San Juan Basin Action Plan

VEGETATION TECHNICAL REPORT

for the
Environmental Impact Statement on Public Service Company of New Mexico's Proposed New Mexico Generating Station and Possible New Town

United States
Department
of the Interior

Bureau of Land Management
New Mexico State Office
Santa Fe, New Mexico

October 1982

Report 13 of 22

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
NEW MEXICO STATE OFFICE
P.O. BOX 1449
SANTA FE, NEW MEXICO 87501

IN REPLY REFER TO
NM30840EIS
1792.73(934A)

October 1982

Dear Interested Citizen:

Attached is one of twenty-two technical reports developed as a basis for writing the Environmental Impact Statement on Public Service Company of New Mexico's Proposed New Mexico Generating Station and Possible New Town (NMGS EIS). (A list of the technical reports is attached.)

These technical reports provide detailed information on the existing environment, methods used for the impact analysis, and related data supportive of the analysis and conclusions presented in the EIS. These reports should be retained for use with the Draft and Final EIS and other documents related to BLM's San Juan Basin Action Plan (SJBAP).

The Draft NMGS EIS will be filed with the Environmental Protection Agency and released for public review on November 30, 1982. Comments on the Draft EIS will be due by close of business February 7, 1983, at the BLM New Mexico State Office. Because of the large volume of material presented in the technical reports, the BLM is distributing these reports in advance of the Draft EIS to provide sufficient time for public review. The technical reports will be available for public review at the places indicated on the attached list. Copies will also be available from the BLM New Mexico State Office, U.S. Post Office and Federal Building, Santa Fe, for a copy fee.

Informational public meetings are scheduled for December 1982 to provide a public forum to clarify questions and concerns about the SJBAP proposals and the related environmental documents, which will all have been issued by that time. The meetings are scheduled as follows:

- December 14, Civic Center, Farmington, 3 to 9 PM
- December 14, Convention Center, Albuquerque, 3 to 9 PM
- December 15, Chapter House, Crownpoint, 3 to 9 PM
- December 16, Holiday Inn, Gallup, 3 to 9 PM
- December 16, Kachina Lodge, Taos, 3 to 9 PM

In addition, formal public hearings will be held in January 1983 to solicit public comments on the SJBAP Proposals. These meetings are scheduled as follows:

- January 10, Chapter House, Crownpoint, beginning at 1:00 PM
- January 12, Civic Center, Farmington, beginning at 9:00 AM
- January 14 (and 15th if necessary because of the number of registrants), Four Seasons Motor Lodge, Albuquerque, I-40 and Carlisle Blvd., beginning at 9:00 AM (each day)

Questions on the public meetings, hearings, and the technical reports themselves should be directed to:

Leslie M. Cone
NMGS Project Manager
BLM, New Mexico State Office
P.O. Box 1449
Santa Fe, NM 87501
(505) 988-6184 FTS 476-6184

Sincerely yours,

Charles W. Luscher
State Director, New Mexico

List of Technical Reports

1. Purpose and Need
2. Project Description
3. Alternatives to the Project
4. Site Alternatives
5. Permit Reconnaissance
6. Air Quality
7. Geologic Setting
8. Mineral Resources
9. Paleontology
10. Soils, Prime and Unique Farmlands
11. Hydrology
12. Water Quality
13. Vegetation
14. Wildlife and Aquatic Biology
15. Threatened and Endangered Species
16. Cultural Resources
17. Visual Resources
18. Recreation Resources
19. Wilderness Values
20. Transportation
21. Social and Economic Conditions
22. Land Use Controls and Constraints

Availability of Technical Reports for Public Review

Individual copies of the technical reports can be obtained for a copy fee. Inquiries should be directed to:

Bureau of Land Management, New Mexico State Office
Title Records and Public Assistance Section (943B)
U.S. Post Office and Federal Building
P.O. Box 1449
Santa Fe, NM 87501
(505) 988-6107 FTS 476-6107

Copies of the reports are available for public review at the locations listed below. [Formal and informal cooperating agencies are denoted by an asterisk (*).]

BUREAU OF LAND MANAGEMENT OFFICES

New Mexico State Office

NMGS Project Staff (934A)
Room 122, Federal Building
Cathedral Place
P.O. Box 1449
Santa Fe, NM 87501
(505) 988-6184 FTS 476-6184

San Juan Energy Projects Staff (911)
Room 129, Federal Building
Cathedral Place
P.O. Box 1449
Santa Fe, NM 87501
(505) 988-6226 FTS 476-6226

Public Affairs Staff (912)
Room 2016
U.S. Post Office and Federal Building
P.O. Box 1449
Santa Fe, NM 87501
(505) 988-6316 FTS 476-6316

Division of Resources(930)
509 Camino de los Marquez, Suite 3
P.O. Box 1449
Santa Fe, NM 87501
(505) 988-6212 FTS 476-6212

Albuquerque District Office
3550 Pan American Freeway NE
P.O. Box 6770
Albuquerque, NM 87107
(505) 766-2455 FTS 474-2455

Farmington Resource Area Headquarters
900 La Plata Road
P.O. Box 568
Farmington, NM 87401
(505) 325-3581

Taos Resource Area Office
Montevideo Plaza
P.O. Box 1045
Taos, NM 87571
(505) 758-8851

Socorro District Office
198 Neel Avenue
P.O. Box 1219
Socorro, NM 87801
(505) 835-0412 FTS 476-6280

Las Cruces District Office
1705 N. Valley Drive
P.O. Box 1420
Las Cruces, NM 88001
(505) 524-8551 FTS 571-8312

Roswell District Office
1717 W. Second Street
P.O. Box 1397
Roswell, NM 88201
(505) 622-7670 FTS 476-9251

Carlsbad Resource Area Headquarters
114 S. Halagueno Street
P.O. Box 506
Carlsbad, NM 88220
(505) 887-6544

