within the drawdown area and relative risk of impacts by hydrographic basin are summarized in **Table F3.3.9-5A** in **Appendix F3.3.9**. Specific inventoried springs located within the drawdown area at the representative points in time are listed in **Table F3.3.10-1A** in **Appendix F3.3-10**. The estimated miles of perennial streams (by hydrographic basin) located in the predicted drawdown areas where surface waters could be impacted are listed in **Table F3.3.11-5A** in **Appendix F3.3.11**.

Potential total effects to perennial springs and streams are summarized in **Table 3.3.2-17**. For the predicted drawdown area at full build out plus 75 years, there are 13 inventoried springs and 28 "other" springs located within the high and moderate risk areas. By full build out plus 200 years, this increased to 31 inventoried springs and 92 "other" springs located within the high and moderate risk areas. These springs occur in Cave Steptoe, Hamlin, Spring (HA 184), Snake, Lake, Spring (HA 201), and Patterson valleys.

The total estimated length of perennial streams located in areas where there is a high to moderate risk of impacts resulting from the predicted drawdown increases from approximately 4 miles at full build out plus 75 years to 48 miles at full build out plus 200 years. This includes stream reaches located in Steptoe, Spring (HA 184), Snake, Lake, and Spring (HA 201) valleys.

Potential site-specific impacts to individual springs and streams affected by drawdown would be the same as discussed for the Proposed Action.

Model-simulated Spring and Stream Discharge Estimates. Model-simulated changes in spring flow for selected springs are presented in **Table 3.3.2-18**. The model-simulated results for springs in White River Valley and others within the White River flow system are essentially the same as previously described for Alternative A.

In the Great Salt Lake Desert Flow System, the model simulations results indicate that Alternative D would not impact flows at Keegan, North Millick, and South Millick springs. In Snake Valley, the model simulation results are very similar to those described for the Proposed Action.

Water Resources Within or Adjacent to GBNP. Surface water resources located within or adjacent to the GBNP that occur within both the model-simulated drawdown area and the susceptibility zones identified by Elliot et al. (2006) are listed in **Table 3.3.2-8**. For the purpose of the EIS analysis, these areas are considered zones of moderate risk as defined in **Table 3.3.2-3** (i.e., impacts may occur to some perennial waters that are hydraulically connected to the regional flow system). Potential effects to water resources within or adjacent to GBNP are essentially the same as described under Alternative C.

Table 3.3.2-17 Summary of Potential Effects to Water Resources Resulting from the Alternative D Pumping Scenario[1,2]

Water Resource Issue / Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Drawdown:			
• Number of hydrographic basins affected by drawdown	6	11	16
Drawdown effects on perennial springs:			
• Number of inventoried springs located in areas where impacts to flow could occur[3]	1	13	31
• Number of other springs located in areas where impacts to flow could occur[4]	0	28	92
• Model-simulated flow reduction at Big Spring (as percent flow reduction)	19%	100%	100%
Drawdown effects on perennial streams:			
• Number of basins with perennial stream reaches where impacts to flow could occur	0	3	5
• Miles of perennial stream located in areas where impacts to flow could occur	0	4	48
Drawdown effects on surface water rights:			
• Number of surface water rights located in areas where impacts to flow could occur	1	23	56
Drawdown effects on groundwater rights:			
• Number of groundwater rights located within the 10-50 foot drawdown area	2	21	196
• Number of groundwater rights located within the 50-100 foot drawdown area	0	4	11
• Number of groundwater rights located within the greater than 100-foot drawdown area	0	2	6
• (Total groundwater rights in drawdown area)	(2)	(27)	(213)
Percent reduction in ET and spring discharge[5]:			
• Spring Valley	0%	18%	28%
• Snake Valley	0%	4%	8%
• Great Salt Lake Desert Flow System[1]	0%	10%	16%
• White River Flow System	0%	0%	0%
Reduction in flow from Snake Valley to Pine, Wah Wah, and Tule Valleys Hydrographic Basins[5]:			
• AFY	0	0	200
• Percent Reduction	0%	0%	1%

[1] Located within the groundwater flow model domain.

[2] Unless otherwise noted, supporting information used to develop these estimated effects are provided in **Appendices F3.3.5** through **F3.3.16**.

[3] Specific inventoried springs identified in moderate or high risk areas are identified in **Table F3.3.10-1A** in **Appendix F3.3.10**.

[4] "Other Springs" are springs identified in the National Hydrography Database or topographic maps that have not been field verified.

[5] Estimate derived from the model-simulated values provided in SNWA 2010a with comparison to No Action pumping results.

Table 3.3.2-18 Model-simulated Flow Changes (Alternative D Pumping)

(Project Specific)					Alternative D (LCCRDA)		
					Incremental Change in Flow % (from No-Action)		
Flow System	Hydrographic Basin	Spring	Average Flow (Actual) in gpm	Model-simulated Average Flow (2005) in gpm	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
White River	White River Valley (207)	Arnoldson Spring	1,608	946	0	0	0
		Butterfield Spring	1,225	471	0	-3	-9
		Cold Spring	582	503	0	0	0
		Flag Springs 3	969	560	0	-3	-9
		Hardy Springs	200	73	0	0	-1
		Hot Creek Spring	5,032	6,899	0	0	-2
		Lund Spring	3,594	3,314	0	0	-1
		Moon River Spring	1,707	1,457	0	0	-1
		Moorman Spring	405	353	0	0	-1
		Nicolas Spring	1,185	872	0	0	0
		Preston Big Spring	3,572	3,794	0	0	0
	Pahranagat Valley (209)	Ash Springs	6,909	7,453	0	0	-1
		Brownie Spring	224	277	0	0	0
		Crystal Springs	4,235	4,647	0	0	0
		Hiko Spring	2,735	1,985	0	0	-1
	Muddy River Springs Area (219)	Muddy River near Moapa[1]	20,931	15,383	0	0	0
	Lower Moapa Valley (220)	Muddy River near Glendale[1]	19,565	14,895	0	0	0
	Black Mountains Area (215)	Blue Point Spring	223	393	0	0	0
		Rogers Spring	771	515	0	0	0
Goshute Valley	Steptoe Valley (179)	Campbel Ranch Springs	2,746	2,088	0	0	0
		Currie Spring	2,181	1,419	0	0	0
		McGill Spring	4,783	2,074	0	0	0
		Monte Neva Hot Springs	649	280	0	0	0
Great Salt Lake Desert	Spring Valley (184)	Keegan Spring	234	63	0	0	0
		North Millick Spring	284	98	0	0	0
		South Millick Spring	506	278	0	0	0
	Snake Valley (195)	Big Springs	4,289	1,977	-19	-100	-100
		Foote Res. Spring	1,300	211	0	0	0
		Kell Spring	120	59	0	0	0
		Warm Creek near Gandy, Utah	7,426	2,697	0	0	0
Meadow Valley	Panaca Valley (203)	Panaca Spring	1,455	1,208	0	0	0

[1] Simulated using Stream Flow Routing 2 package for MODFLOW.

Source: SNWA 2010b.

Utah Surface Water Resources. Reduced flows at Big Springs would reduce flows in Big Springs Creek, and likely reduce flows to Lake Creek and into Pruess Lake. The model simulations indicate potential flow reductions at Big Springs (and downstream in Lake Creek).

The model simulations indicate that drawdown could propagate into Pine Valley. At the full build out plus 75 years and full build out plus 200 years time frames, the maximum drawdown simulated at the boundary of the model between Snake and Pine valleys is approximately 18 feet and 53 feet, respectively. As described under the Proposed Action, available information suggest that drawdown from pumping in Snake Valley is unlikely to impact surface water resources in Pine Valley (see Proposed Action for further discussion).

Impacts to Surface Water Rights

The locations and manner of use of the active surface water rights within the drawdown area at full build out, full build out plus 75 years, and full build out plus 200 years are presented in **Figures F3.3.12A-13**, **F3.3.12A-14**, and **F3.3.12A-15**, respectively, in **Appendix F3.3.12**. **Table F3.3.13-5A** lists the number of active surface water rights within the drawdown area that occur within the high-, moderate-, and low-risk areas at the three representative time frames. At full build out plus 75 years, there are a total of 23 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows. By the full build out plus 200 years time frame, there are 56 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows. For surface water rights that are dependent on groundwater discharge, a potential reduction in the water table at the point of diversion could reduce or eliminate the flow available at the point of diversion for the surface water right.

Impacts to Groundwater Rights

Figures F3.3.14A-13, **F3.3.14A-14**, and **F3.3.14A-15** in **Appendix F3.3.14** illustrate the location and manner of use of existing groundwater rights in relation to the magnitude of the model-simulated drawdown at full build out, full build out plus 75 years, and full build out plus 200 years. **Table F3.3.15-5A** (**Appendix F3.3.15**) lists the groundwater rights by hydrographic basin within the drawdown area. At full build out plus 75 years, there are 27 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. At full build out plus 200 years, the number increases to 213 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. The potential impacts to individual wells are the same as discussed under the Proposed Action.

Impacts to Water Balance

The model-simulated groundwater budget for the Alternative D pumping scenario is presented in **Appendix F3.3.16**, **Table F3.3.16-5B**. Compared to the simulated conditions under the No Action for Spring Valley, the pumping is estimated to result in an 18 percent reduction of groundwater discharge for ET at full build out plus 75 years time frame and 28 percent reduction at full build out plus 200 years time frame. In Snake Valley, the pumping is estimated to result in reductions of groundwater discharge to support ET and spring discharge of 4 percent at full build out plus 75 years, and 8 percent at full build out plus 200 years in the southern portion of the valley. Alternative D pumping is estimated to have minimal impact (1 percent or less) on ET discharge within the White River Flow System and reductions of flow to Pine, Wah Wah, and Tule valleys and Fish Springs.

The GBNP Model (Halford and Plume 2011) was set up to simulate flows at Fish Springs. The simulation results from the GBNP Model indicate that pumping in Snake Valley (at the points of diversion listed in the SNWA water rights applications), at the full application rate (50,000 afy) combined with continuation of existing agricultural pumping would not reduce flows in Fish Springs over the 200-year simulation period. These model results suggest that pumping associated with the groundwater development in Snake Valley is unlikely to result in a measureable reduction in flows at Fish Springs.

Water Quality

Potential impacts to water quality would be the same as described under the Proposed Action.

Monitoring and Mitigation Recommendations

Additional mitigation recommendations GW-WR-3a (Comprehensive Water Resources Monitoring Plan) and GW-3b (Numerical Groundwater Flow Modeling Requirements); GW-WR-4 (Monitoring, Mitigation and Management Plan for Snake Valley); GW-WR-5 (Shoshone Ponds Mitigation); GW-WR-6 (Water Rights Mitigation); and GW-WR-7 (Groundwater Development & Drawdown Effects to Federal Resources and Federal Water Rights) described under the Proposed Action , and the COM Plan described in Section 3.20, Monitoring and Mitigation Summary, would apply to Alternative D.

Potential Residual Impacts

Potential unavoidable residual impacts associated with the groundwater development are described under the Proposed Action. The magnitude of potential unavoidable adverse impacts to water resources resulting from reduced pumping in Delamar, Dry Lake, and Cave valleys would be less than the Proposed Action. The magnitude of potential unavoidable adverse impacts to Snake Valley also would be considerably less than the Proposed Action since there would be no pumping in Snake Valley. The intensive groundwater withdrawal focused in southern Spring Valley would result in substantially higher magnitude of drawdown in the south Spring Valley and adjacent areas compared to the Proposed Action and all other pumping alternatives. Implementation of adaptive mitigation measures proposed by the applicant and included in the stipulated agreements would be difficult to implement to control the magnitude and aerial extent of drawdown resulting from the pumping in southern Spring Valley. Therefore, the potential for residual adverse impacts in southern Spring Valley and adjacent areas affected by pumping in southern Spring Valley would likely be greater than under the Proposed Action and all other alternatives.

3.3.2.14 Alternative E

Groundwater Development Areas

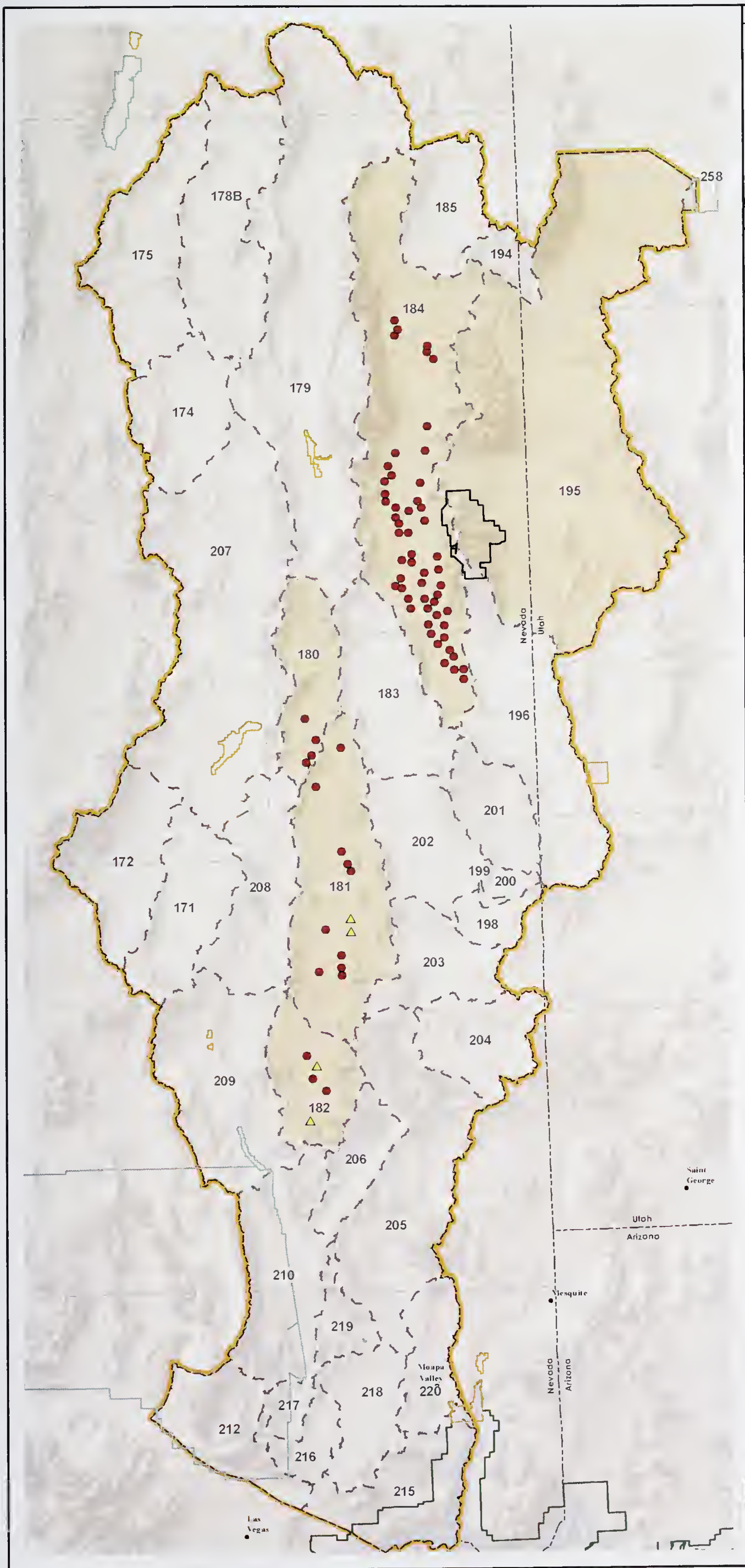
Development in Snake Valley would be eliminated under Alternative E (Spring, Delamar, Dry Lake, and Cave valleys Alternative). The delineated groundwater development areas for Spring, Delamar, Dry Lake, and Cave valleys are assumed to be the same as those defined for the Proposed Action. Development within the groundwater development areas would include groundwater production wells, collector pipelines, staging areas, power facilities, pumping stations, and access roads. The actual location of specific facilities within the groundwater development areas has not been determined at this stage of the project and will be subject to future site-specific NEPA analysis.

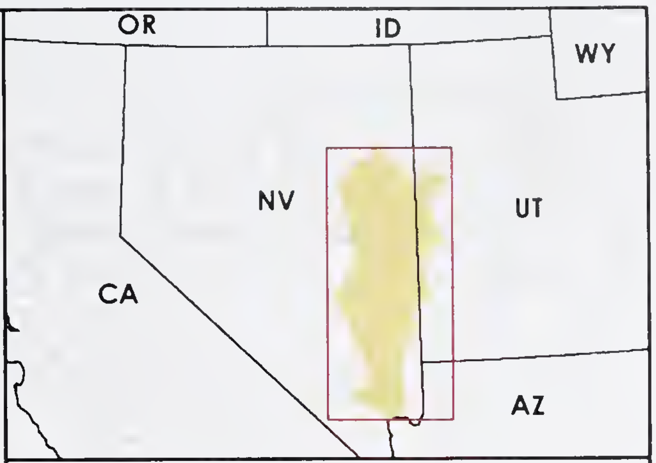
Conclusion. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated maximum surface disturbance of approximately 4,080 acres within 4 hydrographic basins. There are 49 known or suspected springs identified within the groundwater development areas (**Table 3.3.2-4**). These springs occur within the groundwater development areas within Spring Valley (37 springs), Delamar Valley (7 springs), Dry Lake Valley (4 springs), and Cave Valley (1 spring). There also are 23 separate perennial stream reaches with a total length of 20.3 miles that occur within the groundwater development areas (**Table 3.3.2-5**). All of these perennial stream reaches are located in Spring Valley. The potential for impacts to springs and streams located within these groundwater development areas would depend on the location of facilities. Implementation of the ACMs would minimize impacts to perennial water sources associated with the well field development. Additional monitoring and mitigation recommendations (GW-WR-1, GW-WR-2) described under the Proposed Action would apply to Alternative E and include identifying and establishing an avoidance buffer around all springs, and developing site-specific plans to minimize impacts at perennial stream crossings within the groundwater development areas.

Groundwater Pumping

Groundwater Pumping Scenario

The groundwater pumping scenario for Alternative E assumes that no pumping will occur in Snake Valley as shown in **Figure 3.3.2-26**. The maximum groundwater production rate under this scenario is approximately 79,000 afy for the four pumping basins (Spring, Snake, Delamar, Dry Lake, and Cave valleys), the same as is assumed for these same basins under Alternatives A, C, and D. The well distribution developed by SNWA for this model scenario includes the same spatial distribution of wells included in Alternative A for Spring, Delamar, Dry Lake, and Cave valleys. Details regarding the assumed pumping schedule used for the model simulations are provided in the model simulation report (SNWA 2010a). The pumping schedule reflects the proposed staged general south to north sequence of basin development for the project.





Legend

Pumping Scenario Well Locations[1]

- SNWA Project Well
- Lincoln County Water District Approved Water Right
- Hydrographic Basin
- Pumping Basin
- Water Resources Region of Study
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

[1]The SNWA well locations represent the production well locations simulated in the numerical groundwater flow model for evaluating potential impacts. The actual number and location of the wells will be determined after additional field investigations.

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-26

Pumping Distribution
Alt. E - (Spring, Delamar, Dry Lake and Cave Valleys)

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000

Impacts to Water Levels

The predicted change in groundwater levels attributable to groundwater development under the Alternative E at full build out, full build out plus 75 years, and full build out plus 200 years are provided in **Figures 3.3.2-27**, **3.3.2-28**, and **3.3.2-29**, respectively. These figures illustrate areas where the water levels are predicted to decrease in comparison to the simulated No Action water levels.

Because the pumping schedule for Alternative E is identical to Alternative A for Spring, Delamar, Dry Lake, and Cave valleys, the predicted drawdown for Spring, Delamar, Dry Lake, and Cave valleys (and adjacent areas) are essentially the same as previously described for Alternative A. Pumping in Spring Valley is predicted to eventually result in drawdown along the southwest margin of Snake Valley and northern portion of Hamlin Valley. As shown on **Figure 3.3.2-7**, this alternative would substantially reduce the drawdown area in Snake Valley in the vicinity of Baker compared with the Proposed Action compared to the Proposed Action, and Alternatives A, B, and C.

The potential for groundwater withdrawal to reduce the storage properties of the basin-fill sediments within the drawdown cone are the same as previously discussed for the Proposed Action (Section 3.3.2.9).

Potential effects to water resources resulting from the Alternative E pumping scenario are summarized in **Table 3.3.2-19**.

Impacts to Springs and Streams

The estimated potential risks to springs located within the projected drawdown area at full build out, full build out plus 75 years, and full build out plus 200 years are presented in **Figures F3.3.8A-16**, **F3.3.8A-17**, and **F3.3.8A-18**, respectively, in **Appendix F3.3.8**. The number of springs within the drawdown area and relative risk of impacts by hydrographic basin are summarized in **Table F3.3.9-6A** in **Appendix F3.3.9**. Specific inventoried springs located within the drawdown area at the representative points in time are listed in **Table F3.3.10-1A** in **Appendix F3.3.10**. The estimated miles of perennial streams (by hydrographic basin) located in the predicted drawdown areas where surface waters could be impacted are listed in **Table F3.3.11-6A** in **Appendix F3.3.11**.

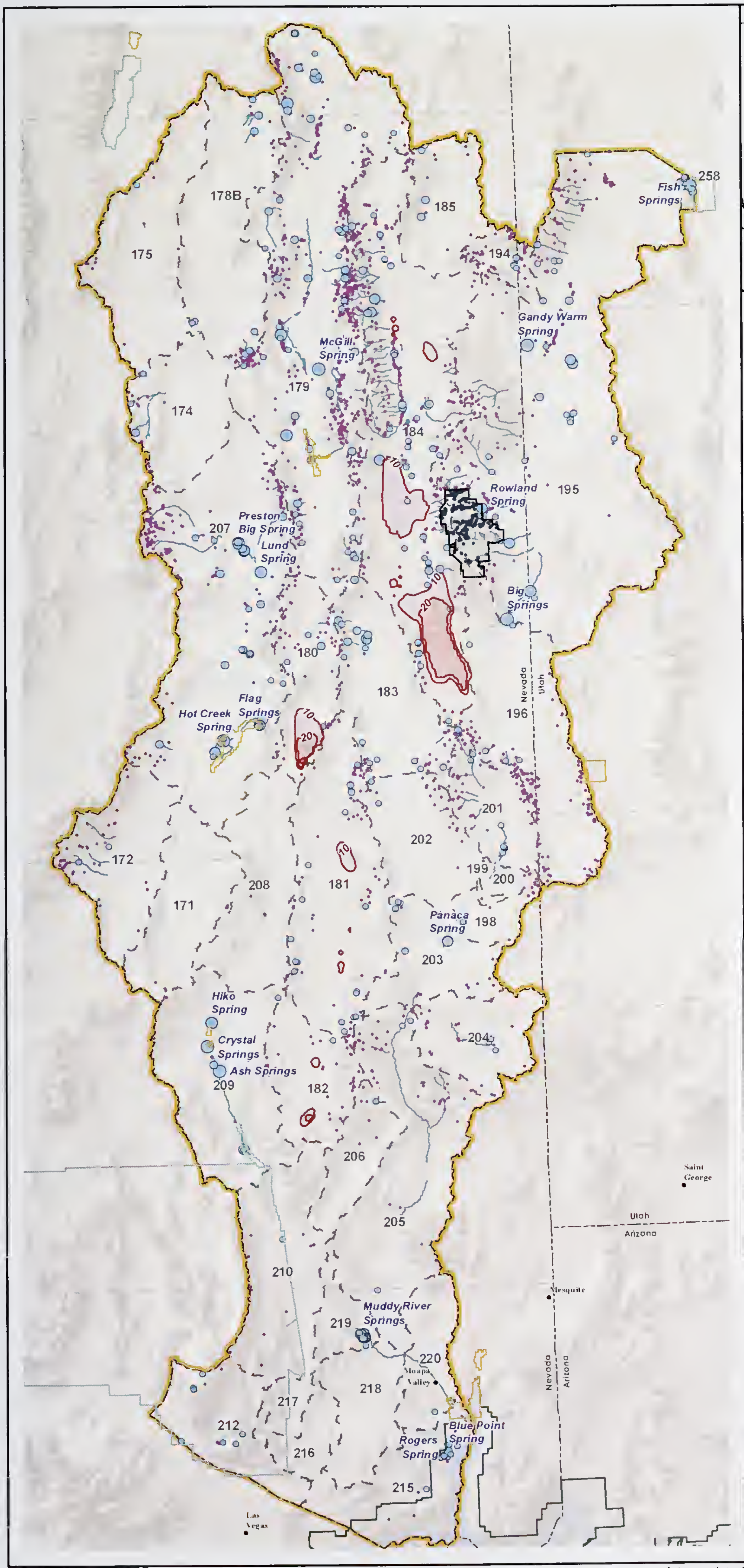
Potential total effects to perennial springs and streams are summarized in **Table 3.3.2-19**. For the predicted drawdown area at full build out plus 75 years, there are 19 inventoried springs and 36 "other" springs located within the high and moderate risk areas. By full build out plus 200 years, this increased to 30 inventoried springs and 174 "other" springs located within the high and moderate risk areas. These springs occur in Cave, Steptoe, Hamlin, Spring (HA 184), Snake, and Lake valleys.

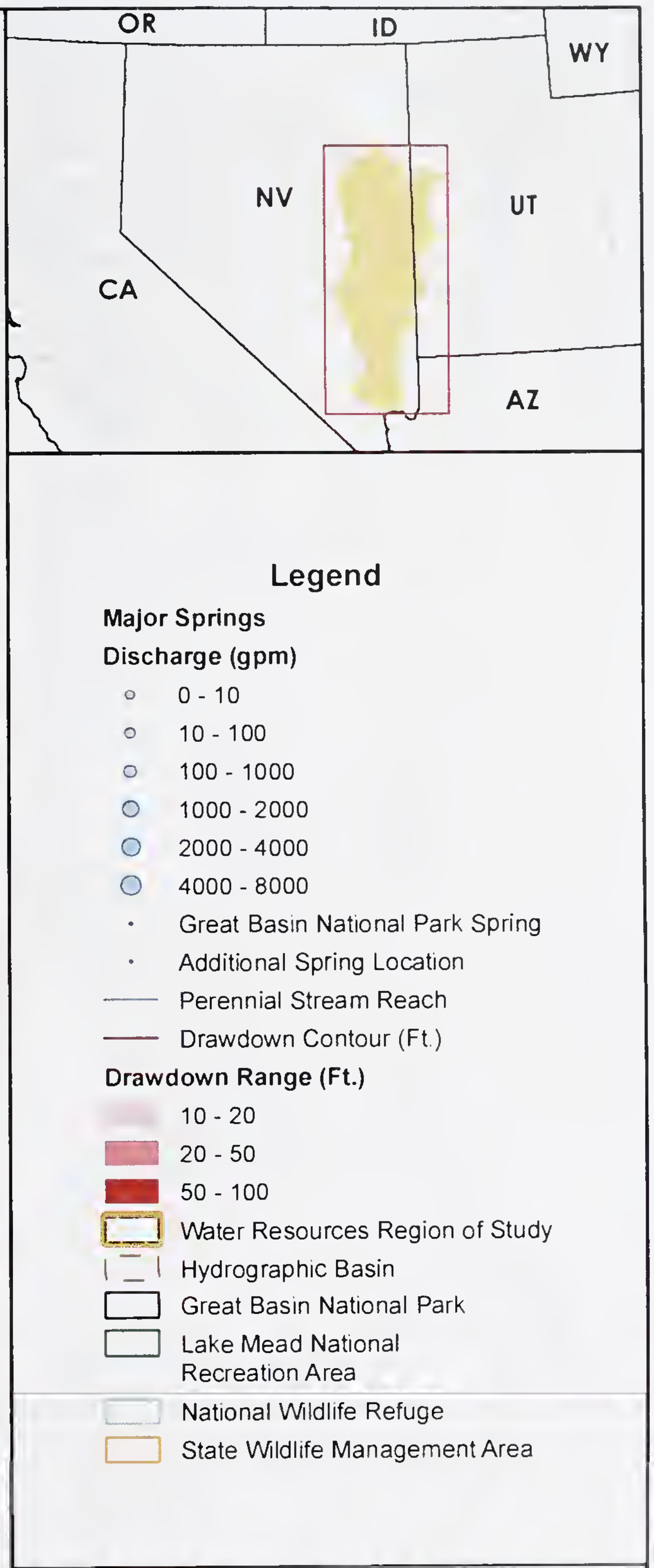
The total estimated length of perennial streams located in areas where there is a high to moderate risk of impacts resulting from the predicted drawdown increases from approximately 7 miles at full build out plus 75 years to 23 miles at full build out plus 200 years. This includes stream reaches located in Steptoe, Spring (HA 184), Snake, and Lake valleys.

Potential site-specific impacts to individual springs and streams affected by drawdown would be the same as discussed for the Proposed Action.

Model-simulated Spring and Stream Discharge Estimates. Model-simulated changes in spring flow for selected springs are presented in **Table 3.3.2-20**. The model-simulated flows and predicted changes in flows for springs in White River Valley, other springs within the White River flow system, and Spring Valley are the same as previously described for Alternative A. The model-simulated flows for springs in Snake Valley are the same as the Proposed Action and Alternative A except that Big Springs is predicted to experience a 26 percent reduction in flow by the full build out plus 75 years time frame and 78 percent reduction in the full build out plus 200 year time frame. Reductions of flow at Big Springs would reduce flows in Big Springs Creek and likely reduce flows to Lake Creek and into Pruess Lake. The results suggest that the springs located on the valley floor in the in the southern portion of the valley potentially could experience a reduction in flow from pumping in Spring Valley.

Water Resources Within or Adjacent to the GBNP. Surface water resources located within or adjacent to the GBNP that occur within both the model-simulated drawdown area and the susceptibility zones identified by Elliot et al. (2006) are listed in **Table 3.3.2-8**. For the purpose of the EIS analysis, these areas are considered zones of moderate risk as



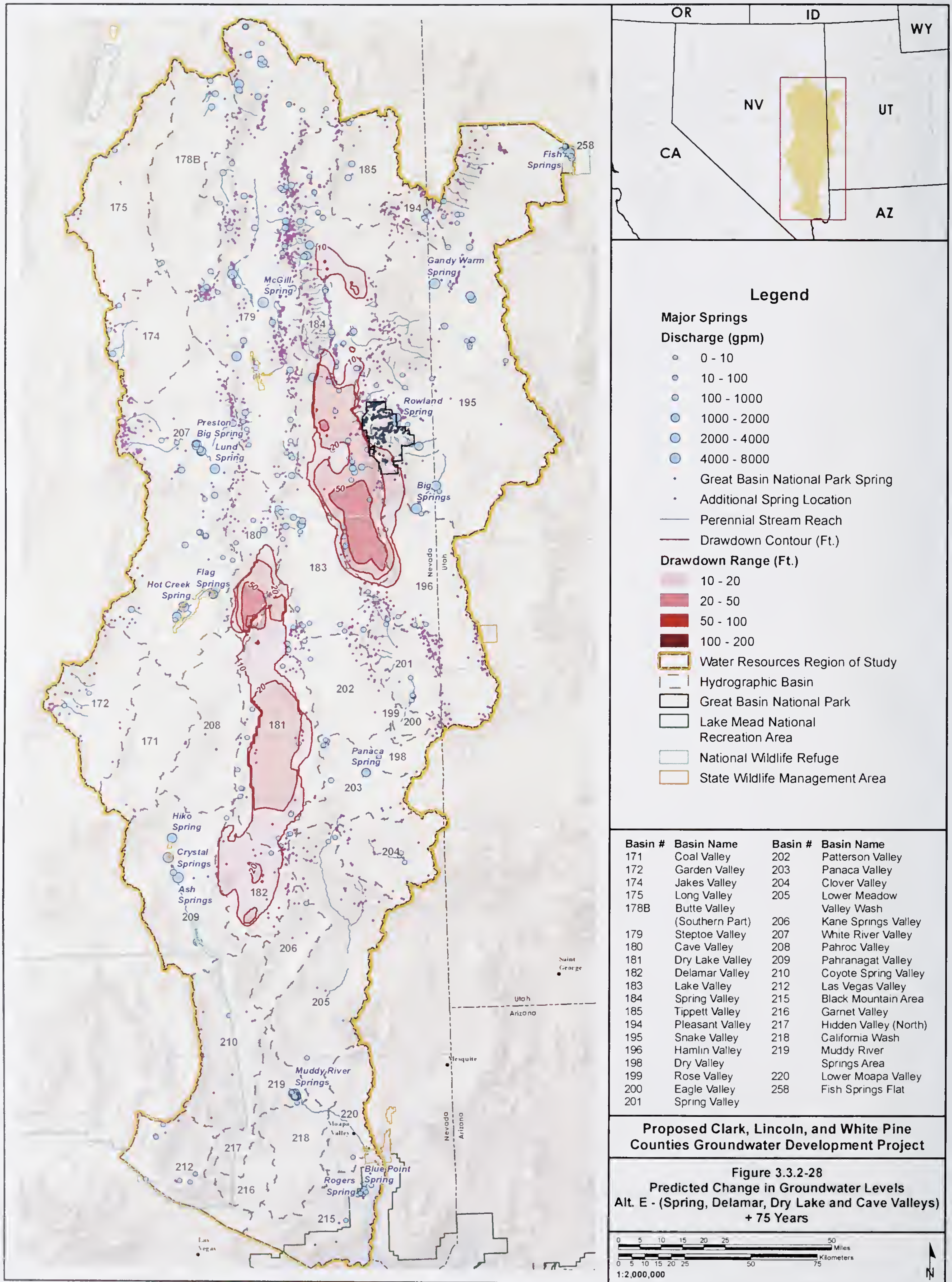


Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-27
Predicted Change in Groundwater Levels
Alt. E - (Spring, Delamar, Dry Lake and Cave Valleys)
Full Build Out

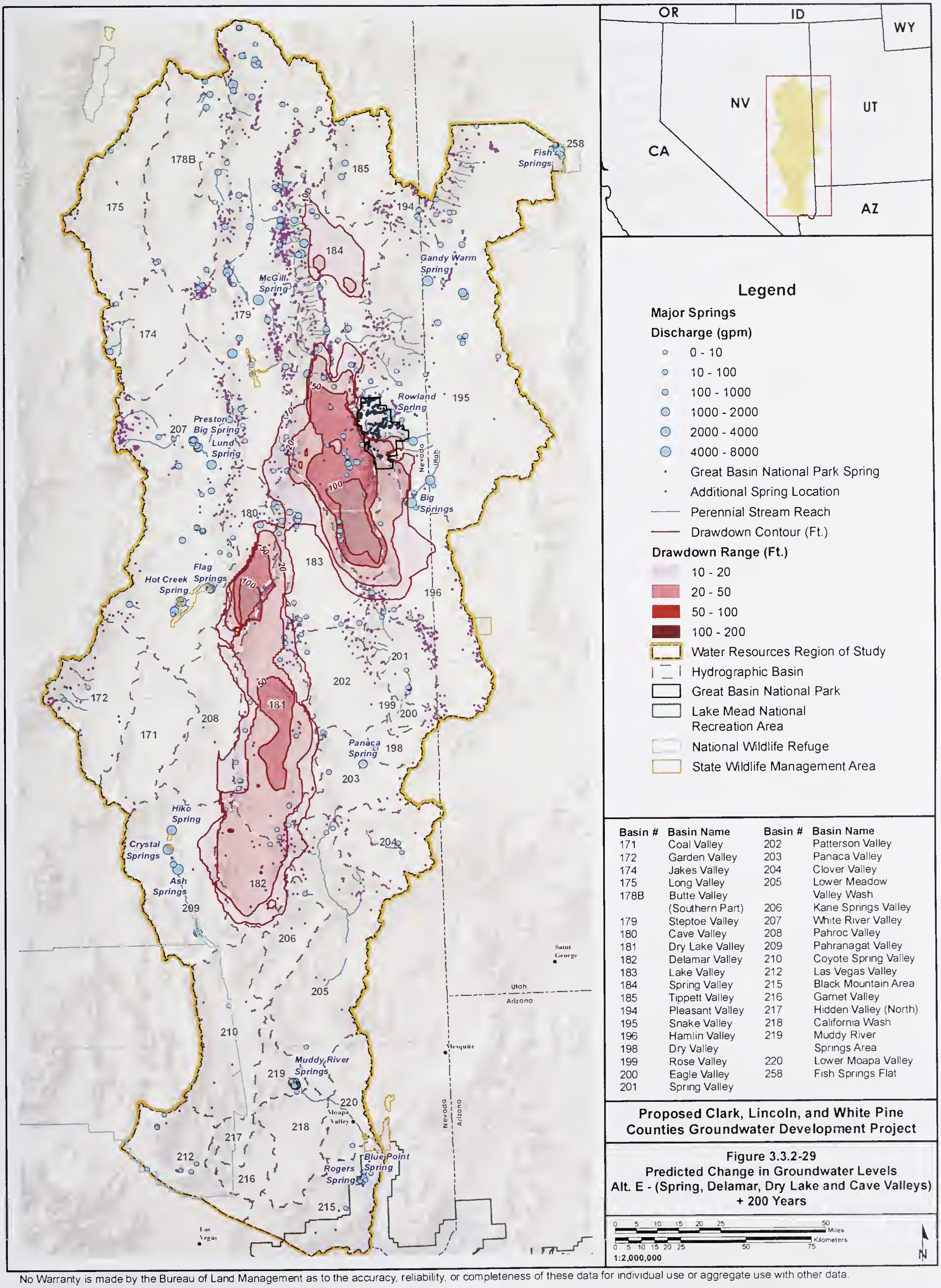
0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000



Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-28
Predicted Change in Groundwater Levels
Alt. E - (Spring, Delamar, Dry Lake and Cave Valleys)
+ 75 Years



Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-29
Predicted Change in Groundwater Levels
Alt. E - (Spring, Delamar, Dry Lake and Cave Valleys) + 200 Years

Table 3.3.2-19 Summary of Potential Effects to Water Resources Resulting from the Alternative E Pumping Scenario[1,2]

Water Resource Issue / Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Drawdown:			
• Number of hydrographic basins affected by drawdown	5	10	16
Drawdown effects on perennial springs:			
• Number of inventoried springs located in areas where impacts to flow could occur[3]	1	19	30
• Number of other springs located in areas where impacts to flow could occur[4]	2	36	74
• Model-simulated flow reduction at Big Spring (as percent flow reduction)	2%	26%	78%
Drawdown effects on perennial streams:			
• Number of basins with perennial stream reaches where impacts to flow could occur	1	1	4
• Miles of perennial stream located in areas where impacts to flow could occur	1	7	23
Drawdown effects on surface water rights:			
• Number of surface water rights located in areas where impacts to flow could occur	14	60	94
Drawdown effects on groundwater rights:			
• Number of groundwater rights located within the 10-50 foot drawdown area	15	68	58
• Number of groundwater rights located within the 50-100 foot drawdown area	0	2	50
• Number of groundwater rights located within the greater than 100-foot drawdown area	0	0	2
• (Total groundwater rights in drawdown area)	(15)	(70)	(110)
Percent reduction in ET and spring discharge:[5]			
• Spring Valley	30%	52%	56%
• Snake Valley	0%	0%	3%
• Great Salt Lake Desert Flow System[1]	12%	21%	24%
• White River Flow System	0%	0%	1%
Reduction in flow from Snake Valley to Pine, Wah Wah, and Tule Valleys Hydrographic Basins[5]			
• AFY	0	0	0
• Percent Reduction	0%	0%	0%

[1] Located within the groundwater flow model domain.

[2] Unless otherwise noted, supporting information used to develop these estimated effects are provided in **Appendices F3.3.5** through **F3.3.16**.

[3] Specific inventoried springs identified in moderate or high risk areas are identified in **Table F3.3.10-1A** in **Appendix F3.3.10**.

[4] "Other Springs" are springs identified in the National Hydrography Database or topographic maps that have not been field verified.

[5] Estimate derived from the model-simulated values provided in SNWA 2010a with comparison to No Action pumping results.

Table 3.3.2-20 Model-simulated Flow Changes (Alternative E Pumping)

(Project Specific)					Alternative E (Spring, Delamar, Dry Lake, and Cave Only)		
					Incremental Change in Flow % (from No-Action)		
Flow System	Hydrographic Basin	Spring	Average Flow (Actual) in gpm	Model-simulated Average Flow (2005) in gpm	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
White River	White River Valley (207)	Arnoldson Spring	1,608	946	0	0	0
		Butterfield Spring	1,225	471	0	-3	-8
		Cold Spring	582	503	0	0	-1
		Flag Springs 3	969	560	-1	-3	-8
		Hardy Springs	200	73	0	0	-1
		Hot Creek Spring	5,032	6,899	0	-1	-2
		Lund Spring	3,594	3,314	0	0	-1
		Moon River Spring	1,707	1,457	0	0	-1
		Moorman Spring	405	353	0	0	-1
		Nicolas Spring	1,185	872	0	0	0
		Preston Big Spring	3,572	3,794	0	0	-1
	Pahranagat Valley (209)	Ash Springs	6,909	7,453	0	0	-1
		Brownie Spring	224	277	0	0	0
		Crystal Springs	4,235	4,647	0	0	-1
		Hiko Spring	2,735	1,985	0	0	-1
	Muddy River Springs Area (219)	Muddy River near Moapa[1]	20,931	15,383	0	0	0
	Lower Moapa Valley (220)	Muddy River near Glendale[1]	19,565	14,895	0	0	0
	Black Mountains Area (215)	Blue Point Spring	223	393	0	0	0
		Rogers Spring	771	515	0	0	0
Goshute Valley	Steptoe Valley (179)	Campbel Ranch Springs	2,746	2,088	0	0	0
		Currie Spring	2,181	1,419	0	0	0
		McGill Spring	4,783	2,074	0	0	0
		Monte Neva Hot Springs	649	280	0	0	0
Great Salt Lake Desert	Spring Valley (184)	Keegan Spring	234	63	-12	-28	-36
		North Millick Spring	284	98	-4	-9	-11
		South Millick Spring	506	278	-10	-21	-24
	Snake Valley (195)	Big Springs	4,289	1,977	-2	-26	-78
		Foote Res. Spring	1,300	211	0	0	0
		Kell Spring	120	59	0	0	0
		Warm Creek near Gandy, Utah	7,426	2,697	0	0	0
Meadow Valley	Panaca Valley (203)	Panaca Spring	1,455	1,208	0	0	0

[1] Simulated using Stream Flow Routing 2 package for MODFLOW.

Source: SNWA 2010b.

defined in **Table 3.3.2-3** (i.e., impacts may occur to some perennial waters that are hydraulically connected to the regional flow system). There are no resources identified in the moderate risk zone at the full build out plus 75 years time frame, and 2.1 miles of Snake Creek at the full build out plus 200 years time frame. Potential risk to water resources (associated with the simulated drawdown) within or adjacent to the GBNP would be less under Alternative E than the Proposed Action and all other pumping alternatives.

Utah Surface Water Resources. Reduced flows at Big Springs would reduce flows in Big Springs Creek, and likely reduce flows to Lake Creek and into Pruess Lake. However, the model simulations suggest that potential flow reductions at Big Springs (and downstream in Lake Creek) likely would be less than under the other pumping alternatives. Also, model simulations indicate that drawdown is not expected to extend to the boundary of Snake and Pine valleys.

Impacts to Surface Water Rights

The locations and manner of use of the active surface water rights within the drawdown area at full build out, full build out plus 75years, and full build out plus 200 years are presented in **Figures F3.3.12A-16**, **F3.3.12A-17**, and **F3.3.12A-18**, respectively, in **Appendix F3.3.12**. **Table F3.3.13-6A** lists the number of active surface water rights within the drawdown area that occur within the high-, moderate-, and low-risk areas at the three representative time frames. At full build out plus 75 years, there are a total of 60 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows. By the full build out plus 200 years time frame, there are 94 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows. For surface water rights that are dependent on groundwater discharge, a potential reduction in the water table at the point of diversion could reduce or eliminate the flow available at the point of diversion for the surface water right.

Impacts to Groundwater Rights

Figures F3.3.14A-16, **F3.3.14A-17**, and **F3.3.14A-18** in **Appendix F3.3.14** illustrate the location and manner of use of existing groundwater rights in relation to the magnitude of the model-simulated drawdown at full build out, full build out plus 75 years, and full build out plus 200 years. **Table F3.3.15-6A** (**Appendix F3.3.15**) lists the groundwater rights by hydrographic basin within the drawdown area. At full build out plus 75 years, there are 70 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. At full build out plus 200 years, the number increases to 110 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. The potential impacts to individual wells are the same as discussed under the Proposed Action.

Impacts to Water Balance

The model-simulated groundwater budget for the Alternative E pumping scenario is presented in **Appendix F3.3.16**, **Table F3.3.16-6B**. Compared to the simulated conditions under the No Action for Spring Valley, the pumping is estimated to result in a 52 percent reduction of groundwater discharge for ET at the full build out plus 75 years time frame and 56 percent reduction at full build out plus 200 years time frame. In Snake Valley, the pumping is estimated to result in minimal reductions (less than 4 percent) of groundwater discharge to support ET. Alternative E pumping is estimated to have minimal impact (1 percent or less) on ET discharge within the White River Flow System, and reductions of flow to Pine, Wah Wah, and Tule valleys and Fish Springs.

Water Quality

Potential impacts to water quality would be the same as described under the Proposed Action.

Monitoring and Mitigation Recommendations

Additional mitigation recommendations GW-WR-3a (Comprehensive Water Resources Monitoring Plan) and GW-3b (Numerical Groundwater Flow Modeling Requirements); GW-WR-4 (Monitoring, Mitigation and Management Plan for Snake Valley); GW-WR-5 (Shoshone Ponds Mitigation); GW-WR-6 (Water Rights Mitigation); and GW-WR-7 (Groundwater Development & Drawdown Effects to Federal Resources and Federal Water Rights) described under the Proposed Action, and the COM Plan described in Section 3.20, Monitoring and Mitigation Summary, would apply to Alternative E.

Potential Residual Impacts

Potential unavoidable residual impacts associated with the groundwater development are described under the Proposed Action. The magnitude of potential unavoidable adverse impacts would be less than the Proposed Action in Spring, Delamar, Dry Lake, and Cave valleys (because of reduced pumping). The magnitude of potential unavoidable adverse impacts to Snake Valley also would be considerably less than the Proposed Action and Alternatives A, B, and C since there would be no pumping in Snake Valley. The potential residual impacts to Snake Valley also likely would be less under Alternative E and Alternative D because of the reduction in the magnitude of drawdown that likely would propagate into this basin.

3.3.2.15 Alternative F

Groundwater Development Areas

Development in Snake Valley would be eliminated under Alternative F. The delineated groundwater development areas for Spring, Delamar, Dry Lake, and Cave valleys are assumed to be the same as those defined for the Proposed Action. Development within the groundwater development areas would include groundwater production wells, collector pipelines, staging areas, power facilities, pumping stations, and access roads. The actual location of specific facilities within the groundwater development areas has not been determined at this stage of the project and will be subject to future site-specific NEPA analysis.

Conclusion. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated maximum surface disturbance of approximately 4,080 acres within 4 hydrographic basins. There are 49 known or suspected springs identified within the groundwater development areas (**Table 3.3.2-4**). These springs occur within the groundwater development areas within Spring Valley (37 springs), Delamar Valley (7 springs), Dry Lake Valley (4 springs), and Cave Valley (1 spring). There also are 23 separate perennial stream reaches with a total length of 20.3 miles that occur within the groundwater development areas (**Table 3.3.2-5**). All of these perennial stream reaches are located in Spring Valley. The potential for impacts to springs and streams located within these groundwater development areas would depend on the location of facilities. Implementation of the ACMs would minimize impacts to perennial water sources associated with the well field development. Additional monitoring and mitigation recommendations (GW-WR-1, GW-WR-2) described under the Proposed Action would apply to Alternative F and include identifying and establishing an avoidance buffer around all springs, and developing site-specific plans to minimize impacts at perennial stream crossings within the groundwater development areas.

Groundwater Pumping

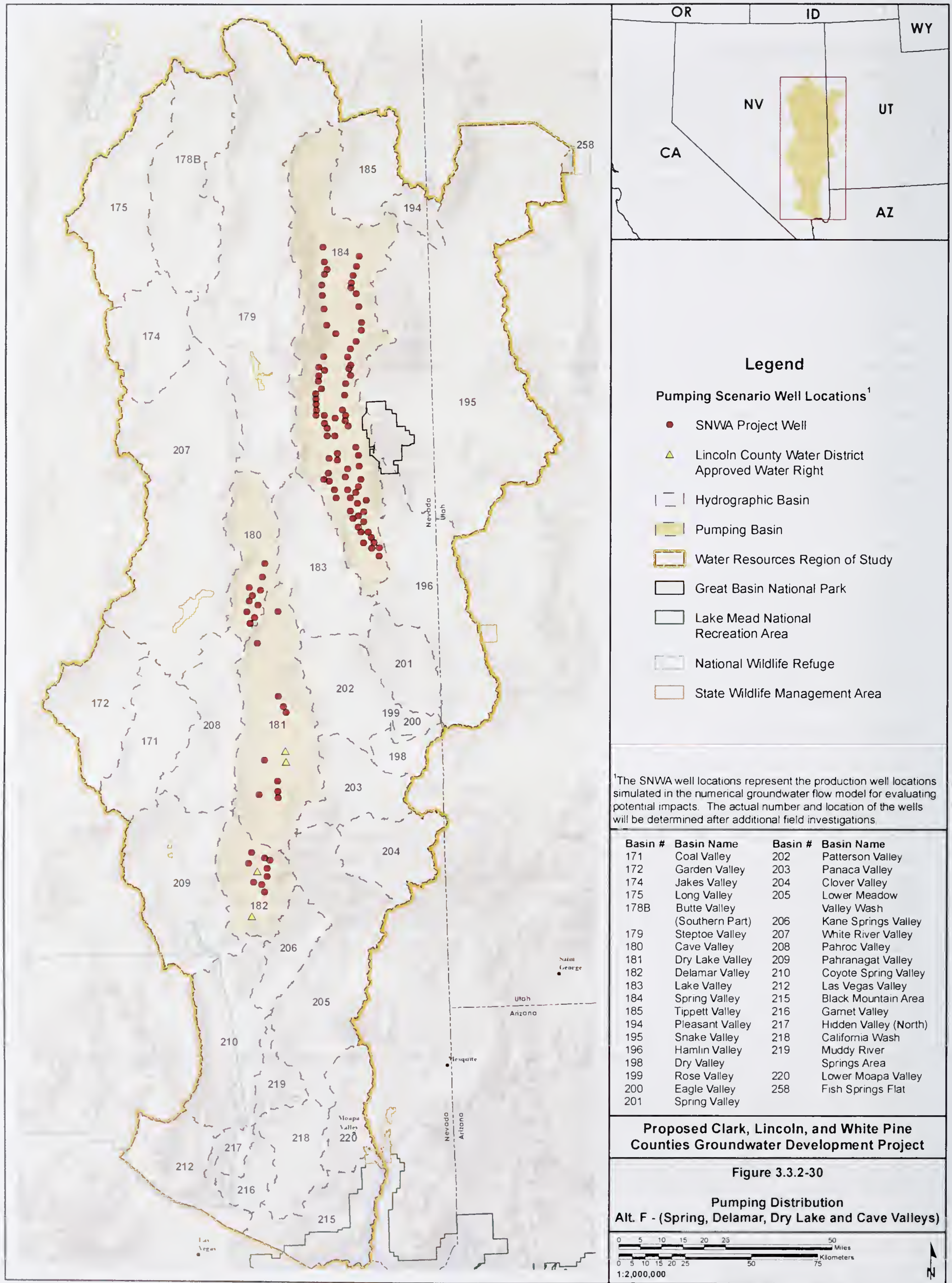
Groundwater Pumping Scenario

The groundwater pumping scenario for Alternative F assumes that no pumping would occur in Snake Valley as shown in **Figure 3.3.2-30**. The maximum groundwater production rate under this scenario is 114,129 afy for the four pumping basins (Spring, Delamar, Dry Lake, and Cave valleys). The well distribution developed by SNWA for this model scenario includes the same spatial distribution of wells included in Proposed Action for Spring, Delamar, Dry Lake, and Cave valleys. Details regarding the assumed pumping schedule used for the model simulations are provided in the model simulation report addendum (SNWA 2012a). The pumping scenarios for Alternatives E and F have similar distributed pumping in Spring, Delamar, Dry Lake, and Cave valleys and exclude pumping in Snake Valley. However, the assumed pumping rates for Alternative F (114, 129 afy) represent an increase in pumping in Spring, Delamar, and Cave valleys (and the same pumping rate in Dry Lake Valley) compared to Alternative E (78,755 afy).

Impacts to Water Levels

The predicted change in groundwater levels attributable to groundwater development under the Alternative F at full build out, full build out plus 75 years, and full build out plus 200 years are provided in **Figures 3.3.2-31**, **3.3.2-32**, and **3.3.2-33**, respectively. These figures illustrate areas where the water levels are predicted to decrease in comparison to the simulated No Action water levels. Comparison of the simulation results for the three representative points in time indicates that the drawdown area continues to progressively expand as pumping continues into the future.

At full build out, the drawdown areas are localized in the vicinity of the pumping wells in central and southern Spring Valley, southern Cave Valley, and Dry Lake Valley. Drawdown does not occur at this time period in Snake Valley.



Legend

Pumping Scenario Well Locations[1]

- SNWA Project Well
- Lincoln County Water District Approved Water Right
- Hydrographic Basin
- Pumping Basin
- Water Resources Region of Study
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

[1]The SNWA well locations represent the production well locations simulated in the numerical groundwater flow model for evaluating potential impacts. The actual number and location of the wells will be determined after additional field investigations.

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

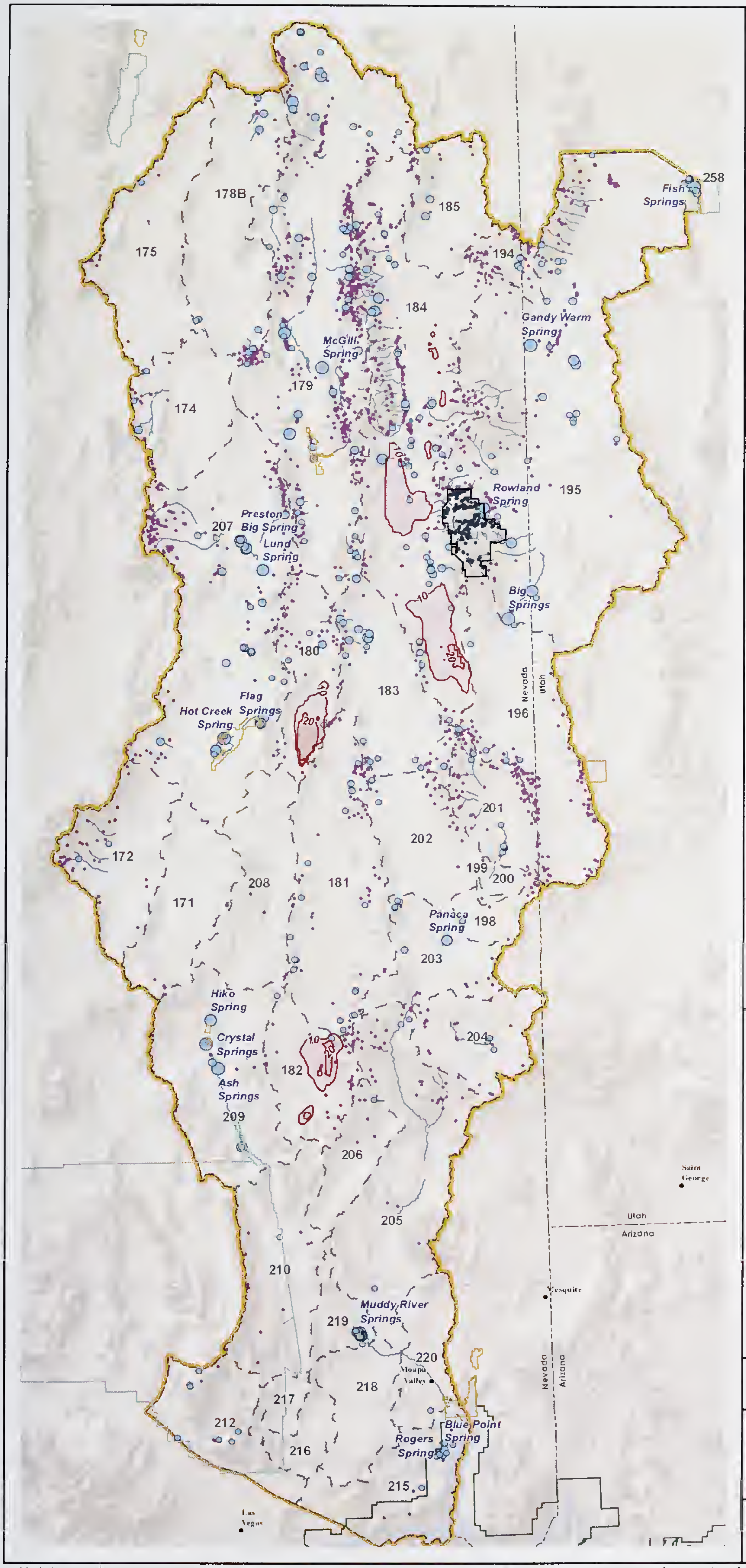
Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

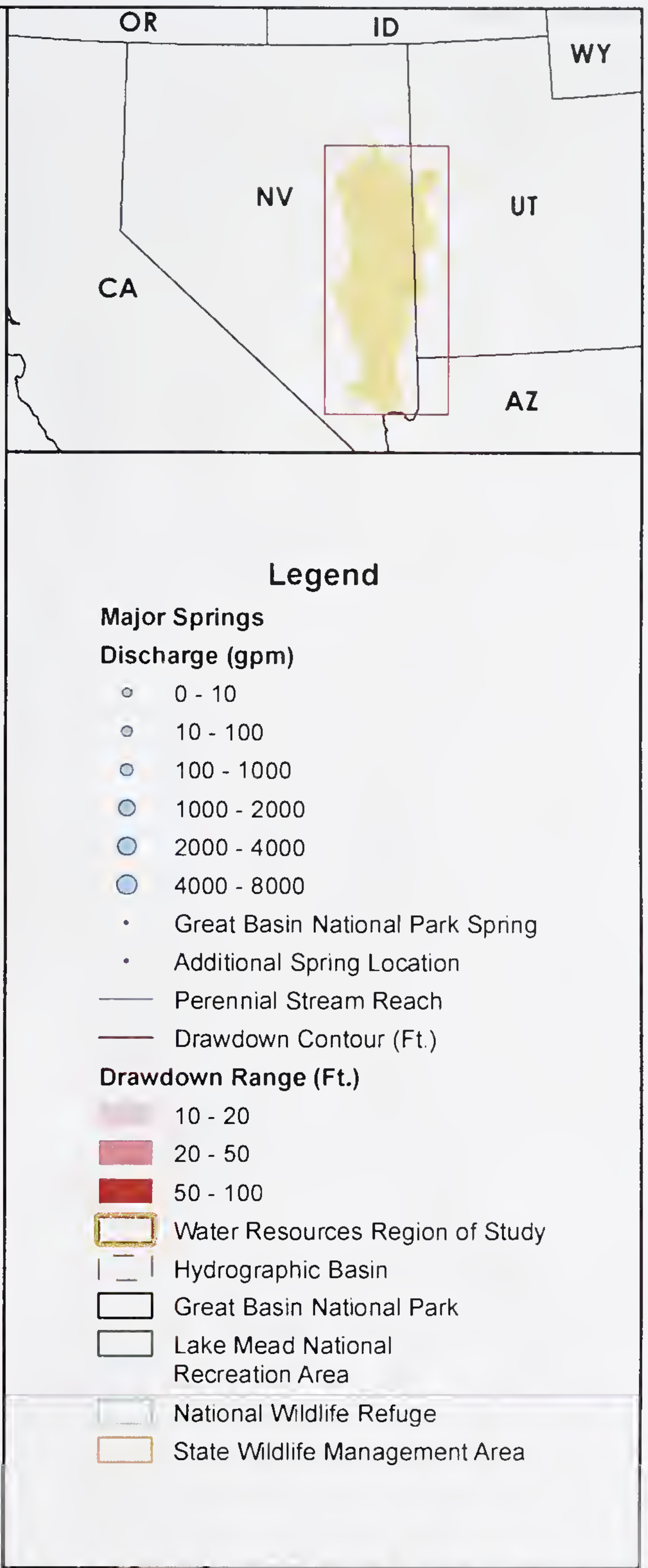
Figure 3.3.2-30

Pumping Distribution
Alt. F - (Spring, Delamar, Dry Lake and Cave Valleys)

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.





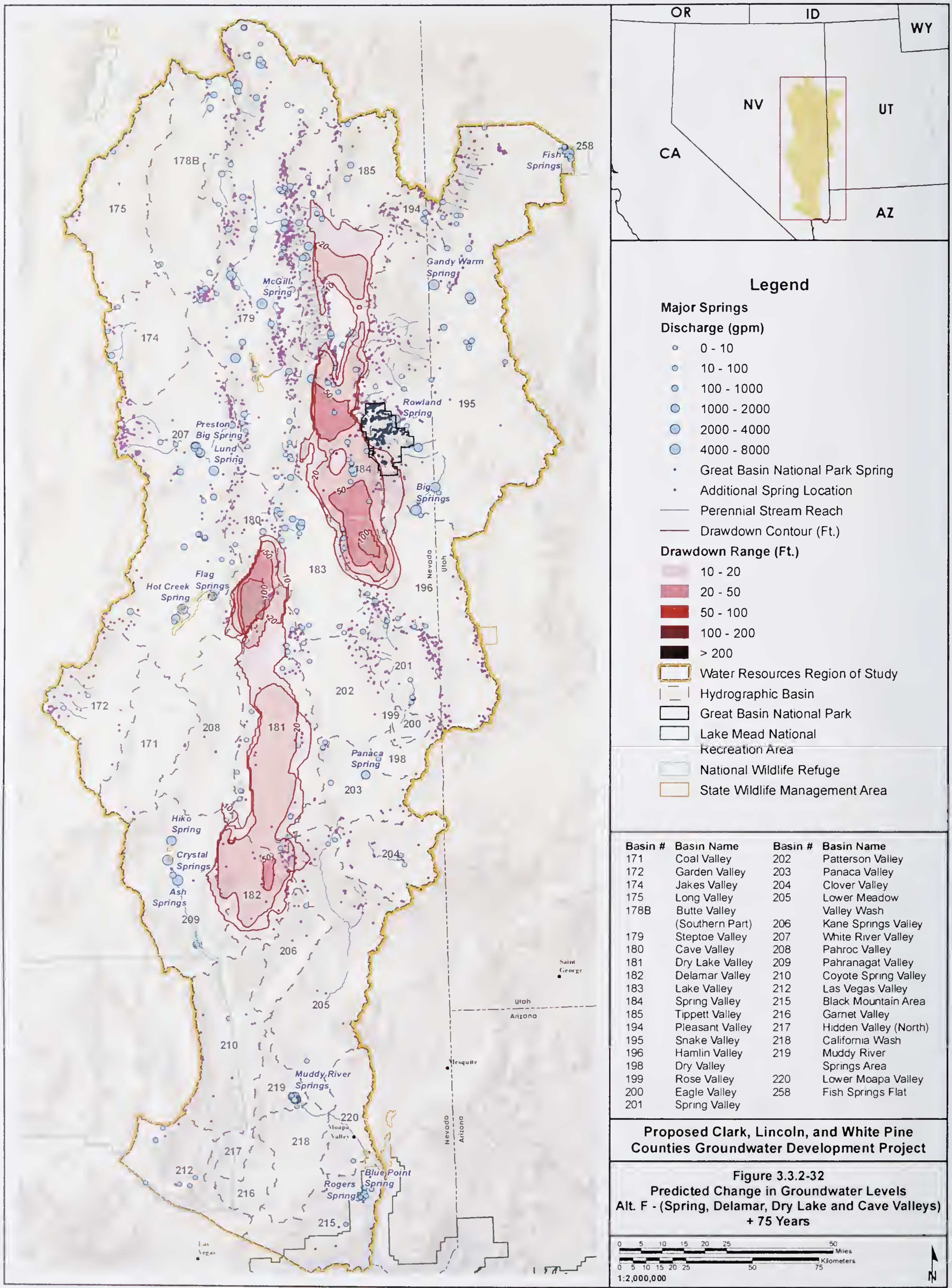
Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-31
Predicted Change in Groundwater Levels
Alt. F - (Spring, Delamar, Dry Lake and Cave Valleys)
Full Build Out

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

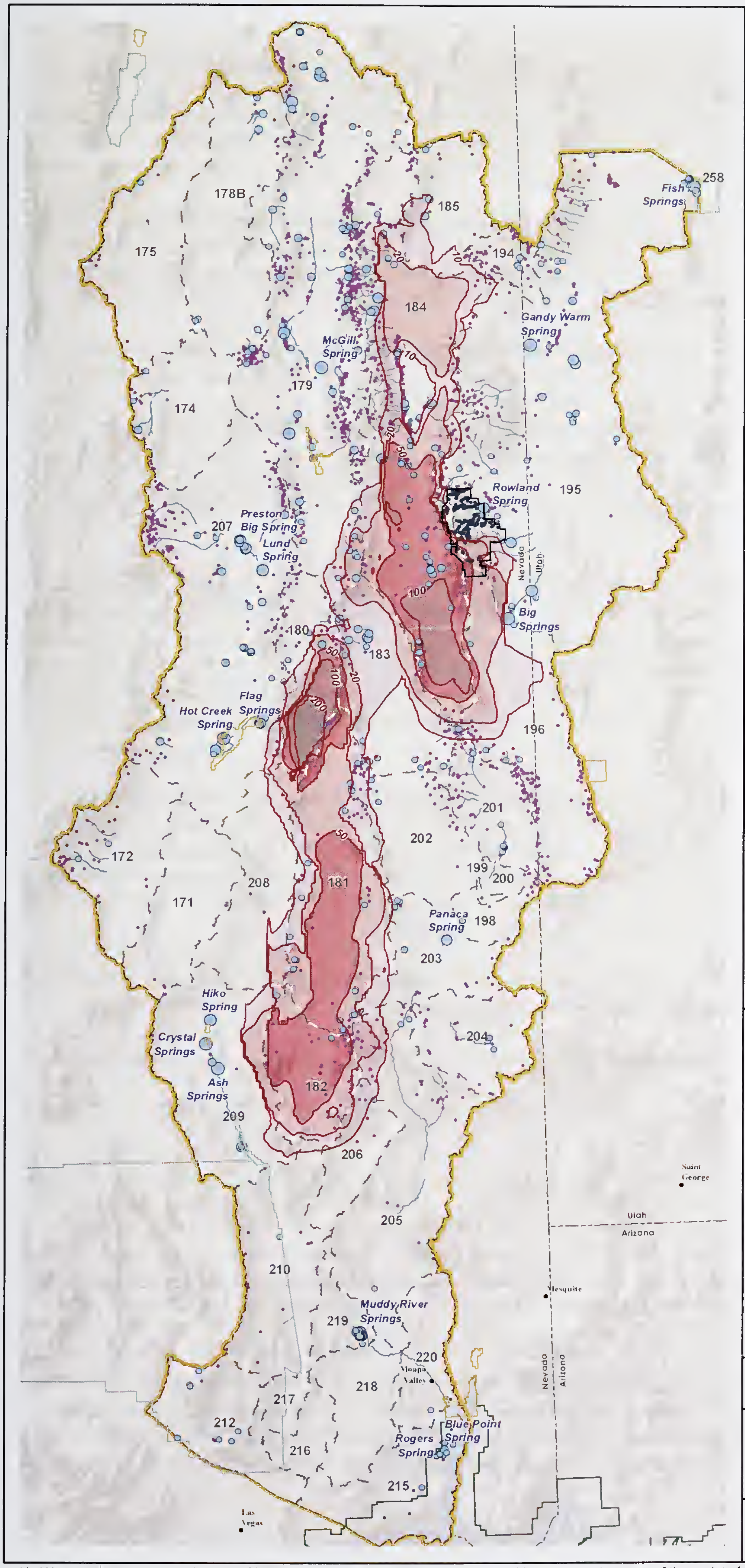


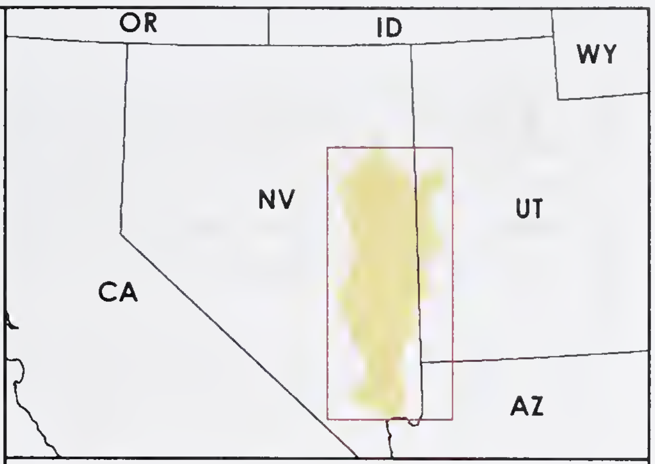
Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-32
Predicted Change in Groundwater Levels
Alt. F - (Spring, Delamar, Dry Lake and Cave Valleys)
+ 75 Years

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data





Legend

Major Springs

Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location
- Perennial Stream Reach
- Drawdown Contour (Ft.)

Drawdown Range (Ft.)

- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- > 200
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-33
Predicted Change in Groundwater Levels
Alt. F - (Spring, Delamar, Dry Lake and Cave Valleys)
+ 200 Years

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N

At the full build out plus 75 years time frame, there are two distinct drawdown areas. The northern drawdown area encompasses most of valley floor in Spring Valley, and extends into northern Hamlin Valley and along the southwest margin of Snake Valley. The southern drawdown area extends across the Delamar, Dry Lake, and Cave valleys in an elongate north-south direction and extends into the eastern margin of Pahranagat Valley and northwestern margin of Lower Meadow Valley Wash.

By the full build out plus 200 years time frame, the 2 drawdown areas merge into one that extends approximately 190 miles in a north-south direction and up to 50 miles in a east-west direction. At this time frame, the simulated drawdown area extends into Tippetts Valley, southeastern Steptoe Valley, the eastern margins of Pahroc and Pahranagat valleys, and the western margins of Panaca Valley and Lower Meadow Valley Wash.

The locations of six selected observation wells located within the proposed pumping basins are presented in **Figure 3.3.2-6**. Water-level hydrographs for each of these observation wells within the pumping basins are provided in **Figures 3.3.2-7** and **3.3.2-8**. The hydrographs illustrate the predicted rate and magnitude of water level decline at these representative locations over the simulation period. The hydrographs for the observation wells indicate that water levels are predicted to continue to decrease over the model simulation and are not predicted to reach a renewed equilibrium (or steady state condition) before the end of the simulation period. These results further suggest that with continued pumping beyond 200 years, additional drawdown is likely to occur after the model simulation period (i.e., after the full build out plus 200-year period).

The hydrographs illustrate that the magnitude of drawdown at the well in Spring Valley would be less than the Proposed Action; similar to Alternatives A, B, and E; and greater than the drawdown simulated under Alternatives D, C, and the No Action. Pumping in Spring Valley is predicted to eventually result in drawdown along the southwest margin of Snake Valley and northern portion of Hamlin Valley. As shown on **Figure 3.3.2-7**, in the vicinity of Baker in Snake Valley, the results for Alternative F (which are essentially the same as for Alternatives D and E) indicate that this alternative would substantially reduce the drawdown area in Snake Valley compared with the Proposed Action (and Alternatives A, B, and C).

The predicted magnitude of drawdown in Cave Valley is essentially the same as the Proposed Action and greater than the drawdown simulated under Alternatives A, B, C, D, E, and the No Action. The simulated drawdown in Dry Lake Valley is less than under Alternatives B; similar to the drawdown simulated for the Proposed Action and Alternatives A, D, and E; and greater than the drawdown simulated for Alternatives C and the No Action. In Delamar Valley, the simulated drawdown is less than under the Proposed Action and Alternative B, and greater than the simulated drawdown for the other alternatives (Alternatives A, C, D, E, and the No Action).

The potential for groundwater withdrawal to reduce the storage properties of the basin-fill sediments within the drawdown cone are the same as previously discussed for the Proposed Action (Section 3.3.2.9).

Potential effects to water resources resulting from the Alternative F pumping scenario are summarized in **Table 3.3.2-21**.

Impacts to Springs and Streams

The estimated potential risks to springs located within the projected drawdown area at full build out, full build out plus 75 years, and full build out plus 200 years are presented in **Figures F3.3.8A-19**, **F3.3.8A-20**, and **F3.3.8A-21**, respectively, in **Appendix F3.3.8**. The number of springs within the drawdown area and relative risk of impacts by hydrographic basin are summarized in **Table F3.3.9-7A** in **Appendix F3.3.9**. Specific inventoried springs located within the drawdown area at the representative points in time are listed in **Table F3.3.10-1A in Appendix F3.3.10**. The estimated miles of perennial streams (by hydrographic basin) located in the predicted drawdown areas where surface waters could be impacted are listed in **Table F3.3.11-7A** in **Appendix F3.3.11**.

Potential total effects to perennial springs and streams are summarized in **Table 3.3.2-21**. For the predicted drawdown area at full build out plus 75 years, there are 30 inventoried springs and 101 "other" springs located within the high and moderate risk areas. By full build out plus 200 years, this would increase to 41 inventoried springs and 162 "other" springs located within the high and moderate risk areas. These springs occur in Cave, Steptoe, Hamlin, Spring (HA 184), Snake, and Lake valleys.

Table 3.3.2-21 Summary of Potential Effects to Water Resources Resulting from the Alternative F Pumping Scenario[1,2]

Water Resource Issue / Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Drawdown:			
• Number of hydrographic basins affected by drawdown	5	10	18
Drawdown effects on perennial springs:			
• Number of inventoried springs located in areas where impacts to flow could occur[3]	1	30	41
• Number of other springs located in areas where impacts to flow could occur[4]	4	101	162
• Model-simulated flow reduction at Big Spring (as percent flow reduction)	2%	25%	83%
Drawdown effects on perennial streams:			
• Number of basins with perennial stream reaches where impacts to flow could occur	1	1	5
• Miles of perennial stream located in areas where impacts to flow could occur	1	21	46
Drawdown effects on surface water rights:			
• Number of surface water rights located in areas where impacts to flow could occur	14	88	132
Drawdown effects on groundwater rights:			
• Number of groundwater rights located within the 10-50 foot drawdown area	14	70	72
• Number of groundwater rights located within the 50-100 foot drawdown area	0	13	54
• Number of groundwater rights located within the greater than 100-foot drawdown area	0	1	5
• (Total groundwater rights in drawdown area)	(14)	(84)	(131)
Percent reduction in ET and spring discharge:[5]			
• Spring Valley	33%	73%	80%
• Snake Valley	0%	1%	3%
• Great Salt Lake Desert Flow System[1]	13%	30%	34%
• White River Flow System	0%	1%	2%
Reduction in flow from Snake Valley to Pine, Wah Wah, and Tule Valleys Hydrographic Basins[5]			
• AFY	0	10	50
• Percent Reduction	0%	0%	0%

[1] Located within the groundwater flow model domain.

[2] Unless otherwise noted, supporting information used to develop these estimated effects are provided in **Appendices F3.3.6** through **F3.3.16**.

[3] Specific inventoried springs identified in moderate or high risk areas are identified in **Table F3.3.10-1A** in **Appendix F3.3.10**.

[4] "Other Springs" are springs identified in the National Hydrography Database or topographic maps that have not been field verified.

[5] Estimate derived from the model-simulated values provided in SNWA 2010a with comparison to No Action pumping results.

The total estimated length of perennial stream located in areas where there is a high to moderate risk of impacts resulting from the predicted drawdown increases from approximately 21 miles at full build out plus 75 years to 46 miles at full build out plus 200 years. This includes stream reaches located in Pahranagat, Steptoe, Spring (HA 184), Snake, and Lake valleys.

Potential site-specific impacts to individual springs and streams affected by drawdown would be the same as discussed for the Proposed Action (Section 3.3.2.9).

Model-simulated Spring and Stream Discharge Estimates. Model-simulated changes in spring flow for selected springs are presented in **Table 3.3.2-22**. The model-simulated flows and predicted changes in flows for springs in White River Valley, other springs within the White River flow system, and Spring Valley are essentially the same as previously described for the Proposed Action. The model-simulated flows for springs in Snake Valley are similar but slightly greater than Alternative E. Big Springs in Snake Valley is predicted to experience a 25 percent reduction in flow by the full build out plus 75 years time frame, and 83 percent reduction in the full build out plus 200 year time frame. Reductions of flow at Big Springs would reduce flows in Big Springs Creek, and likely would reduce flows to Lake Creek and into Pruess Lake. The results suggest that the springs located on the valley floor in the southern portion of the valley potentially could experience a reduction in flow from pumping in Spring Valley.

Water Resources Within or Adjacent to the GBNP. Surface water resources located within or adjacent to the GBNP that occur within both the model-simulated drawdown area and the susceptibility zones identified by Elliot et al. (2006) are listed in **Table 3.3.2-8**. For the purpose of the EIS analysis, these areas are considered zones of moderate risk as defined in **Table 3.3.2-3** (i.e., impacts may occur to some perennial waters that are hydraulically connected to the regional flow system). There are no resources identified in the moderate risk zone at the full build out plus 75 years time frame, and 4.2 miles of Snake Creek at the full build out plus 200 years time frame. Potential risk to water resources (associated with the simulated drawdown) within or adjacent to the GBNP would be less under Alternative F than the Proposed Action and the alternatives that include pumping in Snake Valley (i.e., Alternatives A, B, and C).

Utah Surface Water Resources. Reduced flows at Big Springs would reduce flows in Big Springs Creek, and likely reduce flows to Lake Creek and into Pruess Lake. However, the model simulations suggest that potential flow reductions at Big Springs (and downstream in Lake Creek) likely would be less than under the other pumping alternatives except Alternative E. Also, model simulations indicate that drawdown is not expected to extend to the boundary of Snake and Pine valleys.

Impacts to Surface Water Rights

The locations and manner of use of the active surface water rights within the drawdown area at full build out, full build out plus 75years, and full build out plus 200 years are presented in **Figures F3.3.12A-19**, **F3.3.12A-20**, and **F3.3.12A-21**, respectively, in **Appendix F3.3.12**. **Table F3.3.13-7A** in **Appendix F3.3.13** lists the number of active surface water rights within the drawdown area that occur within the high-, moderate-, and low-risk areas at the three representative time frames. At full build out plus 75 years, there are a total of 88 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows. By the full build out plus 200 years time frame, there are 132 surface water rights located in areas with a moderate to high risk of impacts to surface flows. For surface water rights that are dependent on groundwater discharge, a potential reduction in the water table at the point of diversion could reduce or eliminate the flow available at the point of diversion for the surface water right.

Impacts to Groundwater Rights

Figures F3.3.14A-19, **F3.3.14A-20**, and **F3.3.14A-21** in **Appendix F3.3.14** illustrate the location and manner of use of existing groundwater rights in relation to the magnitude of the model-simulated drawdown at full build out, full build out plus 75 years, and full build out plus 200 years. **Table F3.3.15-7A** (**Appendix F3.3.15**) lists the groundwater rights by hydrographic basin within the drawdown area. At full build out plus 75 years, there are 84 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. At full build out plus 200 years, the number increases to 131 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. The potential impacts to individual wells are the same as discussed under the Proposed Action.

Table 3.3.2-22 Model-simulated Flow Changes (Alternative F Pumping)

(Project Specific)					Alternative F		
					Incremental Change in Flow % (from No-Action)		
Flow System	Hydrographic Basin	Spring	Average Flow (Actual) in gpm	Model Simulated Average Flow (2005) in gpm	Full Build-Out	75 years after Full Build-Out	200 years after Full Build-Out
White River	White River Valley (207)	Arnoldson Spring	1,608	946	0	0	-1
		Butterfield Spring	1,225	471	-1	-6	-17
		Cold Spring	582	503	0	0	-1
		Flag Springs 3	969	560	-1	-6	-16
		Hardy Springs	200	73	0	0	-1
		Hot Creek Spring	5,032	6,899	0	-1	-3
		Lund Spring	3,594	3,314	0	0	-1
		Moon River Spring	1,707	1,457	0	0	-1
		Moorman Spring	405	353	0	-1	-2
		Nicolas Spring	1,185	872	0	0	-1
		Preston Big Spring	3,572	3,794	0	0	-1
	Pahranagat Valley (209)	Ash Springs	6,909	7,453	0	0	-1
		Brownie Spring	224	277	0	0	0
		Crystal Springs	4,235	4,647	0	0	-1
		Hiko Spring	2,735	1,985	0	0	-1
	Muddy River Springs Area (219)	Muddy River near Moapa[1]	20,931	15,383	0	0	-1
	Lower Moapa Valley (220)	Muddy River near Glendale[1]	19,565	14,895	0	0	-1
	Black Mountains Area (215)	Blue Point Spring	223	393	0	0	0
		Rogers Spring	771	515	0	0	0
Goshute Valley	Steptoe Valley (179)	Campbel Ranch Springs	2,746	2,088	0	0	0
		Currie Spring	2,181	1,419	0	0	0
		McGill Spring	4,783	2,074	0	0	0
		Monte Neva Hot Springs	649	280	0	0	-1
Great Salt Lake Desert	Spring Valley (184)	Keegan Spring	234	63	-35	-98	-100
		North Millick Spring	284	98	-20	-52	-60
		South Millick Spring	506	278	-36	-86	-95
	Snake Valley (195)	Big Springs	4,289	1,977	-2	-25	-83
		Foote Res. Spring	1,300	211	0	0	0
		Kell Spring	120	59	0	0	0
		Warm Creek near Gandy, Utah	7,426	2,697	0	0	-1
Meadow Valley	Panaca Valley (203)	Panaca Spring	1,455	1,208	0	0	0

[1] Simulated using Stream Flow Routing 2 package for MODFLOW.

Source: SNWA 2012a.

Impacts to Water Balance

The model-simulated groundwater budget for the Alternative F pumping scenario is presented in **Appendix F3.3.16, Table F3.3.16-7B**. Compared to the simulated conditions under the No Action for Spring Valley, the pumping is estimated to result in a 73 percent reduction of groundwater discharge for ET at the full build out plus 75 years time frame and 80 percent reduction at full build out plus 200 years time frame. In Snake Valley, the pumping is estimated to result in minimal reductions (less than 4 percent) of groundwater discharge to support ET. Alternative F pumping is estimated to have minimal impact (1 percent or less) on ET discharge within the White River Flow System and reductions of flow to Pine, Wah Wah, and Tule valleys and Fish Springs.

Water Quality

Potential impacts to water quality would be the same as described under the Proposed Action.

Monitoring and Mitigation Recommendations

Additional mitigation recommendations GW-WR-3a (Comprehensive Water Resources Monitoring Plan) and GW-3b (Numerical Groundwater Flow Modeling Requirements); GW-WR-4 (Monitoring, Mitigation and Management Plan for Snake Valley); GW-WR-5 (Shoshone Ponds Mitigation); GW-WR-6 (Water Rights Mitigation); and GW-WR-7 (Groundwater Development & Drawdown Effects to Federal Resources and Federal Water Rights) described under the Proposed Action, and the COM Plan described in Section 3.20, Monitoring and Mitigation Summary, would apply to Alternative F.

Potential Residual Impacts

Potential unavoidable residual impacts associated with the groundwater development are described under the Proposed Action. The magnitude of potential unavoidable adverse impacts would be similar to the Proposed Action in Spring, Delamar, Dry Lake, and Cave valleys. The magnitude of potential unavoidable adverse impacts to Snake Valley also would be considerably less than the Proposed Action and Alternatives A, B, and C since there would be no pumping in Snake Valley.

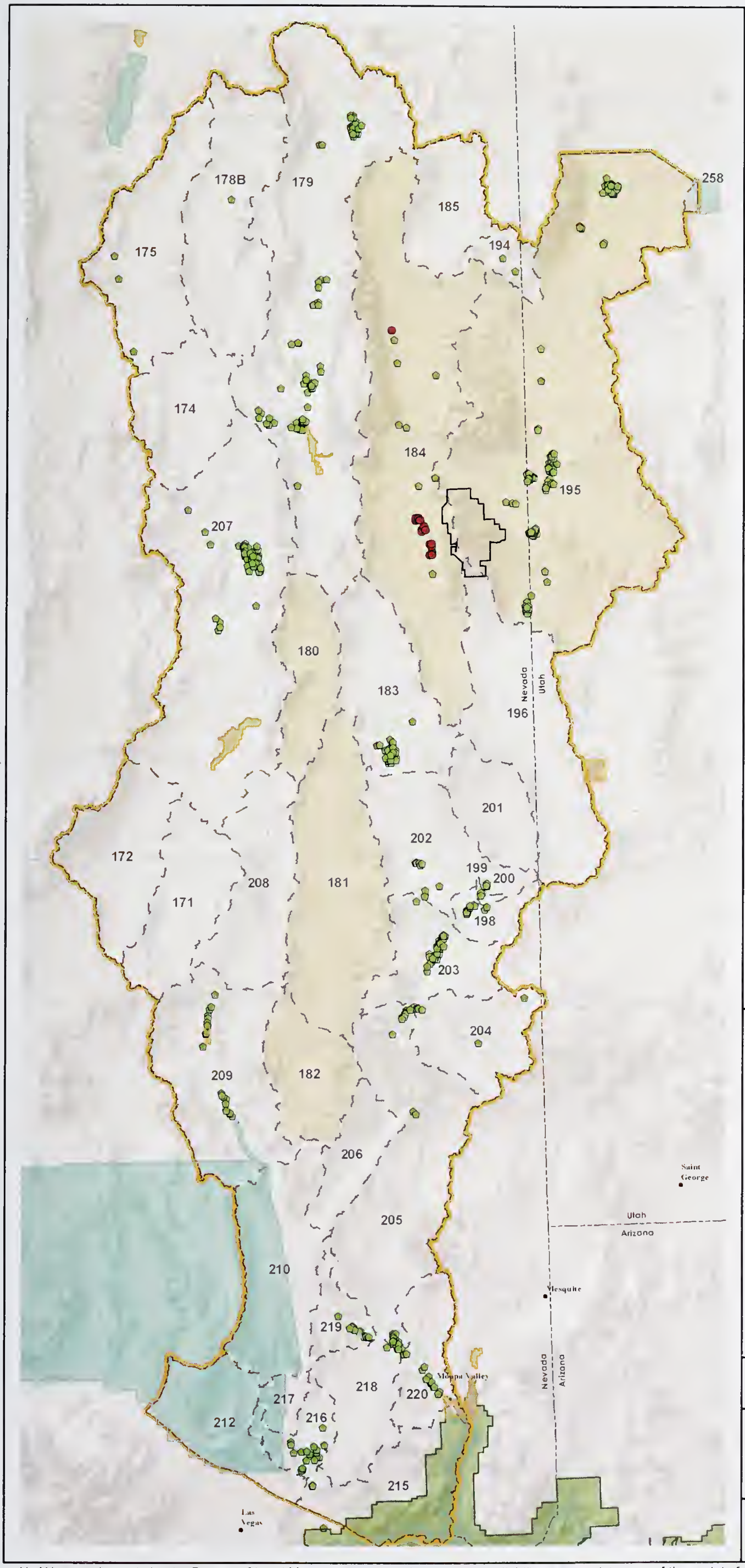
3.3.2.16 No Action

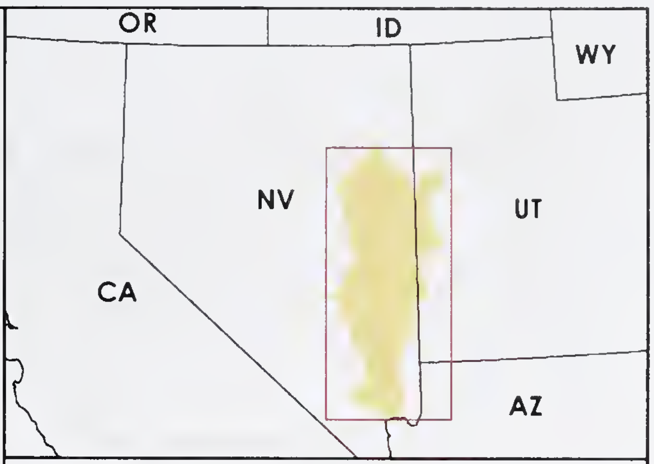
As described in Chapter 2, the No Action assumes that the BLM would not grant ROWs for the proposed project. Under this scenario, the proposed pipelines, power lines, ancillary facilities, and well fields would not be developed. Therefore, no construction or operational impacts to water resources would be associated with the proposed GWD Project.

Groundwater Pumping

Groundwater Pumping Scenario

The locations of the groundwater development wells assumed for modeling of the No Action pumping scenario are shown in **Figure 3.3.2-34**. The pumping scenario used for the No Action represents a continuation of currently existing water uses over the duration of the future model simulation period. The No Action also includes pumping SNWA's existing water rights associated with their ranch properties in Spring Valley (SNWA 2010b). The No Action groundwater pumping scenario is based on the estimates of existing consumptive water use for the model area for agricultural, municipal, mining and milling, industrial, and power plant uses as described in the transient numerical model report (SNWA 2009b). Other uses associated with domestic wells and stock watering wells are not included; however, these are assumed to represent a relatively small percentage of the estimated consumptive uses in the model area (SNWA 2009b). Additional information on the methodology used to derive the consumptive water-use estimates and identified points of diversion are provided in **Appendix C** of the transient numerical model report (SNWA 2009b).





Legend

Pumping Scenario Well Locations

- Existing Pumping Well[1]
- SNWA - Owned Properties[2]
- Hydrographic Basin
- Pumping Basin
- Region of Study
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

[1]Based on water rights and estimated consumptive uses for agricultural, mining and milling, industrial and power plant, and municipal purposes (SNWA 2009b).

[2]Existing water rights associated with SNWA owned ranch properties in Spring Valley

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-34
Pumping Distribution
No Action

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N

Impacts to Water Levels

The predicted changes in groundwater levels attributable to the No Action pumping scenario at the full build out time frame[2], full build out plus 75 years time frame, and full build out plus 200 years time frame are provided in **Figures 3.3.2-35**, **3.3.2-36**, and **3.3.2-37**, respectively. These figures illustrate areas where the water levels are predicted to decrease in comparison to the baseline groundwater elevations at the end of 2004. It is important to understand that these drawdowns are predicted to occur without any groundwater development associated with the proposed project.

Comparison of the simulation results indicate that the drawdown effects under the No Action continue to expand as pumping continues into the future. At the full build out time frame, the largest drawdown area encompasses the southern portion of Lake Valley and northern Patterson Valley. Other smaller drawdown cones are localized in the near vicinity of pumping centers.

At the full build out plus 75 years time frame, there are 3 major drawdown areas. The largest drawdown area extends in a north-south direction from Lake Valley south to the northern margin of Meadow Valley Wash, a distance of approximately 70 miles. The two other major drawdown areas occur in the northern portion of White River Valley, and along the southern margin of the model area in the Black Mountain Area and Las Vegas Valley hydrographic basins.

At the full build out plus 200 years time frame, the drawdown area that extends from the Lake Valley to Lower Meadow Valley Wash hydrographic basins is up to 85 miles long (north-south). The drawdown areas in White River Valley and along the southern margin of the model area also are predicted to continue to expand between the time frames associated with full build out plus 75 years and full build out plus 200 years.

Water-level hydrographs for each of these observation wells within the pumping basins provided in **Figures 3.3.2-7** and **3.3.2-8** show the predicted rate and magnitude of water level decline at these representative locations over the simulation period. The hydrographs indicate that water levels are relatively steady or exhibit minor drawdown (less than 10 feet) in all of the pumping basins over the model simulation period compared to the other groundwater development alternatives.

The potential for groundwater withdrawal to reduce the storage properties of the basin-fill sediments within the drawdown cone are the same as previously discussed for the Proposed Action (Section 3.3.2.9).

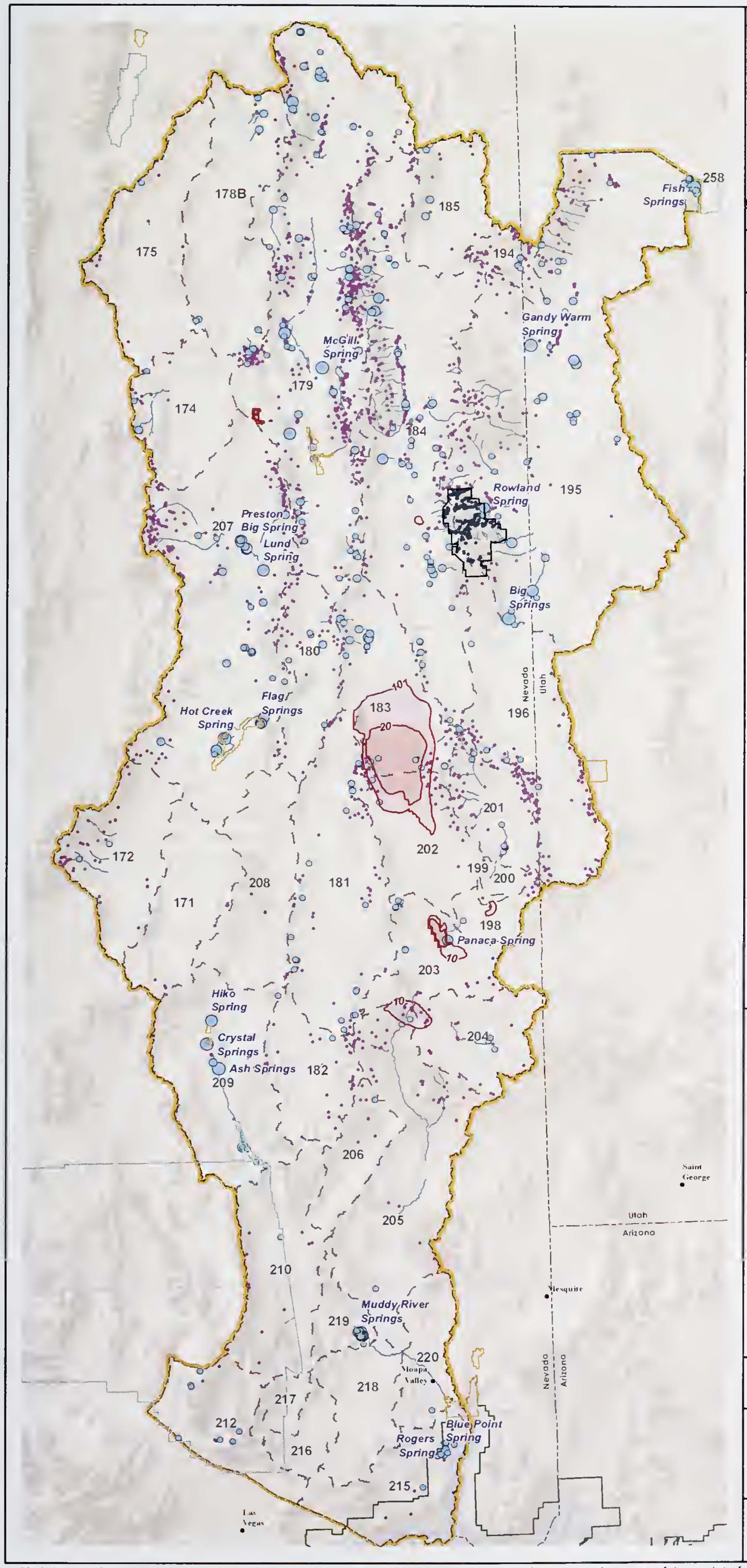
Potential effects to water resources resulting from the No Action pumping scenario are summarized in **Table 3.3.2-23**.

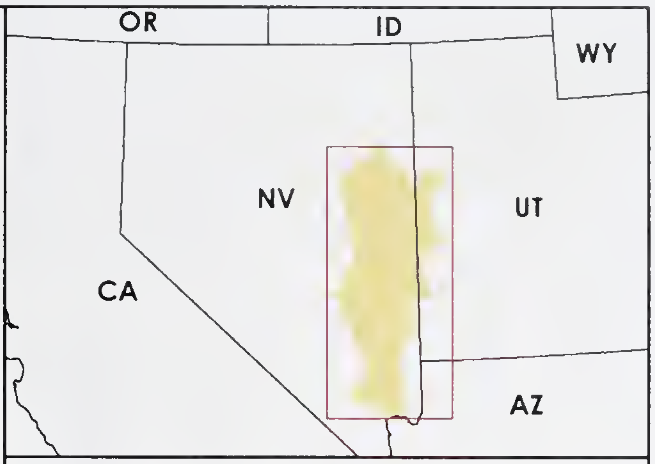
Impacts to Springs and Streams

The estimated potential risks to springs located within the projected drawdown area at the full build out, full build out plus 75 years, and full build out plus 200 years time frames are presented in **Figures F3.3.8A-22**, **F3.3.8A-23**, and **F3.3.8A-24** (**Appendix F3.3.8**), respectively. The springs within the drawdown area and relative risk of impacts by hydrographic basin is summarized in **Table F3.3.9-8A** (**Appendix F3.3.9**). The estimated miles of perennial streams (by hydrographic basin) located in the predicted drawdown areas where surface waters could be impacted are listed in **Table F3.3.11-8A** in **Appendix F3.3.11**.

---

[2] The term "full build out time frame" refers to representative points in time in the future that were selected for comparison of potential effects associated with each of the alternatives. The full build out time frame corresponds to full build out of the groundwater development project as defined for Proposed Action.





Legend

Major Springs

Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location
- Perennial Stream Reach
- Drawdown Contour (Ft.)

Drawdown Range (Ft.)

- 10 - 20
- 20 - 50
- 50 - 100
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

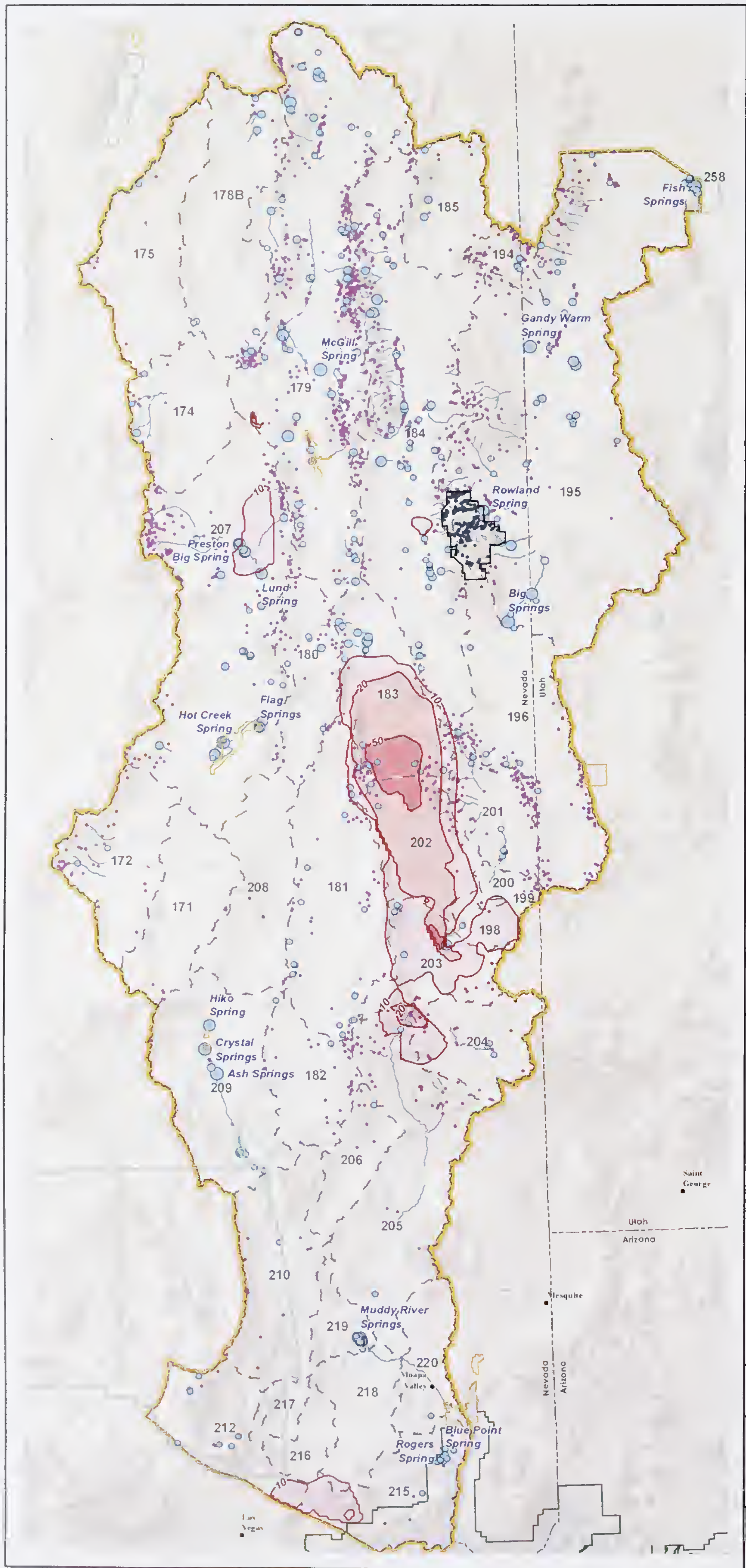
Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

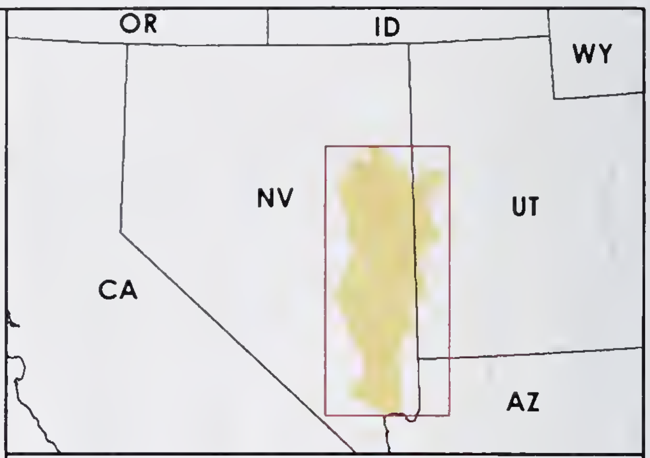
Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-35
Predicted Change in Groundwater Levels
No Action
Full Build Out

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000

N





Legend

Major Springs

Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location
- Perennial Stream Reach
- Drawdown Contour (Ft.)

Drawdown Range (Ft.)

- 10 - 20
- 20 - 50
- 50 - 100
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
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194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

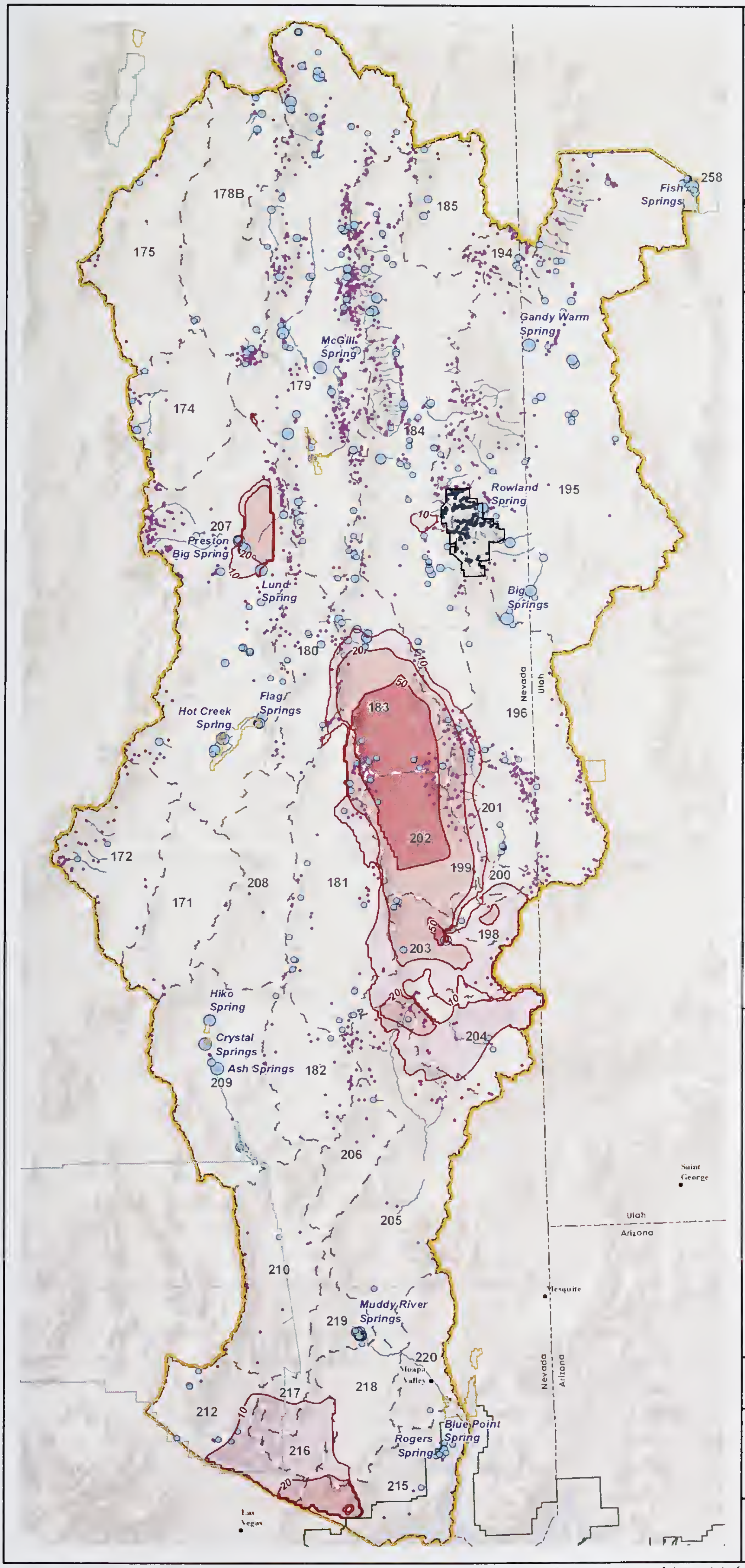
Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

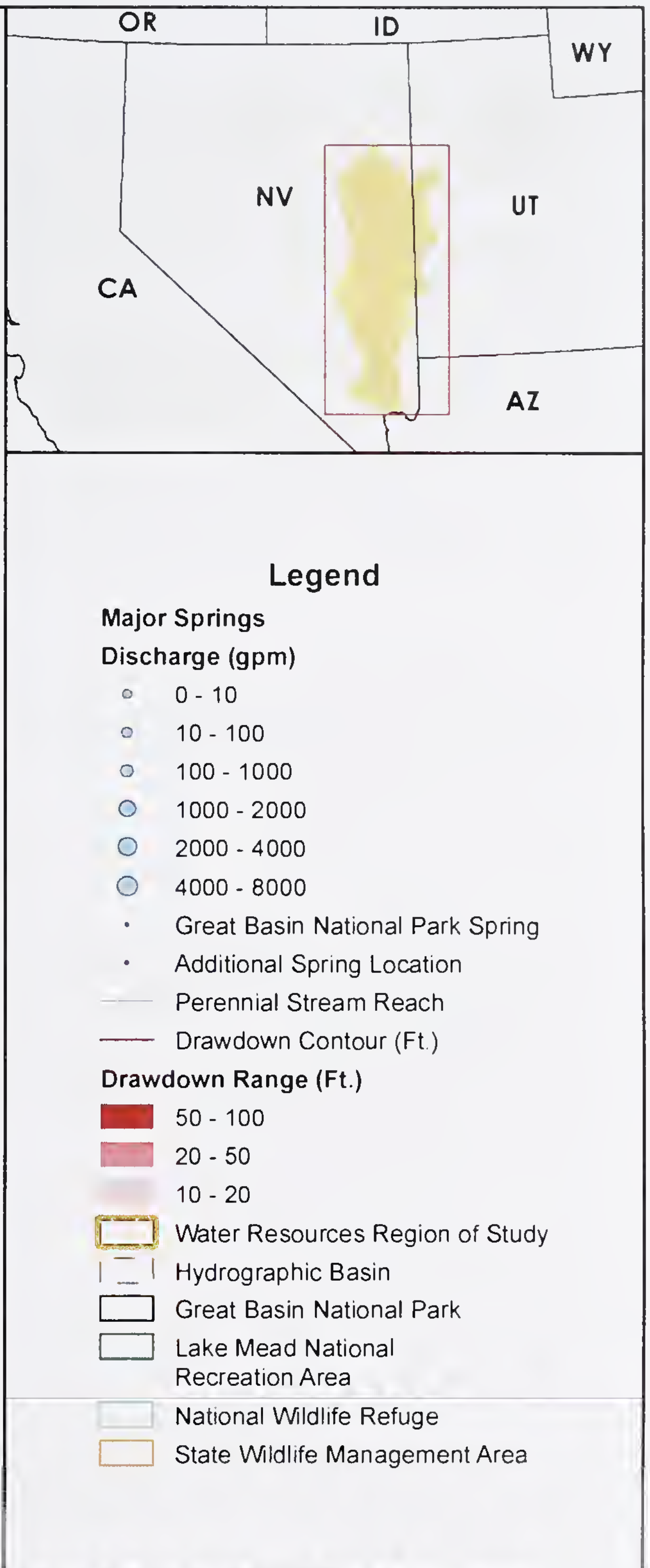
Figure 3.3.2-36
Predicted Change in Groundwater Levels
No Action
+ 75 Years

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000

N

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data





Basin #	Basin Name	Basin #	Basin Name
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196	Hamlin Valley	219	Muddy River Springs Area
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199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-37
Predicted Change in Groundwater Levels
No Action
+ 200 Years

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

Table 3.3.2-23 Summary of Potential Effects to Water Resources Resulting from the No Action Pumping Scenario[1,2]

Water Resource Issue / Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Drawdown:			
• Number of hydrographic basins affected by drawdown	10	18	20
Drawdown effects on perennial springs:			
• Number of inventoried springs located in areas where impacts to flow could occur[3]	6	12	20
• Number of other springs located in areas where impacts to flow could occur[4]	22	34	66
• Model-simulated flow reduction at Big Spring (as percent flow reduction)	9%	13%	16%
Drawdown effects on perennial streams:			
• Number of basins with perennial stream reaches where impacts to flow could occur	3	6	7
• Miles of perennial stream located in areas where impacts to flow could occur	7	19	52
Drawdown effects on surface water rights:			
• Number of surface water rights located in areas where impacts to flow could occur	58	105	164
Drawdown effects on groundwater rights:			
• Number of groundwater rights located within the 10-50 foot drawdown area	174	281	293
• Number of groundwater rights located within the 50-100 foot drawdown area	1	91	116
• Number of groundwater rights located within the greater than 100-foot drawdown area	0	0	0
• (Total groundwater rights in drawdown area)	(175)	(372)	(409)
Percent reduction in ET and spring discharge[5]:			
• Spring Valley	5%	7%	7%
• Snake Valley	2%	3%	3%
• Great Salt Lake Desert Flow System[1]	3%	5%	5%
• White River Flow System	2%	3%	4%
Reduction in flow from Snake Valley to Pine, Wah Wah, and Tule Valleys Hydrographic Basins[5]:			
• AFY	0	0	0
• Percent Reduction	0%	0%	0%

[1] Located within the groundwater flow model domain.

[2] Unless otherwise noted, supporting information used to develop these estimated effects are provided in **Appendices F3.3.5** through **F3.3.16**.

[3] Specific inventoried springs identified in moderate or high risk areas are identified in **Table F3.3.10-1A** in **Appendix F3.3.10**.

[4] "Other Springs" are springs identified in the National Hydrography Database or topographic maps that have not been field verified.

[5] Estimate derived from the model-simulated values provided in SNWA 2010a with comparison to simulated 2004 conditions.

For the predicted drawdown area at full build out plus 75 years, there are 12 inventoried springs and 34 "other" springs located within the high and moderate risk areas. By full build out plus 200 years, this increased to 20 inventoried springs and 66 "other" springs located within the high and moderate risk areas. These springs occur in White River, Spring (HA 184), Lake, Spring (HA 201), Panaca, and Clover valleys, Lower Meadow Valley Wash, and Las Vegas Valley.

The total estimated length of perennial streams located in areas where there is a high to moderate risk of impacts resulting from the predicted drawdown increases from approximately 19 miles at full build out plus 75 years to 52 miles at full build out plus 200 years time frame. This includes stream reaches located in White River, Spring (HA 184), Lake, Spring (HA 201), Patterson, Eagle, Dry, Panaca, Clover valleys, and Lower Meadow Valley Wash.

Potential site-specific impacts to individual springs and streams affected by drawdown would be the same as discussed for the Proposed Action.

Model-simulated Spring and Stream Discharge Estimates. Model-simulated changes in spring flow for selected springs are presented in **Table 3.3.2-24**. Spring discharges simulated at 11 springs within White River Valley were used for this evaluation. At the full build out plus 75 years and full build out plus 200 year time frame, there are 4 springs (Arnoldson Spring, Cold Spring, Nicholas Spring, and Preston Big Spring in White River Valley) with a predicted reduction of 5 percent or greater. For these springs, the model simulations indicate flow reductions of less than 10 percent for all three time periods.

The model results also indicate that the continuation of existing pumping simulated under the No Action is not predicted to result in a measurable flow reduction (i.e., greater than 5 percent) in discharge at regional springs in Pahranagat Valley within the White River Flow System. However, the existing pumping in the Muddy River Springs Area, Lower Meadow Valley Wash, and Lower Moapa Valley hydrographic basins is predicted to result in a progressive reduction of flow over time in the Muddy River. At the full build out plus 200 years time frame, the flows in the Muddy River are predicted to be reduced by 9 percent at Moapa, 10 percent near Glendale, and 60 percent at Overton. (Note that the numerical model simulations do not account for the existing Muddy River Memorandum of Agreement regarding groundwater withdrawal in Coyote Spring Valley and California Wash basins, among the SNWA, Moapa Valley Water District, Coyote Spring Investment, Moapa Band of Paiutes, and USFWS, which includes minimum in-stream flow levels. The groundwater model could not address these minimum in-stream flow requirements, thus they are not reflected in the simulation results. Based on the agreement, potential flow reductions under the No Action pumping scenario are anticipated to be less than those simulated by the model.)

In the Great Salt Lake Desert Flow System, the model simulations results indicate that the No Action pumping would not impact flows at Keegan, North Millick, and South Millick springs in Spring Valley. In Snake Valley, Big Springs is predicted to experience flow reductions of 13 and 16 percent at the full build out plus 75 years and full build out plus 200 years time frame, respectively. As with the Proposed Action, the No Action is not predicted to reduce flows in the 4 other simulated springs located in the central portion of Snake Valley (Foote Reservoir Spring, Kell Spring, and Warm Creek near Gandy).

Water Resources Within or Adjacent to the GBNP. Surface water resources located within or adjacent to Great Basin National Park that occur within both the model-simulated drawdown area and the susceptibility zones identified by Elliot et al. (2006) are listed in **Table 3.3.2-8**. For the purpose of the EIS analysis, these areas are considered zones of moderate risk as defined in **Table 3.3.2-3** (i.e., impacts may occur to some perennial waters that are hydraulically connected to the regional flow system). The simulation results indicate there are no water resources identified in the moderate risk zone at the full build out plus 75 years time frame or the full build out plus 200 years time frame. These results indicate that a continuation of existing pumping under the No Action alternative presents the least amount of risk to water resources (associated with the simulated drawdown) within or adjacent to GBNP when compared to similar results related to the Proposed Action and all other pumping alternatives evaluated under this EIS.

Utah Surface Water Resources. The predicted small reduction in flow at Big Springs under the No Action would result in small reductions in flow to Big Springs Creek, Lake Creek, and into Pruess Lake. However, the No Action model simulations suggest that potential flow reductions at Big Springs (and downstream in Lake Creek) would be considerably less than under all other pumping alternatives. The model simulations also indicate that, like

Table 3.3.2-24 Model-simulated Flow Changes (No Action Pumping)

(Project Specific)					No Action		
					Incremental Change in Flow % (from Current Conditions)		
Flow System	Hydrographic Basin	Spring	Average Flow (Actual) in gpm	Model-simulated Average Flow (2005) in gpm	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
White River	White River Valley (207)	Arnoldson Spring	1,608	946	-4	-6	-8
		Butterfield Spring	1,225	471	0	-1	-3
		Cold Spring	582	503	-3	-6	-8
		Flag Springs 3	969	560	0	-1	-3
		Hardy Springs	200	73	-1	-2	-2
		Hot Creek Spring	5,032	6,899	0	-1	-1
		Lund Spring	3,594	3,314	0	0	-1
		Moon River Spring	1,707	1,457	0	0	0
		Moorman Spring	405	353	0	-1	-1
		Nicolas Spring	1,185	872	-5	-7	-9
		Preston Big Spring	3,572	3,794	-2	-5	-7
	Pahranagat Valley (209)	Ash Springs	6,909	7,453	0	-1	-1
		Brownie Spring	224	277	0	0	0
		Crystal Springs	4,235	4,647	-1	-1	-2
		Hiko Spring	2,735	1,985	-1	-2	-3
	Muddy River Springs Area (219)	Muddy River near Moapa[1]	20,931	15,383	-4	-6	-9
	Lower Moapa Valley (220)	Muddy River near Glendale[1]	19,565	14,895	-5	-7	-10
	Black Mountains Area (215)	Blue Point Spring	223	393	0	-1	-2
		Rogers Spring	771	515	0	-1	-2
Goshute Valley	Steptoe Valley (179)	Campbel Ranch Springs	2,746	2,088	0	0	-1
		Currie Spring	2,181	1,419	0	-1	-1
		McGill Spring	4,783	2,074	0	0	0
		Monte Neva Hot Springs	649	280	0	-1	-1
Great Salt Lake Desert	Spring Valley (184)	Keegan Spring	234	63	-2	-2	-2
		North Millick Spring	284	98	0	0	0
		South Millick Spring	506	278	-1	-1	-1
	Snake Valley (195)	Big Springs	4,289	1,977	-9	-13	-16
		Foote Res. Spring	1,300	211	0	0	0
		Kell Spring	120	59	0	0	0
		Warm Creek near Gandy, Utah	7,426	2,697	0	0	0
Meadow Valley	Panaca Valley (203)	Panaca Spring	1,455	1,208	-2	-5	-7

[1] Simulated using Stream Flow Routing 2 package for MODFLOW.

Source: SNWA 2010b.

Alternative E, drawdown is not expected to extend to the boundary of Snake and Pine valleys. As a result, it is not anticipated that surface water or groundwater resources would be impacted in Pine Valley as a result of a continuation of existing pumping under the No Action.

Impacts to Surface Water Rights

The locations and manner of use of the active surface water rights within the simulated drawdown area for the No Action at the full build out, full build out plus 75 years time frame, and full build out plus 200 years time frame are presented in **Figures F3.3.12A-22**, **F3.3.12A-23**, and **F3.3.12A-24**, respectively, in **Appendix F3.3.12. Table F3.3.13-7A** in **Appendix F3.3.7** lists the number of active surface water rights within the drawdown area that occur within the high-, moderate-, and low-risk areas at the three representative time frames. At full build out plus 75 years, there are a total of 105 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows. By the full build out plus 200 years time frame, there are 164 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows. For surface water rights that are dependent on groundwater discharge, a potential reduction in the water table at the point of diversion could reduce or eliminate the flow available at the point of diversion for the surface water right.

Impacts to Groundwater Rights

Figures F3.3.14A-22, **F3.3.14A-23**, and **F3.3.14A-24** in **Appendix F3.3.14** illustrate the location and manner of use of existing groundwater rights in relation to the magnitude of the model-simulated drawdown at full build out, full build out plus 75 years, and full build out plus 200 years. **Table F3.3.15-8A** (**Appendix F3.3.15**) lists the groundwater rights by hydrographic basin within the drawdown area. At full build out plus 75 years, there are 372 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. At full build out plus 200 years, the number increases to 409 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. The potential impacts to individual wells are the same as discussed under the Proposed Action.

Impacts to Water Balance

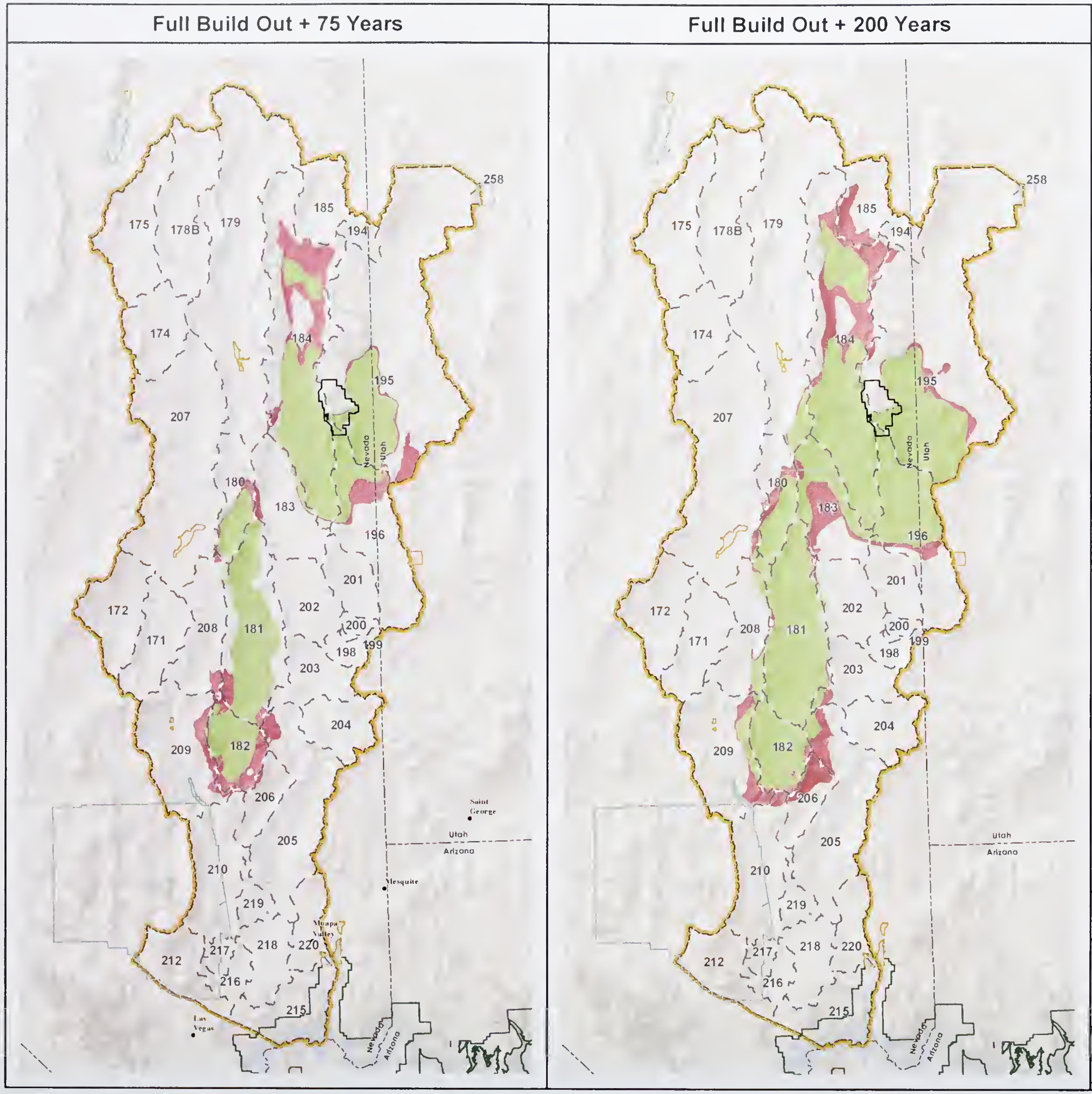
The model-simulated groundwater budget for the No Action pumping scenario is presented in **Appendix F3.3.16**, **Table F3.3.16-8B**. Compared to the simulated conditions in 2005 for Spring Valley, the No Action pumping is estimated to result in a 7 percent reduction of groundwater discharge for ET at the full build out plus 75 years and full build out plus 200 years time frames. In Snake Valley, the pumping is estimated to result in minimal reductions (less than 4 percent) of groundwater discharge to support ET. The pumping is estimated to result in a 3 to 4 percent reduction in groundwater discharge ET and springs within the White River Flow System. Reductions of flow to Pine, Wah Wah, and Tule valleys and Fish Springs are not predicted.

3.3.2.17 Summary and Comparison of Alternative Pumping Scenarios

Impacts to Water Levels

The drawdown areas predicted for the Proposed Action at the full build out plus 75 years and full build out plus 200 years time frame are compared to the drawdown areas for the various alternative pumping scenarios in **Figures 3.3.2-38** to **3.3.2-44**. All of the project pumping scenarios (Proposed Action and Alternatives A through F) simulation results indicate that the drawdown area continues to progressively expand as pumping continues into the future. The alternatives with the highest groundwater withdrawal volumes (Proposed Action and Alternative B) show the largest drawdown effects; and the alternatives with the lower groundwater withdrawal volume (Alternatives C, D, and E) show the smallest drawdown effects.

The groundwater pumping scenario for the Proposed Action assumes pumping at the full quantities (i.e., approximately 177,000 afy) listed on the pending water rights application for the five proposed project pumping basins (Spring, Snake, Delamar, Dry Lake, and Cave valleys). The well distribution developed by the SNWA for this model scenario distributes the simulated production wells spatially within the groundwater development areas in an effort to minimize pumping effects to surface water resources. For the Proposed Action pumping scenario, at full build out plus 75 years time frame, there are two distinct drawdown areas (**Figure 3.3.2-38**). The northern drawdown area encompasses most of valley floor in Spring Valley, southern Snake Valley, and northern Hamlin Valley. The southern drawdown area extends across the Delamar, Dry Lake, and Cave valleys in an elongate north-south direction and extends into the



Legend

10 Ft. Drawdown Polygon

- Proposed Action
- Area Common to Proposed Action and Alternative A
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
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184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-38

Drawdown Area Comparison
Alternative A vs. Proposed Action

0 5 10 15 20 25 50 75 Miles
0 10 20 30 40 50 100 Kilometers

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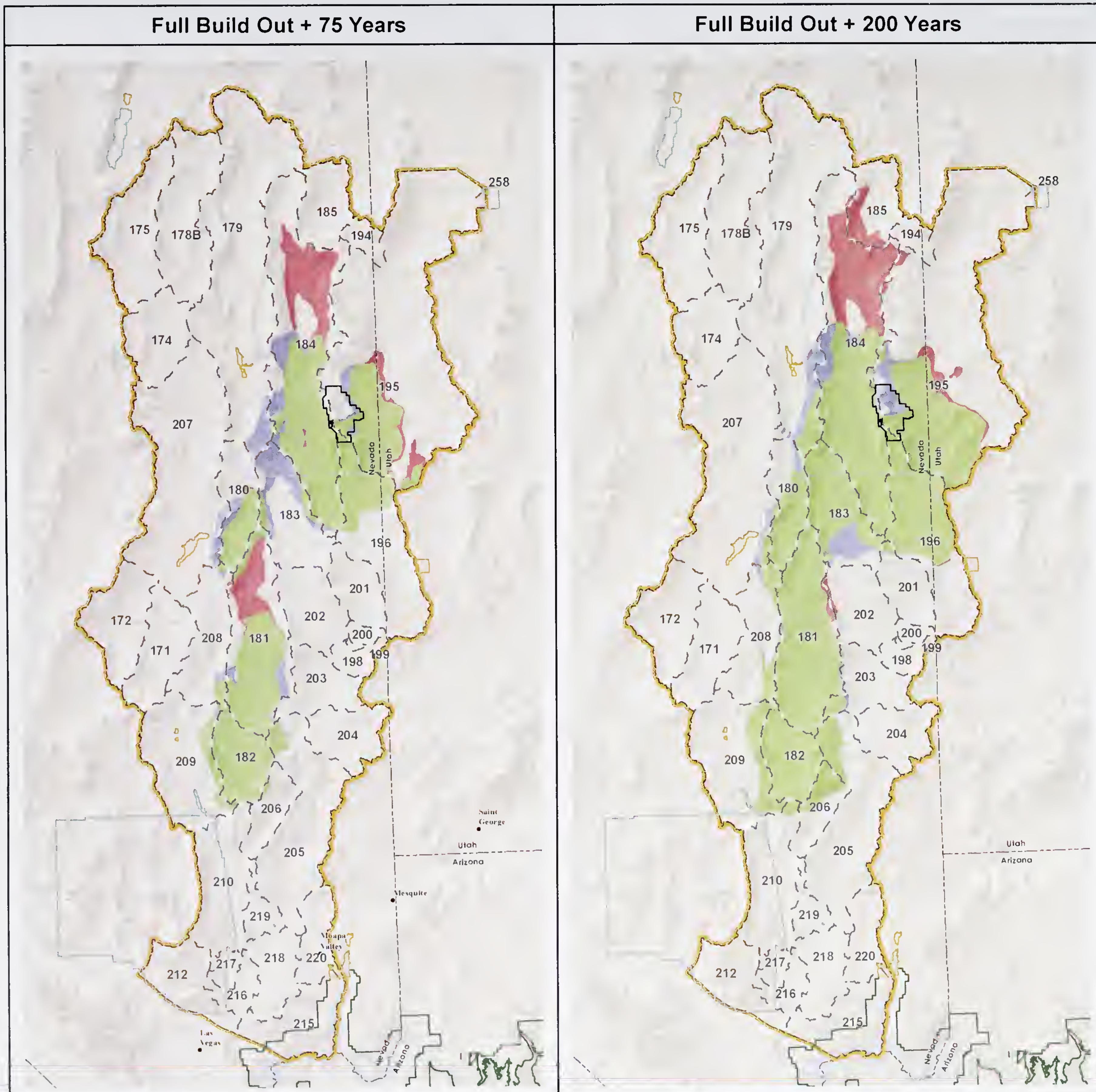
No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.



Legend

10 Ft. Drawdown Polygon

- Proposed Action
- Alternative B Only
- Area Common to Proposed Action and Alternative B
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-39

Drawdown Area Comparison
Alternative B vs. Proposed Action

0 5 10 15 20 25 50 75 Miles
0 10 20 30 40 50 100 Kilometers

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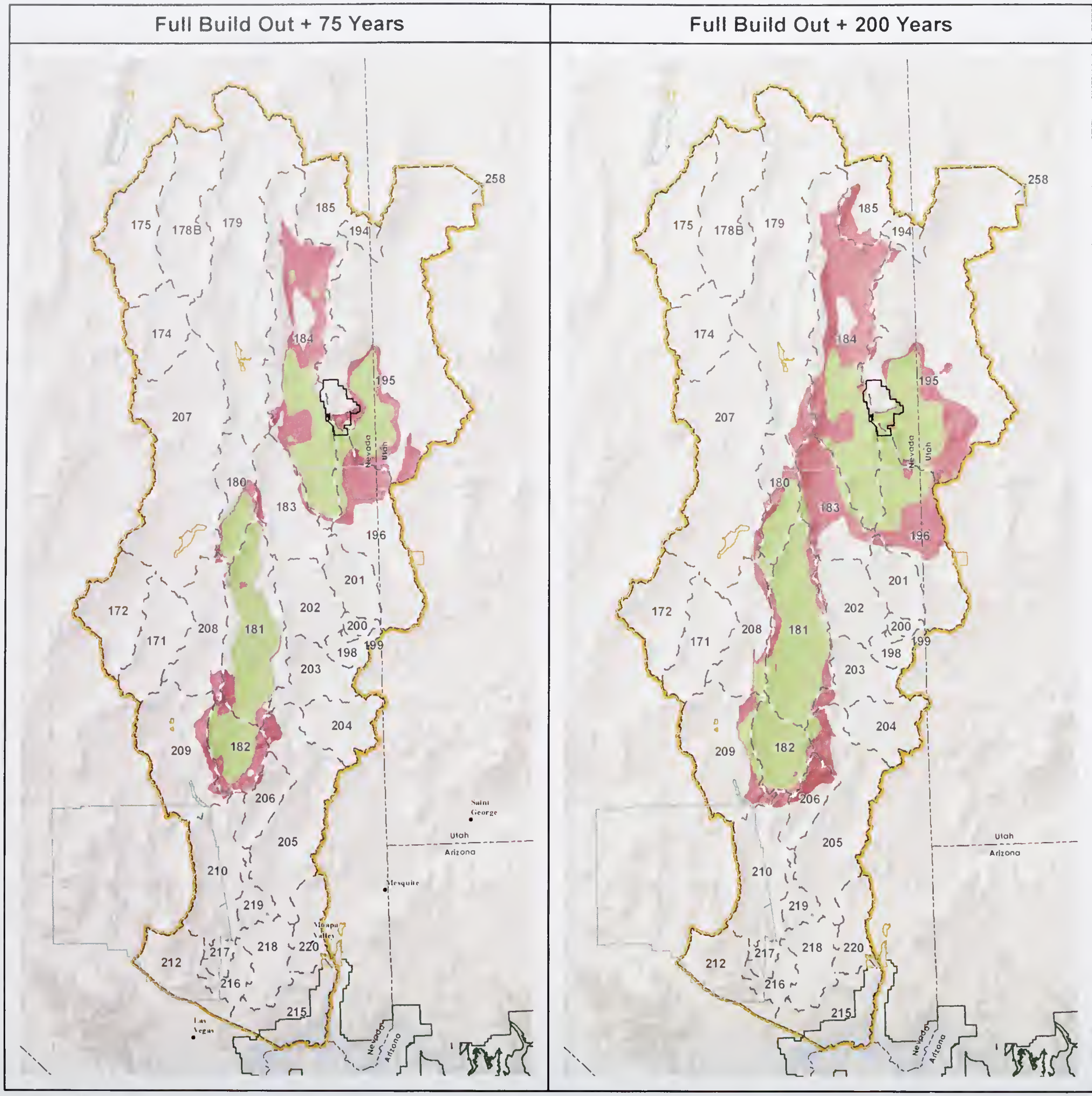
No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data



Legend

10 Ft. Drawdown Polygon

- Proposed Action
- Area Common to Proposed Action and Alternative C
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-40

Drawdown Area Comparison
Alternative C vs. Proposed Action

0 5 10 15 20 25 50 75 Miles
0 10 20 30 40 50 100 Kilometers
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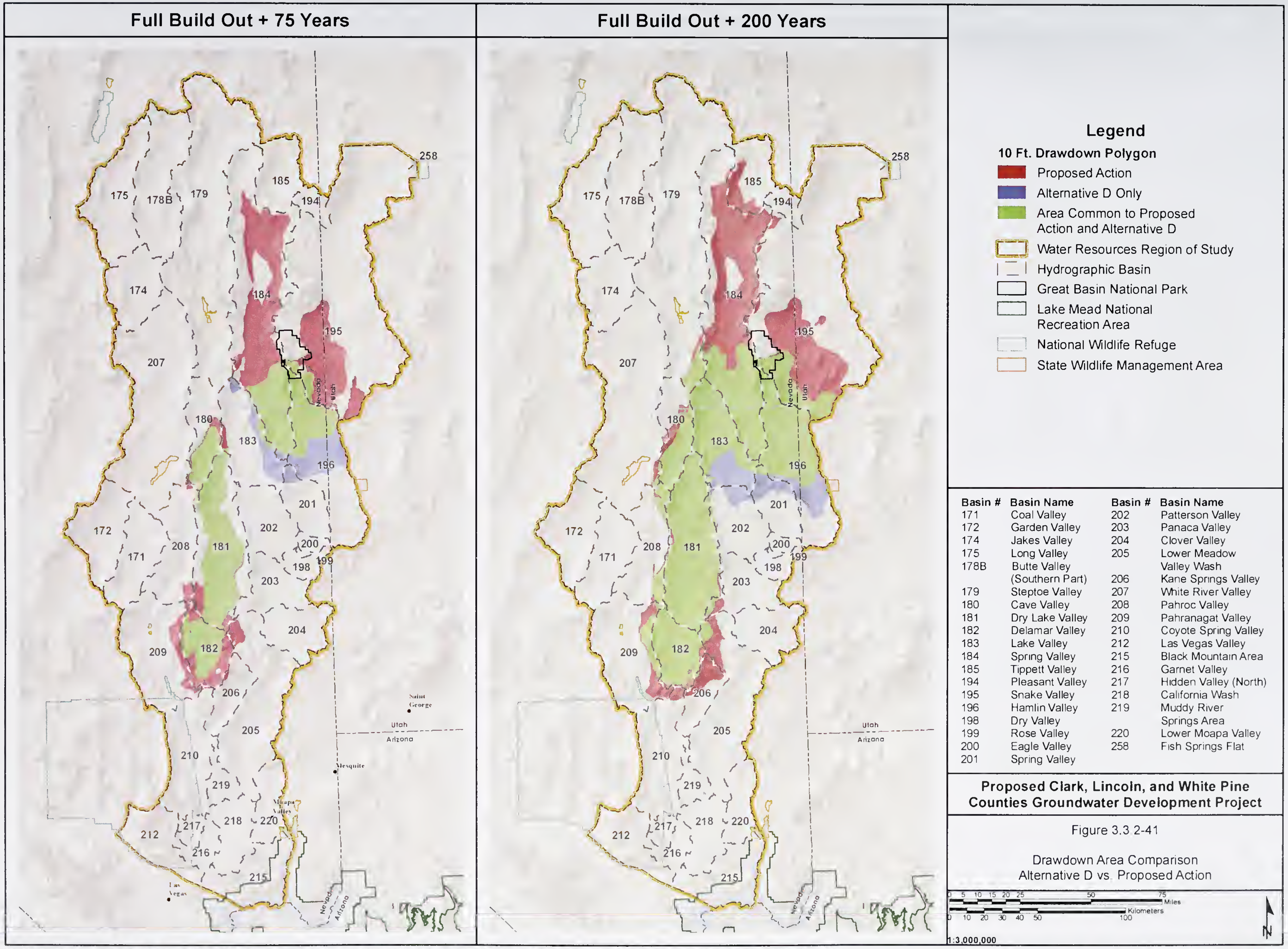
No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.



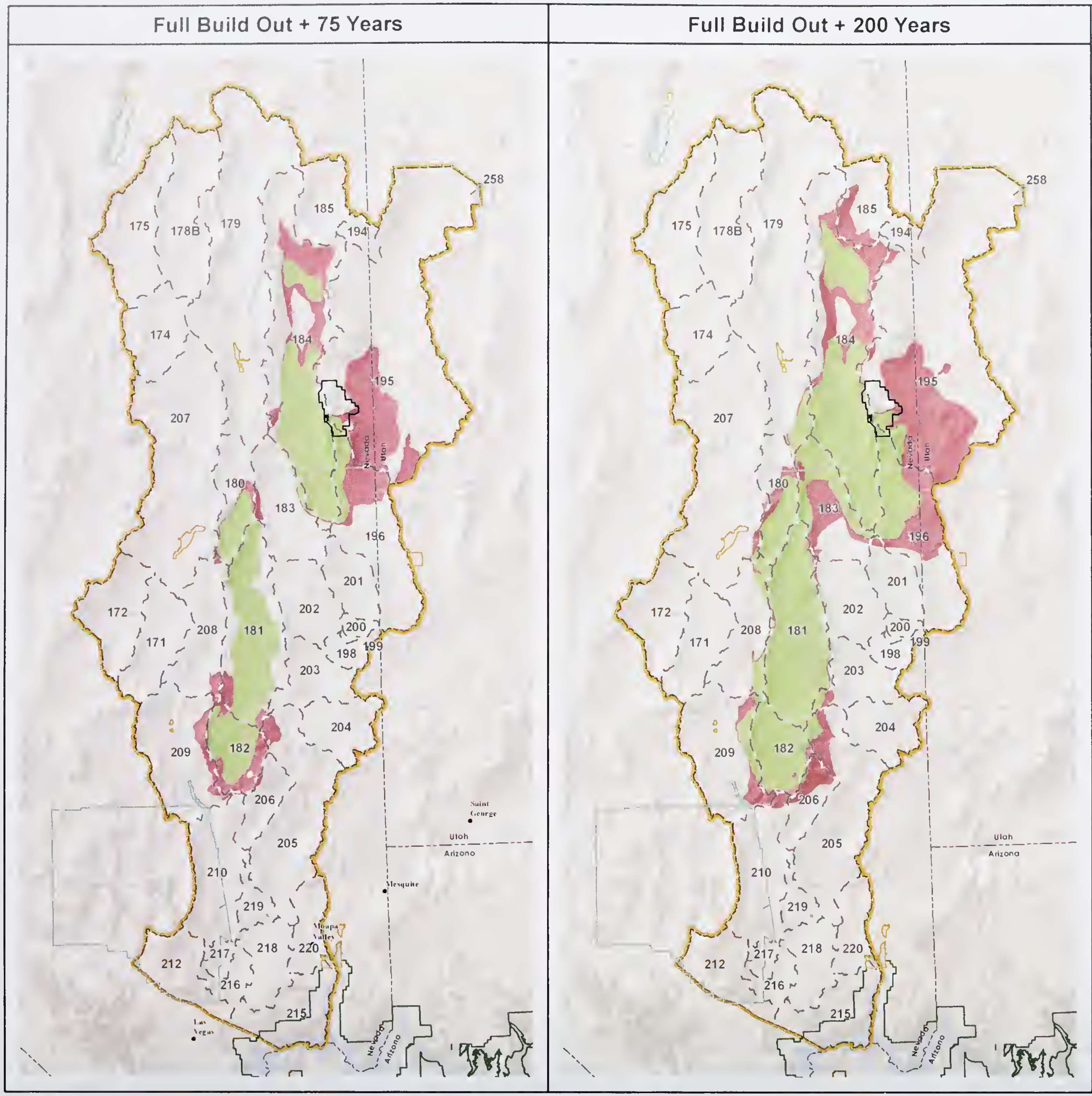
Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-41

Drawdown Area Comparison
Alternative D vs. Proposed Action

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data



Legend

10 Ft. Drawdown Polygon

- Proposed Action
- Area Common to Proposed Action and Alternative E
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-42

Drawdown Area Comparison Alternative E vs. Proposed Action

0 5 10 15 20 25 50 75 Miles

0 10 20 30 40 50 100 Kilometers

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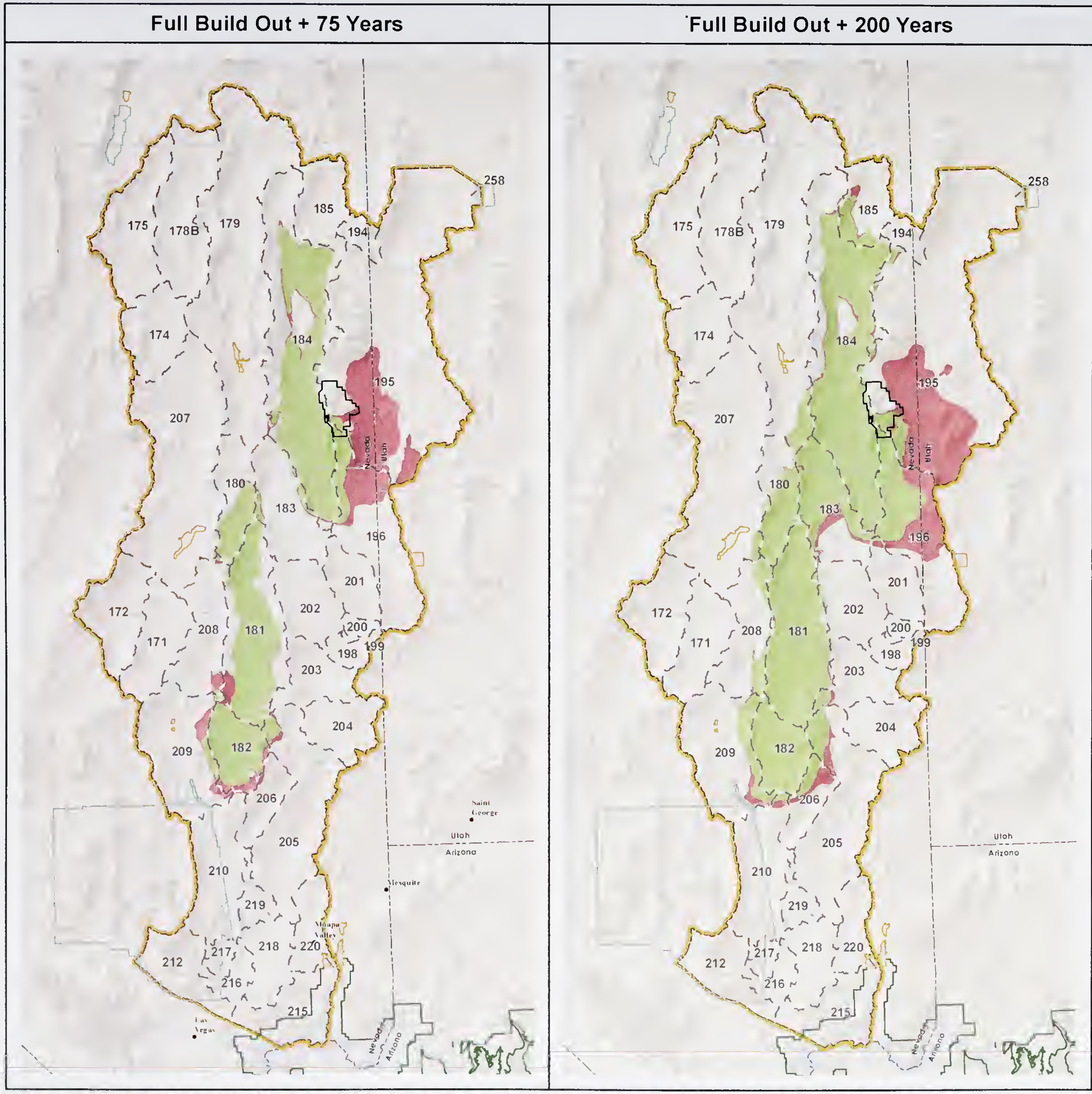

Legend

10 Ft. Drawdown Polygon

- Proposed Action
- Area Common to Proposed Action and Alternative F
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-43

Drawdown Area Comparison
Alternative F vs. Proposed Action

0 5 10 15 20 25 50 75 Miles
0 10 20 30 40 50 100 Kilometers

1:3,000,000

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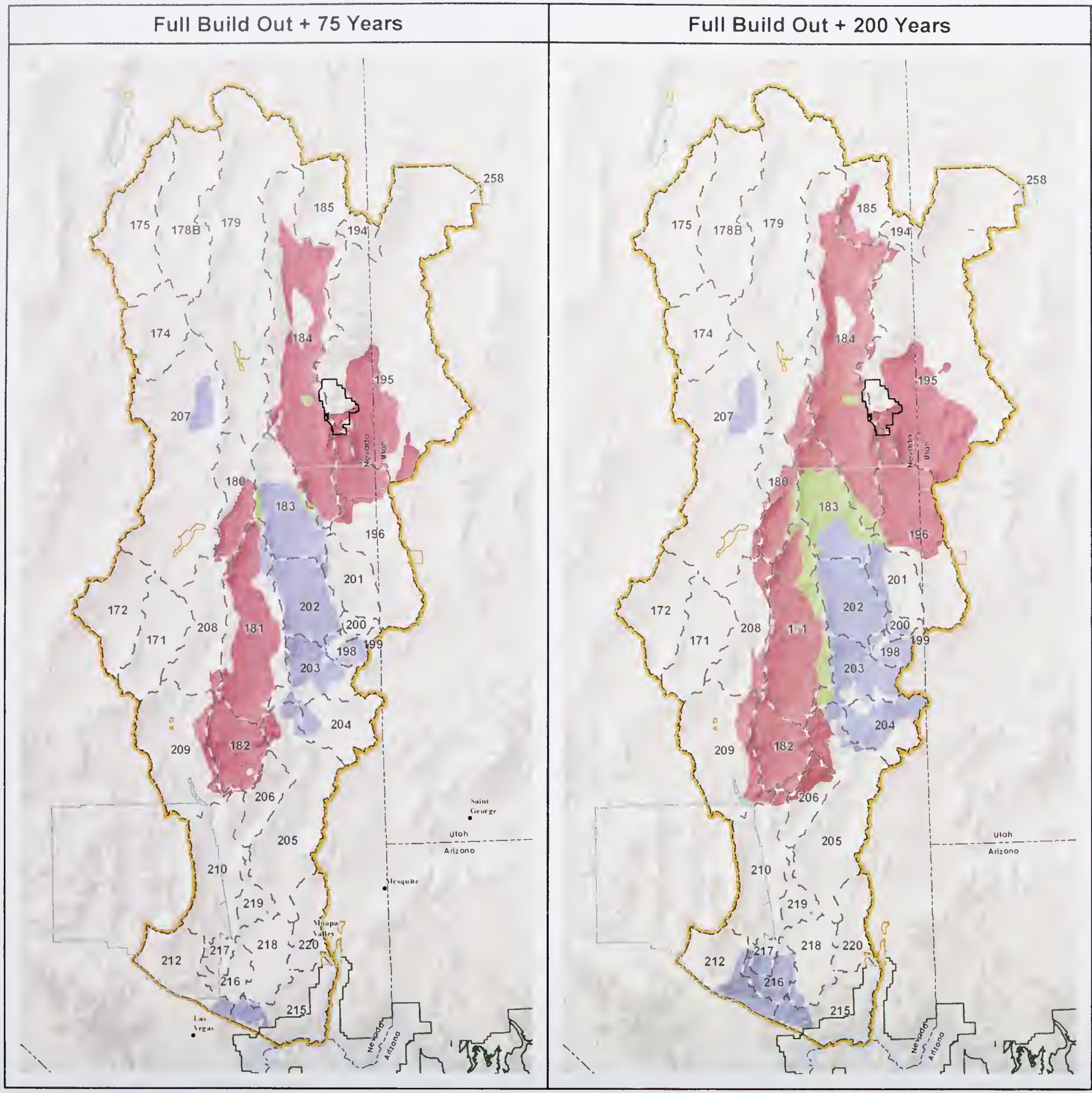


Legend

10 Ft. Drawdown Polygon

- Proposed Action
- No Action Only
- Area Common to Proposed Action and No Action
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-44

Drawdown Area Comparison
No Action vs Proposed Action

0 5 10 15 20 25 50 75 Miles
0 10 20 30 40 50 100 Kilometers

1:3,000,000

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

eastern margin of Pahranagat Valley and northwestern margin of Lower Meadow Valley Wash. By the full build out plus 200 years time frame, the two drawdown areas merge. At this time frame, the simulated drawdown area extends into Tippetts Valley, southeastern Steptoe Valley, and the eastern margins of Pahroc and Pahranagat valleys, and the western margins of Panaca Valley and Lower Meadow Valley Wash.

The groundwater pumping scenario for Alternative A assumes pumping at reduced quantities (approximately 115,000 afy) from those listed on the pending water rights application for the five proposed project pumping basins (Spring, Snake, Delamar, Dry Lake, and Cave valleys). The well distribution developed by the SNWA for this model scenario distributes the simulated production wells spatially within the groundwater development areas in an effort to minimize pumping effects. Compared to the Proposed Action, the reduced pumping under Alternative A would reduce the drawdown area (**Figure 3.3.2-38**) particularly in northern Spring Valley, northern Lake Valley, and along the southern margin of the drawdown area.

The Alternative B pumping scenario assumes pumping at the full diversion rates (i.e., approximately 177,000 afy) listed on the pending water rights application for the five proposed project pumping basins (Spring, Snake, Delamar, Dry Lake, and Cave valleys) and that wells would be developed at the actual points of diversion listed on the water rights applications. Compared to the Proposed Action, the Alternative B pumping scenario would expand the area of drawdown along the southeast margin of Steptoe Valley, and in the Southern Snake Range between Spring and Snake valleys, and in southern Lake Valley (**Figure 3.3.2-39**). The drawdown area for Alternative B also does not extend into northern Spring Valley (HA 184) or Tippett Valley.

The Alternative C pumping scenario assumes the same groundwater production wells defined for Alternative A and that instead of pumping at a sustained rate (as in Alternative A) after full build out, the pumping rates would cycle from minimum (9,000 afy) to maximum (115,000 afy) pumping rates every 5 years after full build out. The maximum pumping rate under this scenario is the same as for Alternative A (approximately 115,000 afy). The model simulations indicate that the reduction in groundwater withdrawal under Alternative C would further reduce the drawdown area as shown on **Figure 3.3.2-40**.

The groundwater pumping scenario for Alternative D assumes that no pumping would occur in Snake Valley, and pumping in Spring Valley would be restricted to the southern portion of the valley within Lincoln County. The maximum groundwater production rate under this scenario is approximately 79,000 afy for the four pumping basins (Spring, Delamar, Dry Lake, and Cave valleys), the same as is assumed for these basins under Alternative A, C, and E. The well distribution developed by the SNWA for this model scenario includes the same spatial distribution of wells included in Alternative A for Delamar, Dry Lake, and Cave valleys. Compared to the Proposed Action, Alternative D limits drawdown in the central and northern portion of Spring Valley and southern portion of Snake Valley; and expands drawdown in Lake Valley, Hamlin Valley, and into northern Spring Valley (HA 201) (**Figure 3.3.2-41**).

The Alternative E pumping scenario includes the same spatial distribution of wells included in Alternative A for Spring, Delamar, Dry Lake, and Cave valleys but assumes no pumping in Snake Valley. The maximum groundwater production rate under this scenario is approximately 79,000 afy for the four pumping basins (Spring, Delamar, Dry Lake, and Cave valleys), the same as the maximum pumping rate assumed for these same basins under Alternative A, C, and D. Because the pumping schedule for Alternative E is identical to Alternative A for Spring, Delamar, Dry Lake, and Cave valleys, the predicted drawdown for Spring, Delamar, Dry Lake, and Cave valleys (and adjacent areas) are essentially the same as for Alternative A (**Figure 3.3.2-42**). This alternative would substantially reduce the drawdown area in Snake Valley compared with the Proposed Action and Alternative A.

The groundwater pumping scenario for Alternative F is similar to Alternative E in that it assumes a spatial distribution of wells for Spring, Delamar, Dry Lake, and Cave valleys and no pumping in Snake Valley. However, the assumed pumping rates for Alternative F (114, 129 afy) represent an increase in pumping in Spring, Delamar, and Cave valleys (and the same pumping rate in Dry Lake Valley) compared to Alternative E (78,755 afy). The spatial distribution of wells is essentially the same as included in Proposed Action for Spring, Delamar, Dry Lake, and Cave valleys. Compared to the Proposed Action, the pumping under Alternative F would reduce the drawdown area (**Figure 3.3.2-43**) along the southern margin of the drawdown area adjacent to Delamar Valley. In Snake Valley, this alternative substantially would reduce the drawdown area compared with the Proposed Action and Alternatives A, B, C, and D; and increase the drawdown area compared to Alternative E.

For the No Action, the groundwater pumping scenario represents an estimate of the potential effects that would occur in the future resulting from a continuation of currently existing water uses. The No Action pumping scenario is based on the estimates of existing and consumptive water use for the model area for agricultural, municipal, mining and milling, industrial, and power plant uses. This includes pumping the SNWA's existing water rights associated with their ranch properties in Spring Valley. However, the No Action pumping scenario does not include any groundwater development associated with the water rights applications in Spring, Snake, Delamar, Dry Lake, or Cave valleys that are included in the proposed project (i.e., Proposed Action pumping scenario). The estimated drawdown attributable to the No Action pumping scenario was estimated by comparison to the baseline groundwater elevations at the end of 2004. The No Action would substantially reduce the drawdown area in Spring, Snake, Delamar, Dry Lake, and Cave valleys compared with the Proposed Action and Alternative A through F (**Figure 3.3.2-44**).

Comparison of the simulation results indicate that the drawdown effects under the No Action continue to expand as pumping continues into the future. At the full build out plus 75 years time frame, there are 3 major drawdown areas. The largest drawdown area extends in a north-south direction from Lake Valley south to the northern margin of Meadow Valley Wash, a distance of approximately 70 miles. The two other major drawdown areas occur in the northern portion of White River Valley, and along the southern margin of the model area in the Black Mountain Area and Las Vegas Valley hydrographic basins. At the full build out plus 200 years time frame, the drawdown area that extends from the Lake Valley to Lower Meadow Valley Wash hydrographic basins is up to 85 miles long (north-south). The drawdown areas in White River Valley and along the southern margin of the model area also are predicted to continue to expand in the future over the model simulation period.

Table 3.3.2-25 provides a comparison of the potential impacts to water resources in the region of study associated with the various alternative pumping scenarios.

Impacts to Springs and Streams

As described previously, springs that are controlled by discharge from (or hydraulically interconnected with) the regional groundwater flow system and located within areas that experience a reduction in groundwater levels likely would experience a reduction in flow. The number of inventoried springs and miles of perennial stream located within the model-simulated drawdown area and located within areas determined to have a high or moderate risk of impacts are graphically illustrated in **Figures 3.3.3-45** and **3.3.3-46**. These charts indicate that the number of springs and miles of stream at risk of impacts increases over time for all of the alternative pumping scenarios. The model-simulated drawdown for the two alternatives with the largest groundwater withdrawal rate (Proposed Action and Alternative B) potentially could impact flows in the largest number of springs and miles of perennial stream reach. However, the distributed pumping assumed for Alternative A would reduce the number of springs and miles of perennial stream potentially at risk from drawdown effects. Compared to the Proposed Action, the reduced drawdown areas resulting from the Alternative A pumping scenario would reduce the number of springs and miles of streams potentially impacted. The Alternative C, D, E, and F pumping scenarios would further reduce the drawdown area compared to Alternative A, and Alternative E potentially would impact the smallest number of inventoried springs and miles of perennial stream reach in the region.

Water Resources within or Adjacent to Great Basin National Park

<u>Water Resources Within or Adjacent to the GBNP</u>. Surface water resources located within or adjacent to the GBNP that occur within both the model-simulated drawdown area and the susceptibility zones identified by Elliot et al. (2006) are listed in **Table 3.3.2-8**. These results indicate that the potential risk to water resources would be greater under the Alternative B pumping scenario. Alternative B is the only pumping scenario where the drawdown area is projected to propagate into the susceptibility zones identified along Baker Creek. Because there is a moderate risk of impacts to the lower perennial segment of Baker Creek, there also is a moderate risk to water resource in the Model Cave under Alternative B.

At the full build out plus 75 years and full build out plus 200 years time frame, Outhouse, Rowland, and Spring Creek Spring and portions of Lehman Creek and Snake Creek are within the area of moderate risk under the Proposed Action, and Alternatives A and B. Compared to the Proposed Action, and Alternatives A and B, the potential risk to water resources in the GBNP would be reduced under Alternatives C and D; further minimized under Alternatives E and F; and not projected to occur under the No Action (**Table 3.3.2-8**).

Table 3.3.2-25 Comparison of Potential Incremental Effects to Water Resources at the Full Build Out Plus 75 Years and Full Build Out Plus 200 Years Time Frame Resulting from the Alternative Pumping Scenarios[1]

Water Resource Issue	Proposed Action	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	No Action
Full Build Out Plus 75 Years								
Drawdown effects on perennial springs:								
• Number of inventoried springs located in areas where impacts to flow could occur[2]	44	29	54	19	13	19	30	12
Drawdown effects on perennial streams:								
• Miles of perennial stream located in areas where impacts to flow could occur[2]	80	58	91	37	4	7	21	19
Drawdown effects on surface water rights:								
• Number of surface water rights located in areas where impacts to flow could occur[2]	145	109	141	78	23	60	88	105
Drawdown effects on groundwater rights:								
• Total groundwater rights in areas with greater than 10 feet of drawdown	199	174	184	133	27	70	84	372
• Number of groundwater rights in areas with greater than 100 feet of drawdown	2	0	8	0	2	0	1	0
Percent reduction in groundwater discharge to ET:								
• Spring Valley	77%	51%	66%	37%	18%	52%	73%	7%
• Snake Valley	28%	23%	18%	15%	4%	0%	1%	3%
• Great Salt Lake Desert Flow System	48%	34%	37%	24%	10%	21%	30%	5%
Full Build Out Plus 200 Years								
Drawdown effects on perennial springs:								
• Number of inventoried springs located in areas where impacts to flow could occur[2]	57	46	78	26	31	30	41	20
Drawdown effects on perennial streams:								
• Miles of perennial stream located in areas where impacts to flow could occur[2]	112	81	120	59	48	23	46	52
Drawdown effects on surface water rights:								
• Number of surface water rights located in areas where impacts to flow could occur[2]	212	151	186	98	56	94	132	164
Drawdown effects on groundwater rights:								
• Total groundwater rights in areas with greater than 10 feet of drawdown	264	223	301	171	213	110	131	409
• Number of groundwater rights in areas with greater than 100 feet of drawdown	34	2	45	0	6	2	5	0
Percent reduction in groundwater discharge to ET:								
• Spring Valley	84%	57%	73%	37%	28%	56%	80%	7%
• Snake Valley	33%	27%	24%	17%	8%	3%	3%	3%
• Great Salt Lake Desert Flow System[1]	54%	39%	44%	25%	16%	24%	34%	5%

[1] Supporting information used to develop these estimated effects are provided in **Appendices F3.3.6** through **F3.3.16**.

[2] Total located in high or moderate risk areas.

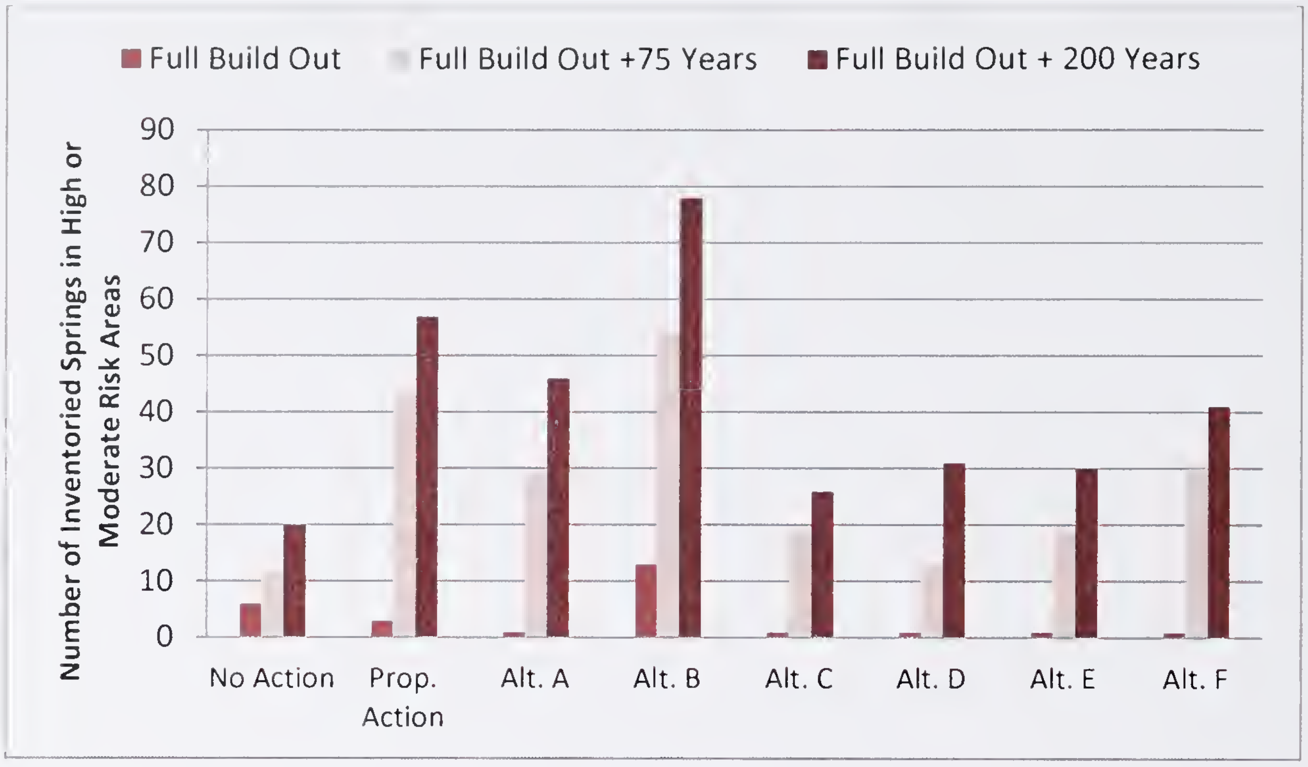


Figure 3.3.2-45 Number of Inventoried Springs Located within the Drawdown Area and Areas Where Impacts to Flow Could Occur (High or Moderate Risk Areas)

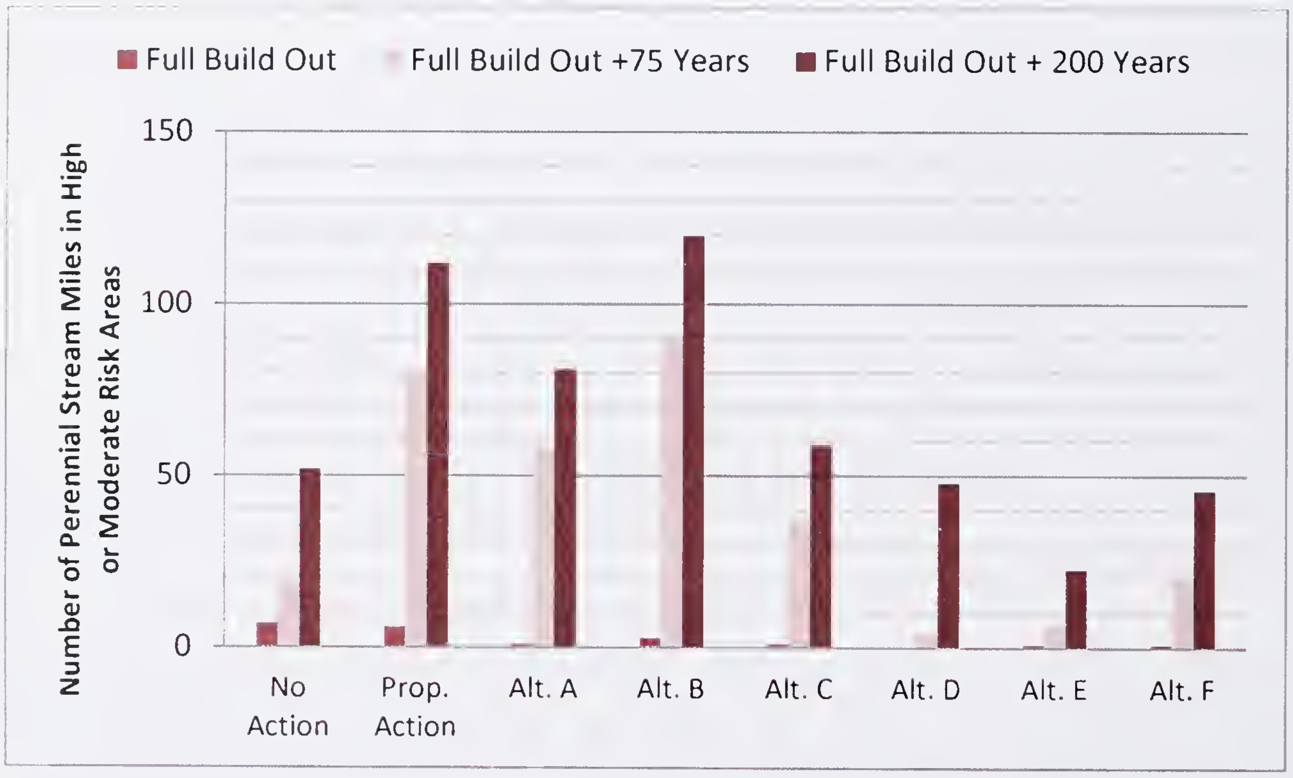


Figure 3.3.2-46 Miles of Perennial Streams Located within the Drawdown Area and Areas Where Impacts to Flow Could Occur (High or Moderate Risk Areas)

Utah Surface Water Resources

The model results indicate that there is a high risk of impacts to flows at Big Spring under all of the groundwater development pumping alternatives. Reduced flows at Big Springs would reduce flows in Big Springs Creek and downstream resources in Utah (i.e., Lake Creek and the flow into Pruess Lake). Comparison of the model simulated flow reductions at the full build out plus 75 year time frame indicates that projected flow reductions are similar (87 percent to 100 percent flow reduction) for the Proposed Action and Alternatives A, B, C, and D; with less flow reductions simulated under Alternatives E and F (26 percent and 25 percent) and the No Action (13 percent). These results suggest that the risk to the flow at Big Springs, Lake Creek, and Pruess Lake (and Stateline Spring that occurs in the same area) would be reduced under either Alternatives E or F and further reduced under the No Action compared to the other alternative pumping scenarios. Caine Spring is located in the moderate risk area, and is within the drawdown area under the Proposed Action and Alternatives A, B, and D; and not within the drawdown area under Alternatives C, E, and F. Measurable effects to Foot Reservoir Spring (i.e., Bishop Springs area) are not anticipated under any of the alternative pumping scenarios.

As described under the Proposed Action, available information suggests that drawdown from pumping in Snake Valley is unlikely to impact surface water resources in Pine Valley.

Impacts to Water Rights

The number of surface water rights located in areas where impacts to surface water resources could occur and number of groundwater rights located within the areas where the model simulations indicate drawdown of 10 feet or more are listed in **Table 3.3.2-25**. There are a large number of existing surface water rights located in areas where impacts from drawdown could occur under both the No Action and groundwater development pumping scenarios. The model results indicate that drawdown for the two alternatives with the largest groundwater withdrawal rate (Proposed Action and Alternative B) potentially could impact the largest number of water rights. The reduced drawdown areas resulting from the other alternatives (Alternatives A through F) would decrease the number of water rights impacted. At the full build out plus 200 year time frame, Alternative D is likely to affect the least number of existing surface water rights, and Alternative E is likely to affect the least number of existing groundwater rights.

Impacts to Water Balance

Potential changes in the water balance for the groundwater system within the region of study were estimated using the groundwater flow model (SNWA 2010b). The estimated reductions in groundwater discharge to the ET areas for selected basins and flow systems are summarized in **Table 3.3.2-25** and illustrated in **Figure 3.3.3-47**.

The Proposed Action would result in the largest reductions in groundwater discharge to the ET areas within Spring and Snake valleys, with estimated reductions of up to 84 percent in Spring Valley and up to 34 percent in Snake Valley. For Snake valley, most of the reductions of discharge to areas would occur in the south portion of the valley. The model results indicate that Alternative D would have the least impact to the ET areas in Spring Valley because the pumping is concentrated in the south end of the valley away from much of the ET areas. The concentrated pumping under Alternative D results in the deepest drawdown cone indicating that a higher percentage of the groundwater withdrawn under this scenario is from groundwater storage compared to the other groundwater development alternatives. Alternatives E and F would result in the smallest impacts (less than 4 percent reduction) to the groundwater discharged to ET area in Snake Valley.

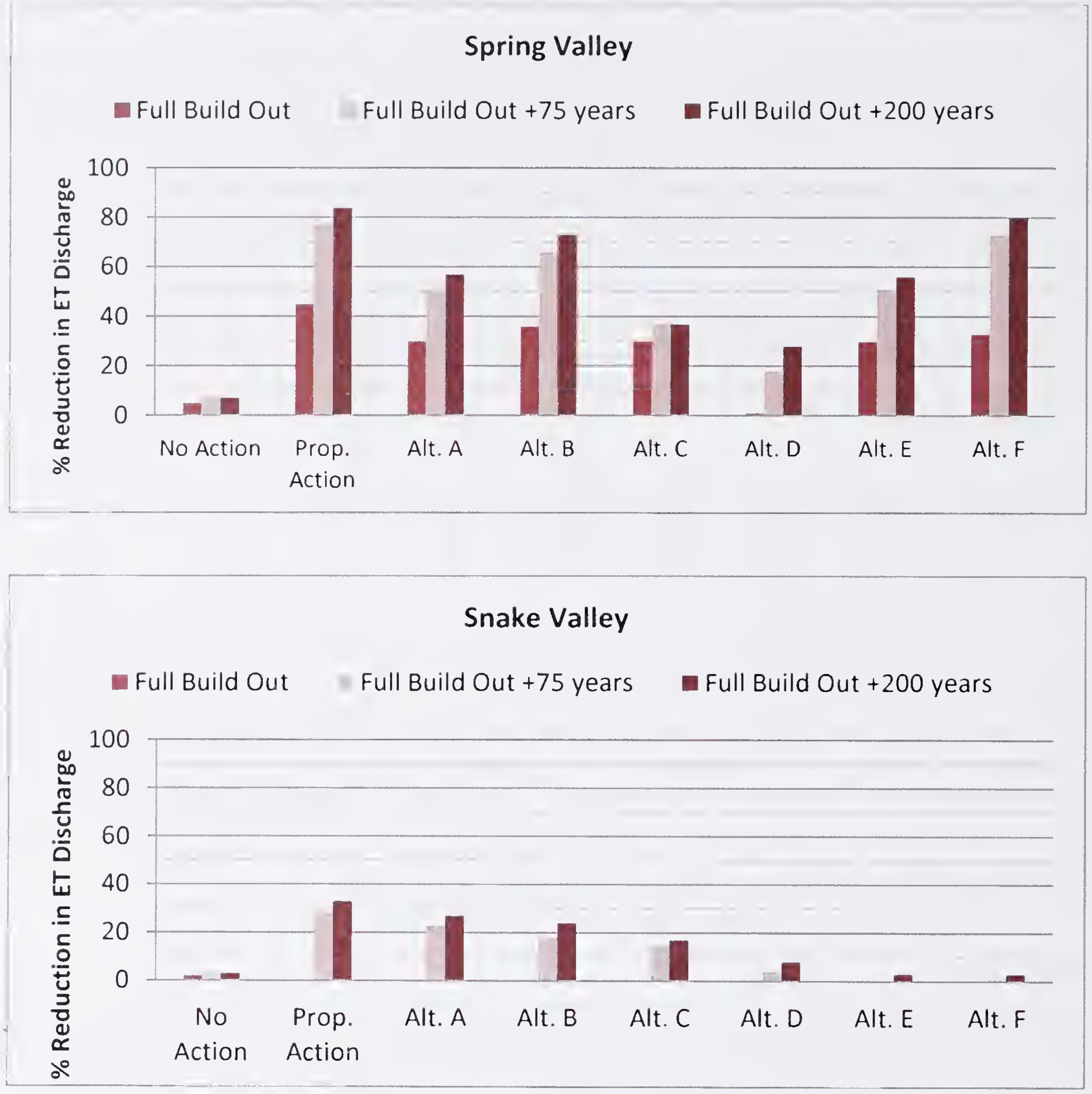


Figure 3.3.2-47 Model-simulated Reductions in Groundwater Discharge to Evapotranspiration Areas in Spring and Snake Valleys

3.3.3 Cumulative Impacts

3.3.3.1 Impacts Common to All Alternatives

Climate Change Effects

Climate change already appears to be influencing both natural and managed ecosystems of the American Southwest (Breshears et al. 2005; Westerling et al. 2006; Seager et al. 2007) and models indicate the likelihood of the Southwest being a climate change "hotspot" in the coming decades (Diffenbaugh et al. 2008). Recent warming in the Southwest is among the most rapid in the nation, significantly more than the global average in some areas (U.S. Global Change Research Program [USGCRP] 2009). Projections suggest continued strong warming in the region, with significant increases in temperature (USGCRP 2009) and decreases in precipitation (Seager et al. 2007). A warmer atmosphere and an intensified water cycle are likely to mean not only a greater likelihood of drought for the Southwest, but also an increased risk of flooding (USGCRP 2009). Greater variability in patterns of precipitation can be anticipated in the future. In the coming century, mean global temperature could increase significantly, with an associated increase in both the frequency of extreme events (heat waves, droughts, storms) and the frequency and extent of wildfire (IPCC 2007; Westerling & Bryant 2008; Krawchuk et al. 2009). Under such conditions, future impacts could be substantial for some resources, impacting biodiversity, protected areas, and agricultural lands.

Climate Change Effects to Water Resources

Global climate change models predict potential alterations in the distribution and seasonality of precipitation (Houghton et al. 1996; Mahlman 1997; Giorgi et al. 1998). The effects of this climate change already are being observed in the western U.S., including the reduction and earlier melting of mountain snowpacks, earlier timing of spring runoff, and associated declines in river flows (Dettinger et al. 2004; Stewart et al. 2004; Barnett et al. 2008). Climate change simulations also clearly indicate a general, large-scale warming over the western U.S. (Barnett et al. 2004), which likely will lead to more widespread drought. Paradoxically, a warmer atmosphere and an intensified water cycle are likely to mean not only a greater likelihood of drought for the Southwest, but also an increased risk of flooding (USGCRP 2009). Patterns of precipitation currently are changing, with more rain falling in heavy downpours that also can lead to such flooding events (IPCC 2007; Allan and Soden 2008). Moreover, increased flood risk in the Southwest is likely to result from a combination of decreased snow cover on the lower slopes of high mountains and an increased fraction of winter precipitation falling as rain and therefore running off more rapidly (Knowles et al. 2006). This increase in rain-on-snow events also could result in rapid runoff and flooding (Bales et al. 2006). Winter precipitation in Arizona is becoming increasingly variable, with a trend toward both extremely dry and extremely wet winters (Goodrich and Ellis 2008). Greater variability in patterns of precipitation can be anticipated in the future. Rapid landscape transformation due to vegetation die-off and wildfire as well as loss of wetlands along rivers also is likely to reduce flood-buffering capacity.

The effect of climate change on streamflow and groundwater recharge will vary regionally and locally, likely following projected changes in precipitation. The impact of climate change on water resources depends not only on changes in the volume, timing, and quality of streamflow and recharge but also on system characteristics, changing pressures on the system, how the management of the system evolves, and what adaptations to climate change are implemented (Arnell et al. 2001). Recent studies from the Sierra Nevada of California indicate that climate change will lead to increasing winter streamflow and decreasing late spring and summer flow (Miller et al. 2003; Maurer 2007). The amount and timing of runoff are dependent on the characteristics of each basin, especially elevation. Increased temperatures lead to a higher freezing line, and therefore, less snow accumulation and increased melting below the freezing height (Miller et al. 2003). These studies suggest that a decrease in late winter snow accumulation is a confident projection, as is the earlier arrival of the annual flow volume.

Climate change could affect water resources in the Project Area by impacting:

- Surface hydrology (volume and timing of surface flows, rainfall-runoff response, flood events, water quality, sediment and contaminant transport);
- Vadose zone hydrology (runoff, ET, infiltration, groundwater recharge); and
- Hydrogeology (groundwater flow).

3.3.3.2 Rights-of-way and Groundwater Development Area Construction and Operation

The water resources cumulative effects study area for evaluating impacts associated with surface-disturbance related effects includes all hydrographic basins experiencing surface disturbance associated with construction of the GWD Project. This includes all hydrographic basins crossed by the primary pipelines, power line ROWs and ancillary facilities; and groundwater production wells, collector pipelines, access roads, and other ancillary facilities constructed within the groundwater development areas identified in Spring, Delamar, Dry Lake, and Cave valleys.

The issues, methodologies, and assumptions used for the evaluation of cumulative effects are the same as previously described for the project specific impacts in Section 3.3.2.

3.3.3.3 No Action

Groundwater Development

As described in Chapter 2, the No Action assumes that the BLM would not grant ROWs for the proposed project. Under this scenario, the proposed pipelines, power lines, ancillary facilities, and well fields would not be developed. Therefore, construction or operational impacts (or cumulative impacts) to water resources associated with the proposed GWD Project would not occur.

3.3.3.4 Proposed Action and Alternatives A through F

Groundwater Development

The potential impacts to surface water resources associated with construction and operation of the Proposed Action and Alternatives A through F are described in Section 3.3.2. The potential construction- and operation-related impacts are similar for all of these alternatives. With respect to water resources, the main difference between these alternatives is that the Proposed Action and Alternatives A through C would construct a pipeline and well field(s) in Snake Valley; whereas, Alternatives D, E, and F would not include surface disturbance in Snake Valley. The Proposed Action and Alternatives A through C would include pipeline construction across one perennial stream (Snake Creek), and two intermittent streams (Big Wash and Lexington Creek) in Snake Valley. Implementation of the BMPs, ACMs, and mitigation recommendations would mitigate long-term residual impacts to perennial stream and springs.

Depending on the alternative, the primary pipeline also would cross 504 to 720 ephemeral streams; typically consisting of dry washes. Implementation of required erosion control measures and ACMs are expected to generally limit these to short-term (up to 2 years) effects.

The cumulative impacts to water resources within the areas to be disturbed for the GWD Project take into account other actions that also could affect water resources. Past and present actions involving grazing, road construction, mining and recent wildfires have affected perennial water sources and contributed to localized erosion and sedimentation to drainages. The primary future actions consist of construction of new utilities (e.g., pipelines, electrical distribution lines), roads and turbine pads for wind energy projects, and collector fields for solar energy projects) in Spring, Dry Lake, Muleshoe, Delamar, and Coyote Spring valleys. These future actions would result in surface disturbance that could (depending the facility locations and access roads) directly disturb or contribute sediment to perennial streams and springs located within the cumulative effects study area.

Surface disturbance would overlap with past and present actions, and potentially would overlap or intersect with RFFAs in the areas shown on **Figures 2.9-1** and **2.9-2**. Overlapping or intersecting areas of ground disturbance would include existing road and highway crossings; utility corridor crossings; and service roads for future wind energy projects in Spring and Dry Lake valleys. The major additive cumulative effects would be the expansion in the width of adjacent utility ROWs, which could cross streams or be located adjacent to streams and springs in Spring Valley. New roads associated with these RFFAs potentially could cross live streams in Spring and Snake valleys. Overall, the ground disturbance associated with the Proposed Action and Alternatives A through F are not anticipated to result in a substantial increase in cumulative impacts to surface water resources in the study area.

3.3.3.5 Groundwater Pumping

The hydrologic study area for cumulative impacts from groundwater withdrawal encompasses the 35 hydrographic basin region defined in **Figure 3.3.1-1**. The boundaries of the hydrologic study area for cumulative effects are the same as those used for the regional numerical groundwater flow model developed to evaluate potential effects of the proposed groundwater development project. The study area for cumulative effects was selected to include the 5 hydrographic basins where the proposed pumping would occur and all or portions of the potentially affected regional groundwater flow systems. Unless otherwise noted in the impact discussion, the issues, methodology, assumptions, and limitations used to quantify potential effects to water resources are the same as those previously described in Section 3.3.2.8. The baseline conditions in this regional study area are summarized in Section 3.3.1. For the purposes of the analysis, the proposed groundwater pumping is assumed to continue in perpetuity. As described in Section 3.3.2, drawdown-related impacts to water resources are predicted to progressively increase over time for the foreseeable future. To evaluate these increasing effects over time, the cumulative impact analysis estimated potential impacts to water resources at three representative time frames (full build out, full build out plus 75 years, and full build out plus 200 years) as discussed previously in Section 3.3.2. Detailed results of the cumulative effects at these three representative time frames are provided in tables and figures in **Appendix F3.3**. The summary of potential cumulative impacts provided in the following paragraphs is restricted to a description of the impacts at the later two time frames (i.e., full build out plus 75 years and full build out plus 200 years).

The estimated historical groundwater consumptive uses for the study area are described in Appendix C of the Transient Numerical Model Report (SNWA 2009b). The baseline conditions are described in Section 3.3.1 and reflect the aggregate effects of past groundwater withdrawals that have historically occurred across the region. The cumulative effects to water resources described in this analysis estimate the total effects that potentially could occur relative to conditions at the end of 2004. The end of 2004 corresponds to the end date used for the final calibration period for the transient numerical flow model (SNWA 2009b).

Groundwater Pumping Scenarios

The cumulative effects to water resources were evaluated using the regional groundwater flow model developed for the GWD Project. The pumping scenarios for the cumulative effects analysis were developed to simulated the combined effects associated with: 1) the continuation of existing pumping in the region included under the No Action pumping scenario described in Section 3.3.2.16; 2) additional pumping associated with the proposed groundwater development project, or alternative groundwater development scenarios (i.e., Alternatives A through F); and 3) additional reasonably foreseeable groundwater developments that have been identified within the cumulative study area.

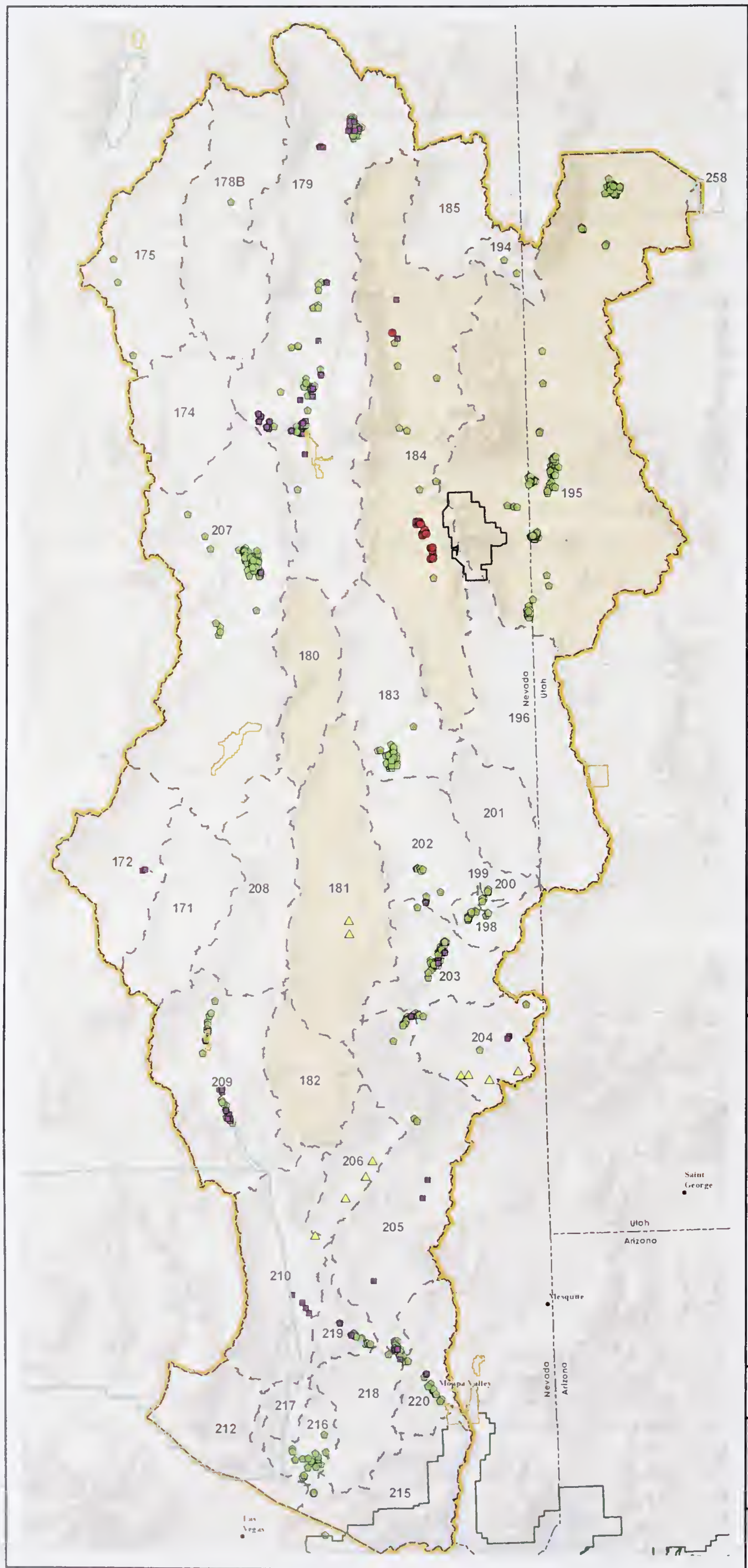
The reasonably foreseeable future groundwater developments included in this cumulative impact evaluation are listed in **Table 2.9-3**. These include future development of existing permitted groundwater rights associated with private lands and previously authorized projects and potential future projects with a groundwater-demand component that have submitted formal development plans to regulatory agencies for permitting purposes.

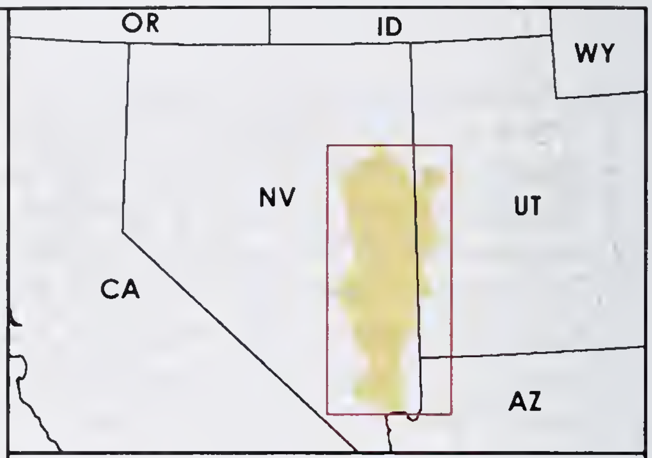
<u>No Action Cumulative Pumping Scenario</u>. The cumulative pumping scenario for the No Action includes the No Action pumping described in Section 3.3.2.15 and reasonable foreseeable future groundwater developments. The location of the existing pumping wells and reasonable foreseeable future groundwater development assumed for the No Action cumulative pumping scenario are shown in **Figure 3.3.3-1**.

<u>Groundwater Development Project Pumping Scenarios (Proposed Action and Alternatives A through F)</u>. The cumulative pumping scenarios for each of the groundwater development alternatives provide an estimate of the effects associated with the combined pumping included in: 1) the No Action cumulative pumping scenario (i.e., existing pumping and reasonably foreseeable future pumping); and 2) the well distributions and pumping schedules used for the simulations of the productions wells previously described for the incremental effects analysis (Sections 3.3.2.9 to Section 3.3.2.15).

Impacts to Water Levels

<u>No Action Cumulative Pumping Scenario</u>. The predicted changes in groundwater levels attributable to the No Action cumulative pumping scenario at the full build out plus 75 years and full build out plus 200 years time frames are provided in **Figures 3.3.3-2** and **3.3.3-3**, respectively. Comparisons between these figures with the drawdown at the same time frame for the No Action pumping scenario (**Figures 3.3.2-36** and **3.3.2-37**) illustrate areas where the additional pumping included under reasonably foreseeable future actions would result in additional drawdown. The





Legend

Pumping Scenario Well Locations

No Action

- Existing Pumping Well[1]
- SNWA - Owned Properties[2]

Reasonably Foreseeable Future Uses

- Future Development[3]
- Lincoln County Water District Approved Water Right
- Hydrographic Basin
- Pumping Basin
- Water Resources Region of Study
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

[1]Based on water rights and estimated consumptive uses for agricultural, mining and milling, industrial and power plant, and municipal purposes (SNWA 2009b).