USDI, Bureau of Land Management
Division of Rights-of-Way (330)
18th and C Streets, NW
Washington, D.C. 20240
(202) 343-5441 FTS 343-5441

USDI, Bureau of Land Management
Denver Service Center (D-460)
Technical Publications Library
Denver Federal Center, Bldg. 50
Denver, CO 80225
(303) 234-2368 FTS 234-2368

NEW MEXICO STATE AGENCIES

New Mexico State Environmental Improvement Division*
725 St. Michaels Drive
P.O. Box 968
Santa Fe, NM 87503
(505) 827-5217, ext. 2416

New Mexico Energy and Minerals Department*
525 Camino de los Marquez
P.O. Box 2770
Santa Fe, NM 87503
(505) 827-3326

New Mexico Historic Preservation Bureau*
State Historic Preservation Officer
505 Don Gasper Avenue
Santa Fe, NM 87503
(505) 827-2108

New Mexico Natural Resource Department*
Villagra Building
Santa Fe, NM 87503
(505) 827-5531

New Mexico Public Service Commission*
Bataan Memorial Building
Santa Fe, NM 827-3361
(505) 827-3361

New Mexico State Engineer's Office*
Bataan Memorial Building
Santa Fe, NM 87503
(505) 827-2423

New Mexico State Planning Office*
505 Don Gaspar Avenue
Santa Fe, NM 87503
(505) 827-5191

OTHER ORGANIZATIONS

Public Service Company of New Mexico
Alvarado Square
P.O. Box 2268
Albuquerque, NM 87158
(505) 848-2700

Woodward-Clyde Consultants, Inc.
3 Embarcadero Center, Suite 700
San Francisco, California 94111
(415) 956-7070

PUBLIC AND UNIVERSITY LIBRARIES

Reading copies of the NMGS EIS and associated technical reports will be available at the following public and university libraries:

State and Public Libraries

Albuquerque Public Library
501 Copper Avenue NW
Albuquerque, NM 87102

Aztec Public Library
201 W. Chaco
Aztec, NM 87401

Crownpoint Community Library
c/o Lioness Club, P.O. Box 731
Crownpoint, NM 87313

Cuba Public Library
Box 5, La Jara
Cuba, NM 87027

Farmington Public Library
302 N. Orchard
Farmington, NM 87401

Gallup Public Library
115 W. Hill Avenue
Gallup, NM 87301

Mother Whiteside Memorial Library (Public)
525 W. High Street
P.O. Box 96
Grants, NM 87020

New Mexico State Library
325 Don Gaspar Avenue
Santa Fe, NM 87503

OTHER DEPARTMENT OF THE INTERIOR AGENCIES

Bureau of Indian Affairs*
Albuquerque Area Office
123 4th Street
P.O. Box 2088
Albuquerque, NM 87198
(505) 766-3374 FTS 474-3374

Bureau of Indian Affairs*
Eastern Navajo Agency
P.O. Box 328
Crownpoint, NM 87313
(505) 786-5228

Bureau of Indian Affairs*
Navajo Area Office
Box M - Mail Code 305
Window Rock, AZ 86515
(602) 871-5151 FTS 479-5314

Bureau of Reclamation*
Upper Colorado Regional Office
125 S. State Street
P.O. Box 11568
Salt Lake City, UT 84147
(801) 524-5463 FTS 588-5463

Minerals Management Service*
South Central Region
505 Marquette Avenue NW, Suite 815
Albuquerque, NM 87102
(505) 766-1173 FTS 474-1173

Minerals Management Service*
Resource Evaluation Office
411 N. Auburn
Farmington, NM 87401
(505) 327-7397 FTS 572-6254

National Park Service*
Southwest Regional Office
1100 Old Santa Fe Trail
Santa Fe, NM 87501
(505) 988-6375 FTS 476-6375

National Park Service*
Environmental Coordination Office
Pinon Building, 1220 St. Francis Drive
P.O. Box 728
Santa Fe, NM 87501
(505) 988-6681 FTS 476-6681

U.S. Fish and Wildlife Service*
Field Supervisor, Ecological Services
3530 Pan American Highway, Suite C
Albuquerque, NM 87107
(505) 766-3966 FTS 479-3966

U.S. Geological Survey (WRD)*
505 Marquette Avenue, Room 720
Albuquerque, NM 87101
(505) 766-2810 FTS 474-2817

OTHER FEDERAL AGENCIES AND ORGANIZATIONS

Environmental Protection Agency*
Region VI
1201 Elm Street
Dallas, TX 75270
(214) 767-2716 FTS 729-2716

Navajo Tribe*
c/o Division of Resources
P.O. Box 308
Window Rock, AZ 86515
(602) 871-6592

Pueblo of Zia*
General Delivery
San Ysidro, NM 87053
(505) 867-3304

Soil Conservation Service*
424 N. Mesa Verde
Aztec, NM 87410
(505) 334-9437

U.S. Corps of Engineers*
P.O. Box 1580
Albuquerque, NM 87103
(505) 766-2657 FTS 474-2657

USDA, Forest Service*
717 Gold Avenue
Albuquerque, NM 87102
(505) 474-1676 FTS 474-1676

USDA, Forest Service*
District Ranger
Mt. Taylor Ranger District
201 Roosevelt Avenue
Grants, NM 87020
(505) 287-8833

Harwood Foundation Library
(Public)
25 LeDoux
P.O. Box 766
Taos, NM 87571

University/College Libraries

University of New Mexico
General Library
Albuquerque, NM 87131

Navajo Community College Library
Shiprock Branch
P.O. Box 580
Shiprock, AZ 87420

Northern New Mexico Community College
P.O. Box 250
Espanola, NM 87532

New Mexico State University
San Juan Campus
4601 College Blvd.
Farmington, NM 87401

University of New Mexico, Gallup Campus
Learning Resources Center
200 College Road
Gallup, NM 87301

New Mexico State University/Grants
1500 Third Street
Grants, NM 87020

New Mexico Highlands University
Donnelly Library
National Avenue
Las Vegas, NM 87701

College of Santa Fe
Fogelson Memorial Library
St. Michaels Drive
Santa Fe, NM 87501

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Prepared by

Woodward-Clyde Consultants

for the

U.S. Department of the Interior Bureau of Land Management

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MAPS AND FIGURE

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NEW MEXICO GENERATING STATION

1.0
INTRODUCTION

BACKGROUND

Included in the recent Council on Environmental Quality Regulations (1979) are several important objectives to reduce excessive paperwork in the preparation of environmental impact statements (EISs):

- Discuss only briefly issues other than significant ones.

- Emphasize the portions of the EIS that are useful to decision makers and the public and reduce emphasis on background material.

- Prepare analytic rather than encyclopedic EISs.

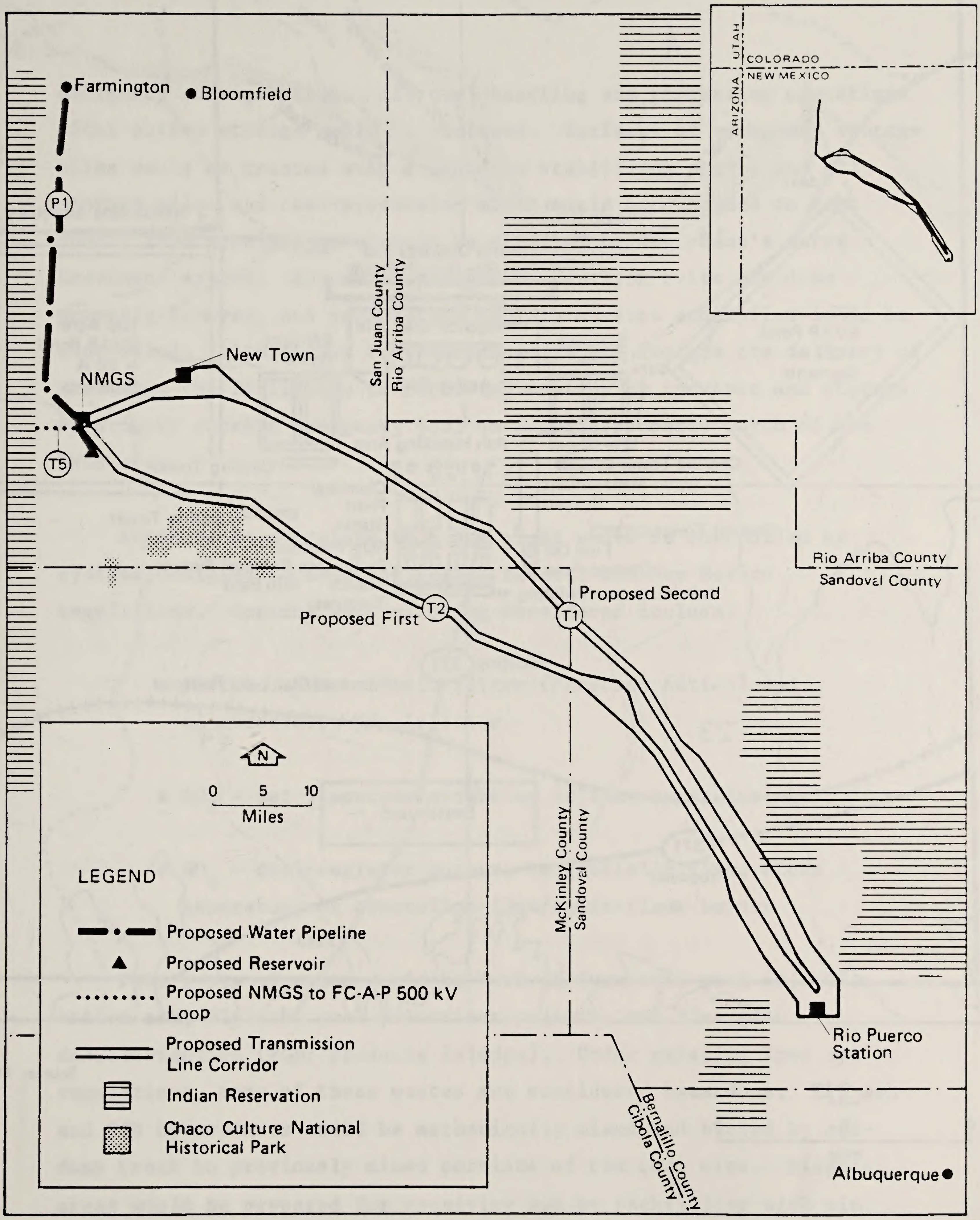
In order to accomplish these objectives and still provide the depth and background required for an analytic impact statement, this technical report has been prepared for the New Mexico Generating Station (NMGS) project. In this report, impacts that were not identified as significant but which are still considered important by the public or technical specialists are analyzed. Background material is provided for those issues and impacts that were considered necessary for the comparison of alternatives. Impacts that were not identified as significant or important by the public and by technical preparers are summarized, and reasons for their elimination from detailed analysis are discussed.

SUMMARY DESCRIPTION OF PROJECT COMPONENTS

Public Service Company of New Mexico (PNM) proposes to construct a 2000-megawatt (MW) coal-fired electric generation plant approximately 35 miles south of Farmington, New Mexico, in San Juan County (Map 1-1). The proposed NMGS, at ultimate development, would have four 500-MW generating units. Each generating unit would include a turbine generator area, coal pulverizer area, boiler area, particulate removal system, SO_2 removal system, and chimney stack. The proposed arrangement of these and other power plant components is shown in Figure 1-1. For the environmental analysis, it was assumed that commercial operation of the first 500-MW unit would begin in 1990 and that other units would start operating during the 1990s.