[2]Existing water rights associated with SNWA owned ranch properties in Spring Valley

[3]See Table 2.8-3 for a list of included actions

Source: SNWA 2008a

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

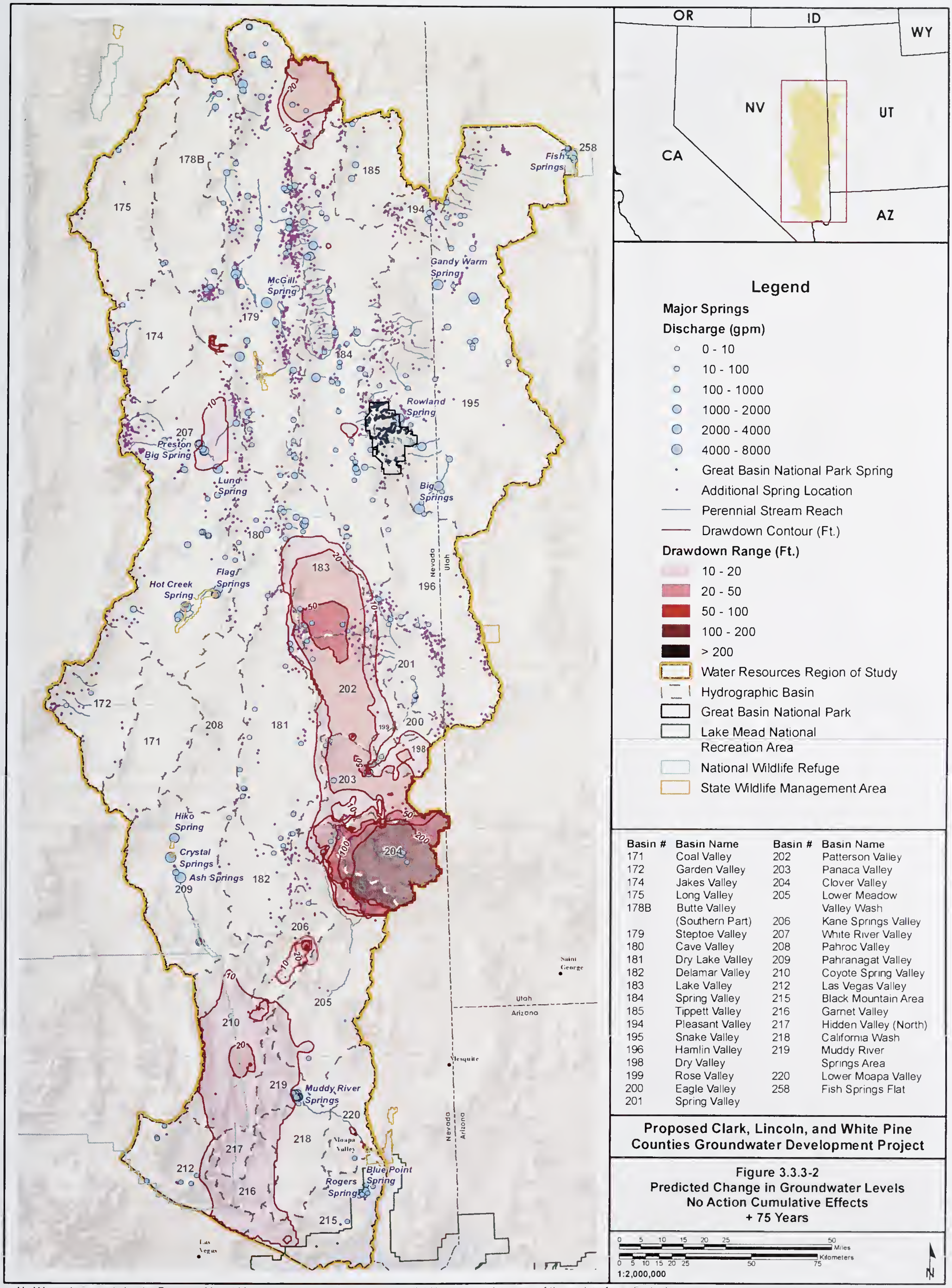
Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.3-1

Pumping Distribution
No Action Cumulative Scenario

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000

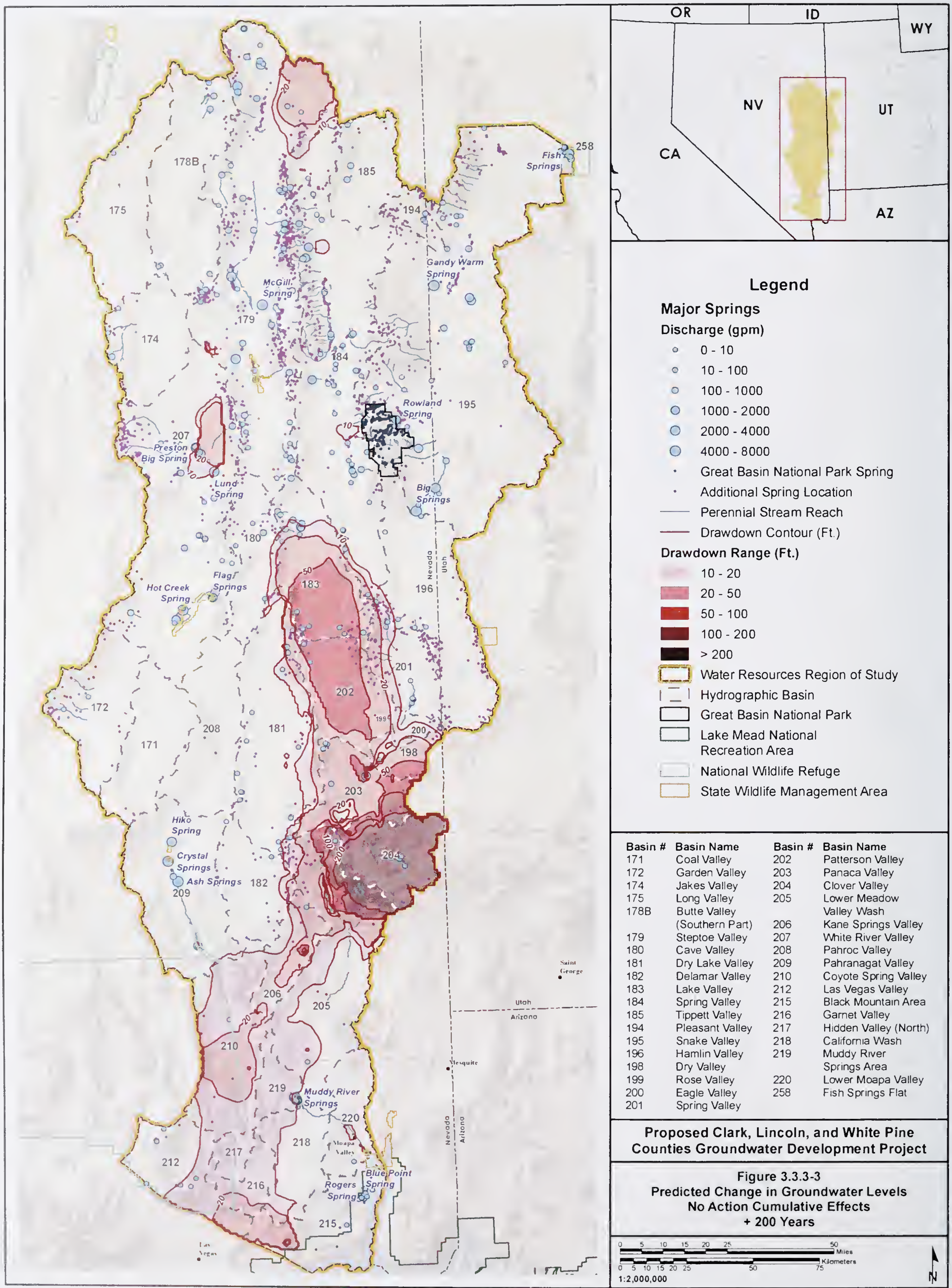
No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data



Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.3-2
Predicted Change in Groundwater Levels
No Action Cumulative Effects
+ 75 Years



Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.3-3
Predicted Change in Groundwater Levels
No Action Cumulative Effects
+ 200 Years

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

major differences attributable to the assumed reasonably foreseeable future pumping included in the No Action cumulative scenario results in the development of new or expanded drawdowns in the following areas:

Steptoe Valley: Development of a new drawdown area along the northern margin of Steptoe Valley associated with existing permitted water rights for a proposed power plant.

Clover Valley: Substantial expansion of the areal extent and magnitude of drawdown in Clover Valley and adjacent areas resulting from the assumed pumping from the proposed Lincoln County/Vidler groundwater development project.

Kane Springs: Development of a new drawdown area in Kane Springs Valley and adjacent areas resulting from pumping of existing permitted water rights for Lincoln County/Vidler.

Coyote Spring Valley: Development of a new drawdown area in Coyote Spring Valley and adjacent areas resulting from pumping of existing permitted water rights for the SNWA Coyote Spring Pipeline and Coyote Springs Investment.

The model simulations indicate that pumping included in the No Action cumulative scenario does not substantially contribute to drawdowns in Spring and Snake valleys.

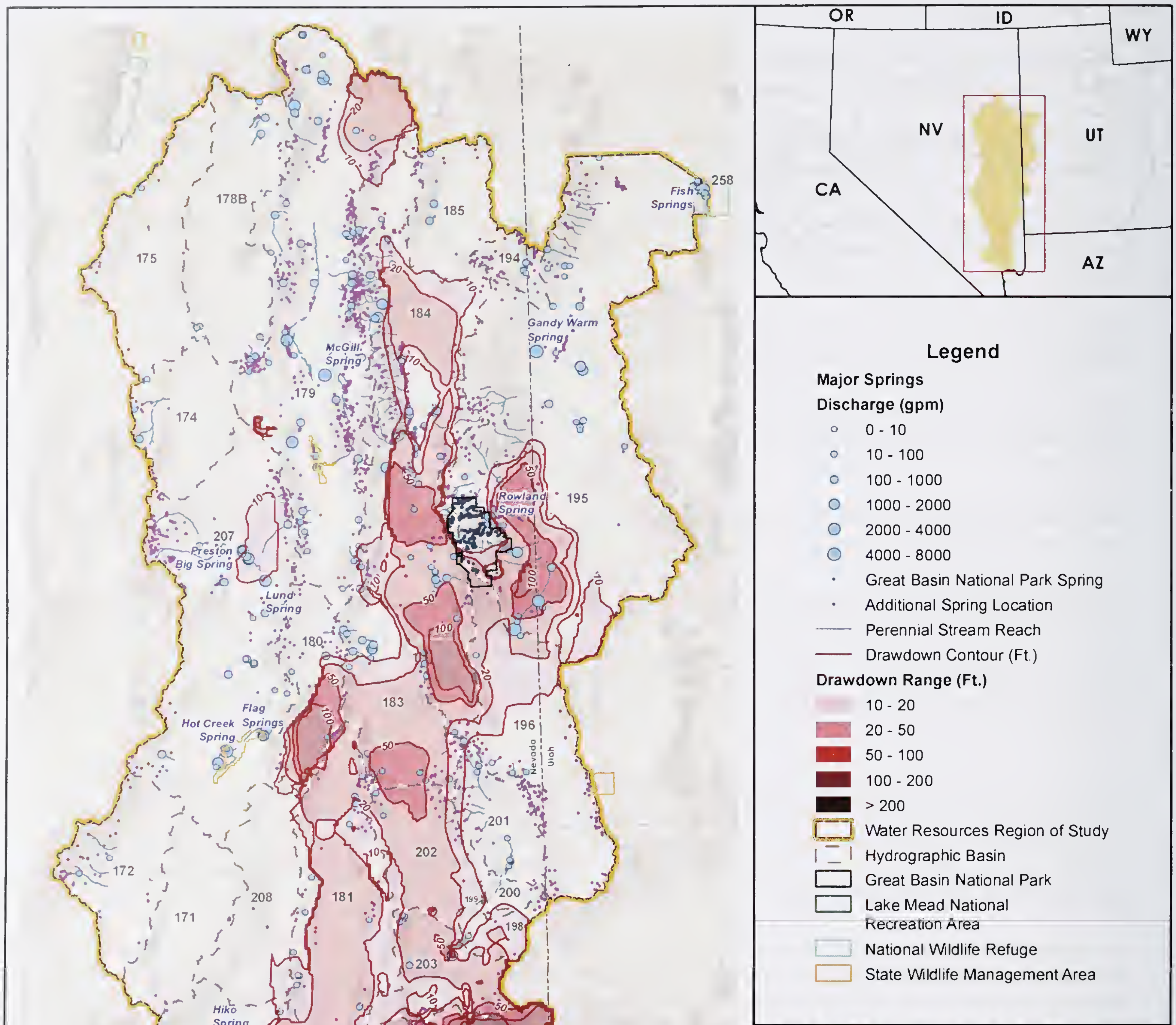
Groundwater Development Pumping Scenarios (Proposed Action and Alternatives A through F). The cumulative drawdown predicted for each of the six groundwater development pumping scenarios (Proposed Action and Alternatives A through F) at the representative time frames are provided in **Appendix F3.3.7**. These drawdown maps reflect the combined effects associated with the No Action cumulative drawdown scenario described above, and the incremental effects attributable to the groundwater pumping under the specific alternate described in Sections 3.3.2.9 to 3.3.2.15.

Figures 3.3.3-4 to **3.3.3-5** illustrate the predicted drawdown associated with the Proposed Action cumulative pumping scenario at the full build out plus 75 years and full build out plus 200 years time frame. The Proposed Action provides an example of the maximum extent of the cumulative drawdown predicted to occur for the six groundwater development cumulative pumping scenarios. Comparison of the results for the No Action cumulative pumping scenario with the six project alternative pumping cumulative scenarios results in the following major observations.

(1) Spring and Snake Valleys: The predicted cumulative drawdown is essentially the same as the project only drawdowns described previously. In other words, the continuation of existing pumping and reasonably foreseeable pumping (included in the No Action cumulative pumping scenario) is not expected to substantially increase drawdown effects over those predicted in Section 3.3.2 for the project-specific effects. Exceptions include an increase in drawdown observed in the Shoshone Ponds area that occurs under the Proposed Action, and Alternatives A, B, C, E, and F.

(2) White River, Cave, Dry Lake, and Lake Valleys: Drawdown associated with the project pumping scenarios is predicted to overlap with the drawdowns predicted for the No Action cumulative scenario in Lake Valley and adjacent areas. The overlap of the drawdown effects associated with the project pumping and existing pumping in Lake Valley is predicted to result in increased drawdown in Lake Valley and in Cave and Dry Lake valleys. (Drawdown impacts to springs in White River Valley associated with pumping in Cave Valley are discussed below under model-simulated spring and stream discharge estimates.)

(3) Delamar Valley, Lower Meadow Valley Wash, and Clover Valley: Substantial drawdown is predicted to occur in Clover Valley under the No Action cumulative pumping scenario. The proposed groundwater development is not anticipated to contribute to drawdown in Clover Valley. However, the overlapping drawdown from pumping in Clover Valley and Delamar Valley is predicted to increase drawdown in the northern portion of the Lower Meadow Valley Wash, which is situated between these two pumping centers.



Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
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179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
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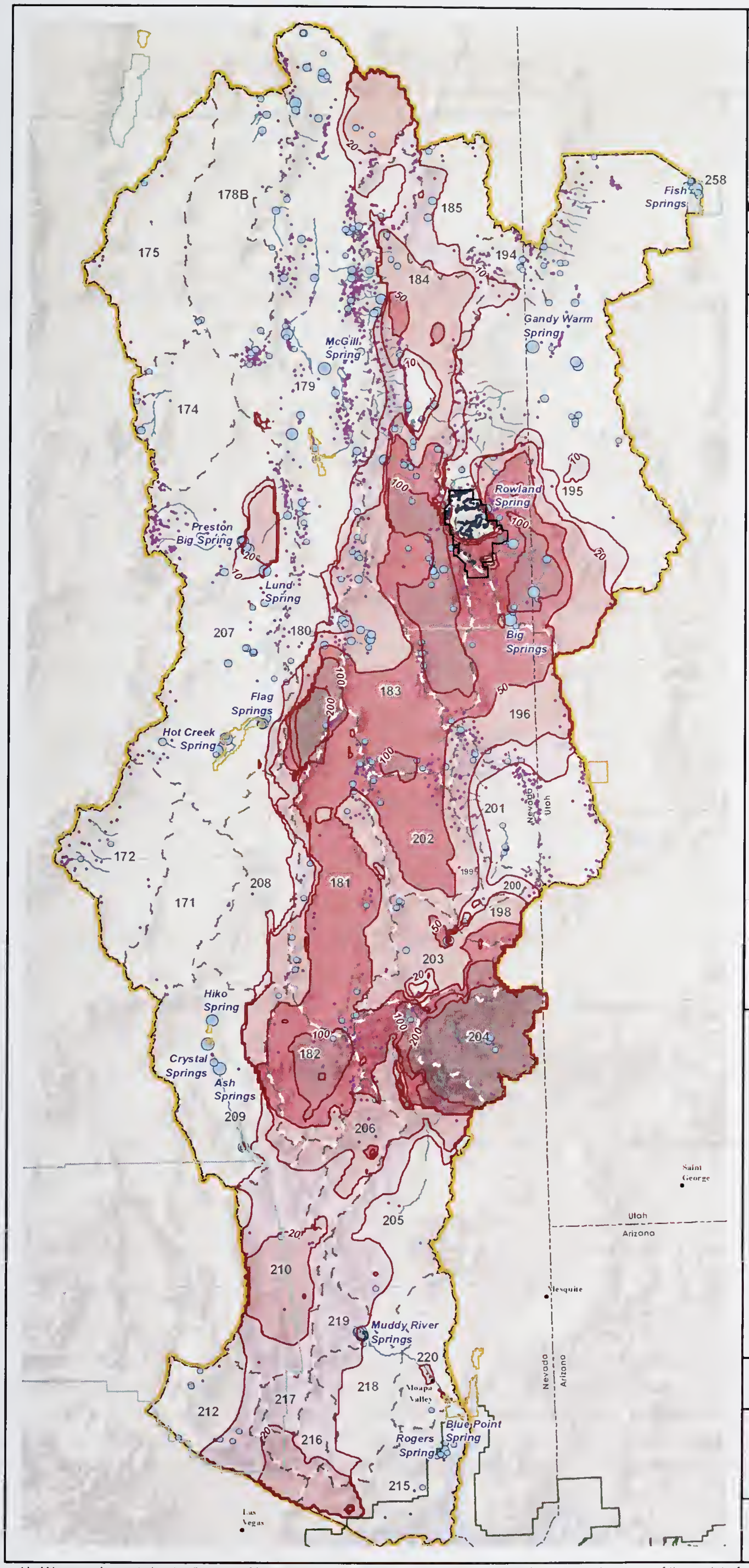
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

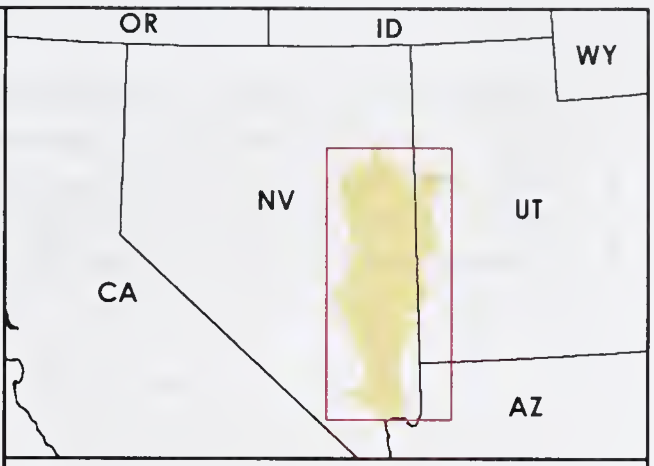
Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.3-4
Predicted Change in Groundwater Levels
Proposed Action Cumulative Effects
+ 75 Years

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data





Legend

Major Springs

Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location
- Perennial Stream Reach
- Drawdown Contour (Ft.)

Drawdown Range (Ft.)

- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- > 200
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
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195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.3-5
Predicted Change in Groundwater Levels
Proposed Action Cumulative Effects
+ 200 Years

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000

N

(4) Coyote Spring, Muddy River Springs, Hidden Valley North, Garnet Valley, Black Mountain Area, and Las Vegas Valley: The drawdown effects in these basins is essentially the same under both the No Action cumulative scenarios, and project pumping cumulative scenarios. These results indicate that the incremental drawdown attributable to project pumping is not anticipated to substantially contribute to drawdown effects beyond those simulated for the No Action cumulative scenario in Coyote Spring, Muddy River Springs, Hidden Valley North, Garnet Valley, Black Mountain Area, and Las Vegas Valley.

These observations generally apply to all seven action alternative cumulative pumping scenarios unless otherwise noted. However, the alternatives with the highest groundwater withdrawal volume (Proposed Action and Alternative B) show the largest overlapping drawdown effects; and the alternative with the lowest groundwater withdrawal volume (Alternative C) show the smallest amount of overlapping drawdown effects.

Impacts to Water Resources

The estimated potential risks to perennial springs and streams, water rights, and simulated water balance resulting from the cumulative groundwater pumping projected at full build out, full build out plus 75 years, and full build out plus 200 years for each of the cumulative pumping scenarios are provided in the following locations:

- Tables presenting the model-simulated flow changes for selected springs (**Appendix F3.3.6**);
- Drawdown maps for each pumping scenario at each time frame (**Appendix F3.3.7**);
- Maps delineating the risk to perennial surface water resources within the model-simulated drawdown areas (**Appendix F3.3.8**);
- Tables listing the number of springs by basin that occur within the high, moderate, and low risk areas for each pumping scenario and time frame (**Appendix F3.3.9**);
- Tables identifying the inventoried springs that occur within the moderate and high risk areas for each pumping scenario and time frame (**Appendix F3.3.10**);
- Tables listing the miles of perennial stream present within areas where effects to surface waters could occur for each pumping scenario and time frame (**Appendix F3.3.11**);
- Maps illustrating the risks to surface water rights by manner of use within the drawdown areas for each pumping scenario and time frame (**Appendix F3.3.12**);
- Tables defining the risk to surface water rights by basin within the drawdown areas for each pumping scenario and time frame (**Appendix F3.3.13**);
- Maps illustrating the drawdown effects to groundwater rights by manner of use for each pumping scenario and time frame (**Appendix F3.3.14**);
- Tables defining the risk to groundwater rights by basin within the drawdown areas for each pumping scenario and time frame (**Appendix F3.3.15**);
- Tables presenting the simulated groundwater budgets by basin and flow system for each pumping scenario and time frame (**Appendix F3.3.16**).

Potential effects to water resources resulting from the cumulative pumping scenario at the full build out plus 75 years and full build out plus 200 years time frames are summarized in **Table 3.3.3-1**. The following discussion provides a summary of potential major effects and compares the results for the alternative pumping scenarios.

Impacts to Springs and Streams

As described previously, springs that are controlled by discharge from (or hydraulically interconnected with) the regional groundwater flow system and located within areas that experience a reduction in groundwater levels would likely experience a reduction in flow. The number of inventoried springs and miles of perennial stream located within the model-simulated cumulative drawdown area and located within areas determined to have a high or moderate risk of impacts are presented in **Figure 3.3.3-6** and **Figure 3.3.3-7**. These charts illustrate that the number of springs and miles

Table 3.3.3-1 Comparison of Potential Cumulative Effects to Water Resources at the Time Periods Associated with Full Build Out Plus 75 and Full Build Out Plus 200 Years[1]

Water Resource Issue	Proposed Action	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt F	No Action
Full Build Out Plus 75 Years								
Drawdown effects on perennial springs:								
• Number of inventoried springs located in areas where impacts to flow could occur[2]	65	53	77	42	34	42	51	19
Drawdown effects on perennial streams:								
• Miles of perennial stream located in areas where impacts to flow could occur[2]	131	110	137	98	53	56	69	42
Drawdown effects on surface water rights:								
• Number of surface water rights located in areas where impacts to flow could occur[2]	305	274	299	257	198	224	245	159
Drawdown effects on groundwater rights:								
• Total groundwater rights in areas with greater than 10 feet of drawdown	683	667	679	635	541	558	567	500
• Number of groundwater rights in areas with greater than 100 feet of drawdown	21	19	27	19	21	19	21	19
Percent reduction in ET and spring discharge:								
• Spring Valley	78%	55%	69%	43%	24%	55%	76%	6%
• Snake Valley	30%	25%	21%	17%	7%	4%	4%	2%
• Great Salt Lake Desert Flow System[1]	50%	38%	41%	28%	14%	25%	33%	4%
Full Build Out Plus 200 Years								
Drawdown effects on perennial springs:								
• Number of inventoried springs located in areas where impacts to flow could occur[2]	82	74	102	63	53	62	70	28
Drawdown effects on perennial streams:								
• Miles of perennial stream located in areas where impacts to flow could occur[2]	193	166	201	151	119	120	140	79
Drawdown effects on surface water rights:								
• Number of surface water rights located in areas where impacts to flow could occur[2]	422	372	393	341	302	315	352	228
Drawdown effects on groundwater rights:								
• Total groundwater rights in areas with greater than 10 feet of drawdown	783	752	754	730	672	642	650	555
•								
• Number of groundwater rights in areas with greater than 100 feet of drawdown	181	76	171	66	139	76	97	66
Percent reduction in groundwater discharge to ET:								
• Spring Valley	86%	61%	76%	42%	35%	60%	82%	9%
• Snake Valley	35%	29%	27%	20%	11%	6%	6%	3%
• Great Salt Lake Desert Flow System[1]	56%	42%	47%	29%	21%	28%	37%	5%

[1] Supporting information used to develop these estimated effects are provided in **Appendices F3.3.6** through **F3.3.16**.

[2] Total located in high or moderate risk areas.

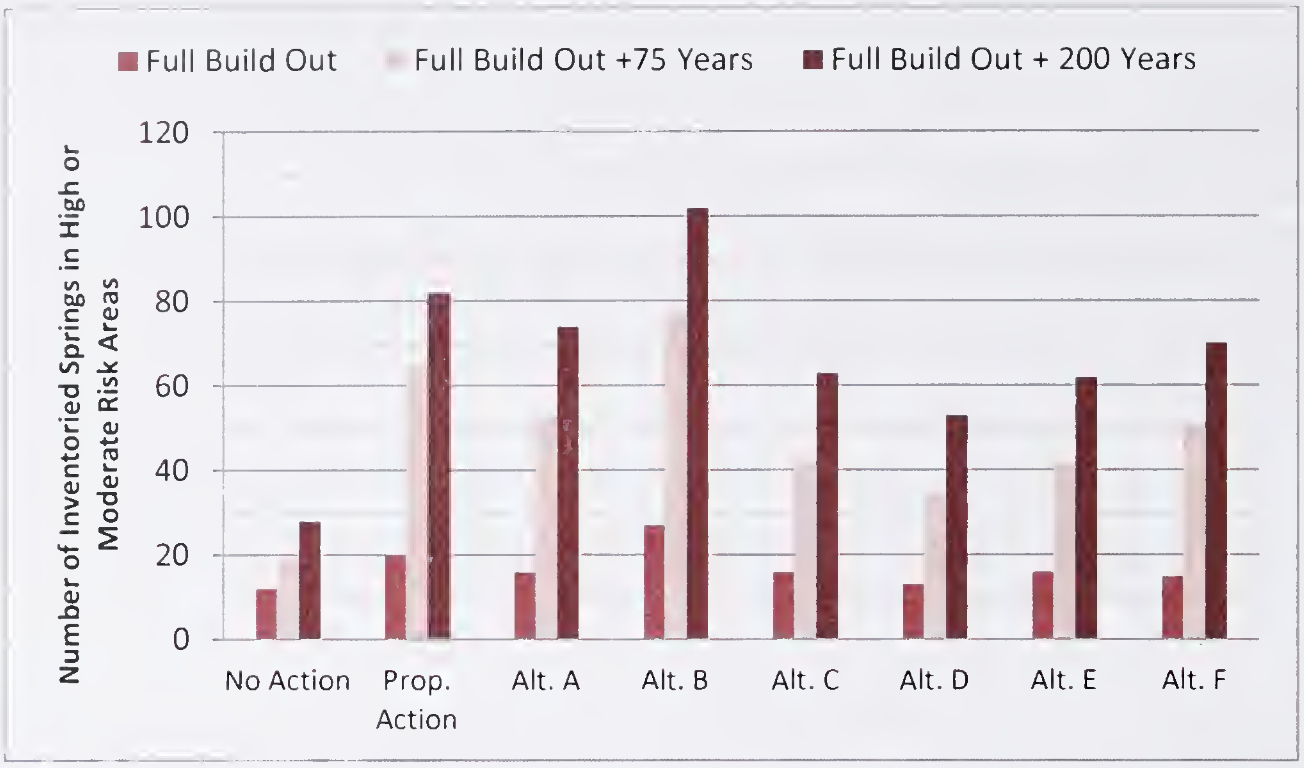


Figure 3.3.3-6 **Number of Inventoried Springs Located within the Cumulative Drawdown Area and Areas Where Impacts to Flow Could Occur**

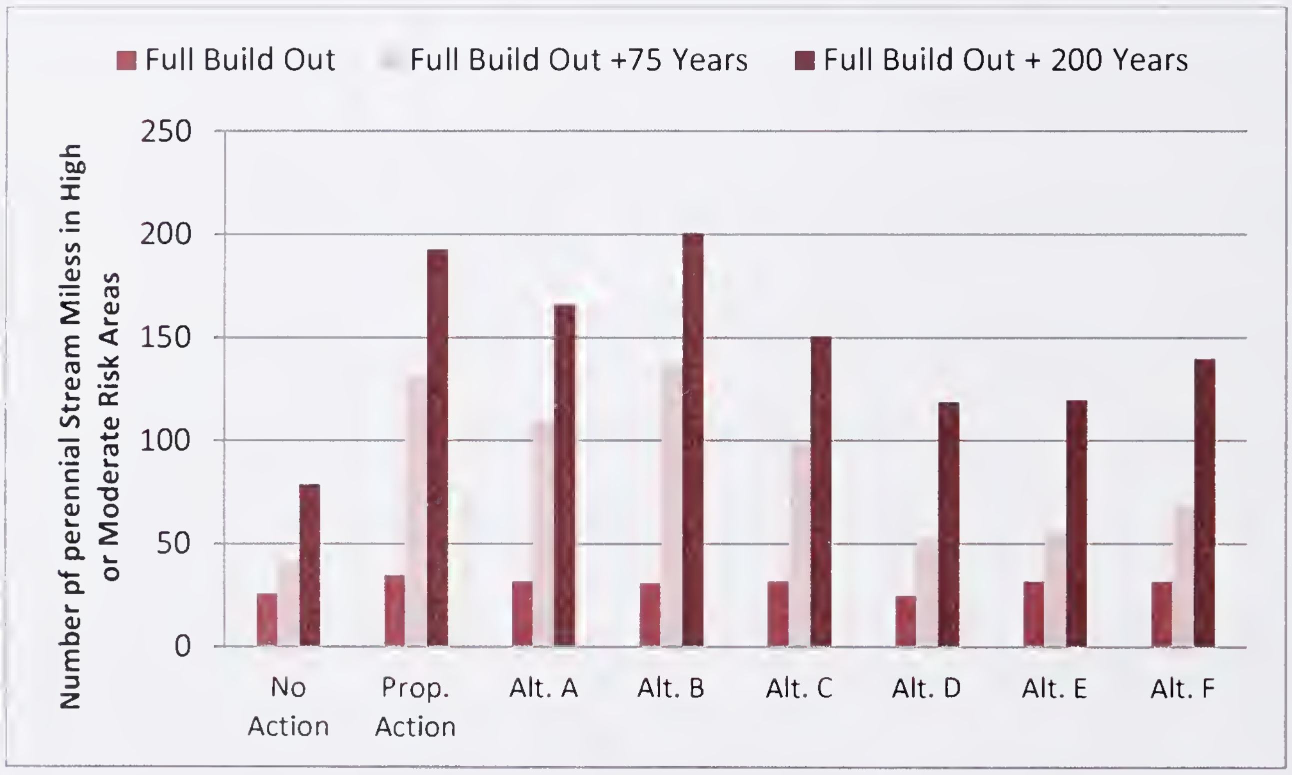


Figure 3.3.3-7 **Miles of Perennial Stream Located within the Cumulative Drawdown Area and Areas Where Impacts to Flow Could Occur**

of stream at risk of impacts increases over time for all of the cumulative pumping scenarios. For the No Action cumulative pumping scenario, there are 19 and 28 inventoried springs, and 42 miles and 79 miles of perennial streams, at the full build out plus 75 years and full build out plus 200 years time frames, respectively, located in areas where impacts to perennial water could occur. Because the No Action cumulative pumping scenario is a component of the other alternative pumping scenarios, the total number of springs and miles of perennial stream identified for the No Action cumulative scenario is included in the other 7 groundwater development pumping alternatives (i.e., Proposed Action and Alternatives A through F).

The model-simulated drawdown for the two alternatives with the largest groundwater withdrawal rate (Proposed Action and Alternative B) potentially could impact flows in the largest number of springs and miles of perennial stream reach. The reduced drawdown areas resulting from the Alternative A cumulative pumping scenario potentially would reduce the number of springs and miles of streams impacted. The C, D, E, and F cumulative alternatives would further reduce the drawdown area compared to Alternative A, and potentially would impact the smallest number of inventoried springs and miles of perennial stream reach.

Model-simulated Spring and Stream Discharge Estimates

Model-simulated changes in spring flow for selected springs for each of the cumulative pumping scenarios are provided in **Appendix F3.3.6**. The model results for Preston Big Spring, Butterfield Spring, and Flag Springs 3 in White River Valley are presented in **Figure 3.3.3-8**. Preston Big Spring is located in the valley floor in the northern portion of White River Valley. The model results indicate that the flow at Preston Big Springs would be reduced by up to 7 percent from groundwater withdrawals included in the No Action cumulative pumping scenario. Additional reductions in flow resulting from the pumping included in the groundwater development alternatives (i.e., Proposed Action and Alternatives A through F) would be negligible. The model-simulated flow changes at Cold Spring and Nicolas Spring, located in the same general area within White River Valley, show essentially the same results.

Butterfield Springs and Flag Spring are located near the eastern margin of the valley floor in the southern portion of White River Valley. The model results indicate that the No Action cumulative pumping scenario would result in a small reduction in flow (up to 3 percent) over the model-simulation period. The model simulations indicate that all of the groundwater development alternatives would result in reduced flow at these springs. These potential flow reductions result from pumping in Cave Valley. The maximum pumping rate in Cave Valley would occur under the Proposed Action and Alternatives B and F (11,548 afy for all three alternatives) and the greatest flow reduction at these springs would occur under Alternative B. The model results indicate that distributed pumping used in Proposed Action and Alternative F substantially would reduce the potential flow reduction in these springs compared to Alternative B. The reduced pumping in Cave Valley in Alternatives A, C, D, and E pumping scenarios is anticipated to reduce effects to flows at these springs.

The regional springs that discharge in Pahranagat Valley (i.e., Hiko, Crystal, and Ash Springs) are predicted to experience small flow reductions (up to 4 percent) under the No Action cumulative pumping scenario. These model-simulated flow changes are essentially the same for all of the groundwater development cumulative pumping scenarios indicating that additional reductions in flow resulting from the GWD Project would be negligible for all alternatives.

Muddy River Springs near Moapa is the headwaters for Muddy River and represents the largest groundwater discharge at the lower end of the White River flow system. The predicted reductions in flow at Muddy River Springs are presented in **Figure 3.3.3-9**. The model results predict that groundwater withdrawal included in the No Action cumulative pumping scenario eventually would result in up to 61 percent reduction in flow at the Muddy River Springs. Most of the reduction in flow can be attributed to the pumping included under RFFAs in the region including the pumping of SNWA's existing water rights in nearby Coyote Spring Valley. These model-simulated flow changes are essentially the same for all of the groundwater development cumulative pumping scenarios. (Note that the numerical model simulations do not account for the existing Muddy River Memorandum of Agreement regarding groundwater withdrawal in Coyote Spring Valley and California Wash basins, among the SNWA, Moapa Valley Water District, Coyote Spring Investment, Moapa Band of Paiutes, and USFWS. This agreement requires that minimum in-stream flow levels will be maintained through the implementation of mitigation measures such as redistribution of pumping and/or cessation or reduction in pumping, if necessary. The groundwater model could not address these minimum in-stream flow requirements, thus they are not reflected in the simulation results. Based on the agreement, potential flow reductions under the No Action cumulative pumping scenario are anticipated to be less than those simulated by the model.) The flow at Panaca Spring located in Panaca Valley also is expected to experience flow reductions from pumping included in the No Action cumulative pumping scenario; however, the groundwater development pumping likely would not contribute to these flow reductions.

Figure 3.3.3-8 Model-simulated Cumulative Reduction in Flows at Preston Big Springs, Butterfield Springs, and Flag Springs 3, White River Valley

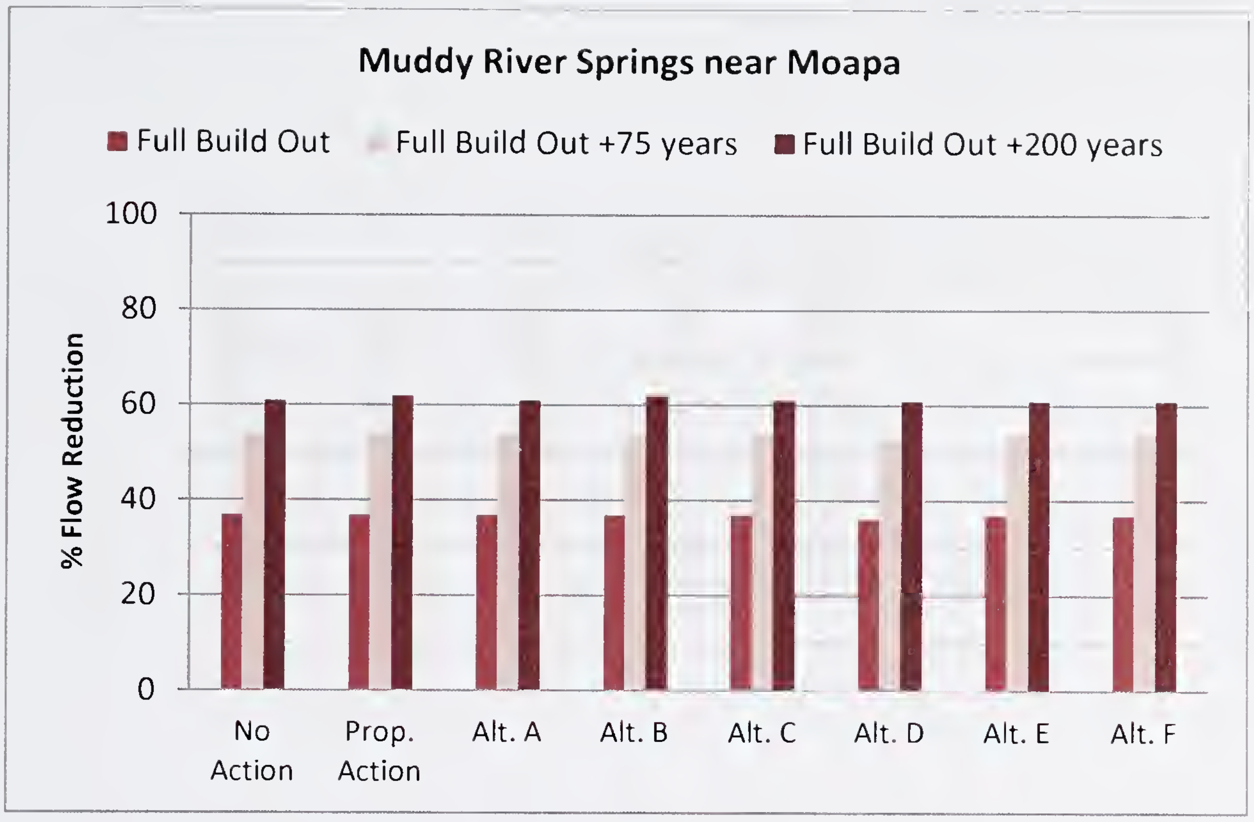


Figure 3.3.3-9 Model-simulated Cumulative Reduction in Flows at Muddy River Springs near Moapa

The magnitude of flow changes predicted at Keegan, North Millick, and South Millick springs in Spring Valley predicted under the cumulative pumping scenarios are similar to those simulated for the project-specific effects summarized in Section 3.3.2. These results indicate that potential cumulative impacts to perennial spring and stream discharge in Spring Valley are attributable to the GWD project pumping, and not existing pumping or reasonably foreseeable future pumping in the immediate area.

For Big Springs in Snake Valley, the model simulations results indicate that flow reductions for the No Action cumulative scenario are the same as previously described under the No Action pumping scenario (Section 3.3.2.16). All of the groundwater development alternatives are expected to result in substantial reduction in flow at Big Springs (**Figure 3.3.3-10**). As described previously, reductions of flow at Big Springs would reduce flows in Big Springs Creek and flows to Lake Creek and Pruess Lake. The model simulations indicate that none of the cumulative pumping scenarios would reduce flows in the three other springs simulated in the groundwater model. These springs are located in the central portion of Snake Valley (Foote Reservoir Spring, Kell Spring, and Warm Creek near Gandy).

Water Resources within or Adjacent to Great Basin National Park

Surface water resources located within or adjacent to the GBNP that occur within both the model-simulated drawdown area and within the susceptibility zones identified by Elliot et al. (2006) for the cumulative pumping scenarios are listed in **Table 3.3.3-2**. For the purpose of the EIS analysis, these areas are considered zones of moderate risk as defined in **Table 3.3.2-3** (i.e., impacts may occur to some perennial waters that are hydraulically connected to the regional flow system). Impacts to GBNP water resources are not anticipated under the No Action cumulative pumping scenario. However, comparison between **Table 3.3.2-8** (incremental effects) with **Table 3.3.3-2** (cumulative effects) indicates that combined effects of the pumping under No Action with pumping included for the project development alternatives (Proposed Action and Alternatives A through F) tends to increase the drawdown in the vicinity of GBNP, resulting in an increase in the length of stream within the drawdown area that is potentially susceptible to project pumping effects. Other effects are the same as previously described for the incremental effects in Section 3.3.2.9 to 3.3.2.16.

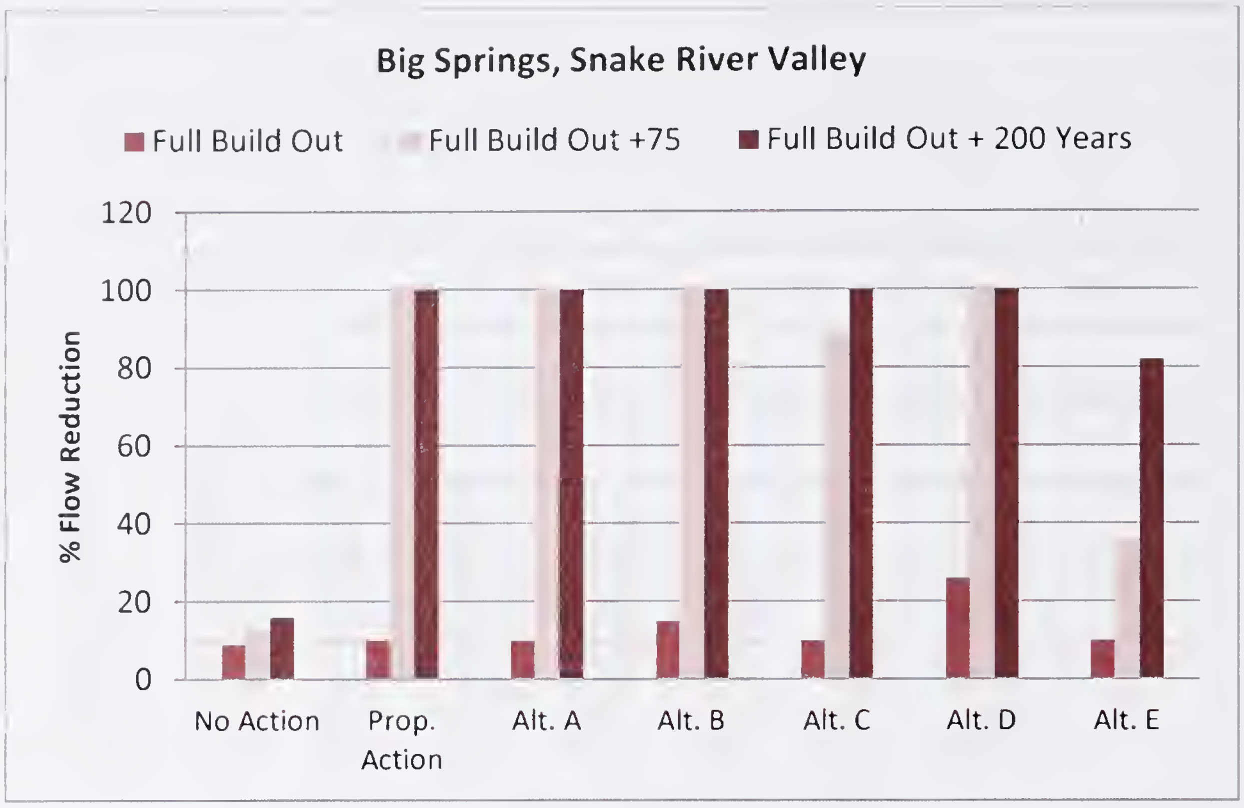


Figure 3.3.3-10 Model-simulated Cumulative Reduction in Flows at Big Springs, Snake Valley

Table 3.3.3-2 GBNP Water Resources Risk Evaluation Summary by Alternative (Cumulative Pumping Scenarios)

	Proposed Action		Alt. A		Alt. B		Alt. C		Alt. D		Alt. E		Alt. F		No Action	
Years	75	200	75	200	75	200	75	200	75	200	75	200	75	200	75	200
Springs[1]																
Cave Spring					X	X										
Outhouse Springs	X	X	X	X	X	X	X	X		X		X		X		
Rowland Springs		X		X	X	X		X								
Spring Creek Spring	X	X	X	X	X	X	X	X		X		X		X		
Other springs[2]	0	0	0	0	15	25	0	0	0	0	0	0	0	0	0	0
Streams (Miles[3])																
Baker Creek and tributaries	0.0	0.0	0.0	0.0	1.7	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lehman Creek and tributaries	0.0	0.5	0.0	0.5	2.0	2.3	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Snake Creek and tributaries	7.7	9.1	6.4	8.3	9.1	10.2	3.8	8.0	0.0	8.0	0.0	8.0	0.0	8.0	0.0	0.0

[1] "X" indicates spring is located both within the simulated drawdown area and susceptibility zones as defined by Elliot et al. (2006).

[2] Other springs identified in GBNP are listed in **Appendix F3.3.1**, **Table F3.3.1-1B**.

[3] Miles of perennial stream identified in the GBNP located both within the simulated drawdown area and susceptibility zones as defined by Elliot et al. (2006).

Utah Surface Water Resources

The model results indicate that there is a high risk of impacts to flows at Big Spring under all of the Cumulative groundwater development pumping alternatives. The risk of flow reductions generally is similar to but slightly greater than previously described for the project specific incremental effects (Section 3.3.2.9 through Section 3.3.2.16). Reduced flows at Big Springs would reduce flows in Big Springs Creek and downstream resources in Utah (i.e., Lake Creek and flow into Pruess Lake). Comparison of the model-simulated flow reductions at the full build out plus 75 year time frame indicates that projected flow reductions are similar (89 percent to 100 percent flow reduction) for the

Proposed Action and Alternatives A, B, C, and D; with less flow reductions simulated under Alternatives E and F (36 percent and 35 percent) and the No Action (13 percent). These results suggest that the risk to the flow at Big Springs, Lake Creek, and Pruess Lake would be reduced under either Alternative E or F cumulative pumping scenarios and further reduced under the cumulative No Action pumping scenario compared to the other alternative pumping scenarios. Measurable effects to Foot Reservoir Spring (i.e., Bishop Springs area) are not anticipated under the cumulative pumping scenarios for all alternatives.

Available information suggests that drawdown from cumulative pumping under all pumping scenarios is unlikely to impact surface water resources in Pine Valley (see Section 3.3.2.9 for additional discussion) within Utah.

Impacts to Water Rights

The number of surface water rights located in areas where impacts to surface water resources could occur and number of groundwater rights located within the areas where the model simulations indicate drawdown of 10 feet or more are listed in **Table 3.3.3-1**. There are a large number of existing surface water rights located in areas where impacts from drawdown could occur under both the No Action and groundwater development cumulative pumping scenarios. The model results indicate that drawdown for the two alternatives with the largest groundwater withdrawal rate (Proposed Action and Alternative B) potentially could impact the largest number of water rights. The reduced drawdown areas resulting from the other alternatives (Alternatives A through F) would decrease the number of water rights impacted. Potential impacts to individual water rights are the same as discussed under the Proposed Action (Section 3.3.2.9).

Impacts to Water Balance

Potential changes in the water balance for the groundwater system within the region of study were estimated using the groundwater flow model (SNWA 2010b). The estimated reductions in groundwater discharge to the ET areas for selected basins and flow systems are summarized in **Table 3.3.3-1** and illustrated in **Figure 3.3.3-11**. The model simulations indicate that groundwater withdrawal included in the No Action cumulative pumping scenario would have a relatively small effect on the groundwater discharge to ET areas in the Great Salt Lake Desert Flow System. For Spring Valley, the No Action pumping is estimated to result in a 6 and 9 percent reduction of groundwater discharge for ET at the full build out plus 75 years and full build out plus 200 years time frames, respectively. In Snake Valley, the pumping is estimated to result in minimal reductions (less than 4 percent) of groundwater discharge to support ET.

The Proposed Action would result in the largest reductions in groundwater discharge to the ET areas within Spring and Snake valleys; with estimated reductions of up to 86 percent in Spring Valley, and up to 35 percent in Snake Valley. For Snake valley, most of the reductions of discharge to areas would occur in the south portion of the valley. The model results indicate that Alternative D would have the least impact to the ET areas in Spring Valley because the pumping is concentrated in the south end of the valley away from much of the ET areas. The concentrated pumping under Alternative D results in the deepest drawdown cone indicating that a higher percentage of the groundwater withdrawn under this scenario is from storage compared to the other groundwater development alternatives. Alternatives E and F would result in the smallest impacts to the ET area in Snake Valley.

As described in Section 3.3.2, the model simulations indicate that the groundwater withdrawal associated with the groundwater pumping alternatives would have a have a minimal effect on amount of groundwater discharged to the ET areas within the White River Flow System. Pumping under the No Action cumulative scenario would not increase the potential reduction of flow to Pine, Wah Wah, and Tule valleys; and Fish Springs previously described for the specific groundwater pumping alternatives.

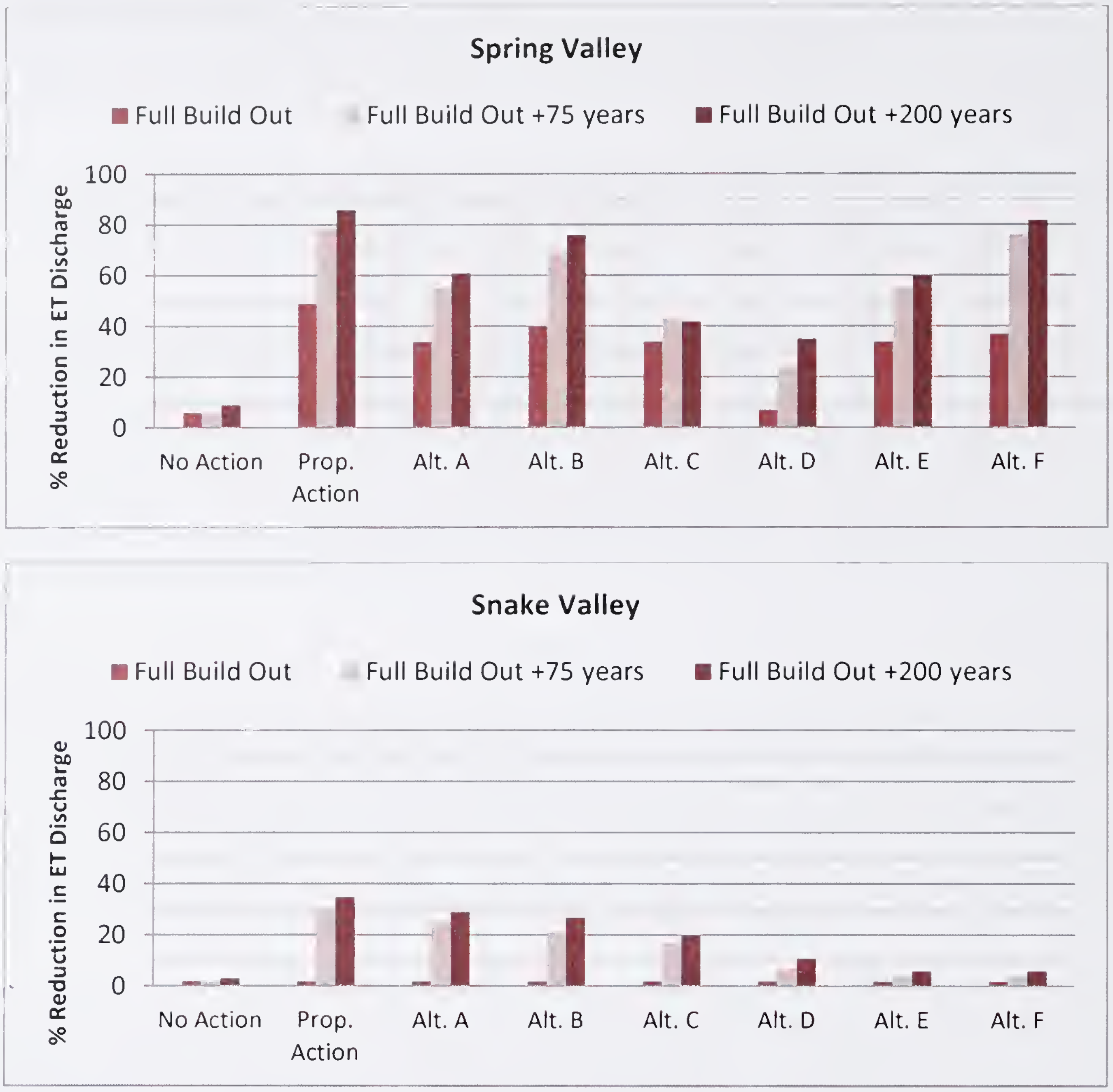


Figure 3.3.3-11 Model-simulated Cumulative Reductions in Groundwater Discharge to Evapotranspiration Areas in Spring and Snake Valleys

3.4 Soils

3.4.1 Affected Environment

The study area for soils includes the proposed ROWs and groundwater development areas associated with surface disturbance from the Proposed Action and other alternatives (**Figure 3.0-1**). In addition, the overall region of study includes areas of hydric soils associated with surface water features such as wetlands, springs, seeps, and riparian areas.

3.4.1.1 Overview

Soil resources within the project area have formed within four major land resource areas (MLRAs) (USDA NRCS 2006a) (**Figure 3.4-1**). Generally from north to south, these include:

- MLRA 28A – The Great Salt Lake Area;
- MLRA 28B – Central Nevada Basin and Range;
- MLRA 29 – Southern Nevada Basin and Range; and
- MLRA 30 – Mohave Basin and Range.

Each of these MLRAs contains one or more of the following soil orders: Aridisols, Entisols, and Mollisols. Aridisols are soils that develop in arid ecosystems. Entisols lack soil development and typically are shallow or sandy. Mollisols have a thick, dark, fertile surface layer.

QUICK REFERENCE

Alluvial – Composed of, or found in alluvium.

Soil Horizon – The layers in the upper crust of the earth. The differences in the horizons are most easily seen in soils that have not been touched in decades. The A horizon is topsoil, where most roots grow; B is the subsoil; and C is the parent material from which soil is formed. Although some roots can penetrate into the C horizon, few microorganisms live there.

Soil Orders – Aridisols are soils that develop in arid ecosystems

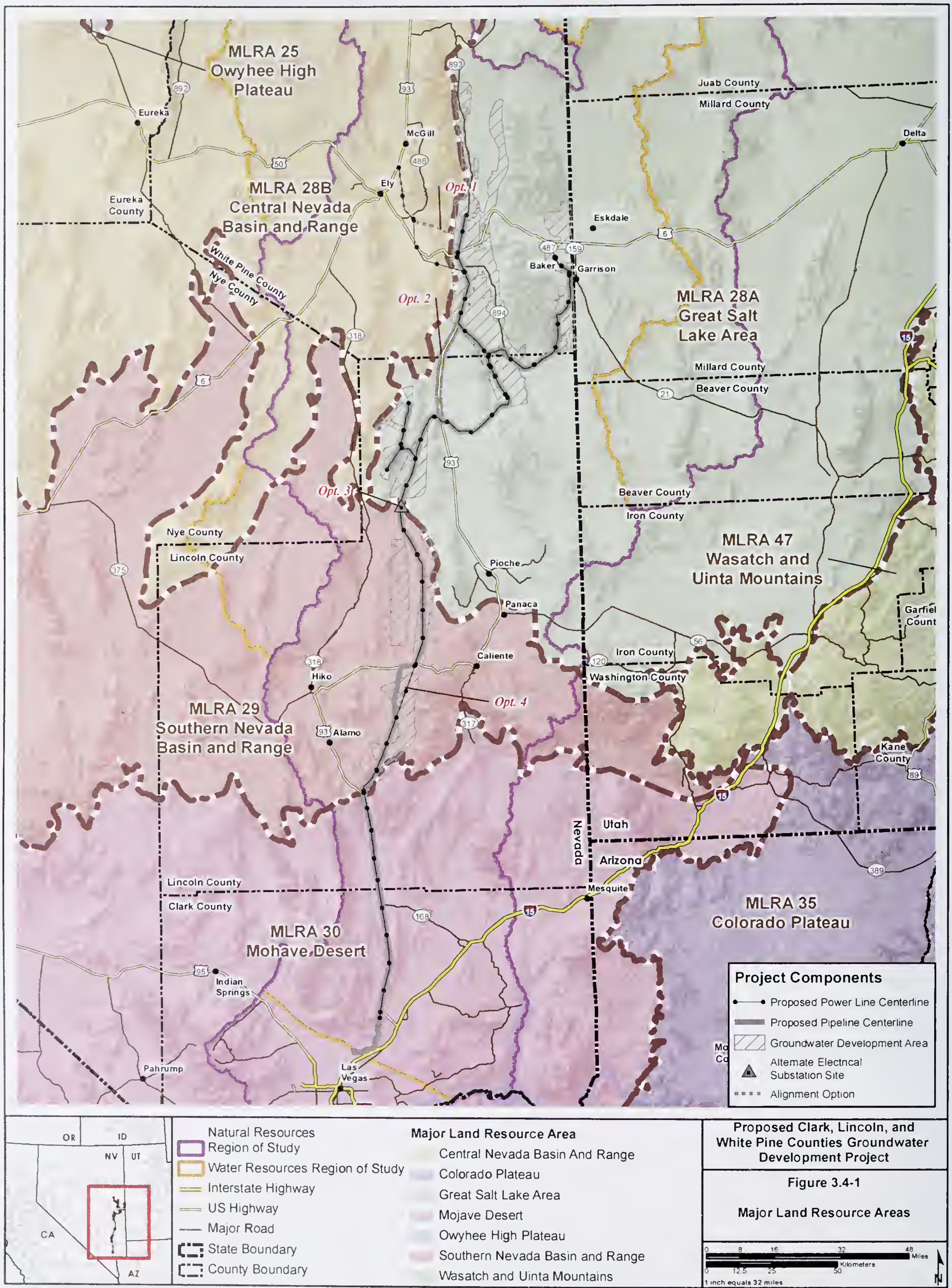
Entisols lack soil development and typically are shallow or sandy.

Mollisols have a thick, dark, fertile surface layer.

Great Salt Lake Area (MLRA 28A)

The Great Salt Lake Area is comprised of nearly level basins between widely separated mountain ranges trending north to south. The basins are bordered by long, gently sloping alluvial fans. The mountains are uplifted fault blocks with steep side slopes, and are not well dissected because of low rainfall. A large salt desert playa is located south and west of Great Salt Lake. Most of the valleys are closed basins containing sinks or playa lakes (USDA NRCS 2006a).

The dominant soil orders are Aridisols, Entisols, and Mollisols. The soils in this area generally are well drained or somewhat excessively drained, loamy or loamy skeletal (lacking soil horizons and rocky), and very deep. The soils developed from sedimentary and igneous parent materials. Soils in this area commonly contain high calcium carbonate contents. Alkalinity commonly increases with depth. Soils along alluvial fans, lake plains, and flats often have high concentrations of salts and sodium.



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Central Nevada Basin and Range (MLRA 28B)

The Central Nevada Basin and Range is an area of nearly level, aggraded desert basins and valleys between a series of mountain ranges trending north to south. The basins are bordered by long, gently sloping to strongly sloping alluvial fans. The mountains are uplifted fault blocks with steep side slopes. Many of the valleys are closed basins containing sinks or playas. The mountains in the southern half of this area are dominated by igneous parent materials. Sedimentary carbonate parent materials are prominent in the mountains to the north. The valleys consist mostly of alluvial fill. The alluvial valley fill consists of cobbles, gravel, and coarse sand near the mountains in the apex of the alluvial fans. Finer textured materials are found on the fan edges (USDA NRCS 2006a).

The dominant soil orders are Aridisols, Entisols, and Mollisols. They generally are well drained, loamy or loamy-skeletal, and shallow to very deep. Soils in this area commonly contain high calcium carbonate contents due to the carbonate parent materials. Soils along alluvial fans, lake plains, and flats often have high concentrations of salts and sodium.

Southern Nevada Basin and Range (MLRA 29)

The Southern Nevada Basin and Range is an area of broad, nearly level, aggraded desert basins and valleys between a series of mountain ranges trending north to south. The basins are bordered by sloping fans and terraces. The mountains are uplifted fault blocks with steep side slopes. Most of the valleys in this MLRA are closed basins containing sinks or playa lakes. The mountains in this area are dominated by igneous and sedimentary carbonate rocks. The valleys consist mostly of alluvial fill. The alluvial valley fill consists of cobbles, gravel, and coarse sand near the mountains in the apex of the alluvial fans. Finer textured materials are found on the fan edges (USDA NRCS 2006a).

The dominant soil orders are Aridisols and Entisols. Mollisols also are important in the mountainous areas. They generally are very shallow to very deep, well drained or somewhat excessively drained, and loamy-skeletal or sandy-skeletal. Soils in this area commonly contain high calcium carbonate contents due to the carbonate parent materials. Soils found in sinks and playa lakes typically have high concentrations of salts and sodium.

Mohave Basin and Range (MLRA 30)

The Mohave Basin and Range consists of broad basins, valleys, and old lakebeds with widely spaced mountains trending north to south. Isolated, short mountain ranges are separated by an aggraded desert plain. The mountains are fault blocks that have been tilted up. Long alluvial fans coalesce with dry lakebeds between some of the ranges. Most of this area is underlain by alluvial deposits on alluvial fans and valley floors. Recent alluvial fans and remnant alluvial fan terraces typically grade from boulder-strewn deposits and coarse desert pavement near the fan apex to finer grained sands, silts, and clays at the lower ends. Playas are at the lowest elevations in the closed basins. Wind-blown deposition commonly occurs along playa downward fringes. Water from shallow subsurface flow (and from surface flows that periodically fill the playa basins) evaporates, leaving accumulations of evaporite minerals, including salts and borates (USDA NRCS 2006a).

The dominant soil orders are Aridisols and Entisols. The soils generally are well drained to excessively drained, loamy-skeletal or sandy-skeletal, and shallow to very deep. They developed from metamorphic, igneous, carbonates, granitics, and nonmarine sedimentary and volcanic deposits. Saline and sodic soils are common.

3.4.1.2 Right-of-way Areas

The soil baseline characterization described in this section presents an overview of the soils within the basins that are projected to be disturbed by construction of pipelines and ancillary facilities within ROWs. The information is based on review and analyses of the Soil Survey Geographic Database (SSURGO) database for the region. SSURGO is the most detailed level of soil mapping done by the USDA, NRCS. SSURGO data are not available where soil surveys have not been completed. General Soil Map data based on the U.S. General Soil Map (STATSGO) data set (USDA NRCS 2006b) are used for those areas where SSURGO data are unavailable. New soil mapping is underway in Snake Valley (Soil Survey Area UT617), but it was not completed in time to use for this EIS. Updated or newly completed soil mapping will be used for future NEPA analyses and site-specific reclamation and revegetation plans, as it becomes available.

Figure 3.4-2 displays the various soil survey areas crossed by the ROWs associated with the Proposed Action and alternatives. SSURGO/STATSGO soils maps generally are grouped for mapping into units known as soil complexes and soil associations. A soil complex has a characteristic pattern that is so intricately mixed or small in size that it is not practical to separate the soils at the standard mapping scale. A soil association has a characteristic pattern of soils on the land surface, largely determined by relief, drainage, slope aspect, or other soil-determining factors. The percentage of the soils characteristics was determined by calculating the percentage of soils within a map unit with a specific characteristic and multiplying that percentage by the total miles crossed by the ROW or acres within the groundwater development areas.

Table 3.4-1 summarizes soil characteristics within the hydrologic basins that may be disturbed by construction. Important constraints relevant to surface disturbance and stabilization include low reclamation potential, erosion prone, compaction prone, shallow soils, and hydric soils. The amount of soil classified as prime farmland also is an important consideration relevant to surface disturbance and stabilization.

Table 3.4-1 Important Soil Characteristics by Hydrologic Basin[1]

Hydrologic Basin	Total Acres	Percent of Hydrologic Basin Area[2]							
		Compaction Prone	Shallow Bedrock[3]	Hydric	LRP[4]	Droughty[5]	Severe Wind Erosion	Severe Water Erosion	Prime Farm-land[6]
Cave	229,646	10	54	2	11	75	<1	29	14
Coyote Spring	392,730	2	23	0	<1	27	1	13	0
Delamar	231,443	23	41	1	8	86	0	36	18
Dry Lake	573,399	4	46	1	8	69	1	20	15
Garnet	100,936	1	27	1	4	13	0	27	0
Hamlin	520,085	14	20	<1	1	45	<1	13	1
Hidden	53,475	<1	10	1	6	0	0	10	0
Lake	354,464	11	33	1	7	74	2	20	9
Las Vegas	987,568	<1	1	<1	0	2	<1	<1	0
Lower Meadow Wash	605,291	29	52	<1	1	82	1	46	0
Pahranagat	495,042	1	51	<1	9	80	2	44	2
Snake	1,766,192	<1	7	2	3	8	<1	7	0
Spring (184)	1,066,063	19	22	3	12	34	<1	15	3
Steptoe	1,248,646	11	34	3	8	62	<1	27	1

[1] Portions of Coyote Spring, Las Vegas, Pahranagat, Spring (184), and Steptoe valleys have no soils data or are limited to the more general STATSGO data. STATSGO are included in the table when more specific data are not available.

[2] Percentages represent the proportion of each characteristic that meet the listed limitations and do not total 100 percent of each basin.

[3] Shallow bedrock soils were identified by querying the SSURGO database for component soil series that have a bedrock contact less than 60 inches from the surface.

[4] LRP = Low reclamation potential.

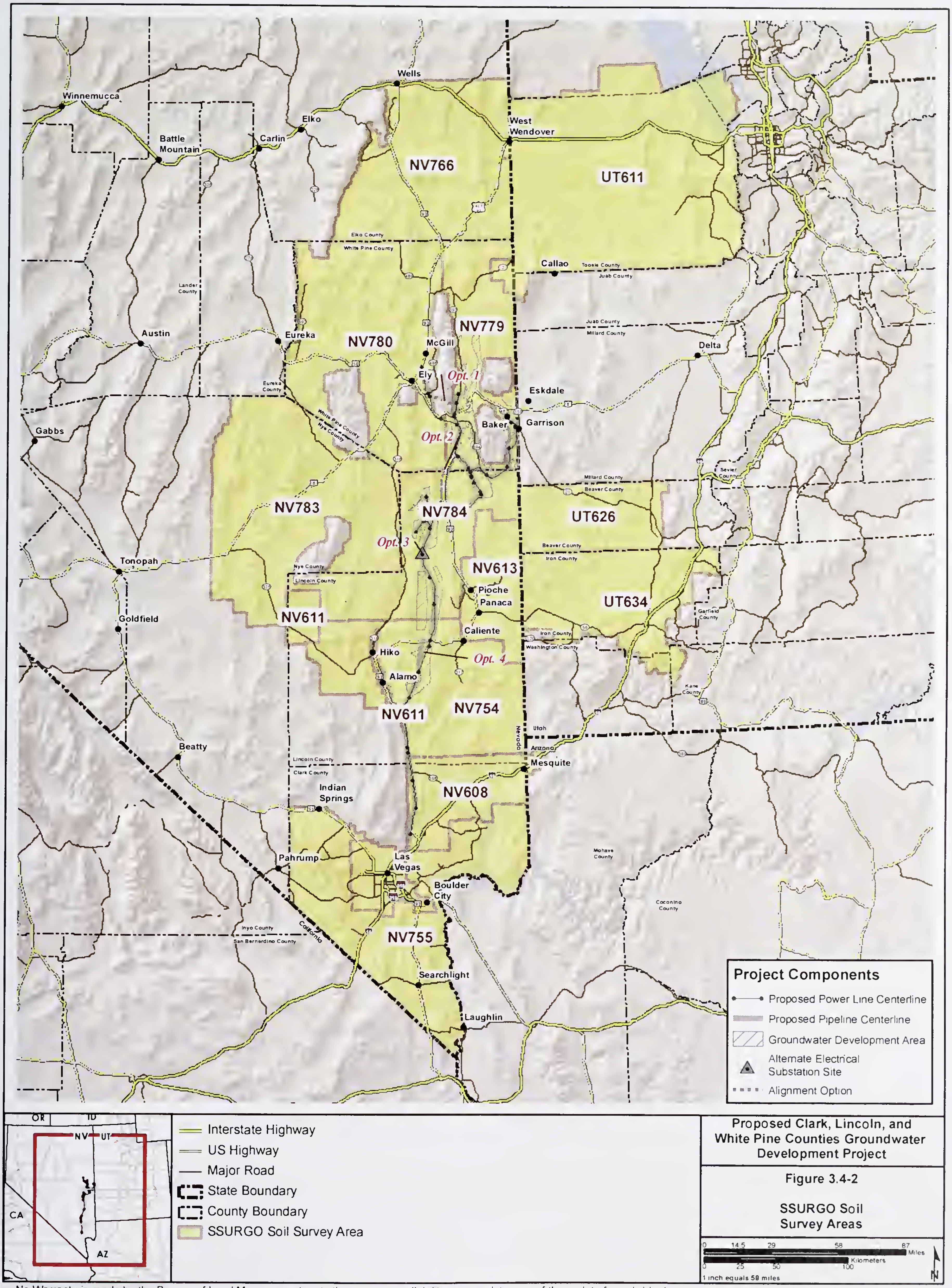
[5] Droughty soils were identified by querying the SSURGO database for coarse textured soils (sandy loams and coarser) that are well drained to excessively drained. The database for survey area NV780 (Western White Pine County and parts of White Pine and Eureka counties) did not have soil textures populated so only the drainage class was used.

[6] These soils have the capability to be prime farmland, but may not have yet been developed for irrigated agriculture uses. Not all soils in all hydrologic basins were rated for Prime Farmland classification.

Source: USDA NRCS 2006c,d; 2007a,b,c,d,e,f,g; 2008, 2009a,b.

Descriptions and figures of the soil characteristics relevant to management of soils in the region are summarized below.

- Compaction Prone are fine-textured soils that have clay loam or finer textures. These soils are especially prone to compaction when moist or wet.
- Shallow Bedrock soils are listed because they may affect excavation for foundations and pipelines.



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.4-2

SSURGO Soil Survey Areas

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

- Hydric soils are soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part. These soils are commonly associated with floodplains, lake plains, basin plains, and with riparian areas, wetlands, springs, and seeps (**Figure 3.4-3**). Nearly all hydric soils exhibit characteristics that result from repeated periods of saturation or inundation for more than a few days during the growing season, resulting in a depletion of oxygen. This promotes biogeochemical processes, such as the accumulation of organic matter and the reduction, translocation, and/or accumulation of iron and other elements (USDA NRCS 2006b). Hydric soils are rare in the region due to the arid climate. There are small, localized areas showing evidence of the past occurrence of hydric soils (relict hydric soils) in Snake Valley where water tables have lowered due to drought and water usage (Bryant 2010).

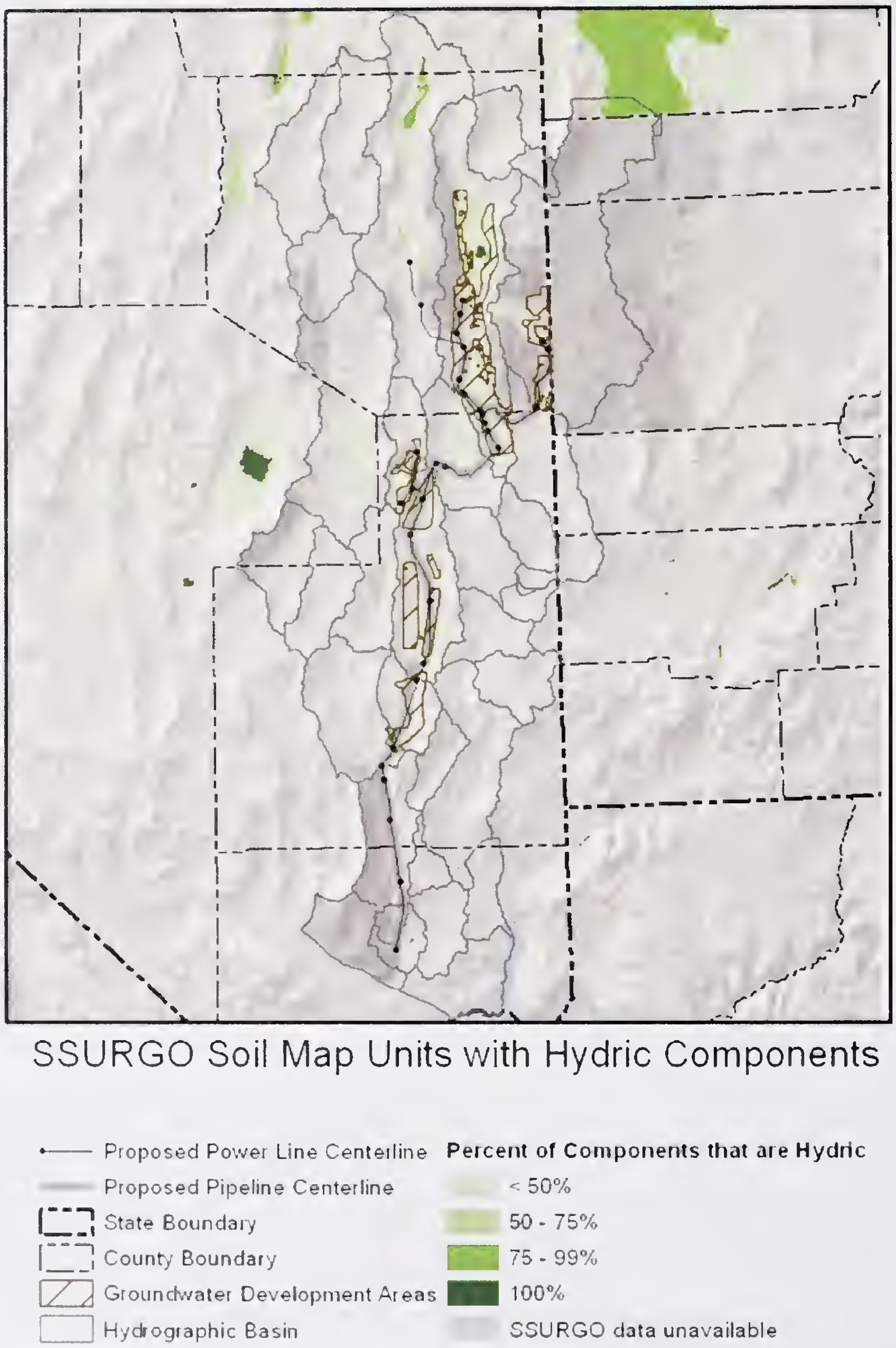


Figure 3.4-3 SSURGO Soil Map Units with Hydric Components

- Severe Water Erosion Potential rates the erodibility of the whole soil by surface water runoff. The estimates are modified by the presence of rock fragments and slope.
- Low Reclamation (Revegetation) Potential includes soils that are saline, sodic, or strongly alkaline/acid have low potential for successful stabilization if disturbed. These chemical characteristics are likely to adversely affect plant re-establishment and growth.
- Droughty soils are coarse-textured soils with poor water holding capacity that can be difficult to revegetate during periods of low precipitation.
- Severe Wind Erosion Potential. Wind erodibility is expressed as a soil grouping index of 1 to 8. The group number is based on sand, silt, and clay content and the susceptibility of soils to being blown by wind. Sandier soils have the highest wind erodibility potential and are assigned to Group 1. Soils with the lowest wind erodibility are assigned to Group 8 (USDA-NRCS 2007h). While soils in other groups would be subject to wind erosion, the soils in Groups 1and 2 were characterized in this analysis as having severe wind erosion potential to represent the acreage most likely to erode (**Figure 3.4-4**).

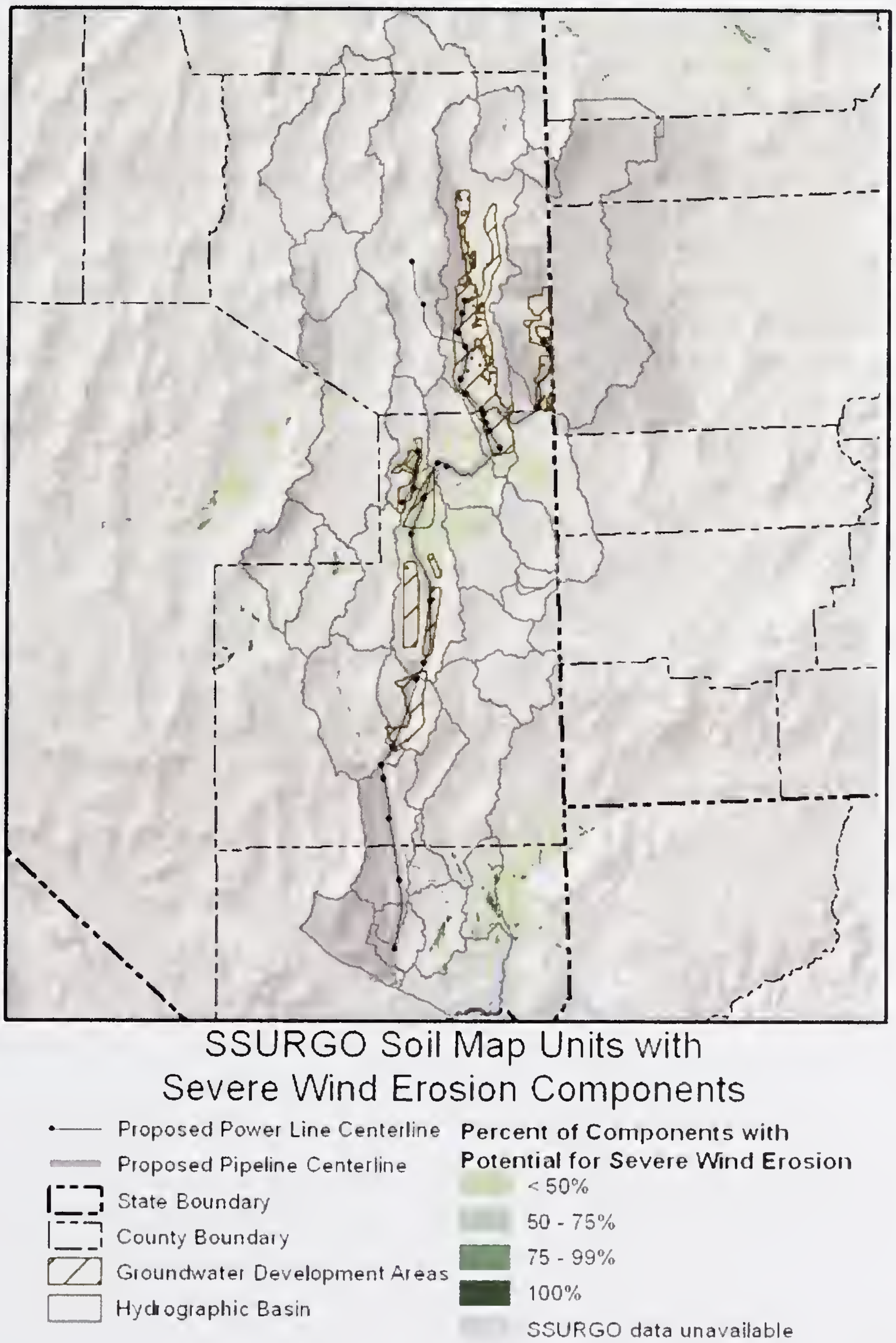


Figure 3.4-4 SSURGO Soil Map Units with Severe Wind Erosion Components

- Prime farmland is land that has the best combination of physical and chemical characteristics and is available for producing crops. It has the combination of soil properties, growing season, and moisture supply needed to produce sustained high yields of crops in an economic manner if it is treated and managed according to acceptable farming methods. Based on an aerial photo interpretation, no mapped prime farmland soils in the project area are currently irrigated and farmed, but there are prime farmland soils in the region.

Biological soil crusts are considered an important component in dry arid ecosystems. They provide soil stability, prevent erosion, fix nitrogen, increase infiltration rates, and may reduce noxious weed migration. The southern portion of the project area (the northeast portion of the Mojave Desert) has a relatively high cover of biological soil crusts. No site-specific data are available on soil crust coverage in the study area; however, research shows that biological soil crusts do best where sedimentary parent materials are found (Belnap et al. 2003). Biological soil crusts are vulnerable to disturbance and difficult to restore in arid environments. The success of biological soil crust recovery depends on many factors, including the extent and type of surface disturbance, soil texture, amount of effective precipitation, and condition of adjacent soils (Belnap et al. 2001).

Radionuclide testing was conducted to investigate the possibility of radioactivity in the soils due to airborne transport of particulates associated with nuclear testing conducted at the Nevada test site in the 1950s and 1960s. Forty-seven surface and subsurface samples were collected along the proposed mainline ROW for analysis. The samples were analyzed for Cesium-137 by spectral analysis of gamma radiation. Cesium-137 is a radioactive product that does not occur naturally, and is specific to nuclear testing. The results indicate that any fallout from nuclear testing conducted in the past has decayed to low levels that are not considered harmful to human health (Converse Consultants 2007).

Erionite is described in Section 3.2, Geologic Resources, as a mineral occurring in some volcanic tuff deposits that may be hazardous to human health if inhaled. While some of the shallow soils in the project area overlie volcanic tuff, no erionite occurrences are known in the project area (Sweetkind 2009). Therefore, the excavation of shallow soils during installation of pipelines or other construction activities would not cause erionite particles to be released.

3.4.1.3 Groundwater Development Areas

The construction activity within the proposed groundwater development areas falls within Cave, Delamar, Dry Lake, Snake, and Spring (184) valleys. The soil characteristics within these valleys are summarized in **Table 3.4-1** and explained in Section 3.4.1.2 above.

3.4.1.4 Region of Study

The region of study for soils encompasses those basins in which soils would be disturbed during construction and maintenance operations for the proposed facilities, as well as those areas where the soils may be affected by groundwater drawdown. **Table 3.4-1** shows the important soil limitations within the basins where surface disturbance is anticipated. There are up to 14 hydrologic basins (depending on the pumping scenario in each alternative) in which hydric soils may be altered if groundwater levels were lowered due to pumping. The basins and the acreage considered are listed in **Table 3.4-1** and essentially are the Water Resources Region of Study described in more detail in Section 3.3, Water Resources.

3.4.2 Environmental Consequences

3.4.2.1 Rights-of-way

Issues

The following issues for soil resources are evaluated for ROW construction and operation:

- Potential disturbance to soils causing accelerated erosion;
- Potential disturbance to soils causing compaction due to vehicle traffic;
- Reclamation in areas with poor vegetation growth characteristics; and
- Long-term soil quality concerns.

Assumptions

The following assumptions were made to support the analysis of the impacts to soils from implementation of the alternatives.

- SSURGO data are more accurate than the general STATSGO soil mapping. SSURGO is the most detailed level of soil geographic data, collected based on field mapping. STATSGO consists of a broad-based inventory using data on geology, topography, vegetation, and climate at a coarse resolution. Therefore, the percentages of the hydrologic basins with specific soil characteristics were derived from SSURGO data, which were assumed to represent those areas that are currently without detailed soil mapping.
- BMPs and management direction listed in the Ely and Las Vegas BLM RMPs and the ACMs related to soils in **Appendix E** will be implemented during construction, operation, and maintenance of the proposed project. In reality, measures will have varying degrees of success due to variable climatic conditions, soils limitations, and a range of factors. Monitoring of these measures and maintenance or reestablishment where needed, as addressed in ACMs A.2.9 and A.2.10, will be important to improve the probability of success.
- Where the ACMs require review and approval by the BLM, their review will ensure compliance with the applicable RMP objectives and management direction intended to minimize adverse impacts to soils.
- In general, it was assumed for purposes of this analysis that the BMPs and ACMs implemented for erosion control will be effective if established using recommended guidelines and maintained. Because there are no guaranteed methods of reestablishing vegetative cover and stabilizing disturbed soils in the arid climate present in the study area, it is likely that a portion of the reclamation efforts may not be successful or may take many years to be stabilized. Careful monitoring of reclaimed areas as part of the Restoration Plan will be important to achieve success in stabilizing problem areas.
- Soils that are highly erodible or with low revegetation potential will require more extensive and aggressive erosion control measures and more frequent maintenance than other soils without those characteristics in order to minimize erosion and downstream sedimentation. Some soils may not be successfully stabilized following disturbance or may take many years for reclamation to be successful.
- Soils disturbed during construction (vegetation damage or removal, excavation, grading) will be susceptible to wind and water erosion until they are stabilized, which is likely to take several growing seasons due to the arid climate. Some sites may not be fully reclaimed or stabilized following surface disturbance.
- Short-term impacts such as minor soil compaction from equipment traffic, excavation and handling, and spills of fuels and lubricants may alter the functioning of these soils temporarily following construction.

Methodology for Analysis

Impact assessments were based on a range of soil characteristics using the SSURGO spatial and tabular data using the following method:

- The acreage of each soil map unit that would be disturbed within the proposed facility footprints and ROWs within each hydrologic basin was calculated using GIS.
- Some soil characteristics are important because they influence the magnitude of construction impacts, success of BMPs, and the potential for reclamation. The extent that the disturbed soils with these important characteristics are relevant to the project was identified.
- The BLM RMP management actions, BMPs, and ACMs available to limit the extent and duration of predicted impacts were evaluated.
- Additional mitigation measures to reduce or offset impacts were proposed.
- SNWA would be required to implement a comprehensive COM Plan that would include all future hydrographic basins and all facilities associated with the SNWA GWD Project. The COM Plan includes a requirement for comprehensive monitoring and mitigation program for the entire project that would integrate the various required monitoring and mitigation actions. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary, along with measures to protect soil resources from ROW construction and operation activities.

3.4.2.2 Proposed Action, Alternatives A through C

Construction and Facility Maintenance

All Impact Issues

Grading and excavating for the proposed pipelines and ancillary facilities would disturb a variety of soils. Certain inherent soil characteristics influence the productivity and revegetation potential after disturbance. The major soil characteristics of concern and the percentages encountered of each type within each hydrologic basin are listed in **Table 3.4-1**. An estimate of the amount of soils with characteristics of importance to construction and reclamation that are projected to be disturbed due to construction is included in **Table 3.4-2** by hydrologic basin. The following discussions present the data in **Table 3.4-2** as a percentage of the total project area (rather than by basin).

Approximately 5 percent of the overall project surface disturbance would affect soils that are highly erodible by water, and 12 percent is susceptible to severe wind erosion. Soils that lose surface roughness or crusts (biological or salt) would be damaged by construction activities (i.e., clearing, grubbing, excavation, vehicle traffic) and are likely to be susceptible to wind or water erosion even if they are not rated as severe. Disturbed soils that are not successfully reclaimed or stabilized are likely to lose productivity and the ability to sustain vegetation over the long term, which would reduce watershed health and contribute to sedimentation in surface water or degradation of local air quality. It is not possible to quantify or locate all of the areas where this may occur. However, the BLM reports that exceedance of soil loss thresholds and losses in soil productivity due to wind erosion are most likely to occur on soils that are saline or alkaline, fine-textured, and formed in some lake sediments (Bryant 2010).

Overall, approximately 19 percent of the proposed ROW and facility construction would have short-term impacts on soils designated by the NRCS as prime farmland. Some of these soils would be permanently altered due to the construction of permanent facilities.

While compaction may occur on any soils under some conditions, approximately 1 percent of the proposed surface disturbance would occur on soils that are especially compaction prone. Soil compaction and rutting likely would result from the movement of heavy construction vehicles in the construction ROWs. The degree of compaction would depend on the moisture content and texture of the soil at the time of construction. Compaction would be most severe where heavy equipment with rubber tires operates on moist to wet soils with high clay content. Compaction also can occur on soils of various textures and moisture contents if multiple passes are made by high ground weight equipment. If soils are moist or wet where topsoil trenching has occurred, topsoil would likely adhere to tires and/or tracked vehicles and be carried away.

Typically, soils that are compaction prone also are likely to become rutted or displaced when saturated. Rutting occurs when the soil strength is not sufficient to support the applied load from vehicle traffic. Rutting affects the surface hydrology of a site as well as the rooting environment. The process of rutting physically severs roots and reduces the aeration and infiltration of the soil, thereby degrading the rooting environment. Rutting also disrupts natural surface water hydrology by damming surface water flows, creating increased soil saturation upgradient from ruts, or by diverting and concentrating water flows, creating gully erosion. Rutting is most likely to occur on moist or wet fine-textured soils, but also may occur on dry sandy soils due to low soil strength.

Table 3.4-2 Summary by Basin of Soils of Concern Projected to be Disturbed during Right-of-way Construction under Proposed Action and Alternatives A through C[1]

Hydrologic Basin	Disturbance Footprint (ac.)	Percent of Hydrologic Basin Area							
		Compaction Prone	Shallow Depth to Bedrock[2]	Hydric	LRP[3]	Droughty[4]	Severe Wind Erosion	Severe Water Erosion	Prime Farm-land[5]
Cave	712	1	0	1	99	80	0	0	79
Coyote Spring	1,727	0	0	0	95	95	28	3	0
Delamar	891	1	0	1	67	92	0	0	51
Dry Lake	2,631	0	8	0	83	99	24	0	42
Garnet	306	0	0	0	94	94	0	6	0
Hamlin	384	0	0	0	100	100	0	1	0
Hidden	478	0	0	0	97	61	0	2	0
Lake	804	7	2	0	80	76	1	0	17
Las Vegas	223	0	0	0	21	21	0	12	0
Lower Meadow Wash	121	0	0	0	95	95	0	10	10
Pahranagat	252	0	0	0	93	100	5	65	3
Snake	879	0	0	0	97	96	0	1	0
Spring (184)	2,553	0	0	0	77	79	12	3	2
Steptoe	327	0	0	0	10	29	0	56	<1
Summary of ROW Footprint[6]	**12,288**	**1**	**2**	**<1**	**83**	**86**	**12**	**5**	**19**

[1] Small portions of Coyote Spring, Las Vegas, Spring (184), and Steptoe valleys have no detailed soils data so they were excluded from this table. The percentages are assumed to be representative of the entire basin where affected by construction.

[2] Shallow bedrock soils are those that have bedrock contact less than 40 inches from the surface.

[3] LRP = Low reclamation potential; includes soils that are very saline, sodic, or alkaline.

[4] Droughty soils were identified by querying the SSURGO database for coarse textured soils (sandy loams and coarser) that are well drained to excessively drained.

[5] These soils have the capability to be prime farmland, but may have not yet been developed for irrigated agriculture uses.

[6] Percentages in summary row are not totals of the column but represent the overall proportion of the footprint with the listed limitations. Construction and permanent acreage numbers in the table include a minimal acreage of facilities that currently exist. Therefore, the reported acreages conservatively overestimate the amount of disturbance anticipated by the proposed project by approximately 1 percent across all alternatives.

Note: To generate the information in this table, SSURGO data queries included only major components of soil map units within the areas that would be disturbed for construction.

Source: USDA NRCS 2006c,d; 2007a,b,c,d,e,f,g,h; 2009a,b.

In areas of shallow bedrock, excavation may result in rock fragments remaining on the surface or within the trench backfill at levels that would limit the success of restoration efforts. Shallow bedrock occurs on approximately 2 percent of the soils within proposed ROWs and other construction areas. Where the pipeline route crosses soils with hard bedrock, blasting or rock saws may be required for trenching.

Soils with low reclamation potential disturbed during construction would be prone to wind erosion and would be more difficult to successfully stabilize and revegetate following construction. Overall, 83 percent of soils affected have chemical or physical characteristics which may inhibit revegetation after disturbance. Saline or sodic soils often have drainage limitations and may undergo compaction impacts similar to the hydric or compaction prone soils. The success of stabilization and restoration efforts in these areas may be limited unless additional treatments and practices are employed to offset the adverse physical and chemical characteristics of the soils. With such a low percentage of hydric soils within the ROWs and project facility footprints, it is unlikely that they would be affected by surface disturbance because they could be avoided.

A long-term loss of soil productivity and quality would occur in association with permanent ancillary facilities. Temporary, isolated surface disturbance impacts may result in accelerated erosion, soil compaction, and related reductions in the productivity of desirable vegetation or crops due to operation and maintenance traffic and occasional repairs. Impacts related to excavation and topsoil handling would be limited to small areas where certain maintenance activities take place. These impacts would be temporary because BMPs would be implemented and all areas would be stabilized following surface disturbance. However, due to the high percentage of soils that are droughty or have low reclamation potential, successful revegetation to stabilize soils may be a lengthy process.

Drain valves, if utilized during hydrostatic testing or in an emergency situation, would discharge the water in the pipe to an existing dry wash. The wash typically would be protected by an energy dissipater at and immediately below the discharge location to minimize the potential for scouring, as described in ACMs A.1.62, A.1.64, and B.2.3. A detailed hydrologic analysis would be conducted during facility design for each discharge point to provide sufficient erosion control measure and prevent scouring; however, it currently is anticipated that discharge flow rates and volumes would not be allowed to exceed the 2- to 5-year storm event for the individual drainages. If, in an emergency situation, flows exceed these rates, the potential for erosion and scour would increase, resulting in deposition of sediment downstream.

SNWA plans to minimize potential impacts to soils by:

- Segregating and replacing topsoil,
- Trench backfilling,
- Relieving areas compacted by heavy equipment, and
- Implementing water and wind erosion control practices.

Conclusion. Grading and excavating during construction of the proposed pipelines, power lines, and ancillary facilities would disturb a variety of agricultural, rangeland, desert, riparian, playa, or wetland soils. This surface disturbance within the ROWs and construction areas would affect 12 percent of the soils that are highly wind erodible, approximately 5 percent of the soils that are very susceptible to water erosion, and approximately 19 percent of the soils within the ROWs is designated by the NRCS as prime farmland, some of which would be permanently altered. Approximately 83 percent of soils within the ROWs and construction areas have chemical characteristics that may inhibit revegetation, which would be difficult to reclaim and revegetate to stabilize.

During construction, the soil profiles may be mixed, with a corresponding loss of soil structure. Soils may be compacted and crusts would be disturbed due to repeated vehicle and foot traffic.

The soils within the ROWs consist of 1 percent that are compaction prone and likely to be subject to rutting or displacement from vehicle traffic when wet. Rutting disrupts natural surface water hydrology by damming surface water flows, creating increased soil saturation upgradient from ruts, or by diverting and concentrating water flows, potentially creating accelerated erosion and sedimentation.

The hydrologic basins with the most acreage to be disturbed and the highest percentages of soils with low reclamation potential and severe erosion limitations have the potential to be the most affected over the long term because successful stabilization and reclamation would be the most difficult to achieve. The basins where the most surface disturbance is projected that also have the highest percentage of problem soils that would be affected by construction and facility maintenance include Coyote Spring, Dry Lake, and Spring (184).