Coal for NMGS would be acquired through long-term contracts with Sunbelt Mining and Arch Minerals (Proposed Action) or other producers in the San Juan Basin (alternative coal supply). Coal acquired from a joint venture of Sunbelt and Arch Minerals would be supplied from surface mines (referred to as the Bisti mine in this analysis) in the immediate vicinity of the proposed plant site. Coal acquired from other producers in the San Juan Basin would be hauled from mines located as much as 30 miles from the proposed plant site. Coal required for NMGS would average 7.5 million tons per year, or a total of 300 million tons over the 40-year project life.

The proposed fuel-handling system would involve hauling coal from the Bisti mine (or other mine locations) by truck to a receiving facility located adjacent to the NMGS site. Coal would then be transferred via conveyor belt from the receiving station to active or



Note: For more information, see the location maps in Appendix G of the EIS.

Source: BLM 1982.

Map 1-1. GENERAL LOCATION OF PROPOSED ACTION

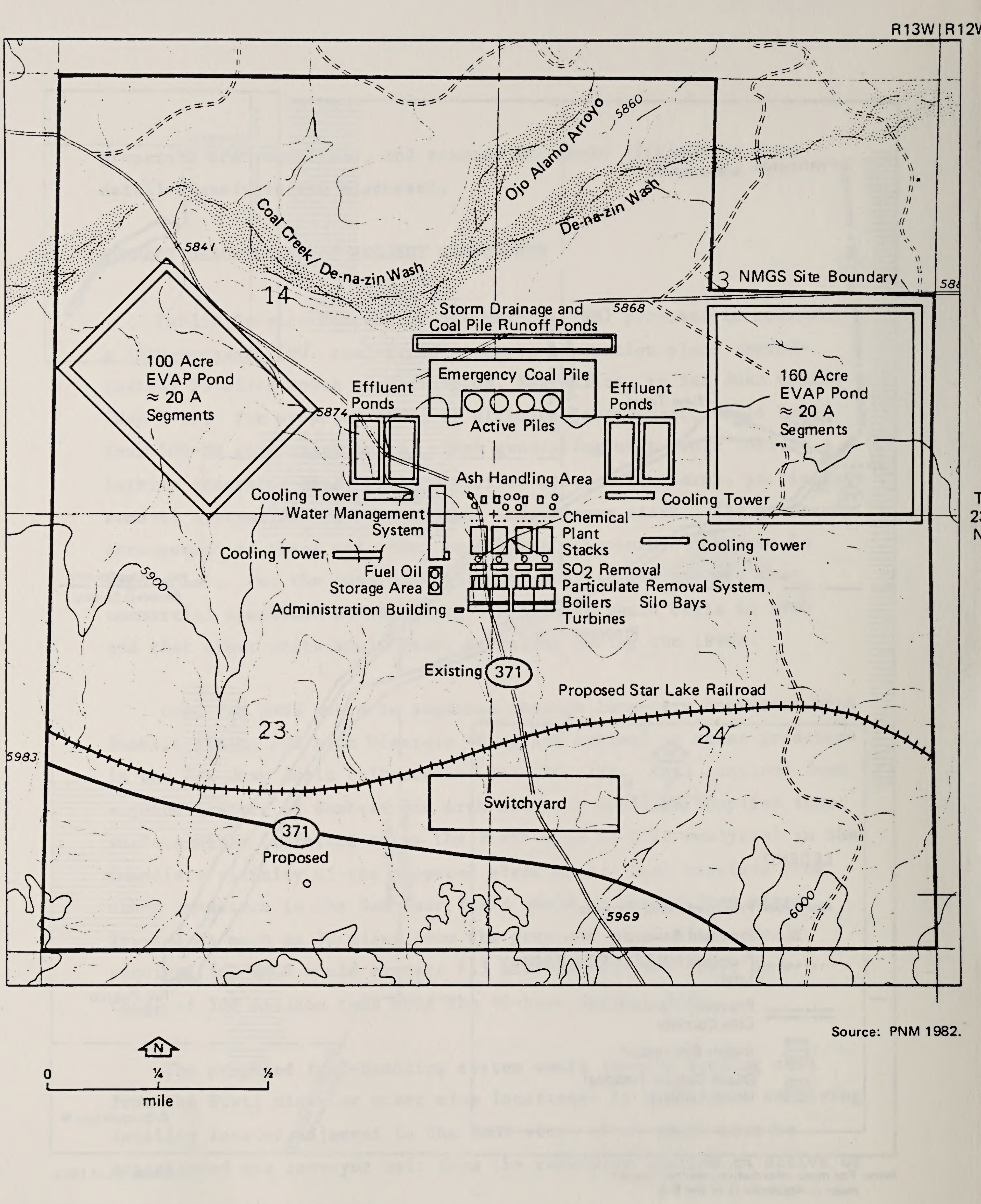


Figure 1-1. STATION LAYOUT

emergency storage piles. All coal-handling and processing operations after active storage would be enclosed. Surfaces of emergency storage piles would be treated with a nontoxic stabilizing agent, and all storage piles and coal-processing areas would be designed so that runoff from precipitation would be diverted to the plant's water treatment system. Any coal spills from conveyor belts would be promptly removed, and percolation beneath on-site stockpiles would be controlled. Alternative fuel-handling systems include the delivery of coal from the Bisti mine to receiving station by conveyor and storage of primary crushed emergency coal on Sunbelt property north of the NMGS site.