Temporary, isolated surface disturbance impacts may result in accelerated erosion, soil compaction, and related reductions in the productivity of desirable vegetation or crops due to operation and maintenance traffic and occasional repairs.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on soil resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

Compliance with the ACMs and the BLM RMP management actions and BMPs would minimize the impacts to soils resulting from construction and facility maintenance under the Proposed Action and Alternatives A, B, and C. Monitoring and maintenance of these ACMs would be important to achieve the desired goal of minimizing impacts. In soils that are very saline or alkaline, soil ripping to relieve compaction (ACM A.1.77) may not be beneficial because mixing the soil layers may bring subsoil with undesirable chemical properties to the surface, reducing the potential for successful site restoration. A detailed reclamation plan will be submitted to the BLM prior to the start of construction activities. The plan will specify methods for successful reclamation.

Soils would be altered by surface disturbance, excavation, compaction, and reclamation, primarily during construction activities, but the implementation of the BLM management actions and BMPs and the proposed ACMs would stabilize disturbed soils and minimize offsite erosion. Because many of the soils are difficult to revegetate and stabilize due to their physical and chemical characteristics, monitoring and maintenance of ACMs for as long as needed to ensure successful soil stabilization is critical to effectively minimizing adverse impacts to soils.

Proposed mitigation measures:

None.

Residual impacts include:

- Short-term disturbance to soils during construction would be difficult to stabilize in most of the basins.
- Unsuccessful or slow revegetation could lead to increased erosion on bare soil surfaces. Erosion of the topsoil would lead to a long-term loss of soil productivity in discrete locations.
- A long-term or permanent loss of soil productivity and quality would occur in association with permanent ancillary facilities and permanent access roads.

3.4.2.3 Alternative D

Construction and Facility Maintenance

All Impact Issues

The same ROW construction and facility maintenance issues discussed for the Proposed Action and Alternatives A through C would apply to Alternative D, which would require 225 miles of pipeline and 208 miles of power line ROWs in Clark and Lincoln counties, Nevada.

Grading and excavating for the proposed pipelines and ancillary facilities would disturb a variety of soils. Certain inherent soil characteristics influence the productivity and revegetation potential after disturbance. The major soil characteristics of concern and the percentages encountered of each type within each hydrologic basin are listed in **Table 3.4-1**. An estimate of the amount of soils with characteristics of importance to construction and reclamation that are projected to be disturbed due to construction is included in **Table 3.4-3** by hydrologic basin. The bullet items below recapture the data presented in **Table 3.4-3** as a percentage of the total project area (rather than by basin).

Table 3.4-3 Summary by Basin of Soils of Concern Projected to be Disturbed during Right-of-way Construction under Alternative D[1]

Hydrologic Basin	Disturbance Footprint (acre)	Percent of Hydrologic Basin Area							
		Compaction Prone	Shallow Depth to Bedrock[2]	Hydric	LRP[3]	Droughty[4]	Severe Wind Erosion	Severe Water Erosion	Prime Farmland[5]
Cave	712	1	0	1	99	80	0	0	79
Coyote Spring	1,727	0	0	0	95	95	28	3	0
Delamar	891	1	0	1	67	92	0	0	51
Dry Lake	2,631	0	8	0	83	99	24	0	42
Garnet	306	0	0	0	94	94	0	6	0
Hamlin	0	0	0	0	0	0	0	0	0
Hidden	478	0	0	0	97	61	0	2	0
Lake	804	7	2	0	80	76	1	0	17
Las Vegas	223	0	0	0	21	21	0	12	0
Lower Meadow Wash	121	0	0	0	95	95	0	10	10
Pahranagat	252	0	0	0	93	100	5	65	3
Snake	0	0	0	0	0	0	0	0	0
Spring (184)	683	0	0	0	100	100	45	3	1
Steptoe	0	0	0	0	0	0	0	0	0
Summary of ROW Footprint[6]	**8,828**	**1**	**3**	**<1**	**86**	**90**	**17**	**4**	**26**

[1] Small portions of Coyote Spring, Las Vegas, Spring (184), and Steptoe valleys have no detailed soils data so were excluded from this table. The percentages are assumed to be representative of the entire basin where affected by construction.

[2] Shallow bedrock soils are those that have bedrock contact less than 40 inches from the surface.

[3] LRP = Low reclamation potential; includes soils that are very saline, sodic, or alkaline.

[4] Droughty soils were identified by querying the SSURGO database for coarse textured soils (sandy loams and coarser) that are well drained to excessively drained.

[5] These soils have the capability to be prime farmland, but may have not yet been developed for irrigated agriculture uses.

[6] Percentages in summary row are not totals of the column but represent the overall proportion of the footprint with the listed limitations. Construction and permanent acreage numbers in the table include a minimal acreage of facilities that currently exist. Therefore, the reported acreages conservatively overestimate the amount of disturbance anticipated by the proposed project by approximately 1 percent across all alternatives.

Note: To generate the information in this table, SSURGO data queries included only major components of soil map units within the areas that would be disturbed for construction.

Source: USDA NRCS 2006c,d; 2007a,b,c,d,e,f,g,h; 2009a,b.

The following types of soils would be disturbed for Alternative D:

- Approximately 4 percent of the overall project surface disturbance would affect soils that are highly erodible by water, and 17 percent is susceptible to severe wind erosion.
- Overall, approximately 26 percent of the proposed ROW and facility construction would have short-term impacts on soils designated by the NRCS as prime farmland.
- While compaction may occur on any soils under some conditions, approximately 1 percent of the proposed surface disturbance would occur on soils that are especially compaction prone.
- Shallow bedrock occurs on approximately 3 percent of the soils within proposed ROWs and other construction areas. Where the pipeline route crosses soils with hard bedrock, blasting or rock saws may be required for trenching.
- Soils with low reclamation potential (86 percent) disturbed during construction would be prone to erosion and would be more difficult to successfully stabilize and revegetate following construction.

- Overall, approximately 90 percent of soils affected are droughty, which may inhibit revegetation after disturbance.
- A long-term loss of soil productivity and quality would occur in association with permanent ancillary facilities. Few, if any, hydric soils would be affected.

The same RMP management actions, BMPs, and ACMs as under the Proposed Action would be applied to Alternative D to reduce construction-related impacts to soils.

Conclusion. Grading and excavating during construction of the proposed pipelines, power lines, and ancillary facilities would disturb a variety of agricultural, rangeland, desert, riparian, playa, or wetland soils. This surface disturbance within the ROWs and construction areas would affect 17 percent of the soils that are highly wind erodible, approximately 4 percent of the soils that are very susceptible to water erosion, and approximately 26 percent of the soils within the ROWs is designated by the NRCS as prime farmland, some of which would be permanently altered. Approximately 86 percent of soils within the ROWs and construction areas have chemical characteristics that may inhibit revegetation, which would be difficult to reclaim and revegetate to stabilize.

The soils within the ROWs consist of 1 percent that are compaction prone and likely to be subject to rutting or displacement from vehicle traffic when wet. Rutting disrupts natural surface water hydrology by damming surface water flows, creating increased soil saturation upgradient from ruts, or by diverting and concentrating water flows, potentially creating accelerated erosion and sedimentation.

The hydrologic basins with the most acreage to be disturbed and the highest percentages of soils with low reclamation potential and severe erosion limitations have the potential to be the most affected over the long term because successful stabilization and reclamation would be the most difficult to achieve. The basins where the most surface disturbance is projected that also have the highest percentage of problem soils that would be affected by construction and facility maintenance include Coyote Spring, Dry Lake, and Spring (184).

Temporary, isolated surface disturbance impacts may result in accelerated erosion, soil compaction, and related reductions in the productivity of desirable vegetation or crops due to operation and maintenance traffic and occasional repairs.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on soil resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

Compliance with the ACMs and the BLM RMP management actions and BMPs would minimize the impacts to soils resulting from construction and facility maintenance under the Proposed Action and Alternatives A, B, and C. Monitoring and maintenance of these ACMs would be important to achieve the desired goal of minimizing impacts. In soils that are very saline or alkaline, soil ripping to relieve compaction (ACM A.1.77) may not be beneficial because mixing the soil layers may bring subsoil with undesirable chemical properties to the surface, reducing the potential for successful site restoration. A detailed reclamation plan will be submitted to the BLM prior to the start of construction activities. The plan will specify methods for successful reclamation.

Proposed mitigation measures:

None.

Residual impacts include:

- Short-term disturbance to soils during construction would be difficult to stabilize in most of the basins.
- Unsuccessful or slow revegetation could lead to increased erosion on bare soil surfaces. Erosion of the topsoil would lead to a long-term loss of soil productivity in discrete locations.

- A long-term or permanent loss of soil productivity and quality would occur in association with permanent ancillary facilities and permanent access roads.

3.4.2.4 Alternatives E and F

Construction and Facility Maintenance

All Impact Issues

The same ROW construction and facility maintenance issues discussed for the Proposed Action and Alternatives A through C would apply to Alternatives E and F, which would require 263 miles of pipeline and 280 miles of power line ROWs in Clark, Lincoln, and White Pine counties, Nevada.

Grading and excavating for the proposed pipelines and ancillary facilities would disturb a variety of soils. Certain inherent soil characteristics influence the productivity and revegetation potential after disturbance. The major soil characteristics of concern and the percentages encountered of each type within each hydrologic basin are listed in **Table 3.4-1**. An estimate of the amount of soils with characteristics of importance to construction and reclamation that are projected to be disturbed due to construction is included in **Table 3.4-4** by hydrologic basin. The bullet items below recapture the data presented in **Table 3.4-4** as a percentage of the total project area (rather than by basin).

Table 3.4-4 Summary of Soils of Concern Projected to be Disturbed during Right-of-way Construction under Alternatives E and F[1]

Hydrologic Basin	Disturbance Footprint (acre)	Percent of Hydrologic Basin Area							
		Compaction Prone	Shallow Depth to Bedrock[2]	Hydric	LRP[3]	Droughty[4]	Severe Wind Erosion	Severe Water Erosion	Prime Farmland[5]
Cave	712	1	0	1	99	80	0	0	79
Coyote Spring	1,727	0	0	0	95	95	28	3	0
Delamar	891	1	0	1	67	92	0	0	51
Dry Lake	2,631	0	8	0	83	99	24	0	42
Garnet	306	0	0	0	94	94	0	6	0
Hamlin	0	0	0	0	0	0	0	0	0
Hidden	478	0	0	0	97	61	0	2	0
Lake	804	7	2	0	80	76	1	0	17
Las Vegas	223	0	0	0	21	21	0	12	0
Lower Meadow Wash	121	0	0	0	95	95	0	10	10
Pahranagat	252	0	0	0	93	100	5	65	3
Snake		0	0	0	0	0	0	0	0
Spring (184)	2,209	0	0	0	74	76	14	3	3
Steptoe	327	0	0	0	10	29	0	56	0
Summary of ROW Footprint[6]	**10,681**	**1**	**2**	**<1**	**81**	**84**	**14**	**5**	**22**

[1] Small portions of Coyote Spring, Las Vegas, Spring (184), and Steptoe valleys have no detailed soils data so were excluded from this table. The percentages are assumed to be representative of the entire basin where affected by construction.

[2] Shallow bedrock soils are those that have bedrock contact less than 40 inches from the surface.

[3] LRP = Low reclamation potential; includes soils that are very saline, sodic, or alkaline.

[4] Droughty soils were identified by querying the SSURGO database for coarse textured soils (sandy loams and coarser) that are well drained to excessively drained.

[5] These soils have the capability to be prime farmland, but may have not yet been developed for irrigated agriculture uses.

[6] Percentages in summary row are not totals of the column but represent the overall proportion of the footprint with the listed limitations. Construction and permanent acreage numbers in the table include a minimal acreage of facilities that currently exist. Therefore, the reported acreages conservatively overestimate the amount of disturbance anticipated by the proposed project by approximately 1 percent across all alternatives.

Note: To generate the information in this table, SSURGO data queries included only major components of soil map units within the areas that would be disturbed for construction.

Source: USDA NRCS 2006c,d; 2007a,b,c,d,e,f,g,h; 2009a,b.

The following types of soils would be disturbed under Alternatives E and F:

- Approximately 5 percent of the overall project surface disturbance would affect soils that are highly erodible by water, and 14 percent is susceptible to severe wind erosion.
- Overall, approximately 22 percent of the proposed ROW and facility construction would have short-term impacts on soils designated by the NRCS as prime farmland.
- While compaction may occur on any soils under some conditions, approximately 1 percent of the proposed surface disturbance would occur on soils that are especially compaction prone.
- Shallow bedrock occurs on approximately 2 percent of the soils within proposed ROWs and other construction areas. Where the pipeline route crosses soils with hard bedrock, blasting or rock saws may be required for trenching.
- Soils with low reclamation potential (81 percent) disturbed during construction would be prone to wind erosion and would be more difficult to successfully stabilize and revegetate following construction.
- Overall, approximately 84 percent of soils affected are droughty, which may inhibit revegetation after disturbance.
- A long-term loss of soil productivity and quality would occur in association with permanent ancillary facilities. Few, if any, hydric soils would be affected.

The same RMP management actions, BMPs, and ACM as under the Proposed Action would be applied to Alternatives E and F to reduce construction-related impacts to soils.

Conclusion. Grading and excavating during construction of the proposed pipelines, power lines, and ancillary facilities would disturb a variety of agricultural, rangeland, desert, riparian, playa, or wetland soils. This surface disturbance within the ROWs and construction areas would affect 14 percent of the soils that are highly wind erodible, approximately 5 percent of the soils that are very susceptible to water erosion, and approximately 22 percent of the soils within the ROWs is designated by the NRCS as prime farmland. Approximately 81 percent of soils within the ROWs and construction areas have chemical characteristics that may inhibit revegetation, which would be difficult to reclaim and revegetate to stabilize.

The soils within the ROWs consist of 1 percent that are compaction prone and likely to be subject to rutting or displacement from vehicle traffic when wet. Rutting disrupts natural surface water hydrology by damming surface water flows, creating increased soil saturation upgradient from ruts, or by diverting and concentrating water flows, potentially creating accelerated erosion and sedimentation.

The hydrologic basins with the most acreage to be disturbed and the highest percentages of soils with low reclamation potential and severe erosion limitations have the potential to be the most affected over the long term because successful stabilization and reclamation would be the most difficult to achieve. The basins where the most surface disturbance is projected that also have the highest percentage of problem soils that would be affected by construction and facility maintenance include Coyote Spring, Dry Lake, and Spring (184).

Temporary, isolated surface disturbance impacts may result in accelerated erosion, soil compaction, and related reductions in the productivity of desirable vegetation or crops due to operation and maintenance traffic and occasional repairs.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on soil resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

Compliance with the ACMs and the BLM RMP management actions and BMPs would minimize the impacts to soils resulting from construction and facility maintenance under Alternatives E and F. Monitoring and maintenance of these ACMs would be important to achieve the desired goal of minimizing impacts. In soils that are very saline or alkaline, soil ripping to relieve compaction (ACM A.1.77) may not be beneficial because mixing the soil layers may bring subsoil with undesirable chemical properties to the surface, reducing the chances for site restoration to be successful. The depth of ripping or soil mixing could be crucial to successful reclamation.

Proposed mitigation measures:

None.

Residual impacts include:

- Short-term disturbance to soils during construction would be difficult to stabilize in most of the basins.
- Unsuccessful or slow revegetation could lead to increased erosion on bare soil surfaces. Erosion of the topsoil would lead to a long-term loss of soil productivity in discrete locations.
- A long-term or permanent loss of soil productivity and quality would occur in association with permanent ancillary facilities and permanent access roads.

3.4.2.5 Alignment Options 1 through 4

Table 3.4-5 presents impacts for the Alignment Options (1 through 4) in relation the relevant underground or aboveground facility segment(s) of the Proposed Action.

Table 3.4-5 Soils Impact Summary for Alignment Options 1 through 4, Compared to Proposed Action

Alignment Option	Analysis
Alignment Option 1 (Humboldt-Toiybe Power Line Alignment) **Option Description**: Change the locations of a portion of the 230-kV power line from Gonder Substation near Ely to Spring Valley (184). **Applicable To**: Proposed Action and Alternatives A through C, E, and F.	• Impacts associated with Alignment Option 1 would be the same as the comparable Proposed Action segment on 96 fewer acres.
Alignment Option 2 (North Lake Valley Pipeline Alignment) **Option Description**: Change the locations of portions of the mainline pipeline and electrical transmission line in North Lake Valley. **Applicable To**: Proposed Action and Alternatives A through C, E, and F.	• Impacts associated with Alignment Option 2 would result in similar impacts to the comparable Proposed Action segment. • Approximately 51 more acres would be affected by surface disturbance, but the percentage of the disturbed soils with severe limitations related to wind erosion, water erosion, and low reclamation potential would be about 1% less than the Proposed Action.
Alignment Option 3 (Muleshoe Substation and Power Line Alignment) **Option Description**: Eliminate the Gonder to Spring Valley transmission line, and construct a substation with an interconnection with an interstate, high voltage power line in Muleshole Valley. **Applicable To**: Proposed Action and Alternatives A through C, E, and F.	• This alternative would result in 364 acres less surface disturbance relative to the Proposed Action. • The different route would disturb a slightly higher percentage (85%) of soils with low reclamation potential, compared to the Proposed Action (83%). • The relative percentages of soils susceptible to wind erosion would be the same as that described for the Proposed Action, and slightly less for water erosion (3% compared to 5% for the Proposed Action). • The proportion of prime farmland that would be disturbed is slightly higher (20%) than under the Proposed Action (19%).
Alignment Option 4 (North Delamar Valley Pipeline and Power Line Alignment) **Option Description**: Change the location of a short section of mainline pipeline in Delamar Valley to follow an existing transmission line. **Applicable To**: All alternatives.	• This alternative would result in 52 acres less surface disturbance relative to the Proposed Action. • The proportions of soils with severe limitations affected by construction would be the same as under the Proposed Action.

3.4.2.6 No Action

Under the No Action Alternative, the proposed project would not be constructed or operated. No project-related disturbance would occur to soils. Impacts would continue at present levels as a result of natural conditions and existing development in the project area. Soils would continue to be impacted to varying degrees as a result of grazing, wildfire, drought, recreation, and other land use activities. Surface disturbance to soils associated with development in the area is anticipated to increase as population grows.

3.4.2.7 Comparison of Alternatives

Table 3.4-6 provides a comparison of impacts to key soils parameters across the primary ROW and facility maintenance alternatives.

Table 3.4-6 Comparison of Important Soils Parameters across Alternatives

Parameter	Proposed Action, Alternatives A through C	Alternative D	Alternatives E and F
Disturbance Area (Acres)[1]	12,303	8,843	10,696
Low Revegetation Potential Soils Disturbed (Percent of Total Disturbance)	83	86	81
High Wind Erodible Soils Disturbed (Percent of Total Disturbance)	12	17	14
High Water Erodible Soils Disturbed (Percent of Total Disturbance)	5	4	5
Prime Farmland Disturbed (Percent of Total Disturbance)	19	26	22

[1] Construction and permanent acreage numbers in the table include a minimal acreage of facilities that currently exist. Therefore, the reported acreages conservatively overestimate the amount of disturbance anticipated by the proposed project by approximately 1 percent across all alternatives.

3.4.2.8 Groundwater Development and Groundwater Pumping

Issues

Groundwater Development Construction and Facility Maintenance

- Potential disturbance to soils causing accelerated erosion.
- Potential disturbance to soils causing compaction due to vehicle traffic.
- Reclamation in areas with poor vegetation growth characteristics.
- Disturbance to soils containing contaminants such as radionuclides and erionite.
- Long-term soil quality concerns.

Groundwater Pumping

Potential effects of groundwater drawdown on hydric soils and the vegetation supported by these soils.

Assumptions

Groundwater Development Construction and Facility Maintenance

- The Ely and Las Vegas RMP management actions and BMPs would be applied to all proposed construction activities, based on the most current RMPs – Ely 2008 and Las Vegas 1998.
- The ACMs included in the SNWA POD to manage surface disturbance effects for ROWs provide a basis for appropriate measures that may be submitted in future SNWA ROW applications. For purposes of the impact analysis, it has been assumed that measures appropriate for ROW construction would be applied to ROW construction in groundwater development areas.
- The location of future facilities is unknown. It is assumed that the maximum total estimated acreage for construction and permanent facilities would affect soils. A summary of the general project disturbance numbers is in Chapter 2, **Table 2.10-2**.

Groundwater Pumping

- Existing hydric soils located within areas where saturated conditions during the growing season no longer occur for a period of 30 years are likely to exhibit morphological changes in soil color and ferrous iron content (Hayes and Vepraskas 2000). One cause of change in the source of water that creates saturated conditions is the drawdown of shallow groundwater. In some cases, it may take longer than 30 years of lowered groundwater levels to observe these morphological changes.
- The soil surveys in the region identify soil map units that are partially hydric (often a small percentage of the map unit is hydric) and fully hydric soil map units. For analysis purposes, the percentage of each hydric soil map unit component that is partially hydric was used to estimate the acreage of hydric soils in each basin.
- The analysis of hydric soils affected by drawdown was limited to those areas most likely to be affected by groundwater drawdown in the High and Moderate Risk Zones within the projected 10-foot drawdown contours (described in the Section 3.3, Water Resources). The 10-foot drawdown contour, calculated from the water model, is used as an indicator of the spatial extent of impacts resulting from pumping. Limiting the spatial extent of the hydric soils in this way is consistent with the analysis for Section 3.5, Vegetation, and facilitates the comparison of impacts to hydric soils by basin across all alternatives on a programmatic, broad-based scale.
- In the hydrologic basins where most of the existing groundwater elevations are deep, such as Delamar and Dry Lake valleys, it is likely that most of the water supplying hydric soils comes from localized perched water tables or overbank flooding of waterways rather than the existing groundwater table. For this reason, the hydric soils in these basins are not likely to be greatly affected by the projected groundwater drawdown and the acreage of hydric soils in these basins were not included in the projected impacts to hydric soils due to drawdown.
- Assumptions about the potential changes in soil characteristics (primarily hydrc soils) from groundwater pumping do not incorporate additional assumptions about the effects of climate change because specific long term effects of

climate change are not presently known, and the incremental contribution of climate change effects to project effects cannot be reasonably estimated.

Methodology for Analysis

Groundwater Development Construction and Facility Maintenance

- The methods listed under ROWs were applied to project groundwater development activities.
- Mitigation measures discussed in this resource section focus on new measures. Where applicable, some of the ROW mitigation measures may apply to surface disturbance activities associated with groundwater development. These ROW mitigation measures also would be considered in subsequent NEPA tiers.

Groundwater Pumping

- GIS was used to identify the acreage of each SSURGO soil map unit within the 10-foot drawdown contours of all delineated Risk Zones in each hydrologic basin.
- The GIS datasets were imported into the SSURGO tabular database to identify the hydric soils and to calculate the acreage by using the percentage of each hydric component within each soil map unit.
- The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on soil resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

The data were summarized to compare the total acreage of hydric soils in the 10-foot drawdown area of each hydrologic basin under each alternative and time period to the existing acreage of hydric soils within the High Risk Zones in order to compare the percent change under each alternative.

3.4.2.9 Proposed Action

Groundwater Development Area

All Impact Issues

The types of impacts associated with the construction of groundwater development areas would be similar those described for construction of ROWs and ancillary facilities. Total surface disturbance would range from approximately 3,590 to 8,410 acres including future facilities. It is assumed that approximately 66 percent of the construction surface disturbance, or up to 5,536 acres, would be committed to long-term industrial uses, resulting in long-term soil changes that would not be revegetated during the life of the project. Where well pads are developed, grading and leveling would be required to construct these facilities, with the greatest level of effort required on more steeply sloping terrain. Where connector pipelines are added, impacts would be similar to what is described for the ROW Areas associated with the main pipeline.

During construction, the soil profiles would be mixed with a corresponding loss of soil structure. Soils may be compacted as a result of the construction of wells and associated facilities due to continued vehicle and foot traffic. The types of impacts associated with the maintenance of groundwater development areas would be similar to those described for operation and maintenance of ROWs and ancillary facilities. The extent of the impacts would be less because a smaller acreage would be affected. Where they occur, the impacts to soils would be limited to small areas where pipeline or well maintenance activities are performed.

> Over 30 years or more, an eventual change in the morphology of hydric soils and the plant communities they support would be anticipated in areas where existing shallow groundwater would be lowered due to pumping.

A long-term loss of soil productivity and quality would occur on the acreage of permanent facilities and permanent access roads. These impacts would begin as the soils are subjected to grading and construction activities. Rutting and soil mixing could occur from vehicle traffic on access roads especially when moist or wet. Rutting disrupts the natural surface water hydrology by damming surface water flows, creating increased soil saturation upgradient from ruts, or by diverting and concentrating water flows, and may create accelerated erosion adjacent to the roads.

Proposed mitigation measures:

No additional mitigation measures are needed.

Potential residual impacts include:

- Short-term disturbance to soils during construction would be difficult to stabilize in most of the basins.
- Unsuccessful or slow revegetation could lead to increased erosion on bare soil surfaces. Erosion of the topsoil would lead to a long-term loss of soil productivity in discrete locations.
- A long-term or permanent loss of soil productivity and quality would occur in association with permanent ancillary facilities and permanent access roads.

Groundwater Pumping

Hydric soils that do not have an alternative source of water, such as overbank flooding near streams or a perched water table, are likely to have morphological changes where drawdown lowers the shallow water table more than 10 feet. Over 30 years or more, the lack of intermittent saturation of soils during the growing season would cause hydric soils to no longer meet the hydric criteria, which may result in an eventual change to plant communities, especially in wetlands.

The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table is currently within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term. **Table 3.4-7** summarizes the amount of hydric soils that are at risk from drawdown. "At risk" means that the hydric soils may be morphologically altered by drawdown. The table lists the estimated total acreage of hydric soils in each basin affected and the acreage of hydric soils in each basin that would be at risk from drawdown due to pumping (within the high and moderate risk zones described in Section 3.3, Water Resources, **Table 3.3.2-3** and **Appendix F3.3.8**).

Table 3.4-7 Estimate of Impacts to Hydric Soils from Drawdown within High and Moderate Risk Zones for the Proposed Action

Basins with Hydric Soils Affected by Drawdown	Total Hydric Soils in Basin (acre) [1]	Hydric Soils at Risk from Drawdown (acre)		
		Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Cave Valley	3,916	—	—	99
Lake Valley	3,852	—	—	3,221
Lower Meadow Valley Wash	825	—	—	11
Pahranagat Valley	1,178	—	—	157
Snake Valley	42,641	—	1,838	1,976
Spring Valley (184)	26,766	1,862	11,304	14,600
Steptoe Valley	40,282	—	—	13
Total Acres	**119,461**	**1,862**	**13,143**	**20,077**

[1] Based on SSURGO map data.

Note: "At Risk" refers to hydric soils potentially affected by drawdown in High or Moderate Risk Zones. Where no hydric soils would be at risk, cell is marked with the — symbol.

Based on a literature review of phreatophytic vegetation responses to groundwater drawdown (Section 3.5, Vegetation Resources), it is expected that there would be changes in species composition, but overall plant cover would likely remain similar to baseline conditions over time. Therefore, it is unlikely that there would be an increase in soil erosion due to decreases in hydric soils and associated changes in plant communities. The maintenance of a relatively constant plant canopy cover and soil stabilization by plant roots may vary from place to place, depending on the soil chemistry and texture, alterations of soil biological and physical crusts, and the proximity of seed sources of plants that are adapted to changing soil moisture conditions.

Hydric soils may underlie small wetland and riparian communities associated with smaller springs and the riparian zone along perennial stream channels. Groundwater drawdown could reduce the soil moisture availability in these areas, with consequent changes in hydric soil morphology over the long term, depending on the reliability of spring and stream flows. The location and magnitude of flow effects of springs and streams are addressed by alternative in Section 3.3, Water Resources, and potential drawdown effects on wetland and meadow plant communities are discussed in Section 3.5, Vegetation Resources.

The COM Plan and relevant ACMs would be implemented to reduce groundwater pumping effects on environmental resources. Several of the adaptive management measures could reduce impacts on hydric soils, as described below.

- Modify use of SNWA's agricultural water rights in Spring Valley (184) to offset changes in spring discharges needed to maintain wet meadows in the northwest and southeast portions of the valley (ACM C.2.15).
- Conduct large-scale seeding to assist with vegetation transition from phreatophytic communities in Spring (184) and Snake valleys (ACM C.2.5). This measure would provide soil stability.
- Conduct facilitated recharge projects to offset local groundwater drawdown (ACM C.2.21).

Proposed monitoring measure:

Water resources monitoring measure GW-WR-3a would monitor springs and streams at risk from groundwater drawdown. GW-WR-3a (Comprehensive Water Resources Monitoring Plan) would be implemented for surface water sites identified as critical to providing early warning of potential effects to federal water rights and vital water-dependent habitat identified by the BLM.

Proposed mitigation measures:

As described in Water Resources, Section 3.3, water resources mitigation measure GW-WR-7 would assist in avoiding or minimizing impacts to federal resources and federal water rights. Implementation of this measure would reduce potential effects to hydric soils associated with locations where federal water rights or federal water dependant resources are mitigated. Monitoring of surface water resources and groundwater elevations under monitoring measure GW-WR-3a would be used to determine the effectiveness of the implemented measures.

As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7).

Potential residual impacts include:

- The COM Plan, ACMs, and water resources monitoring and mitigation measures could be effective in reducing impacts to hydric soils. ACMs involving modification of the SNWA's agriculture water rights, large scale seeding, and facilitated recharge projects would be applied to reduce effects on environmental resources including hydric soils. One relevant objective of the COM Plan to hydric soils is to avoid and minimize impacts to water-dependent ecosystems and associated components. Long-term drying of hydric soils may permanently reduce the ability of these soils to support wetland vegetation. It is not possible to determine the level of impact reduction at this time.

Residual effects on hydric soils could exist considering the potential long recovery period that could occur. Some unavoidable adverse impacts to hydric soils could occur at some locations.

3.4.2.10 Alternative A

Groundwater Development Area

All Impact Issues

The types of impacts associated with the construction of groundwater development areas would be similar those described for construction of Proposed Action ROWs and ancillary facilities. Maximum total surface disturbance would range from approximately 2,070 to 4,800 acres, including future facilities. It is assumed that approximately 66 percent of the construction surface disturbance, or up to 3,171 acres would be committed to long-term industrial uses, resulting in long-term soil changes that would not be revegetated during the life of the project.

Proposed mitigation measures:

None.

Potential residual impacts include:

- Same as those described for the Proposed Action.

Groundwater Pumping

The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table is currently within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term. **Table 3.4-8** summarizes the amount of hydric soils that are at risk from drawdown. "At risk" means that the hydric soils may be morphologically altered by drawdown. The table lists the estimated total acreage of hydric soils in each basin affected and the acreage of hydric soils in each basin that would be at risk from drawdown due to pumping (within the high and moderate risk zones described in Section 3.3, Water Resources, **Table 3.3.2-3** and **Appendix F3.3.8**).

Table 3.4-8 Estimate of Impacts to Hydric Soils from Drawdown within High and Moderate Risk Zones for Alternative A

Basins with Hydric Soils Affected by Drawdown	Total Hydric Soils in Basin (acre) [1]	Hydric Soils at Risk from Drawdown (acre)		
		Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Lake Valley	3,852	—	—	1,767
Snake Valley	42,641	—	1,788	1,958
Spring Valley (184)	26,766	655	5,586	8,199
Total Acres	**73,259**	**655**	**7,374**	**11,924**

[1] Based on SSURGO map data.

Note: "At Risk" refers to hydric soils potentially affected by drawdown in High or Moderate Risk Zones. Where no hydric soils would be at risk, cell is marked with the — symbol.

The COM Plan and the same ACMs as listed under the Proposed Action would be implemented to reduce groundwater pumping effects on environmental resources including hydric soils. The adaptive management measures that would reduce effects on hydric soils include the SNWA's use of agricultural water rights in Spring Valley (184) to offset changes in spring discharges needed to maintain wet meadows in the northwest and southeast portions of the valley, large-scale seeding, and facilitated recharge projects.

Proposed monitoring measure:

As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).

Proposed mitigation measures:

As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented and provide options in avoiding or minimizing pumping effects on hydric soils (see Water Resources, Section 3.3, for complete wording of GW-WR-7).

Potential residual impacts include:

- The COM Plan, ACMs, and water resources monitoring and mitigation measures could be effective in reducing impacts to hydric soils. ACMs involving modification of the SNWA's agriculture water rights, large scale seeding, and facilitated recharge projects would be applied to reduce effects on environmental resources including hydric soils. One relevant objective of the COM Plan to hydric soils is to avoid and minimize impacts to water-dependent ecosystems and associated components. Long-term drying of hydric soils may permanently reduce the ability of these soils to support wetland vegetation. It is not possible to determine the level of impact reduction at this time. Residual effects on hydric soils could exist considering the potential long recovery period that could occur. Some unavoidable adverse impacts to hydric soils could occur at some locations.

3.4.2.11 Alternative B

Groundwater Development Area

All Impact Issues

The types of impacts associated with the construction of groundwater development areas would be similar those described for construction of Proposed Action ROWs and ancillary facilities. The maximum extent of the surface disturbance impacts would range up to approximately 4,660 acres, including future facilities. It is assumed that approximately 66 percent of the construction surface disturbance, or 3,077 acres would be committed to long-term industrial uses, resulting in long-term soil changes that would not be revegetated during the life of the project.

Proposed mitigation measures:

None.

Potential residual impacts include:

- Same as those described for the Proposed Action.

Groundwater Pumping

The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table is currently within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term. **Table 3.4-9** summarizes the amount of hydric soils that are at risk from drawdown. "At risk" means that the hydric soils may be morphologically altered by drawdown. The table lists the estimated total acreage of hydric soils in each basin affected and the acreage of hydric soils in each basin that would be at risk from drawdown due to pumping (within the high and moderate risk zones described in Section 3.3, Water Resources, **Table 3.3.2-3** and **Appendix F3.3.8**).

The COM Plan and the same ACMs as listed under the Proposed Action would be implemented to reduce groundwater pumping effects on environmental resources including hydric soils. The adaptive management measures that would reduce effects on hydric soils include the SNWA's use of agricultural water rights in Spring Valley (184) to offset changes in spring discharges needed to maintain wet meadows in the northwest and southeast portions of the valley, large-scale seeding, and facilitated recharge projects.

Table 3.4-9 Estimate of Impacts to Hydric Soils from Drawdown within High and Moderate Risk Zones for Alternative B

Basins with Hydric Soils Affected by Drawdown	Total Hydric Soils in Basin (acre) [1]	Hydric Soils at Risk from Drawdown (acre)		
		Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Cave Valley	3,916	—	—	99
Lake Valley	3,852	—	332	3,248
Lower Meadow Valley Wash	825	—	—	11
Pahranagat Valley	1,178	—	—	157
Snake Valley	42,641	—	1,973	2,005
Spring Valley (184)	26,766	1,047	4,499	6,460
Steptoe Valley	40,282	—	12	25
Total Acres	**119,461**	**1,047**	**6,817**	**12,005**

[1] Based on SSURGO map data.

Note: "At Risk" refers to hydric soils potentially affected by drawdown in High or Moderate Risk Zones. Where no hydric soils would be at risk, cell is marked with the — symbol.

Proposed monitoring measure:

As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).

Proposed mitigation measures:

As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented and provide options in avoiding or minimizing pumping effects on hydric soils (see Water Resources, Section 3.3, for complete wording of GW-WR-7).

Potential residual impacts include:

- The COM Plan, ACMs, and water resources monitoring and mitigation measures could be effective in reducing impacts to hydric soils. ACMs involving modification of the SNWA's agriculture water rights, large scale seeding, and facilitated recharge projects would be applied to reduce effects on environmental resources including hydric soils. One relevant objective of the COM Plan to hydric soils is to avoid and minimize impacts to water-dependent ecosystems and associated components. Long-term drying of hydric soils may permanently reduce the ability of these soils to support wetland vegetation. It is not possible to determine the level of impact reduction at this time. Residual effects on hydric soils could exist considering the potential long recovery period that could occur. Some unavoidable adverse impacts to hydric soils could occur at some locations.

3.4.2.12 Alternative C

Groundwater Development Area

All Impact Issues

The types of impacts associated with the construction of groundwater development areas would be similar those described for construction of Proposed Action ROWs and ancillary facilities. The maximum extent of the surface disturbance impacts would range from approximately 2,070 to 4,800 acres, including future facilities. It is assumed that approximately 66 percent of the construction surface disturbance, or up to 3,171 acres would be committed to long-term industrial uses, resulting in long-term soil changes that would not be revegetated during the life of the project.

Proposed mitigation measures:

None.

Potential residual impacts include:

- Same as those described for the Proposed Action.

Groundwater Pumping

The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table is currently within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term. **Table 3.4-10** summarizes the amount of hydric soils that are at risk from drawdown. "At risk" means that the hydric soils may be morphologically altered by drawdown. The table lists the estimated total acreage of hydric soils in each basin affected and the acreage of hydric soils in each basin that would be at risk from drawdown due to pumping (within the high and moderate risk zones described in Section 3.3, Water Resources, **Table 3.3.2-3** and **Appendix F3.3.8**).

Table 3.4-10 Estimate of Impacts to Hydric Soils from Drawdown within High and Moderate Risk Zones for Alternative C

Basins with Hydric Soils Affected by Drawdown	Total Hydric Soils in Basin (acre)[1]	Hydric Soils at Risk from Drawdown (acre)		
		Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Snake Valley	42,641	—	1,380	1,748
Spring Valley (184)	26,766	655	1,246	1,246
Total Acres	**69,407**	**655**	**2,626**	**2,995**

[1] Based on SSURGO map data.

Note: "At Risk" refers to hydric soils potentially affected by drawdown in High or Moderate Risk Zones. Where no hydric soils would be at risk, cell is marked with the — symbol.

The COM Plan and the same ACMs as listed under the Proposed Action would be implemented to reduce groundwater pumping effects on environmental resources including hydric soils. The adaptive management measures that would reduce effects on hydric soils include SNWA's use of agricultural water rights in Spring Valley (184) to offset changes in spring discharges needed to maintain wet meadows in the northwest and southeast portions of the valley, large-scale seeding, and facilitated recharge projects.

Proposed monitoring measure:

As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).

Proposed mitigation measures:

As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented and provide options in avoiding or minimizing pumping effects on hydric soils (see Water Resources, Section 3.3, for complete wording of GW-WR-7).

Potential residual impacts include:

- The COM Plan, ACMs, and water resources monitoring and mitigation measures could be effective in reducing impacts to hydric soils. ACMs involving modification of the SNWA's agriculture water rights, large scale seeding, and facilitated recharge projects would be applied to reduce effects on environmental resources including hydric soils. One relevant objective of the COM Plan to hydric soils is to avoid and minimize impacts to water-dependent ecosystems and associated components. Long-term drying of hydric soils may permanently reduce the ability of these soils to support wetland vegetation. It is not possible to determine the level of impact reduction at this time. Residual effects on hydric soils could exist considering the potential long recovery period that could occur. Some unavoidable adverse impacts to hydric soils could occur at some locations.

3.4.2.13 Alternative D

Groundwater Development Area

All Impact Issues

The types of impacts associated with the construction of groundwater development areas would be similar those described for construction of Proposed Action ROWs and ancillary facilities. The maximum extent of the surface disturbance impacts would range from approximately 2,500 to 4,000 acres, including future facilities. It is assumed that approximately 66 percent of the construction surface disturbance, or up to 2,635 acres would be committed to long-term industrial uses, resulting in long-term soil changes that would not be revegetated during the life of the project.

Proposed mitigation measures:

None.

Potential residual impacts include:

- Same as those described for the Proposed Action.

Groundwater Pumping

The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table is currently within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term. **Table 3.4-11** summarizes the amount of hydric soils that are at risk from drawdown. "At risk" means that the hydric soils may be morphologically altered by drawdown. The table lists the estimated total acreage of hydric soils in each basin affected and the acreage of hydric soils in each basin that would be at risk from drawdown due to pumping (within the high and moderate risk zones described in Section 3.3, Water Resources, **Table 3.3.2-3** and **Appendix F3.3.8**).

The COM Plan and the same ACMs as listed under the Proposed Action would be implemented to reduce groundwater pumping effects on environmental resources including hydric soils. The adaptive management measures that would reduce effects on hydric soils include SNWA's use of agricultural water rights in Spring Valley (184) to offset changes in spring discharges needed to maintain wet meadows in the northwest and southeast portions of the valley, large-scale seeding, and facilitated recharge projects.

Table 3.4-11 Estimate of Impacts to Hydric Soils from Drawdown within High and Moderate Risk Zones for Alternative D

Basins with Hydric Soils Affected by Drawdown	Total Hydric Soils in Basin (acre) [1]	Hydric Soils at Risk from Drawdown (acre)		
		Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Cave Valley	3,916	—	—	45
Lake Valley	3,852	8	196	3,248
Snake Valley	42,641	—	41	714
Spring Valley (184)	26,766	98	906	2,358
Steptoe Valley	40,282	—	—	11
Total Acres	**117,458**	**106**	**1,143**	**6,377**

[1] Based on SSURGO map data.

Note: "At Risk" refers to hydric soils potentially affected by drawdown in High or Moderate Risk Zones. Where no hydric soils would be at risk, cell is marked with the — symbol.

Proposed monitoring measure:

As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).

Proposed mitigation measures:

As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented and provide options in avoiding or minimizing pumping effects on hydric soils (see Water Resources, Section 3.3, for complete wording of GW-WR-7).

Potential residual impacts include:

- The COM Plan, ACMs, and water resources monitoring and mitigation measures could be effective in reducing impacts to hydric soils. ACMs involving modification of the SNWA's agriculture water rights, large scale seeding, and facilitated recharge projects would be applied to reduce effects on environmental resources including hydric soils. One relevant objective of the COM Plan to hydric soils is to avoid and minimize impacts to water-dependent ecosystems and associated components. Long-term drying of hydric soils may permanently reduce the ability of these soils to support wetland vegetation. It is not possible to determine the level of impact reduction at this time. Residual effects on hydric soils could exist considering the potential long recovery period that could occur. Some unavoidable adverse impacts to hydric soils could occur at some locations.

3.4.2.14 Alternative E

Groundwater Development Area

All Impact Issues

The types of impacts associated with the construction of groundwater development areas would be similar those described for construction of Proposed Action ROWs and ancillary facilities. The maximum extent of the surface disturbance impacts would range from approximately 1,750 to 4,100 acres, including future facilities. It is assumed that approximately 66 percent of the construction surface disturbance, or up to 2,683 acres would be committed to long-term industrial uses, resulting in long-term soil changes that would not be revegetated during the life of the project.

Groundwater Pumping

The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table currently is within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term. **Table 3.4-12** summarizes the amount of hydric soils that are at risk from drawdown. "At risk" means that the hydric soils may be morphologically altered by drawdown. The table lists the estimated total acreage of hydric soils in each basin affected and the acreage of hydric soils in each basin that would be at risk from drawdown due to pumping (within the high and moderate risk zones described in Section 3.3, Water Resources, **Table 3.3.2-3** and **Appendix F3.3.8**).

The COM Plan and the same ACMs would be implemented to reduce groundwater pumping effects on environmental resources including hydric soils. The adaptive management measures that would reduce effects on hydric soils include the SNWA's use of agricultural water rights in Spring Valley (184) to offset changes in spring discharges needed to maintain wet meadows in the northwest and southeast portions of the valley, large-scale seeding, and facilitated recharge projects.

Table 3.4-12 Estimate of Impacts to Hydric Soils from Drawdown within High and Moderate Risk Zones for Alternative E

Basins with Hydric Soils Affected by Drawdown	Total Hydric Soils in Basin (acre) [1]	Hydric Soils at Risk from Drawdown (acre)		
		Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Lake Valley	3,852	—	—	1,597
Spring Valley (184)	26,766	655	5,586	8,088
Steptoe Valley	40,282	—	—	11
Total Acres	**70,900**	**655**	**5,586**	**9,696**

[1] Based on SSURGO map data.

Note: "At Risk" refers to hydric soils potentially affected by drawdown in High or Moderate Risk Zones. Where no hydric soils would be at risk, cell is marked with the — symbol.

Proposed monitoring measure:

As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).

Proposed mitigation measures:

As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented and provide options in avoiding or minimizing pumping effects on hydric soils (see Water Resources, Section 3.3, for complete wording of GW-WR-7).

Potential residual impacts include:

- The COM Plan, ACMs, and water resources monitoring and mitigation measures could be effective in reducing impacts to hydric soils. ACMs involving modification of the SNWA's agriculture water rights, large scale seeding, and facilitated recharge projects would be applied to reduce effects on environmental resources including hydric soils. One relevant objective of the COM Plan to hydric soils is to avoid and minimize impacts to water-dependent ecosystems and associated components. Long-term drying of hydric soils may permanently reduce the ability of these soils to support wetland vegetation. It is not possible to determine the level of impact reduction at this time. Residual effects on hydric soils could exist considering the potential long recovery period that could occur. Some unavoidable adverse impacts to hydric soils could occur at some locations.

3.4.2.15 Alternative F

Groundwater Development Area

All Impact Issues

The types of impacts associated with the construction of groundwater development areas would be similar those described for construction of Proposed Action ROWs and ancillary facilities. The maximum extent of the surface disturbance impacts would range from approximately 2,700 to 6,600 acres, including future facilities. It is assumed that approximately 66 percent of the construction surface disturbance, or up to 4,359 acres would be committed to long-term industrial uses, resulting in long-term soil changes that would not be revegetated during the life of the project.

Groundwater Pumping

The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table currently is within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term. **Table 3.4-13** summarizes the amount of hydric soils that are at risk from drawdown. "At risk" means that the hydric soils may be morphologically altered by drawdown. The table lists the estimated total acreage of hydric soils in each basin affected and the acreage of hydric soils in each basin that would be at risk from drawdown due to pumping (within the high and moderate risk zones described in Section 3.3, Water Resources, **Table 3.3.2-3** and **Appendix F3.3.8**).

Table 3.4-13 Estimate of Impacts to Hydric Soils from Drawdown within High and Moderate Risk Zones for Alternative F

Basins with Hydric Soils Affected by Drawdown	Total Hydric Soils in Basin (acre) [1]	Hydric Soils at Risk from Drawdown (acre)		
		Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Lake Valley	3,852	—	—	1,963
Spring Valley (184)	26,766	79	4,949	6,283
Pahranagat Valley	1,178	—	—	157
Total Acres	**31,796**	**79**	**4,949**	**8,403**

[1] Based on SSURGO map data.

Note: "At Risk" refers to hydric soils potentially affected by drawdown in High or Moderate Risk Zones. Where no hydric soils would be at risk, cell is marked with the — symbol.

The COM Plan and the same ACMs would be implemented to reduce groundwater pumping effects on environmental resources including hydric soils. The adaptive management measures that would reduce effects on hydric soils include the SNWA's use of agricultural water rights in Spring Valley (184) to offset changes in spring discharges needed to maintain wet meadows in the northwest and southeast portions of the valley, large-scale seeding, and facilitated recharge projects.

Proposed monitoring measure:

As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).

Proposed mitigation measures:

As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented and provide options in avoiding or minimizing pumping effects on hydric soils (see Water Resources, Section 3.3, for complete wording of GW-WR-7).

Potential residual impacts include:

- The COM Plan, ACMs, and water resources monitoring and mitigation measures could be effective in reducing impacts to hydric soils. ACMs involving modification of the SNWA's agriculture water rights, large scale seeding, and facilitated recharge projects would be applied to reduce effects on environmental resources including hydric soils. One relevant objective of the COM Plan to hydric soils is to avoid and minimize impacts to water-dependent ecosystems and associated components. Long-term drying of hydric soils may permanently reduce the ability of these soils to support wetland vegetation. It is not possible to determine the level of impact reduction at this time. Residual effects on hydric soils could exist considering the potential long recovery period that could occur. Some unavoidable adverse impacts to hydric soils could occur at some locations.

3.4.2.16 No Action

Groundwater Development Area

Under the No Action Alternative, the proposed project would not be constructed or maintained. No project-related surface disturbance would occur. Soils would continue to be influenced by natural events such as drought and fire, and land use activities including grazing and existing water diversions. Management activities on public lands would continue to be directed by the Ely and Las Vegas RMPs, which include measures to maintain soil stability and productivity. Management guidance for other public lands in the project study area would be provided by Great Basin National Park General Management and the Forest Plan for the Humbolt-Toiyabe National Forest.

Groundwater Pumping

Under the No Action Alternative, only already approved pumping would be implemented. The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table currently is within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term. **Table 3.4-14** summarizes the amount of hydric soils that are at risk from drawdown. "At risk" means that the hydric soils may be morphologically altered by drawdown. The table lists the estimated total acreage of hydric soils in each basin affected and the acreage of hydric soils in each basin that would be at risk from drawdown due to pumping (within the high and moderate risk zones described in Section 3.3, Water Resources, **Table 3.3.2-3** and Appendix **F3.3.8**).

Table 3.4-14 Estimate of Impacts to Hydric Soils from Drawdown within High and Moderate Risk Zones for the No Action Alternative

Basins with Hydric Soils Affected by Drawdown	Total Hydric Soils in Basin (acre)[1]	Hydric Soils at Risk from Drawdown (acre)		
		Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Clover Valley	33	5	5	13
Lake Valley	3,852	619	1,342	2,589
Lower Meadow Valley Wash	825	14	19	20
Panaca Valley	138	27	85	85
Spring Valley (184)	26,766	12	70	122
White River Valley	3,562	—	51	239
Total Acres	**35,175**	**676**	**1,571**	**3,068**

[1] Based on SSURGO map data.

Note: "At Risk" refers to hydric soils potentially affected by drawdown in High or Moderate Risk Zones. Where no hydric soils would be at risk, cell is marked with the — symbol.

3.4.2.17 Alternatives Comparison

Hydric soils would be affected in Spring (184) Valley under all pumping alternatives and Snake Valley under all but Alternatives E and F to varying degrees. Drawdown lasting longer than 30 years, which is assumed to be the case for these projected long pumping scenarios, would result in morphologic changes to hydric soils causing the soils to become non-hydric. The change from hydric to non-hydric soils would mean that these soils could no longer support phreatophytes and other hydrophytic vegetation. **Table 3.4-15** provides a comparison of projected impacts to hydric soils under each pumping alternative.

Table 3.4-15 Comparison of Impacts to Hydric Soils from Groundwater Pumping

Alternative	Hydrologic Basins Most Affected (in descending order of magnitude)	Maximum area[1] (acres) of hydric soils potentially affected by 10-foot pumping drawdown within High and Moderate Risk Zones
Proposed Action	Spring (184), Lake, Snake	20,077
A	Spring (184), Snake, Lake	11,924
B	Spring (184), Lake, Snake	12,005
C	Snake, Spring (184)	2,995
D	Lake, Spring (184), Snake	6,377
E	Spring (184), Lake	9,696
F	Spring (184), Lake	8,403
No Action	Lake, White River	3,068

[1] Maximum area indicates drawdown effects from the full build out plus 200 years time frame.

3.4.3 Cumulative Impacts

3.4.3.1 Impacts Common to All Alternatives

Climate Change Effects

Climate change already appears to be influencing both natural and managed ecosystems of the American Southwest (Breshears et al. 2005, Westerling et al. 2006, Seager et al. 2007) and models indicate the likelihood of the Southwest being a climate change "hotspot" in the coming decades (Diffenbaugh et al. 2008). Recent warming in the Southwest is among the most rapid in the nation, significantly more than the global average in some areas (USGCRP 2009). Projections suggest continued strong warming in the region, with significant increases in temperature (USGCRP 2009) and changes to precipitation regimes (Seager et al. 2007). A warmer atmosphere and an intensified water cycle are likely to mean not only a greater likelihood of drought for the Southwest, but also an increased risk of flooding (USGCRP 2009). Greater variability in patterns of precipitation can be anticipated in the future. In the coming century, mean global temperature could increase significantly, with an associated increase in both the frequency of extreme events (heat waves, droughts, storms) and the frequency and extent of wildfire (IPCC 2007; Westerling & Bryant 2008; Krawchuk et al. 2009). Under such conditions, future impacts could be substantial for some resources, impacting biodiversity, protected areas, and agricultural lands.

Climate Change Effects to Soils

Warmer atmospheric temperatures associated with global climate change are expected to lead to a more vigorous hydrologic cycle, including more extreme rainfall events (IPCC 2007). This change in precipitation, along with expected changes in temperature, solar radiation, and atmospheric CO_2 concentrations, will likely have significant impacts on both soil moisture and soil erosion rates. A change in soil moisture can be calculated as a difference between the input to and output from the soil system. Input to the soil system is primarily from precipitation, while output includes evaporation, transpiration, surface water runoff, and deep percolation that may reach the groundwater. Some soil moisture is held in the soil profile. Soil moisture is a critical factor for the growth of food crops as well as to support natural vegetation, determining its type and extent.

Increasing variability of precipitation patterns and ET rates due to climate change will directly affect soil moisture in addition to surface water runoff and groundwater recharge. In regions with decreasing precipitation, soil moisture may be substantially reduced. It could also be reduced in regions with increasing precipitation as long as the evaporation due to high temperatures is greater than the increase in precipitation. Soil moisture is expected to increase in areas where precipitation is significantly greater than the increase in ET. At the same time, a large-scale drying of the soil surface is expected due to higher temperatures, especially during the summer, coupled with insufficient precipitation increases or a reduction in rainfall. An indirect effect of reduced soil moisture is increased air temperature. Air temperature increases when regional soils are dry, because there is less soil water available to be evaporated by energy from the sun, causing a cooling effect, so the sun's energy heats the ambient atmosphere. Fischer et al. (2007) recently found that land-atmosphere interactions have had a major contribution on the spatial and temporal extent of recent heat waves in Europe.

The processes involved in the impact of climate change on soil erosion by water are complex, involving changes in rainfall amounts and intensities, number of days of precipitation, ratio of rain to snow, plant biomass production, plant residue decomposition rates, soil microbial activity, ET rates, and shifts in land use (Nearing 2004). In regions where rainfall amounts increase, erosion and runoff will also likely increase. Even in cases where annual rainfall would decrease, system feedbacks related to decreased biomass production, surface roughness, or site condition could lead to greater soil erosion. In general, erosion/climate change studies to date suggest that increased rainfall amounts and intensities will lead to greater rates of water erosion (Nearing 2004).

Climate change could affect soil resources in the Project Area by impacting:

- Soil moisture – projections of decreasing or more variable precipitation could lead to lower soil moistures, potentially affecting agriculture, regional plant species composition, and regional weather patterns; and
- Erosion – projections of increasing rates or amounts of precipitation and/or changes in vegetation as a result of synergistic climate changes could lead to significant increases in water erosion rates.

3.4.3.2 Issues

Rights-of-way and Groundwater Development Area Construction and Maintenance

- Potential disturbance to soils causing accelerated erosion.
- Potential disturbance to soils causing compaction due to vehicle traffic.
- Reclamation in areas with poor vegetation growth characteristics.
- Disturbance to soils containing contaminants such as radionuclides and erionite.
- Long-term soil quality concerns.

Groundwater Pumping

- Potential effects of groundwater drawdown on hydric soils and the vegetation supported by these soils.

3.4.3.3 Assumptions

Rights-of-way and Groundwater Development Area Construction and Maintenance

- Study area. The soils cumulative study area encompasses the proposed ROW project surface disturbance area (pipelines, power facilities, roads) for each project alternative plus the total project groundwater development area surface disturbance footprint (well pads, roads, gathering pipelines, power lines) within each hydrologic basin affected. The overall rationale for this cumulative study area is that the majority of the changes in soils occur within areas where soils have been disturbed.
- Time Frames. Effects range from 2 to 5 years after surface disturbance initially occurs.
- The PPAs footprints are based on utility ROWs and other surface disturbance activities identified in the BLM and other databases (Chapter 2, Section 2.9).
- The RFFAs are those outlined in Chapter 2, Section 2.9.
- When soils are disturbed, management concern include compaction, problems related to low reclamation potential, and accelerated wind and water erosion.

Groundwater Pumping

- Study area. The study area is the boundary for the groundwater model simulations (**Figure 2.9-1**, Chapter 2).
- Time frames. Effects range from full build out of the entire project (at approximately 2050) to full build out plus 200 years. Existing hydric soils located within areas where saturated conditions during the growing season no longer occur for a period of 30 years are likely to exhibit morphological changes in soil color and ferrous iron content (Hayes and Vepraskas 2000). One cause of change in the source of water that creates saturated conditions is the drawdown of shallow groundwater. In some cases, it may take longer than 30 years of lowered groundwater levels to observe these morphological changes.

3.4.3.4 Methodology for Analysis

Rights-of-way and Groundwater Development Area Construction and Maintenance

- The cumulative surface disturbance effects to soil productivity and stability were estimated by considering the acreage that would be disturbed in all hydrologic basins due to the combination of PPAs, RFFAs, and the development areas for the project alternative under evaluation.

Groundwater Pumping

- GIS was used to identify the acreage of each SSURGO soil map unit within the 10-foot drawdown contours of all delineated Risk Zones in each hydrologic basin.
- The GIS datasets were imported into the SSURGO tabular database to identify the hydric soils and to calculate the acreage by using the percentage of each hydric component within each soil map unit.

- The data were summarized to compare the total acreage of hydric soils in the 10-foot drawdown area of each hydrologic basin under each alternative and time period to the existing acreage of hydric soils within the High Risk Zones in order to compare the percent change under each alternative.

3.4.3.5 No Action

Rights-of-way and Groundwater Development Area Construction and Maintenance

Under the No Action Alternative, soils would continue to be influenced by natural events such as drought and fire and land use activities including grazing and existing water diversions. Other surface disturbing projects, such as renewable energy development projects and associated electrical transmission projects, would be constructed. An estimated 917,130 acres have been disturbed by PPAs. Management activities on public lands would continue to be directed by the Ely and Las Vegas RMPs, which include measures to maintain soil stability and productivity. Management guidance for other public lands in the project study area would be provided by GBNP General Management and the Forest Plan for the Humbolt-Toiyabe National Forest.

Groundwater Pumping Effects

Under the No Action Alternative, only already approved pumping would be implemented. The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table is currently within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term. Steptoe and Lake valleys would have the most hydric soils affected by drawdown due to groundwater pumping for the PPAs and RFFAs. The total acreage of hydric soils at risk would be 3,546 acres at full build out, 6,521 acres at full build out plus 75 years, and 8,798 acres at full build out plus 200 years.

3.4.3.6 Proposed Action

Rights-of-way and Groundwater Development Area Construction and Maintenance

The areas where the surface disturbance (12,288 acres) potentially would overlap with PPAs and RFFAs (942,000 acres) (see **Figures 2.9-1** and **2.9-2**, and **Table 2.9-1**, Chapter 2) include existing road and highway crossings in all hydrologic basins affected. The projected surface disturbance amounts to approximately 9 percent of the affected basins.

Conclusion:

- Short-term disturbance to soils during construction would be difficult to stabilize in most of the basins.
- Unsuccessful or slow revegetation could lead to increased erosion on bare soil surfaces. Erosion of the topsoil would lead to a long-term loss of soil productivity in discrete locations.
- A long-term or permanent loss of soil productivity and quality would occur in association with permanent ancillary facilities and permanent access roads.

Groundwater Pumping Effects

The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table is currently within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term.

Figure 3.4-5 visually compares the quantity of hydric soils at risk due to groundwater pumping from the Proposed Action to the cumulative impacts of the Proposed Action pumping with all PPAs and RFFAs included. Also displayed is the amount of hydric soils that would be affected by just the PPAs and RFFAs under No Action (Cumulative) into the future. For display purposes, any valleys with less than 500 acres of hydric soils affected are not shown. The incremental differences in the extent of hydric soils affected by just the Proposed Action compared to the Proposed Action plus the PPAs and RFFAs (Proposed Action Cumulative) and No Action Cumulative pumping is readily visible. Note that in the basins where the Proposed Action impacts to hydric soils are minor (shown by a blank space or very small red bar), the bars for No Action and Proposed Action Cumulative are equal or close to equal, indicating little or no contribution to impacts on hydric soils due to drawdown in those valleys during the projected time periods. The chart shows that Spring Valley would be the most affected under the Proposed Action, Lake Valley has minor amounts of hydric soils at risk until full build out plus 200 years, and the incremental difference between the Proposed Action impacts and Proposed Action Cumulative impacts in Snake Valley is very small.

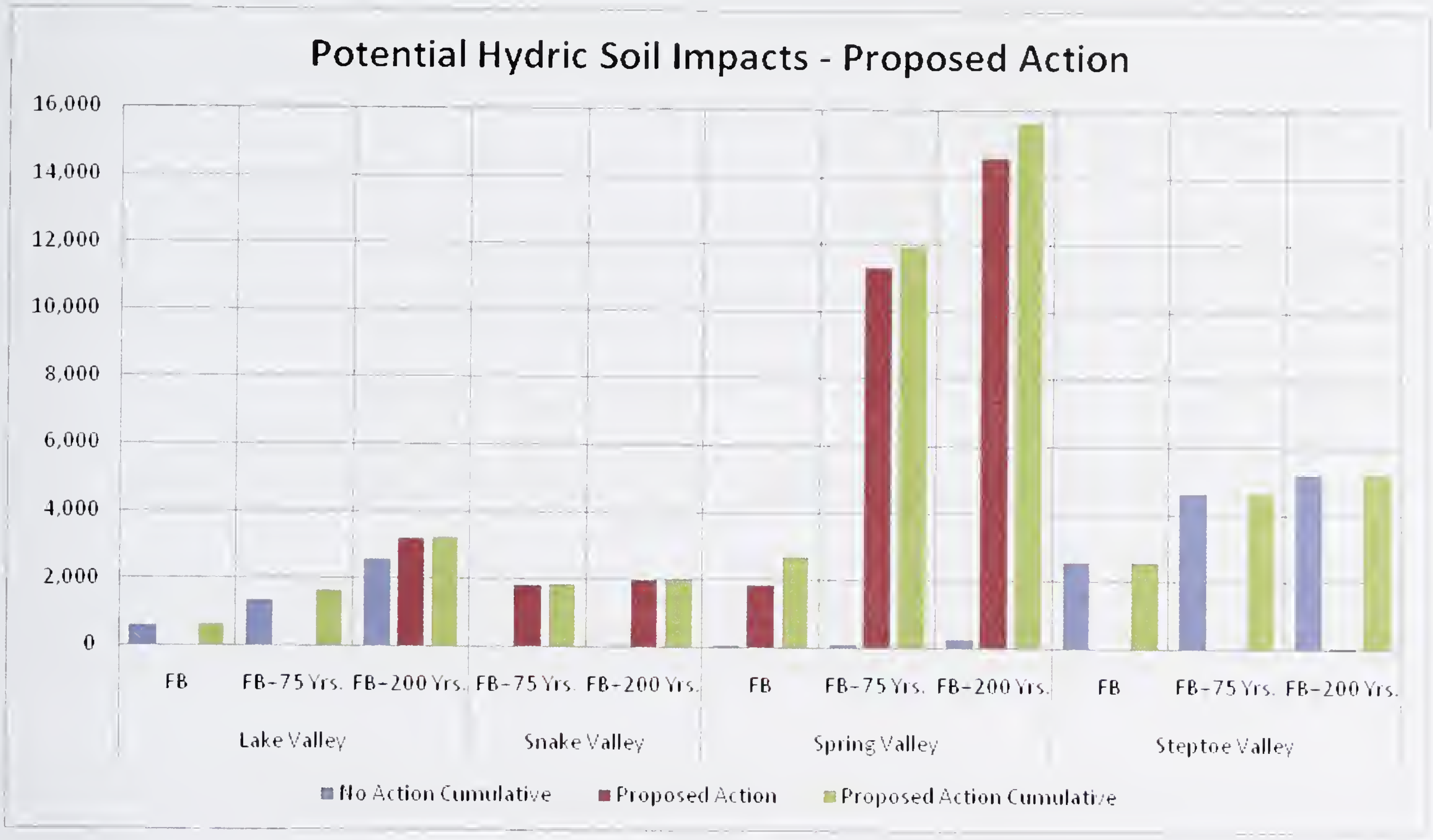


Figure 3.4-5 **Potential Hydric Soil Impacts – Proposed Action**

Based on a literature review of phreatophytic vegetation responses to groundwater drawdown (Section 3.5, Vegetation Resources), it is expected that there would be changes in species composition, but overall plant cover likely would remain similar to baseline conditions over time. Therefore, it is unlikely that there would be an increase in soil erosion due to decreases in hydric soils and associated plant communities. The maintenance of a relatively constant plant canopy cover and soil stabilization by plant roots may vary from place to place, depending on the soil chemistry and texture, alterations of soil biological and physical crusts, and the proximity of seed sources of plants that are adapted to changing soil moisture conditions.

Hydric soils may underlie small wetland and riparian communities associated with smaller springs and the riparian zone along perennial stream channels. Groundwater drawdown could reduce the soil moisture availability in these areas, with consequent changes in hydric soil morphology over the long term, depending on the reliability of spring and stream flows. The location and magnitude of flow effects of springs and streams are addressed by alternative in Section 3.3, Water Resources, and potential drawdown effects on wetland and meadow communities are discussed in Section 3.5, Vegetation Resources.

ACMs would be implemented to reduce groundwater pumping effects on environmental resources. Several of the adaptive management measures could reduce impacts on hydric soils, as described below.

- Modify use of SNWA's agricultural water rights in Spring Valley (184) to offset changes in spring discharges needed to maintain wet meadows in the northwest and southeast portions of the valley (ACM C.2.15).
- Conduct large-scale seeding to assist with vegetation transition from phreatophytic communities in Spring (184) and Snake valleys (ACM C.2.5). This measure would improve soil stability.
- Conduct facilitated recharge projects to offset local groundwater drawdown (ACM C.2.21).

Conclusion:

- Based on the model simulations and the 10-foot drawdown contour, pumping would reduce the source of water that sustains hydric soils. Long-term drying of hydric soils may permanently reduce the ability of these soils to support wetland vegetation. Spring (184), Steptoe, Lake, and Snake valleys would have the most extensive potential impacts to hydric soils. ACMs involving modification of the SNWA's agricultural water rights, large scale seeding, and facilitated recharge projects could be applied to Proposed Action pumping to reduce effects on environmental resources including hydric soils.

3.4.3.7 Alternative A

Rights-of-way Groundwater Development Area Construction and Maintenance

The types and acreage of cumulative impacts to soils associated with the construction of ROWs and groundwater development areas would be similar those described for the Proposed Action.

Conclusion:

- Same as those described for the Proposed Action.

Groundwater Pumping Effects

The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table is currently within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term.

Figure 3.4-6 visually compares the quantity of hydric soils at risk due to groundwater pumping from the Alternative A to the cumulative impacts of Alternative A pumping with all PPAs and RFFAs included. Also displayed is the amount of hydric soils that would be affected by just the PPAs and RFFAs under No Action (Cumulative) into the future. For display purposes, any valleys with less than 500 acres of hydric soils affected are not shown. The incremental differences in the extent of hydric soils affected by just Alternative A compared to the Alternative A plus the PPAs and RFFAs (Alternative A Cumulative) and No Action Cumulative pumping is readily visible. Note that in the basins where Alternative A impacts to hydric soils are minor (shown by a blank space or very small red bar), the bars for No Action and Alternative A Cumulative are equal or close to equal, indicating little or no contribution to impacts on hydric soils due to drawdown in those valleys during the projected time periods. The chart shows that Spring Valley would be the most affected under Alternative A, Lake Valley has minor amounts of hydric soils at risk until full build out plus 200 years, and the incremental difference between Alternative A impacts and Alternative A Cumulative impacts in Snake Valley is very small.

The same ACMs as listed under the Proposed Action would be implemented to reduce groundwater pumping effects on environmental resources including hydric soils. The adaptive management measures that would reduce effects on hydric soils include SNWA's use of agricultural water rights in Spring Valley (184) to offset changes in spring discharges needed to maintain wet meadows in the northwest and southeast portions of the valley, large-scale seeding, and facilitated recharge projects.

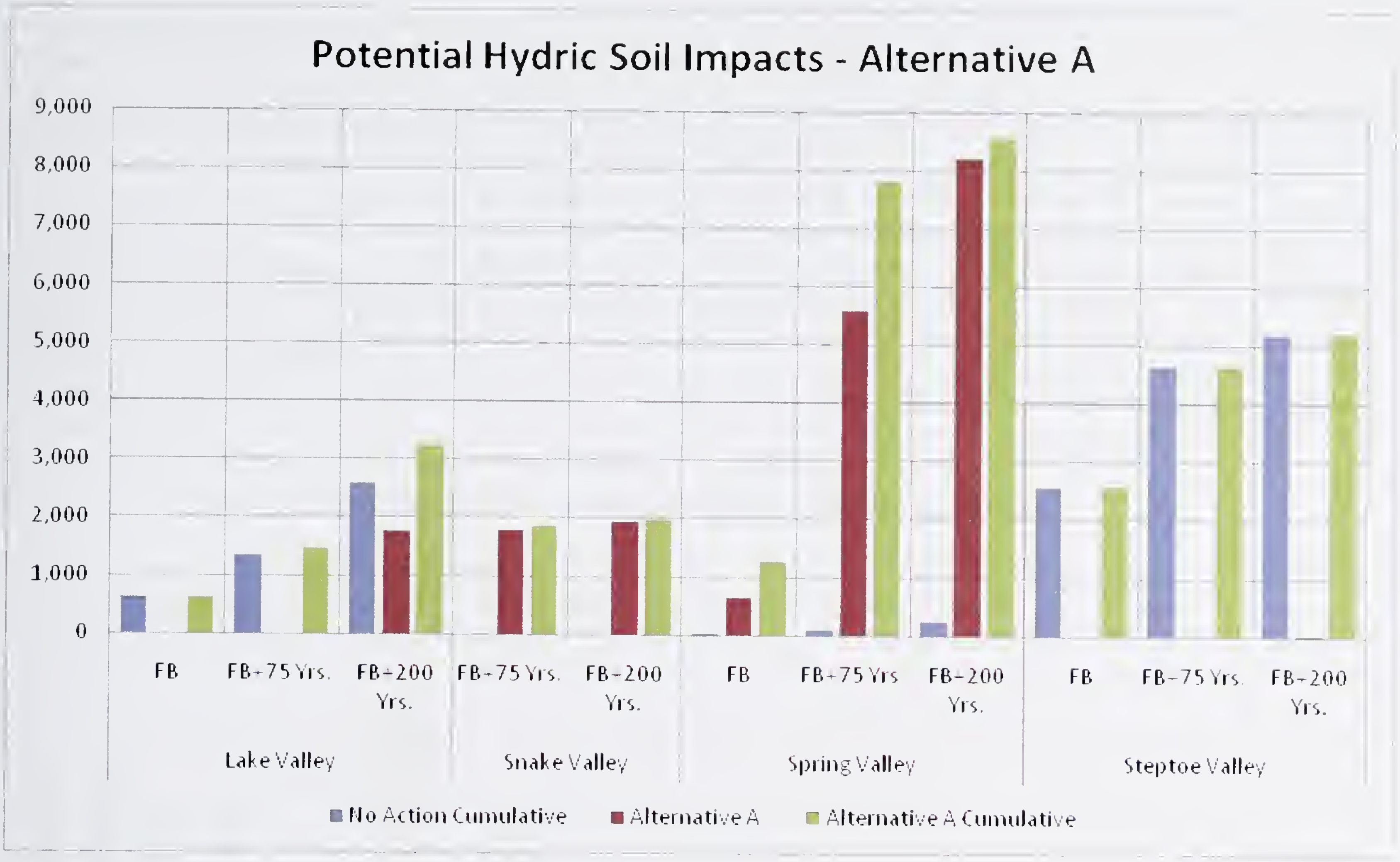


Figure 3.4-6 **Potential Hydric Soil Impacts – Alternative A**

Conclusion:

- Based on the model simulations and the 10-foot drawdown contour, pumping would reduce the source of water that sustains hydric soils. Spring (184), Steptoe, Lake, and Snake valleys would have the most extensive potential impacts to hydric soils. Long-term drying of hydric soils may permanently reduce the ability of these soils to support wetland vegetation. ACMs involving modification of the SNWA's agricultural water rights, large scale seeding, and facilitated recharge projects would be applied to reduce effects on environmental resources including hydric soils.

3.4.3.8 Alternative B

Rights-of-way and Groundwater Development Area Construction and Maintenance

All Impact Issues

The types and acreage of cumulative impacts to soils would be similar to those described for construction of Proposed Action ROWs and ancillary facilities. Overall surface disturbance within the groundwater development areas would be slightly less than the Proposed Action.

Conclusion:

- Same as those described for the Proposed Action.

Groundwater Pumping Effects

The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table is currently within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term.

Figure 3.4-7 visually compares the quantity of hydric soils at risk due to groundwater pumping from Alternative B to the cumulative impacts of Alternative B pumping with all PPAs and RFFAs included. Also displayed is the amount of hydric soils that would be affected by just the PPAs and RFFAs under No Action (Cumulative) into the future. For display purposes, any valleys with less than 500 acres of hydric soils affected are not shown. The incremental differences in the extent of hydric soils affected by just Alternative B compared to Alternative B plus the PPAs and RFFAs (Alternative B Cumulative) and No Action Cumulative pumping is readily visible. Note that in the basins where Alternative B impacts to hydric soils are minor (shown by a blank space or very small red bar), the bars for No Action and Alternative B Cumulative are equal or close to equal, indicating little or no contribution to impacts on hydric soils due to drawdown in those valleys during the projected time periods. The chart shows that Spring Valley would be the most affected under Alternative B, Lake Valley has greater amounts of hydric soils at risk at full build out plus 75 years than Alternative B, and the incremental difference between Alternative B impacts and Alternative B Cumulative impacts in Snake Valley is very small.

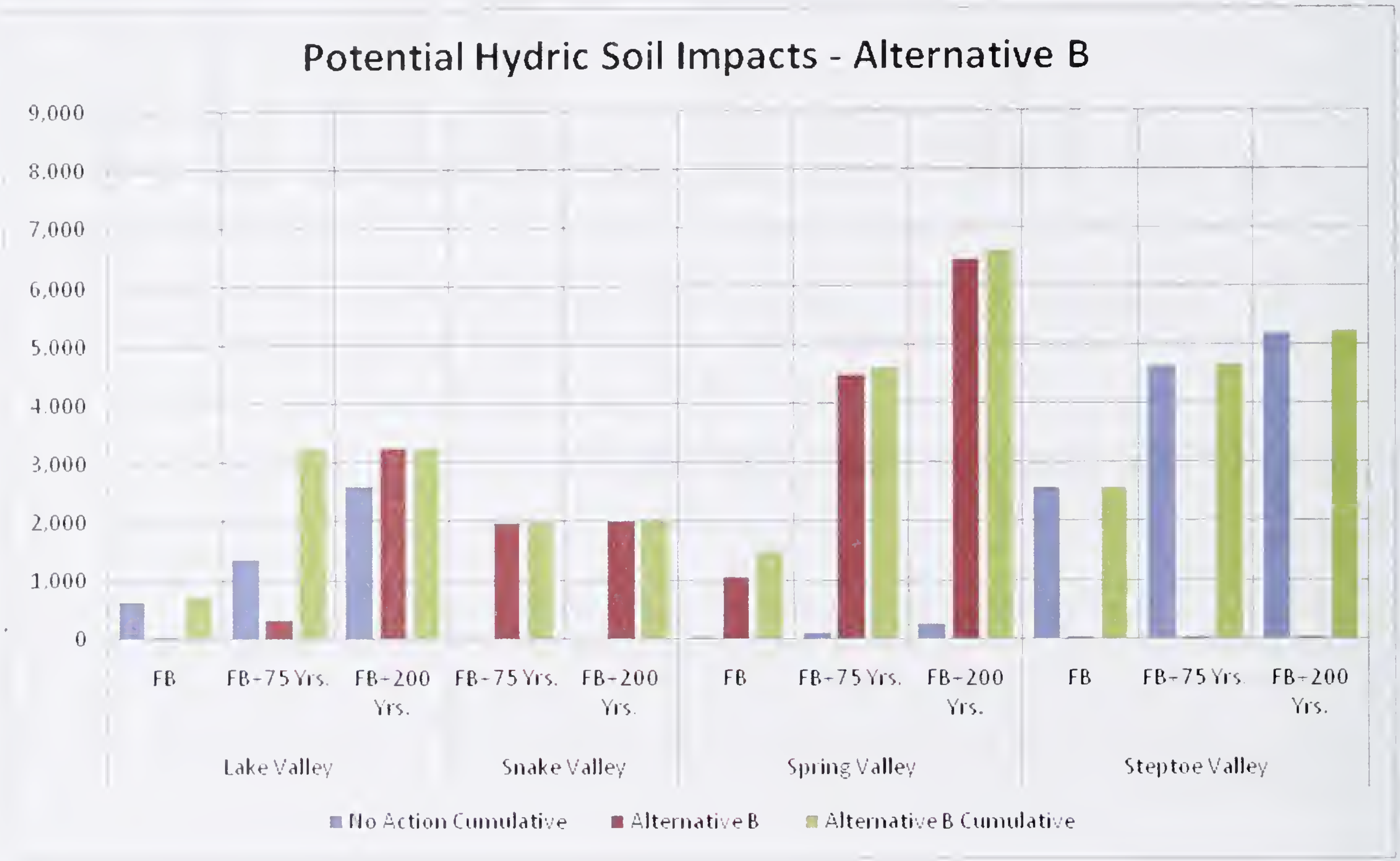


Figure 3.4-7 Potential Hydric Soil Impacts – Alternative B

The same ACMs as listed under the Proposed Action would be implemented to reduce groundwater pumping effects on environmental resources including hydric soils. The adaptive management measures that would reduce effects on hydric soils include SNWA's use of agricultural water rights in Spring Valley (184) to offset changes in spring discharges needed to maintain wet meadows in the northwest and southeast portions of the valley, large-scale seeding, and facilitated recharge projects.

Conclusion:

- Based on the model simulations and the 10-foot drawdown contour, pumping would reduce the source of water that sustains hydric soils. Spring (184), Steptoe, Lake, and Snake valleys would have the most extensive potential impacts to hydric soils. Long-term drying of hydric soils may permanently reduce the ability of these soils to support wetland vegetation. ACMs involving modification of the SNWA's agricultural water rights, large scale seeding, and facilitated recharge projects would be applied to reduce effects on environmental resources including hydric soils.

3.4.3.9 Alternative C

Rights-of-way and Groundwater Development Area Construction and Maintenance

The types and acreage of cumulative surface impacts to soils would be similar to those described for construction of Proposed Action ROWs and ancillary facilities.

Conclusion:

- Same as those described for the Proposed Action.

Groundwater Pumping Effects

The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table is currently within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term.

Figure 3.4-8 visually compares the quantity of hydric soils at risk due to groundwater pumping from Alternative C to the cumulative impacts of Alternative C pumping with all PPAs and RFFAs included. Also displayed is the amount of hydric soils that would be affected by just the PPAs and RFFAs under No Action (Cumulative) into the future. For display purposes, any valleys with less than 500 acres of hydric soils affected are not shown. The incremental differences in the extent of hydric soils affected by just Alternative C compared to Alternative C plus the PPAs and RFFAs (Alternative C Cumulative) and No Action Cumulative pumping is readily visible. Note that in the basins where Alternative C impacts to hydric soils are minor (shown by a blank space or very small red bar), the bars for No Action and Alternative C Cumulative are equal or close to equal, indicating little or no contribution to impacts on hydric soils due to drawdown in those valleys during the projected time periods. The chart shows that Snake Valley would be the most affected under Alternative C, closely followed by Spring Valley, Lake Valley has minor amounts of hydric soils at risk, and the incremental difference between Alternative C impacts and Alternative C Cumulative impacts in Snake Valley is very small.

The same ACMs as listed under the Proposed Action would be implemented to reduce groundwater pumping effects on environmental resources including hydric soils. The adaptive management measures that would reduce effects on hydric soils include SNWA's use of agricultural water rights in Spring Valley (184) to offset changes in spring discharges needed to maintain wet meadows in the northwest and southeast portions of the valley, large-scale seeding, and facilitated recharge projects.

Conclusion:

- Based on the model simulations and the 10-foot drawdown contour, pumping would reduce the source of water that sustains hydric soils. Steptoe, Spring (184), Lake, and Snake valleys would have the most extensive potential impacts to hydric soils. Long-term drying of hydric soils may permanently reduce the ability of these soils to support wetland vegetation. ACMs involving modification of the SNWA's agricultural water rights, large scale seeding, and facilitated recharge projects would be applied to reduce effects on environmental resources including hydric soils.

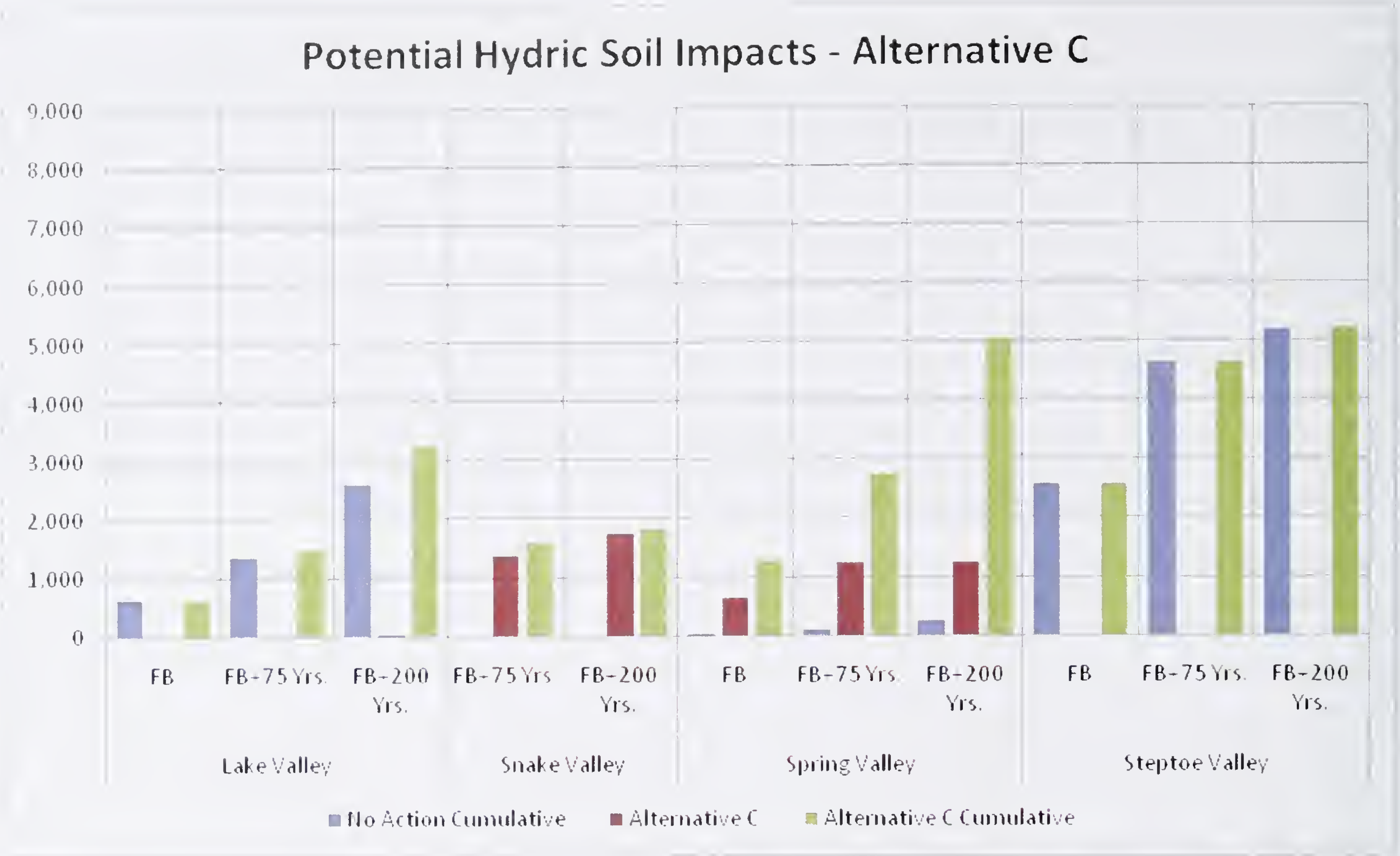


Figure 3.4-8 Potential Hydric Soil Impacts – Alternative C

3.4.3.10 Alternative D

Rights-of-way and Groundwater Development Area Construction and Maintenance

The types of cumulative impacts to soils would be similar to those described for construction of Proposed Action ROWs and ancillary facilities. Overall acreage of surface disturbance would be less because groundwater development would not occur in northern Spring (184) and Snake valleys.

Conclusion:

- Same as those described for the Proposed Action.

Groundwater Pumping Effects

The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table is currently within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term.

Figure 3.4-9 visually compares the quantity of hydric soils at risk due to groundwater pumping from the Alternative D to the cumulative impacts of Alternative D pumping with all PPAs and RFFAs included. Also displayed is the amount of hydric soils that would be affected by just the PPAs and RFFAs under No Action (Cumulative) into the future. For display purposes, any valleys with less than 500 acres of hydric soils affected are not shown. The incremental differences in the extent of hydric soils affected by just Alternative D compared to the Alternative D plus the PPAs and RFFAs (Alternative D Cumulative) and No Action Cumulative pumping is readily visible. Note that in the basins where Alternative D impacts to hydric soils are minor (shown by a blank space or very small red bar), the bars for No Action and Alternative D Cumulative are equal or close to equal, indicating little or no contribution to impacts on hydric soils due to drawdown in those valleys during the projected time periods. The chart shows that Lake Valley would be the most affected under Alternative D, followed by Spring Valley, and the incremental difference between Alternative D impacts and Alternative D Cumulative impacts in Snake Valley is very small.

The same ACMs as listed under the Proposed Action would be implemented to reduce groundwater pumping effects on environmental resources including hydric soils. The adaptive management measures that would reduce effects on hydric soils include SNWA's use of agricultural water rights in Spring Valley (184) to offset changes in spring discharges needed to maintain wet meadows in the northwest and southeast portions of the valley, large-scale seeding, and facilitated recharge projects.

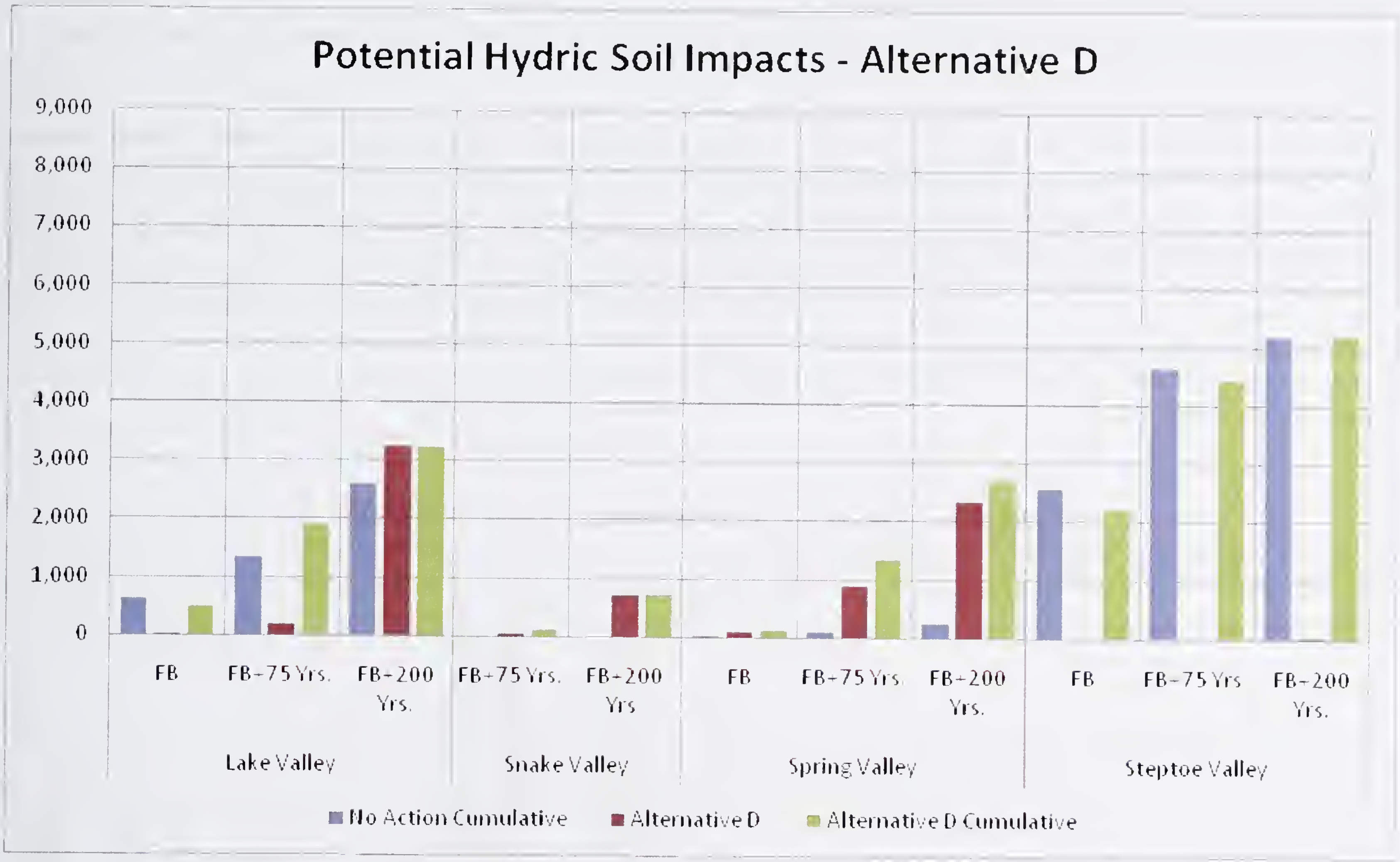


Figure 3.4-9 Potential Hydric Soil Impacts – Alternative D

Conclusion:

- Based on the model simulations and the 10-foot drawdown contour, pumping would reduce the source of water that sustains hydric soils. Steptoe, Lake, and Spring (184) valleys would have the most extensive potential impacts to hydric soils. Long-term drying of hydric soils may permanently reduce the ability of these soils to support wetland vegetation. ACMs involving modification of the SNWA's agricultural water rights, large scale seeding, and facilitated recharge projects would be applied to reduce effects on environmental resources including hydric soils.

3.4.3.11 Alternative E

Rights-of-way and Groundwater Development Area Construction and Maintenance

The types of cumulative impacts to soils would be similar to those described for construction of ROWs and ancillary facilities for the Proposed Action. Overall acreage of surface disturbance would be less because groundwater development would not occur in Snake Valley.

Conclusion:

- Same as those described for the Proposed Action.

Groundwater Pumping Effects

The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table is currently within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term.

Figure 3.4-10 visually compares the quantity of hydric soils at risk due to groundwater pumping from the Alternative E to the cumulative impacts of Alternative E pumping with all PPAs and RFFAs included. Also displayed is the amount of hydric soils that would be affected by just the PPAs and RFFAs under No Action (Cumulative) into the future. For display purposes, any valleys with less than 500 acres of hydric soils affected are not shown. The incremental differences in the extent of hydric soils affected by just Alternative E compared to the Alternative E plus the PPAs and RFFAs (Alternative E Cumulative) and No Action Cumulative pumping is readily visible. Note that in the basins where Alternative E impacts to hydric soils are minor (shown by a blank space or very small red bar), the bars for No Action and Alternative E Cumulative are equal or close to equal, indicating little or no contribution to impacts on hydric soils due to drawdown in those valleys during the projected time periods. The chart shows that Spring Valley would be the most affected under Alternative E, Lake Valley has minor amounts of hydric soils at risk until full build out plus 200 years, and the incremental difference between Alternative E impacts and there would be no effect on hydric soils in Snake Valley due to pumping.

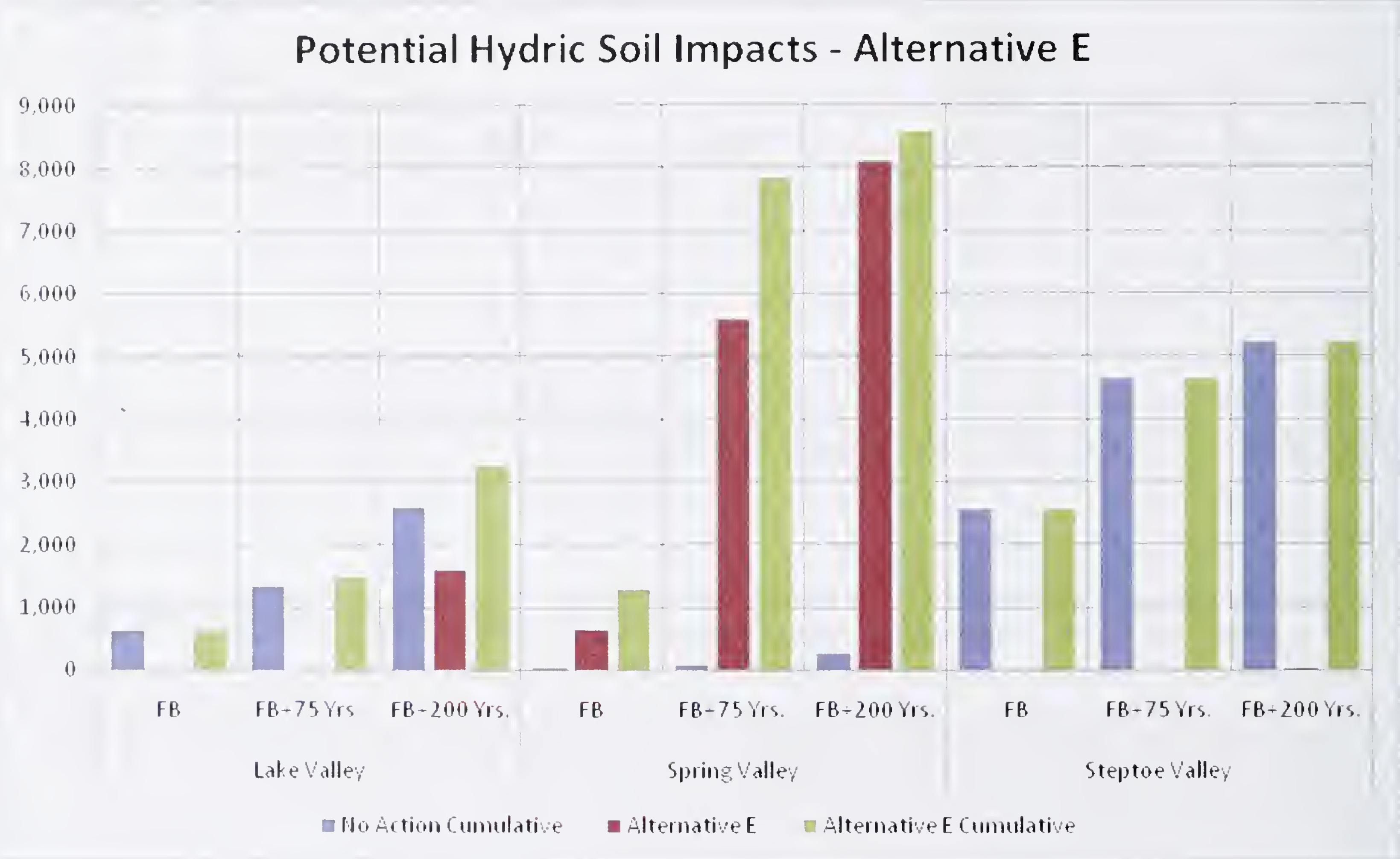


Figure 3.4-10 Potential Hydric Soil Impacts – Alternative E

The same ACMs as listed under the Proposed Action would be implemented to reduce groundwater pumping effects on environmental resources including hydric soils. The adaptive management measures that would reduce effects on hydric soils include SNWA's use of agricultural water rights in Spring Valley (184) to offset changes in spring discharges needed to maintain wet meadows in the northwest and southeast portions of the valley, large-scale seeding, and facilitated recharge projects.