Atmospheric emissions from the plant would be controlled by systems designed to meet applicable federal and New Mexico regulations. Control systems being considered include:

- Particulates - fabric filter (Proposed Action) and electrostatic precipitator
- SO_2 - wet limestone scrubbing or lime spray drying
- NO_x - dual-register burner, tangentially fired steam generator, or controlled-flow/split-flame burner

Four types of waste would be derived from coal used in NMGS: bottom ash, fly ash, coal pulverizer rejects, and flue gas desulfurization (FGD) products (sludge). Under existing laws and regulations, none of these wastes are considered hazardous. Fly ash and FGD by-products would be mechanically mixed and hauled by end-dump truck to previously mined portions of the coal mine. Disposal areas would be prepared for receiving ash by backfilling with mine overburden. Ash would then be dumped and spread in layers over the mine overburden. After the ash was placed and spread, it would be covered with layers of overburden and surface soil or topsoil and then a vegetative cover would be established. Bottom ash and pulverizer rejects would be collected for disposal in dewatering bins and then hauled by end-dump trucks for disposal into previously mined portions of the coal mine. Procedures for disposal would be the same as for fly ash.

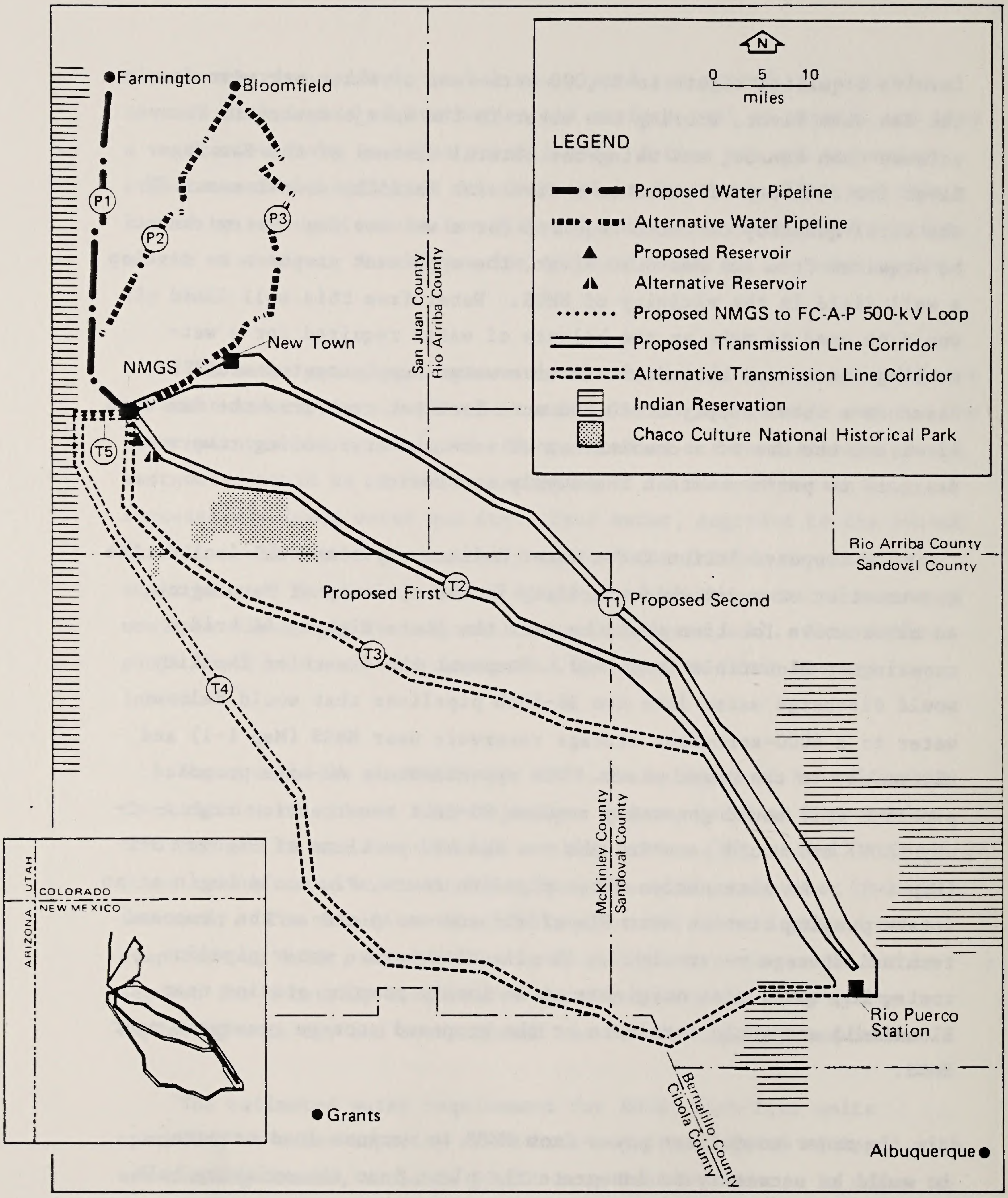
The water management system would contain all equipment necessary to treat and supply all the plant makeup water and potable water. The power plant would be designed and operated as a zero-discharge plant; wastewater would be reused by cascading it to uses requiring successively lower water quality. Used water, degraded to the extent that it could not be economically treated for further in-plant use, would be used for transport and disposal of plant-generated wastes or would be discharged to evaporation ponds (Figure 1-1). Evaporation ponds would be lined with impervious material to limit seepage losses.

Water supplies available for NMGS are believed to be sufficient to construct an all-wet heat-rejection system, based on evaporative cooling, and to use forced-draft cooling towers (Figure 1-1). Cooling-tower makeup water would be drawn from the nearby raw-water storage reservoir. The makeup water would replace the tower losses from evaporation, drift, and blowdown. If sufficient water could not be secured for a totally evaporative system, a water-cooling system employing both dry and conventional wet towers might be required.

The estimated water requirement for NMGS, with four units operating at rated capacity and a heat-rejection system equipped with wet-cooling towers, would be 35,000 acre-feet per year. In order to supply this quantity of water to NMGS, the Proposed Action would involve acquiring rights to 35,000 acre-feet of water per year from the San Juan River, storing the water in the Navajo Reservoir for release upon demand, and using the natural channel of the San Juan River for delivery of water to a diversion facility downstream. If the total quantity of water required for a wet-cooling system cannot be acquired from the San Juan River, the applicant proposes to develop a well field in the vicinity of NMGS. Water from this well field would be used to make up the balance of water required for a wet-cooling system. A second alternative water supply system would be based on a total supply of 20,000 acre-feet per year from the San Juan River and the use of a combination of wet- and dry-cooling towers designed to perform within the supply constraint.

The Proposed Action for a water delivery system would include the construction of a diversion facility in the vicinity of Farmington; an alternative location would be near the State Highway 44 bridge crossing at Bloomfield (Map 1-2). Pumps at the diversion facility would discharge water into two 36-inch pipelines that would deliver water to a 4000-acre-foot storage reservoir near NMGS (Map 1-1) and ultimately to the power plant. The approximately 40-mile proposed pipeline (P1) would generally require 90-foot construction rights-of-way (ROW) and would parallel the new and old portions of Highway 371 (Map 1-1). An alternative water pipeline route, P2, would begin at an intake pumping station near Bloomfield and would end at the proposed terminal storage reservoir. A 49-mile alternative water pipeline route, P3, would also originate at an intake pumping station near Bloomfield and would terminate at the proposed storage reservoir near NMGS.

In order to deliver power from NMGS to various load centers, it would be necessary to integrate the plant into the existing bulk



Note: For more information, see the location maps in Appendix G of the EIS.

Source: BLM 1982.

Map 1-2. GENERAL LOCATION OF ALTERNATIVES INCLUDING THE PROPOSED ACTION transmission systems of PNM and neighboring utilities. Thus the proposed transmission system would consist of a 500-kilovolt (kV) loop linking NMGS with PNM's approved 500-kV Four Corners-Ambrosia-Pajarito (FC-A-P) line, located approximately 5 miles west of NMGS, and two 500-kV lines linking NMGS with the Albuquerque distribution and load center at the proposed Rio Puerco Station (Map 1-1). The NMGS-Albuquerque system would be installed in phases: the 500-kV loop in 1990 with commencement of commercial operation of Unit 1, the first 500-kV line with Unit 2 in 1993, and the second 500-kV line with Unit 4 in 1998.

Four routes are considered technically and economically feasible for construction of the 500-kV transmission system. Route T2 is proposed for the first 500-kV line and route T1 is proposed for the second 500-kV line; routes T3 and T4 are alternatives to the Proposed Action. The total distance traversed would be similar for the two proposed and two alternative corridors: 101 miles (T2), 107 miles (T1), 105 miles (T3), and 126 miles (T4). With the exception of tower sites, the proposed 200-foot ROW could support other compatible land uses, such as grazing. PNM would keep the transmission line ROW closed and would patrol the line by helicopter each month. Lands disturbed by heavy equipment and temporary access roads would be restored to their original condition.

Table 1-1 displays construction work force estimates over time. Construction employment for station facilities would reach peaks of 1515 employees in 1987 and 1530 employees in 1992. Operations employment at station facilities would increase steadily, from 30 employees in 1989 to 900 employees in 1999 when all four units are expected to be on-line.

Table 1-1. NMGS CONSTRUCTION AND OPERATION EMPLOYMENT

			NMGS											
	Intake Pipeline and	500-kV Trans-mission	Construction					Operation						
Year	Reservoir	Line	Unit 1	Unit 2	Unit 3	Unit 4	Total	Unit 1	Unit 2	Unit 3	Unit 4	Total	Total Employment	Annual Change
1985	—	—	85	—	—	—	85	—	—	—	—	—	85	+85
1986	—	—	800	—	—	—	800	—	—	—	—	—	800	+715
1987	115	—	1515	—	—	—	1630	—	—	—	—	—	1630	+830
1988	295	104	1180	30	—	—	1505	—	—	—	—	—	1505	-125
1989	—	—	360	450	—	—	914	30	—	—	—	30	944	-560
1990	—	—	100	940	40	—	1080	200	—	—	—	200	1280	+336
1991	—	—	—	750	570	—	1320	250	—	—	—	250	1570	+290
1992	—	—	—	270	1260	—	1530	250	24	—	—	274	1804	+234
1993	—	—	—	105	955	30	1090	250	160	—	—	410	1500	-304
1994	—	78	—	—	325	435	838	250	200	30	—	480	1318	-182
1995	—	—	—	—	90	940	1030	250	200	200	—	650	1680	+362
1996	—	—	—	—	—	775	775	250	200	250	—	700	1475	-205
1997	—	—	—	—	—	255	255	250	200	250	24	724	979	-496
1998	—	—	—	—	—	95	95	250	200	250	160	860	955	-24
1999	—	—	—	—	—	—	0	250	200	250	200	900	900	-55

Source: PNM 1980, unpublished data.

According to PNM (unpublished data, 1980), estimated construction employment skill requirements would be as follows:

Skill	Percent of Total Construction Work Force
Boilermakers	9.4
Pipefitters	14.2
Electricians	14.4
Carpenters	5.6
Ironworkers	10.0
Operators	10.0
Laborers	9.0
Teamsters	4.1
Cement masons	0.8
Millwrights	3.3
Insulators	4.0
Sheetmetal workers	1.1
Painters	1.2
Others	0.5
Supervision	12.4

The above estimates are averaged for construction of all four units.