Conclusion:

- Based on the model simulations and the 10-foot drawdown contour, pumping would reduce the source of water that sustains hydric soils. Spring (184), Steptoe, and Lake valleys would have the most extensive potential impacts to hydric soils. Long-term drying of hydric soils may permanently reduce the ability of these soils to support wetland vegetation. ACMs involving modification of the SNWA's agricultural water rights, large scale seeding, and facilitated recharge projects would be applied to reduce effects on environmental resources including hydric soils.

3.4.3.12 Alternative F

Rights-of-way and Groundwater Development Area Construction and Maintenance

The types of cumulative impacts to soils would be similar to those described for construction of ROWs and ancillary facilities under the Proposed Action. Overall acreage of surface disturbance for ROWs and Groundwater Development Areas, not including future facilities, would be the same as described for Alternative E.

Conclusion:

- Same as those described for the Proposed Action.

Groundwater Pumping Effects

The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table is currently within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term.

Figure 3.4-11 visually compares the quantity of hydric soils at risk due to groundwater pumping from the Alternative F to the cumulative impacts of Alternative F pumping with all PPAs and RFFAs included. Also displayed is the amount of hydric soils that would be affected by just the PPAs and RFFAs under No Action (Cumulative) into the future. For display purposes, any valleys with less than 500 acres of hydric soils affected under this alternative are not shown. The incremental differences in the extent of hydric soils affected by just Alternative F compared to the Alternative F plus the PPAs and RFFAs (Alternative F Cumulative) and No Action Cumulative pumping is readily visible. Note that in the basins where Alternative F impacts to hydric soils are minor (shown by a blank space or very small red bar), the bars for No Action and Alternative E Cumulative are equal or close to equal, indicating little or no contribution to impacts on hydric soils due to drawdown in those valleys during the projected time periods. The chart shows that Spring Valley would be the most affected under Alternative E, Lake Valley has minor amounts of hydric soils at risk until full build out plus 200 years, and the incremental difference between Alternative E impacts and there would be no effect on hydric soils in Snake Valley due to pumping.

The same ACMs as listed under the Proposed Action would be implemented to reduce groundwater pumping effects on environmental resources including hydric soils. The adaptive management measures that would reduce effects on hydric soils include SNWA's use of agricultural water rights in Spring Valley (184) to offset changes in spring discharges needed to maintain wet meadows in the northwest and southeast portions of the valley, large-scale seeding, and facilitated recharge projects.

Conclusion:

- Based on the model simulations and the 10-foot drawdown contour, pumping would reduce the source of water that sustains hydric soils. Spring (184), Steptoe, and Lake valleys would have the most extensive potential impacts to hydric soils. Long-term drying of hydric soils may permanently reduce the ability of these soils to support wetland vegetation. ACMs involving modification of the SNWA's agricultural water rights, large scale seeding, and facilitated recharge projects would be applied to reduce effects on environmental resources including hydric soils.

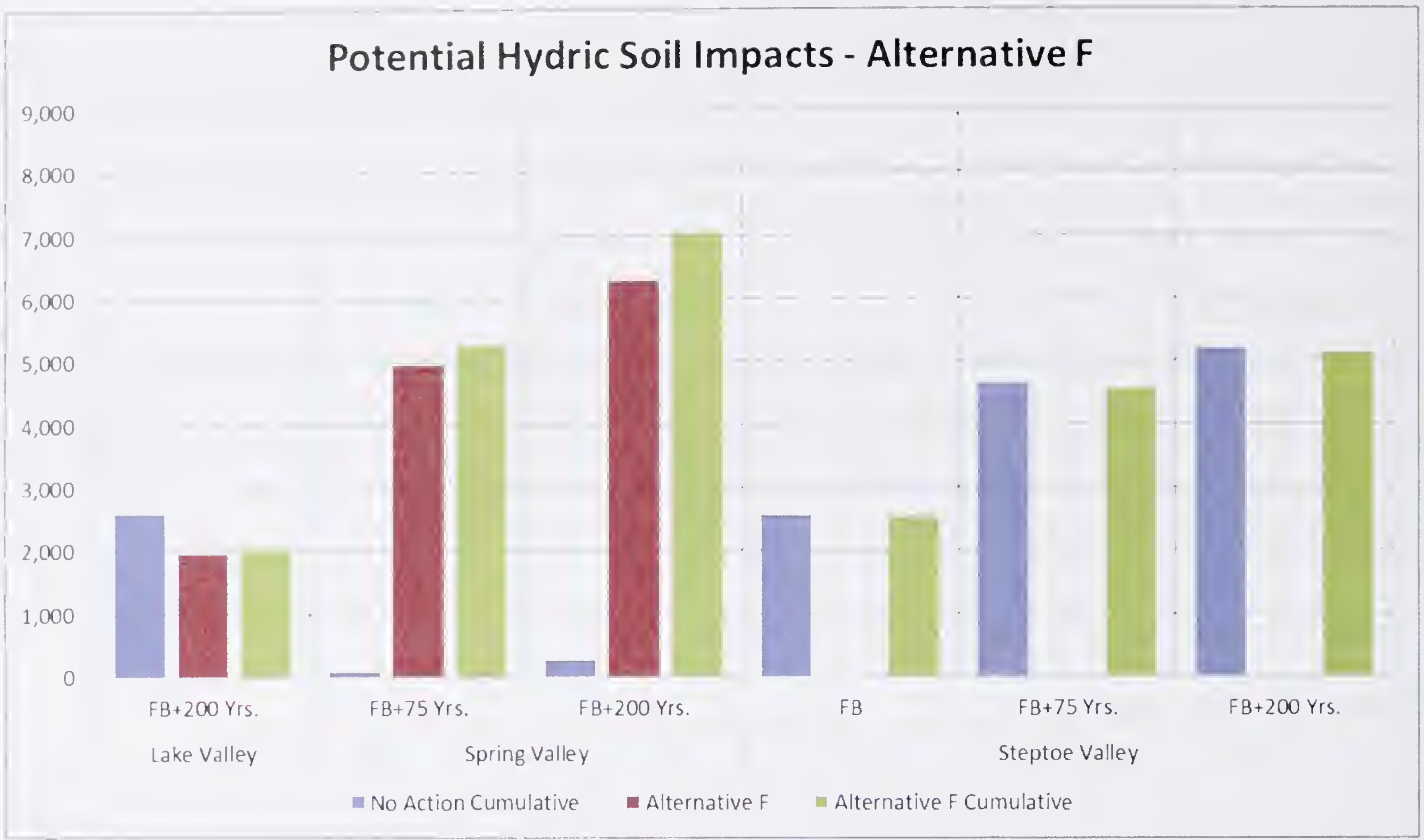


Figure 3.4-11 Potential Hydric Soil Impacts – Alternative F

3.4.3.13 Comparison of Cumulative Impacts to Hydric Soils

Table 3.4-16 summarizes the maximum acreage of hydric soils that may be affected by groundwater drawdown when considering the total contribution of the proposed project pumping alternatives in combination with the PPAs and RFFAs that involve groundwater pumping.

Table 3.4-16 Comparison of Cumulative Impacts to Hydric Soils from Groundwater Pumping

Project Alternative plus RFFAs and Past and Present Actions (Cumulative)	Hydrologic Basins Most Affected (in descending order of magnitude)	Maximum area[1] (acres) of hydric soils potentially affected by 10-foot pumping drawdown within High and Moderate Risk Zones
Proposed Action	Spring (184), Steptoe, Lake	26,936
A	Spring (184), Steptoe, Lake, Snake	19,839
B	Spring (184), Steptoe, Lake, Snake	18,022
C	Steptoe, Spring (184), Lake, Snake	16,110
D	Steptoe, Lake, Spring (184)	12,712
E	Spring (184), Steptoe, Lake	17,854
F	Spring (184), Steptoe, Lake	14,727
No Action	Steptoe, Lake	8,798

3.5 Vegetation Resources

3.5.1 Affected Environment

3.5.1.1 Overview

The GWD Project is located in the Basin and Range Geographic Province. The northern two-thirds of the project lies within Great Basin Desert (also known as the Intermountain Region) and the southern one-third is within the Mojave Desert. The transitional area between these two regions is located in Delamar Valley and southern Dry Lake Valley.

QUICK REFERENCE

ET – evapotranspiration
NRS – Nevada Revised Statutes
TCWCP – Tri-County Weed Control Project
ESA – Endangered Species Act
BARCAS – Basin and Range Carbonate Rock Aquifer System

Hot, dry Mojave Desert lowlands are characterized by low shrub vegetation dominated by a few common perennial species. Characteristic Mojave vegetation includes burrobush (*Ambrosia dumosa*), creosote bush (*Larrea tridentata*), and Fremont's dalea (*Psorothamnus fremontii*) (Bowers 1993). Joshua tree (*Yucca brevifolia*) is an important component of lowland elevations up to approximately 6,500 feet and has been regarded by some plant geographers and ecologists as an indicator of Mojave Desert vegetation (Baldwin et al. 2002). Historically, fire has not been an important ecological component of the Mojave Desert as the native perennial vegetation is relatively resistant to fires. The spread of non-native species, specifically red brome (*Bromus rubens*) and cheatgrass (*Bromus tectorum*), has increased fuels and fire occurrence in this ecological system.

Great Basin Desert lowlands are characterized by low shrub vegetation. Common shrub species of the central Great Basin include big sagebrush (*Artemisia tridentata*), Wyoming big sagebrush (*Artemisia tridentata* ssp. *Wyomingensis*), black sagebrush (*Artemisia nova*), rubber rabbitbrush (*Ericameria nauseous*), fourwing saltbush (*Atriplex canescens*), shadscale (*Atriplex confertifolia*), winterfat (*Kraschennikovia lanata*), and greasewood (*Sarcobatus vermiculatus*). Common understory perennial grasses include Indian ricegrass (*Achnatherum hymenoides*), needle-and-thread grass (*Hesperostipa comata*), western wheatgrass (*Pascopyrum smithii*), basin wildrye (*Leymus cinereus*), Sandberg bluegrass (*Poa secunda*), James'galleta (*Pleuraphis jamesii*), and inland saltgrass (*Distichlis spicata*). The spread of non-native annual grass species has increased fuels and fire occurrence in this ecological system.

Open evergreen woodlands consisting of Utah juniper (*Juniperus osteosperma*), singleleaf pinyon (*Pinus monophylla*), or curlleaf mountain-mahogany (*Cercocarpus ledifolius*) are found on the slopes of most ranges. Cottonwoods (*Populus* ssp.) and willows (*Salix* ssp.) proliferate in low elevation areas with dependable water. Historically, an infrequent mixed fire regime occurred in the Great Basin. Fire is an integral part of the ecological process for many of the vegetation types. Most of the vegetation types are adapted to the effects of fire. Fire most often occurs in this area during drought cycles.

Community characterizations were compiled based on literature research, agency consultation, field survey reports, aerial photograph interpretation, SWReGAP Land Cover descriptions (USGS 2005), and information from the Las Vegas and Ely RMPs. Species nomenclature is consistent with the NRCS Plants Database (NRCS 2009).

A work group process, designated as the Natural Resources Group (NRG), was used to obtain the following types of information for biological resources: 1) compile and evaluate baseline data on biological resources (vegetation, wildlife, and aquatic species); 2) prepare a summary of the data; and 3) assist the BLM and AECOM in developing the impact analysis approach for the EIS and make recommendations for monitoring and mitigation. The NRG included representatives from the BLM in Nevada and Utah, USFWS in Nevada and Utah, NDOW, Utah Division of Wildlife Resources (UDWR), SNWA, AECOM (BLM's EIS Contractor), and Entrix (subcontractor to AECOM). The BLM directed the activities of the NRG. As a result of the NRG work, a report entitled the *Natural Resources Baseline Summary Report – Clark, Lincoln, and White Pine Counties Groundwater Development EIS* (ENSR/AECOM 2008) was prepared in support of the EIS.

The *natural resources region of study* consisted of the 5 hydrologic basins proposed for groundwater development, along with 28 other hydrologic basins which collectively encompass all or a portion of 5 flow systems (Las Vegas Wash Flow System, White River Flow System, Meadow Valley Wash Flow System, Goshute Valley Flow System, and Salt Lake Desert Flow System). The natural resources region of study differed from the water resources model area in that four basins (Long, Jakes, Garden, and Coal) were excluded on the eastern boundary due to a lack of sensitive species habitat. The natural resources region of study also included four basins (Pine, Wah Wah, Tule, and Deep Creek) that were not part of the water resources model area. These four basins contained game or special status species.

3.5.1.2 Right-of-way Areas

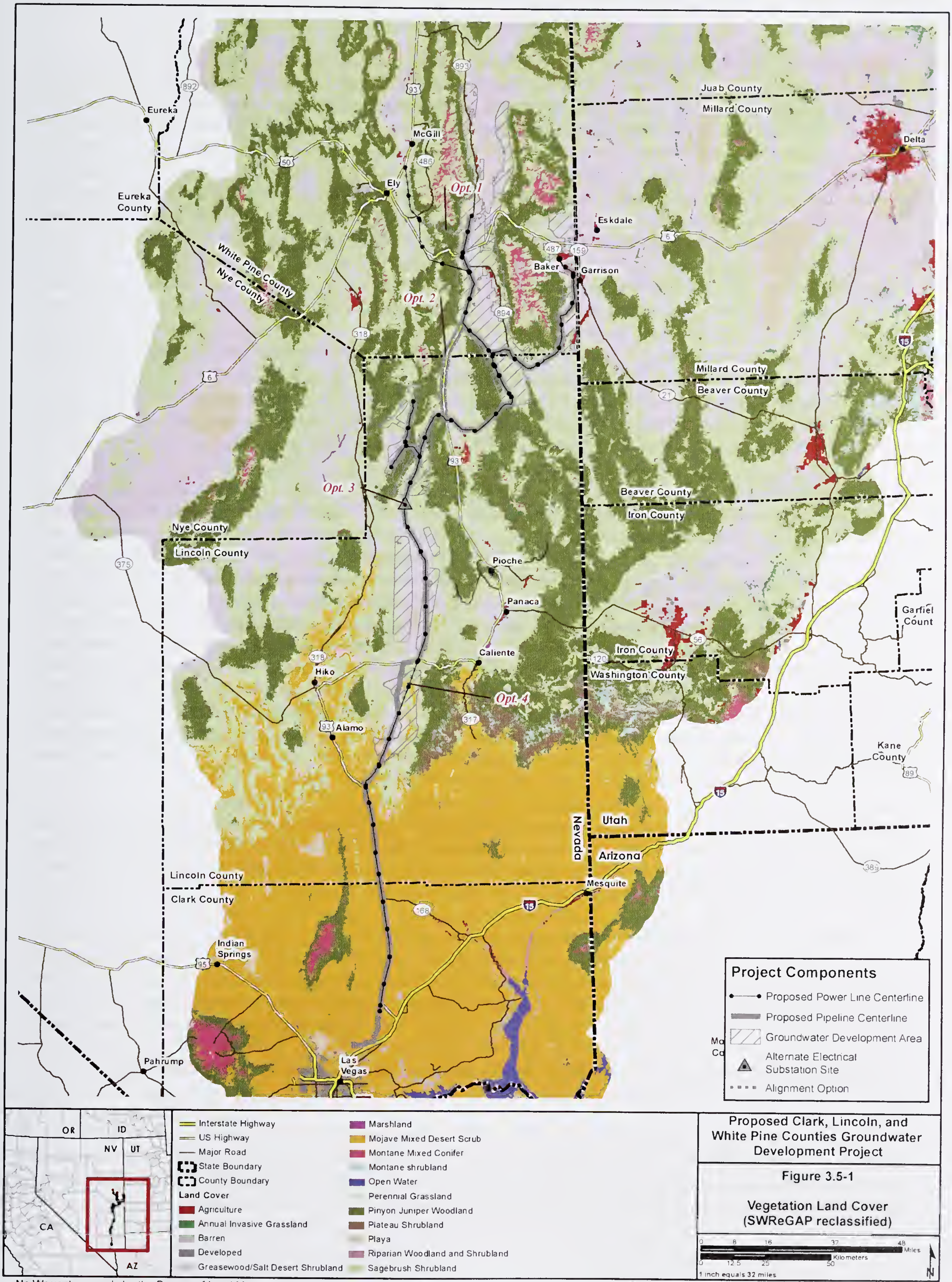
Land Cover Types

The regional SWReGAP Land Cover types were grouped into broader cover classes to provide a description of the major wildlife habitat types (see Section 3.6, Wildlife) (**Figure 3.5-1**). The ROW study area is defined as the maximum potential project surface disturbance footprint associated with the pipeline and ancillary facilities, including the staging Caliente construction support area (Lower Meadow Valley Wash). **Table 3.5-1** provides the cover types, the hydrologic basins where the ROW study area coincides with these cover types, and the relative percentage of each cover type that would be occupied by ROW facilities. The ROW areas are dominated by three major cover types: sagebrush shrubland (48 percent), Mojave mixed desert shrubland (25 percent), and greasewood/salt desert shrubland (24 percent). All other cover types represent 3 percent or less.

Table 3.5-1 Land Cover Types that Occur within the GWD Project Right-of-way Study Area and Hydrologic Basins

Cover Type	ROW Area by Hydrologic Basin	Percentage of ROW Area Occupied by Cover Type
Agriculture/Developed	LMV	Less than 1
Annual Invasive Grassland	D,H,LMV	Less than 1
Barren	D	Less than 1
Greasewood/Salt Desert Shrubland	C,D,DL,H,L,LMV,P,SN,SP,ST	24
Marshland	LMV	Less than 1
Mojave Mixed Desert Shrubland	CS,D,DL,G,HV,LV,P	25
Perennial Grassland	D,DL,L,SN,SP,	Less than 1
Pinyon-Juniper Woodland	C,DL,H,L,LMV,SN, SP,ST	2
Playa	CS,D,DL,	Less than 1
Riparian Woodland and Shrubland	LMV	Less than 1
Sagebrush Shrubland	C,D,DL,H,L,LMV,P,SN,SP,ST	48

C= Cave Valley, CS = Coyote Springs Valley, D = Delamar Valley; DL = Dry Lake Valley, G = Garnet Valley, H = Hamlin Valley, HV = Hidden Valley, L = Lake Valley, LV = Las Vegas Valley, LMV = Lower Meadow Valley Wash, P = Pahranagat Valley, SN = Snake Valley, SP = Spring Valley, ST = Steptoe Valley.



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.5-1

Vegetation Land Cover (SWReGAP reclassified)

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

Wetland and Floodplain Protection

Many wetlands are protected under the CWA as waters of the United States and special aquatic sites. Wetlands are defined by the USACE based on the presence of wetland vegetation, wetland hydrology, and hydric soils. EO 11990, Protection of Wetlands (42 *Federal Register* 26961), directs all federal agencies to minimize the destruction, loss, or degradation of wetlands, and to enhance the natural and beneficial values of wetlands. As a result, federal regulation and management of both USACE jurisdictional and non-jurisdictional wetlands follows a "no net loss" policy. Executive Order 11988, floodplain management requires federal agencies to avoid to the extent possible the long and short-term adverse impacts associated with the occupancy and modification of flood plains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative.

United States Army Corps of Engineers Jurisdictional Determinations

SNWA conducted preliminary jurisdictional determinations to determine the location and extent of any Waters of the U.S. for which a USACE 404 Permit would be required for constructing the water pipeline and ancillary facilities. A total of 68 ephemeral washes were identified as Waters of the U.S., with channel widths averaging 2 feet. This inventory of crossings is combined with 51 ephemeral washes identified in a prior permit application for a total of 119 ephemeral wash crossings for the GWD Project. Snake Creek (in the Snake Valley) was identified as a perennial stream (SNWA 2008). The stream channel is lined by a narrow band of sandbar willows (*Salix exigua*) classified as an obligate wetland species. The USACE (2009) confirmed the jurisdictional determination findings.

Wildland Fire Risk

Within each vegetation community type, there is a characteristic fire regime. A fire regime is a general description of the role fire would play across a landscape in the absence of modern human mechanical intervention, but including the influence of aboriginal burning (Agee 1993, Brown 1995). Historical fire regimes are classified based on average number of years between fires (fire frequency) combined with the severity (amount of replacement) of the fire on the dominant overstory vegetation. Generally the fire frequency is inversely related to fire intensity. For example, due to higher precipitation levels and cooler mean temperatures (which foster plant growth), there are higher fuel loads in pinyon-juniper woodlands and upper montane forest vegetation types as compared to lowland shrublands. In addition, the higher precipitation amounts and cooler temperatures provide higher resistance to fire for longer periods. This leads to fires of high intensity that occur infrequently. The reverse is true in grasslands where fine fuel types lead to fires at a high frequency that burn rapidly with low intensity. Other factors that determine fire behavior include site topography, weather conditions, time of year, type of plant community, health of the ecosystem, fuel moisture levels, depth and duration of heat penetration, fire frequency and site productivity. The highest potential rates of spread occur in areas with flashy fuels such as cured-out annual bromes, and steep brushy mountain slopes.

Wildland fire risk tends to be high in disturbed grasslands and forblands dominated by non-native noxious and invasive species, specifically the annual brome species such as cheatgrass and red brome (BLM 2010). Areas dominated by crested wheatgrass tend to have lower fire risk because this species stays green during the early part of the fire season, and because grass clumps within rows are widely spaced as the result of drill seeding.

The response and revegetation potential of each vegetation type varies depending on actual fire conditions, the seasonal timing, pre- and post-fire vegetation, elevation and post-fire weather patterns. Vegetation in low-intensity fire areas (for example areas, where native perennial bunchgrass cover and site productivity are high) can frequently revegetate naturally without seeding. High intensity fires in areas with dense sagebrush or pinyon-juniper stands can result in scorched, water-resistant soils that become unproductive until the condition changes, which could take several years. Extremely severe fires have been known to sterilize soils and lead to the permanent loss of productivity. **Appendix F3.5** describes general fuel conditions, fire frequency, and succession timelines for vegetation communities present in the ROW.

The Mojave Desert region historically had few, very infrequent fire events due to the limited amount of herbaceous understory vegetation between and around shrub species (Rogstad et al. 2009). The spread of invasive species, specifically annual invasive grass, such as red brome and cheatgrass, into these interspaces has dramatically increased the fuel load in these communities (Brooks and Matchett 2006).

Fire Regime Condition Class (FRCC) is a discrete metric that describes how similar a landscape's fire regime is to its natural or historical state. FRCC quantifies the amount that current vegetation has departed from the simulated historical vegetation reference conditions (Hann and Bunnell 2001; Hardy et al 2001; Barrett et al. 2010; Holsinger et al. 2006). The three condition classes describe low departure (FRCC 1), moderate departure (FRCC 2), and high departure (FRCC 3). Landscapes determined to fall within the category of FRCC 1 contain vegetation, fuels, and disturbances characteristic of the natural regime; FRCC 2 landscapes are those that are moderately departed from the natural regime; and FRCC 3 landscapes reflect vegetation, fuels, and disturbances that are uncharacteristic of the natural regime. A map of Fire Regime Condition Classes along the project ROW can be found in **Appendix F3.5**. The FRCC layer depicted in this figure represents the departure of current vegetation conditions from simulated historical reference conditions according to the methods outlined in the *Interagency Fire Regime Condition Class Guidebook* (Barrett et al. 2010). Full descriptions of the FRCC categories, their associated fire regimes, and management options are found in **Appendix F3.5**.

Noxious and Non-native Invasive Weeds

Under the Federal Plant Protection Act of 2000 (formerly the Noxious Weed Act of 1974 [7 USC SS 2801-2814]), a noxious weed is defined as "any plant or plant product that can directly or indirectly injure or cause damage to crops, livestock, poultry, or other interests of agriculture, irrigation, navigation, the natural resources of the U.S., the public health, or the environment" (Animal and Plant Health Inspection Service 2000; Institute of Public Law 1994). Each state is federally mandated to uphold the rules and regulations set forth by this act and manage its lands accordingly. In addition, the federal Noxious Weed Act of 1974, as amended (7 USC Secs.2801 et seq.) requires cooperation with state, local, and other federal agencies in the application and enforcement of all laws and regulations relating to the management and control of noxious weeds.

The State of Nevada also regulates noxious weeds. Under the NRS, a noxious weed is defined as "any species of plant which is, or is likely to be, detrimental or destructive and difficult to control or eradicate" (NRS 555.005 – Control of insects, pests, and noxious weeds). Noxious weeds are classified into three categories based on the statewide importance, distribution, and the ability of eradication or control measures to be successful. Category A weeds are not currently found or are limited in distribution throughout the state (control is required by the state in all infestations); Category B weeds are found in scattered populations in some counties of the state (control is required by the state in areas where populations are not well established or previously unknown to occur); and Category C weeds are currently established and generally widespread in many counties of the state (control is at the discretion of the state quarantine officer) (NRS 555.010).

The spread of noxious weeds has resulted in substantial economic impacts on some sectors in Utah. As a result, Utah has enacted laws requiring the control of noxious weed species (Utah State Legislature 2008). Under the Utah Noxious Weed Act, a "noxious weed" is defined as any plant the commissioner determines to be especially injurious to public health, crops, livestock, land, or other property (Utah State Legislature 2008). In 2008, the Utah Noxious Weed Act was amended to allow for the categorization of weeds into three categories: Class A (Early Detection Rapid Response) Class B (Control) and Class C (Containment). Class A Early Detection Rapid Response weeds are noxious weeds not native to the state of Utah and that pose a serious threat to the state and should be considered as a very high priority for control and prevention. Class B Control weeds are noxious weeds not native to the state that pose a threat to the state and should be considered a high priority for control. Lastly, Class C Containment weeds are noxious weeds that are not native to the state, are widely spread, and pose a threat to the agriculture industry and to agricultural products, and control methods should focus on stopping invasion.

An invasive species is defined as a species that is: 1) non-native (or alien) to the ecosystem under consideration and 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health (National Invasive Species Council 2001).

Data from the Tri-County Weed Control Project (TCWCP) (2007) and the BLM Ely District Office (BLM 2009) were compiled and integrated into a GIS database. Weed occurrences within the ROW study area and hydrologic basins were then compiled. Based on field surveys conducted within the ROW study area between 2001 and 2008 (BLM 2010), infestations of the following noxious weed species are known to occur within 1,000 feet of the ROWs for all alternatives: Russian knapweed (*Acroptilon repens*), Sahara mustard (*Brassica tournefortii*), Spotted knapweed (*Centaurea stoebe*), Canada thistle (*Cirsium arvense*), poison hemlock (*Conium maculatum*), hoary cress (*Lepidium draba*), tall whitetop (*Lepidium latifolium*), Dalmation toadflax (*Linaria dalmatica*), Scotch thistle (*Onoporodum acanthium*), salt cedar (*Tamarix sp.*), and Malta starthistle (*Centaurea solstitalis*).

The biological characteristics of noxious weeds are provided in **Appendix F3.5** including; 1) status; 2) general distribution in the world, USA or North America; 3) general habitat; 4) life history and flowering period; 5) any details regarding a species' propensity to invade wildlands and any specific mechanisms for doing so (if available); and 6) any preferred control measures (if available). Information on invasive species that are widely distributed within the ROW area, including red brome, cheatgrass, and salt lover (*Halogeton glomeratus*), also is provided.

An Ely District Integrated Weed Management Plan and Preliminary EA (BLM 2009) was prepared by the Ely District for application across all field offices (**Appendix F3.5**). A project-specific weed risk management plan (BLM 2010) was prepared, based on guidance contained in the integrated weed management plan.

Cactus and Yucca

Nevada state law regulates the removal or possession of native cacti and yucca in commercial quantities. A permit must be obtained from the Nevada Department of Forestry to remove and transplant these species. Within the ROW area, 23 protected species of cactus and yucca were identified (**Appendix F3.5**). Surveys for these species were conducted by SNWA (Wildland 2009; Jones & Stokes 2005). Surveys consisted of a complete inventory and total stem count within the proposed ROW and associated ancillary facility sites. These surveys were used to calculate the density of species per acre along the proposed ROW, as well as the number of stems per linear mile. For the ancillary facilities, the stems per acre by species were calculated.

Within the Mojave Desert portion of the project from the south end of Delamar Valley to the pipeline terminus near Las Vegas, approximately 35,000 cacti representing 11 species were inventoried within the ROW. Additionally, approximately 106,000 Mojave yuccas (*Yucca schidigera*); 4,250 Joshua trees (*Yucca brevifolia*); and 2,670 banana yuccas (*Yucca baccata*) were inventoried (Jones & Stokes 2005). Additional yucca and cactus surveys were conducted in Dry Lake and Delamar valleys (Wildland 2009). Joshua trees, banana yuccas, Wiggins' cholla (*Cylindropuntia echinocarpa*), and grizzly bear pricklypear (*Opuntia polyacantha* var. *erinacea*) were the most abundant species. Cactus and yucca density was 1,299 stems per mile in Dry Lake Valley. Cactus and yucca populations were much lower in the remaining valleys crossed by proposed facilities.

Special Status Plant Species

Occurrence data for special status species in the ROW area were obtained from the Nevada Natural Heritage Program (NNHP). Additional occurrence information was obtained through field surveys sponsored by SNWA (Wildland 2009, 2007; Jones & Stokes 2005). The overall list includes 35 BLM sensitive species, 17 USFS sensitive species, 6 Nevada protected critically endangered species, 24 Nevada protected cactus or yucca species, and 1 federally threatened species (**Appendix F3.5**). Additional species of concern that may occur in the ROW were identified by a technical cooperating agency group that was comprised of representatives from the BLM in Nevada and Utah, USFWS in Nevada and Utah, NDOW, and UDWR.

Individuals of five special status species were found to occur within the construction ROW and suitable habitats for four species were identified, based on nearby survey occurrences (**Table 3.5-2**).

Table 3.5-2 Special Status Plant Species Occurrence and Suitable Habitat within the Right-of-way Area

Common Name/Scientific Name	Status	Occurrence
Eastwood milkweed *Asclepias eastwoodiana*	BLM Sensitive, USFS Sensitive Nevada Critically Endangered	ROW
Threecorner milkvetch *Astragalus geyeri* var. *triquetrus*	BLM Sensitive, Nevada Critically Endangered	Habitat in ROW
Long-calyx eggvetch (egg milkvetch) *Astragalus oophorus* var. *lonchocalyx*	BLM Sensitive	ROW
Las Vegas buckwheat *Eriogonum corymbosum* var. *nilesii*	USFWS Candidate, BLM Sensitive	Low potential habitat identified in ROW
Yellow twotone beardtongue *Penstemon bicolor* ssp. *Bicolor*	BLM Sensitive, USFS Sensitive	ROW
Rosy twotone beardtongue *Penstemon bicolor* var. *roseus*	BLM Sensitive, USFS Sensitive	ROW
Blaine's fishhook cactus *Sclerocactus blainei*	BLM Sensitive; Nevada Harvest Regulated	ROW
Nachlinger catchfly (*Silene nachlingerae*)	BLM Sensitive, USFS Sensitive	Habitat in ROW
White bearpoppy (*Arctomecon merriamii*)	BLM Sensitive, USFS Sensitive	Habitat in ROW

3.5.1.3 Groundwater Development Areas

Land Cover

Eleven land cover types are mapped within the groundwater development areas (**Table 3.5-3**). The greasewood/salt desert shrubland and sagebrush shrubland are the dominant cover types in all development areas. The Mojave mixed desert shrubland represented 22 percent of the land cover in Delamar Valley. The remaining cover types provide less than 20 percent cover in the individual hydrologic basins.

Table 3.5-3 Percent Cover of Land Cover Types Within GWD Project Groundwater Development Areas

	Cave Valley	Delamar Valley	Dry Lake Valley	Snake Valley	Spring Valley
Agriculture/Developed	0	0	0	< 1	0
Annual Invasive Grassland	0	< 1	< 1	3	0
Greasewood/Salt Desert Shrubland	23	20	36	43	32
Mojave Mixed Desert Shrubland	0	22	< 1	0	0
Perennial Grassland	0	< 1	< 1	0	< 1
Marshland	0	< 1	0	0	< 1
Barren	0	< 1	< 1	0	< 1
Pinyon-Juniper Woodland	16	< 1	11	6	7
Playa	0	4	1	0	< 1
Riparian Woodland and Shrubland	0	0	0	< 1	0
Sagebrush Shrubland	61	53	51	47	61
Groundwater Development Area Size (acres)	34,787	71,889	168,769	92,703	361,795

Source: SWReGAP (USGS 2005).

United States Army Corps of Engineers Jurisdictional Wetlands

No jurisdictional wetland delineations have been completed for potential future GWD Project in any of the groundwater development areas within the proposed pumping basins. Subsequent NEPA analysis would further identify and quantify wetland impacts associated with the groundwater development project and develop mitigation measures.

Noxious Weed Species

The data sources and field surveys for noxious and non-native invasive weed species in the groundwater development areas are the same as described for the ROW. Noxious weed species found in the groundwater development areas by hydrologic basin are presented in **Appendix F3.5**. Nine noxious weed species have been documented in the groundwater development areas: Russian knapweed, hoary cress, musk thistle, spotted knapweed, water hemlock, Canada thistle, tall whitetop, Scotch thistle, and tamarisk.

Special Status Species

A summary of special status plant species known or potentially present within the groundwater development areas is presented in **Table 3.5-4**. There were four species observed in the groundwater development areas, and three species with potential habitat. Potential habitat was based on the similarity in associated vegetation, soils, and slopes to areas occupied by known populations.

Table 3.5-4 Special Status Species Known or Potentially Present within Groundwater Development Areas

Common/Scientific Name	Status	Occurrence
Eastwood milkweed *Asclepias eastwoodiae*	BLM Sensitive, USFS Sensitive	Dry Lake Valley, Muleshoe Valley – populations found in groundwater development areas
Meadow milkvetch *Astragalus diversifolius*	USFS Sensitive	Spring Valley – Moderate potential habitat
Long-calyx egg milkvetch *Astragalus oophorus* var. *lonchocalyx*	BLM Sensitive	Spring Valley – one population with two individuals
Tunnel Springs beardtongue *Penstemon concinnus*	BLM Sensitive	Spring Valley – Low potential habitat Snake Valley – Moderate potential habitat
Parish's phacelia *Phacelia parishii*	BLM Sensitive	Dry Lake Valley – Large population along playa margin Cave Valley – Very large population (estimated at more than a million plants)
Blaine fishhook cactus *Sclerocactus blainei*	BLM Senstive, Nevada Harvest Regulated	Dry Lake Valley – one individual was observed, and low to high potential habitat identified on 12 transects
Ute ladies'-tresses *Spiranthes diluvialis*	USFWS Threatened, BLM Sensitive, USFS Sensitive	Spring Valley – Based on field surveys, the following springs provide high potential habitat (i.e. ideal conditions) for the orchid : Keegan Ranch (Middle) and Keegan Ranch (South); Stonehouse Spring; Swallow Spring, and West Spring Valley Complex (North). No Ute ladies'-tresses orchids were located during 2007 surveys (BIO-WEST 2007a,b,c)

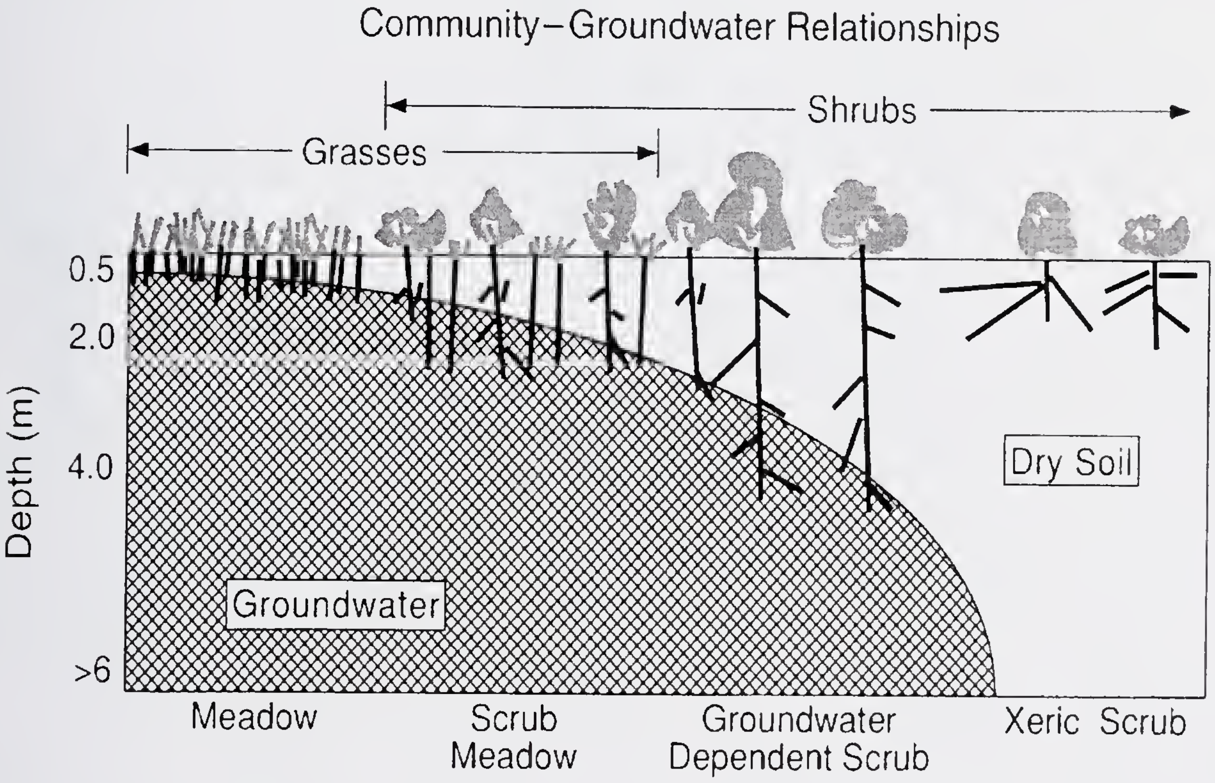
The Ute ladies'-tresses was listed as threatened under the ESA on January 17, 1992 (USFWS 1992). The species is threatened due to scarcity of populations, small population sizes, and loss of habitat due to urbanization and stream channelization for agriculture and development, as well as competition from non-native plant species, and vegetation succession (NatureServe 2009). The species typically inhabits moist, sub-irrigated, or seasonally flooded soils at elevations between 4,200 to 5,300 feet amsl (USFWS 1995). A wide variety of soils are suitable for this species, including sandy or coarse, cobbly alluvium to calcareous, histic (high in organic matter) fine-textured clays, and loams. Primary habitats include valley bottoms, gravel bars, and floodplains along springs, lakes, rivers, or perennial streams that receive periodic disturbance from over-bank flooding and livestock grazing.

3.5.1.4 Region of Study

Overview

The region of study for vegetation resources is the natural resources region of study, discussed in Section 3.0. The focus of this section is on surface and groundwater dependent vegetation resources, riparian areas, located within hydrologic basins potentially affected by future groundwater pumping. Riparian areas are transitional zones between terrestrial and aquatic ecosystems and are distinguished by gradients in biophysical conditions, ecological processes and biota (NRC 2002). These areas are connected to surface and/or sub-surface (groundwater) waterbodies and exhibit unique soil characteristics. Vegetation communities within riparian areas include both woody, such as trees and shrubs, and non-woody species, such as forbs and grasses.

Figure 3.5-2 provides a generalized relationship of groundwater dependent vegetation to groundwater depths. Where groundwater remains at or near the surface for the majority of the growing season, wetland plants such as sedges (*Carex* spp.), rushes (*Juncus* spp.), bulrushes (*Schoenoplectus* spp.) and cattails (*Typha* spp.) are commonly the dominant community components. Root systems of these plants are typically shallow, because the roots are in contact with the groundwater surface over the majority of the year. These wetland plants are characteristic of meadows that form below the spring discharge points. Water dependent shrubs such as willows and cottonwoods often line the channel of streams with perennial to intermittent flow.



Source: Elmore et al. 2006.

Figure 3.5-2 Relationship of Plant Community Components to Groundwater Depths

As groundwater depths increase, perennial grasses and shrubs that are capable of extending their root systems to greater soil depths can take advantage of both precipitation and groundwater soil moisture. Several of these species are classified as phreatophytes, which are discussed below. Species that are adapted to grow on soils with no sub-surface moisture provided by groundwater are classified as xerophytes.

Spring Vegetation

Section 3.3, Water Resources, provides detailed information on spring locations and flows within the region of study. **Figures 3.5-3** and **3.5-4** illustrate the major springs of high biological importance within the hydrologic study area. Aquatic and wetland communities that have developed around and downgradient of springs were mapped into dominant species associations (BIO-WEST 2007a). Spring meadow vegetation in these areas ranges from herbaceous wetlands to woody plants along drainages. A summary of the vegetation community types associated with springs sampled within hydrologic basins in eastern Nevada and western Utah is provided in **Table 3.5-5**.

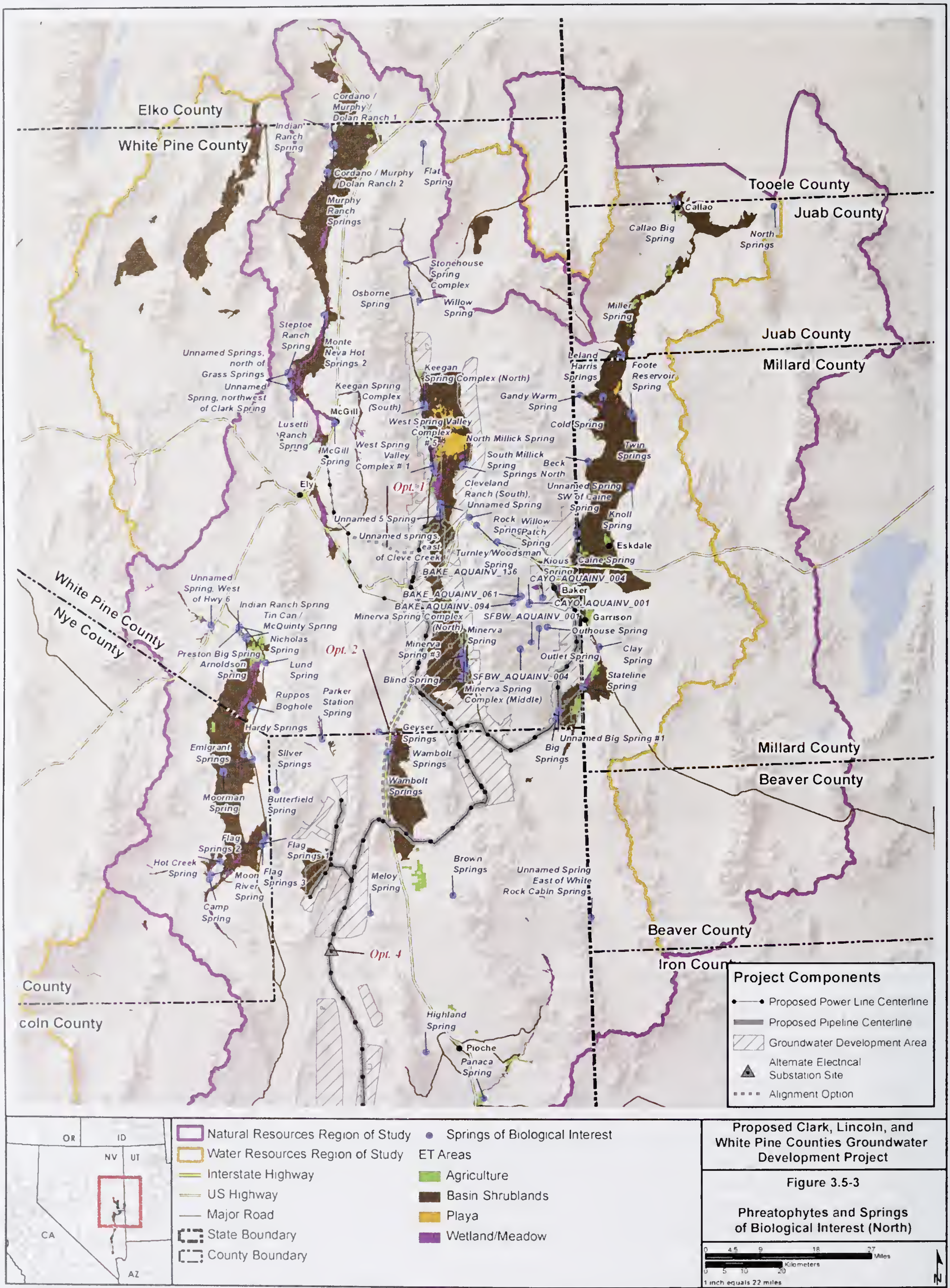
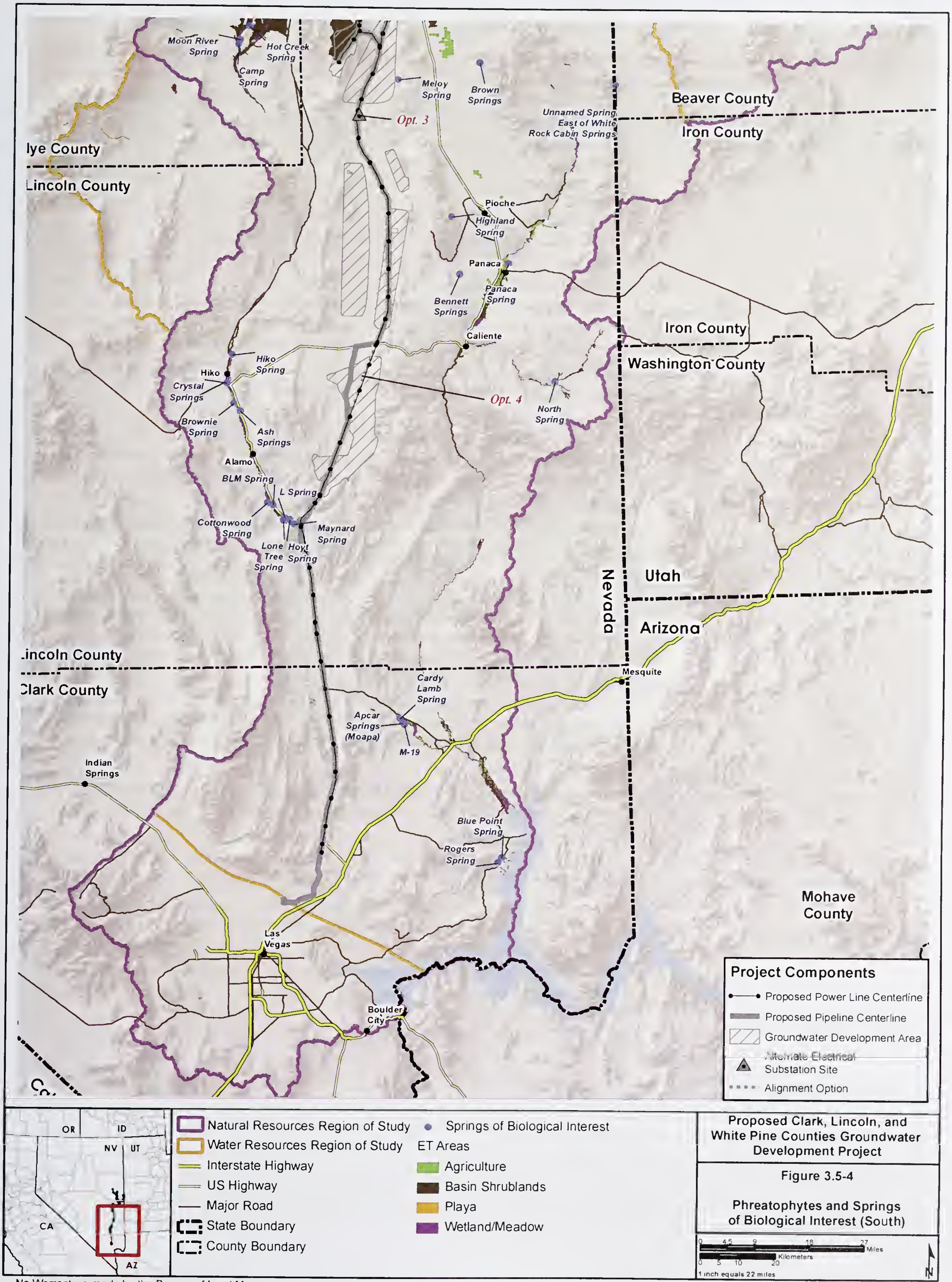


Figure 3.5-3
Phreatophytes and Springs of Biological Interest (North)

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.5-4

Phreatophytes and Springs of Biological Interest (South)

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

Table 3.5-5 Vegetation Community Characteristics for Example Spring Systems Sampled in Hydrologic Basins within the Region of Study

Nevada Hydrologic Basins Proposed for Project Groundwater Pumping	
Spring Valley 19 spring systems mapped	Dominant aquatic vegetation in the Unnamed Springs East of Cleve Creek, South Millick Spring and South Bastion Spring in northern Spring Valley include watercress (*Rorippa nasturtium aquaticum*), fine-leaf pondweed (*Suckenia filiformis*), horsehair algae (*Chlorophyceae* sp.), and stonewort (*Chara vulgaris*). Arctic rush and spike rush (*Eleocharis* sp.) are the dominant wetland species. Dominant aquatic vegetation in southern Spring Valley springs (Willard, Minerva, and Swallow) is similar to that in the northern part of Spring Valley.
Snake Valley 21 spring systems mapped.	Dominant aquatic vegetation in the Big Spring system, South Little Spring, and North Little Spring include watercress, horsehair algae, and muskgrass (*Chara vulgaris*). The dominant wetland species include Arctic rush, Nebraska sedge (*Carex nebrascensis*), redtop (*Agrostis gigantea*), spikerush, and three square bulrush (*Schoenoplectus americanus*).
Cave Valley 2 small springs identified, no access.	Cave Spring, Unnamed Spring at Parker Station.
Dry Lake Valley 3 spring systems mapped	Bailey, Coyote, and Fence Springs. Very small springs (less than 1 acre each). Primarily introduced species in the herbaceous layer: curly dock (*Rumex crispus*), sweet clover (*Melilotus officinalis*). Shrubs: skunkbush (*Rhus trilobata*). Trees: Fremont cottonwood (*Populus fremontii)*.
Delamar Valley 1 spring system mapped	Grassy spring. Highly disturbed small spring, developed for stock watering. Open water with no vegetation, small areas of hardstem bulrush (*Schoenoplectus acutus*).
Other Hydrologic Basins within the Region of Study	
White River Valley, Nevada 9 spring systems mapped	The most abundant aquatic species include horsehair algae and watercress. The most abundant emergent wetland species include Arctic rush, Olney's three-square bulrush (*Schoenoplectus americanus*), broadleaf cattail (*Typha latifolia*), saltgrass, and spike rush. Some trees (cottonwoods, boxelder, black locust, and Russian olive) were established in several wetlands sampled.
Pahranagat Valley (including Pahranagat National Wildlife Refuge [NWR]), Nevada 8 spring systems mapped	Dominant species composition is similar to that of the White River Valley, with the addition of yerba mansa (*Anemopsis californica*). An extensive emergent wetland system is supported by spring flows in the Pahranagat Valley between Hiko and Alamo (Pahranagat NWR).
Lake Valley, Nevada 1 spring system mapped	Wambolt Spring Complex. Mare's tail (*Hippuris vulgaris*) and watercress are the primary aquatic species. Dominant emergent wetland species are Nebraska sedge and spikerush.
Panaca Valley, Nevada 1 spring system mapped	Panaca Big Spring. Algae, the sole aquatic vegetation type, covered about 30 percent of the wet area. Olney's three-square bulrush was the dominant emergent wetland species.
Tule Valley, Utah 4 spring systems mapped	Coyote, South Tule, Tule (4a), and Willow Springs. Horsehair algae and watercress are the dominant aquatic species; Olney's three-square bulrush, Arctic rush, salt grass, and common reed (*Phragmites australis*) are the dominant emergent wetland species.
Fish Springs NWR (Fish Springs Flat), Utah 8 spring systems mapped	Species composition is similar to that described for Tule Valley. Willows, cottonwood trees, and tamarisk also are present.

Woody Riparian

Mountain streams flow for short distances onto the valley floors before being diverted for agriculture or infiltrating into coarse outwash materials on valley side slopes. Surface water from the mountain snowpack and groundwater from springs contribute to the base flows of these perennial streams (see Section 3.3, Water Resources). Examples of mountain streams with well developed bands of riparian vegetation include Cleve Creek on the east side of the Schell Creek Range and Snake Creek, Lehman Creek, Baker Creek, and Big Wash that drain from watersheds in GBNP on the east side of the Snake Range. Woody riparian species occur in narrow bands adjacent to perennial stream reaches.

Example riparian woody species include narrowleaf cottonwood (*Populus angustifolia*), Fremont cottonwood (*Populus fremontii*), willows (*Salix* spp.), chokecherry (*Prunus virginiana*), and water birch (*Betula occidentalis*) (GBNP 2007). A tall riparian shrubland lines the channel of larger regional stream systems (Meadow Valley Wash, Muddy River) in the southern portion of the region of study. These riparian species include cottonwoods, various willow species, and tamarisk (*Tamarix* spp.). These riparian areas have been distinguished as a distinct ET (DeMeo et al. 2008) (see next section).

Evapotranspiration Areas and Phreatophytes

ET areas are ground surface locations where groundwater is discharged (lost to the atmosphere) from plant transpiration, and evaporation from soils and open water bodies. The ET areas within individual hydrologic basins were mapped as an input variable for estimating groundwater discharge (see Section 3.3, Water Resources). ET rates are an essential input to groundwater recharge and discharge budgets, which are in turn used to define sustainable groundwater yields. A variety of reconnaissance studies have been conducted to estimate ET rates from major water supply basins (Harrill et al. 1988; Nichols 2000).

Evapotranspiration (ET): Water lost to the atmosphere from the ground surface, evaporation from the capillary fringe of the groundwater table, and the transpiration of groundwater by plants whose roots tap the capillary fringe of the groundwater table. Source: USGS 2010.

To estimate ET, the amount of water entering the atmosphere from vegetation leaves must be included. Transpiration is the loss of water from the leaves of plants as the result of cellular respiration, and as a response to high atmospheric temperatures and low relative humidity. Water is withdrawn from the soil root system and transported through the stems and branches to the leaves. Water transported upward from the roots replaces water lost from the leaves through pores called stomata.

ET Area: An area of similar vegetation composition and density with similar evapotranspiraton rates.

Certain plants, called phreatophytes, are capable of withdrawing water from the groundwater through a deep and extensive root system. The plants then release a fraction of that water to the atmosphere. There are various definitions for phreatophytes: 1) they are plants dependent on groundwater as a moisture source (Robinson 1958; Busch et al. 1992); 2) they grow where there is insufficient precipitation and thus require groundwater for survival (Naumburg et al. 2005); 3) they habitually obtain their water supply from the saturated zone (Le Maitre et al. 1999); 4) they obtain at least some water from shallow groundwater (Cooper et al. 2006) and through root system adaptations they normally reach and consume groundwater. Plants usually classified as phreatophytes access groundwater by deep roots and can achieve high transpiration rates even during times of low precipitation (Busch et al. 1992; Dileanis and Groeneveld 1989; Le Maitre et al. 1999; Naumburg et al. 2005).

Transpiration: Evaporation of water from plant leaves. The rate of evaporation is affected by temperature, relative humidity, and wind and air movement. Source: USGS 2010.

The phreatophyte shrub greasewood (*Sarcobatus vermiculatus*) is a key indicator of relatively shallow groundwater depths in the Great Basin. Studies of root depths of this shrub species in relation to groundwater depth indicate that rooting depths range from the soil surface to greater than 50 feet (Meinzer 1927; Robinson 1958). Recent studies in the Snake, Spring, and White River valleys (Moreo et al. 2007; Devitt et al. 2011) indicate that depth to groundwater ranged between 10 and 45 feet on sites dominated by greasewood. Greasewood is highly adapted to utilizing water from precipitation as well as groundwater because of the distribution of its root system from near the soil surface down to the groundwater capillary fringe. The sources for plant respiration and growth vary seasonally. Micro-meteorological studies of plant transpiration losses and evaporation from adjacent soils indicated that greasewood shrubs first consumed available shallow soil moisture during the early part of the growing season. As surface soils dried out, the shrubs increasingly transpired water from groundwater source and groundwater depths declined seasonally (Nichols1993; Moreo et al. 2007).

Capillary Fringe: The subsurface layer in which groundwater seeps up from a water table by capillary action to fill pores.

Three stands of an unusual Rocky Mountain juniper "swamp cedar" community type occur in Spring Valley. Two of these three stands are described by Charlet (2006) in a study of interbasin water transport in Spring Valley. The more northern (north of U.S. Highways 6 and 50) stand is approximately 1.5 square miles, and the southern (south of U.S. Highways 6 and 50) stand occupies about 2.5 square miles. These two stands are part of the BLM-NV Swamp Cedar ACEC (see further discussion in Section 3.14, Special Designations). The third stand of "swamp cedar" is located in the vicinity of Shoshone Ponds in southern Spring Valley, and is part of the BLM-NV Shoshone Ponds ACEC. Charlet (2006) reports that common shrub associates include greasewood, yellow rabbitbrush (*Chrysothamnus viscidiflorus*), rubber rabbitbrush, shadscale saltbush, and Basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*). Native grasses associated with these woodlands include basin wildrye (*Leymus cinereus*), saltgrass, and alkali cordgrass (*Spartina gracilis*). Permanently wet areas around springs may support arctic rush (*Juncus arcticus*) and bulrush (*Scirpus* sp.). Depending on conditions, the community structures vary from an open park-like savanna to dense woodlands and thickets.

The "swamp cedar" communities in Spring Valley are unique to the low elevation landscape that occurs in seasonally flooded valley bottoms. Rocky Mountain juniper is not assigned a wetland indicator status by the USDA, as it is considered an upland species throughout its range. The distinct low-elevation populations of swamp cedars occurring in the GWD Project area are unique biological systems occurring on the edge of this species' geographic distribution. While no quantitative research has been conducted on these populations to determine the ecological factors that allow them to exist at these low-elevation sites, it is hypothesized that their occurrence is the result of more water being available to the trees than is available solely from precipitation. **Table 3.5-6** lists plant species commonly occurring in ET areas mapped for this project that can function as phreatophtyes, depending upon the availability of shallow groundwater. Big sagebrush, four wing saltbush, shadscale saltbush, rubber rabbitbrush, and greasewood can exploit shallow groundwater systems and therefore function as phreatophytic plants. These species can take advantage of groundwater when present but also can tolerate periods of low water availability (Barbour et al. 1987).

Table 3.5-6 Occurrence of Representative Species within Evapotranspiration Areas Mapped in the GWD Project Region of Study

Species	Life Form	Wetland/Meadow	Basin Shrubland	Riparian Shrubland
Big sagebrush (Artemisia tridentata ssp. tridentata)	Shrub		X	X
Fourwing saltbush (Atriplex canescens)	Shrub		X	X
Shadscale saltbush (Atriplex confertifolia)	Shrub		X	
Saltgrass (Distichlis spicata)	Herb	X	X	X
Rubber rabbitbrush (Ericameria nauseosa)	Shrub		X	X
Basin wildrye (Leymus cinereus)	Herb	X	X	X
Cottonwoods (Populus ssp.)	Tree	X		X
Willows (Salix ssp.)	Shrub	X		X
Greasewood (Sarcobatus vermiculatus)	Shrub		X	X
Alkali sacaton (Sporobolus airoides)	Herb	X	X	X

A first step for estimating water lost to the atmosphere from plant transpiration is to map the distribution and abundance of phreatophyte shrub and herbaceous communities within a hydrologic basin. If the annual transpiration rate can be determined for the dominant phreatophyte species, then the transpiration losses over large areas of similar vegetation composition and density (ET) can be calculated. In groundwater supply reconnaissance studies conducted from the 1940s through 1960s, phreatophyte shrubs that were transpiring groundwater were identified by examining the relative shrub foliage vigor during the summer months (after winter precipitation soil moisture had been evaporated, or taken up by plants). Actively photosynthesizing (green) foliage was considered to be sustained by groundwater. Shrubs with low or no photosynthetic activity (often dormant) were assumed not to be sustained by groundwater. Ground reconnaissance estimates of phreatophyte foliar activity were augmented by the use of multi-spectral satellite imagery to identify and map photosynthetically active vegetation over large areas, based on infrared light reflectance (Nichols 2000). Satellite imagery also allows examination of vegetation in multiple seasons and multiple years. This multiple sampling approach provides a tool for assessing the variability of phreatophyte and other vegetation dependence on underlying groundwater.

The USGS (Smith et al. 2007) used multiple sources of information to map nine ET areas within several of the region of study basins (Snake, Spring, White River, Lake, and Cave) (**Table 3.5-7**). This mapping was a component of the BARCAS studies to estimate the groundwater resources within these basins. The ET boundaries were established from: 1) existing land cover mapping SWReGAP; 2) analysis of certain infrared wavelength bands within LandSat Thematic Mapper Imagery to identify photosynthetically active vegetation; 3) field measurements of ET losses; and 4) inspection of relative vigor of phreatophyte and other vegetation from ground reconnaissance within each basin. The ET areas were aggregated so that relative loss of water from transpiration and evaporation could be estimated for individual hydrologic basins.

Table 3.5-7 Evapotranspiration Areas Established within the GWD Project Hydrologic Region of Study

USGS Vegetation ET (Smith et al. 2007)	Characteristic Species (Smith et al. 2007)	Range of depths to groundwater (feet) (Smith et al. 2007)	SNWA ET[1] (SNWA 2007)	Combination of units for EIS display and analysis
Marshland	Densc wetland vegetation – tall reeds, rushes, some grasses.	Less than 1; soil nearly always saturated	Wetland/Meadow	Wetland/Meadow
Meadowland	Dominated by short, dense perennial grasses; may include shrubs and trees (e.g., Rocky Mountain juniper, cottonwoods).	Less than 5 feet; soil typically moist except late summer	Wetland/Meadow	Wetland/Meadow
Grassland	Dominated by short perennial grasses, including salt grass, sod and pasture grasses. Includes desert shrubs and occasional trees (Rocky Mountain juniper, cottonwoods).	Less than 8 feet; soil damp to dry	Wetland/Meadow	Wetland/Meadow
Dense Desert Shrubland	Mixture of desert shrubs (greasewood, rabbitbrush, shadscale, big sagebrush, and saltbush). Vegetation cover greater than 25 percent.	3 to 50	Phreatophyte/ Medium Vegetation	Basin Shrubland
Moderately Dense Desert Shrubland	Mixture of desert shrubs (greasewood, rabbitbrush, shadscale, big sagebrush, and saltbush). Vegetation cover ranges from 10 to 30 percent.	3 to 50	Phreatophyte/ Medium Vegetation	Basin Shrubland
Sparse Desert Shrubland	Mixture of desert shrubs (greasewood, rabbitbrush, shadscale, big sagebrush, and saltbush). Vegetation cover ranges from 5 to 15 percent.	3 to 50	Bare Soil/Low Vegetation	Basin Shrubland
Recently Irrigated Cropland	Irrigated cropland.	Generally greater than 5	Agriculture	Agriculture
Moist Bare Soil	Moist playa – no vegetation.	At or near the soil 4	Playa	Playa
Dry Playa	Dry playa – no vegetation.	Greater than 10	Playa	Playa
No Category	Not Applicable.	Greater than 10	Wetland/Meadow	Wetland/Meadow (Riparian Shrubland)

[1] Phreatophyte/Medium Vegetation encompasses shrublands with >20% cover within ET areas, and Bare Soil/Low Vegetation encompasses shrublands with <20% cover within ET areas.

The SNWA mapped ET areas in the same hydrologic basins using similar methods to those of the USGS (BIO-WEST 2007a; SNWA 2009). The SNWA ET areas were divided into five categories; the correlation of these units with those identified by the USGS is displayed on **Table 3.5-7**. SNWA also included the riparian shrublands along Meadow Valley Wash and the Muddy River in the wetland/meadow ET area.

For purposes of mapping the vegetation ET areas for impact analysis in this EIS, the three herbaceous meadow types (marshland, meadowland, grassland) defined by the USGS were combined into a single wetland/meadow ET area (consistent with a similar consolidation by SNWA) (**Table 3.5-6**). Depth to water under all three areas is less than 10 feet, with decreasing soil moisture at or near the surface from marshland to grassland.

The three USGS shrub density classes (dense, moderate, sparse) were consolidated into a single ET area called Basin Shrubland. The species composition of these three shrubland ET areas is similar; the primary difference among them is the relative density of shrubs. The Riparian Shrublands mapped along the Meadow Valley and Muddy River drainages (DeMeo et al. 2008) were distinguished from Basin Shrublands because of the differences in species composition and water supply sources (surface and groundwater). Areas currently used for irrigated agriculture are mapped, based on recent satellite imagery.

Figures 3.5-3 and **3.5-4** illustrate the location of the ET areas, and the vegetation communities that comprise these areas. The same ET areas are illustrated by individual basin in Section 3.3, Water Resources. **Figure 3.5-5** illustrates the relationship of groundwater depth to the occurrence of ET areas in Spring and Snake valleys.

Special Status Plant Species

There is one known Nevada population of Ute ladies'-tresses in the Panaca Springs near Panaca in Lincoln County (Fertig et al. 2005; BIO-WEST 2007c). There also is a record of Ute ladies'-tresses from the Utah portion of Snake Valley in Juab County. BIO-WEST (2007a,b,c) conducted habitat surveys for this species at 32 springs and spring complexes in lower Snake Valley and Spring Valley in Nevada and Utah. Populations were not found in these surveys, but suitable habitat was identified.

Culturally Significant Plants

The Confederated Tribes of the Goshute Reservation (Steele 2010a), the Paiute Indian Tribe of Utah (Martineau 2010), and the Ely Shoshone (Ely Shoshone 2010) submitted lists of plants to the BLM that are culturally significant to members of these tribes. These plants have traditional values for food, medicine, and tools. The lists were combined to identify important plants to all three Tribes, as well as plants unique to each Tribe (**Table 3.5-8**). The plant species known to be dependent, or partially dependent, on surface and groundwater sources are noted. In addition, general plant species occurrences by major land cover types within the study area are indicated. The Tribal correspondence concerning culturally significant plants is contained in **Appendix F3.5**.

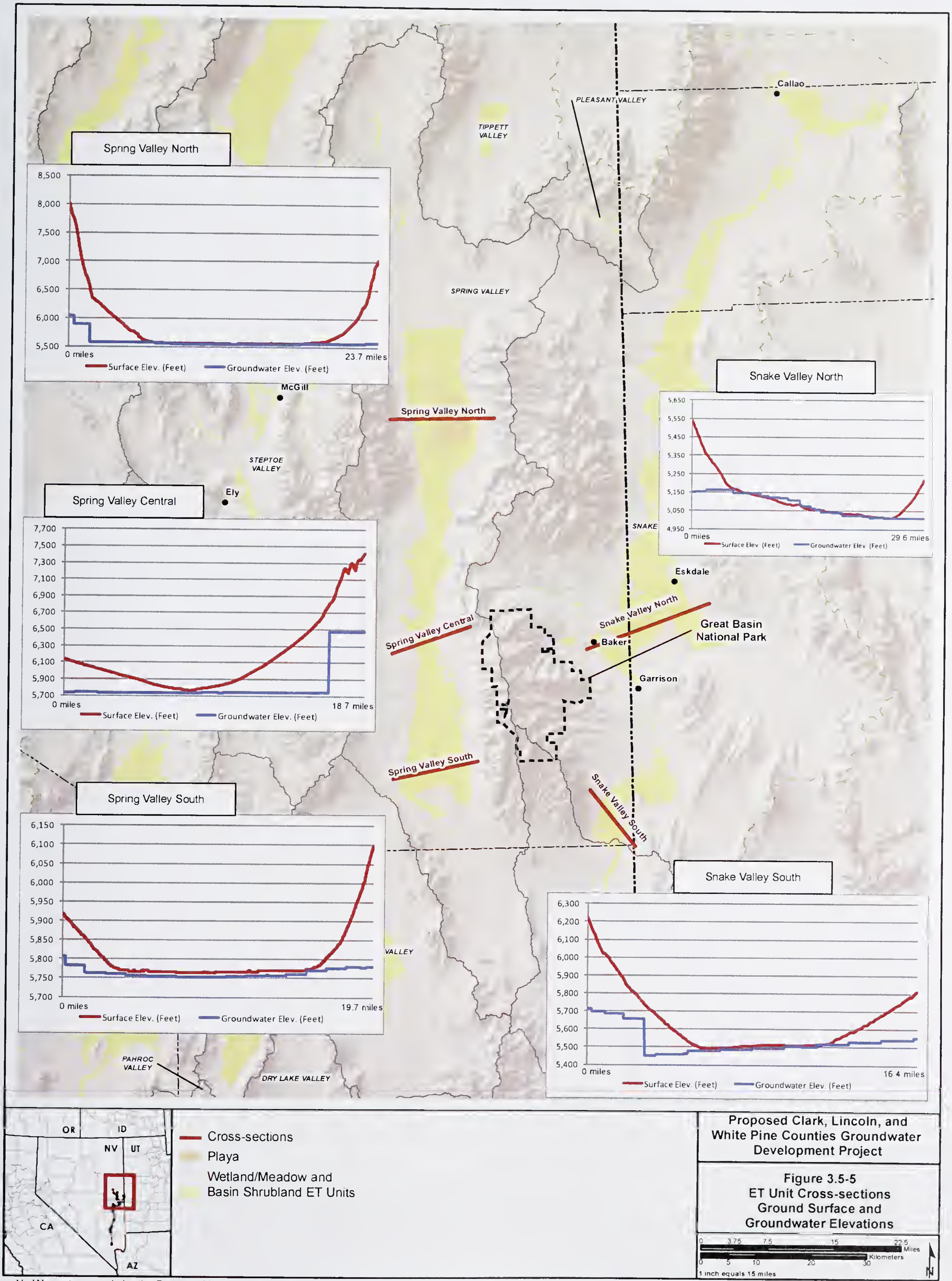


Figure 3.5-5
ET Unit Cross-sections
Ground Surface and
Groundwater Elevations

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

Table 3.5-8 Culturally Significant Plants

Scientific Name	Common Name	Tribe			Occurrence by Land Cover Type						
		Paiute Indian Tribe of Utah	Confederated Tribes of the Goshute Reservation	Ely Shoshone	Greasewood/ Salt Desert Shrubland	Mojave Mixed Desert Shrubland	Perennial Grassland	Marshland	Pinyon-Juniper Woodland	Riparian Woodland and Shrubland	Sagebrush Shrubland
FORB/HERB											
Achillea millefolium	Common yarrow	X			X	X	X		X		X
Agastache urticifolia	Nettleleaf giant hyssop		X	X					X	X	
Allium bisceptrum	twincrest onion	X	X	X		X		X		X	
Allium nevadense	Nevada onion			X					X		
*Anemopsis californica**	Yerba mansa	X				X					
Anethum graveolens (Peucedanum graveolens)	Dill		X	X							
Apios sp.	Groundnut	X						X			
Apocynum androsaemifolium	Spreading dogbane		X	X						X	
Apocynum cannabinum	Indianhemp	X		X			X	X			
Argemone munita	Flatbud prickly poppy			X		X					
Artemisia campestris	Field sagewort	X			X				X	X	X
Artemisia dracunculus	Tarragon	X						X		X	
Artemisia ludoviciana	White sagebrush	X			X		X		X		X
Asclepias fascicularis	Mexican whorled milkweed	X						X		X	
*Asclepias speciosa**	Showy milkweed	X						X		X	
Asclepias tuberosa	Butterfly milkweed	X					X		X	X	
Atriplex truncata	Wedgescale saltbush		X	X	X						
Balsamorhiza hookeri	Hooker's balsamroot		X	X					X	X	X
Balsamorhiza sagittata	Arrowleaf balsamroot	X	X	X						X	
Calandrinia ciliata	Fringed redmaids	X					X	X		X	
Calochortus flexuosus	Winding mariposa lily			X	X	X					X

Table 3.5-8 Culturally Significant Plants (Continued)

Scientific Name	Common Name	Tribe			Occurrence by Land Cover Type						
		Paiute Indian Tribe of Utah	Confederated Tribes of the Goshute Reservation	Ely Shoshone	Greasewood/ Salt Desert Shrubland	Mojave Mixed Desert Shrubland	Perennial Grassland	Marshland	Pinyon-Juniper Woodland	Riparian Woodland and Shrubland	Sagebrush Shrubland
Calochortus nuttallii	Sego lily		X	X			X		X		X
Camassia scilloides?	Camas			X				X		X	
*Camassia quamash**	Small camas		X	X				X		X	
Carum gairdneri	Gairdner's yampah [1]		X	X				X	X	X	
Castilleja angustifolia?	Indian paintbrush			X			X	X	X	X	X
Chenopodium atrovirens	Pinyon goosefoot			X		X			X		X
Cirsium eatoni	Eaton's thistle		X	X					X		
Cirsium undulatum	Wavy leaf thistle		X	X			X		X	X	X
Claytonia caroliniana	Carolina springbeauty		X	X			X		X	X	
Cymopterus longipes	Longstalk springparsley		X	X					X		X
Dichelostemma capitatum	Bluedicks	X					X		X		X
Dracocephalum parviflorum	American dragonhead		X	X					X		X
Echinacea angustifolia	Blacksamson echinacea	X					X		X		X
*Erigeron philadelphicus**	Philadelphia fleabane	X							X	X	X
Eriogonum jamesii	James' buckwheat		X	X		X					X
Eriogonum umbellatum	Sulfur-flower buckwheat		X	X		X	X		X		X
Erythronium grandiflorum	Yellow avalanche-lily		X	X					X	X	
Fragaria vesca	Woodland strawberry	X							X	X	
Fragaria virginiana	Virginia strawberry	X							X	X	
Fritillaria affinis	Checker lily	X							X		
Fritillaria pudica	Yellow fritillary		X	X					X	X	
Ipomopsis aggregata	Scarlet gilia		X	X					X	X	X
Heliomeris longifolia	Showy goldeneye		X	X			X				X

Table 3.5-8 Culturally Significant Plants (Continued)

Scientific Name	Common Name	Tribe			Occurrence by Land Cover Type						
		Paiute Indian Tribe of Utah	Confederated Tribes of the Goshute Reservation	Ely Shoshone	Greasewood/ Salt Desert Shrubland	Mojave Mixed Desert Shrubland	Perennial Grassland	Marshland	Pinyon-Juniper Woodland	Riparian Woodland and Shrubland	Sagebrush Shrubland
Helianthus annuus	Common sunflower	X	X	X	X	X	X		X	X	X
Ipomopsis aggregata (same as above)	Scarlet gilia, scarlet trumpet, skyrocket		X	X					X	X	X
*Iris missouriensis**	Rocky Mountain iris	X								X	
Lewisia rediviva	Bitter root	X									
Linum lewisii	Lewis flax			X	X	X	X			X	X
*Lobelia cardinalis**	Cardinal flower	X						X		X	
Lobelia siphilitica	Great blue lobelia	X						X		X	
Lomatium dissectum var. *multifidum*	carrotleaf biscuit root		X	X					X		X
Lomatium multifidum	Biscuit root		X	X					X		X
Agastache urticifolia	Nettleleaf giant hyssop		X	X					X	X	
Sphaeralcea munroana	Munro's globemallow		X	X							X
*Mentha arvensis**	Wild mint		X	X			X			X	
Mentha Canadensis	Mint		X	X			X			X	
Mentzelia dispersa	Bushy blazingstar	X				X			X		X
Monarda fistulosa	Wild bergamot	X							X		X
Nicotiana attenuata	Coyote tobacco		X	X	X	X			X		X
Oenothera sp.	Evening primrose	X					X		X		X
Penstemon eatonii	Firecracker penstemon			X					X		X
Penstemon grandiflorus	Large beardtongue	X					X				X
Phlox longifolia	Longleaf phlox			X			X		X		X
Proboscidea parviflora	Doubleclaw	X				X					
Ratibida columnifera	Upright prairie coneflower	X				X	X				
Rumex salicifolius	Willow dock			X				X		X	

Table 3.5-8 Culturally Significant Plants (Continued)

Scientific Name	Common Name	Tribe: Paiute Indian Tribe of Utah	Tribe: Confederated Tribes of the Goshute Reservation	Tribe: Ely Shoshone	Occurrence by Land Cover Type: Greasewood/ Salt Desert Shrubland	Mojave Mixed Desert Shrubland	Perennial Grassland	Marshland	Pinyon-Juniper Woodland	Riparian Woodland and Shrubland	Sagebrush Shrubland
*Sagittaria cuneata**	Arumleaf arrowhead	X						X		X	
*Sagittaria latifolia**	Broadleaf arrowhead	X						X		X	
*Salicornia europaea**	Glasswort		X	X				X		X	
Salicornia herbacea	Brittlewort		X	X	X						
Salvia columbariae	Chia			X	X	X			X		X
Salvia sp.	Chia	X			X	X			X		X
Sisymbrium canescens	Tansy mustard		X	X	X	X	X		X		X
*Trifolium wormskioldii**	Cows clover	X						X			
*Typha domingensis**	Southern cattail	X						X			
*Typha latifolia**	Broadleaf cattail	X	X	X				X			
Urtica dioica	Stinging nettle			X				X		X	
Wyethia amplexicaulis	Mule's ear		X	X					X		X
Zigadenus elegans (Anticlea elegans)	Mountain deathcamas		X	X					X		X
Zigadenus nuttallii	Nuttall's deathcamas		X	X							
CACTUS											
Carnegiea sp.	Saguaro	X									
Hesperoyucca whipplei	Chapparal yucca	X				X					
GRAMINOID											
Achnatherum hymenoides	Indian ricegrass			X			X		X		X
Carex rossii	Ross' sedge	X					X		X	X	X
Elymus elymoides	Bottlebrush squirreltail	X							X		X
Elymus glaucus	Blue wildrye	X			X		X		X		X
Festuca ovina	Sheep fescue	X					X		X		X

Table 3.5-8 Culturally Significant Plants (Continued)

Scientific Name	Common Name	Tribe: Paiute Indian Tribe of Utah	Tribe: Confederated Tribes of the Goshute Reservation	Tribe: Ely Shoshone	Occurrence by Land Cover Type: Greasewood/ Salt Desert Shrubland	Mojave Mixed Desert Shrubland	Perennial Grassland	Marshland	Pinyon-Juniper Woodland	Riparian Woodland and Shrubland	Sagebrush Shrubland
*Hierochloe hirta**	Northern sweetgrass	X						X			
*Juncus arcticus**	Mounatin rush	X		X				X			
*Juncus effusus**	Common rush	X						X			
Leymus cinereus	Basin wildrye			X			X		X		X
Muhlenbergia rigens	Deergrass	X			X	X					
*Phragmites australis**	Common reed			X				X			
Pseudoroegneria spicata	Bluebunch wheatgrass	X									
Schoenoplectus acutus var. *occidentalis*	Tule	X						X			
*Schoenoplectus californicus**	California bulrush	X						X			
*Schoenoplectus pungens**	Common threesquare	X						X			
Schoenoplectus acutus var. *acutus* *	Hardstem bulrush		X	X				X			
Sporobolus airoides	Alkali sacaton	X			X	X					X
*Triglochin maritima**	Seaside arrowgrass		X	X				X			
SHRUB											
Amelanchier alnifolia	Serviceberry (Saskatoon serviceberry)	X	X	X					X		
Arctostaphylos uva-ursi	Kinnikinnick	X									
Artemisia frigida	Prairie sagewort	X			X		X		X		X
Artemisia tridentata	Big sagebrush	X	X	X							X
Atriplex confertifolia	Shadscale saltbush		X	X	X	X					X
Chrysothamnus viscidiflorus	Yellow rabbitbrush				X						X
Ceanothus herbaceus	Jersey tea	X									
Celtis laevigata	Sugarberry	X								X	
Cercis orbiculata	California redbud	X				X				X	

Table 3.5-8 **Culturally Significant Plants (Continued)**

Scientific Name	Common Name	Tribe			Occurrence by Land Cover Type						
		Paiute Indian Tribe of Utah	Confederated Tribes of the Goshute Reservation	Ely Shoshone	Greasewood/ Salt Desert Shrubland	Mojave Mixed Desert Shrubland	Perennial Grassland	Marshland	Pinyon-Juniper Woodland	Riparian Woodland and Shrubland	Sagebrush Shrubland
Cercocarpus ledifolius	Curl leaf mountain mahogany	X							X		
Cercocarpus montanus	Mountain mahogany		X	X					X		
Ericameria nauseosa	Rubber rabbitbrush		X	X	X				X		X
Cornus sericea	Redosier dogwood	X								X	
Cornus sericea ssp. *occidentalis*	Western dogwood	X								X	
Cornus stolonifera[2*]	Redosier dogwood		X	X						X	
Cylindropuntia acanthocarpa	Buckhorn cholla	X				X					
Elaeagnus commutata	Silverberry			X							
Ephedra nevadensis	Nevada jointfir	X			X	X			X		X
Ephedra sp.	Jointfir		X	X	X	X			X		X
Ephedra viridis	Mormon tea	X			X	X			X		X
Ericameria teretifolia	Green rabbitbrush	X			X				X		X
Krascheninnikovia lanata	Winterfat		X	X	X	X					X
Gutierrezia sarothrae	Broom snakeweed	X			X	X			X		X
Juniperus pinchotii	Pinchot's juniper	X							X		
Mahonia nervosa	Cascade barberry	X							X		
Nolina microcarpa	Sacahuista	X				X					
Poliomintha incana	Frosted mint	X				X					
Prosopis glandulosa	Honey mesquite	X				X					
Prosopis glandulosa var. *torreyana*	Western honey mesquite	X				X					
Prosopis pubescens	Screwbean mesquite	X				X					
Prunus americana	American plum	X								X	
Prunus demissa[3]	Chokecherry	X	X	X						X	

Table 3.5-8 Culturally Significant Plants (Continued)

Scientific Name	Common Name	Tribe			Occurrence by Land Cover Type						
		Paiute Indian Tribe of Utah	Confederated Tribes of the Goshute Reservation	Ely Shoshone	Greasewood/ Salt Desert Shrubland	Mojave Mixed Desert Shrubland	Perennial Grassland	Marshland	Pinyon-Juniper Woodland	Riparian Woodland and Shrubland	Sagebrush Shrubland
Purshia tridentata	Antelope bitterbrush	X			X				X		X
Quercus undulata	Scrub oak		X	X		X					
*Ribes aureum**	Golden currant	X						X		X	
Ribes cereum	Wax currant		X	X				X	X	X	
Ribes sp.	Gooseberry or currant			X				X	X	X	
Rosa californica	California wildrose		X	X							
Rosa fendleri[4]	Rose hips		X	X							
Rosa woodsii	Wood's rose	X		X							
Rubus idaeus	American red raspberry	X								X	
Rubus spectabilis	Salmonberry	X								X	
*Salix amygdaloides**	Peachleaf willow	X								X	
*Salix exigua**	Narrowleaf willow	X								X	
Salix lucida	Shining willow	X								X	
Salix scouleriana	Scouler's willow	X								X	
Sambucus nigra ssp. *cerulea*	Blue elderberry			X						X	
Sambucus racemosa	Red elderberry	X								X	
Sambucus sp.	Common elderberry	X								X	
Shepherdia canadensis	Russet buffaloberry	X							X		
Shepherdia sp.	Buffalo berry		X	X					X		
Vaccinium deliciosum	Cascade bilberry	X									
Vaccinium membranaceum	Thinleaf huckleberry	X									

Table 3.5-8 Culturally Significant Plants (Continued)

		Tribe			Occurrence by Land Cover Type						
Scientific Name	**Common Name**	**Paiute Indian Tribe of Utah**	**Confederated Tribes of the Goshute Reservation**	**Ely Shoshone**	**Greasewood/ Salt Desert Shrubland**	**Mojave Mixed Desert Shrubland**	**Perennial Grassland**	**Marshland**	**Pinyon-Juniper Woodland**	**Riparian Woodland and Shrubland**	**Sagebrush Shrubland**
TREE											
Abies concolor	White fir	X									
Abies lasiocarpa	Subalpine fir	X									
Cercis canadensis	Eastern redbud	X								X	
Juniperus communis	Common juniper	X							X		
Juniperus osteosperma	Utah juniper		X	X					X		
Juniperus scopulorum	Rocky Mountain juniper	X							X		
Pinus edulis	Twoneedle pinyon	X							X		
Pinus monophylla	Singleleaf pinyon pine	X	X	X					X		
Pinus ponderosa	Ponderosa pine	X									
*Populus fremontii**	Fremont cottonwood	X								X	
Populus sp.	Aspen	X									
Pseudotsuga douglasii[5]	Douglas-fir	X	X	X						X	
Quercus gambelii	Gambel oak	X							X		
Salix sp.	Willow		X	X				X		X	
Washingtonia filifera	California fan palm	X				X					

[1] Scientific name changed to *Perideridia gairdneri* ssp. *gairdneri* within the USDA PLANTS database.

[2] Scientific name changed to *Cornus sericea* within the USDA PLANTS database.

[3] Scientific name changed to *Prunus virginiana* var. *demissa* within the USDA PLANTS database.

[4] Scientific name changed to *Rosa woodsii* and the common name changed to Woods' rose within the USDA PLANTS database.

[5] Scientific name changed to *Pseudotsuga menziesii* within the USDA PLANTS database.

* Facultative wetland species occur in wetlands 67 to 99 percent of the time and obligate wetland species occur in wetlands >99 percent of the time per the Region 8 National Wetlands Inventory Plant List (USFWS 1988).

3.5.2 Environmental Consequences

3.5.2.1 Rights-of-way

Issues

The following issues for vegetation resources are evaluated for ROW construction and facility maintenance:

- Short-term, long-term, and permanent loss of vegetation communities due to surface disturbance and conversion of natural vegetation to industrial uses, as a result of construction-related activities and operational maintenance.
- Potential introduction or population expansion of noxious and non-native invasive weeds due to surface disturbance.
- Loss of individuals or populations of federally listed, candidate, or special status plant species (including cacti and yucca) due to surface disturbance.
- Accidental wildfires caused by construction equipment or smoking during construction and operation.
- Availability of plant species traditionally used for food and fiber by regional tribes.

Assumptions

The following assumptions were used in the impact analysis for vegetation resources:

- Vegetation community disturbance calculations were based on the proposed construction and operational configurations (footprints) presented for each pipeline, power facility, and ancillary facility ROW in Chapter 2, Proposed Action and Alternatives A through F and Alignment Options 1 through 4.
- Construction disturbances, while temporary in nature, have been defined as "long-term" for all vegetation cover types due to existing vegetation structure and composition, long recovery times, and limiting revegetation factors (e.g., low precipitation rates, soil chemistry constraints, and low levels of soil moisture over most the year for most vegetation communities).
- The mainline pipeline ROW would not be realigned or curved to avoid sensitive plant populations because of the large diameter of the pipeline. Temporary work space along the construction ROW may be narrowed to avoid sensitive resources. Access roads and power line pole locations can be adjusted to avoid sensitive plant populations.
- No woody plant maintenance would be required within the permanent pipeline ROW because of the very slow growth and low stature of shrub, pinyon pine, and junipers.

Methodology for Analysis

Construction surface disturbance impacts by alternative were evaluated according to the following steps:

- The area of vegetation communities and the extent of special status species that would be removed temporarily or permanently during project facility resource construction were estimated, based on SWReGAP cover types and field surveys for special status plants.
- Recovery times for disturbed vegetation communities were estimated from a literature review. Recovery times were based on ecological characteristics, fire response, and climatic factors.
- The risk of weed invasion was estimated from field surveys conducted by SNWA and from a weed occurrence database maintained by the BLM Ely District.
- SNWA would be required to implement a comprehensive COM Plan that would include all future hydrographic basins and all facilities associated with the SNWA GWD Project. The COM Plan includes a requirement for comprehensive monitoring and mitigation program for the entire project that would integrate the various required monitoring and mitigation actions. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation

recommended in this EIS. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary, along with measures to protect vegetation resources from ROW construction and operation activities.

- The BLM RMP Management Actions and BMPs, as well as ACMs available were evaluated to limit the extent and duration of predicted impacts. Additional mitigation measures were recommended to reduce or offset impacts; mitigation measure effectiveness was estimated and a residual impact summary was developed for each impact issue.

3.5.2.2 Proposed Action, Alternatives A through C

Construction and Facility Maintenance

Vegetation Community Surface Disturbance and Restoration

Pipeline, power facility, and ancillary facility construction activities would clear and blade shrub and herbaceous vegetation from the construction ROW. The root systems and dormant seeds would be piled in excavated topsoil along the ROW margins. Excavated soil would then be replaced over the disturbed construction ROW after construction was completed. Disturbed soils within the ROW would be reseeded with an approved seed mixture. **Table 3.5-9** summarizes construction surface disturbance to each cover type for all project facilities. Estimates of vegetation community recovery are based on post-fire responses (see **Appendix F3.5**). A breakdown of surface disturbance by land cover types within the hydrologic basins is contained in **Appendix F3.5**.

Table 3.5-9 Proposed Action and Alternatives A through C – Construction Disturbance, Operational Conversion of Land Cover Types, and Estimated Vegetation Recovery Periods

Land Cover Type	Construction Disturbance (acres)	Operation (Conversion to aboveground industrial uses) (acres)	Estimated Vegetation Community Recovery Time (years)
Agriculture/Developed	9	9	2
Annual Invasive Grassland	30	7	2
Barren	1	0	0
Greasewood/Salt Desert Shrubland	2,983	252	20-50
Marshland	6	6	2-5
Mojave Mixed Desert Scrub	3,052	260	100-200
Perennial Grassland	28	2	5-15
Pinyon-Juniper Woodland	262	26	100-200
Playa	21	1	0
Riparian Woodland and Shrubland	5	5	20-50
Sagebrush Shrubland	5,891	431	20-50
Total	**12,288**	**999**	

Pipeline, power facility, aboveground facility ROW, construction access roads, and temporary construction areas would remove vegetation for the long-term from approximately 12,288 acres. Of this amount, the land cover types that would be most affected include: sagebrush shrubland (48 percent); Mojave mixed desert shrubland (25 percent); and greasewood/saltbush shrubland (24 percent). Installation of aboveground facility and access road ROWs would result in the commitment of approximately 999 acres to long-term industrial uses. These areas would not be restored until after abandonment, which is considered a permanent land use commitment.

Site stabilization and restoration techniques, as presented in the POD (**Appendix E**), would minimize the duration of vegetation disturbance and provide the framework for a successful vegetation restoration program. The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on vegetation resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section. ACMs include topsoil segregation and salvage and an integrated Restoration Plan including a restoration monitoring protocol. These measures are described in

Appendix E, as part of general construction practices, general operation practices, and restoration monitoring. Preservation of intact root systems during grading (ACM A1.20), topsoil, and seedbank protection (ACM A.1.23), and topsoil erosion control measures (ACM A.1.25) would be implemented. Commitments to prepare a detailed Restoration Plan are included in ACM A.1.69 and ACM A.1.70. BLM RMP BMPs regarding vegetation would provide additional protective measures (**Appendix D**).

Post-construction revegetation and restoration of each vegetation cover type back to its baseline structure and composition may vary depending on various factors such as soil mixing, timing and duration of disturbance, topography, slope, soil moisture, and precipitation. Reclamation efforts likely would reestablish an early seral vegetation community within two growing seasons following construction for all herbaceous- and woody-dominated communities; however, full recovery of shrub-dominated and pinyon-juniper woodland communities to baseline structure and composition would take longer due to poor soil and low moisture conditions. The shrub component in these cover types would require 50 to 100 years or more to recover to former height and density. Some plant communities (e.g., winterfat) may not return to a pre-construction density because of specialized soil structure requirements that would be permanently altered by soil removal and replacement during pipeline trench excavation.

BLM RMP BMPs for Soil Resources and Vegetation Resources provide guidance and protection measures for construction and restoration practices. **Appendix D** provides a full list of the BMPs, which include:

- Keep removal and disturbance of vegetation to a minimum through construction site management;
- Resoration requirements include reshaping, re-contouring, and/or resurfacing with topsoil, installation of water bars, and seeding on the contour;
- Generally, conduct reclamation with native seeds that are representative of the indigenous species present in the adjacent habitat. Document rationale for potential seeding with selected nonnative species; and
- An area is considered to be satisfactorily reclaimed when all disturbed areas have been recontoured to blend with the natural topography, erosion has been stabilized, and an acceptable vegetative cover has been established. Use the Nevada Guidelines for Successful Revegetation prepared by the NDEP, the BLM, and the U.S. Department of Agriculture Forest Service (or most current revision or replacement of this document) to determine if revegetation is successful.

SNWA ACMs A.1.69 through A.1.81 provide additional protective measures. Restoration efforts would continue as required by the BLM until SNWA received a written release from the BLM. Some areas would recover more quickly than others; therefore, the BLM would issue incremental restoration releases for segments of the ROW over time.

SNWA would be required to develop a Restoration Plan that addresses how restoration will be accomplished in accordance with BLM RMP management decisions and BMPs, as well as SNWA ACMs. The Restoration Plan would be submitted to the BLM for approval, and implemented through the COM Plan.

<u>Conclusion</u>. Approximately 12,288 acres of native shrublands and woodlands removed or disturbed by construction would require 20 to 200 years for recovery to similar species composition and vertical structure as adjacent undisturbed areas. Approximately 64 acres of annual invasive and perennial grassland and marshland cover types would require from 2 to 15 years for recovery. Approximately 999 acres of natural land cover types would be permanently converted to aboveground industrial uses. Operational maintenance activities are expected to disturb small areas, primarily within the permanent ROW. The area of vegetation communities affected by construction surface disturbance would represent less than 1 percent of the surface area of these cover types within the hydrologic basins occupied by the Proposed Action and Alternatives A through C.

BLM RMP BMPs and SNWA ACMs include measures to salvage and preserve soil and during construction, to follow best practices for revegetation seeding and erosion control, to follow a long-term restoration monitoring program, and to obtain a written release of restoration success from the BLM. These measures provide the framework for meeting the desired conditions for vegetation community types specified in the Ely District RMP within the time frames expected for natural recovery of these communities.

Proposed mitigation measures:

ROW-VEG-1: Native Seed Collection. The SNWA, in consultation with the BLM, would develop a seed collection program for native plant species found within the ROW. These native plant seeds would be used along the ROW corridor in revegetation and reclamation activities, to the extent feasible, to enhance the rate and quality of recovery. Seed from locally adapted native sources would likely provide the greatest rates of establishment and subsequent growth, increasing the success of reclamation efforts. Target species and collection methods would be identified in the Restoration Plan. Effectiveness: This measure would be effective in mitigating impacts to native plant species found within the Project ROW by enhancing re-establishment. Effects on other resources: Seed collection activities would contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife.

ROW-VEG-2: Temporary Fencing or Closure to Livestock Grazing. The SNWA would conduct pre-construction surveys to determine areas of livestock use within and adjacent to the construction ROW where application of temporary fencing or closure would be needed for revegetation species establishment. The results of these surveys would be provided to the BLM for review and approval. Revegetation areas would be rested from grazing for two full years or until BLM determines that reclamation meets BLM RMP standards. Effectiveness: Temporary fencing or closure would be effective in improving the stabilization and persistence of reseeded areas in the short-term. In the long-term, annual precipitation from year to year, and the seasonal distribution of livestock within the allotment would determine the survival of reseeded plants. Effects on other resources: Temporary fencing would also limit wild horse access to forage inside fenced areas. Big game species would not likely be deterred by temporary livestock fencing. Temporary fencing in riparian areas could improve the recovery rate of shrubs and herbs that assist in stabilizing channel banks.

Residual impacts include:

- Long (20 to 200 years) restoration periods for shrublands and woodlands on 12,288 acres of disturbed ROWs because of sparse and uncertain precipitation, and soil-induced growth constraints (salinity, alkalinity, shallow soil depths).
- Permanent removal of shrubland (primarily sagebrush shrubland, greasewood/salt desert shrubland, Mojave mixed desert scrub) from approximately 999 acres required for permanent aboveground facilities.
- An unknown fraction of some disturbed communities would not recover to previous composition and density because of specialized soil requirements (e.g., winterfat on hardpan/caliche soils within the greasewood/salt desert shrubland type).