SAN JUAN BASIN ACTION PLAN OVERVIEW AND RELATIONSHIP OF THE NMGS EIS TO ACTIONS INCLUDED IN THE PLAN

The proposed site for the NMGS is located in the San Juan Basin of northwestern New Mexico. The Bureau of Land Management (BLM) is responsible for the management of much of the land and mineral resources in this area, and currently has six separate but interrelated proposals under consideration within the basin. In order to respond to these, the BLM has developed a San Juan Basin Action Plan (SJBAP). This plan provides for the organizational arrangements whereby the environmental analyses and decision making can be implemented in a timely and efficient manner. The plan describes the process for preparation of three site-specific EISs (including the NMGS EIS) and three Environmental Assessments (EAs):

- Coal Preference Right Lease Applications (EA)
- San Juan River Regional Coal Leasing (EIS)
- Wilderness Study Areas (WSAs) (EIS)
- New Mexico Generating Station (EIS)
- Ute Mountain Land Exchange (EA)
- Bisti Coal Lease Exchange (EA)

In addition to these documents, the action plan provides for the preparation of a Cumulative Overview (CO). The CO is intended to focus on the cumulative impacts that would result from the proposed actions analyzed in the EISs and EAs listed above and therefore to facilitate public review and decision making. As a result of this organization, the impact analysis in the NMGS EIS and technical background reports concentrates on the impacts expected to result from the specific NMGS components proposed. The cumulative impacts expected to result from the proposed NMGS, in addition to the cumulative impacts of other proposals to be developed in the same time period, are described in the CO.

BASELINE CONDITIONS ASSUMED FOR THE NMGS TECHNICAL REPORT IMPACT ANALYSES

The site-specific impact analysis for this technical report was based on the affected environment and available resources that would be existing at the time of construction and operation of the NMGS facility. Since construction at the NMGS facility would not begin until 1985, certain assumptions regarding project development in the San Juan Basin were necessary. Two levels of project development were considered, along with criteria for each, in developing a status for the various non-SJBAP actions proposed for the San Juan Basin area.

- Baseline 1 - The projects considered in this level of development are those that have approval and are to be built or under construction in 1985. This level represents the projected existing environment without the proposals included in the SJBAP.

- Baseline 2 - The projects considered in this level are in some phase of the application stage. In this level, Baseline 1 projects are added to any projects in Baseline 2 along with any revision in resource production or uses (e.g., coal).

Where differences in Baselines 1 and 2 affect the results of impact analyses, discussion is provided. If no differences are identified, it should be assumed that consideration of the two different baselines did not alter the impact analyses.

A complete list of projects and comprehensive location maps for Baselines 1 and 2 are provided in Appendix C of the NMGS EIS.

ORGANIZATION OF THE REPORT

Section 2.0 of this technical report describes the assumptions and methodological approach used in the assessment of potential impacts of the Proposed Action on the affected environment. In addition, Section 2.0 contains a definition of the study area and identification of data sources.

Section 3.0, Affected Environment, contains baseline data on existing conditions in the study area, as well as projections of future conditions without the Proposed Action. Information on historical trends is presented where it is useful in providing a basis for predicting most likely future trends. The description of projected future trends takes into consideration the changes in the environment that are expected to occur as a result of the projects identified in Baseline 1. This provides a reasonable estimate of the future existing environment against which the potential impacts of the Proposed Action and alternatives can be assessed.

Section 4.0 describes the potential effects of implementing the Proposed Action and alternatives. Impacts identified are measured against indicators of significance in order to estimate the importance of the impact to the affected human environment. (Potential impacts associated with alternatives to the Proposed Action are compared in Section 9.0.)

In Section 5.0, mitigation measures are suggested. These measures would help to alleviate the potentially significant adverse impacts or enhance the beneficial impacts identified in the Section 4.0 analysis. Those potentially adverse impacts for which no appropriate mitigation measures have been suggested are discussed in Section 6.0 as "unavoidable adverse impacts."

2.0
FRAMEWORK FOR ANALYSIS

2.1 GEOGRAPHIC AREA OF INFLUENCE

2.1.1 Direct Impacts

Direct impacts to plants and vegetation would be caused primarily by construction-related activities. These include removal of or damage to plants or their habitat on or near project components. Most impacts would be expected in a 10-mile corridor centered on linear project components or within a 5-mile radius of the plant site.

2.1.2 Indirect Impacts

Indirect impacts are removed in time or space from the construction and operation of the proposed project but are still caused by it. Potential indirect impacts to plants and vegetation examined for the proposed project included possible effects of increased air pollutants and acid rain, the effect of river water withdrawal on riparian vegetation, and others. The geographic area examined varies with the mechanism and scale of the potential disturbance.

2.1.3 Regional Base for Comparison

The anticipated impacts of each project component were compared with the existing vegetation resources in a region of comparison. This region was defined as the area within a 20-mile-wide corridor centered on linear components (pipelines and transmission lines), or within a 10-mile radius of NMGS.

2.2 INDICATORS OF IMPACT SIGNIFICANCE

Impacts to vegetative resources of concern include the following general categories:

- Disturbance to rare or unusual vegetation types
- Large-scale impacts on more common vegetation types
- Permanent loss of productive capacity (site quality) in any vegetation type

Areas that support unusual vegetation or very productive plant communities are important in maintaining both the animal and plant diversity of the region. Plant community types that occupy less than 1 percent of the regional area (20-mile corridor centered on the rights-of-way (ROWs) or a 10-mile radius from NMGS) are defined as being locally unique or rare plant communities. Riparian communities are also defined as unique and critically important because they provide unique structural habitat for wildlife and because they are the most productive habitat in the area. Impacts on such unique, rare, or critically important plant communities meet the first criterion for significance if a proposed or alternative project component would remove or alter 1 percent or more of that vegetation type present in the region. Any such effects were then examined in greater detail to determine if the impacts are on the whole beneficial or adverse to the natural communities involved and human use of them. Additionally, the duration of these impacts was then evaluated as short-term (less than 3 years or 3 growing seasons) or long-term (greater than 3 years or 3 growing seasons). Adverse impacts that would affect at least 1 percent of the regional type and are long-term are defined as significant impacts.