ACMs for Noxious Weeds

- **A.1.82** SNWA will prepare and submit an integrated Weed Management Plan to the BLM for approval before construction begins. Noxious weeds will be controlled during and following construction activities.
- **A.1.83** ROW areas with pre-existing noxious weed infestations will be treated with a BLM-approved control method, two to three years prior to the start of construction activities, as feasible.
- **A.1.84** Borrow or fill material be inspected by a qualified biologist or weed scientist to ensure it is free of noxious weeds or others in the approved Integrated Weed Management Plan for the project.
- **A.1.85** Organic products used during construction, restoration, operations, maintenance, or for stabilization will be certified free of plant species listed on the Nevada noxious weed list or specifically identified in the BLM approved Integrated Weed Management Plan for the project.
- **A.1.86** Vehicles and equipment will be cleaned with a high pressure washer to prevent or minimize the introduction or spread of noxious weeds.

  A.1.87 Specific vehicle washing stations will be designated within the ROW for vehicle and equipment washing. Growth of noxious weeds in that area will be treated.
- **A.1.88** SNWA or its certified licensed contractor will submit a Pesticide Use Proposal to the BLM before application of any herbicide. A Pesticide Application Record will be produced following the application.
- **A.1.89** Herbicides will not be sprayed within or around an exclusion area containing sensitive resources. Removal shall be accomplished by alternative method(s) approved by the BLM.

Spread and Introduction of Noxious and Non-native Invasive Weed Species

The prevention of the spread of noxious and non-native invasive weed species and the eradication of known populations are high priorities of Nevada, Utah, and the BLM. Vegetation removal and soil disturbance during construction would create optimal conditions for the establishment of weed species. Construction equipment travelling from weed-infested areas into weed-free areas could disperse weed seeds and propagules, resulting in the establishment of noxious weeds in previously weed-free locations.

BLM (2010) prepared a noxious and invasive weeds risk assessment for the GWD Project (**Appendix F3.5**). The Ely District weed inventory indicated that infestations of 11 listed weeds were located within 1,000 feet of the proposed ROWs; infestations of 14 listed weed species were located within 3 miles of the ROWs along roads or drainages. Several of these species are highly persistent and spread in patches from underground rhizomes. Examples include Russian knapweed (*Acroptilon repens)* and tall whitetop (*Lepidium latifolium).* These species are highly resistant to herbicide treatment. The assessment concluded that the risk of noxious/invasive weeds spreading into the project is "High – Heavy infestations of noxious/invasive weeds are located within or immediately adjacent to the project area. GWD Project activities, even with preventive management actions, are likely to result in the establishment and spread of noxious/invasive weeds on disturbed sites throughout much of the project area." The assessment indicates that facilities would be located in several currently weed-free areas, including the power line routes across the Schell Range between Steptoe and Spring valleys; the pipeline lateral from Lake Valley to Snake Valley; the east side of the Fortification Range; the pipeline spur route to Cave Valley; and the main pipeline route that crosses Muleshoe, Dry Lake, and Delamar valleys. The assessment notes that several recent fires have expanded the dominance of cheatgrass and red brome throughout the burn areas. These fires have occurred in the southern portion of Lincoln County in Pahrangat Valley. Approximately 34 acres of the construction ROW have been directly impacted by these fires and likely have non native invasives present in higher densities than unburned areas. An increase of red brome or cheatgrass could alter the fire regime throughout the project area and increase the fire frequency. This may impact native vegetation. SNWA also sponsored weed surveys along the ROWs.

The BLM noxious and invasive weed risk assessment (**Appendix F3.5**) includes a list of measures to be included in an Integrated Weed Management Plan within the project Construction, Operation, and Maintenance Plan that would be approved by the BLM Weed Coordinator. Example measures include requirements for removal of manually controlled weeds; use of weed-free seed mixtures and mulches; use of weed-free soil from borrow areas; the use of equipment wash stations to prevent weed spread; minimization of overall surface disturbance; stockpiling of weed-infested soils to prevent spread; avoidance of weed contamination from water sources used for fire suppression; herbicide management to prevent contamination of water bodies and unintended effects on special status species, residences, and recreation areas; selection of revegetation species capable of outcompeting weeds; and project proponent responsibilities for monitoring and controlling weeds within the ROW and for infestations that spread outside the ROW.

SNWA applicant-committed weed management measures (ACMs A.1.5, A.1.26, A.1.35, A.1.82 through A.1.89, and A.2.12 [**Appendix E**]) are consistent with the preventive measures and proponent control responsibilities outlined in the BLM noxious and invasive weed risk assessment.

Conclusion. The proposed ROWs for 306 miles of buried water pipelines and 323 miles of overhead power lines are at high risk for invasion by

ACM for Special Status Plants

- **A.5.9** Pre-construction surveys during the blooming or fruiting season will verify plant identification. Locations of sensitive plants will be recorded for salvage or seed collection.
- **A.5.10** Construction activities will avoid any identified sensitive plant populations within the ROW when possible.
- **A.5.11** If sensitive plant species cannot be avoided, SNWA will implement plant or seed salvage before construction.
- **A.5.12** SNWA will consult with the BLM on appropriate plant and/or seed salvage if previously unknown special status plant species are discovered within the ROW.
- **A.5.13** The on-site biological monitor can temporarily halt non-emergency construction activities if protected plant species are discovered within the ROW during construction.
- **A.5.14** SNWA will avoid exclusion areas created for sensitive plants when spraying herbicides.
- **A.5.15** Construction practices will be modified to avoid known Blaine's fishhook cacti identified within the ROW in Dry Lake Valley.

noxious and non-native weed species. Construction and operational maintenance equipment travelling from weed-infested areas into weed-free areas could disperse weed seeds and propagules, resulting in new weed establishment. SNWA would implement a variety of measures to be included in an integrated weed management plan. These measures include management of weed contaminated topsoil, pre-construction weed treatments, and equipment wash stations to prevent the transport of weed plants and seeds along the ROW into new areas. SNWA would continue to monitor and control weeds within the ROW in accordance with overall restoration responsibilities.

Proposed mitigation measures:

The BLM noxious and invasive weed risk assessment states that "green stripping" should be considered as a part of an integrated weed control plan. Green stripping involves planting revegetation species (usually fast growing non-native grasses with low livestock forage values) on disturbed surfaces that are at high risk of weed invasion from adjacent noxious and invasive weed populations. The purpose of this type of revegetation procedure is to prevent the spread of weeds through competition by seeded species and to provide a green firebreak during the early fire season to help limit the spread of wildfires. Green stripping can reduce plant diversity, wildlife habitat suitability, and the recovery of shrublands over the long term. The appearance of a wide ROW dominated by herbaceous species can strongly contrast with adjacent shrublands. To provide flexibility in addressing both the risks of weed invasion and wildfires, while accounting for other resource values, additional mitigation measure ROW-VEG-3 would include the use of green stripping revegetation methods in areas where weed invasion and wildfire risks are high, and the reductions in other resource values (wildlife habitat, grazing, visual resources) can be accommodated under current and future BLM land management actions.

ROW-VEG-3: Green Stripping. SNWA, in consultation with the BLM, would develop a green stripping revegetation prescription where BLM and SNWA preventive and control measures may be inadequate to mitigate risks of weed invasion and wildfire. Green stripping is defined as ROW revegetation with fast-growing herbaceous species that can outcompete annual and perennial weeds and can provide a green firebreak. Locations where this measure may be applied would be identified in the Restoration Plan, Integrated Weed Management Plan, and Fire Prevention Plan, and approved by the BLM Visual Resource Management Coordinator. For example, it would be applied primarily to Great Basin Desert low elevation bottomlands, with limited applications to open evergreen woodlands (due to low risk for weed invasion) and Mojave Desert lowlands (due to low risk as a fire disturbance ecosystem). Effectiveness: This measure may be highly to moderately effective in reducing the spread of annual weeds into the ROW from adjacent areas. Effects on other resources: The extent and number of locations where this measure may be applied may be limited by the management considerations for other resources. Application may require evaluation for management consistency for other resource values including wildlife habitat and grazing. To minimize visual resource impacts, the green stripping prescription shall avoid straight line seeding, and the seed mix shall contain shrubs and grasses with plant and structural diversity to harmonize with the existing colors and textures of surrounding vegetation to the extent feasible. Where VRM is a priority (within 1,000 feet adjacent to scenic byways U.S. 50/6/93, at the junction of U.S. 50/6/93, and in Cave and Delamar Valleys, other BLM BMPs and ACMs shall be utilized first to mitigate fire risk and weed infestations.

Residual impacts include:

- Implementation of these weed control and management methods could prevent expansion of existing weed populations into new areas, but may be insufficient to control highly herbicide-resistant perennial weed species that are already established within, or adjacent to the ROWs.

Cacti and Yucca, Special Status Plants

Approximately 150,000 cacti and yucca plants have been inventoried in the construction ROW in the Las Vegas, Garnet, Hidden, Coyote Springs, Delamar, Pahranagat, and Dry Lake valleys. Cacti and yuccas would be salvaged and replanted (ACMs A.1.71 through A.1.78, A.1.80). Excavated plants would be brought to nursery areas and maintained until the next suitable planting season. Salvaged plants would be replanted back into the ROW and watered. In addition to other exceptions, Joshua trees (*Yucca brevifolia*) and banana yucca (*Yucca baccata*) over 6 feet tall, and all cacti and yucca less than 1 foot tall (with the exception of special status species) would not be salvaged (ACM A.1.71).

Based on recent field inventories, surface disturbance associated with pipeline, power facility, and/or construction access roads would remove individuals of five BLM and/or USFS special status plant species within ROW construction areas and would remove suitable habitat for four BLM and/or USFWS (Candidate) additional species (**Table 3.5-2**). SNWA would salvage topsoil and implement avoidance, transplant, and seed collection measures, depending on the species and location within the ROW. None of these species are federally listed by the USFWS and there are multiple (five or more) known populations of each of these species in Nevada and adjacent Utah (NNHP 2010).

Protection measures for special status plants include pre-construction species-specific surveys, avoidance and minimization practices, and salvage techniques (ACMs A.5.9 through A.5.15). To reduce the long-term loss of individual plants as a result of pipeline construction activities and access road usage, specific locations of sensitive plants, based on the BLM sensitive plant list in effect at the time, will be recorded for subsequent salvage or seed collection. Blaine's fishhook cactus individuals located in the construction ROW would be avoided, or salvaged and transplanted immediately into suitable adjacent habitat on BLM land that will not be disturbed. Impacts to the white bearpoppy, threecorner milkvetch, and Las Vegas buckwheat would be limited to loss of suitable habitat.

Conclusion. Several thousand yucca and cacti would be salvaged from the ROWs over a distance of approximately 100 miles, retained in nurseries along the ROW, and replanted and watered in the next appropriate planting season. Mature Joshua trees and immature cacti would not be salvaged, and therefore would be removed from existing plant populations along the ROW. Criteria that would be used to determine which cacti and yucca would be salvaged is listed in **Appendix E**, ACM A.1.71. Transplanting and seed gathering of special status plant species would assist in restoration of disturbed sites, but would not likely replace existing populations at an equivalent level. The net reduction in individuals and seeds of directly affected special status plant species is not likely to lead to future federal listings because there are five or more populations of these species elsewhere in Nevada and Utah.

Many species of cacti and yucca potentially impacted by the GWD Project - which include sagebrush cholla (*Grusonia pulchella)*, pincushion cactus (*Pediocactus* sp.), Great Basin fishhook cactus (*Sclerocactus pubispinus)*, and Blaine fishhook cactus (*Sclerocactus spinosior* spp. *blainei*) - may be suitable candidates for salvage and relocation as survival rates in the Great Basin are generally good (Abella and Newton 2009). Studies of *Opuntia basilaris* (Newton 2001) and *Ferocactus cylindraceus* indicate high success rates for both species after 2 years with 92 percent survival for *O. basilaris* and 85 percent survival of *F. cylindraceus*. Eighteen years of monitoring data for Knowlton's cactus in New Mexico similarly show good success rates with 41 to 65 percent survival on average (Sivinski and McDonald 2007). Other research indicates that Saguaros, ocotillos, and barrel cacti can be transplanted with success (Archuleta and Dhruv 1995; Harris et al. 2004), except during the winter rainy season when cool temperatures and moisture promotes decay in fresh transplants.

Proposed mitigation measures:

ROW-VEG-4: Special Status Plant Species Establishment. In addition to salvaging and transplanting special status species found in the ROW for tier 1 or subsequent tier construction activities, the SNWA would grow additional plants from seed (collected from individuals prior to salvage) or by grafting (from the salvaged plants) to enhance the new, transplanted populations. Seed collection for this effort would occur over multiple years prior to plant salvage. Specific special status plant species and collection methods would be identified in the Restoration Plan. Effectiveness: This measure would be effective in mitigating impacts to special status plant species found within the Project ROW by enhancing re-establishment. Effects on other resources: Seed/plant collection activities would contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife.

ROW-VEG-5: Blaine's Fishhook Cactus Surveys. The SNWA would begin Blaine's fishhook cactus (*Sclerocactus blainei*) surveys as soon as possible after project design and engineering is complete; conducting the surveys within known and potential habitat during the next appropriate season for plant identification. The goal of this mitigation measure is to allow for a minimum of two to three years of surveys, since this species may stay underground for several years. A 3-meter exclusion area would be established around any individuals found during the surveys. Effectiveness: This measure would be effective in avoiding impacts to *Sclerocactus blainei*. Effects on other resources: Conducting surveys would contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife.

ROW-VEG-6: Blaine's Fishhook Cactus Transplantation. If found during surveys, Blaine's fishhook cactus (*Sclerocactus blainei*) individuals would be transplanted to undisturbed BLM land that is as similar as possible to the habitat from which it was removed. Site selection requirements and details would be provided in the Restoration Plan. Effectiveness: This measure would be effective in mitigating impacts to *Sclerocactus blainei*. Effects on other resources: Transplanting activities would contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife.

ROW-VEG-7: Blaine's Fishhook Cactus Compensation. If enhancement measures fail to restore Blaine's fishhook cactus (*Sclerocactus blainei*) where it is found in the ROW prior to construction, SNWA would establish a compensatory mitigation fund for direct, indirect, and cumulative impacts to the species. A single payment of $10,000 would be made by the project applicant (SNWA) to the Center of Plant Conservation. This funding would specifically be used for preserving the genetic material of this species in perpetuity. Details regarding the definition of success with regard to *Sclerocactus blainei* would be determined, in coordination with the USFWS and the BLM, in the COM Plan. Effectiveness: This measure would be effective in offsetting impacts to *Sclerocactus blainei*, should adverse impacts occur. Effects on other resources: Implementation of this measure would not adversely affect other environmental resources.

Residual impacts include:

- There would be lower populations of yucca, cacti, and five special status species within the construction ROWs after surface disturbance and the initiation of restoration efforts. The recovery times for these species would depend on tolerance to surface disturbance and seed germination and growth rates. Perennial tall desert species such as Joshua trees would require many years (100 to 200) to recover; annual and short-lived perennial herbaceous species could potentially recover in a few (2 to 5) years.

Accidental Wildfires

Accidental wildfires ignited as a result of pipeline, power facility, and ancillary facility construction activities could affect vegetation communities in a variety of ways. Impacts may include, but are not limited to, the following: partial to complete removal of aboveground plant cover and belowground components (e.g., roots, rhizomes, and seed bank); soil moisture loss and possible subsequent hydrophobic soil; loss of cacti, yucca, and special status plant species and/or their associated habitats; propensity to increase the spread or introduction of noxious and non-native invasive weed species; and loss of suitable habitat for wildlife and grazing animals.

The land cover type with the highest overall risk of accidental fires spreading upon ignition is sagebrush shrubland, which occupies 48 percent of the overall length of the ROWs. The risk of fire spread in the sagebrush cover type would largely depend on the shrub interspaces and the cover of the herbaceous understory. Wide interspaces among shrubs and low herbaceous cover would limit fire spread, while dense sagebrush shrub stands, and/or extensive herbaceous plant cover would increase the risk of fire spread. Areas dominated by invasive exotic grasses (red brome, cheatgrass) represent less than 1 percent of the ROW length.

Post-wildfire revegetation to a pre-disturbance baseline structure and composition may vary depending on physical, environmental, and physiological factors such as the severity, intensity, and duration of the wildfire; extent of disturbance; topography; slope; soil moisture; precipitation; and sensitivity of the impacted species. Vegetation cover type recovery time frames would be generally consistent with those described in **Table 3.5-9**.

Conclusion. Accidental wildfires ignited as a result of pipeline, power facility, and ancillary facility construction activities could result in the partial to complete removal of aboveground plant cover. Areas most susceptible to fire are estimated to be sagebrush shrublands and invasive annual grasslands, which occupy about 50 percent of the length of the GWD Project ROWs. SNWA would provide fire suppression equipment and trained personnel to respond to fires that originate on the construction ROW. ACM A.1.47 specifies that fire suppression equipment would be present in construction areas, as well as individuals trained in fire suppression. A comprehensive wildland fire readiness and response plan will be developed as part of the COM Plan to insure adequate training for construction staff; to provide additional fire suppression capability on the construction site (water); and to insure immediate notification of local and federal agencies that would respond to wildfires.

Proposed mitigation measures:

ROW-VEG-3: Green Stripping. SNWA, in consultation with the BLM, would develop a green stripping revegetation prescription where BLM and SNWA preventive and control measures may be inadequate to mitigate risks of weed invasion and wildfire. Green stripping is defined as ROW revegetation with fast-growing herbaceous species that can out compete annual and perennial weeds and can provide a green firebreak. Locations where this measure may be applied would be identified in the Restoration Plan, Integrated Weed Management Plan, and Fire Prevention Plan, and approved by the BLM Visual Resource Management Coordinator. For example, it would be applied primarily to Great Basin Desert low elevation bottomlands, with limited applications to open evergreen woodlands (due to low risk for weed invasion) and Mojave Desert lowlands (due to low risk as a fire disturbance ecosystem). Effectiveness: This measure may be highly to moderately effective in reducing the spread of annual weeds into the ROW from adjacent areas. Effects on other resources: The number of locations where this measure may be applied may be limited by the management considerations for other resources. Application may require evaluation for management consistency for other resource values including wildlife habitat, grazing, and VRM.

Residual impacts include:

- None, if no accidental construction or operation-related fires occur.

Culturally Significant Plants

Individuals and portions of plant species populations used for Tribal traditional uses (**Table 3.5-8**) may be removed during ROW clearing and grading. The majority of these species grow in uplands, commonly in association with sagebrush, greasewood, and mixed desert shrublands, which occupy the largest surface areas among the regional vegetation cover types. Most of the identified traditional use plants are distributed widely in the Great Basin and Mojave Desert regions.

Conclusion. Abundance of Tribal traditional use plants vary from place to place and none are locally endemic or restricted to a single small area. It is not expected that project clearing and grading operations would affect the overall availability or abundance of these plants, unless project surface disturbance is located in a highly localized, traditional plant gathering area. The ethnographic interviews did not reveal any such highly specific plant gathering areas that would be directly affected by proposed project surface disturbance, but this does not preclude that disturbance to traditional plant gathering sites may potentially occur. Specific traditional plant gathering sites along the pipeline route may be identified through ongoing government to government consultation.

Proposed mitigation measures:

None.

Residual impacts include:

- There would be minor reductions in the availability of plant species used for Tribal traditional uses as the result of 12,288 acres of project surface disturbance, relative to the large areas where these species occur in individual hydrologic basins. Long-term disturbance to specific plant gathering areas may potentially occur.

3.5.2.3 Alternative D

Construction and Facility Maintenance

The same ROW construction and facility maintenance issues discussed for the Proposed Action and Alternatives A through C would apply to Alternative D, which would require 225 miles of pipeline and 208 miles of power lines in Clark and Lincoln counties. **Table 3.5-10** provides a summary of the estimated surface disturbance within vegetation cover types.

Vegetation Community Surface Disturbance and Restoration

Conclusion. Approximately 8,828 acres of native shrublands and woodlands removed or disturbed by construction would require 20 to more than 200 years for recovery to similar species composition and vertical structure as adjacent undisturbed areas. Approximately 48 acres of perennial grassland, annual invasive grassland and marshland cover types would require from 2 to 15 years for recovery. Approximately 808 acres of natural land cover types would be permanently converted to aboveground industrial uses. The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on vegetation resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section. ACMs include measures to salvage and preserve soil during construction; to follow BMPs for re-vegetation seeding and erosion control; to follow a long term restoration monitoring program; and to obtain a written release of restoration success from the BLM. Implementation of these measures would insure that vegetation species cover and composition would recover within time frames similar to natural recovery rates, or potentially more quickly over the majority of the surface disturbance areas.

Table 3.5-10 Alternative D – Construction Disturbance and Operational Conversion of Land Cover Types

Land Cover Type	Construction Disturbance (acres)	Operation (Conversion to Aboveground Industrial Uses) (acres)
Agriculture/Developed	9	9
Annual Invasive Grassland	29	7
Barren	1	0
Greasewood/Salt Desert Shrubland	1,673	179
Marshland	6	6
Mojave Mixed Desert Scrub	3,052	260
Perennial Grassland	13	1
Pinyon-Juniper Woodland	183	17
Playa	21	1
Riparian Woodland and Shrubland	5	5
Sagebrush Shrubland	3,836	323
Total	**8,828**	**808**

Please see **Table 3.5-9** for Estimated Vegetation Community Recovery Time.

Proposed mitigation measures:

ROW-VEG-1: Native Seed Collection. The SNWA, in consultation with the BLM, would develop a seed collection program for native plant species found within the ROW. These native plant seeds would be used along the ROW corridor in revegetation and reclamation activities, to the extent feasible, to enhance the rate and quality of recovery. Seed from locally adapted native sources would likely provide the greatest rates of establishment and subsequent growth, increasing the success of reclamation efforts. Target species and collection methods would be identified in the Restoration Plan. Effectiveness: This measure would be effective in mitigating impacts to native plant species found within the Project ROW by enhancing re-establishment. Effects on other resources: Seed collection activities would contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife.

ROW-VEG-2: Temporary Fencing or Closure to Livestock Grazing. The SNWA would conduct pre-construction surveys to determine areas of livestock use within and adjacent to the construction ROW where application of temporary fencing or closure would be needed for revegetation species establishment. The results of these surveys would be provided to the BLM for review and approval. Revegetation areas would be rested from grazing for two full years or until BLM determines that reclamation meets BLM RMP standards. Effectiveness: Temporary fencing or closure would be effective in improving the stabilization and persistence of reseeded areas in the short-term. In the long-term, annual precipitation from year to year, and the seasonal distribution of livestock within the allotment would determine the survival of reseeded plants. Effects on other resources: Temporary fencing would also limit wild horse access to forage inside fenced areas. Big game species would not likely be deterred by temporary livestock fencing. Temporary fencing in riparian areas could improve the recovery rate of shrubs and herbs that assist in stabilizing channel banks.

Residual impacts include:

- Long (20- to 200-years) restoration periods for shrublands and woodlands on 8,828 acres of disturbed ROWs because of sparse and uncertain precipitation, and soil-induced growth constraints (salinity, alkalinity, shallow soil depths).
- Permanent removal of shrubland (primarily sagebrush shrubland, greasewood/salt desert shrubland, Mojave mixed desert scrub) from 808 acres required for aboveground facilities.
- An unknown fraction of some disturbed communities would not recover to previous composition and density because of specialized soil requirements (e.g., winterfat on hardpan/caliche soils within the greasewood/salt desert shrubland type).

Spread and Introduction of Noxious and Non-native Invasive Weed Species

Conclusion. The proposed ROWs for 225 miles of buried water pipelines and 208 miles of overhead power lines are at high risk for invasion by noxious and non-native weed species. SNWA would implement a variety of measures to be included in an integrated weed management plan. These measures include management of weed contaminated topsoil, pre-construction weed treatments, and equipment wash stations to prevent the transport of weed plants and seeds along the ROW into new areas. SNWA would continue to monitor and control weeds within the ROW until released by the BLM, in accordance with overall restoration responsibilities.

Proposed mitigation measures:

ROW-VEG-3: Green Stripping. SNWA, in consultation with the BLM, would develop a green stripping revegetation prescription where BLM and SNWA preventive and control measures may be inadequate to mitigate risks of weed invasion and wildfire. Green stripping is defined as ROW revegetation with fast-growing herbaceous species that can outcompete annual and perennial weeds and can provide a green firebreak. Locations where this measure may be applied would be identified in the Restoration Plan, Integrated Weed Management Plan, and Fire Prevention Plan, and approved by the BLM Visual Resource Management Coordinator. For example, it would be applied primarily to Great Basin Desert low elevation bottomlands, with limited applications to open evergreen woodlands (due to low risk for weed invasion) and Mojave Desert lowlands (due to low risk as a fire disturbance ecosystem). Effectiveness: This measure may be effective in reducing the spread of annual weeds into the ROW from adjacent areas. Effects on other resources: The number of locations where this measure may be applied may be limited by the management considerations for other resources. Application may require evaluation for management consistency for other resource values including wildlife habitat, grazing, and VRM.

Residual impacts include:

- Implementation of weed control and monitoring methods could prevent expansion of existing weed populations into new areas, but may be insufficient to control highly herbicide resistant perennial weed species that are already established within or adjacent to the ROWs.

Cacti and Yucca, Special Status Plants

Conclusion. Several thousand yucca and cacti would be salvaged from the ROWs over a distance of approximately 100 miles, retained in nurseries along the ROW, and replanted and watered in the next appropriate planting season. Criteria that would be used to determine which cacti and yucca would be salvaged is listed in **Appendix E**, ACM A.1.71. Mature Joshua trees and immature cacti would not be salvaged, and therefore removed from existing plant populations along the ROW. Five special status plant species populations have been identified within proposed construction ROWs. Transplanting and seed gathering would assist in restoration of disturbed sites, but would not likely replace existing populations at an equivalent level. The net reduction in individuals and seeds of directly affected special status plant species is not likely to lead to future federal listings because there are five or more populations of these species elsewhere in Nevada and Utah.

Proposed mitigation measures:

ROW-VEG-4: Special Status Plant Species Establishment. In addition to salvaging and transplanting special status species found in the ROW for tier 1 or subsequent tier construction activities, the SNWA would grow additional plants from seed (collected from individuals prior to salvage) or by grafting (from the salvaged plants) to enhance the new, transplanted populations. Seed collection for this effort would occur over multiple years prior to plant salvage. Specific special status plant species and collection methods would be identified in the Restoration Plan. Effectiveness: This measure would be effective in mitigating impacts to special status plant species found within the Project ROW by enhancing re-establishment. Effects on other resources: Seed/plant collection activities would contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife.

ROW-VEG-5: Blaine's Fishhook Cactus Surveys. The SNWA would begin Blaine's fishhook cactus (*Sclerocactus blainei*) surveys as soon as possible after project design and engineering is complete; conducting the surveys within known and potential habitat during the next appropriate season for plant identification. The goal of this mitigation measure is to allow for a minimum of two to three years of surveys, since this species may stay underground for several years. A 3-meter exclusion area would be established around any individuals found during the surveys. Effectiveness: This measure would be effective in avoiding impacts to *Sclerocactus blainei*. Effects on other resources: Conducting surveys would contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife.

ROW-VEG-6: Blaine's Fishhook Cactus Transplantation. If found during surveys, Blaine's fishhook cactus (*Sclerocactus blainei*) individuals would be transplanted to undisturbed BLM land that is as similar as possible to the habitat from which it was removed. Site selection requirements and details would be provided in the Restoration Plan. Effectiveness: This measure would be effective in avoiding impacts to *Sclerocactus blainei*. Effects on other resources: Transplanting activities would contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife.

ROW-VEG-7: Blaine's Fishhook Cactus Compensation. If enhancement measures fail to restore Blaine's fishhook cactus (*Sclerocactus blainei*) where it is found in the ROW prior to construction, SNWA would establish a compensatory mitigation fund for direct, indirect, and cumulative impacts to the species. A single payment of $10,000 would be made by the project applicant (SNWA) to the Center of Plant Conservation. This funding would specifically be used for preserving the genetic material of this species in perpetuity. Details regarding the definition of success with regard to *Sclerocactus blainei* would be determined, in coordination with the USFWS and the BLM, in the COM Plan. Effectiveness: This measure would be effective in offsetting impacts to *Sclerocactus blainei*, should adverse impacts occur. Effects on other resources: Implementation of this measure would not adversely affect other environmental resources.

Residual impacts include:

- There would be lower populations of yucca, cacti, and five special status species within the construction ROWs after surface disturbance, and the initiation of restoration efforts. The recovery times for these species would depend on tolerance to surface disturbance, seed germination, and growth rates. Perennial tall desert species such as Joshua trees would require many years (100 to 200) to recover; annual and short-lived perennial herbaceous species could potentially recover in a few (2 to 5) years.

Accidental Wildfires

GWD Project areas most susceptible to fire are estimated to be sagebrush shrublands and invasive annual grasslands, which occupy about 44 percent of the length of the GWD Project ROWs. SNWA would provide fire suppression equipment and trained personnel to respond to fires that originate on the construction ROW.

Proposed mitigation measures:

ROW-VEG-3: Green Stripping. SNWA, in consultation with the BLM, would develop a green stripping revegetation prescription where BLM and SNWA preventive and control measures may be inadequate to mitigate risks of weed invasion and wildfire. Green stripping is defined as ROW revegetation with fast-growing herbaceous species that can outcompete annual and perennial weeds and can provide a green firebreak. Locations where this measure may be applied would be identified in the Restoration Plan, Integrated Weed Management Plan, and Fire Prevention Plan, and approved by the BLM Visual Resource Management Coordinator. For example, it would be applied primarily to Great Basin Desert low elevation bottomlands, with limited applications to open evergreen woodlands (due to low risk for weed invasion) and Mojave Desert lowlands (due to low risk as a fire disturbance ecosystem). Effectiveness: This measure may be effective in reducing the spread of annual weeds into the ROW from adjacent areas. Effects on other resources: The number of locations where this measure may be applied may be limited by the management considerations for other resources. Application may require evaluation for management consistency for other resource values including wildlife habitat, grazing, and VRM.

Residual impacts include:

- None, if no accidental construction- or operation-related fires occur.

Culturally Significant Plants

Conclusion. Most of the identified traditional-use plants are distributed widely in the Great Basin and Mojave Desert regions. Abundance of these plants varies from place to place and none are locally endemic or restricted to a single small area. It is not expected that project clearing and grading operations would affect the overall availability or abundance of tribal traditional use plants, unless project surface disturbance is located in a highly localized, traditional plant gathering area. The ethnographic interviews did not reveal any such highly specific plant gathering areas that would be directly affected by proposed project surface disturbance , but this does not preclude that disturbance to traditional plant gathering sites may potentially occur. Specific traditional plant gathering sites along the pipeline route may be identified through ongoing government to government consultation.

Proposed mitigation measures:

None.

Residual impacts include:

- There would be minor reductions in the availability of plant species used for Tribal traditional uses as the result of 8,828 acres of project surface disturbance, relative to the large areas where these species occur in individual hydrologic basins. Long-term disturbance to specific plant gathering areas may potentially occur.

3.5.2.4 Alternatives E and F

Construction and Facility Maintenance

The same ROW construction and facility maintenance issues discussed for the Proposed Action and Alternatives A through D would apply to Alternatives E and F, which would require 263 miles of pipeline and 280 miles of power lines in Clark and Lincoln counties. **Table 3.5-11** provides a summary of the estimated surface disturbance within vegetation cover types.

Vegetation Community Surface Disturbance and Restoration

Conclusion. Approximately 10,681 acres of native shrublands and woodlands removed or disturbed by construction would require 20 to more than 200 years for recovery to similar species composition and vertical structure as adjacent undisturbed areas. Approximately 58 acres of annual invasive grassland, perennial grassland, and marshland cover types would require from 2 to 15 years for recovery. Approximately 945 acres of natural land cover types would be permanently converted to aboveground industrial uses. The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on vegetation resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section. ACMs include measures to salvage and preserve soil and, during construction; to follow BMPs for revegetation seeding and erosion control; to follow a long-term restoration monitoring program; and to obtain a written release of restoration success from the BLM. Implementation of these measures would insure that vegetation species cover and composition would recover within time frames similar to natural recovery rates, or potentially more quickly over the majority of the surface disturbance areas.

Table 3.5-11 Alternatives E and F– Construction Disturbance and Operational Conversion of Land Cover Types

Land Cover Type	Construction Disturbance (acres)	Operation (Conversion to Aboveground Industrial Uses) (acres)
Agriculture/Developed	9	9
Annual Invasive Grassland	29	7
Barren	1	0
Greasewood/Salt Desert Shrubland	2,292	223
Marshland	6	6
Mojave Mixed Desert Scrub	3,052	260
Perennial Grassland	23	2
Pinyon-Juniper Woodland	256	26
Playa	21	1
Riparian Woodland and Shrubland	5	5
Sagebrush Shrubland	4,987	405
Total	**10,681**	**945**

Please see **Table 3.5-9** for Estimated Vegetation Community Recovery Time.

Proposed mitigation measures:

ROW-VEG-1: Native Seed Collection. The SNWA, in consultation with the BLM, would develop a seed collection program for native plant species found within the ROW. These native plant seeds would be used along the ROW corridor in revegetation and reclamation activities, to the extent feasible, to enhance the rate and quality of recovery. Seed from locally adapted native sources would likely provide the greatest rates of establishment and subsequent growth, increasing the success of reclamation efforts. Target species and collection methods would be identified in the Restoration Plan. Effectiveness: This measure would be effective in mitigating impacts to native plant species found within the Project ROW by enhancing re-establishment. Effects on other resources: Seed collection activities would contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife.

ROW-VEG-2: Temporary Fencing or Closure to Livestock Grazing. The SNWA would conduct pre-construction surveys to determine areas of livestock use within and adjacent to the construction ROW where application of temporary fencing or closure would be needed for revegetation species establishment. The results of these surveys would be provided to the BLM for review and approval. Revegetation areas would be rested from grazing for two full years or until BLM determines that reclamation meets BLM RMP standards. Effectiveness: Temporary fencing or closure would be effective in improving the stabilization and persistence of reseeded areas in the short-term. In the long-term, annual precipitation from year to year, and the seasonal distribution of livestock within the allotment would determine the survival of reseeded plants. Effects on other resources: Temporary fencing would also limit wild horse access to forage inside fenced areas. Big game species would not likely be deterred by temporary livestock fencing. Temporary fencing in riparian areas could improve the recovery rate of shrubs and herbs that assist in stabilizing channel banks.

Residual impacts include:

- Long (20 to 200 years) restoration periods for shrublands and woodlands on 10,681 acres of disturbed ROWs because of sparse and uncertain precipitation and soil-induced growth constraints (salinity, alkalinity, and shallow soil depths);
- Permanent removal of shrubland (primarily sagebrush shrubland, greasewood/salt desert shrubland, Mojave mixed desert scrub) from 945 acres required for aboveground facilities; and
- An unknown fraction of some disturbed communities would not recover to previous composition and density because of specialized soil requirements (e.g., winterfat on hardpan/caliche soils within the greasewood/salt desert shrubland type).

Spread and Introduction of Noxious and Non-native Invasive Weed Species

Conclusion. The proposed ROWs for 263 miles of buried water pipelines and 280 miles of overhead power lines are at high risk for invasion by noxious and non-native weed species. SNWA would implement a variety of measures to be included in an integrated weed management plan. These measures include management of weed contaminated topsoil, pre-construction weed treatments, and equipment wash stations to prevent the transport of weed plants and seeds along the ROW into new areas. SNWA would continue to monitor and control weeds within the ROW until released by the BLM, in accordance with overall restoration responsibilities.

Proposed mitigation measures:

ROW-VEG-3: Green Stripping. SNWA, in consultation with the BLM, would develop a green stripping revegetation prescription where BLM and SNWA preventive and control measures may be inadequate to mitigate risks of weed invasion and wildfire. Green stripping is defined as ROW revegetation with fast-growing herbaceous species that can outcompete annual and perennial weeds and can provide a green firebreak. Locations where this measure may be applied would be identified in the Restoration Plan, Integrated Weed Management Plan, and Fire Prevention Plan, and approved by the BLM Visual Resource Management Coordinator. For example, it would be applied primarily to Great Basin Desert low elevation bottomlands, with limited applications to open evergreen woodlands (due to low risk for weed invasion) and Mojave Desert lowlands (due to low risk as a fire disturbance ecosystem). Effectiveness: This measure may be effective in reducing the spread of annual weeds into the ROW from adjacent areas. Effects on other resources: The number of locations where this measure may be applied may be limited by the management considerations for other resources. Application may require evaluation for management consistency for other resource values including wildlife habitat, grazing, and VRM.

Residual impacts include:

- Implementation of weed control and monitoring methods could prevent expansion of existing weed populations into new areas, but may be insufficient to control highly herbicide resistant perennial weed species that are already established within, or adjacent to the ROWs.

Cacti and Yucca, Special Status Plants

Conclusion. Several thousand yucca and cacti would be salvaged from the ROWs over a distance of approximately 100 miles, retained in nurseries along the ROW, and replanted and watered in the next appropriate planting season. Criteria that would be used to determine which cacti and yucca would be salvaged is listed in **Appendix E**, ACM A.1.71. Mature Joshua trees and immature cacti would not be salvaged, and therefore would be removed from existing plant populations along the ROW. Five special status plant species populations have been identified within proposed construction ROWs. Transplanting and seed gathering would assist in restoration of disturbed sites, but would not likely replace existing populations at an equivalent level. The net reduction in individuals and seeds of directly affected special status plant species is not likely to lead to future federal listings because there are additional (five or more) populations of these species elsewhere in Nevada and Utah.

Proposed mitigation measures:

ROW-VEG-4: Special Status Plant Species Establishment. In addition to salvaging and transplanting special status species found in the ROW for tier 1 or subsequent tier construction activities, the SNWA would grow additional plants from seed (collected from individuals prior to salvage) or by grafting (from the salvaged plants) to enhance the new, transplanted populations. Seed collection for this effort would occur over multiple years prior to plant salvage. Specific special status plant species and collection methods would be identified in the Restoration Plan. Effectiveness: This measure would be effective in mitigating impacts to special status plant species found within the Project ROW by enhancing re-establishment. Effects on other resources: Seed/plant collection activities would contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife.

ROW-VEG-5: Blaine's Fishhook Cactus Surveys. The SNWA would begin Blaine's fishhook cactus (*Sclerocactus blainei*) surveys as soon as possible after project design and engineering is complete; conducting the surveys within known and potential habitat during the next appropriate season for plant identification. The goal of this mitigation measure is to allow for a minimum of two to three years of surveys, since this species may stay underground for several years. A 3-meter exclusion area would be established around any individuals found during the surveys. Effectiveness: This measure would be effective in avoiding impacts to *Sclerocactus blainei*. Effects on other resources: Conducting surveys would contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife.

ROW-VEG-6: Blaine's Fishhook Cactus Transplantation. If found during surveys, Blaine's fishhook cactus (*Sclerocactus blainei*) individuals would be transplanted to undisturbed BLM land that is as similar as possible to the habitat from which it was removed. Site selection requirements and details would be provided in the Restoration Plan. Effectiveness: This measure would be effective in avoiding impacts to *Sclerocactus blainei*. Effects on other resources: Transplanting activities would contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife.

ROW-VEG-7: Blaine's Fishhook Cactus Compensation. If enhancement measures fail to restore Blaine's fishhook cactus (*Sclerocactus blainei*) where it is found in the ROW prior to construction, SNWA would establish a compensatory mitigation fund for direct, indirect, and cumulative impacts to the species. A single payment of $10,000 would be made by the project applicant (SNWA) to the Center of Plant Conservation. This funding would specifically be used for preserving the genetic material of this species in perpetuity. Details regarding the definition of success with regard to *Sclerocactus blainei* would be determined, in coordination with the USFWS and the BLM, in the COM Plan. Effectiveness: This measure would be effective in offsetting impacts to *Sclerocactus blainei*, should adverse impacts occur. Effects on other resources: Implementation of this measure would not adversely affect other environmental resources.

Residual impacts include:

- There would be lower populations of yucca, cacti, and five special status species within the construction ROWs after surface disturbance, and the initiation of restoration efforts. The recovery times for these species would depend on tolerance to surface disturbance and seed germination and growth rates. Perennial tall desert species such as Joshua trees would require many years (100 to 200) to recover, while annual and short-lived perennial herbaceous species could potentially recover in a few (2 to 5) years.

Accidental Wildfires

GWD Project areas most susceptible to fire are estimated to be sagebrush shrublands and invasive annual grasslands, which occupy about 47 percent of the length of the GWD Project ROWs. SNWA would provide fire suppression equipment and trained personnel to respond to fires that originate on the construction ROW.

Proposed mitigation measures:

ROW-VEG-3: Green Stripping. SNWA, in consultation with the BLM, would develop a green stripping revegetation prescription where BLM and SNWA preventive and control measures may be inadequate to mitigate risks of weed invasion and wildfire. Green stripping is defined as ROW revegetation with fast-growing herbaceous species that can outcompete annual and perennial weeds and can provide a green firebreak. Locations where this measure may be applied would be identified in the Restoration Plan, Integrated Weed Management Plan, and Fire Prevention Plan, and approved by the BLM Visual Resource Management Coordinator. For example, it would be applied primarily to Great Basin Desert low elevation bottomlands, with limited applications to open evergreen woodlands (due to low risk for weed invasion) and Mojave Desert lowlands (due to low risk as a fire disturbance ecosystem). Effectiveness: This measure may be effective in reducing the spread of annual weeds into the ROW from adjacent areas. Effects on other resources: The number of locations where this measure may be applied may be limited by the management considerations for other resources. Application may require evaluation for management consistency for other resource values including wildlife habitat, grazing, and VRM.

Residual impacts include:

- None, if no accidental construction or operation-related fires occur.

Culturally Significant Plants

Conclusion. Most of the identified traditional uses plants are distributed widely in the Great Basin and Mojave Desert regions. Abundance of these plants varies from place to place, and none are locally endemic or restricted to a single small area. It is not expected that project clearing and grading operations would affect the overall availability or abundance of Tribal traditional use plants, unless project surface disturbance is located in a highly localized, traditional plant gathering area. The ethnographic interviews did not reveal any such highly specific plant gathering areas that would be directly affected by proposed project surface disturbance, but this does not preclude that disturbance to traditional plant gathering sites may potentially occur. Specific traditional plant gathering sites along the pipeline route may be identified through ongoing government to government consultation.

Proposed mitigation measures:

None.

Residual impacts include:

- There would be minor reductions in the availability of plant species used for Tribal traditional uses as the result of approximately 10,681 acres of project surface disturbance, relative to the large areas where these species occur in individual hydrologic basins. Long-term disturbance to specific plant gathering areas may potentially occur.

3.5.2.5 Alignment Options 1 through 4

Table 3.5-12 presents impacts for the Alignment Options (1 through 4) in relation the relevant underground or aboveground facility segment(s) of the Proposed Action.

Table 3.5-12 Potential Effects on Vegetation Resources from Implementation of GWD Project Alignment Options 1 through 4 as Compared to the Proposed Action

Alignment Options	Analysis
Alignment Option 1 (Humboldt-Toiyabe Power Line Alignment) **Option Description**: Change the locations of a portion of the 230-kV power line from Gonder Substation near Ely to Spring Valley. **Applicable To**: Proposed Action and Alternatives A through C, E, and F.	• The option transmission line route would result in 24 fewer acres of surface disturbance and less removal of mature pinyon pine, sagebrush, and juniper trees. • The option transmission line would be located adjacent to an existing transmission line and would represent an expansion of an existing ROW. The corresponding segment of the Proposed Action would require a new 100-foot-wide ROW.
Alignment Option 2 (North Lake Valley Pipeline Alignment) **Option Description**: Change the locations of portions of the mainline pipeline and electrical transmission line in North Lake Valley. **Applicable To**: Proposed Action and Alternatives A through C, E, and F.	• This option would require 23 more acres of sagebrush shrubland clearing to construct the mainline pipeline and transmission line. • This option would require additional acreage (approximately 5 acres) to be committed to long-term industrial uses for an additional pump station along U.S. 93.
Alignment Option 3 (Muleshoe Substation and Power Line Alignment) **Option Description**: Eliminate the Gonder to Spring Valley transmission line and construct a substation with a interconnection with an interstate, high voltage power line in Muleshole Valley. **Applicable To**: Proposed Action and Alternatives A through C, E, and F.	• This option would eliminate all vegetation clearing associated with construction of a 230-kV line from Gonder Substation near Ely to Spring Valley, for a reduction of 365 acres relative to the Proposed Action. This impact reduction is based on a 33.8-mile length and 100-foot cleared ROW width. • Construction of the Muleshoe Substation would require an additional long-term land commitment of 43 acres of sagebrush shrubland for industrial uses as compared to the Proposed Action.
Alignment Option 4 (North Delamar Valley Pipeline and Power Line Alignment) **Option Description**: Change the location of a short section of mainline pipeline in Delamar Valley to follow an existing transmission line. **Applicable To**: All alternatives.	• The option would be located adjacent to an existing transmission line and would be shorter by 3 miles (representing 53 fewer acres of surface disturbance) as compared to the Proposed Action. However, a 10-acre pump station (5-acre permanent, 5-acre temporary) would be constructed adjacent to U.S. 93. As a consequence, implementation of the option would result in a net of 2 fewer acres of Mojave mixed desert shrubland that would be disturbed and revegetated. • A population of mature and immature Joshua trees and other yucca and cacti occur throughout this portion of Delamar Valley. A comparative estimate of the number of Joshua trees that would be removed under this alternative route or the Proposed Action is not available. However, it is likely that fewer Joshua trees and other species would require salvage if the pipeline overlapped with an existing transmission line ROW.

3.5.2.6 No Action

Under the No Action Alternative, the proposed project would not be constructed or maintained. No project-related surface disturbance would occur. Vegetation communities would continue to be influenced by natural events such as drought and fire, and land use activities such as grazing and existing water diversions. Management activities on public lands will continue to be directed by the Ely and Las Vegas RMPs, which involve measures to maintain natural vegetation communities. Management Plan guidance for other public lands in the project study area would be provided by GBNP General Management Plan and the Forest Plan for the Humbolt-Toiyabe National Forest.

3.5.2.7 Comparison of Alternatives

The total vegetation community surface disturbance impacts for each alternative are listed in **Table 3.5-13**.

Table 3.5-13 Summary of Vegetation Community Surface Disturbance Proposed Action and Alternatives A through F

Parameter	Proposed Action, Alternatives A through C	Alternative D	Alternatives E and F
Vegetation Community Surface Disturbance from Construction (acres)	12,288	8,828	10,681

3.5.2.8 Groundwater Development and Groundwater Pumping

This section considers issues, assumptions, and methods related to field development and eventual pumping from up to five hydrologic basins.

Issues

Groundwater Field Development Construction and Facility Maintenance

- Short-term, long-term, and permanent loss of vegetation communities (due to surface disturbance and conversion of natural vegetation to industrial uses) as a result of construction-related activities and operational maintenance.
- Potential introduction or population expansion of noxious and non-native invasive weeds due to surface disturbance.
- Loss of individuals, or populations of federally listed, candidate, or special status plant species (including cacti and yucca) due to surface disturbance.
- Accidental wildfires caused by construction equipment or smoking during construction and operation.
- Availability of plant species traditionally used for food and fiber by regional tribes in relation to project surface disturbance activities.

Groundwater Pumping

- Short-term, long-term, and permanent loss of vegetation communities (including spring-fed wetlands and riparian areas) and special status plant species populations due to groundwater drawdown.
- Changes in the availability of groundwater-dependent plant species traditionally used for food and fiber by regional tribes in relation to groundwater drawdown.

Assumptions

Groundwater Field Development Construction and Facility Maintenance

- The Ely and Las Vegas RMP Management Actions and BMPs would be applied to all proposed construction activities based on the most current Ely and Las Vegas RMPs (BLM 2008, 1998).
- The ACMs included in the SNWA POD to manage surface disturbance effects for future ROWs provide a basis for appropriate measures that may be submitted in future SNWA ROW applications. For purposes of impact analysis, it has been assumed that measures appropriate for ROW construction would be applied to future ROW construction in groundwater development areas.

Groundwater Pumping

- Spring-fed meadows and riparian areas represent small areas within hydrologic basins and are best discussed by individual springs or by perennial stream reaches. The springs and perennial stream reaches of vegetation effects concern are the high and moderate risk water sources as defined in Section 3.3, Water Resources. Both inventoried and other springs are included in the enumeration of potentially affected springs and water bodies. The expected plant successional relationships in response to drawdown are discussed under drawdown effect criteria below.
- It is assumed that a groundwater depth of 50 feet or deeper in relation to the ground surface elevation is not accessible to the roots of most phreatophytic shrubs and this groundwater depth represents a reasonable boundary for: 1) estimating the deepest root zone extent of plant communities that are at least partially dependent on underlying groundwater, and 2) defining a groundwater drawdown boundary that assumes that the roots of overlying plant communities no longer have access to groundwater as a moisture source at depths greater than 50 feet. For example, the phreatophytic shrubland ET that occupies Cave Valley are underlain by existing groundwater depths greater than 50 feet. Therefore, it is assumed that these communities would not be affected by groundwater drawdown in this hydrologic basin.
- The ET areas mapped for each hydrologic basin as part of the water balance estimates (Section 3.3, Water Resources) represent the primary cover types that would be affected by drawdown over large areas. The ET areas were originally mapped primarily on the basis of vegetation density classes and not specifically by species

composition. For purposes of evaluating vegetation community response to groundwater pumping, the primary SNWA ET areas (wetland/meadow, phreatophyte/medium vegetation, and bare soil/low vegetation) were separated into two vegetation cover types (wetland/meadow and basin shrubland) (**Table 3.5-7**). These cover types are encompassed by the ET area boundaries within the primary GWD Project pumping basins and adjacent basins that may experience drawdown effects (**Figures 3.5-3** and **3.5-4**).

- The basin shrubland cover type is comprised of a mosaic of different plant communities, but is dominated by greasewood, low saltbush, big sagebrush, and other shrub species.
- The wetland/meadow cover type is dominated by perennial grasses, sedges, and rushes in spring-fed or sub-irrigated meadows. Also included in this cover type are riparian shrublands adjacent to the channel in Meadow Valley Wash and the Muddy River.
- Playas are classified as ET areas but were distinguished separately because they are barren of vegetation.

- Based on an evaluation of plant rooting depth, physiological responses to drought, available information on groundwater levels, and seasonal soil moisture, an index drawdown contour of 10 feet is assumed to be a reasonable estimate of the point at which long-term changes in plant community vigor and composition would begin to appear. The model drawdown estimates include a wide range of uncertainty (see Section 3.3, Water Resources). Soil texture, soil chemistry, seasonal soil moisture, and rooting depths in these plant communities are highly variable. As a consequence of this variability, the depth index may encompass plant stress levels that would be initiated at shallower drawdown depths or stress that would be initiated at greater depths. Key references that were consulted on wetland and phreatophytic shrub rooting depths, physiological mechanisms to withstand drought, and seasonal water use from underlying soils include: Branson et al. (1976); Busch et al. (1992); Castelli et al. (2000); Hacke et al. (2000); Moreo et al. (2007); Pataki (2008); Sperry and Hacke (2002); Steinwand et al. (2006); Trent et al. (1997); Toft (1995); and Toft and Fraizer (2003).

The vegetation composition and structure response of the Wetland/Meadow and Basin Shrubland ET areas to long-term drawdown stress is expected to vary widely depending on the underlying soil textures, chemistry, and water holding capacity; the relative influence of seasonal and annual precipitation; and the adaptations of individual species to drought stress. Furthermore, multiple sources of water likely support the Wetland/Meadow communities. These communities require high soil moisture during most of the growing season. High soil moisture can result from either 1) a shallow water table (i.e., groundwater within 1 to 3 meters of the soil surface) or 2) substantial amounts of surface flooding, either from outflow from adjacent wetlands or from surface runoff following spring snowmelt or 3) a perched water table, likely resulting from a soil layer with low permeability beneath the Wetland/Meadow communities. The primary source of water maintaining the perched water table is likely a local aquifer that may not be hydraulically connected to the more regional aquifer used for the GWD Project. These meadows also require perturbations sufficiently frequent to exclude dominance by shrubs. Common types of perturbation are high groundwater for at least 6 months of the year or frequent fires.

A limited number of studies have addressed vegetation community responses to groundwater drawdown. These studies were used to develop a general plant successional sequence in response to groundwater drawdown. Relevant studies focused on vegetation community responses to groundwater drawdown in Owens Valley of California (Elmore et al. 2006, 2003; Groeneveld 1992; Manning 1999; Pritchett and Manning 2009; Sorenson et al. 1991). Other studies estimated groundwater drawdown effects on wetland and phreatophytic vegetation in the Great Basin, Arizona, and Colorado (Cooper et al. 2006; 2003; Patten et al. 2008; Naumburg et al. 2005; Stromberg et al. 1996).

The following general changes in these communities may be expected in response to a 10-foot or greater drawdown. As the soil moisture profile dries out and in response to periodic droughts, it is expected that wetland species would become less vigorous and less able to compete against upland species that are either able to spread via rhizomes or by establishment of seedlings that can gain a competitive advantage. In general, it is expected that drawdown-induced root zone stress would result in the following secondary successional sequence:

- Phase 1: A gradual decline in sedges, bulrushes, cattails, and willows that occupy saturated soil sites the majority of the year and an increase in Arctic rush, native grasses such as common reed (*Phragmites australis*), salt grass (*Distichlis spicata*), and alkali sacaton (*Sporobolus airoides*).
- Phase 2: A gradual decrease in grasses and rushes, and an increase in phreatophytic shrubs (rubber rabbitbrush, greasewood) and persistence of drought-tolerant and deep-rooted native grasses (e.g., Basin wildrye, inland saltgrass). Obligate wetland species such as spike rushes and sedges would largely disappear except in areas where year-round soil moisture remains in the root zone.
- Phase 3: A gradual decrease in grass cover and increase in phreatophytic shrub cover and dominance. Bare interspaces among shrubs would increase and some of these interspaces could be invaded by annual native and exotic species. Examples of native species include various species of goosefoot (e.g., *Chenopodium leptophylum*) and exotic species include annual grasses (e.g., cheatgrass, 6-weeks fescue) and salt lover (*Halogeton glomeratus*).
- Phase 4: A gradual reduction in the dominance of deep-rooted phreatophytes (greasewood, rabbitbrush) and an increased dominance of species that rely primarily on shallow soil moisture and are more typical of upland as well as alkaline soil basin sites. Examples of adapted species include mat saltbush (*Atriplex gardneri* and *A. nuttallii*), fourwing saltbush (*A. canescens*) and shadscale on saline/alkaline soils, and sagebrush (*Artemisia tridentata* ssp.), and horsebrush (*Tetradymia canescens*) on non-saline sites. A variety of annual and perennial herbs and grasses would likely occupy the shrub interspaces. While it is expected that greasewood and rabbitbrush would remain in the community, the height and canopy of these species would decline. The endpoint of this successional sequence on non-alkaline or non-saline soils would likely be a sagebrush dominated community – these communities would most likely be found on alluvial fans and the outer margins of valley floors. The successional endpoint of valley floor communities likely would be a mix of the phreatophytic shrubs that already occur there, but at lower densities, more species of low stature saltbush species, and a higher fraction of annual native and exotic species. Invasion by annual grass species would likely increase the wildfire risk in these areas, resulting in fewer shrubs if wildfires occur.

In summary, it is expected that the herbaceous wetland ETs (primarily associated with larger valley floor spring systems) could slowly change toward dominance by phreatophytic shrubs and other species better adapted to lower surface soil moisture levels. Similarly, the areas dominated by greasewood, rabbitbrush, and big sagebrush may be invaded by shrubs, herbs, and grasses that are adapted to seasonal shallow soil moisture, and are capable of withstanding extended droughts, either through complete or partial dormancy, or long-lived seeds.

- Assumptions about the potential changes in vegetation community composition and structure from groundwater pumping do not incorporate additional assumptions about the effects of climate change because the specific long-term effects of climate change are not presently known, and the incremental contribution of climate change effects to project effects cannot be reasonably estimated. A discussion of climate change effects is provided in Section 3.5.3.1, Cumulative Impacts Common to All Alternatives.

Methodology for Analysis

Groundwater Field Development Construction and Facility Maintenance

- The methods outlined under construction ROWs were applied to project surface development activities.
- SNWA would be required to implement a comprehensive COM Plan that would include all future hydrographic basins and all facilities associated with the SNWA GWD Project. The COM Plan includes a requirement for comprehensive monitoring and mitigation program for the entire project that would integrate the various required monitoring and mitigation actions. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary, along with measures to protect vegetation resources from ROW construction and operation activities.
- Mitigation measures discussed in this resource section focus on new measures. Where applicable, some of the ROW mitigation measures may apply to surface disturbance activities associated with groundwater development. These ROW mitigation measures also would be considered in subsequent NEPA tiers.

Groundwater Pumping

- The COM Plan would integrate protective measures from the following: BLM RMPs, BO, ACMs, Stipulated Agreements, the DOI Handbook for Adaptive Management, and additional mitigation recommended in this EIS. Details of the COM Plan are provided in Section 3.20 along with measures to protect vegetation resources from groundwater pumping activities.
- Wetland/Meadow and Basin Shrubland. Vegetation communities within ET boundaries in each pumping basin were compared with the 50-foot or greater depth-to-water contours to determine if other sources of water may be sustaining these plant communities. For example, the depth to groundwater under ET vegetation areas mapped in southern Cave Valley are greater than 50 feet, indicating that these communities may be sustained by shallow impermeable soil layers that provide sufficient soil moisture to support phreatophytic shrubs. The area enclosed by the maximum extent of the 10-foot drawdown contour was superimposed over the area of the primary ETs (wetland/meadow, basin shrubland cover types) to calculate the area of vegetation that could experience reductions in soil moisture and long-term vegetation community composition changes caused by groundwater drawdown of 10 feet or more at different points in time (full build out, full build out plus 75 years, and full build out plus 200 years). Figures were generated that illustrate the expansion of the 10-foot drawdown contours over time in relation to the vegetation communities within the hydrologic ET boundaries.
- Springs and perennial stream reaches. Wetland and riparian shrubland communities have formed below many springs and along stream channels with perennial flows. These wetland and riparian communities typically occupy small areas of several acres in association with spring brook channels. These areas are important as wildlife and aquatic biota habitat and are expected to experience changes in vegetation composition toward non-wetland species over time. The 10-foot drawdown index was applied to the springs and perennial stream reaches that were classified as "at risk" from being affected by groundwater drawdown (Section 3.3, Water Resources). The springs included for analysis were those rated as presenting a "high" or "moderate" risk of effects. The number of springs and miles of perennial stream reaches potentially affected for each alternative over time are described in Section 3.3, Water Resources. The locations of the major spring complexes are illustrated on **Figures 3.5-3** and **3.5-4**.

3.5.2.9 Proposed Action

Groundwater Development Area

The construction and maintenance methods for well pad, gathering pipelines, access roads, and distribution power lines are anticipated to be the same as those described for the mainline pipeline and ancillary facilities. Effects on natural vegetation communities also would be similar, since future surface disturbance activities would occur in the same hydrologic basins where the mainline pipeline would be located. The major effect of future groundwater field development would be an expansion of surface disturbance activities over a large area within each hydrologic basin. Consequently, the BLM RMP Management Actions, BMPs, SNWA ACMs for ROWs are applicable, and likely to be proposed as part of future ROW applications to the BLM. Because there is flexibility in the layout of well pads and roads, recommendations to reduce impacts are focused on opportunities to avoid sensitive areas.

Vegetation Community Surface Disturbance and Restoration

Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated surface disturbance of approximately 3,590 to 8,410 acres. It is assumed that approximately 66 percent of the construction surface disturbance, or approximately 2,374 to 5,536 acres, would be committed to long-term industrial uses, and would not be revegetated during the project life. No specific development plans are available, so it is assumed that the vegetation cover types would be affected in proportion to their relative surface area within the groundwater development areas. Consequently, it is expected that sagebrush shrubland, greasewood/salt desert shrubland, and Mojave mixed desert shrubland types would be most extensively disturbed.

Surface restoration, restoration monitoring measures, and mitigation measures would be those identified in BLM RMP Management Actions, BMPs (**Appendix D**), and SNWA ACMs (**Appendix E**). The vegetation community recovery time frames would be the same as those described under ROW Construction and Facility Maintenance.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on vegetation resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

In its Programmatic Environmental Protection Measures, SNWA has stated that it would avoid locating well pads, collector pipelines, distribution power lines, and secondary substations in riparian and wetland areas (ACM B.1.1, B.1.3). SNWA also has committed to colocate pipelines, roads, and electrical service lines within groundwater development areas.

Spread and Introduction of Noxious and Non-native Invasive Weed Species

There would be an expanded risk of noxious and non-native invasive weed species invasion of new, disturbed ROW.

The same target species and control methods as described under ROW Construction and Facility Maintenance would be addressed during the construction of groundwater well field facilities. Implementation of "green stripping" (ROW-VEG-3) to suppress exotic annual grasses and provide a fire resistant strip may be appropriate in many areas.

Cacti and Yucca, Special Status Plants

The same target cacti and yucca species would be salvaged in accordance with the procedures outlined in the ACMs A.1.71 through A.1.78. Yuccas and cacti would be primarily salvaged from the groundwater development areas within Dry Lake and Delamar valleys. Implementation of recommendation GWD-VEG-1 would reduce the loss of mature Joshua trees and other large yucca plants by avoiding these plants wherever possible during the access road and gathering pipeline planning process.

Accidental Wild Fires

The risks of, and control measures for, accidental wild fires would be the same as that discussed under ROWs, Proposed Action and Alternatives A through C. The risk of accidental fires is considered high within all groundwater development areas, with the highest risk in invasive exotic grass-dominated areas and sagebrush communities. Preparation and implementation of a wildfire training and response plan would provide opportunities to control small wildfires before they expand in size and to ensure worker safety.

Culturally Significant Plants

It is expected that project clearing and grading operations within groundwater development areas would slightly reduce the overall availability or abundance of Tribal traditional use plants that occupy upland woodland and shrubland types within project development basins. The ethnographic interviews did not reveal any highly specific plant gathering areas that would be directly affected by proposed project surface disturbance within the overall groundwater development areas, but this does not preclude that disturbance to traditional plant gathering sites may potentially occur. Specific traditional plant gathering sites in the groundwater development areas may be identified through ongoing government to government consultation.

Conclusion. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated maximum surface disturbance of approximately 8,400 acres within 5 hydrologic basins. It is assumed that approximately 66 percent of the construction surface disturbance, or 5,540 acres, would be committed to long-term industrial uses and would not be revegetated during the project life. Vegetation restoration times for shrublands and woodland would require 20 to 200 years. It also is assumed that:

1) SNWA would implement its ROW ACMs, including measures for the BLM approval of successfully revegetated areas and long-term weed monitoring and control, as well as its commitment to avoid construction of groundwater development facilities in wetlands and riparian areas;

2) SNWA would identify and avoid special status plant species (including mature Joshua trees) as part of its infrastructure planning for its groundwater development; and

3) SNWA would develop emergency response plans to reduce the risk of starting accidental wildfires, as well as limiting fire spread.

Based on these measures, it is expected that natural vegetation composition and cover could be restored within the time frames for plants growing in adjacent undisturbed areas. There would be a small incremental reduction in the availability of Tribal traditional plants within the hydrologic basins occupied by groundwater development facilities.

Proposed mitigation measures:

GW-VEG-1: Joshua Tree Avoidance. Mature Joshua trees (*Yucca brevifolia*) would be avoided to the extent possible when laying out access roads in Delamar Valley. Effectiveness: This measure would be effective. Road alignments could be designed to minimize the loss of yuccas, but roads also must be designed with a minimal number of curves to ensure traffic safety. Effects on other resources: Implementation of this measure would not adversely affect other environmental resources. No comprehensive ground surveys for special status plants have been completed within the various groundwater development areas. Based on reconnaissance surveys completed to date, five special status plant species have been identified in groundwater development areas adjacent to the proposed pipeline ROW. These five species have already been located within and adjacent to ROW areas. Implementation of GW-VEG-2 would assist in avoiding special status plant species individuals and populations as part of the groundwater development planning process. Additional special status species may be located within exploratory areas that have not yet been surveyed.

Potential residual impacts include:

- The COM Plan, ACMs, and monitoring and mitigation measures could be effective in reducing impacts to vegetation and special status plant species. The objectives of the COM Plan are to avoid impacts to listed species and critical habitat and avoid, minimize, or mitigate impacts to vegetation. However, it is not possible to determine the level of impact reduction at this time. Effects on some vegetation types and plant species could exist considering the potential long recovery period that could occur. Some unavoidable impacts to vegetation types and species could occur at some locations.

Groundwater Pumping

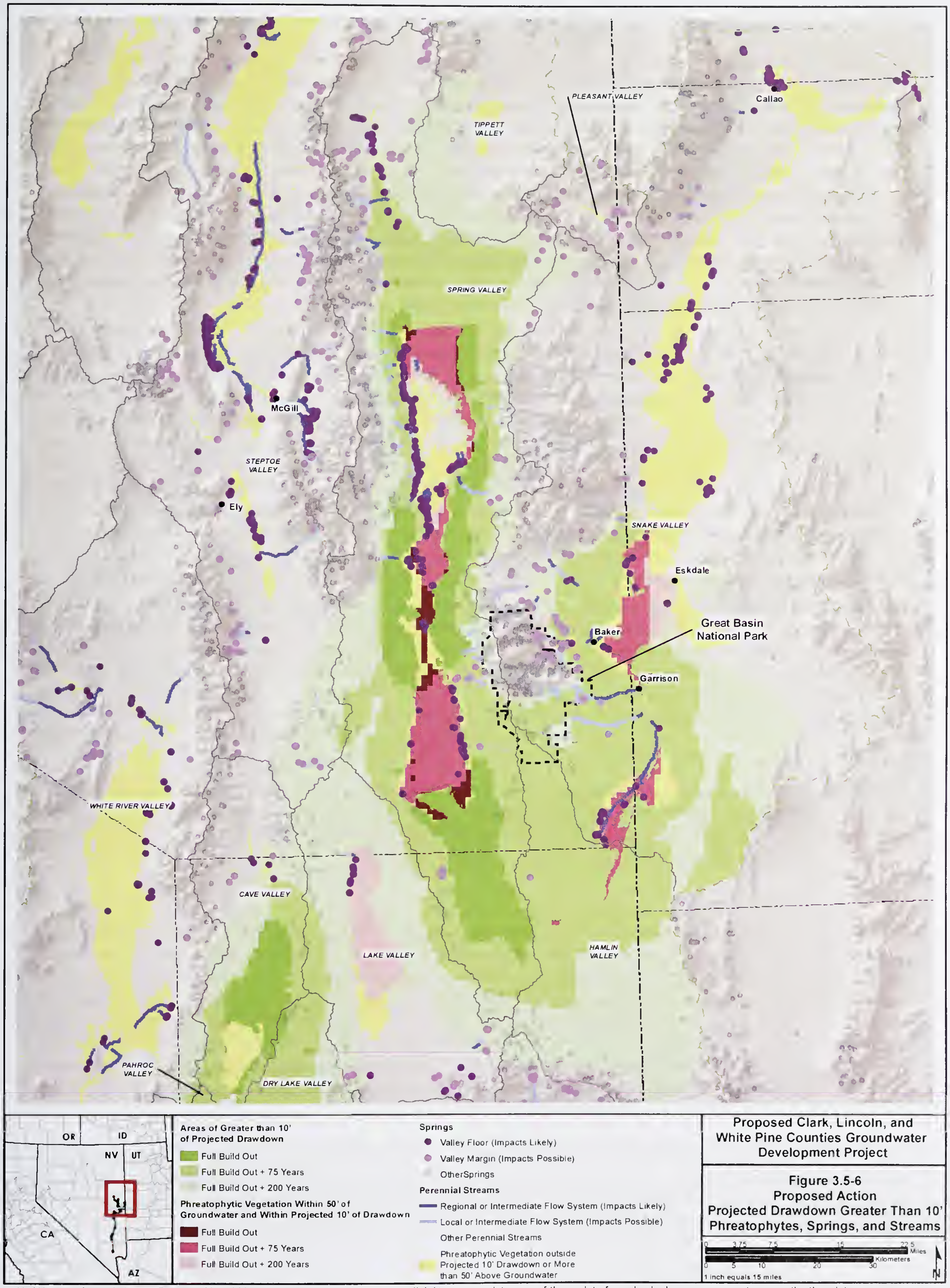
Figure 3.5-6 illustrates the overlap of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. The following is a summary of the incremental expansion of the groundwater drawdown area over time across the primary pumping hydrologic basins describing areas where surface and groundwater supply may be reduced. This includes the majority of the ET area (which encompasses basin shrubland and wetland/meadow cover types), as well as springs and perennial stream reaches.

Full Build Out. Potential drawdown effects are predicted in central, southern, and northeastern Spring Valley.

Full Build Out Plus 75 Years. The potential drawdown effects in ET areas would expand across Spring Valley and would appear in southern Snake Valley near Baker, in the Big Springs Creek drainage, and northeastern Hamlin Valley.

Full Build Out Plus 200 Years. The potential drawdown effects in ET areas would incrementally expand in the Snake Valley in the south of Eskdale and across the majority of the phreatophytic vegetation areas in northern Lake Valley.

The following vegetation community changes could occur in response to groundwater pumping, as outlined under the assumptions. The specific vegetation community responses cannot be predicted on a site-specific basis. The rate of change in plant community composition also would be highly variable, depending on groundwater drawdown rates and local water elevation recovery, as well as the influence of precipitation and overland and runoff in channels.



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.5-6
Proposed Action
Projected Drawdown Greater Than 10'
Phreatophytes, Springs, and Streams

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

Wetland/Meadow

Plant species in vegetation communities that are directly dependent on perennial spring and stream flows would experience the greatest potential change in plant species composition. Based on the general successional model outlined in the assumptions, it is likely that wetland communities consisting of sedges, rushes, and cattails would progressively change toward a community dominated by deep-rooted grasses. The overall surface area occupied by wetland species would decrease, with persistence only in areas that continue to receive sufficient surface and groundwater for long-term survival. Species composition could change toward dominance by phreatophytes and other species better adapted to low near-surface soil moisture. Over the long term, it is expected that areas occupied by this cover type could be invaded by basin shrubland vegetation units, or other upland vegetation types, depending on sources of surface moisture and soil chemistry (texture, salinity, and alkalinity). This successional progression is unlikely to be reversed, since it is expected that hydric soils would lose many of their wetland characteristic and would likely to become more similar to upland soils with better root zone aeration than hydric soils.

Basin Shrubland

Based on groundwater studies in other hydrologic basins, such as the Owens Valley of California, it is likely that the dominant phreatophytic shrubs (greasewood, rabbitbrush) would persist over the long term, but potentially at lower densities and vigor as the result of reduced availability of soil moisture at greater depths and lower suitability for shrub seedling re-establishment and growth. Swamp cedar communities could also be affected by reduced availability of soil moisture in basin shrubland communities. These areas could be invaded by shrubs, herbs, and grasses that are adapted to seasonal shallow soil moisture and are capable of withstanding extended droughts, either through complete or partial dormancy, or long-lived seeds. It is likely that invasive annual grass species would become increasingly dominant and that the risk of wildfires also would likely increase.

Springs and Perennial Stream Reaches

The effects on vegetation dependent on spring flows would vary by the flow volume and flow persistence. Reductions in spring flow would likely reduce the length of the spring brook and reduce the area of wetland vegetation that is dependent on reliable surface and sub-surface soil moisture. Riparian shrubs (such as willows and birches) likely would decline in vigor and would eventually die in areas where groundwater elevations decline below the root zone. The majority of these spring drying effects are predicted to occur in Spring Valley. Potential pumping effects on waterbodies in the GBNP and adjacent to Utah are discussed in Aquatic Biological Resources, Section 3.7.2.

Special Status Species

To date, no Ute Ladies'-tresses orchid populations have been found in any of the areas potentially at risk, although potential habitat has been identified in Spring and southern Snake valleys. If this species is discovered in potential habitats in the future, there is a risk that soil moisture changes in spring meadows could alter the growth and flowering conditions, which could adversely affect the long-term population viability.

Culturally Significant Plants

Traditional use plants that are classified as wetland plants by the USACE (**Table 3.5-8**) occur in wetlands and meadows. Examples of common wetland species on the traditional use list that occur in spring meadows within the affected hydrologic basins include Arctic rush, California bulrush (*Schoenoplectus californicus*), cattail (*Typha latifolia*), and common reed (*Phragmites australis*) (**Table 3.5-5**). Groundwater drawdown effects on these species are generally described under the wetland/meadow ET area above and could range from small changes in species composition in areas where groundwater levels are maintained over the long term to a broad scale conversion of wetlands and meadow to dry grasslands and shrublands, with disappearance of wetland species over time. In summary, it is likely that traditional use wetland plant species occupying wetlands and sub-irrigated grasslands in Spring, Snake, and Lake valleys would become less abundant and less available over time.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on vegetation resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

ACMs. The stipulated agreements for Spring, Delamar, Dry Lake, and Cave valleys specify the development of monitoring programs to identify ecosystem component changes and an adaptive management framework to respond to changes identified (**Appendix C**). The mitigation efforts would be focused primarily on the protection and maintenance of wetland/wet meadow communities, since these communities are dependent on reliable sources of shallow groundwater in the root zone.

Present ACMs could be used to mitigate adverse effects resulting from groundwater pumping. The broad measures that are most applicable to addressing vegetation effects include: 1) geographic redistribution of groundwater withdrawals; 2) reduction or cessation of groundwater withdrawals; 3) acquisition of real property and/or water rights dedicated to the recovery of special status species within their current and historic habitat range; and 4) provision of resources to restore and enhance habitat on the Pahranagat NWR.

SNWA also has identified more specific biological, and land use and range management measures. Specific measures relevant to vegetation resources that are highly or somewhat dependent on groundwater sources include:

- ACM C.2.4 – Prepare an ecological study of the Spring Valley swamp cedars to determine groundwater elevation requirements necessary to maintain a viable community.
- ACM C.2.5 – Conduct large-scale seeding to assist with vegetation transition from phreatophytic communities in Spring and Snake valleys, to benefit wildlife and reduce potential air resources impacts.
- ACM C.2.15 – Modify use of SNWA's agricultural water rights in Spring Valley to offset changes in spring discharges needed to maintain wet meadow areas in the northwest and southeast portions of Spring Valley. This could be accomplished by changing crop production to a less water-intensive type or changing water cycles, and then diverting the saved water to the wet meadow areas.

Proposed mitigation measures:

GW-VEG-2: Monitoring within Ute Ladies'-tresses Habitat. In concert with GW-WR-3, and on BLM lands, biological and hydrologic monitoring would be required for Ute Ladies'-tresses (*Spiranthes diluvialis*) groundwater-dependent habitats in areas that may be affected by groundwater pumping. Effectiveness: This measure would provide additional information, not currently available; to assess potential impacts to Ute Ladies'-tresses and its habitat from groundwater pumping. Effects on other resources: Implementation of this measure would not adversely affect other environmental resources.

GW-VEG-3: Wetlands Monitoring. Prior to any project pumping in Cave, Dry Lake, Delamar or Spring valleys, the SNWA would develop a wetlands monitoring plan. This plan would specify monitoring requirements and metrics for vegetation, soils, and hydrology to provide adequate baseline data to facilitate the creation of an early warning system designed to distinguish between the effects of project pumping, natural variations, and other non-project related groundwater pumping activities. This measure is in concert with GW-WR-3a. Monitoring would be conducted for all wetlands (both USACE jurisdictional and non-jurisdictional) in areas that may be affected by groundwater pumping. Specific monitoring locations would be identified in the COM Plans associated with subsequent NEPA tiers. Effectiveness: This measure would provide additional information, not currently available; to assess potential impacts to wetlands from groundwater pumping. Effects on other resources: Implementation of this measure would not adversely affect other environmental resources.

GW-VEG-4: Phreatophytic Vegetation Monitoring in GW Development Areas. Prior to any project pumping in Cave, Dry Lake, Delamar or Spring valleys, the SNWA would develop a phreatophytic vegetation monitoring plan. This plan would specify monitoring requirements for quantifying the extent and distribution of phreatophytic vegetation at sufficient resolution to detect changes in density and cover in areas that may be affected by groundwater pumping. Baseline data derived from monitoring would facilitate the creation of an early warning system designed to distinguish between the effects of project pumping, natural variations, and other non-project related groundwater pumping activities. Specific monitoring locations would be identified in the COM Plans associated with subsequent NEPA tiers. This measure is in concert with GW-WR-3a. Effectiveness: This measure would provide additional information, not currently available; to assess potential impacts to phreatophytic vegetation and its habitat from groundwater pumping. Effects on other resources: Implementation of this measure would not adversely affect other environmental resources.

GW-VEG-5: Swamp Cedar Monitoring. In concert with GW-WR-3, and on BLM lands including ACECs, biological and hydrologic monitoring would be required for swamp cedar (*Juniperus scopulorum*) groundwater-dependent habitats in areas that may be affected by groundwater pumping. Monitoring of these communities would include the determination of groundwater requirements necessary to maintain viable populations, and metrics to assess the health of individual swamp cedars. The goal of monitoring would be to ensure the long-term survival and continued existence of these populations. Effectiveness: This measure would provide additional information, not currently available; to assess potential impacts to swamp cedar populations and their habitat from groundwater pumping. Effects on other resources: Implementation of this measure would not adversely affect other environmental resources.

As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).

Monitoring of surface water resources and groundwater elevations under monitoring measure GW-WR-3a (Comprehensive Water Resources Monitoring Plan) would be used to determine the effectiveness of the implemented measures (see Water Resources, Section 3.3, for complete wording of GW-WR-3a).

As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7).

Mitigation planning could be developed as part of the Snake Valley 3M Plan (**Appendix B**). Management actions included in the Snake Valley 3M Plan that will be considered will include geographic redistribution of groundwater withdrawals; reduction or cessation of groundwater withdrawals; provision of consumptive water supply requirements using surface and/or groundwater sources; acquisition of property or water rights dedicated to management of special status species; and augmentation of water supply and/or acquisition of existing water rights.

Potential residual impacts include:

- The COM Plan, ACMs, and monitoring and mitigation measures could be effective in reducing impacts to vegetation and special status plant species. The objectives of the COM Plan are to avoid impacts to listed species and critical habitat and avoid, minimize, or mitigate impacts to vegetation. However, it is not possible to determine the level of impact reduction at this time. Effects on some vegetation types and plant species could exist considering the potential long recovery period that could occur. Some unavoidable impacts to vegetation types and species could occur at some locations.

Conclusions and Summary

Table 3.5-14 provides a summary of potential vegetation community effects for three model time frames.

Table 3.5-14 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Proposed Action

Effects/Conclusions

- Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result in long-term changes in plant species composition in the Wetland/Meadow ET area from wetland species such as rushes, sedges, and grasses, to upland species of grasses and shrubs.
- Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result in lower densities of phreatophytic shrubs such as greasewood and an increase in upland species of grasses and shrubs that are not completely, or partially dependent on reliable sources of groundwater.
- Groundwater drawdowns from pumping (index of 10 feet or greater) and changes in spring flows would likely increase stress on spring-fed aquatic vegetation and riparian shrubs. If these water sources dried up over a long period of time (5 years or more), it is likely these communities would not recover and vegetation community composition would change to upland species.
- Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring, Snake, and Lake valleys. The Ute ladies'-tresses orchid has not been identified in any of the areas potentially at risk. If populations of this species are found in the future, evaluations of groundwater drawdown risk to this species would be conducted.

Primary Affected Valleys

- Spring, Snake, and Lake

Impact Indicators By Model Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 years
Wetland/meadow ET area affected by 10 feet or greater drawdown (acres).	117	5,460	8,048
Basin shrubland ET area affected by 10 feet or greater drawdown (acres).	17,702	136,990	191,506
Total number of springs with moderate to high risk of being affected by 10 feet or more of drawdown (number).	8	212	305
Total miles of perennial streams with moderate to high risk of being affected by 10 feet or more of drawdown.	6	80	112

Potential Vegetation Effects in GBNP and adjacent Utah

The streams and springs within GBNP and adjacent Utah that may be affected by 10 foot drawdown or greater are described in Water Resources, Section 3.3.2.9. Riparian and herbaceous wetland vegetation communities that depend on streamflows may be stressed by future flow reductions and these riparian plant communities may progressively change toward more of an upland species composition.

COM Plan

- The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for vegetation resources are summarized below for ACMs and mitigation recommendations.

Stipulation Agreements

The stipulation agreements for Spring, Delamar, Dry Lake, and Cave valleys specify the development of monitoring programs to identify ecosystem component changes and an adaptive management framework to respond to changes identified (**Appendix C**). The mitigation efforts would be focused primarily on the protection and maintenance of springs, streams, ponds, wetlands, meadows, swamp cedars, and phreatophytic shrublands, since these communities are dependent on reliable sources of shallow groundwater in the root zone.

ACMs

- ACM C.2.4 – Prepare an ecological study of the Spring Valley swamp cedars to determine groundwater elevation requirements necessary to maintain a viable community.
- ACM C.2.5 – Conduct large-scale seeding to assist with vegetation transition from phreatophytic communities in Spring and Snake valleys, to benefit wildlife and reduce potential air resources impacts.
- ACM C.2.15 – Modify use of SNWA's agricultural water rights in Spring Valley to offset changes in spring discharges needed to maintain wet meadow areas in the northwest and southeast portions of Spring Valley. This could be accomplished by changing crop production to a less water-intensive type or changing water cycles and then diverting the saved water to the wet meadow areas.

Table 3.5-14 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Proposed Action (Continued)

Monitoring Recommendations
Based on anticipated drawdown effects, the following areas should be considered for vegetation community monitoring: • Minerva Spring Complex, Swallow Spring, Shoshone Ponds, and the springbrook from Shoshone Ponds Well #2 in southern and central Spring Valley. Of this group Minerva Spring Complex, Swallow Spring, and Shoshone Ponds, as well as the wetlands and meadows surrounding Minerva Springs and Shoshone Ponds (including in the Shoshone Ponds ACEC), are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Springs and associated wetlands and meadows along the west side of Spring Valley north of Cleve Creek. West Spring Valley Spring Complex and Keegan Spring Complex, including associated wetlands and meadows, are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • The Big Spring drainage in Snake Valley in Nevada and Utah. Big Springs, Big Spring Creek, Lake Creek, Stateline Springs and Clay Spring (North) are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Swamp Cedar and Baking Powder Flat Blue ACECs. The swamp cedar population in the vicinity of the Swamp Cedar ACEC is being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • **GW-VEG-2 (Monitoring within Ute Ladie's-tresses Habitat)**, **GW-VEG-3 (Wetlands Monitoring)**, **GW-VEG-4 (Phreatophytic Vegetation Monitoring)**, **GW-VEG-5 (Swamp Cedar Monitoring)**, and the Sanke Valley 3M Plan, as listed for the Propoed Action. • As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).
Mitigation Recommendations
GW-VEG-1 (Joshua Tree Avoidance), as listed for the Proposed Action. As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7).
Potential Residual Impacts
• The COM Plan, ACMs, and monitoring and mitigation measures could be effective in reducing impacts to vegetation and special status plant species. The objectives of the COM Plan are to avoid impacts to listed species and critical habitat and avoid, minimize, or mitigate impacts to vegetation. However, it is not possible to determine the level of impact reduction at this time. Effects on some vegetation types and plant species could exist considering the potential long recovery period that could occur. Some unavoidable impacts to vegetation types and species could occur at some locations.

3.5.2.10 Alternative A

Groundwater Development Area

Conclusion. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated surface disturbance of approximately 2,069 to 4,814 acres within 5 hydrologic basins. It is assumed that approximately 66 percent of the construction surface disturbance, or approximately 1,370 to 3,171 acres would be committed to long-term industrial uses and would not be revegetated during the project life. Vegetation restoration times for shrublands and woodland would require 20 to 200 years.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on vegetation resources. The COM Plan would integrate protective measures from the following: BLM RMP

Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section. Based on BLM RMP Management Actions, BMPs, and SNWA ACMs, it is expected that natural vegetation composition and cover could be restored within the time frames for plants growing in adjacent undisturbed areas and that reductions in special status plant populations could be minimized. There would be a small incremental reduction in the availability of Tribal traditional plants within the hydrologic basins occupied by groundwater development facilities. No specific development plans are available, so it is assumed that the vegetation cover types would be affected in proportion to their relative surface area within the groundwater development areas. Consequently, it is expected that sagebrush shrubland, greasewood/salt desert shrubland, and Mojave mixed desert shrubland vegetation types would be most extensively disturbed.

Groundwater Pumping

Figure 3.5-7 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. The following is a summary of the incremental expansion of the groundwater drawdown area over time across the primary pumping hydrologic basins where the majority of the ET area (which encompasses basin shrubland and wetland/meadow cover types), as well as springs and perennial stream reaches whose surface and groundwater supply may be reduced.

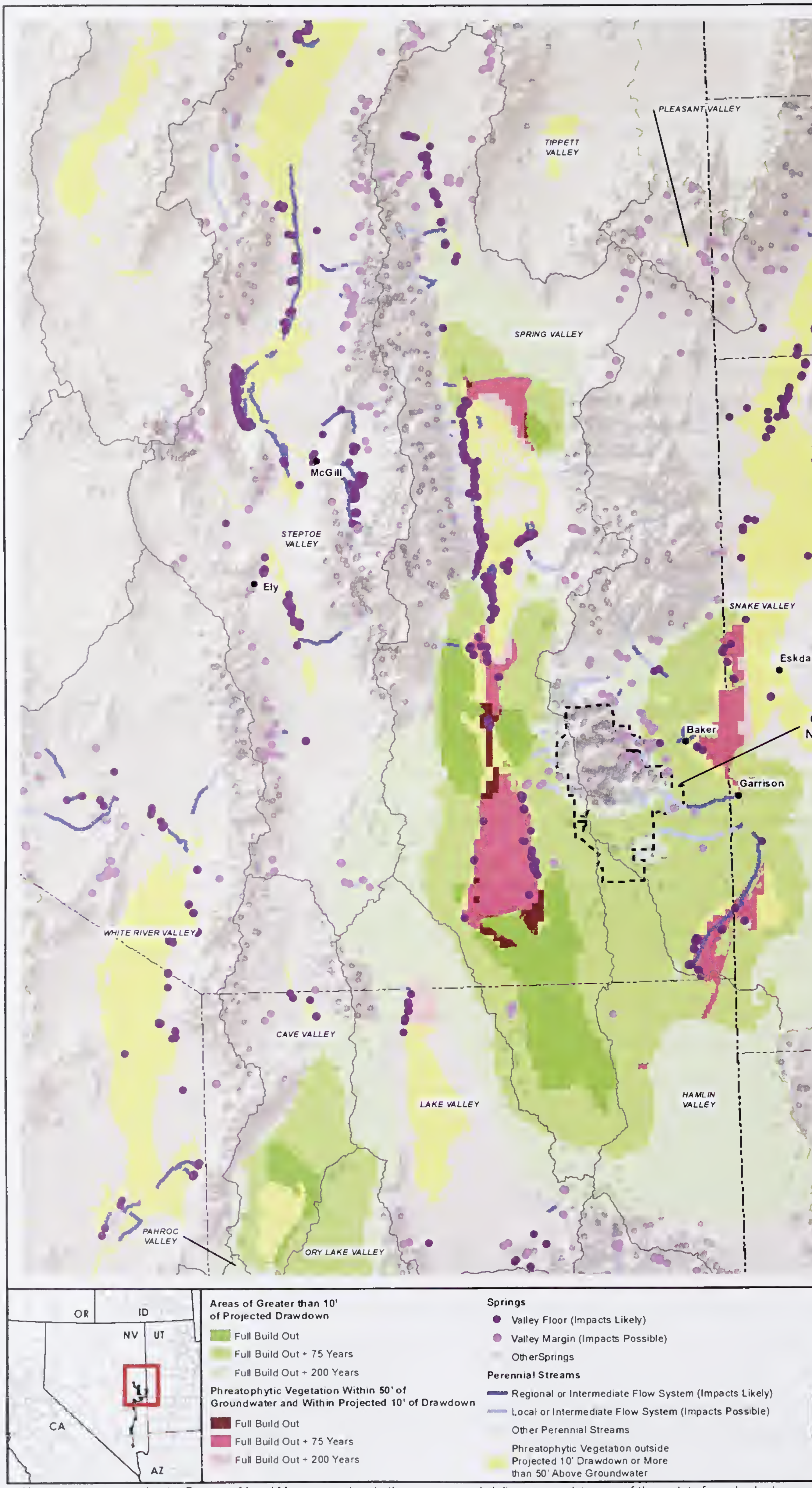
Full Build Out. Potential drawdown effects within ET areas are predicted in central, southern, and northern Spring Valley.

Full Build Out Plus 75 Years. The potential drawdown effects would expand across ET areas in southern Spring Valley and would appear in southern Snake Valley near Baker, in the Big Spring drainage, and northeastern Hamlin Valley.

Full Build Out Plus 200 Years. The 10-foot drawdown area within the ET boundaries would incrementally expand in central Snake Valley, the Snake Valley east of Baker, and the northern portion of Lake Valley.

Conclusion and Summary

Table 3.5-15 provides a summary of potential vegetation community effects for three model time frames.



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.5-7
Alternative A
Projected Drawdown Greater Than 10'
Phreatophytes, Springs, and Streams

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

Table 3.5-15 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative A

Effects/Conclusions

- Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result a long change in plant species composition in the Wetland/Meadow ET area from wetland species such as rushes, sedges, and grasses, to upland species of grasses and shrubs.
- Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result in lower densities of phreatophytic shrubs such as greasewood and an increase in upland species of grasses and shrubs that are not completely, or partially dependent on reliable sources of groundwater.
- Groundwater drawdowns from pumping (index of 10 feet or greater) and changes in spring flows would likely increase stress on spring-fed aquatic vegetation and riparian shrubs. If these water sources dried up over a long period of time (5 years or more), it is likely these communities would not recover and vegetation community composition would change to upland species.
- Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring, Snake, and Lake valleys. The Ute ladies'-tresses orchid has not been identified in any of the areas potentially at risk. If populations of this species are found in the future, evaluations of groundwater drawdown risk to this species would be conducted.

Primary Affected Valleys

- Spring, Snake, and Lake

Impact Indicators By Model Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Wetland/meadow ET area affected by 10 feet or greater drawdown (acres).	92	4,624	6,137
Basin shrubland ET area affected by 10 feet or greater drawdown (acres).	12,059	106,414	123,714
Total number of springs with moderate to high risk of being affected by 10 feet or more of drawdown (number).	3	115	182
Total miles of perennial streams with moderate to high risk of being affected by 10 feet or more of drawdown.	1	58	81

Potential Vegetation Effects in GBNP and adjacent Utah

The streams and springs within GBNP and adjacent Utah that may be affected by 10 foot drawdown or greater are discussed in Section 3.3.2.10, Water Resources. Riparian and herbaceous wetland vegetation communities that depend on streamflows may be stressed by future flow reductions and these riparian plant communities may progressively change toward more of an upland species composition.

COM Plan

- The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for vegetation resources are summarized below for ACMs and mitigation recommendations.

Stipulated Agreements

The stipulation agreements for Spring, Delamar, Dry Lake, and Cave valleys specify the development of monitoring programs to identify ecosystem component changes and an adaptive management framework to respond to changes identified (**Appendix C**). The mitigation efforts would be focused primarily on the protection and maintenance of springs, streams, ponds, wetlands, meadows, swamp cedars, and phreatophytic shrublands, since these communities are dependent on reliable sources of shallow groundwater in the root zone.

Table 3.5-15 **Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative A (Continued)**

ACMs
• ACM C.2.4 – Prepare an ecological study of the Spring Valley swamp cedars to determine groundwater elevation requirements necessary to maintain a viable community. • ACM C.2.5 – Conduct large-scale seeding to assist with vegetation transition from phreatophytic communities in Spring and Snake valleys, to benefit wildlife and reduce potential air resources impacts. • ACM C.2.15 – Modify use of SNWA's agricultural water rights in Spring Valley to offset changes in spring discharges needed to maintain wet meadow areas in the northwest and southeast portions of Spring Valley. This could be accomplished by changing crop production to a less water-intensive type or changing water cycles, and then diverting the saved water to the wet meadow areas.
Monitoring Recommendations
Based on anticipated drawdown effects, the following areas should be considered for vegetation community monitoring: • Minerva Spring Complex, Swallow Spring, Shoshone Ponds, and the springbrook from Shoshone Ponds Well #2 in southern and central Spring Valley. Of this group Minerva Spring Complex, Swallow Spring, and Shoshone Ponds, as well as the wetlands and meadows surrounding Minerva Springs and Shoshone Ponds (including in the Shoshone Ponds ACEC), are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Springs and associated wetlands and meadows along the west side of Spring Valley north of Cleve Creek. West Spring Valley Spring Complex and Keegan Spring Complex, including associated wetlands and meadows, are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • The Big Spring drainage in Snake Valley in Nevada and Utah. Big Springs, Big Spring Creek, Lake Creek, Stateline Springs and Clay Spring (North) are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Swamp Cedar and Baking Powder Flat Blue ACECs. The swamp cedar population in the vicinity of the Swamp Cedar ACEC is being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • **GW-VEG-2 (Monitoring within Ute Ladie's-tresses Habitat)**, **GW-VEG-3 (Wetlands Monitoring)**, **GW-VEG-4 (PhreatophyticVegetation Monitoring)**, **GW-VEG-5 (Swamp Cedar Monitoring)**, and the Sanke Valley 3M Plan, as listed for the Propoed Action. • As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).
Mitigation Recommendations
GW-VEG-1 (Joshua Tree Avoidance), as listd for the Proposed Action. As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7).
Potential Residual Impacts
• The COM Plan, ACMs, and monitoring and mitigation measures could be effective in reducing impacts to vegetation and special status plant species. The objectives of the COM Plan are to avoid impacts to listed species and critical habitat and avoid, minimize, or mitigate impacts to vegetation. However, it is not possible to determine the level of impact reduction at this time. Effects on some vegetation types and plant species could exist considering the potential long recovery period that could occur. Some unavoidable impacts to vegetation types and species could occur at some locations.

3.5.2.11 Alternative B

Groundwater Development Area

Conclusion. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated surface disturbance of approximately 4,664 acres within 5 hydrologic basins. It is assumed that approximately 66 percent of the construction surface disturbance, or 3,077 acres would be committed to long term industrial uses, and would not be revegetated during the project life. Vegetation restoration times for shrublands and woodland would require 20 to 200 years.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on vegetation resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section. Based on BLM RMP Management Actions, BMPs, and SNWA ACMs, it is expected that natural vegetation composition and cover could be restored within the time frames for plants growing in adjacent undisturbed areas, and that reductions in special status plant populations could be minimized. There would be a small incremental reduction in the availability of Tribal traditional plants within the hydrologic basins occupied by groundwater development facilities. No specific development plans are available, so it is assumed that the vegetation cover types would be affected in proportion to their relative surface area within 1 mile of the PODs within the five groundwater development basins. Consequently, it is expected that sagebrush shrubland, greasewood/saltbush shrubland, and pinyon juniper woodland vegetation types would be most extensively disturbed.

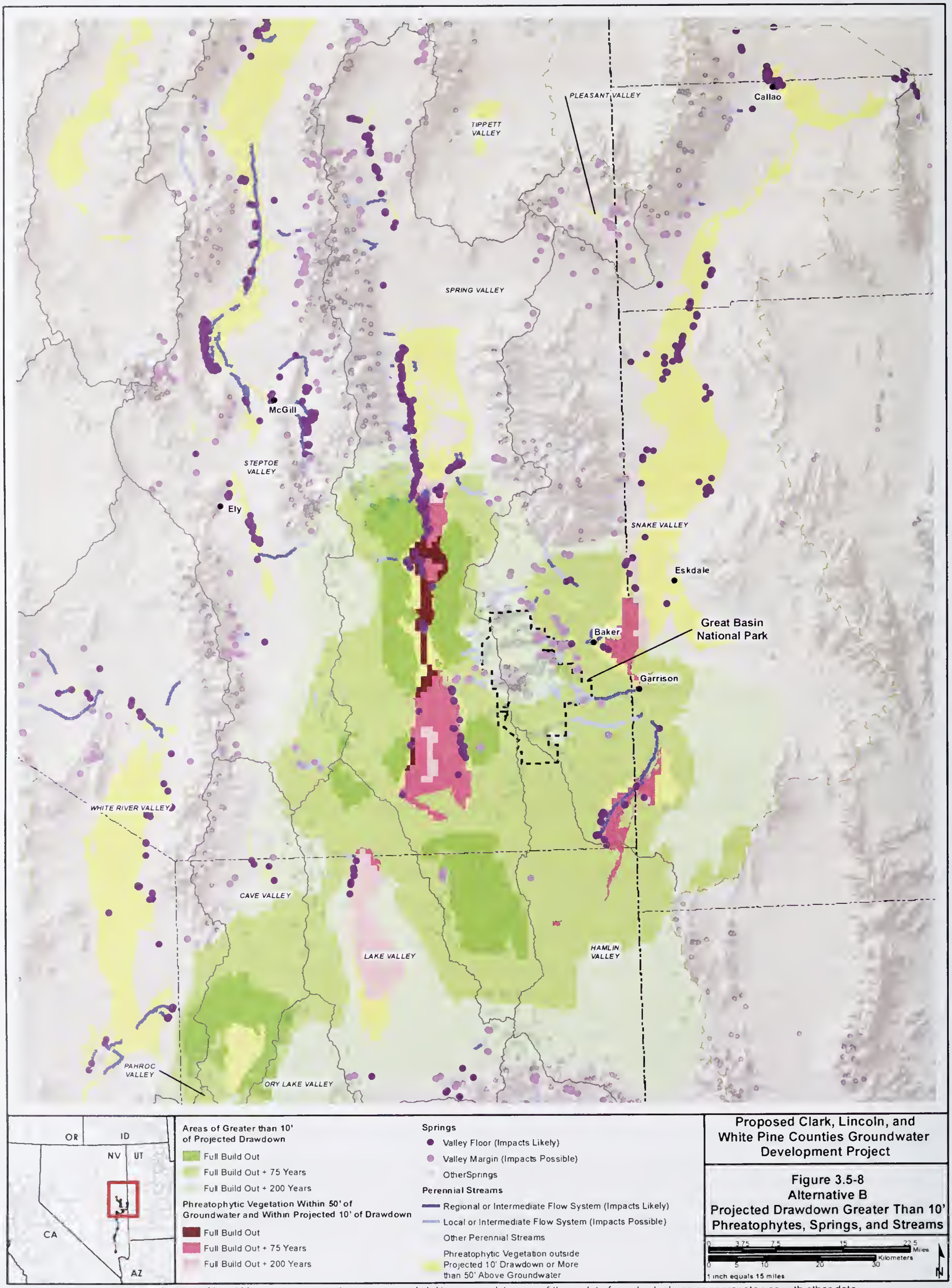
Groundwater Pumping

Figure 3.5-8 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs and perennial stream segments. The following is a summary of the incremental expansion of the groundwater drawdown area over time across the primary pumping hydrologic basins where the majority of the ET area (which encompasses basin shrubland and wetland/meadow cover types), as well as springs and perennial stream reaches whose surface and groundwater supply may be reduced.

Full Build Out. Potential drawdown effects within the ET area boundaries are predicted in central and southern Spring Valley.

Full Build Out Plus 75 Years. The potential drawdown effects within the ET area boundaries would expand across central and southern Spring Valley, and would appear in southern Snake Valley near Baker, in the Big Spring drainage, northeastern Hamlin Valley, Delamar, Dry Lake, Cave, White River, and Steptoe valleys.

Full Build Out Plus 200 Years. The 10-foot drawdown area within the ET area boundaries would incrementally expand in central and southern Spring Valley, the Snake Valley east of Baker, and the southern portions of Lake and Hamlin valleys.



No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

Conclusions and Summary

Table 3.5-16 provides a summary of potential vegetation community effects for the three model time frames.

Table 3.5-16 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative B

Effects/Conclusions

- Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result a long change in plant species composition in the Wetland/Meadow ET area from wetland species such as rushes, sedges, and grasses, to upland species of grasses and shrubs.
- Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result in lower densities of phreatophytic shrubs such as greasewood and an increase in upland species of grasses and shrubs that are not completely, or partially dependent on reliable sources of groundwater.
- Groundwater drawdowns from pumping (index of 10 feet or greater) and changes in spring flows would likely increase stress on spring-fed aquatic vegetation and riparian shrubs. If these water sources dried up over a long period of time (5 years or more), it is likely these communities would not recover and vegetation community composition would change to upland species.
- Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring, Snake, and Lake valleys. The Ute ladies'-tresses orchid has not been identified in any of the areas potentially at risk. If populations of this species are found in the future, evaluations of groundwater drawdown risk to this species would be conducted.

Primary Affected Valleys

- Spring, Snake, and Lake

Impact Indicators By Model Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Wetland/Meadow ET area affected by 10 feet or greater drawdown (acres).	441	5,794	9,190
Basin shrubland ET area affected by 10 feet or greater drawdown (acres).	18,304	97,174	146,998
Total number of springs with moderate to high risk of being affected by 10 feet or more of drawdown (number).	41	175	288
Total miles of perennial streams with moderate to high risk of being affected by 10 feet or greater drawdown	3	91	120

Potential Vegetation Effects in GBNP and adjacent Utah

The streams and springs within GBNP and adjacent Utah that may be affected by 10 foot drawdown or greater are discussed in Section 3.3.2.11, Water Resources. Riparian and herbaceous wetland vegetation communities that depend on streamflows may be stressed by future flow reductions and these riparian plant communities may progressively change toward more of an upland species composition.

COM Plan

- The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for vegetation resources are summarized below for ACMs and mitigation recommendations.

Stipulation Agreements

The stipulation agreements for Spring, Delamar, Dry Lake, and Cave valleys specify the development of monitoring programs to identify ecosystem component changes and an adaptive management framework to respond to changes identified (**Appendix C**). The mitigation efforts would be focused primarily on the protection and maintenance of springs, streams, ponds, wetlands, meadows, swamp cedars, and phreatophytic shrublands, since these communities are dependent on reliable sources of shallow groundwater in the root zone.

Table 3.5-16 **Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative B (Continued)**

ACMs
• ACM C.2.4 – Prepare an ecological study of the Spring Valley swamp cedars to determine groundwater elevation requirements necessary to maintain a viable community. • ACM C.2.5 – Conduct large-scale seeding to assist with vegetation transition from phreatophytic communities in Spring and Snake valleys, to benefit wildlife and reduce potential air resources impacts. • ACM C.2.15 – Modify use of SNWA's agricultural water rights in Spring Valley to offset changes in spring discharges needed to maintain wet meadow areas in the northwest and southeast portions of Spring Valley. This could be accomplished by changing crop production to a less water-intensive type or changing water cycles, and then diverting the saved water to the wet meadow areas.
Monitoring Recommendations
Based on anticipated drawdown effects, the following areas should be considered for vegetation community monitoring: • Minerva Spring Complex, Swallow Spring, Shoshone Ponds, and the springbrook from Shoshone Ponds Well #2 in southern and central Spring Valley. Of this group Minerva Spring Complex, Swallow Spring, and Shoshone Ponds, as well as the wetlands and meadows surrounding Minerva Springs and Shoshone Ponds (including in the Shoshone Ponds ACEC), are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Springs and associated wetlands and meadows along the west side of Spring Valley north of Cleve Creek. West Spring Valley Spring Complex and Keegan Spring Complex, including associated wetlands and meadows, are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • The Big Spring drainage in Snake Valley in Nevada and Utah. Big Springs, Big Spring Creek, Lake Creek, Stateline Springs and Clay Spring (North) are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Swamp Cedar and Baking Powder Flat Blue ACECs. The swamp cedar population in the vicinity of the Swamp Cedar ACEC is being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • **GW-VEG-2 (Monitoring within Ute Ladie's-tresses Habitat)**, **GW-VEG-3 (Wetlands Monitoring)**, **GW-VEG-4 (Phreatophytic Vegetation Monitoring)**, **GW-VEG-5 (Swamp Cedar Monitoring)**, and the Sanke Valley 3M Plan, as listed for the Propoed Action. • As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).
Mitigation Recommendations
GW-VEG-1 (Joshua Tree Avoidance), as listed for the Proposed Action. As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7).
Potential Residual Impacts
• The COM Plan, ACMs, and monitoring and mitigation measures could be effective in reducing impacts to vegetation and special status plant species. The objectives of the COM Plan are to avoid impacts to listed species and critical habitat and avoid, minimize, or mitigate impacts to vegetation. However, it is not possible to determine the level of impact reduction at this time. Effects on some vegetation types and plant species could exist considering the potential long recovery period that could occur. Some unavoidable impacts to vegetation types and species could occur at some locations.

3.5.2.12 Alternative C

Groundwater Development Area

Conclusion. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated surface disturbance of approximately 2,069 to 4,814 acres within 5 hydrologic basins. It is assumed that approximately 66 percent of the construction surface disturbance, or approximately 1,370 to 3,171 acres, would be committed to long-term industrial uses and would not be revegetated during the project life. Vegetation restoration times for shrublands and woodlands would require 20 to 200 years.

The COM Plan would be developed and implemented to protect vegetation resources from groundwater development activities. The COM Plan would integrate protective measures from the following: BLM RMPs, BO, ACMs, Stipulated Agreements, the DOI Handbook for Adaptive Management, and additional mitigation recommended in this EIS. Based on BLM RMP Management Actions, BMPs, and SNWA ACM, it is expected that natural vegetation composition and cover could be restored within the time frames for plants growing in adjacent undisturbed areas and that effects on special status plants could be minimized. There would be a small incremental reduction in the availability of Tribal traditional plants within the hydrologic basins occupied by groundwater development facilities. No specific development plans are available, so it is assumed that the habitat cover types would be affected in proportion to their relative surface area within the groundwater development areas. Consequently, it is expected that sagebrush shrubland, greasewood/saltbush shrubland, and Mojave mixed desert shrubland vegetation types would be most extensively disturbed.

Proposed mitigation measures:

GW-VEG-1: Joshua Tree Avoidance. Mature Joshua trees (*Yucca brevifolia*) would be avoided to the extent possible when laying out access roads in Delamar Valley. Effectiveness: This measure would be effective. Road alignments could be designed to minimize the loss of yuccas, but roads also must be designed with a minimal number of curves to ensure traffic safety. Effects on other resources: Implementation of this measure would not adversely affect other environmental resources. Groundwater Pumping

Figure 3.5-9 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. The following is a summary of the incremental expansion of the groundwater drawdown area over time across the primary pumping hydrologic basins where the majority of the ET area (which encompasses basin shrubland and wetland/meadow cover types), as well as springs and perennial stream reaches whose surface and groundwater supply may be reduced.

Full Build Out. Potential drawdown effects within the ET area boundaries are predicted in central and southern Spring Valley. Three potentially affected springs are located in Spring Valley.

Full Build Out Plus 75 Years. The potential drawdown effects within the ET area boundaries would expand around the margin of central and southern Spring Valley and would appear in southern Snake Valley near Baker and in the Big Spring drainage in Snake Valley.

Full Build Out Plus 200 Years. The 10-foot drawdown area within the ET area boundaries would incrementally expand in southern Spring Valley and the Big Spring drainage.

Conclusions and Summary

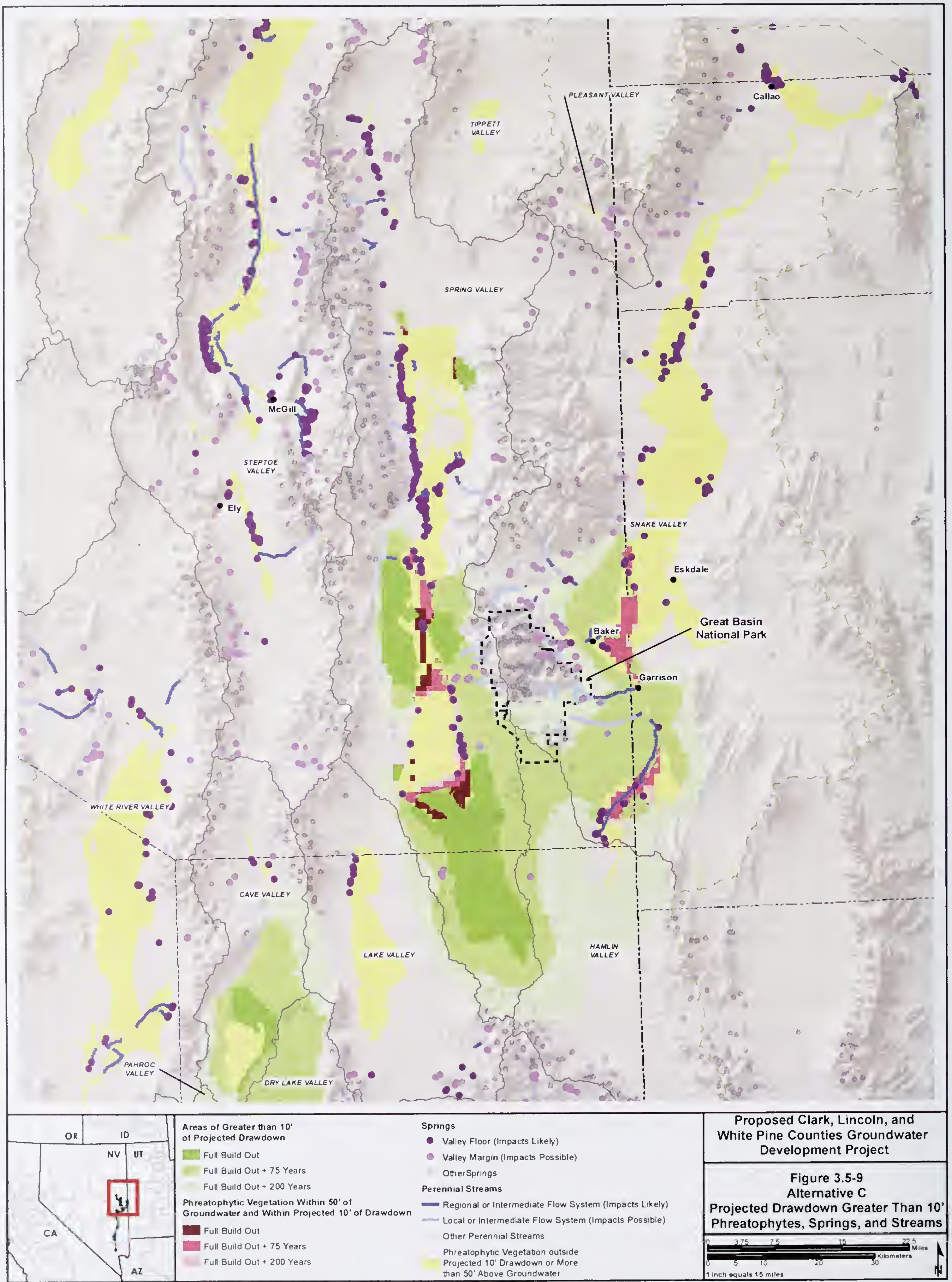
Table 3.5-17 provides a summary of potential vegetation community effects for three model time frames.

Table 3.5-17 **Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative C**

Effects/Conclusions			
• Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result a long change in plant species composition in the Wetland/Meadow ET from wetland species such as rushes, sedges, and grasses, to upland species of grasses and shrubs. • Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result in lower densities of phreatophytic shrubs such as greasewood and an increase in upland species of grasses and shrubs that are not completely, or partially dependent on reliable sources of groundwater. • Groundwater drawdowns from pumping (index of 10 feet or greater) and changes in spring flows would likely increase stress on spring-fed aquatic vegetation and riparian shrubs. If these water sources dried up over a long period of time (5 years or more), it is likely these communities would not recover and vegetation community composition would change to upland species. • Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring, Snake, and Lake valleys. The Ute ladies'-tresses orchid has not been identified in any of the areas potentially at risk. If populations of this species are found in the future, evaluations of groundwater drawdown risk to this species would be conducted.			
Primary Affected Valleys			
• Spring, Snake, Delamar, Dry Lake, and Cave			
Impact Indicators By Model Time Frame	**Full Build Out**	**Full Build Out Plus 75 Years**	**Full Build Out Plus 200 Years**
Wetland/Meadow ET area affected by 10 feet or greater drawdown (acres).	92	2,287	3,250
Basin shrubland ET area affected by 10 feet or greater drawdown (acres).	12,059	42,703	50,076
Total number of springs with moderate to high risk of being affected by 10 feet or more of drawdown (number).	3	63	96
Total miles of perennial streams with moderate to high risk of being affected by 10 feet or greater drawdown.	1	37	59
Potential Vegetation Effects in GBNP and adjacent Utah			
The streams and springs within GBNP and adjacent Utah that may be affected by 10 foot drawdown or greater are discussed in Section 3.3.2.12, Water Resources. Riparian and herbaceous wetland vegetation communities that depend on streamflows may be stressed by future flow reductions and these riparian plant communities may progressively change toward more of an upland species composition.			
COM Plan			
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for vegetation resources are summarized below for ACMs and mitigation recommendations.			
Stipulated Agreements			
The stipulated agreements for Spring, Delamar, Dry Lake, and Cave valleys specify the development of monitoring programs to identify ecosystem component changes and an adaptive management framework to respond to changes identified (**Appendix C**). The mitigation efforts would be focused primarily on the protection and maintenance of springs, streams, ponds, wetlands, meadows, swamp cedars, and phreatophytic shrublands, since these communities are dependent on reliable sources of shallow groundwater in the root zone.			
ACMs			
• ACM C.2.4 – Prepare an ecological study of the Spring Valley swamp cedars to determine groundwater elevation requirements necessary to maintain a viable community. • ACM C.2.5 – Conduct large-scale seeding to assist with vegetation transition from phreatophytic communities in Spring and Snake valleys, to benefit wildlife and reduce potential air resources impacts. • ACM C.2.15 – Modify use of SNWA's agricultural water rights in Spring Valley to offset changes in spring discharges needed to maintain wet meadow areas in the northwest and southeast portions of Spring Valley. This could be accomplished by changing crop production to a less water-intensive type or changing water cycles and then diverting the saved water to the wet meadow areas.			

Table 3.5-17 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative C (Continued)

Monitoring Recommendations
Based on anticipated drawdown effects, the following areas should be considered for vegetation community monitoring: • Minerva Spring Complex, Swallow Spring, Shoshone Ponds, and the springbrook from Shoshone Ponds Well #2 in southern and central Spring Valley. Of this group Minerva Spring Complex, Swallow Spring, and Shoshone Ponds, as well as the wetlands and meadows surrounding Minerva Springs and Shoshone Ponds (including in the Shoshone Ponds ACEC), are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Springs and associated wetlands and meadows along the west side of Spring Valley north of Cleve Creek. West Spring Valley Spring Complex and Keegan Spring Complex, including associated wetlands and meadows, are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • The Big Spring drainage in Snake Valley in Nevada and Utah. Big Springs, Big Spring Creek, Lake Creek, Stateline Springs and Clay Spring (North) are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Swamp Cedar and Baking Powder Flat Blue ACECs. The swamp cedar population in the vicinity of the Swamp Cedar ACEC is being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • **GW-VEG-2 (Monitoring within Ute Ladie's-tresses Habitat)**, **GW-VEG-3 (Wetlands Monitoring)**, **GW-VEG-4 (Phreatophytic Vegetation Monitoring)**, **GW-VEG-5 (Swamp Cedar Monitoring)**, and the Sanke Valley 3M Plan, as listed for the Propoed Action. • As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).
Mitigation Recommendations
GW-VEG-1 (Joshua Tree Avoidance), as listed for the Proposed Action. As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7).
Potential Residual Impacts
• The COM Plan, ACMs, and monitoring and mitigation measures could be effective in reducing impacts to vegetation and special status plant species. The objectives of the COM Plan are to avoid impacts to listed species and critical habitat and avoid, minimize, or mitigate impacts to vegetation. However, it is not possible to determine the level of impact reduction at this time. Effects on some vegetation types and plant species could exist considering the potential long recovery period that could occur. Some unavoidable impacts to vegetation types and species could occur at some locations.



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.5-9
Alternative C
Projected Drawdown Greater Than 10'
Phreatophytes, Springs, and Streams

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

3.5.2.13 Alternative D

Groundwater Development Area

Conclusion. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated maximum surface disturbance of approximately 2,513 to 4,005 acres within 4 hydrologic basins. It is assumed that approximately 66 percent of the construction surface disturbance, or approximately 1,655 to 2,635 acres would be committed to long-term industrial uses and would not be revegetated during the project life. Vegetation restoration times for shrublands and woodland would require 20 to 200 years.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on vegetation resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section. Based on BLM RMP Management Actions, BMPs, and SNWA ACMs, it is expected that natural vegetation composition and cover could be restored within the time frames for plants growing in adjacent undisturbed areas and that effects on special status plants could be minimized. There would be a small incremental reduction in the availability of Tribal traditional plants within the hydrologic basins occupied by groundwater development facilities. No specific development plans are available, so it is assumed that the habitat cover types would be affected in proportion to their relative surface area within the groundwater development areas. Consequently, it is expected that sagebrush shrubland, greasewood/saltbush shrubland, and Mojave mixed desert shrubland vegetation types would be most extensively disturbed.

Groundwater Pumping

Figure 3.5-10 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. The following is a summary of the incremental expansion of the groundwater drawdown area over time across the primary pumping hydrologic basins where the majority of the ET area (which encompasses basin shrubland and wetland/meadow cover types), as well as springs and perennial stream reaches whose surface and groundwater supply may be reduced.

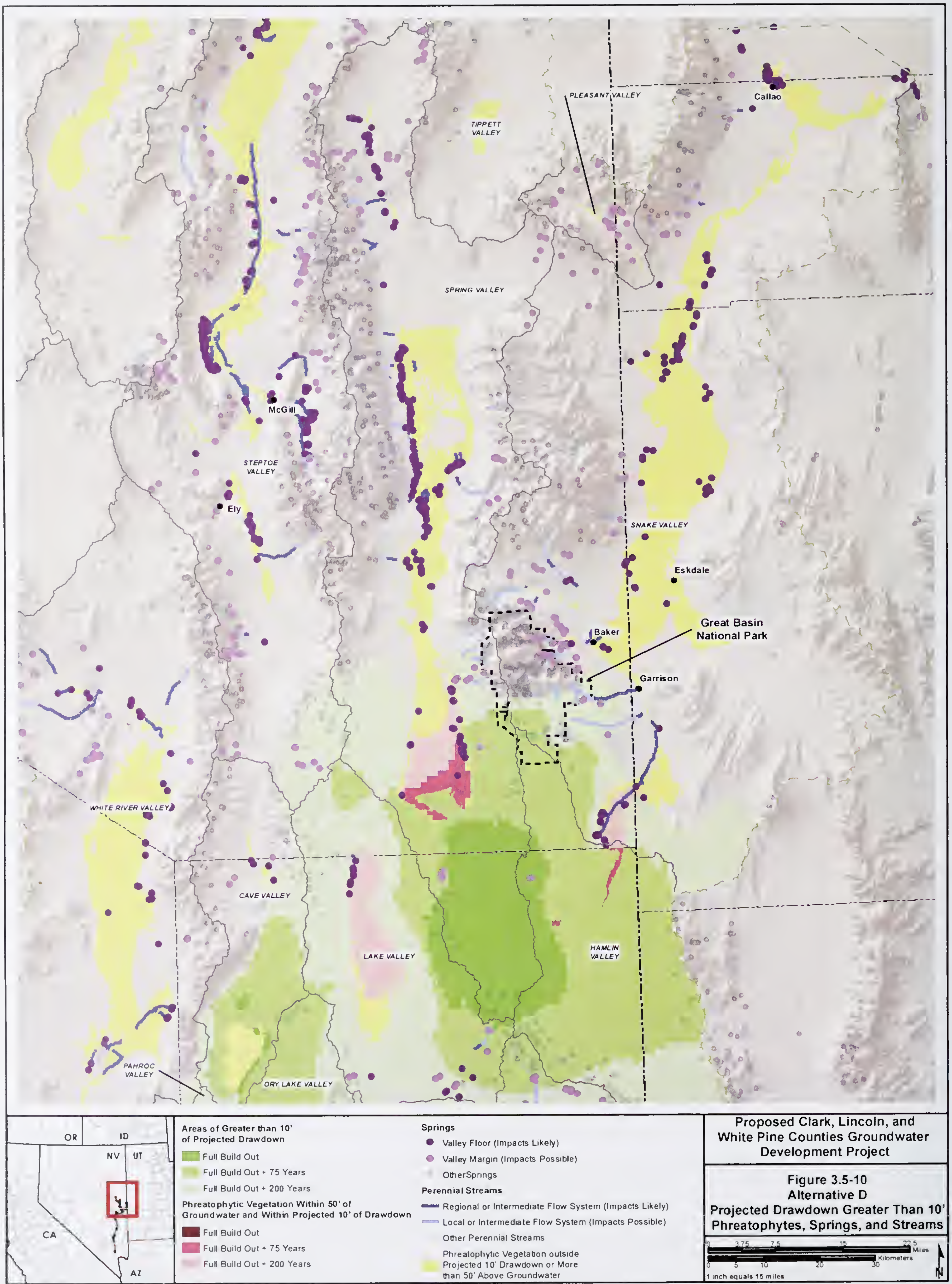
Full Build Out. No potential drawdown effects within the ET area boundaries are predicted in this time frame.

Full Build Out Plus 75 Years. The potential drawdown effects within the ET area boundaries would occur in southern Spring Valley and in northeastern Hamlin Valley.

Full Build Out Plus 200 Years. The 10-foot drawdown area within the ET area boundaries would incrementally expand northward in southern Spring Valley, across northern Lake Valley, and within the Big Spring drainage in Snake Valley.

Conclusions and Summary

Table 3.5-18 provides a summary of potential vegetation community effects for three model time frames.



No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

Table 3.5-18 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative D

Effects/Conclusions

- Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result a long change in plant species composition in the Wetland/Meadow ET area from wetland species such as rushes, sedges, and grasses, to upland species of grasses and shrubs.
- Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result in lower densities of phreatophytic shrubs such as greasewood and an increase in upland species of grasses and shrubs that are not completely, or partially dependent on reliable sources of groundwater.
- Groundwater drawdowns from pumping (index of 10 feet or greater) and changes in spring flows would likely increase stress on spring-fed aquatic vegetation and riparian shrubs. If these water sources dried up over a long period of time (5 years or more), it is likely these communities would not recover and vegetation community composition would change to upland species.
- Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring, Snake, and Lake valleys. The Ute ladies'-tresses orchid has not been identified in any of the areas potentially at risk. If populations of this species are found in the future, evaluations of groundwater drawdown risk to this species would be conducted.

Primary Affected Valleys

- Spring, Snake, Hamlin, and Lake

Impact Indicators By Model Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Wetland/Meadow ET area affected by 10 feet or greater drawdown (acres).	0	1,507	4,453
Basin shrubland ET area affected by 10 feet or greater drawdown (acres).	0	16,747	81,349
Total number of springs with moderate to high risk of being affected by 10 feet or more of drawdown (number).	1	41	123
Total miles of perennial streams with moderate to high risk of being affected by 10 feet or greater drawdown	0	4	48

Potential Vegetation Effects in GBNP and adjacent Utah

The streams and springs within GBNP and adjacent Utah that may be affected by 10 foot drawdown or greater are discussed in Section 3.3.2.13, Water Resources. Riparian and herbaceous wetland vegetation communities that depend on streamflows may be stressed by future flow reductions and these riparian plant communities may progressively change toward more of an upland species composition.

COM Plan

- The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for vegetation resources are summarized below for ACMs and mitigation recommendations.

Stipulation Agreements

The stipulation agreements for Spring, Delamar, Dry Lake, and Cave valleys specify the development of monitoring programs to identify ecosystem component changes and an adaptive management framework to respond to changes identified (**Appendix C**). The mitigation efforts would be focused primarily on the protection and maintenance of springs, streams, ponds, wetlands, meadows, swamp cedars, and phreatophytic shrublands, since these communities are dependent on reliable sources of shallow groundwater in the root zone.

ACMs

- ACM C.2.4 – Prepare an ecological study of the Spring Valley swamp cedars to determine groundwater elevation requirements necessary to maintain a viable community.
- ACM C.2.5 – Conduct large-scale seeding to assist with vegetation transition from phreatophytic communities in Spring and Snake Valley to benefit wildlife and reduce potential air resources impacts.
- ACM C.2.15 – Modify use of SNWA's agricultural water rights in Spring Valley to offset changes in spring discharges needed to maintain wet meadow areas in the northwest and southeast portions of Spring Valley. This could be accomplished by changing crop production to a less water-intensive type or changing water cycles, and then diverting the saved water to the wet meadow areas.

Table 3.5-18 **Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative D (Continued)**

Monitoring Recommendations
Based on anticipated drawdown effects, the following areas should be considered for vegetation community monitoring: • Minerva Spring Complex, Swallow Spring, Shoshone Ponds, and the springbrook from Shoshone Ponds Well #2 in southern and central Spring Valley. Of this group Minerva Spring Complex, Swallow Spring, and Shoshone Ponds, as well as the wetlands and meadows surrounding Minerva Springs and Shoshone Ponds (including in the Shoshone Ponds ACEC), are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Springs and associated wetlands and meadows along the west side of Spring Valley north of Cleve Creek. West Spring Valley Spring Complex and Keegan Spring Complex, including associated wetlands and meadows, are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • The Big Spring drainage in Snake Valley in Nevada and Utah. Big Springs, Big Spring Creek, Lake Creek, Stateline Springs and Clay Spring (North) are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Swamp Cedar and Baking Powder Flat Blue ACECs. The swamp cedar population in the vicinity of the Swamp Cedar ACEC is being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • **GW-VEG-2 (Monitoring within Ute Ladie's-tresses Habitat)**, **GW-VEG-3 (Wetlands Monitoring)**, **GW-VEG-4 (Phreatophytic Vegetation Monitoring)**, **GW-VEG-5 (Swamp Cedar Monitoring)**, and the Sanke Valley 3M Plan, as listed for the Propoed Action. • As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).
Mitigation Recommendations
GW-VEG-1 (Joshua Tree Avoidance), as listed for the Proposed Action.
As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7).
Potential Residual Impacts
• The COM Plan, ACMs, and monitoring and mitigation measures could be effective in reducing impacts to vegetation and special status plant species. The objectives of the COM Plan are to avoid impacts to listed species and critical habitat and avoid, minimize, or mitigate impacts to vegetation. However, it is not possible to determine the level of impact reduction at this time. Effects on some vegetation types and plant species could exist considering the potential long recovery period that could occur. Some unavoidable impacts to vegetation types and species could occur at some locations.

3.5.2.14 Alternative E

Groundwater Development Area

Conclusion. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated surface disturbance of approximately 1,754 to 4,079 acres within 4 hydrologic basins. It is assumed that approximately 66 percent of the construction surface disturbance, or approximately 1,158 to 2,683 acres, would be committed to long-term industrial uses and would not be revegetated during the project life. Vegetation restoration times for shrublands and woodland would require 20 to 200 years.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on vegetation resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section. Based on BLM RMP Management Actions, BMPs, and SNWA ACMs, it is expected that natural vegetation composition and cover could be restored within the time frames for plants growing in adjacent undisturbed areas and that effects on special status plants could be minimized. There would be a small incremental reduction in the availability of Tribal traditional plants within the hydrologic basins occupied by groundwater development facilities. No specific development plans are available, so it is assumed that the habitat cover types would be affected in proportion to their relative surface area within the groundwater development areas. Consequently, it is expected that sagebrush shrubland, greasewood/saltbush shrubland, and Mojave mixed desert shrubland vegetation types would be most extensively disturbed.

Groundwater Pumping

Figure 3.5-11 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. The following is a summary of the incremental expansion of the groundwater drawdown area over time across the primary pumping hydrologic basins where the majority of the ET area (which encompasses basin shrubland and wetland/meadow cover types), as well as springs and perennial stream reaches whose surface and groundwater supply may be reduced.

Full Build Out. Potential drawdown effects within ET area boundaries are predicted in small areas within central and southern Spring Valley.

Full Build Out Plus 75 Years. The potential drawdown effects within the ET area boundaries would expand in southern, central, and northern Spring Valley, and in northern Lake Valley.

Full Build Out Plus 200 Years. The 10-foot drawdown area within the ET area boundaries would incrementally expand in central and southern Spring Valley, and across northern Lake Valley.

Conclusions and Summary

Table 3.5-19 provides a summary of potential vegetation community effects for three model time frames.

Table 3.5-19 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative E

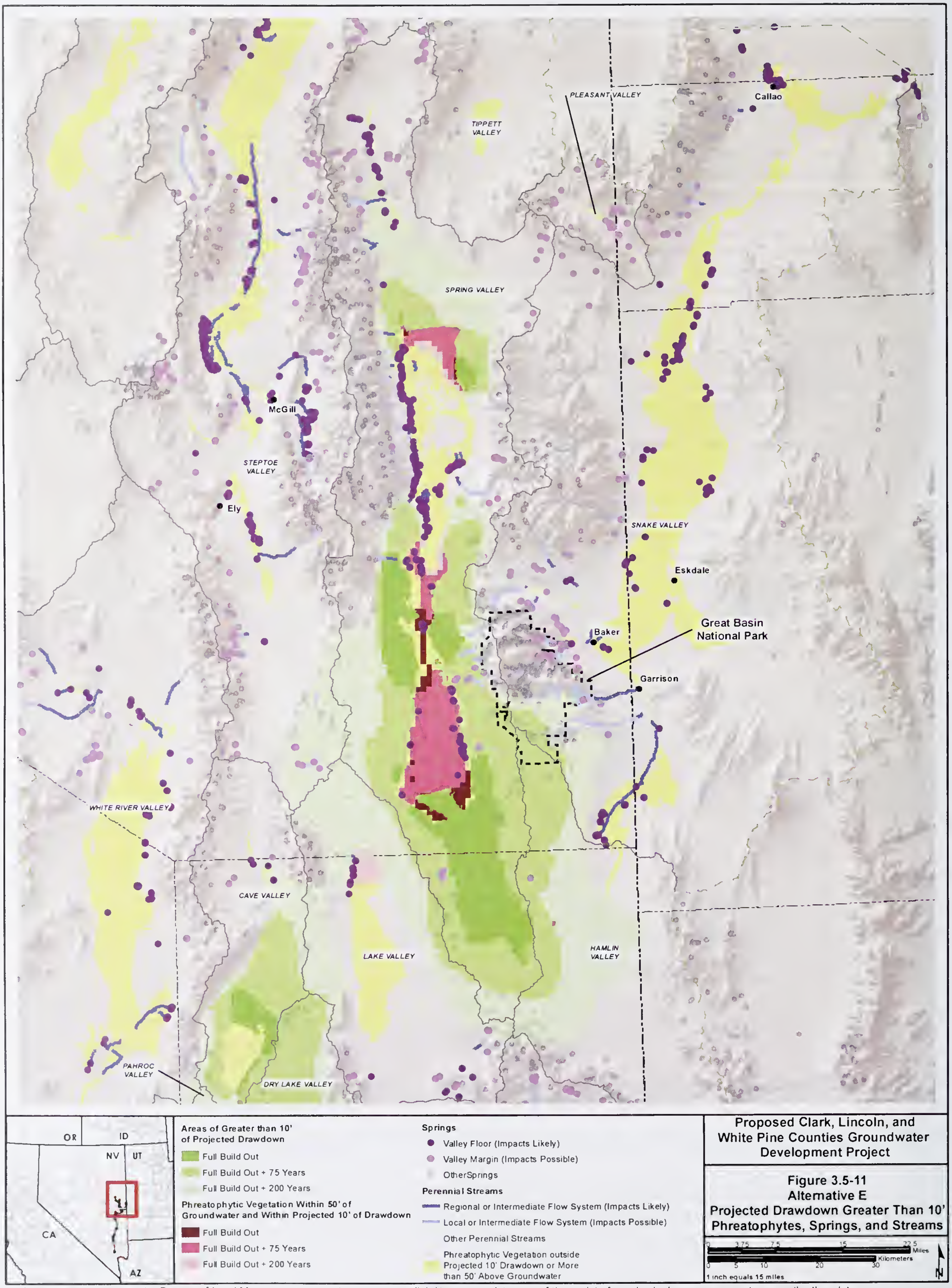
Effects/Conclusions			
• Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result a long change in plant species composition in the Wetland/Meadow ET area from wetland species such as rushes, sedges, and grasses, to upland species of grasses and shrubs. • Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result in lower densities of phreatophytic shrubs such as greasewood and an increase in upland species of grasses and shrubs that are not completely, or partially dependent on reliable sources of groundwater. • Groundwater drawdowns from pumping (index of 10 feet or greater) and changes in spring flows would likely increase stress on spring-fed aquatic vegetation and riparian shrubs. If these water sources dried up over a long period of time (5 years or more), it is likely these communities would not recover and vegetation community composition would change to upland species. • Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring, Snake, and Lake valleys. The Ute ladies'-tresses orchid has not been identified in any of the areas potentially at risk. If populations of this species are found in the future, evaluations of groundwater drawdown risk to this species would be conducted.			
Primary Affected Valleys			
• Spring, Lake, Hamlin, and Lake			
Impact Indicators By Model Time Frame	**Full Build Out**	**Full Build Out Plus 75 Years**	**Full Build Out Plus 200 Years**
Wetland/Meadow ET area affected by 10 feet or greater drawdown (acres).	92	2,548	3,835
Basin shrubland ET area affected by 10 feet or greater drawdown (acres).	12,059	71,429	81,389

Table 3.5-19 **Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative E (Continued)**

Impact Indicators By Model Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Total number of springs with moderate to high risk of being affected by 10 feet or more of drawdown (number).	3	55	104
Total miles of perennial streams with moderate to high risk of being affected by 10 feet or greater drawdown	1	7	23
Potential Vegetation Effects in GBNP and adjacent Utah			
The streams and springs within GBNP and adjacent Utah that may be affected by 10 foot drawdown or greater are discussed in Section 3.3.2.14, Water Resources. Riparian and herbaceous wetland vegetation communities that depend on stream flows may be stressed by future flow reductions and these riparian plant communities may progressively change toward more of an upland species composition.			
COM Plan			
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for vegetation resources are summarized below for ACMs and mitigation recommendations.			
Stipulation Agreements			
The stipulation agreements for Spring, Delamar, Dry Lake, and Cave valleys specify the development of monitoring programs to identify ecosystem component changes and an adaptive management framework to respond to changes identified (**Appendix C**). The mitigation efforts would be focused primarily on the protection and maintenance of springs, streams, ponds, wetlands, meadows, swamp cedars, and phreatophytic shrublands, since these communities are dependent on reliable sources of shallow groundwater in the root zone.			
ACMs			
• ACM C.2.4 – Prepare an ecological study of the Spring Valley swamp cedars to determine groundwater elevation requirements necessary to maintain a viable community. • ACM C.2.5 – Conduct large-scale seeding to assist with vegetation transition from phreatophytic communities in Spring and Snake valleys to benefit wildlife and reduce potential air resources impacts. • ACM C.2.15 – Modify use of SNWA's agricultural water rights in Spring Valley to offset changes in spring discharges needed to maintain wet meadow areas in the northwest and southeast portions of Spring Valley. This could be accomplished by changing crop production to a less water-intensive type or changing water cycles and then diverting the saved water to the wet meadow areas.			
Monitoring Recommendations			
Based on anticipated drawdown effects, the following areas should be considered for vegetation community monitoring: • Minerva Spring Complex, Swallow Spring, Shoshone Ponds, and the springbrook from Shoshone Ponds Well #2 in southern and central Spring Valley. Of this group Minerva Spring Complex, Swallow Spring, and Shoshone Ponds, as well as the wetlands and meadows surrounding Minerva Springs and Shoshone Ponds (including in the Shoshone Ponds ACEC), are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Springs and associated wetlands and meadows along the west side of Spring Valley north of Cleve Creek. West Spring Valley Spring Complex and Keegan Spring Complex, including associated wetlands and meadows, are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • The Big Spring drainage in Snake Valley in Nevada and Utah. Big Springs, Big Spring Creek, Lake Creek, Stateline Springs and Clay Spring (North) are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Swamp Cedar and Baking Powder Flat Blue ACECs. The swamp cedar population in the vicinity of the Swamp Cedar ACEC is being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • **GW-VEG-2 (Monitoring within Ute Ladie's-tresses Habitat)**, **GW-VEG-3 (Wetlands Monitoring)**, **GW-VEG-4 (Phreatophytic Vegetation Monitoring)**, **GW-VEG-5 (Swamp Cedar Monitoring)**, and the Sanke Valley 3M Plan, as listed for the Propoed Action. • As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).			

Table 3.5-19 **Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative E (Continued)**

Mitigation Recommendations
GW-VEG-1 (Joshua Tree Avoidance), as listed for the Proposed Action. As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7).
Potential Residual Impacts
• The COM Plan, ACMs, and monitoring and mitigation measures could be effective in reducing impacts to vegetation and special status plant species. The objectives of the COM Plan are to avoid impacts to listed species and critical habitat and avoid, minimize, or mitigate impacts to vegetation. However, it is not possible to determine the level of impact reduction at this time. Effects on some vegetation types and plant species could exist considering the potential long recovery period that could occur. Some unavoidable impacts to vegetation types and species could occur at some locations.



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.5-11
Alternative E
Projected Drawdown Greater Than 10'
Phreatophytes, Springs, and Streams

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

3.5.2.15 Alternative F

Groundwater Development Area

Conclusion. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated surface disturbance of approximately 2,698 to 6,629 acres within 4 hydrologic basins. It is assumed that approximately 66 percent of the construction surface disturbance, or approximately 1,782 to 4,359 acres, would be committed to long-term industrial uses and would not be revegetated during the project life. Vegetation restoration times for shrublands and woodland would require 20 to 200 years.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on vegetation resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section. Based on BLM RMP Management Actions, BMPs, and SNWA ACMs, it is expected that natural vegetation composition and cover could be restored within the time frames for plants growing in adjacent undisturbed areas and that effects on special status plants could be minimized. There would be a small incremental reduction in the availability of Tribal traditional plants within the hydrologic basins occupied by groundwater development facilities. No specific development plans are available, so it is assumed that the habitat cover types would be affected in proportion to their relative surface area within the groundwater development areas. Consequently, it is expected that sagebrush shrubland, greasewood/saltbush shrubland, and Mojave mixed desert shrubland vegetation types would be most extensively disturbed.

Groundwater Pumping

Figure 3.5-12 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. The following is a summary of the incremental expansion of the groundwater drawdown area over time across the primary pumping hydrologic basins where the majority of the ET area (which encompasses basin shrubland and wetland/meadow cover types), as well as springs and perennial stream reaches whose surface and groundwater supply may be reduced.

Full Build Out. Potential drawdown effects within ET area boundaries are predicted in small areas within central and southern Spring Valley.

Full Build Out Plus 75 Years. The potential drawdown effects within the ET area boundaries would expand in southern, central, and northern Spring Valley, and in northern Lake Valley.

Full Build Out Plus 200 Years. The 10-foot drawdown area within the ET area boundaries would incrementally expand in central and southern Spring Valley, and across northern Lake Valley.

Conclusions and Summary

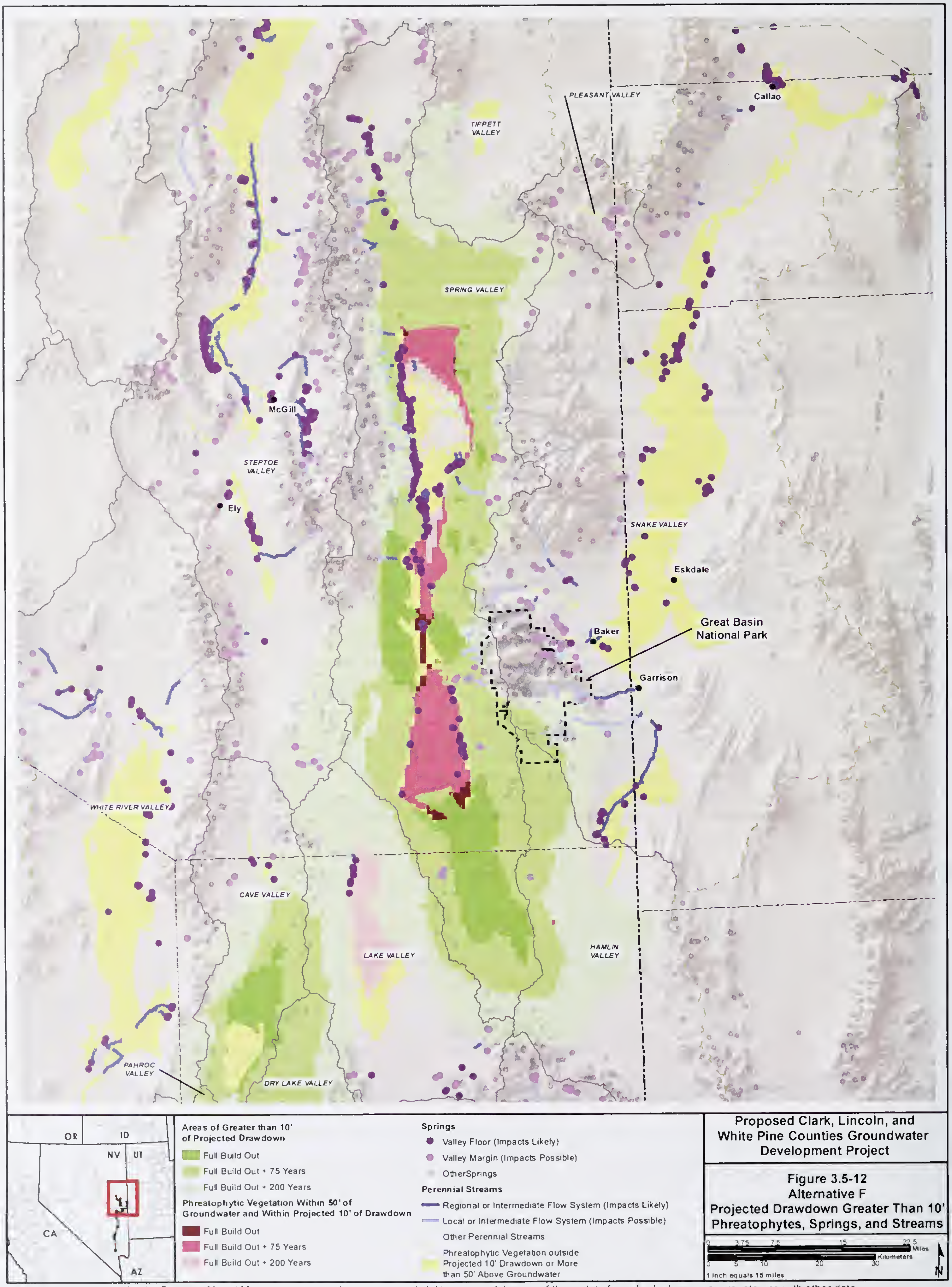
Table 3.5-20 provides a summary of potential vegetation community effects for three model time frames.

Table 3.5-20 **Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative F**

Effects/Conclusions			
• Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result a long change in plant species composition in the Wetland/Meadow ET area from wetland species such as rushes, sedges, and grasses, to upland species of grasses and shrubs. • Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result in lower densities of phreatophytic shrubs such as greasewood and an increase in upland species of grasses and shrubs that are not completely, or partially dependent on reliable sources of groundwater. • Groundwater drawdowns from pumping (index of 10 feet or greater) and changes in spring flows would likely increase stress on spring-fed aquatic vegetation and riparian shrubs. If these water sources dried up over a long period of time (5 years or more), it is likely these communities would not recover and vegetation community composition would change to upland species. • Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring and Lake valleys. The Ute ladies'-tresses orchid has not been identified in any of the areas potentially at risk. If populations of this species are found in the future, evaluations of groundwater drawdown risk to this species would be conducted.			
Primary Affected Valleys			
• Spring, Lake, Hamlin, and Delamar, Dry Lake, and Cave valleys			
Impact Indicators By Model Time Frame	**Full Build Out**	**Full Build Out Plus 75 Years**	**Full Build Out Plus 200 Years**
Wetland/Meadow ET area affected by 10 feet or greater drawdown (acres).	85	3,096	5,519
Basin shrubland ET area affected by 10 feet or greater drawdown (acres).	8,272	89,049	130,591
Total number of springs with moderate to high risk of being affected by 10 feet or more of drawdown (number).	5	131	203
Total miles of perennial streams with moderate to high risk of being affected by 10 feet or greater drawdown	1	21	33
Potential Vegetation Effects in GBNP and adjacent Utah			
The streams and springs within GBNP and adjacent Utah that may be affected by 10 foot drawdown or greater are discussed in Section 3.3.2.14, Water Resources. Riparian and herbaceous wetland vegetation communities that depend on stream flows may be stressed by future flow reductions and these riparian plant communities may progressively change toward more of an upland species composition.			
COM Plan			
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for vegetation resources are summarized below for ACMs and mitigation recommendations.			
Stipulation Agreements			
The stipulation agreements for Spring, Delamar, Dry Lake, and Cave valleys specify the development of monitoring programs to identify ecosystem component changes and an adaptive management framework to respond to changes identified (**Appendix C**). The mitigation efforts would be focused primarily on the protection and maintenance of springs, streams, ponds, wetlands, meadows, swamp cedars, and phreatophytic shrublands, since these communities are dependent on reliable sources of shallow groundwater in the root zone.			
ACMs			
• ACM C.2.4 – Prepare an ecological study of the Spring Valley swamp cedars to determine groundwater elevation requirements necessary to maintain a viable community. • ACM C.2.5 – Conduct large-scale seeding to assist with vegetation transition from phreatophytic communities in Spring Valley to benefit wildlife and reduce potential air resources impacts. • ACM C.2.15 – Modify use of SNWA's agricultural water rights in Spring Valley to offset changes in spring discharges needed to maintain wet meadow areas in the northwest and southeast portions of Spring Valley. This could be accomplished by changing crop production to a less water-intensive type or changing water cycles and then diverting the saved water to the wet meadow areas.			

Table 3.5-20 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative F (Continued)

Monitoring Recommendations
Based on anticipated drawdown effects, the following areas should be considered for vegetation community monitoring: • Minerva Spring Complex, Swallow Spring, Shoshone Ponds, and the springbrook from Shoshone Ponds Well #2 in southern and central Spring Valley. Of this group, Minerva Spring Complex, Swallow Spring, and Shoshone Ponds, as well as the wetlands and meadows surrounding Minerva Springs and Shoshone Ponds (including in the Shoshone Ponds ACEC), are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Springs and associated wetlands and meadows along the west side of Spring Valley north of Cleve Creek. West Spring Valley Spring Complex and Keegan Spring Complex, including associated wetlands and meadows, are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Swamp Cedar and Baking Powder Flat Blue ACECs. The swamp cedar population in the vicinity of the Swamp Cedar ACEC is being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • **GW-VEG-2 (Monitoring within Ute Ladie's-tresses Habitat)**, **GW-VEG-3 (Wetlands Monitoring)**, **GW-VEG-4 (Phreatophytic Vegetation Monitoring)**, **GW-VEG-5 (Swamp Cedar Monitoring)**, and the Sanke Valley 3M Plan, as listed for the Propoed Action. • As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).
Mitigation Recommendations
GW-VEG-1 (Joshua Tree Avoidance), as listed for the Proposed Action. As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7).
Potential Residual Impacts
• The COM Plan, ACMs, and monitoring and mitigation measures could be effective in reducing impacts to vegetation and special status plant species. The objectives of the COM Plan are to avoid impacts to listed species and critical habitat and avoid, minimize, or mitigate impacts to vegetation. However, it is not possible to determine the level of impact reduction at this time. Effects on some vegetation types and plant species could exist considering the potential long recovery period that could occur. Some unavoidable impacts to vegetation types and species could occur at some locations.



No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

3.5.2.16 No Action

Groundwater Development Area

Conclusion. Under the No Action Alternative, the proposed project would not be constructed or maintained. No project-related surface disturbance would occur. Vegetation communities would continue to be influenced by natural events such as drought, fire, and land use activities such as grazing and existing water diversions. Management activities on public lands will continue to be directed by the Ely and Las Vegas RMPs, which involve measures to maintain natural vegetation communities. Management guidance for other public lands in the project study area would be provided by Great Basin Park General Management and the Forest Plan for the Humbolt-Toiyabe National Forest.

Groundwater Pumping

Figure 3.5-13 illustrates the expansion of the 10-foot drawdown contour from existing pumping in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. The following is a summary of the incremental expansion of the groundwater drawdown area over time across the primary pumping hydrologic basins where the majority of the ET area (which encompasses basin shrubland and wetland/meadow cover types), as well as springs and perennial stream reaches whose surface water and groundwater supply may be reduced.

Full Build Out. Potential drawdown effects within the ET area boundaries are predicted in Lake Valley.

Full Build Out Plus 75 Years. The potential drawdown effects within the ET area boundaries would expand northward in Lake Valley.

Full Build Out Plus 200 Years. The 10-foot drawdown area within the ET area boundaries would incrementally expand in northern Lake Valley and a small area in southern Spring Valley.

3.5.2.17 Comparison of Alternatives

Table 3.5-21 provides a summary of impact indicators for the Proposed Action and Alternatives A through F.

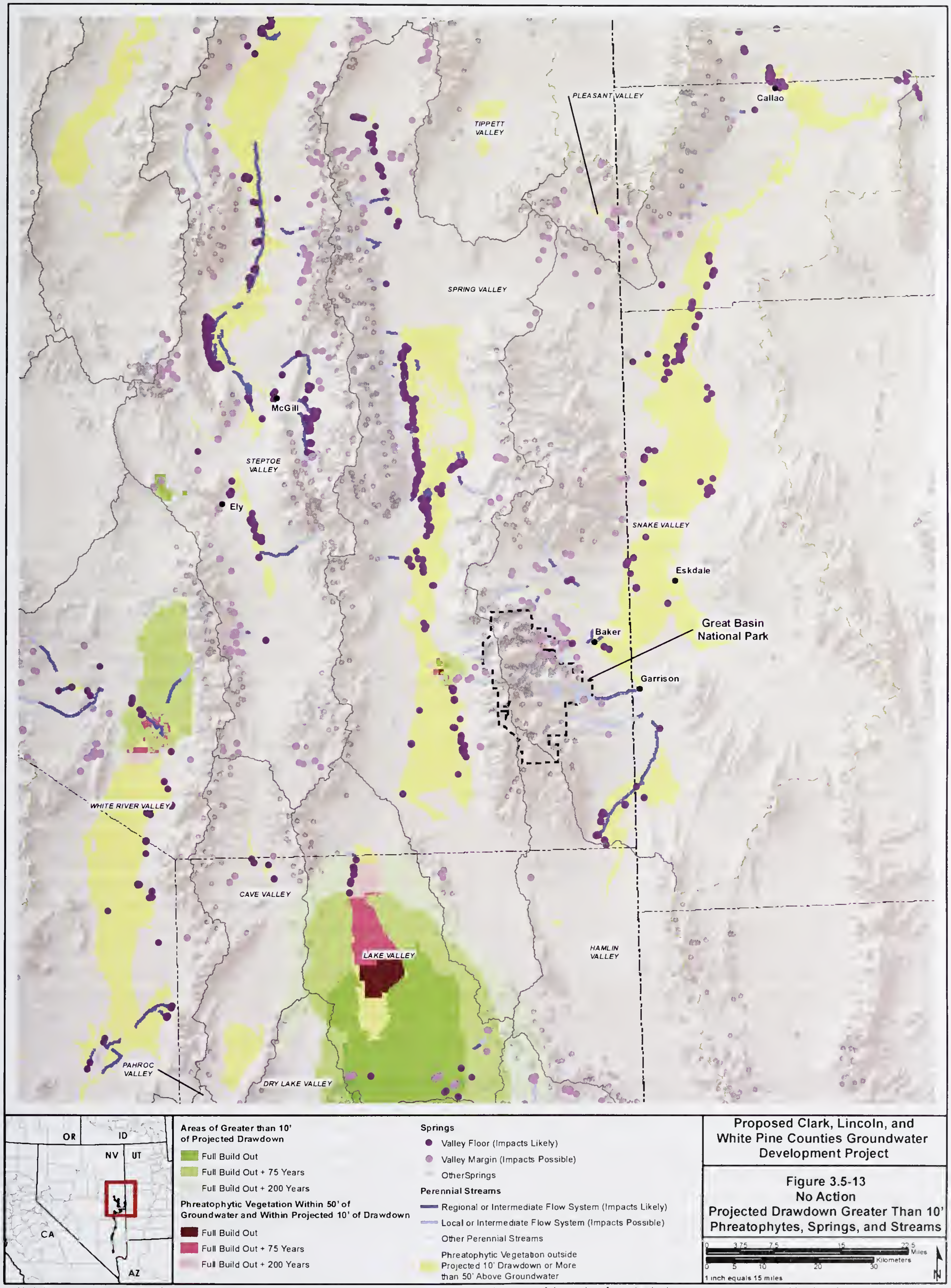
Table 3.5-21 Summary of Vegetation Resource Impacts – Proposed Action, Alternatives A through F Pumping

Impact Information	Impact Indicators (three model periods)	Proposed Action	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E	Alternative F
Wetland/Meadow ET unit area affected by 10 feet or greater draw down (acres)	FBO[1]	117	92	441	92	0	92	85
	FBO + 75 Years	5,460	4,624	5,794	2,287	1,507	2,548	3,096
	FBO + 200 Years	8,048	6,137	9,190	3,250	4,453	3,835	5,519
Basin shrub ET unit area affected by 10 feet or greater draw down (acres)	FBO	17,702	12,059	18,304	12,059	0	12,059	8,272
	FBO + 75 Years	136,990	106,414	97,174	42,703	16,747	71,429	89,049
	FBO + 200 Years	191,506	123,714	146,998	50,076	81,349	81,389	130,591
Total number of springs with moderate to high risk of being affected by 10 feet or greater drawdown	FBO[1]	8	3	41	3	1	3	5
	FBO + 75 Years	212	115	175	63	41	55	131
	FBO + 200 Years	305	182	288	96	123	104	203

Table 3.5-21 Summary of Vegetation Resource Impacts – Proposed Action, Alternatives A through F Pumping (Continued)

Impact Information	Impact Indicators (three model periods)	Proposed Action	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E	Alternative F
Total miles of perennial streams with moderate to high risk of being affected by 10 feet or greater drawdown	FBO	6	1	3	1	0	1	1
	FBO + 75 Years	80	58	91	37	4	7	21
	FBO + 200 Years	112	81	120	59	48	23	33

[1] Full Build Out.



No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data

3.5.3 Cumulative Impacts

3.5.3.1 Impacts Common to All Alternatives

Climate Change Effects

Climate change already appears to be influencing both natural and managed ecosystems of the American Southwest (Breshears et al. 2005, Westerling et al. 2006, Seager et al. 2007) and models indicate the likelihood of the Southwest being a climate change "hotspot" in the coming decades (Diffenbaugh et al. 2008). Recent warming in the Southwest is among the most rapid in the nation, significantly more than the global average in some areas (USGCRP 2009). Projections suggest continued strong warming in the region, with significant increases in temperature (USGCRP 2009) and decreases in precipitation (Seager et al. 2007). A warmer atmosphere and an intensified water cycle are likely to mean not only a greater likelihood of drought for the Southwest, but also an increased risk of flooding (USGCRP 2009). Greater variability in patterns of precipitation can be anticipated in the future. In the coming century, mean global temperature could increase significantly, with an associated increase in both the frequency of extreme events (heat waves, droughts, storms) and the frequency and extent of wildfire (IPCC 2007; Westerling & Bryant 2008; Krawchuk et al. 2009). Under such conditions, future impacts could be substantial for some resources, impacting biodiversity, protected areas, and agricultural lands.

Climate Change Effects to Vegetation Resources

Vegetation

Climate, more than any other factor, controls the broadscale distributions of plant species and vegetation. At finer scales, other factors such as local environmental conditions including soil nutrient status, pH, water-holding capacity and the physical elements of aspect or slope influence the potential presence or absence of a species. However, intra- and inter-specific interactions, such as competition for resources (light, water, nutrients), ultimately determine whether an individual plant is actually found at any particular location (Sykes 2009). Rapid climate change associated with increasing greenhouse gas emissions (IPCC 2007) influences current and future vegetation patterns. Other human-influenced factors are, however, also involved. Sala et al. (2000) identified five different drivers of change that can be expected to affect global biodiversity over the next 100 years. Globally, land use change was considered the most important driver of change, followed by climate change, airborne nitrogen deposition, biotic interactions (invasive species) and direct CO_2 (fertilizing or water use efficiency effects).

Predicted changes in climate that may occur in the southwestern U.S. include increased atmospheric concentrations of CO_2, increased surface temperatures, changes in the amount, seasonality, and distribution of precipitation, more frequent climatic extremes, and a greater variability in climate patterns. Recent temperature increases have made the current drought in the region more severe than the natural droughts of the last several centuries. This drought has caused substantial die-off of piñon trees in approximately 4,600 square miles of piñon-juniper woodland in the Four Corners region (Breshears et al. 2005). The specific physiological effects of increasing greenhouse gas emissions (particularly CO_2) on vegetation include increased net photosynthesis, reduced photorespiration, changes in dark respiration, and reduced stomatal conductance which decreases transpiration and increases water use efficiency (Patterson and Flint 1990). Ambient temperature affects plants directly and indirectly at each stage of their life cycle (Morison and Lawlor 1999). Water (i.e. soil moisture) is usually the abiotic factor most limiting to vegetation, especially in arid and semi-arid regions. CO_2, temperature, and soil moisture effects on plant physiology are exhibited at the whole-plant level in terms of growth and resource acquisition. In addition to the individual effects of increasing temperatures and CO_2, there is the additional interactive effect on photosynthetic productivity and ecosystem-level process (Long 1991).

Plants are finely tuned to the seasonality of their environment and shifts in the timing of plant activity (i.e. phenology) provide some of the most compelling evidence that species and ecosystems are being influenced by global environmental change (Cleland et al. 2007). Changes in the phenology of plants have been noted in recent decades in regions around the world (Bradley et al. 1999; Fitter & Fitter 2002; Walther et al. 2002; Parmesean & Yohe 2003). Phenology of plant species is important both at the individual and population levels. Specific timing is crucial to optimal seed set for individuals and populations; variation among species in their phenology is an important mechanism for maintaining species coexistence in diverse plant communities by reducing competition for pollinators and other resources. Global climate change could significantly alter plant phenology because temperature influences the timing of development, both alone and through interactions with other cues, such as photoperiod.

Shifts in the relative competitive ability of plants that experience changes in CO_2, surface temperatures, or soil moisture may result in changes to their spatial distribution (Bazzaz 1990, Long and Hutchin 1991, Neilson and Marks 1994). In California, two-thirds of the more than 5,500 native plant species are projected to experience range reductions up to 80 percent before the end of this century under projected warming (Loarie et al. 2008). Current research, for example, indicates that temperature increases resulting from climate change in the Southwest will likely eliminate Joshua trees from 90 percent of their current range in 60 to 90 years (Cole et al. 2011). Increases in atmospheric CO_2 and possible increases in winter precipitation would favor woody plant establishment and growth at the expense of grasses and may cause woodland boundaries to shift downslope (Weltzin and McPherson 1994). However, increases in temperature may enhance the competitive ability of C4 plants (such as grasses) relative to C3 plants (shrubs and trees), especially where soil moisture (Neilson 1993) or temperature (Esser 1992) are limiting. In their search for optimal conditions, some species may shift ranges if corridors to do so are present. The potential for successful plant and animal adaptation to coming change is further hampered by existing regional threats such as human-caused fragmentation of the landscape, invasive species, river-flow reductions, and pollution (USGCRP 2009).

Climate change could affect vegetation resources in the GWD Project Area by:

- Altering the distribution of vegetation at local spatial scales; and
- Altering vegetation types and spatial arrangements (i.e., woody vs. herbaceous species).

Wildland Fire

Anthropogenically-induced changes in climate are likely to affect fire frequency and extent. The specific effects of climate change on fire regimes will be spatially variable throughout the Southwest and impacted by a number of factors. In general, total area burned is projected to increase (Lenihan et al. 2008), though regional differences in fuel loading, temperature, and precipitation all influence the likelihood of possible ignition and subsequent fire spread (Westerling and Bryant 2008). Climate change could also cause changes in fire behavior once ignition has occurred (Fried et al. 2008). Alterations in community structure caused by changes in atmospheric composition or climate may have substantial effects on fire regimes. A shift from grassland to woodland could reduce herbaceous biomass and thus reduce fire frequency because of decreased accumulation of fine fuel. Conversely, increased surface temperatures may either increase fire frequency (because hotter, drier conditions cure fuel more quickly) or decrease fire frequency (because of decreased fine fuel production caused by hotter, drier conditions). Increases in summer precipitation may also increase fine fuel loading and thus increase fire frequency.

Climate-fire dynamics will also be affected by changes in the distribution of ecosystems across the Southwest. Increasing temperatures and shifting precipitation patterns will drive declines in high-elevation ecosystems such as alpine forests and tundra (Rehfeldt et al. 2006; Lenihan et al. 2008), while other high-elevation forests are projected to decline by 60 to 90 percent before the end of the century (Hayhoe et al. 2004). At the same time, grasslands are projected to expand, another factor likely to increase fire risk. The effects of changing climate on future fire regimes are difficult to predict, not only due to uncertainties associated with future climate, but because of interactive effects of climate change, biological factors, and activities related to management activities and politics.

Climate change could affect fire ecology and management in the GWD Project Area by impacting:

- The amount, spatial arrangement, connectivity and types of surface fuels; and
- Precipitation patterns, which could lead to prolonged drought, exacerbating the risk of Wildland fire.

3.5.3.2 Issues

Rights-of-way and Groundwater Field Development Construction and Operational Maintenance

- Short-term, long-term, and permanent changes in vegetation community structure and composition (due to surface disturbance and conversion of natural vegetation to industrial uses) as a result of construction-related activities and operational maintenance.
- Potential introduction or population expansion of noxious and non-native invasive weeds due to surface disturbance.
- Loss of individuals or populations of federally listed, candidate, or special status plant species (including cacti and yucca) due to surface disturbance.
- Accidental wildfires caused by construction equipment or smoking during construction and operation.
- Availability of plant species traditionally used for food and fiber by regional Tribes.

Groundwater Pumping

- Short-term, long-term, and permanent changes in vegetation community structure and composition (including spring-fed wetlands and riparian areas) and special status plant species populations due to groundwater drawdown.
- Changes in the availability of groundwater dependent plant species traditionally used for food and fiber by regional Tribes in relation to groundwater drawdown.

3.5.3.3 Assumptions

Rights-of-way and Groundwater Field Development Construction and Operational Maintenance

- Study Area. The study area is the proposed ROW project surface disturbance area (pipelines, power facilities, and roads) for each project alternative plus the total project surface disturbance estimate (well pads, roads, gathering pipelines, power lines) within groundwater development areas within each hydrologic basin. The overall rationale for this cumulative study area is that the majority of the changes in vegetation communities occur within areas where vegetation has been cleared and reseeded, while recognizing that future plant species composition changes can occur in plant communities adjacent to the ROW from the dispersal of seeds by wind and water, as well as seed consuming animals. For ROWs, a buffer of 500 feet was evaluated to account for the potential influence of adjacent or other nearby surface disturbance activities, and account for possible project effects outside the construction ROWs. For groundwater development areas, the presence of PPAs and RFFAs within the overall groundwater development area boundaries within each hydrologic basin was used as the basis for evaluating potential additive cumulative effects.
- Time frames. Effects time frames range from 2 to 5 years after surface disturbance initially occurs for herbaceous components, to 200 years, which is the estimated time for larger woody species (junipers, pinyon pine, Joshua trees) to recover to their former density and size.
- The PPAs footprints are based on utility ROWs and other surface disturbance activities identified in the BLM database and other databases (Section 2.9.1, Past and Present Actions).
- The reasonably foreseeable actions and activities are discussed Section 2.9, Agency Preferred Alternative. No cumulative effects related to surface development activities are anticipated outside hydrologic basins occupied by project water development and conveyance facilities.

Groundwater Pumping

- Study area. The study area is the boundary for the groundwater model simulations (**Figure 3.0-3**).
- Time frames. Effects time frames range from full build out of the entire project (approximately 2050) to full build out plus 200 years.
- A groundwater depth 50 feet or deeper in relation to the ground surface elevation is not accessible to the roots of nearly all phreatophytic shrubs and this groundwater depth represents a reasonable boundary for: 1) estimating the deepest root zone extent of plant communities that are at least partially dependent on underlying groundwater; and

2) defining a groundwater drawdown boundary that assumes that the roots of overlying plant communities no longer have access to groundwater as a moisture source at depths greater than 50 feet.

- The ET areas mapped for each hydrologic basin as part of the water balance estimates (Section 3.3, Water Resources) represent the primary cover types that would be affected by drawdown over large areas within hydrologic basins. These ET areas are mapped as Wetland/Meadow and Basin Shrubland cover types.
- Based on an evaluation of plant rooting depth, physiological responses to drought, available information on groundwater levels and seasonal soil moisture, an index drawdown contour of 10 feet is assumed to be a reasonable estimate of the point at which long term changes in plant community vigor and composition would begin to appear. The expected responses of the Wetland/Meadow and Basin Shrubland are the same as those described for the project alternatives (Section 3.5.2.8).
- Spring-fed meadows and riparian areas represent small areas within hydrologic basins and are best discussed by individual springs or by perennial stream reaches. The springs and perennial stream reaches of vegetation effects concern are the high and moderate risk water sources as defined in Section 3.3, Water Resources.

3.5.3.4 Methodology for Analysis

Rights-of-way and Groundwater Field Development Construction and Operational Maintenance

- The cumulative surface disturbance effects to vegetation communities by hydrologic basin were estimated by overlaying the existing surface disturbances for PPAs and RFFAs and the development areas for the project alternative being evaluated. The estimated cumulative surface disturbance was then compared with the overall area of the hydrologic basin affected. Potential effects on vegetation communities that occupy relatively small areas within individual basins, such as wetlands, were considered.
- The cumulative surface disturbance effects to special status species (including cacti and yucca) were estimated from evaluating the cumulative vegetation community surface disturbance footprint in relation to the habitat requirements of special status plants to provide a risk assessment for future effects on these species.
- The cumulative noxious and invasive species invasion risks were estimated from evaluating the cumulative vegetation community surface disturbance footprint in relation to the currently known distribution of noxious and invasive plant species. The risks of weed invasion were estimated from field surveys conducted by SNWA and from a weed occurrence data based maintained by the BLM Ely Field Office.
- The cumulative accidental wildfire risks were estimated from evaluating the cumulative vegetation community surface disturbance footprint in relation the relative susceptibility of various natural plant communities to wildfires.
- The potential cumulative changes in the availability of plants traditionally used for food and fiber by regional tribes were estimated from evaluating the cumulative vegetation community surface disturbance footprint in relation to the habitat requirements of food and fiber plants.

Groundwater Pumping

- Wetland/Meadow and Basin Shrubland. The area enclosed by the maximum extent of the 10-foot drawdown contour was superimposed over the area of the primary ET areas (wetland/meadow, basin shrubland cover types) to calculate the area of vegetation that could experience reductions in soil moisture and long-term vegetation community composition changes caused by groundwater drawdown of 10 feet or more at different points in time (full build out, full build out plus 75 years, and full build out plus 200 years). The cumulative analysis focuses on those basins with the primary ET areas that were predicted to be affected by each alternative. Figures were generated that illustrate the expansion of the 10-foot and greater drawdown contours over time in relation to the vegetation communities within the hydrologic ET boundaries. The figures depict the incremental effect of each alternative on vegetation resources in combination with other cumulative pumping actions.
- Springs and perennial stream reaches. The 10-foot drawdown index was applied to the springs and perennial stream reaches that were classified as being at risk from being affected by groundwater drawdown (Section 3.3, Water Resources). The springs included for analysis were those rated as presenting a "high" or "moderate" risk of effects. The number of springs and miles of perennial stream reaches potentially affected were enumerated for each alternative over time from the modeling results. The locations of the major spring complexes are illustrated

on the same figures as the ETs (**Figures 3.5-3** and **3.5-4**). The number of springs, and miles of perennial stream reaches potentially affected were graphed for each alternative over time from the modeling results.

3.5.3.5 No Action

Groundwater Development

Under the No Action Alternative, the proposed project would not be constructed or maintained. No project-related surface disturbance would occur. Vegetation communities would continue to be influenced by natural events such as drought, fire, and land use activities such as grazing and existing water diversions. Management activities on public lands will continue to be directed by the Ely and Las Vegas RMPs, which involve measures to maintain natural vegetation communities. Management guidance for other public lands in the project study area would be provided by GBNP General Management Plan and the Forest Plan for the Humbolt-Toiyabe National Forest.

Groundwater Pumping

Figure F3.5-12 illustrates the expansion of the 10-foot drawdown contour from existing pumping in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. The following is a summary of the incremental expansion of the groundwater drawdown area over time across the primary pumping hydrologic basins where the majority of the ET area (which encompasses basin shrubland and wetland/meadow cover types), as well as springs and perennial stream reaches whose surface and groundwater supply may be reduced (**Table 3.5-22**).

Table 3.5-22 No Action – Summary of Potential Cumulative Vegetation Effects Over Three Time Periods

Parameter	Full Build Out	Full Build Out Plus 75 years	Full Build Out Plus 200 years
Wetland/Meadow ET (acres)	1,240	1,840	3,801
Basin shrubland ET (acres)	22,221	47,358	58,492
Springs potentially affected in all hydrologic basins (number)	12	19	28
Springs potentially affected in GBNP (number)	0	0	0
Springs potentially affected in Utah (number)	0	0	0
Streams potentially affected in all hydrologic basins (miles)	26	42	79

Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring, Lake, Patterson, Clover, and Dry Lake valleys and Lower Meadow Valley Wash. Predicted drawdowns in the Panaca Valley affecting up to four springs could affect Ute ladies'-tresses orchid populations occurring in wet meadow habitats in Lower Meadow Valley Wash. There is a risk that soil moisture changes in spring meadows could alter the growth and flowering conditions, which could adversely affect the long-term orchid population viability.

3.5.3.6 Proposed Action

Rights-of-way and Groundwater Field Development Construction and Operational Maintenance

Vegetation Community Surface Disturbance and Restoration

PPAs consist primarily of existing roads, energy utility corridors, mining districts, and recent wildfires (**Figure 2.9-1**). Other activities that have influenced vegetation community composition and area include livestock grazing over nearly all public lands and the development of towns and rural communities (Ely, McGill, Baker, Garrison, Pioche, and Panaca). The primary future actions consist of construction of new utilities (pipelines and electrical distribution lines), roads and turbine pads for wind energy projects, which would be located in Spring and Lake valleys. The total estimated surface area disturbance for construction and maintenance of the main pipeline and ancillary facilities, plus the anticipated groundwater development facilities would be up to 20,570 acres. As described previously, the primary vegetation types that would be cleared, and then restored are greasewood/salt desert shrubland, sagebrush shrubland, and Mojave mixed desert scrub.

Cumulative Effects. The maximum GWD Project surface disturbance (20,570 acres) would potentially overlap with PPAs and RFFAs (**Figure 2.9-1**) in all hydrographic basins.

The GWD Project would occupy the LCCRDA utility corridor from Lake Valley on the north to Garnet Valley on the south. The GWD Project would share the LCCRDA corridor with other projects as follows:

Project	Lake Valley	Dry Lake	Delamar	Pahranagat	Coyote Spring	Garnet
Past and Present Actions						
Existing Transmission Line (s)	X	X	X	X	X	X
U.S. Highway 93	X			X	X	
Proposed Project and Reasonably Foreseeable Future Actions						
GWD Project	X	X	X	X	X	X
ON Transmission Line	X	X	X	X	X	X
Wilson Creek Wind Project	X	X				
Eastern Nevada Transmission Line					X	X
Zephyr Transmission Project			X	X	X	X
TransWest Express Transmission Project			X	X	X	X

The major additive cumulative effects within the LCCRDA corridor would be the expansion of ROW surface disturbance that would be reclaimed, the permanent addition of new service access roads within the corridor, the permanent addition of high voltage transmission line structures and conductors, and the fragmentation of native vegetation communities until they recover (2 to 200 years, depending on the vegetation community). It is not expected that cumulative development would substantially expand the surface disturbance of wetlands and riparian areas, based on the very small (11) acres of these cover types by the GWD Project.

The GWD Project groundwater development area in northern Spring Valley would overlap with the Spring Valley Wind Project near the intersection of Highway 93 and Highway 6 and 50 west of Great Basin National Park. The groundwater development would add access roads, water gathering pipelines, and electrical service to well sites with areas currently proposed for electrical generation turbines. Because the specific locations of GWD Project wells have not determined, there are opportunities to share the wind energy project road system to reduce the cumulative surface disturbance footprint of the two projects.

Spread and Introduction of Noxious and Non-native Invasive Weed Species

PPAs include the historical introductions of at least 14 noxious and non-native weed species into nearly all the hydrologic basins that would be occupied by GWD Project components. Sources of weed introduction include seeds spread along railroads and highways and contaminated hay delivered to farms and livestock feed grounds over wide areas. Weed seeds then are spread by wind, water, livestock grazing, and seed eating wild animals over large areas. Some weeds that propagate by rhizomes have spread on the muddy wheels of farm and excavation machinery and from harvest and distribution of food crops harvested from soil such as potatoes. The RFFAs (renewable energy projects, electrical transmission lines, and other utilities) will disturb new areas of native vegetation, creating new opportunities for weed invasion and spread into recently disturbed ROWs and along new roadways that are periodically maintained. The GWD Project also would require surface disturbance for new ROWs in previously undisturbed native communities, particularly in the groundwater development basins (Spring, Snake, Delamar, Dry Lake, and Cave valleys).

Cumulative Effects. The locations where there would be the greatest risk of expanded additive weed invasion would be in areas where new ROWs intersect with or parallel older ROWs where weeds may already be established. These intersections include roads, utility corridors, gravel pits, and mines. There are almost no crossings of agricultural lands, so weeds associated with cultivated fields represent a very low risk. The GWD Project would intersect multiple primary and secondary roads in all hydrologic basins and would parallel an existing utility corridor from southern Lake Valley to the vicinity of Apex in Clark County. The GWD Project would likely intersect service roads for the Spring Valley Wind Project in Spring Valley. It is anticipated that all projects proposed on BLM lands would be required to identify and control noxious and invasive weed species; these requirements on new projects would likely limit the spread of weeds along new ROWs.

Cacti and Yucca, Special Status Plants

PPAs include the construction and maintenance of utility and highway ROWs that cross cacti and yucca habitats in Las Vegas, Garnet, Coyote Springs, Delamar, Hidden, Pahranagat, and southern Dry Lake valleys in Clark and Lincoln counties. The GWD Project facilities would be located in an existing utility corridor (LCCRDA) from the vicinity of Apex in Clark County to the southern portions of Cave, Lake, and Spring valleys in Lincoln County. It is estimated that the GWD Project would remove cacti and yucca from more than 3,000 acres in these valleys. A large fraction of these plants would be replanted in the disturbed ROWs.

Populations of special status plants including Parish's phacelia and Blaine fishhook cactus were identified in Dry Lake Valley; Eastwood milkvetch was identified in Dry Lake Valley; and Long calyx egg milkvetch was identified in Spring Valley. These species were identified during ROW surveys conducted by SNWA and additional populations of these species may be found over a larger area as the result of future surveys. A reasonably foreseeable project that could encompass populations of the Parish's phacelia, Blaine fishhook cactus, and Eastwood milkvetch is the ON Transmission Line project that will use the LCCRDA and other utility corridors from Dry Lake Valley to Delamar Valley. Populations or individuals of these species were found in and adjacent to GWD Project ROWs.

Cumulative Effects. There would be a reduction in cacti and yucca populations within existing utility corridors, combined with surface disturbance from proposed new renewable energy projects and transmission lines and GWD Project facilities in Las Vegas, Garnet, Hidden, Coyote Springs, Pahranagat, Delamar, and Dry Lake valleys. It is anticipated that recovery of yucca and cacti would require many years (up to 200 years for mature Joshua trees). It is likely that there would be an additive reduction in special status plant species in Dry Lake, Muleshoe, and Spring valleys. These reductions are not likely to result in federal listing of these species, since they occur in other regional hydrologic basins.

Accidental Wildfires

There have been several recent large wildfires in southeastern Lincoln County. The source of most of these fires is lightning. The risk of accidental fires from project activities will always be present when heavy machinery is working across natural landscapes. However, this risk is site- or project-specific and not cumulative, since different projects will be constructed at different time frames and different locations. PPAs shown in **Figure 2.9-1** includes areas affected by wildfire.

Culturally Significant Plants

Cumulative Effects. Traditional use plants occur in the vegetation types that extend across all the hydrologic basins that have been affected by PPAs and would be affected by RFFAs and the proposed GWD Project facilities. As described for vegetation community surface disturbance and restoration, there would be a cumulative additive increase in vegetation surface disturbance on a regional basis. This surface disturbance would likely cause a reduction (estimated to be 1 percent or less) in the availability of traditional use plants within native plant communities, and may potentially cause the disturbance or loss of specific traditional plant gathering areas.

Groundwater Pumping

PPAs are represented by the No Action pumping operations described in Section 3.3, Water Resources. The cumulative past and present groundwater uses are presented in **Table 2.9-1**. The RFFAs are described in **Table 2.9-4**. The following discussions are based on an interpretation of the groundwater model simulations that predict groundwater drawdown elevations and changes in flow in springs and perennial stream reaches.

Figure F3.5-3 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. **Figures 3.5-14** and **3.5-15** illustrate the number of springs and miles of perennial streams by basin, respectively, that would potentially be at risk from the Proposed Action pumping operations. These figures include impact parameter information for cumulative with No Action, Proposed Action, and cumulative pumping with the Proposed Action as a way of identifying the incremental effects of the alternative. Representative basins for which the Proposed Action may have a potential impact have been included in the analysis, and include (north to south): White River, Steptoe, Spring, Snake, Lake valleys, and Lower Meadow Valley Wash.

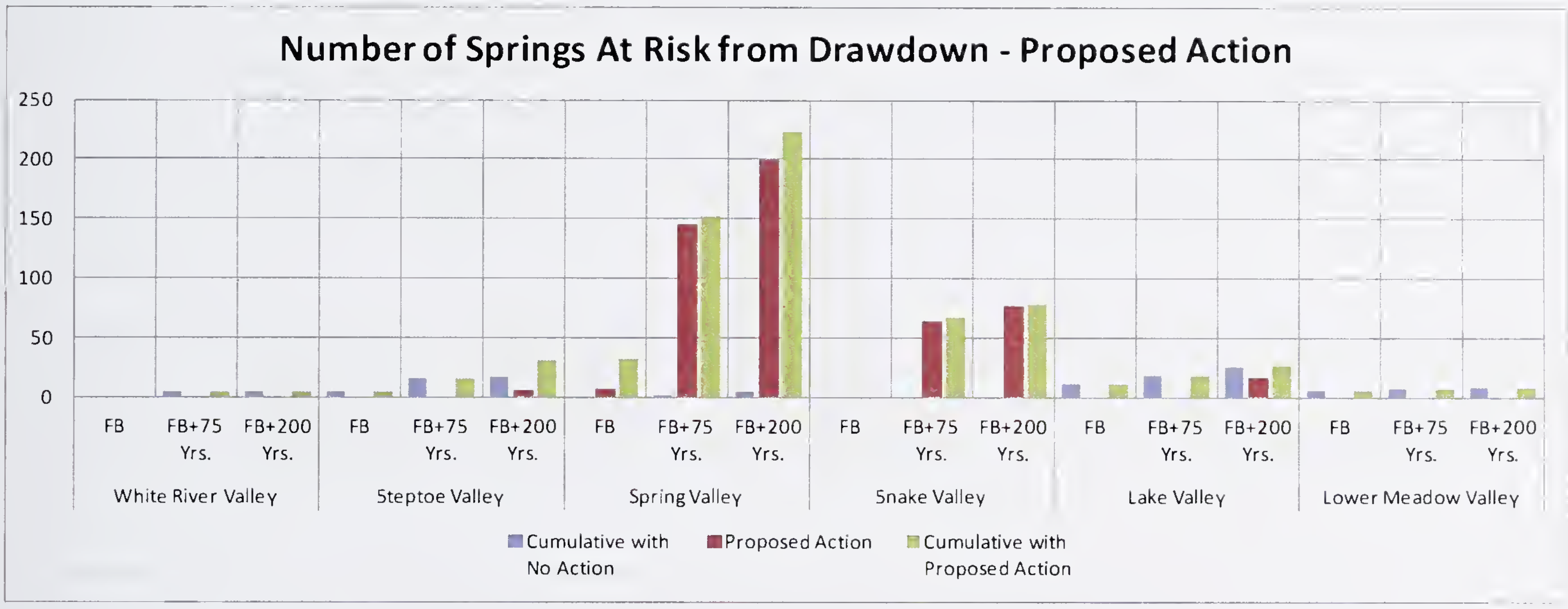


Figure 3.5-14 Number of Springs At Risk from Drawdown, Proposed Action

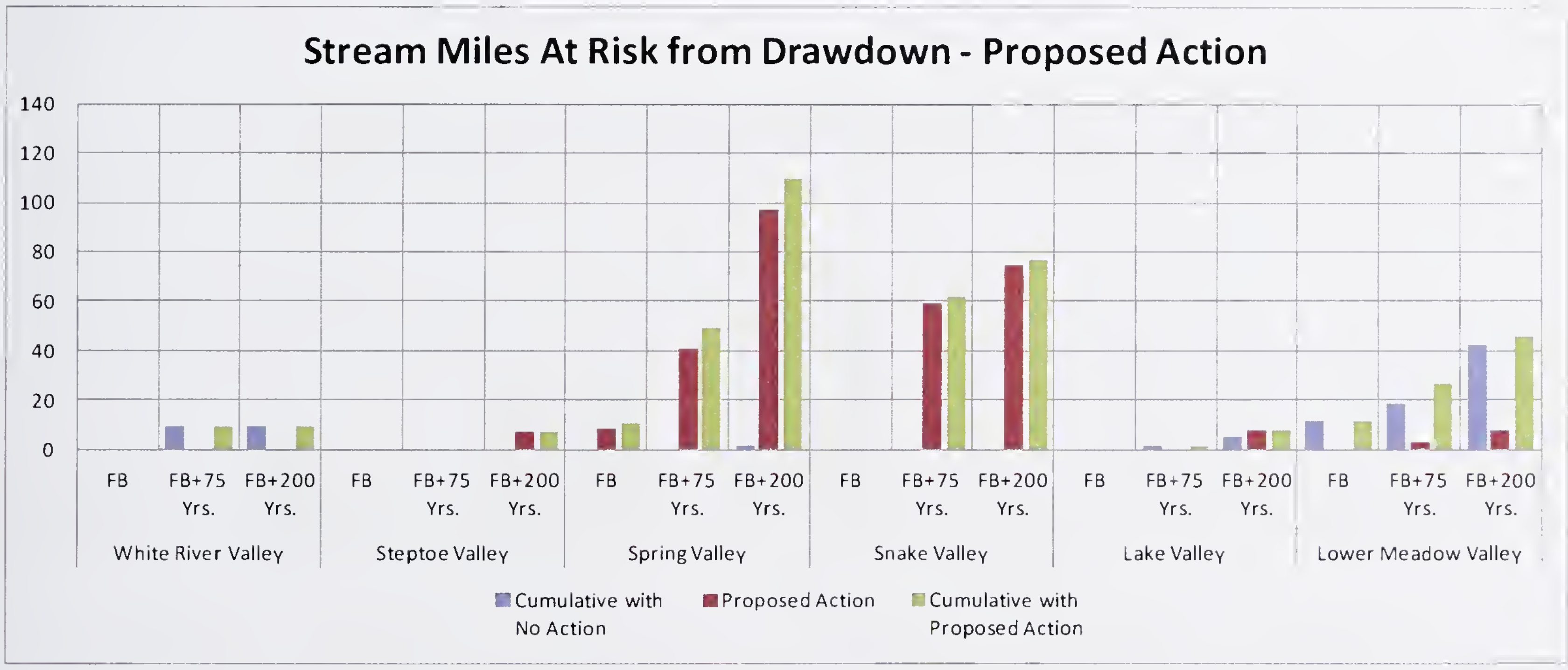


Figure 3.5-15 Stream Miles At Risk from Drawdown, Proposed Action

Cumulative acres of potential root zone soil moisture stress from drawdown for basin shrubland and wetland/meadow ET areas have been graphed by hydrologic basin (**Figures 3.5-16** and **3.5-17**). These figures include impact parameter information for cumulative with No Action, Proposed Action, and cumulative pumping with the Proposed Action as a way of identifying the incremental effects of the alternative. Representative basins for which the proposed action are may have a potential impact have been included in the analysis, and include (north to south): Steptoe, Hamlin, Spring, Snake, Lake, and Lower Meadow Valley Wash. Based on this analysis, the following conclusions were made:

- Steptoe Valley - The Proposed Action would not directly contribute to either basin shrubland or wetland meadow drawdown effects. The cumulative effects on these communities would result from cumulative pumping with No Action.
- Hamlin Valley – The Proposed Action would potentially cause relatively low levels of drawdown effects to both basin shrubland (3,065 acres) and wetland/meadow (154 acres) communities. The adverse effects on these communities would occur during the two later (full build out plus 75 years, full build out plus 200 years) model periods. The impact parameters indicate that the Proposed Action would contribute all of the incremental cumulative effects on basin shrubland and wetland/meadow communities in this basin.

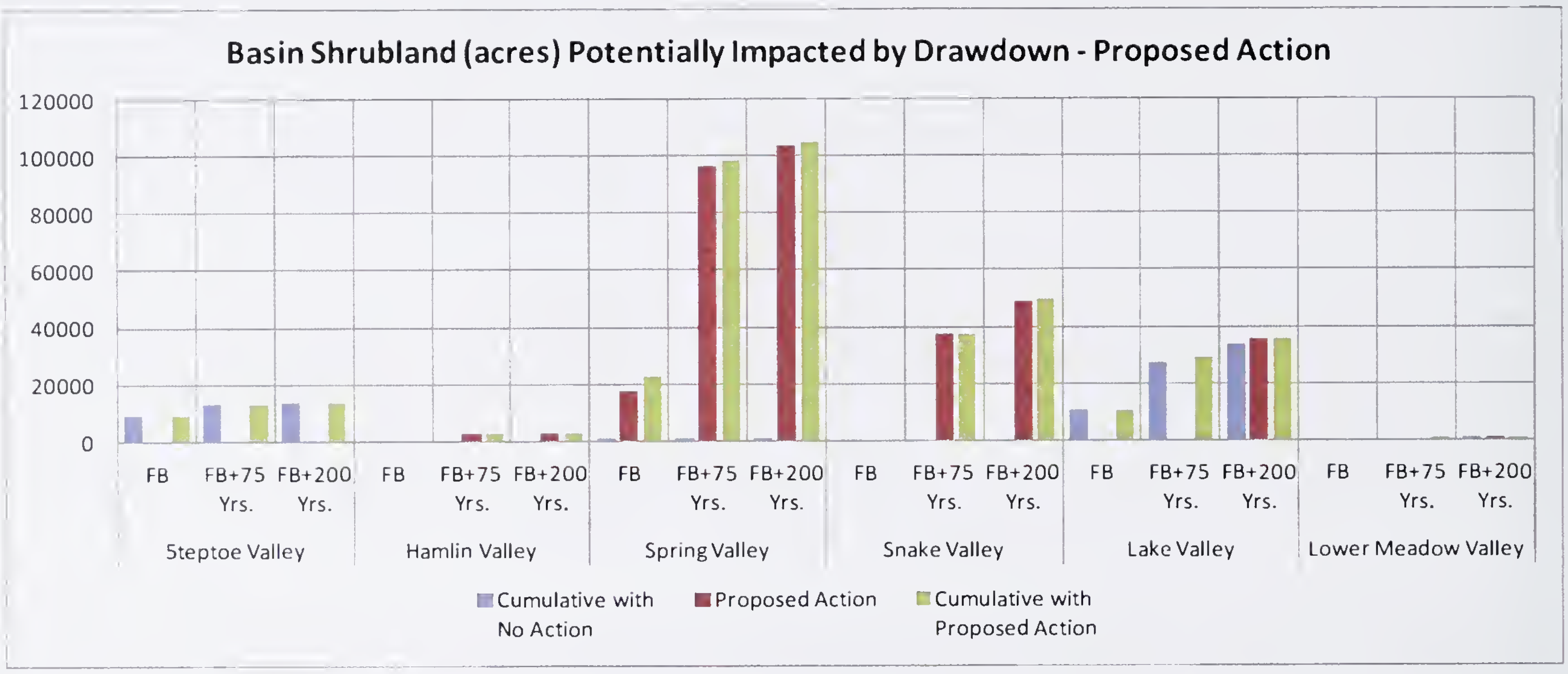


Figure 3.5-16 Basin Shrubland At Risk from Drawdown, Proposed Action

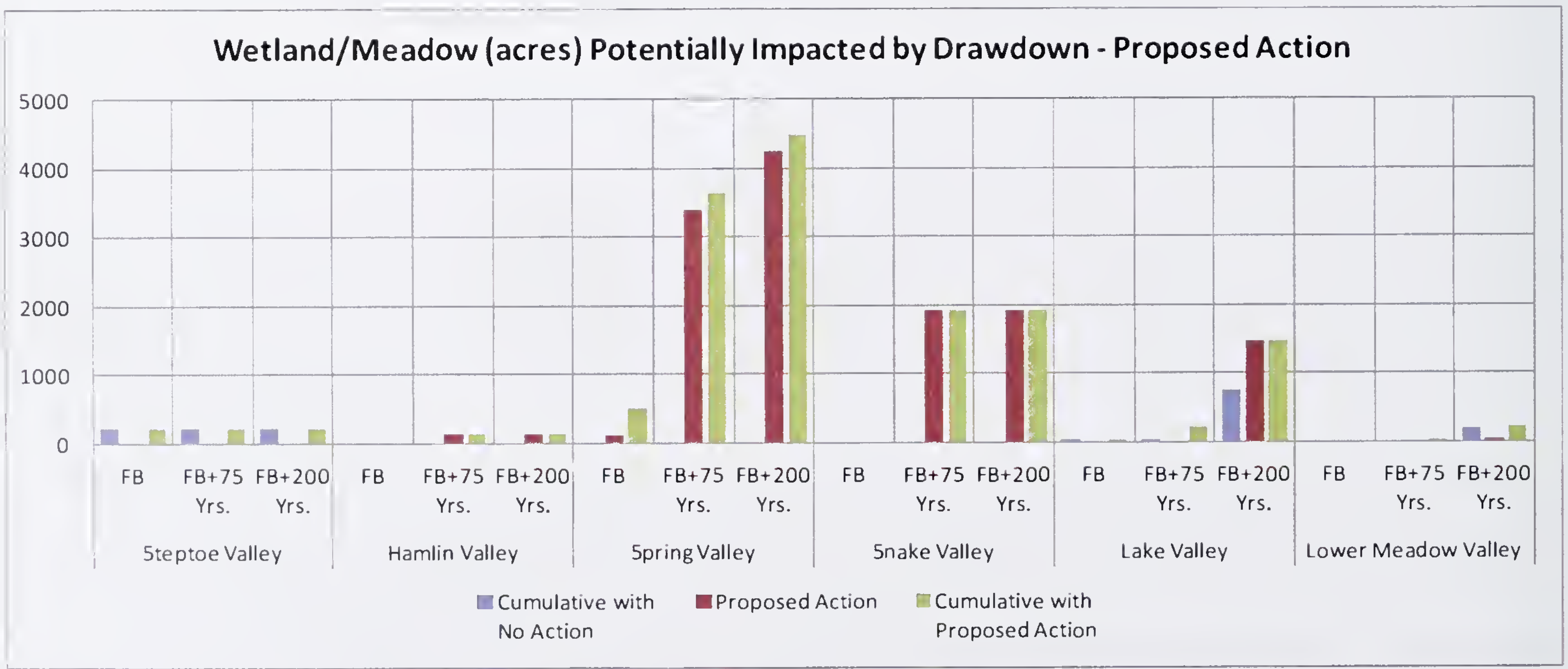


Figure 3.5-17 Wetland/Meadow At Risk from Drawdown, Proposed Action

- Spring Valley – The Proposed Action would potentially cause substantial drawdown effects to both basin shrubland and wetland/meadow communities. The adverse effects on these communities would occur in all 3 model periods. The impact parameters indicate that the Proposed Action would contribute most of the incremental cumulative effects on basin shrubland and wetland/meadow communities in this basin. In total, the Proposed Action would affect a maximum of 103,798 acres of basin shrubland and 4,252 acres of wetland/meadow over the three model periods.
- Snake Valley – The Proposed Action would potentially cause substantial drawdown effects to both basin shrubland and wetland/meadow communities. The adverse effects on these communities would occur in all 3 model periods, though the greatest potential impacts would occur during the full build out plus 75 years and full build out plus 200 years model time frames. The impact parameters indicate that the Proposed Action would contribute to all of the incremental cumulative effects on basin shrubland and wetland/meadow communities in this basin. In total, the Proposed Action would affect 49,068 acres of basin shrubland and 1,927 acres of wetland/meadow for the three model periods.
- Lake Valley – The Proposed Action would potentially cause some drawdown effects to both basin shrubland (35,497 acres) and wetland/meadow (1,486 acres) communities in this basin. The drawdown effects on these communities would occur during the final (full build out plus 200 years) model period. Potential impacts during earlier modeling periods would result from cumulative pumping with No Action, particularly for basin shrubland communities.
- Lower Meadow Valley Wash – The Proposed Action would potentially cause very low levels of potential disturbance to both to basin shrubland (56 acres) and wetland/meadow (26 acres) community types. The drawdown effects on these communities would occur during the final (full build out plus 200 years) model period. The cumulative effects on these communities would result largely from cumulative pumping with No Action.

The following vegetation community changes could occur in response to groundwater pumping, as outlined under the assumptions. The specific vegetation community responses cannot be predicted on a site-specific basis. The rate of change in plant community composition also would be highly variable, depending on groundwater drawdown rates and local water elevation recovery, as well as the influence of precipitation, overland flows, and runoff in channels.

Wetland/Meadow

Plant species in vegetation communities that are directly dependent on perennial spring and stream flows would experience the greatest potential change in plant species composition. Based on the general successional model outlined in the assumptions, it is likely that wetland communities consisting of sedges, rushes, and cattails would progressively change toward a community dominated by deep-rooted grasses. The overall surface area occupied by wetland species would decrease, with persistence only in areas that continue to receive sufficient surface and groundwater for long-term survival. Species composition could change toward dominance by phreatophytes and other species better adapted to low near-surface soil moisture. Over the long-term, it is expected that areas occupied by this cover type could be invaded by basin shrubland vegetation units or other upland vegetation types, depending on sources of surface moisture and soil chemistry (texture, salinity, and alkalinity). This successional progression is unlikely to be reversed, since it is expected that hydric soils will lose many of their wetland characteristics and would likely to become more similar to upland soils with better root zone aeration than hydric soils. Included in this affected area are the swamp cedar areas in central and southern Spring Valley. Also included is the Lower Moapa Area, where riparian vegetation that is at least partially dependent on groundwater sources is present.

Basin Shrubland

Based on groundwater studies in other hydrologic basins, it is likely that the dominant phreatophytic shrubs (greasewood, rabbitbrush) would persist over the long-term, but potentially at lower densities and vigor as the result of reduced availability of soil moisture at greater depths and lower suitability for shrub seedling re-establishment and growth. These areas could be invaded by shrubs, herbs, and grasses that are adapted to seasonal shallow soil moisture and are capable of withstanding extended droughts, either through complete or partial dormancy or long-lived seeds. It is likely that invasive annual grass species would become increasingly dominant and the risk of wildfires also would likely increase. Included in this drawdown area is the habitat for the Baking Powder Flat Blue butterfly, which is protected within a BLM ACEC in central Spring Valley.

Springs and Perennial Stream Reaches

The effects on vegetation dependent on spring flows would vary by the flow volume and persistence. Reductions in spring flow would reduce the length of the spring brook and reduce the area of wetland vegetation that is dependent on reliable surface and sub-surface soil moisture. Riparian shrubs (such as willows and birches) would likely decline in vigor and would eventually die in areas where groundwater elevations decline below the root zone. The majority of these spring drying effects are predicted to occur in Spring Valley.

Special Status Species

To date, no Ute ladies'-tresses orchid populations have been found in inventoried springs in Spring and Snake valleys, where potential habitats exist. Predicted drawdowns in the Panaca Valley affecting up to eight springs could affect Ute ladies'-tresses orchid populations occurring in wet meadow habitats in Lower Meadow Valley Wash. There is a risk that soil moisture changes in spring meadows could alter the growth and flowering conditions, which could adversely affect the long term population viability

Culturally Significant Plants

Traditional use plants that are classified as wetland plants by the USACE (**Table 3.5-8**) occur in wetlands and meadows. Examples of common wetland species on the traditional use list that occur in spring meadows within the affected hydrologic basins include Arctic rush (*Juncus balticus*), California bulrush (*Schoenoplectus californicus*), cattail (*Typha latifolia*), and common reed (*Phragmites australis*) (**Table 3.5-5**). Groundwater drawdown effects on these species are generally described under the wetland/meadow ET above, and could range from small changes in species composition in areas where groundwater levels are maintained over the long term to a broad scale conversion of wetlands and meadow to dry grasslands and shrublands, with disappearance of wetland species of time. In summary, it is likely that traditional use wetland plant species occupying wetlands and sub-irrigated grasslands in Spring, Snake, and Lake valleys would become less abundant and less available over time.

3.5.3.7 Alternative A

Rights-of-way and Groundwater Field Development Construction and Operational Maintenance

The Alternative A surface disturbance (up to 17,035 acres) would intersect with existing road and highway crossings in all hydrologic basins, would parallel approximately 100 miles of designated utility corridor in Clark and Lincoln counties, and would intersect service roads for future wind energy projects in Spring and Lake valleys. Cumulative effects on vegetation include:

- Fragmentation of natural vegetation communities where GWD Project facilities parallel existing utility ROWs or intersect with existing and new roads;
- An additive risk of expanded weed invasion where new ROWs intersect with or parallel older ROWs where weeds may already be established;
- An overall reduction in populations of yucca and cacti as the result of the expansion of existing utility corridors and new renewable energy projects in Coyote Springs and Delamar valleys;
- A potential reduction in special status plant species populations in Dry Lake, and Spring valleys from additional linear projects in utility corridors and construction of a wind energy project; and
- An overall reduction in the availability of Tribal traditional use plants as the result of additive vegetation surface disturbance across all GWD Project hydrologic basins.

Groundwater Pumping

Figure F3.5-4 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. **Figures 3.5-18** and **3.5-19** illustrate the number of springs and miles of perennial streams by basin, respectively, that would potentially be at risk from drawdown from Alternative A operations. These figures include impact parameter information for cumulative with No Action, Proposed Action, and cumulative pumping with the Proposed Action as a way of identifying the incremental effects of the alternative. Representative basins for which the proposed action are may have a potential impact have been included in the analysis, and include (north to south): White River, Steptoe, Spring, Snake, Lake valleys, and Lower Meadow Valley Wash.

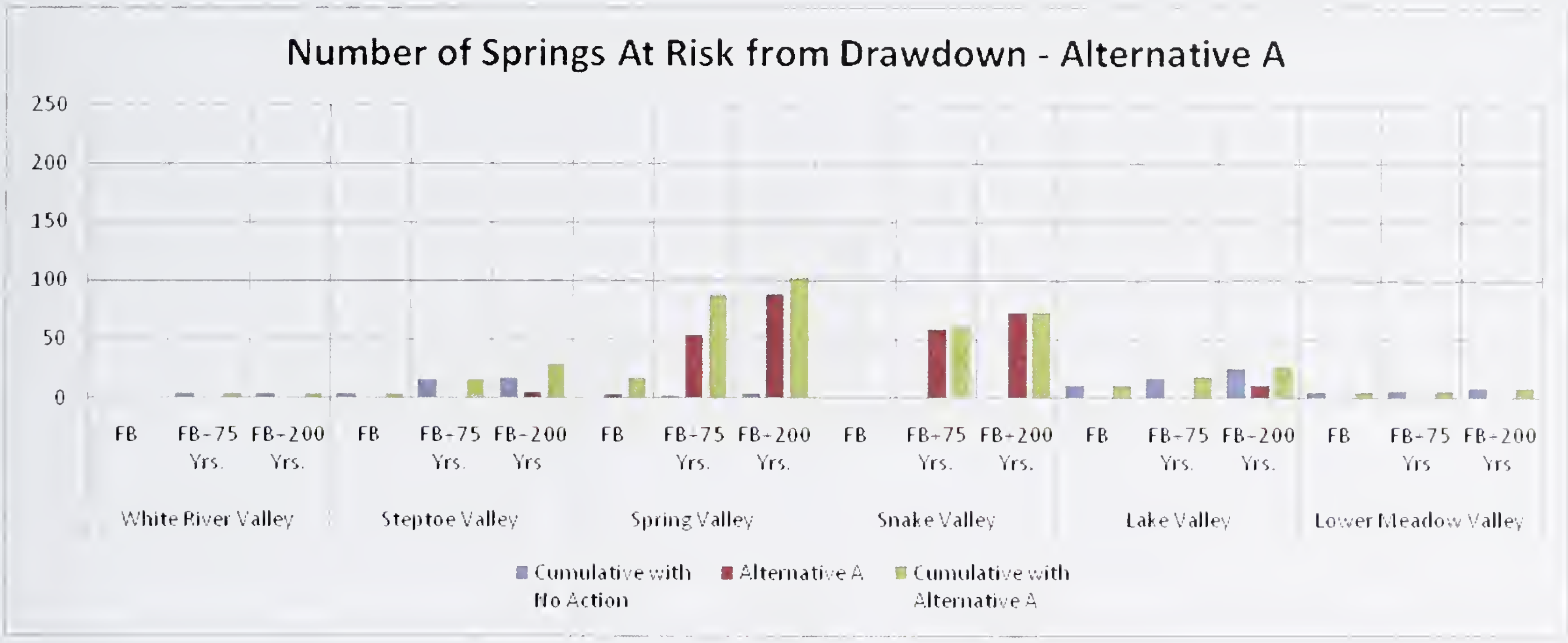


Figure 3.5-18 **Number of Springs At Risk from Drawdown, Alternative A**

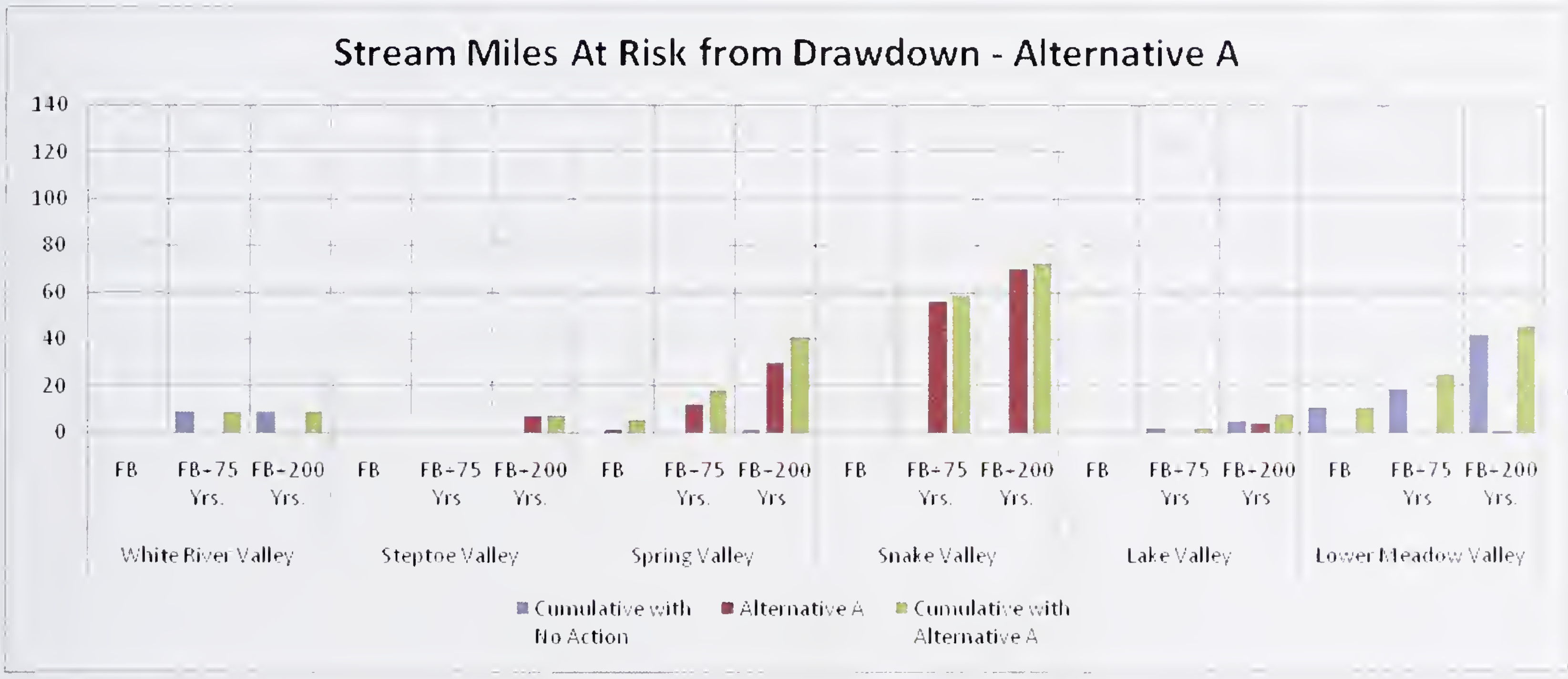


Figure 3.5-19 **Stream Miles At Risk from Drawdown, Alternative A**

Cumulative acres of potential drawdown effects for basin shrubland and wetland/meadow ETs have been graphed by hydrologic basin (**Figures 3.5-20** and **3.5-21**). These figures include impact parameter information for cumulative effects with No Action, Alternative A, and cumulative pumping with the Alternative A as a way of identifying the incremental effects of the alternative. Representative basins for which the alternative may have a potential impact have been included in the analysis, and include (north to south): White River, Steptoe, Spring, Snake, Lake valleys, and Lower Meadow Valley Wash. While a similar pattern of potential drawdown effects would occur with Alternative A, one notable difference for this cumulative pumping scenario would be that the magnitude of flow reduction would be smaller compared to cumulative pumping with the Proposed Action. Therefore, the magnitude of effects on vegetation communities would be lower in Spring, Snake, and Lake valleys. Effects on communities in Steptoe, White River, and Lower Meadow Valley Wash would be nearly identical.

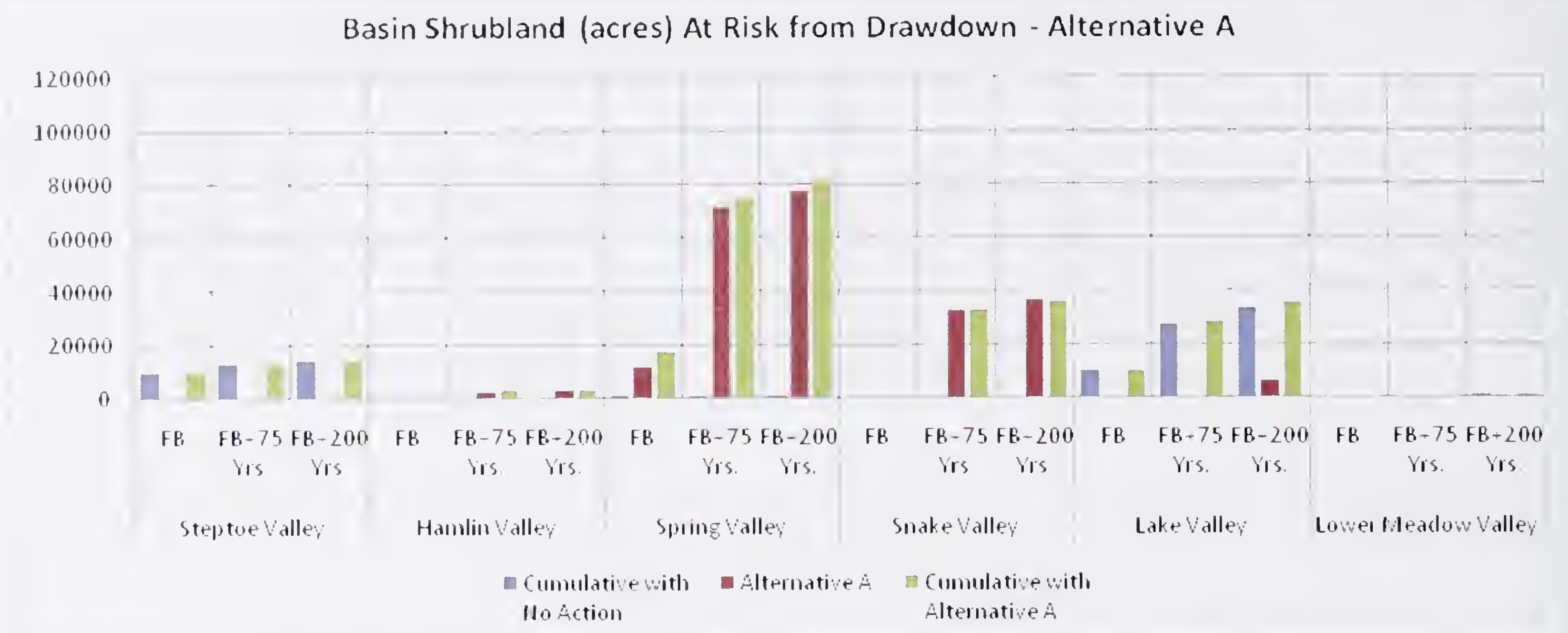


Figure 3.5-20 **Basin Shrubland At Risk from Drawdown, Alternative A**

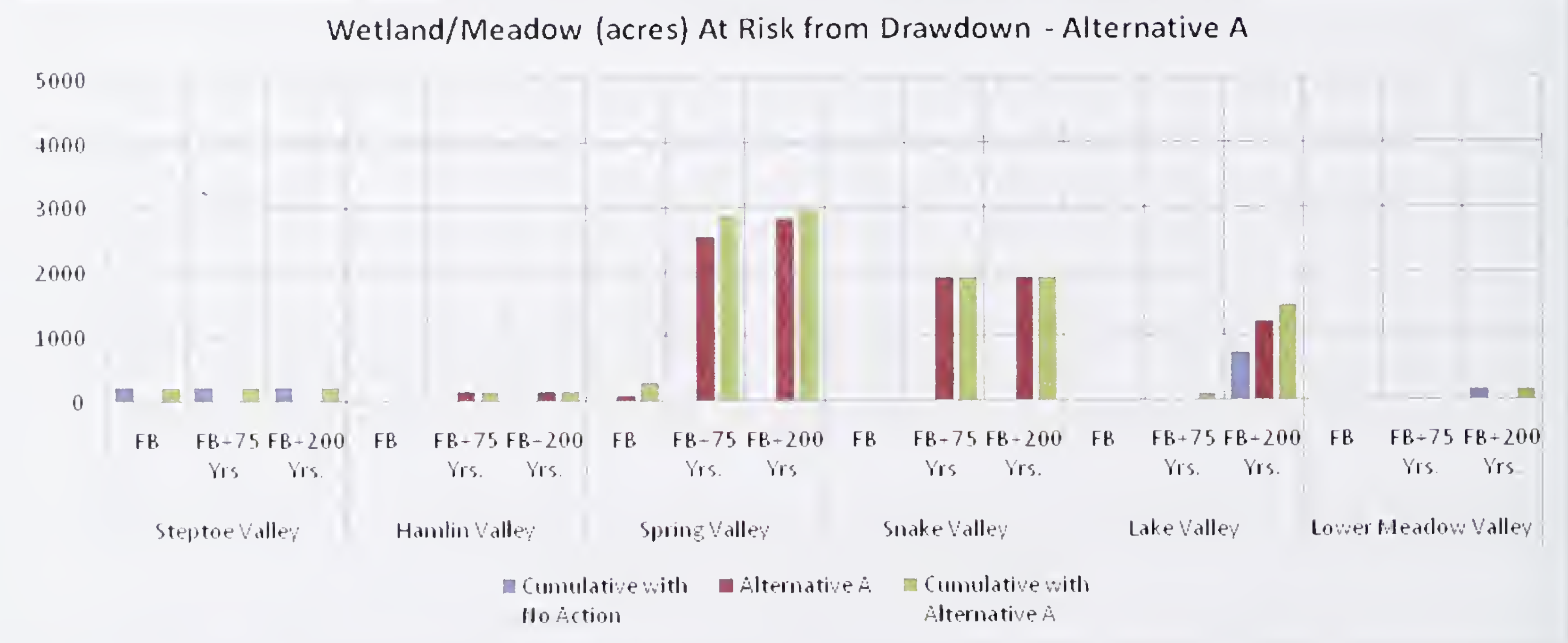


Figure 3.5-21 **Wetland/Meadow At Risk from Drawdown, Alternative A**

Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring, Snake, and Lake valleys. Predicted drawdowns in the Panaca Valley affecting up to four springs could affect Ute ladies'-tresses orchid populations occurring in wet meadow habitats in Lower Meadow Valley Wash. There is a risk that soil moisture changes in spring meadows could alter the growth and flowering conditions, which could adversely affect the long term population viability.

3.5.3.8 Alternative B

Rights-of-way Groundwater Field Development Construction and Operational Maintenance

The GWD Project surface disturbance (up to 16,888 acres) would intersect with existing road and highway crossings in all hydrologic basins; would parallel approximately 100 miles of designated utility corridor in Clark and Lincoln counties; and would intersect service roads for a wind energy project in Spring Valley. Expected cumulative effects would be the same as those described for Alternative A.

Groundwater Pumping

Figure F3.5-5 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. **Figures 3.5-22** and **3.5-23** illustrate the number of springs and miles of perennial streams by basin, respectively, that would potentially be at risk by Alternative B groundwater drawdown.

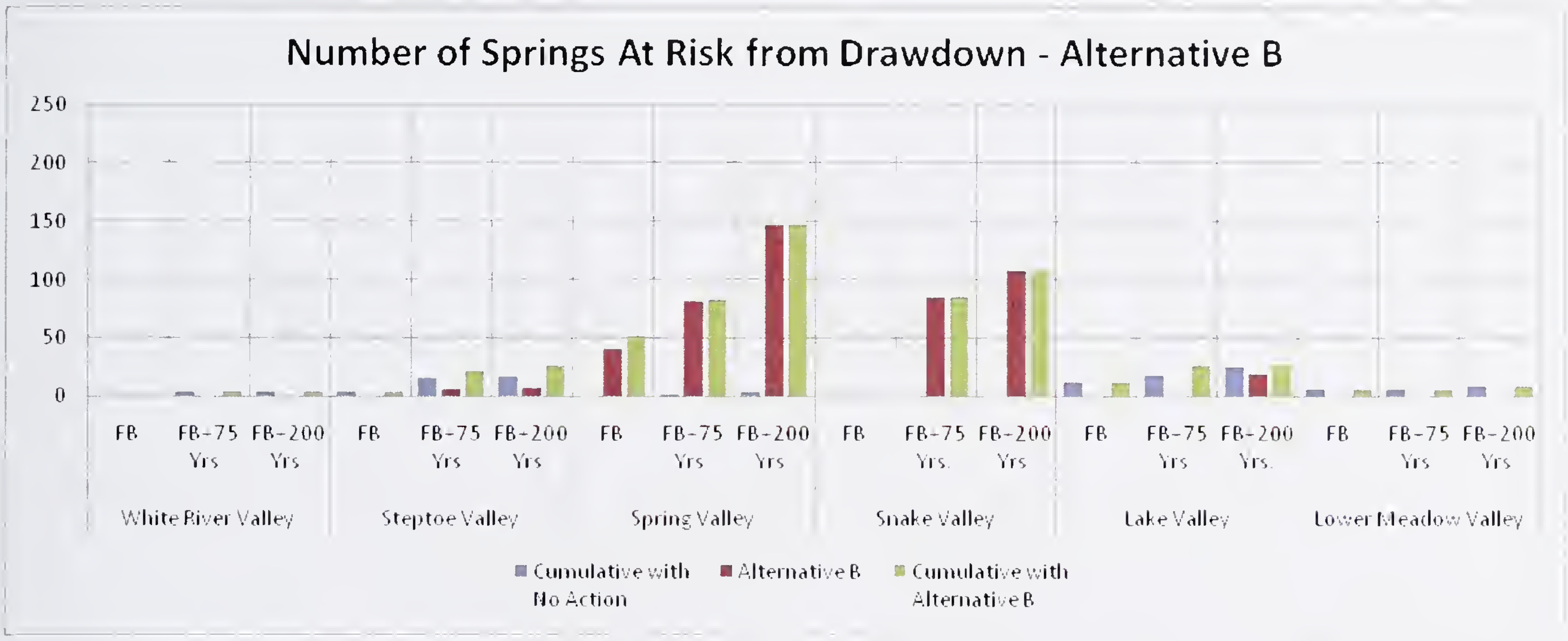


Figure 3.5-22 **Number of Springs At Risk from Drawdown, Alternative B**

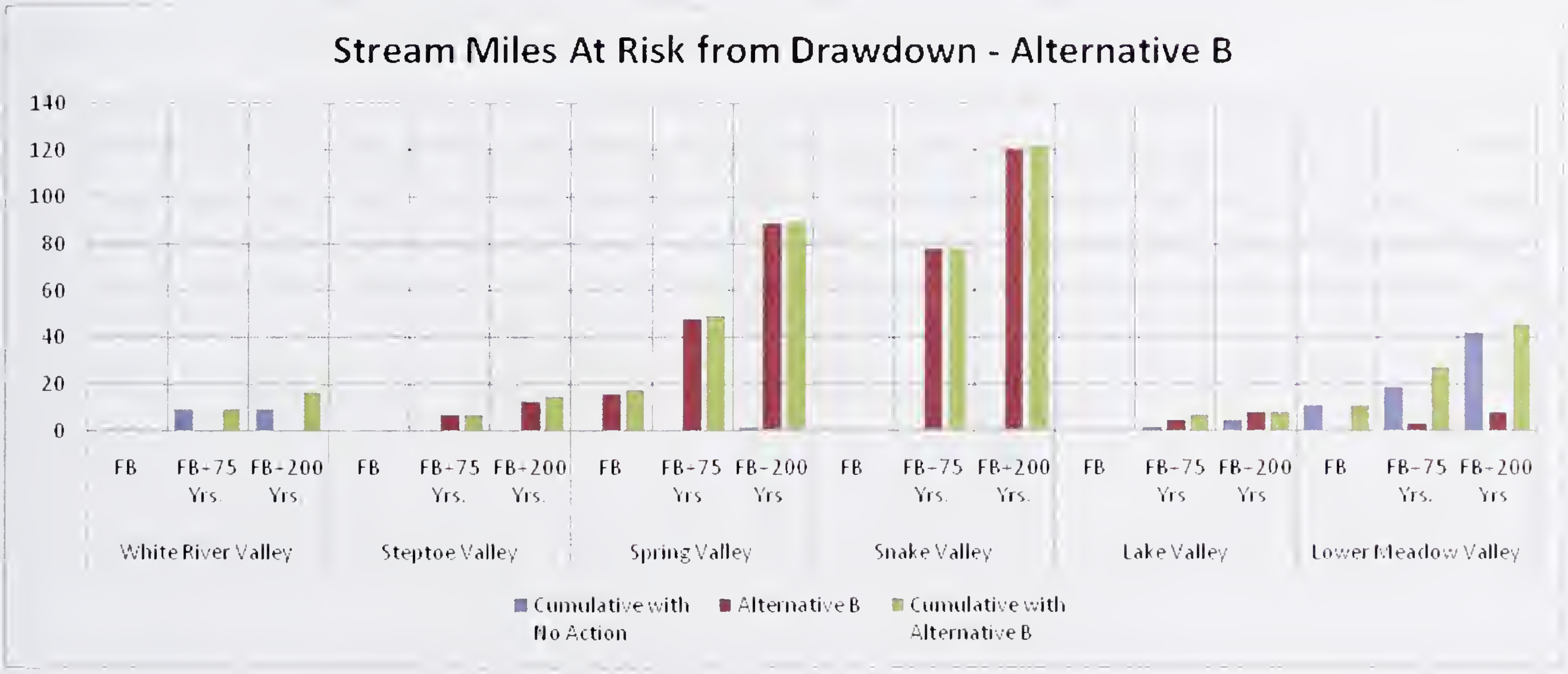


Figure 3.5-23 **Stream Miles At Risk from Drawdown, Alternative B**

Cumulative acres of potential drawdown effects for basin shrubland and wetland/meadow ETs have been graphed by hydrologic basin (**Figures 3.5-24** and **3.5-25**). Alternative B would contribute the predominant cumulative drawdown effects to streams and springs in Spring and Snake valleys. Alternative B is predict to cause larger effects on the Wetland/Meadow ET areas as compared to Alternative A. This difference is attributed to the wider distribution of pumping locations under Alternative A.

Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants. Predicted drawdowns in the Panaca Valley affecting up to four springs could affect Ute ladies'-tresses orchid populations occurring in wet meadow habitats in Lower Meadow Valley Wash. There is a risk that soil moisture changes in spring meadows could alter the growth and flowering conditions, which could adversely affect the long term population viability.

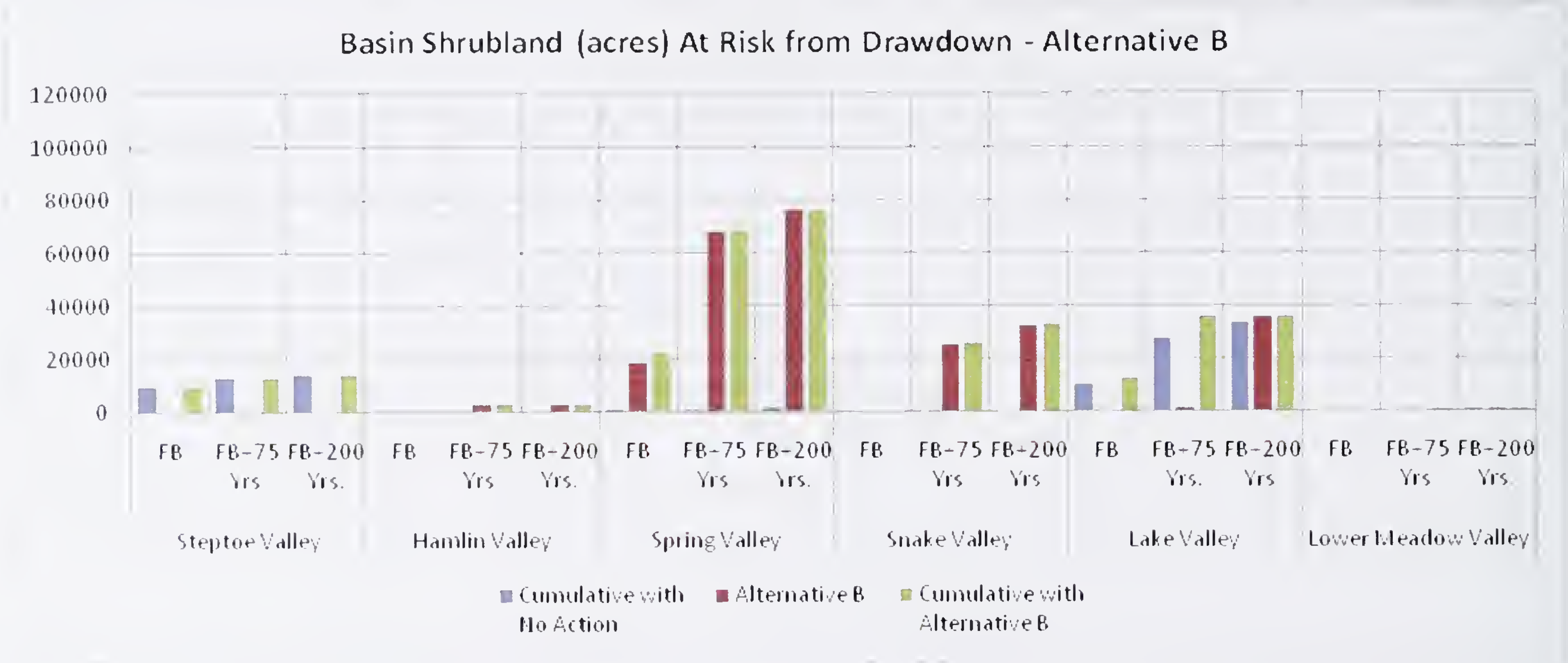


Figure 3.5-24 Basin Shrubland At Risk from Drawdown, Alternative B

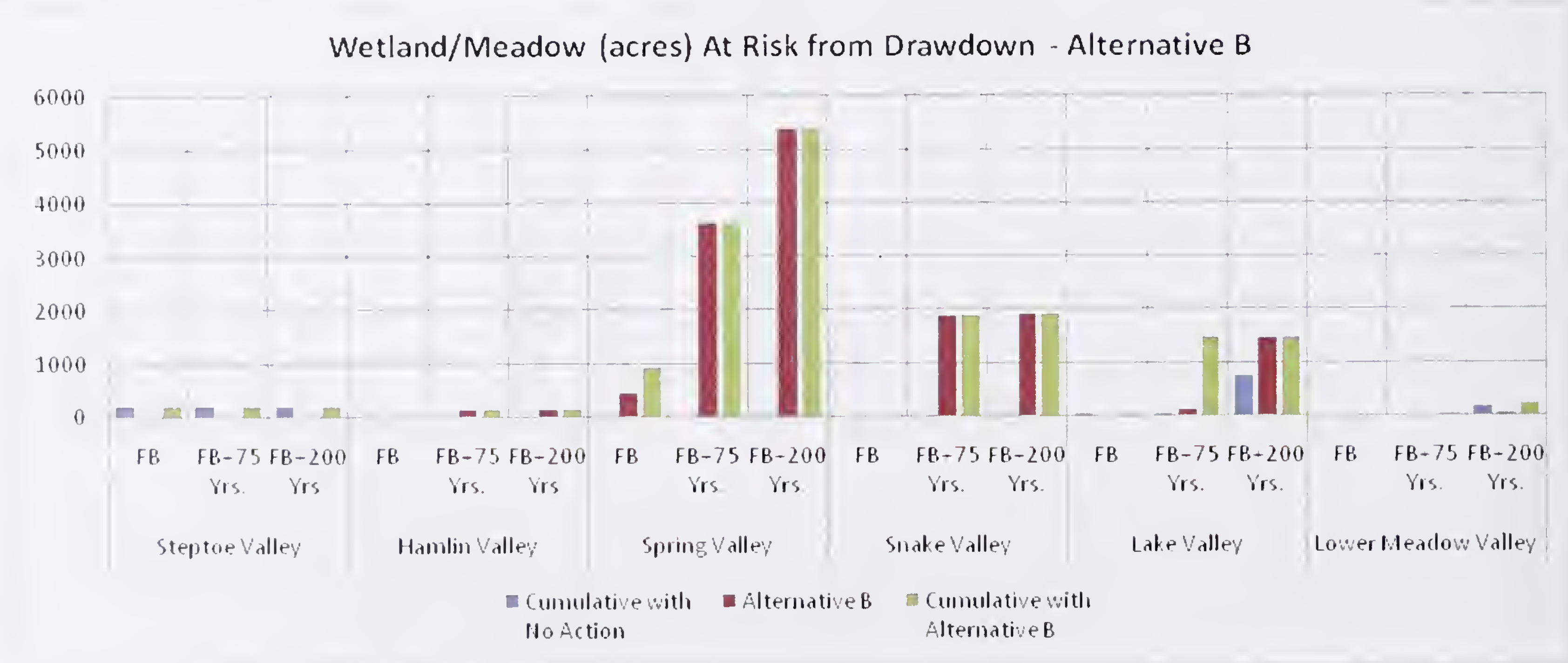


Figure 3.5-25 Wetland/Meadow At Risk from Drawdown, Alternative B

3.5.3.9 Alternative C

Rights-of-way Groundwater Field Development Construction and Operational Maintenance

The GWD Project surface disturbance (up to 17,035 acres) would intersect with existing road and highway crossings in all hydrologic basins, would parallel approximately 100 miles of designated utility corridor in Clark and Lincoln counties, and would intersect service roads for future wind energy projects in Spring and Dry Lake valleys and facilities for a solar energy project in Delamar Valley. Expected cumulative effects to resources would be the same as those described for Alternative A.

Groundwater Pumping

Figure F3.5-6 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. **Figures 3.5-26** and **3.5-27** illustrate the number of springs and miles of perennial streams by basin, respectively, that would potentially be affected by the Alternative C drawdown. Alternative C would contribute much lower levels of drawdown effects to springs and streams in Spring and Snake valleys relative to the cumulative effects predicted for the Proposed Action, and Alternatives and B. This difference is attributed to the overall lower groundwater withdrawal assumed for Alternative C.

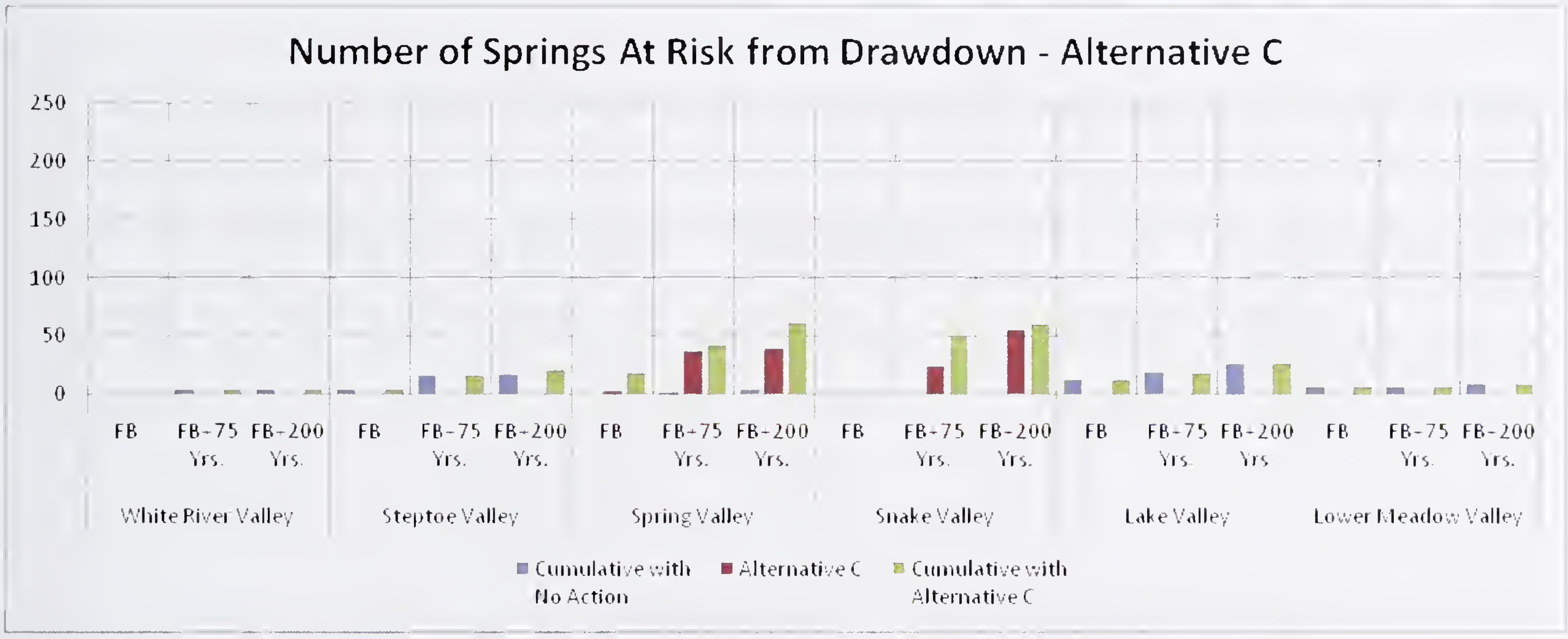


Figure 3.5-26 Number of Springs At Risk from Drawdown, Alternative C

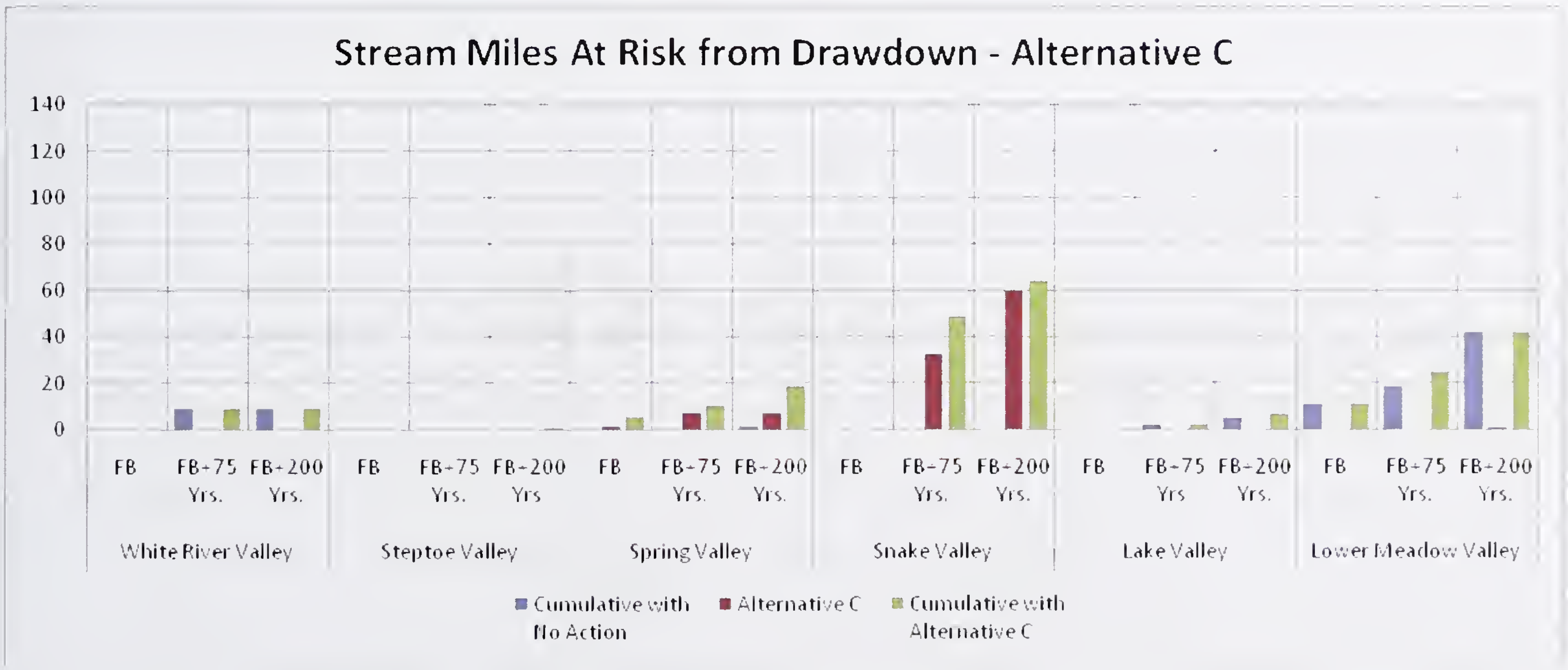


Figure 3.5-27 Stream Miles At Risk from Drawdown, Alternative C

Cumulative acres of potential disturbance due to drawdown for basin shrubland and wetland/meadow ET areas have been graphed by hydrologic basin (**Figures 3.5-28** and **3.5-29**). Similar to springs and streams, there would be lower levels of potential drawdown effects to ET areas from the cumulative contribution of Alternative C as compared to the Proposed Action, and Alternatives A and B.

Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring and Snake valleys. Predicted drawdowns in the Panaca Valley affecting up to four springs could affect Ute ladies'-tresses orchid populations occurring in wet meadow habitats in Lower Meadow Valley Wash. There is a risk that soil moisture changes in spring meadows could alter the growth and flowering conditions, which could adversely affect the long term population viability.

The Ute ladies'-tresses orchid has not been identified in any of the areas potentially at risk. If populations of this species are found in the future, evaluations of groundwater drawdown risk to this species would be conducted.

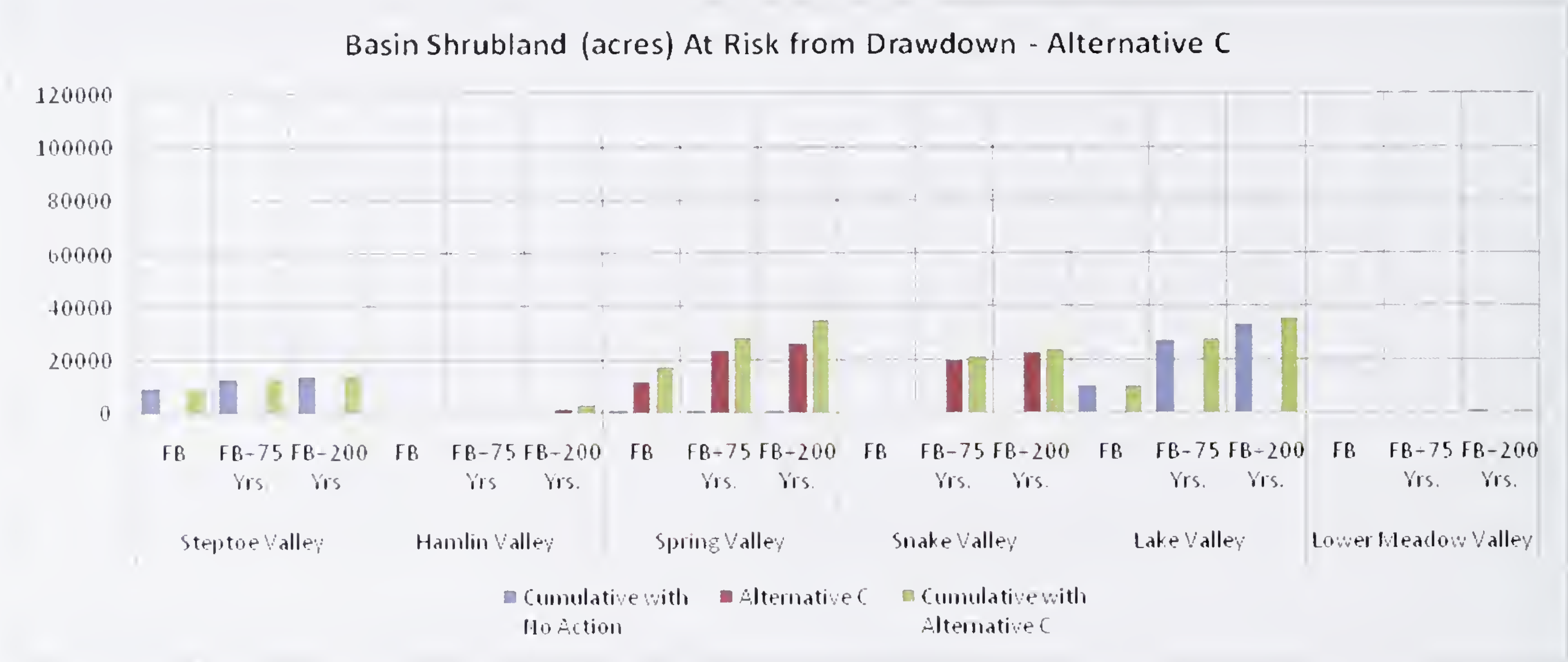


Figure 3.5-28 Basin Shrubland At Risk from Drawdown, Alternative C

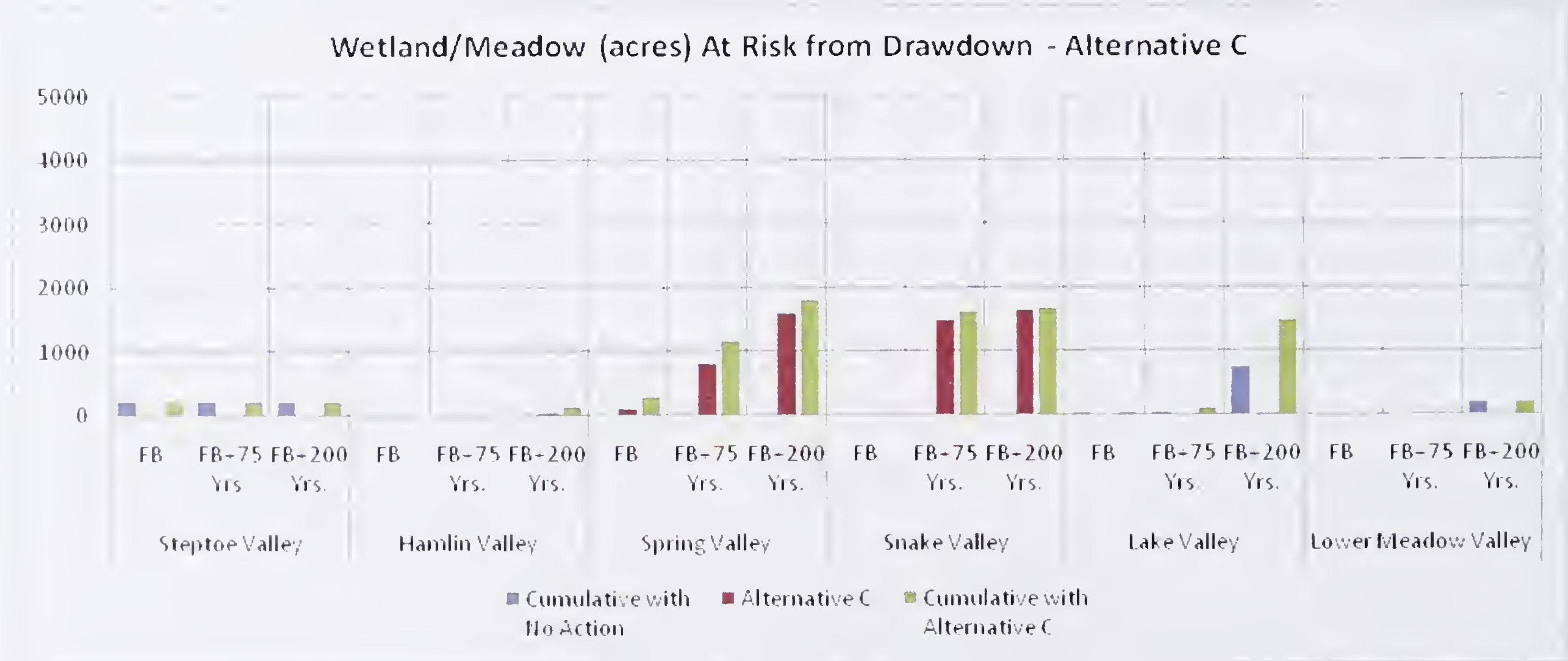


Figure 3.5-29 Wetland/Meadow At Risk from Drawdown, Alternative C

3.5.3.10 Alternative D

Rights-of-way Groundwater Field Development Construction and Operation Maintenance

The GWD Project surface disturbance (up to 12,779 aces) would intersect with existing road and highway crossings in all hydrologic basins, would parallel approximately 100 miles of designated utility corridor in Clark and Lincoln counties. Expected cumulative effects to resources would be the same as those described for Alternative A.

Groundwater Pumping

Figure F3.5-7 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. **Figures 3.5-30** and **3.5-31** illustrate the number of springs and miles of perennial streams by basin, respectively, that would potentially be at risk by Alternative D groundwater drawdown. Alternative D would contribute potential drawdown effects to many fewer springs and stream miles as compared to the Proposed Action, and Alternative B. This difference is attributed to the concentration of Alternative D pumping in southern Spring Valley, which would not affect streams and streams in northern Spring and Snake valleys.

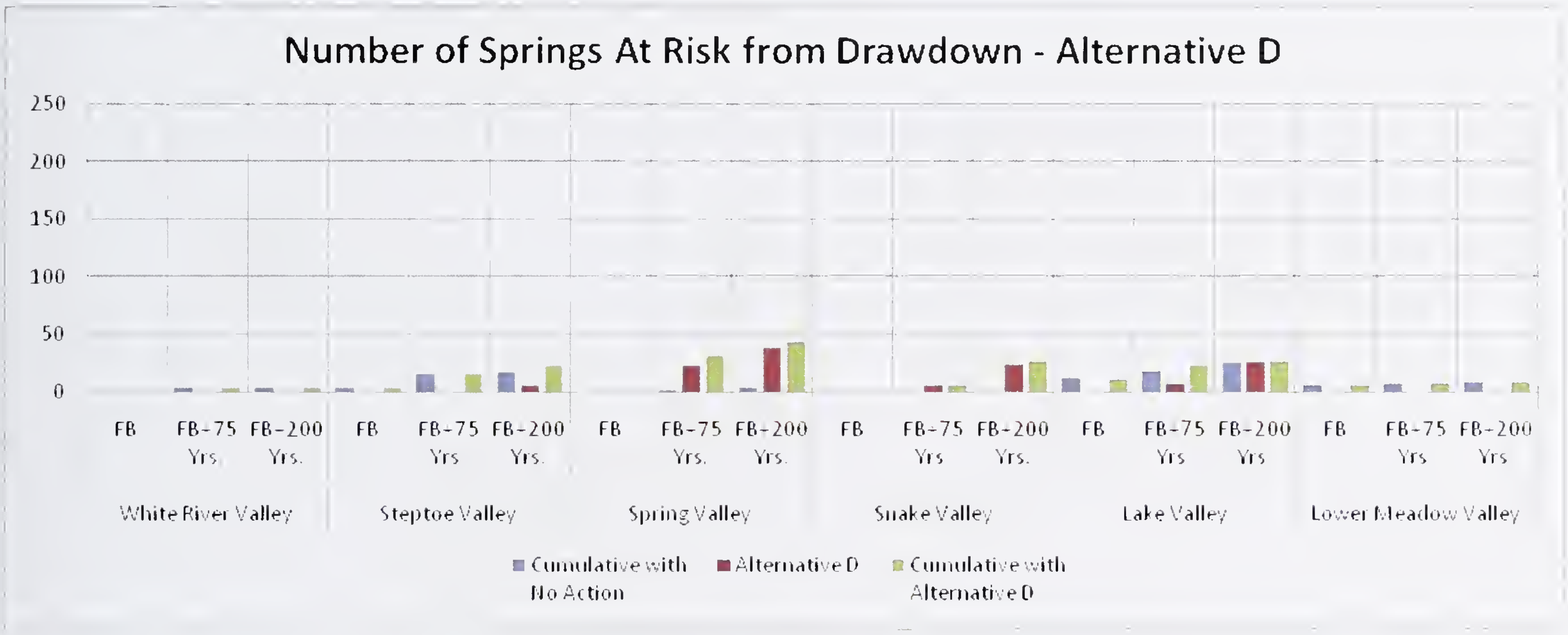


Figure 3.5-30 **Number of Springs At Risk from Drawdown, Alternative D**

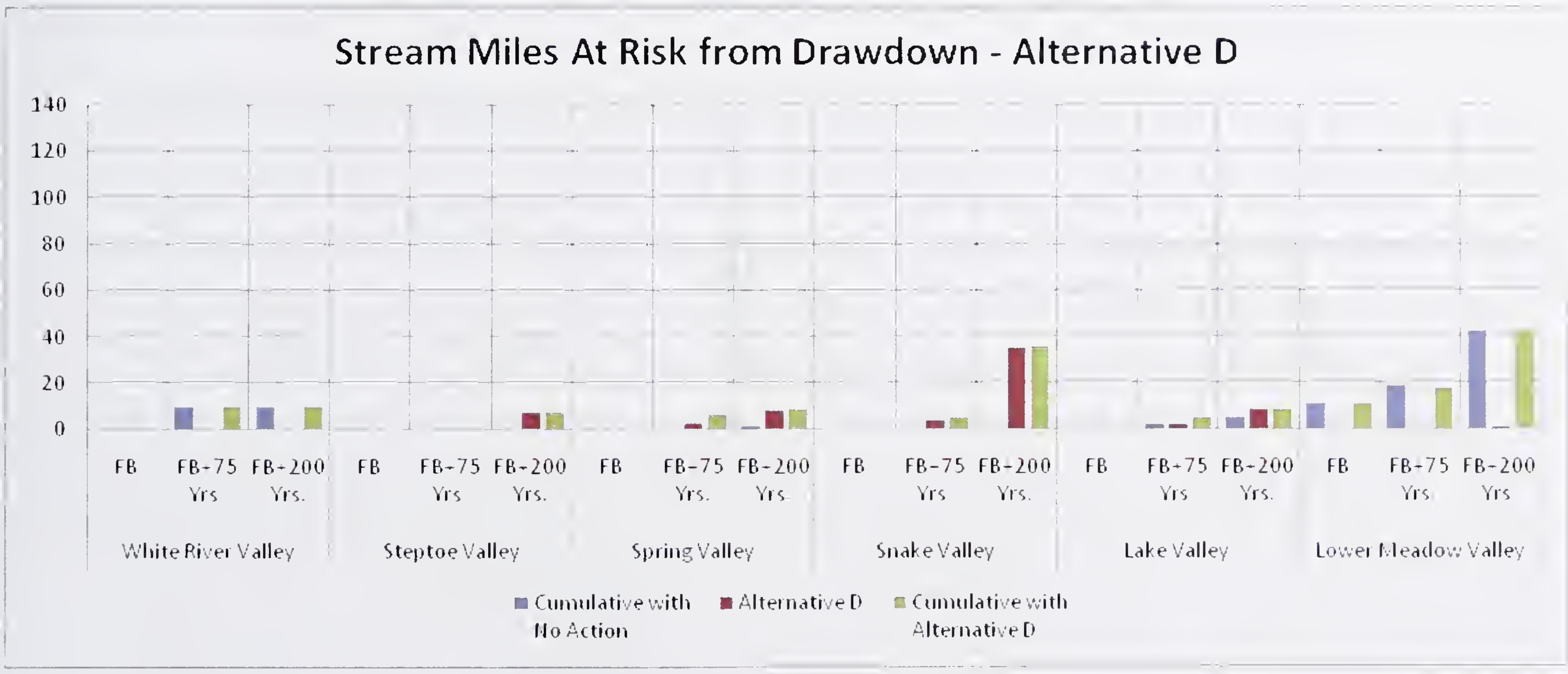


Figure 3.5-31 **Stream Miles At Risk from Drawdown, Alternative D**

Cumulative acres of potential disturbance due to drawdown for basin shrubland and wetland/meadow ETs have been graphed by hydrologic basin (**Figures 3.5-32** and **3.5-33**). Alternative D would affect a much smaller ET area acreage as compared to the Proposed Action and Alternative B. This difference is attributed to the concentration of Alternative D pumping in southern Spring Valley, which would reduce the predicted effects in the large ET areas in central and northern Spring Valley.

Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring, Snake, and Lake valleys. Predicted drawdowns in the Panaca Valley affecting up to three springs could affect Ute ladies'-tresses orchid populations occurring in wet meadow habitats in Lower Meadow Valley Wash. There is a risk that soil moisture changes in spring meadows could alter the growth and flowering conditions, which could adversely affect the long term population viability.

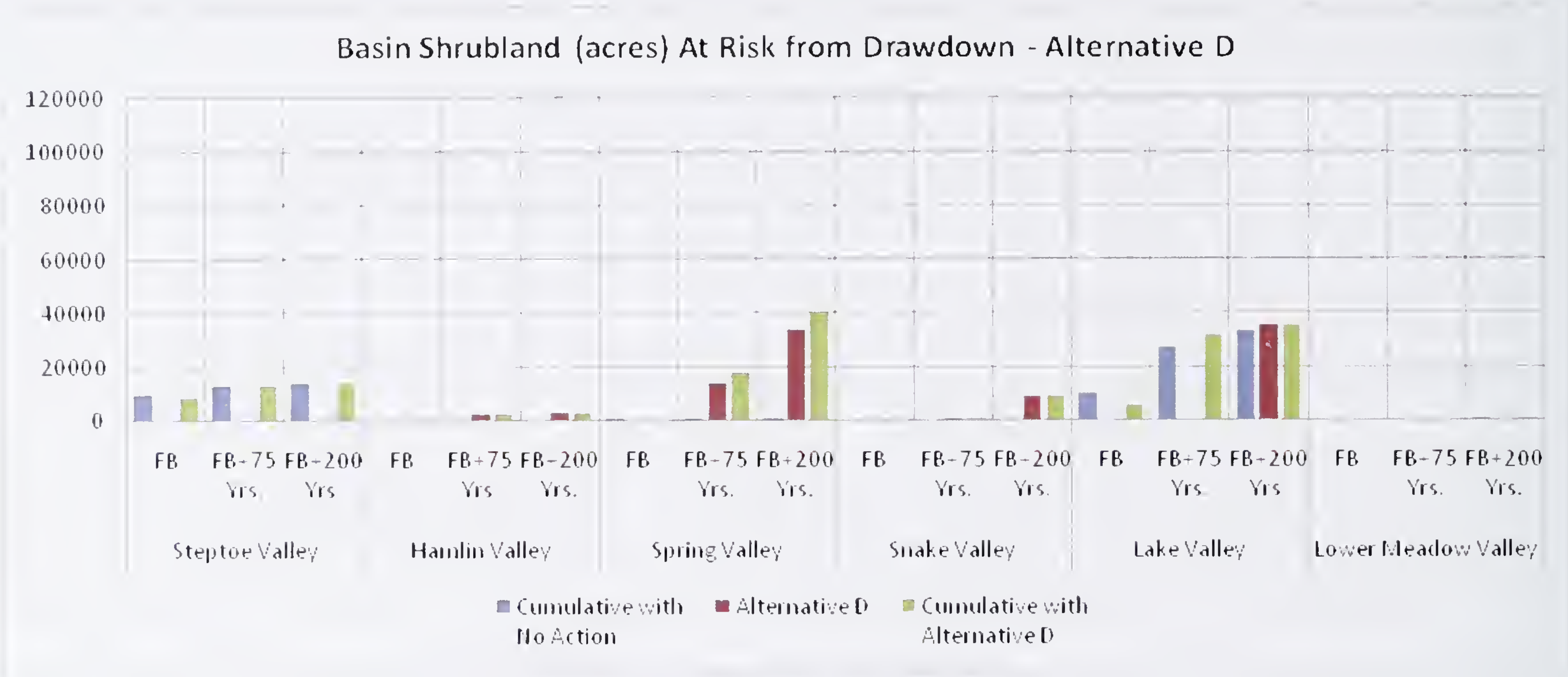


Figure 3.5-32 Basin Shrubland At Risk from Drawdown, Alternative D

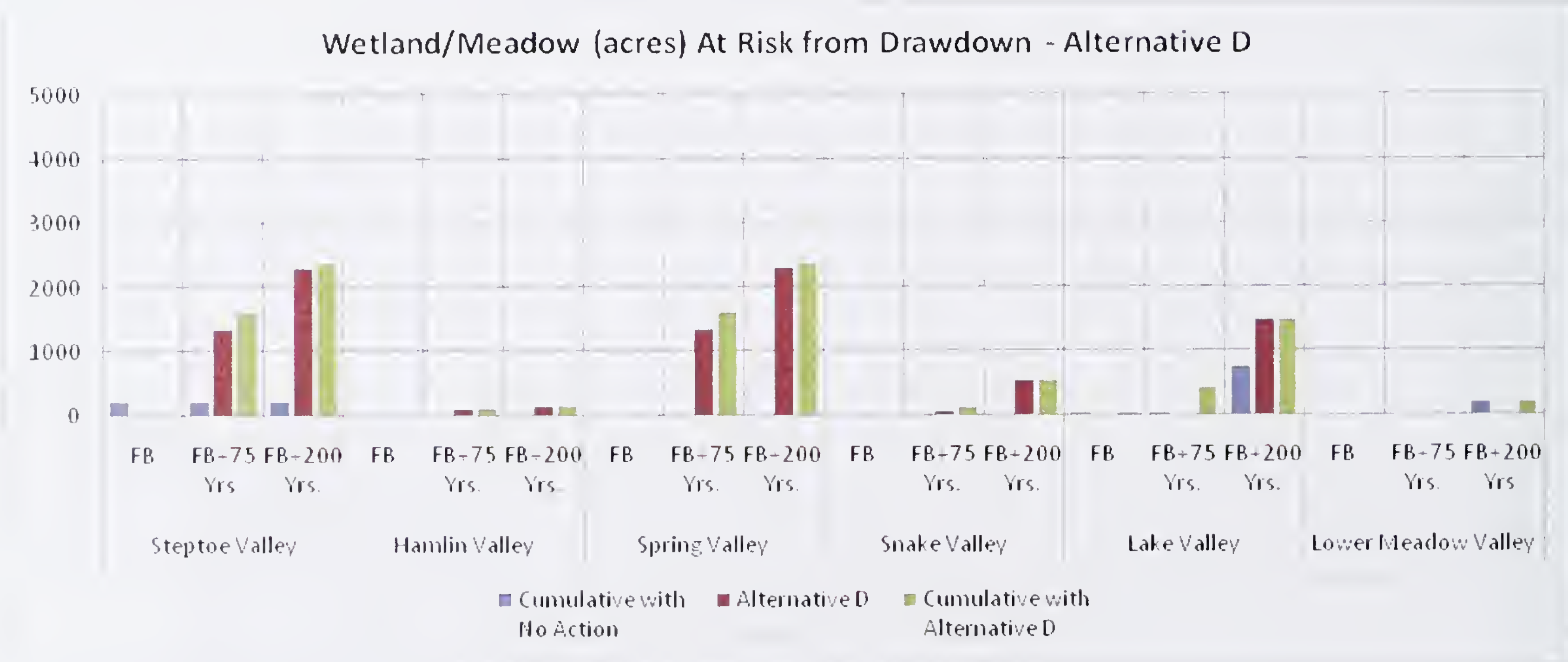


Figure 3.5-33 Wetland/Meadow At Risk from Drawdown, Alternative D

3.5.3.11 Alternative E

Rights-of-way Groundwater Field Development Construction and Operation Maintenance

The GWD Project surface disturbance (up to 14,673 acres) would intersect with existing road and highway crossings in all hydrologic basins, would parallel approximately 100 miles of a designated utility corridor in Clark and Lincoln counties. Expected cumulative effects to resources would be the same as those described for Proposed Action.

Groundwater Pumping

Figure F3.5-8 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. **Figures 3.5-34** and **3.5-35** illustrate the number of springs and miles of perennial streams by basin, respectively, that would potentially be impacted by the Alternative E. Alternative E would contribute potential drawdown effects to many fewer springs and stream miles as compared to the Proposed Action, and Alternative B, especially in Snake Valley. This difference is attributed to the lack of Alternative E pumping in Snake Valley. However, Alternative E pumping would potentially affect approximately twice as many springs as Alternative D in Spring Valley. This difference is attributed to groundwater development over the entire area of Spring Valley under Alternative E, as compared to only the southern portion of Spring Valley in Lincoln County under Alternative D.

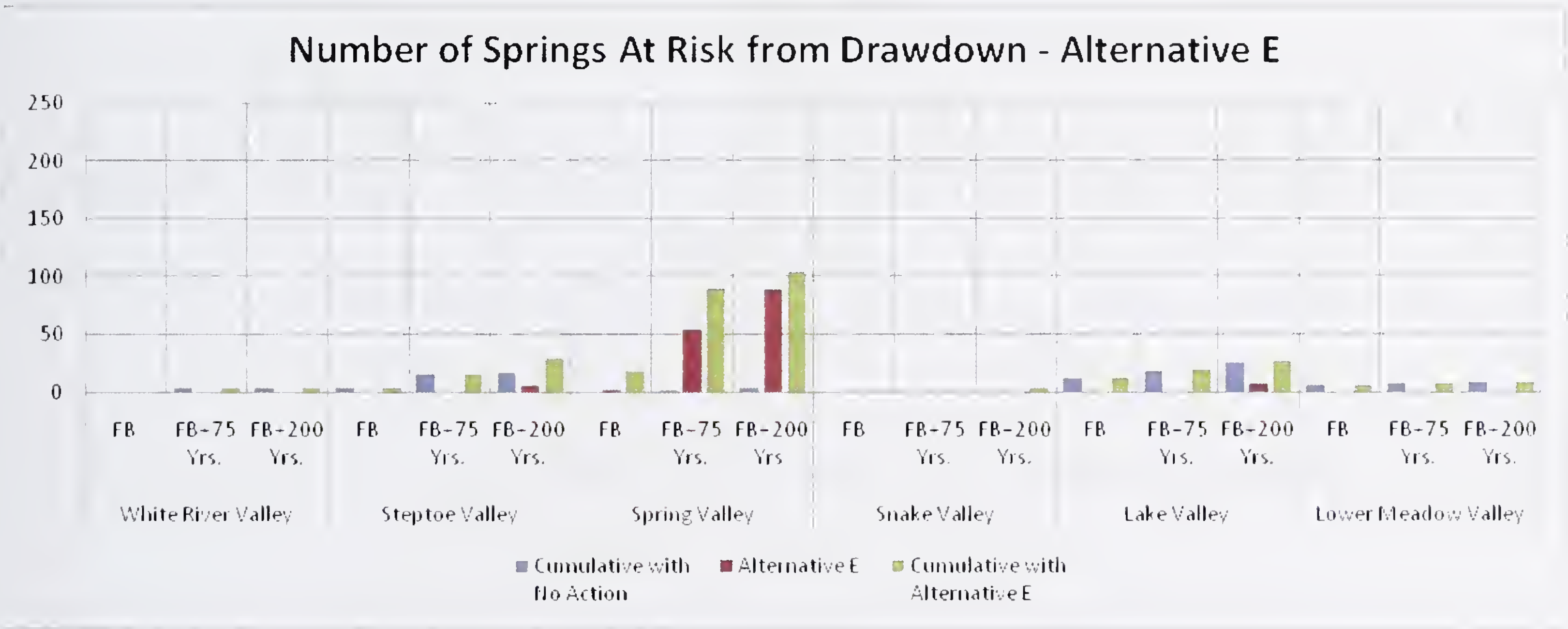


Figure 3.5-34 Number of Springs At Risk from Drawdown, Alternative E

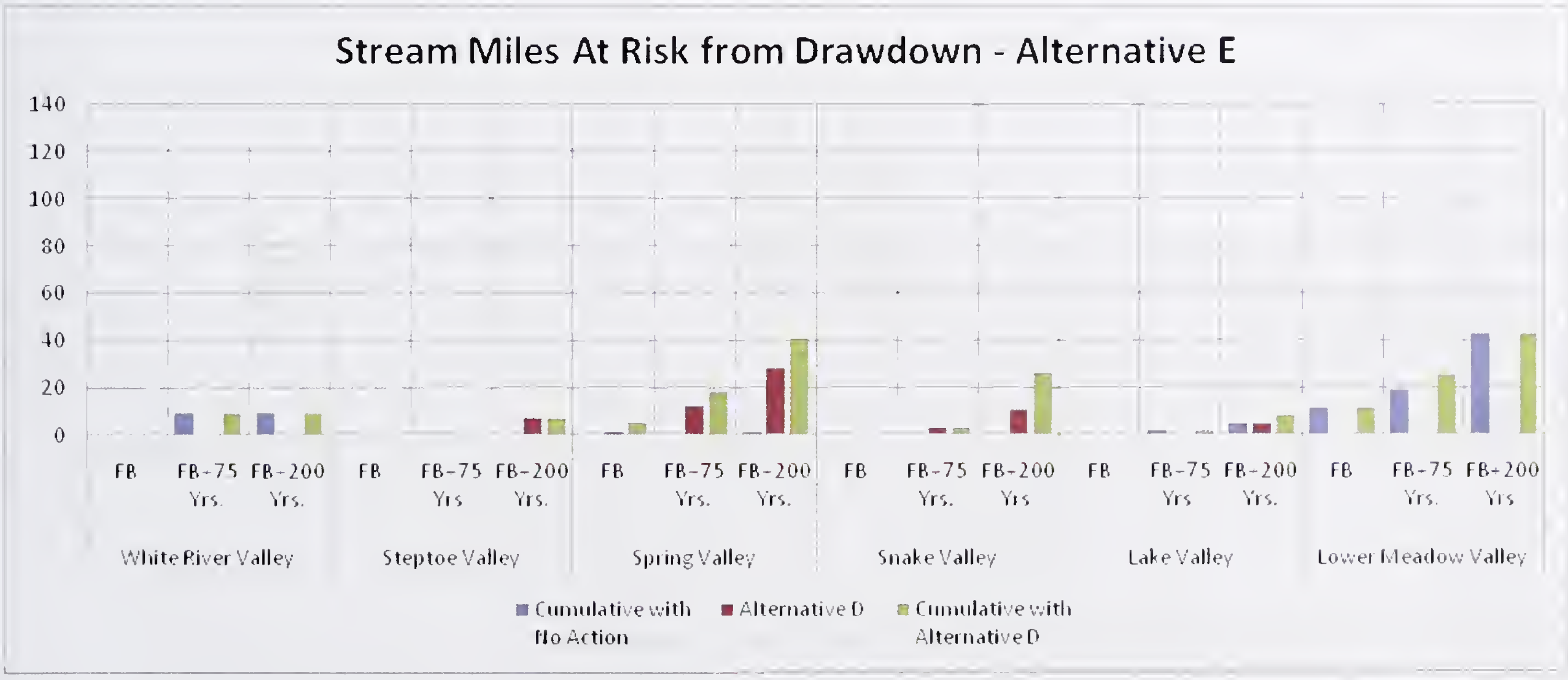


Figure 3.5-35 Stream Miles At Risk from Drawdown, Alternative E

Cumulative acres of potential disturbance due to drawdown for basin shrubland and wetland/meadow ETs have been graphed by hydrologic basin (**Figures 3.5-36** and **3.5-37**). Alternative E would contribute equivalent effects to ET areas in Spring Valley as Alternative A, because the well development pattern would be the same. No effects on ET areas are predicted in Snake Valley at any time interval.

Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants. Predicted drawdowns in the Panaca Valley affecting up to three springs could affect Ute ladies'-tresses orchid populations occurring in wet meadow habitats in Lower Meadow Valley Wash. There is a risk that soil moisture changes in spring meadows could alter the growth and flowering conditions, which could adversely affect the long-term population viability.

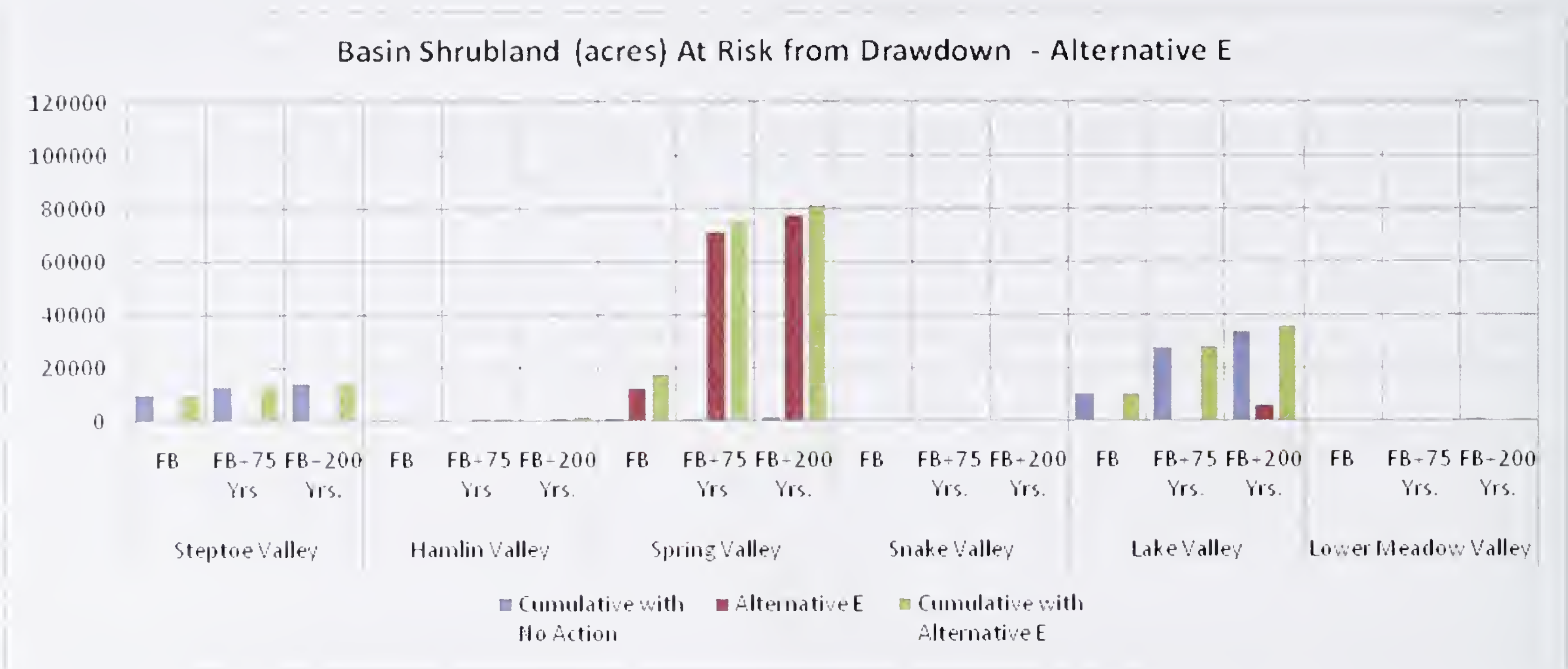


Figure 3.5-36 Basin Shrubland At Risk from Drawdown, Alternative E

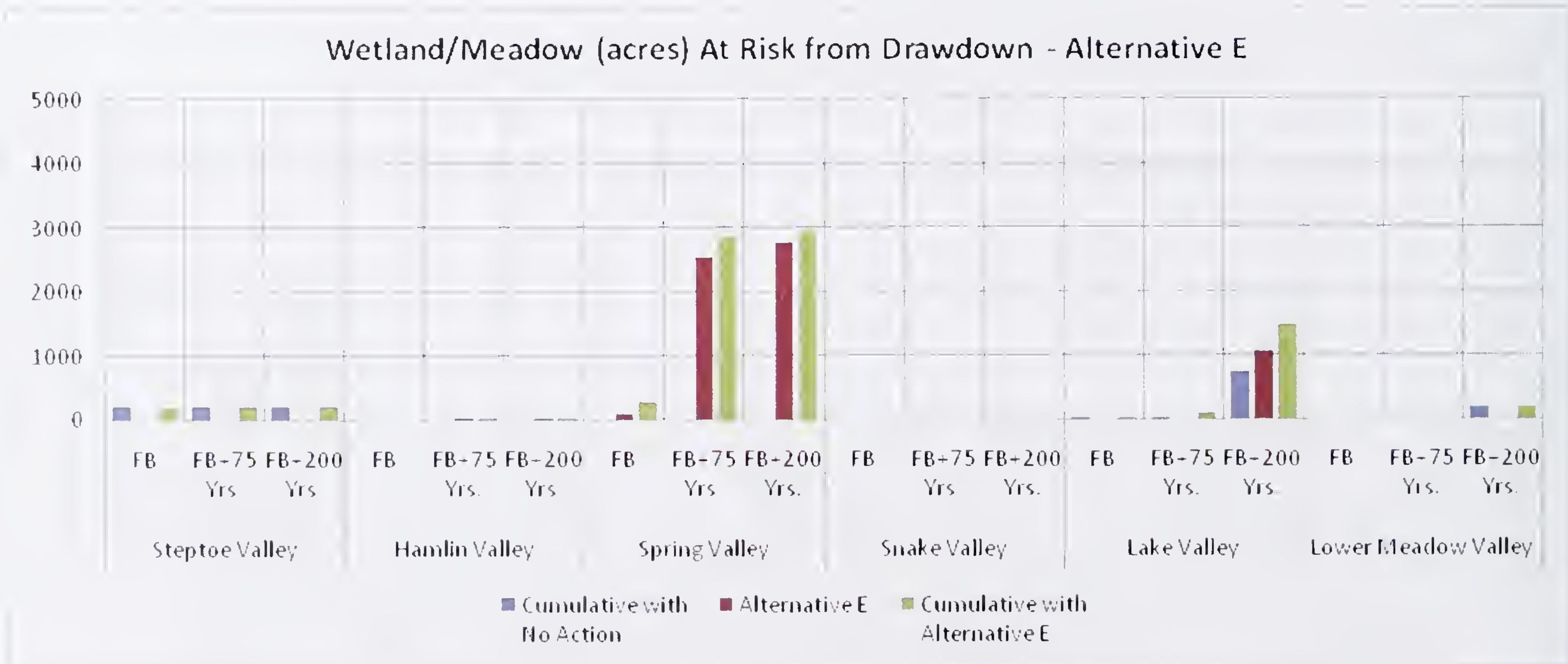


Figure 3.5-37 Wetland/Meadow At Risk from Drawdown, Alternative E

3.5.3.12 Alternative F

Rights-of-way Groundwater Field Development Construction and Operation Maintenance

The GWD Project surface disturbance (up to 17,102 acres) would intersect with existing road and highway crossings in all hydrologic basins, would parallel approximately 100 miles of a designated utility corridor in Clark and Lincoln counties. Expected cumulative effects to resources would be the same as those described for Proposed Action.

Groundwater Pumping

Figure F3.5-8 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. **Figures 3.5-38** and **3.5-39** illustrate the number of springs and miles of perennial streams by basin, respectively, that would potentially be impacted by the Alternative E. Alternative E would contribute potential drawdown effects to many fewer springs and stream miles as compared to the Proposed Action, and Alternative B, especially in Snake Valley. This difference is attributed to the lack of Alternative E pumping in Snake Valley. However, Alternative E pumping would potentially affect approximately twice as many springs as Alternative D in Spring Valley. This difference is attributed to groundwater development over the entire area of Spring Valley under Alternative E, as compared to only the southern portion of Spring Valley in Lincoln County under Alternative D.

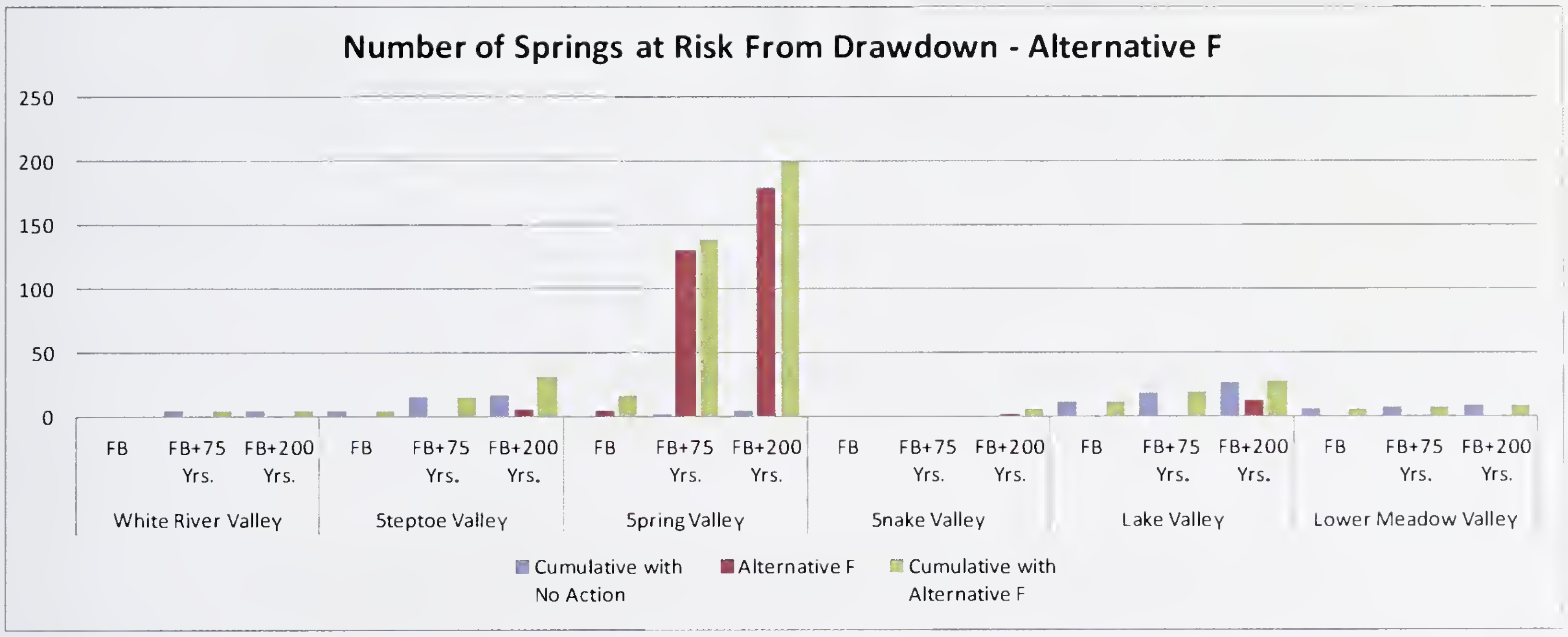


Figure 3.5-38 Number of Springs At Risk from Drawdown, Alternative F

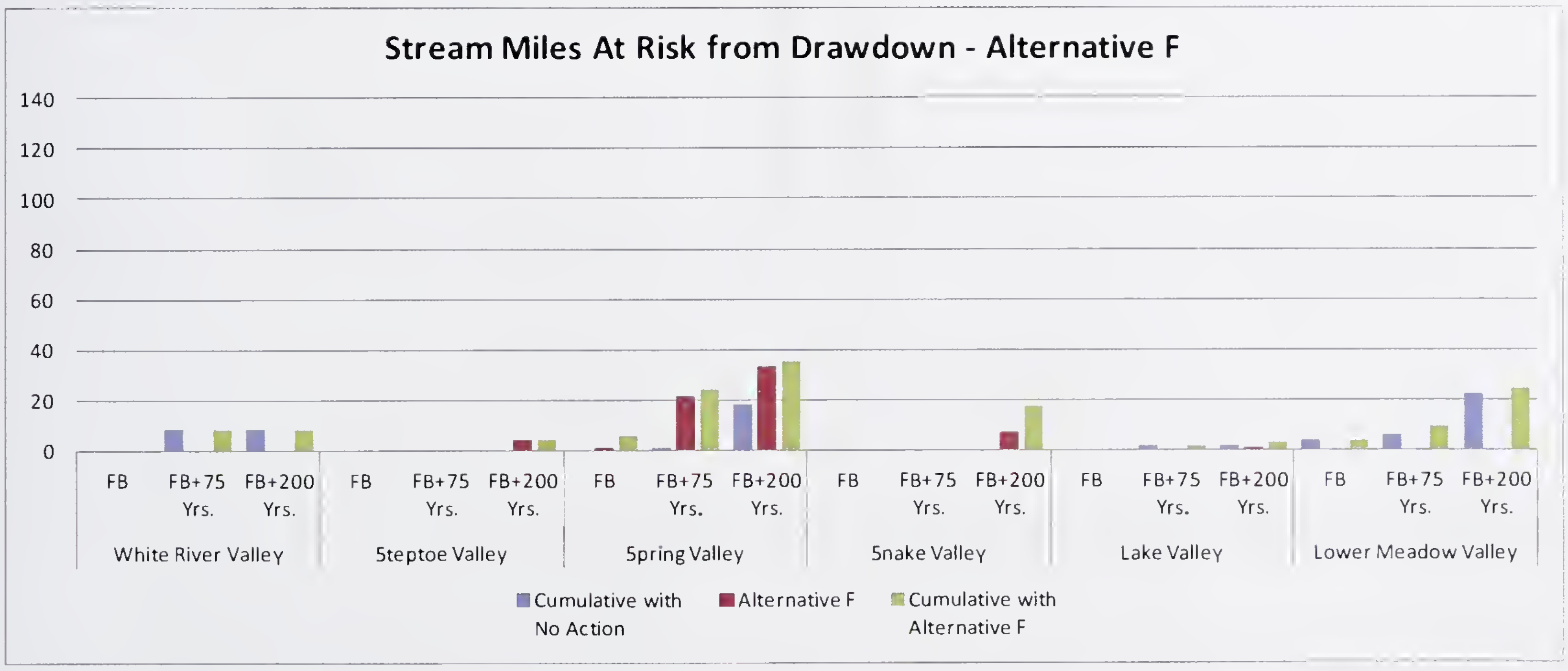


Figure 3.5-39 Stream Miles At Risk from Drawdown, Alternative F

Cumulative acres of potential disturbance due to drawdown for basin shrubland and wetland/meadow ETs have been graphed by hydrologic basin (**Figures 3.5-40** and **3.5-41**). Alternative F would contribute equivalent effects to ET areas in Spring Valley as Alternative A, because the well development pattern would be the same.

Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants. Predicted drawdowns in the Panaca Valley affecting up to three springs could affect Ute ladies'-tresses orchid populations occurring in wet meadow habitats in Lower Meadow Valley Wash. There is a risk that soil moisture changes in spring meadows could alter the growth and flowering conditions, which could adversely affect the long-term population viability.

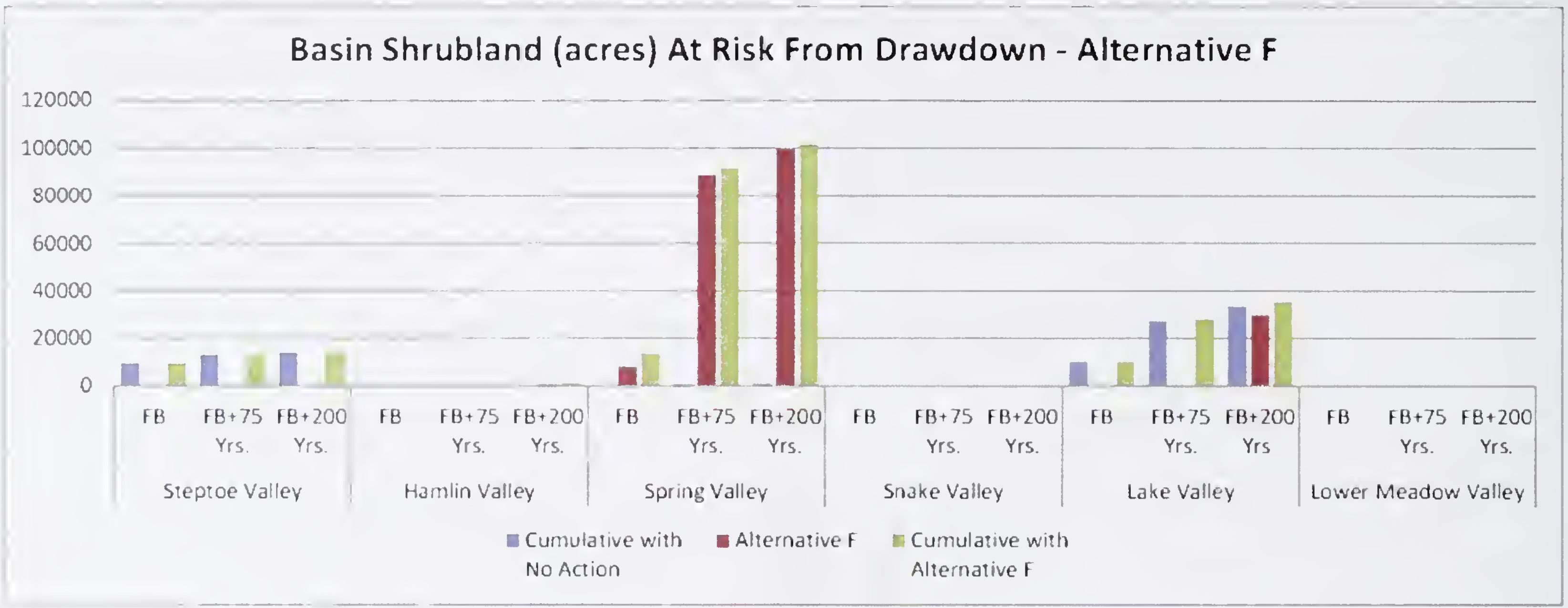


Figure 3.5-40 Basin Shrubland At Risk from Drawdown, Alternative F

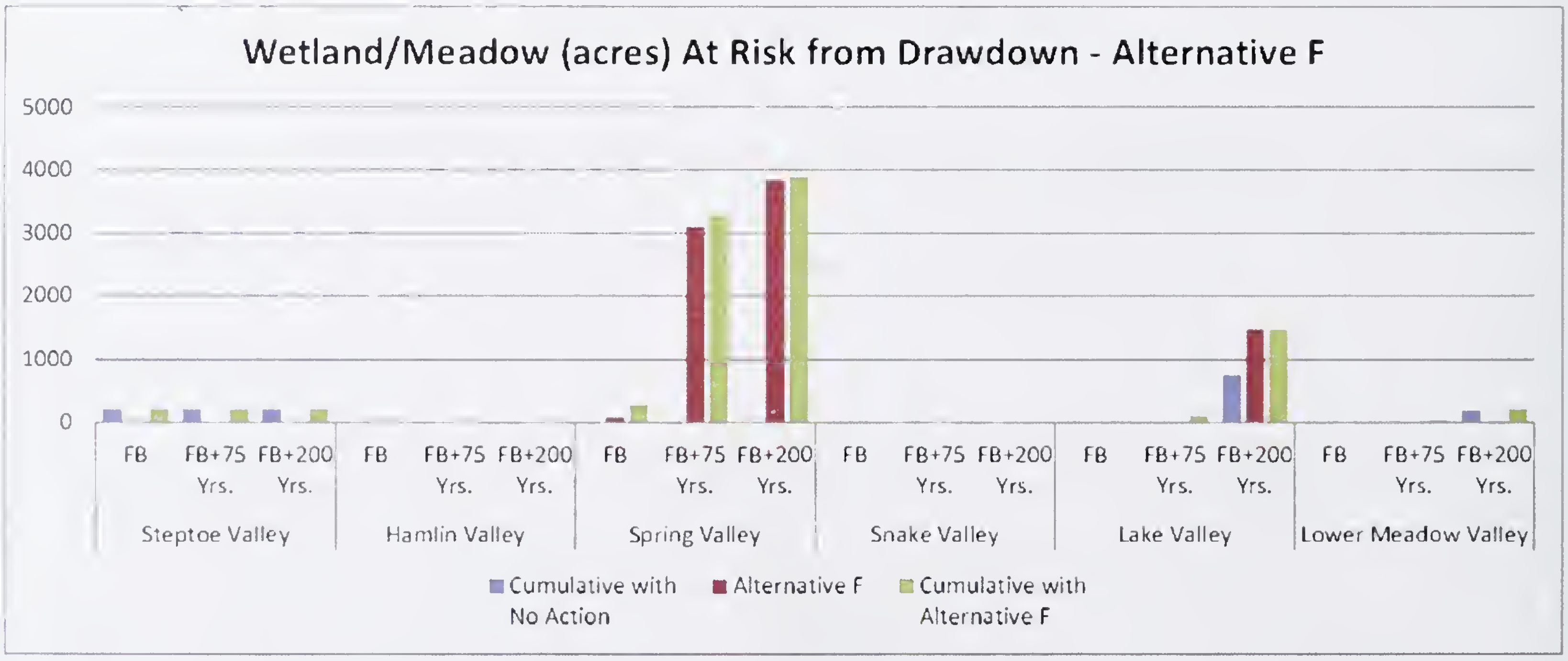


Figure 3.5-41 Wetland/Meadow At Risk from Drawdown, Alternative F