The second general concern--large-scale removal of more common vegetation types--is addressed in a manner similar to that used for unique types. The area of each type disturbed by the Proposed Action is compared with the total area of that type found in the region, and larger (percentage) disturbances are evaluated in greater detail.

The final concern—loss of productive capacity or site quality—is related to the size and duration of surface disturbances that leave soil exposed to erosion. Larger areas that are repeatedly disturbed and not revegetated will suffer greater erosion and loss of production potential (per unit area) than similar sites where a smaller area is cleared for a shorter time. Most of the surface disturbances associated with this project are relatively narrow. The methods needed to assess erosive loss of topsoil are addressed in the Soils; Prime and Unique Farmland Technical Report.

Effects on agriculture are assessed by area of land type directly or indirectly affected by project components. Types affected are analyzed in quantitative detail where data are available.

2.3 METHODS FOR DATA COLLECTION

2.3.1 Sources of Information

General categories of information sources used in the preparation of this technical report are listed below. The major individual sources used are specified under general headings.

Vegetation Maps

- Draft Star Lake-Bisti Regional Coal Environmental Statement. Vegetation (Map F). BLM 1978.
- Draft San Juan Grazing Management EIS. Vegetation (Visual E). BLM 1982.
- Draft EIS on Grazing Management in the Rio Puerco ES Area. Vegetation (Visual B). BLM 1977.
- 7.5-minute soil-vegetation maps from BLM, Farmington Area Office. No date.
- 1/24,000 range site-condition maps, Soil and Range Inventory of the Shiprock District 13 Area, Navajo Indian Reservation, New Mexico. Bureau of Indian Affairs (BIA) 1972.

- 1/1,000,000 state map of potential natural vegetation. Donart, Sylvester, and Hickey 1978.

- Regional vegetation map in EA for the proposed NMGS to Rio Puerco Station 500-kV transmission project. PNM 1980a.

- Vegetation map in proposed Four Corners-Ambrosia-Pajarito 500-kV Transmission Project DEIS. U.S. Department of the Interior (USDI) 1980.

- 7.5-minute U.S. Geological Survey (USGS) orthophotoquads of San Juan River area.

- 1/24,000 and 1/31,680 black-and-white aerial photos of T1, T2, and T3. PNM.

General Vegetation and Natural Resources

- Articles published in open literature, environmental planning documents, and contract research: Flowers 1961; PNM 1978, 1980a, 1980b; USDI 1980; BLM 1977, 1978, 1982; VTN Consolidated, Inc. and the Museum of Northern Arizona 1978; Woodbury 1961; Castetter 1956; Science Applications, Inc. 1980.

- Information from agency files: BLM, range production clipping studies; Soil Conservation Service (SCS), range site technical descriptions.

Threatened, Endangered, and Rare Plants

- Geographic search, habitat information, and personal communications from New Mexico Heritage Program, Santa Fe. These files include and supersede previous local surveys.

- Older surveys of the project area studied, but cited only when necessary to correct misinformation, especially Rangeland Resources International, Inc. 1978.

- Written input from BLM, Farmington; PNM; and U.S. Fish and Wildlife Service (FWS).

Telephone Contacts: BIA, Farmington, Shiprock, Window Rock, Fort Defiance, Santa Fe; BLM, Farmington, Albuquerque, Santa Fe; U.S. Forest Service (USFS), Grants; SCS, Albuquerque; FWS, Albuquerque; New Mexico State University; University of New Mexico.

Site Inspection: September 1981.

2.3.2 Verification Methods

Data gathered were verified by three general methods: internal consistency and consistency with other sources, on-the-ground site validation, and internal review.

Consistency checks included comparing data from different sources (for example, areas where two vegetation maps overlap), and comparing within data from the same source for expected patterns (i.e., relative production or stocking rates of different vegetation types). Existing vegetation maps for the NMGS site were field checked and revised, and overflights were made of transmission line and pipeline ROWs. Internal review consisted of quality control methodology for data collection and data reduction.

2.3.3 Quantification and Data Reduction Methods

Generating quantitative data on vegetation types and resources based on these types (i.e., grazing) involved four basic steps: classification, choosing mean values for each type, measuring areas of each polygon, and summing area by type. The regional classification of vegetation types was chosen as a natural, ecologic classification based on existing knowledge of the area's vegetation and suitable for the scale of the inventory. Although some areas could be inventoried in greater detail, many areas could not. NMGS and intake sites, were mapped on the ground using more detailed classifications. Pipeline and transmission line corridors were mapped with the regional classification from 1/31,680 aerial photos, 1/24,000 orthophotoquads or, when neither was available, topographic maps. Regions of comparison were mapped from the best regional vegetation maps available. Parts of some comparison regions around transmission lines were taken from relatively small scale vegetation maps when better information was not available. Average cover values for each vegetation type were taken from BLM (1977). Mean range production rates were chosen after examining BLM clipping data, SCS technical range site descriptions, and conversations with USFS, BLM, and SCS personnel. Rates chosen were conservative to include areas of lower productivity or poor access, years of low productivity, and desired improvement in range condition. After maps were drawn, the area of individual polygons were measured using either a Numonics 1224 electronic digitizer or K + E 620010 polar planimeter. Polygons were summed by vegetation type, and the total area multiplied by appropriate rates.

Quantitative analysis is usually not an issue in rare plant data voids. Most rare plants suspected of being in the project area are not known to exist there presently, and the relative importance of undiscovered populations to species survival can not be addressed.

2.3.4 Data Gaps

Three data gaps were encountered in the preparation of this document: Certain portions of the comparison regions around potential transmission line ROWs were not covered on existing regional vegetation maps; the total area of natural riparian plant communities along the San Juan River was difficult to determine; and existing data on rare plants of the region were too limited to reasonably predict project impacts and acid rain impacts.

For those portions of the transmission line comparison regions not covered by regional-scale maps of existing vegetation, information was taken from the 1/1,000,000 map of potential vegetation (Donart, Sylvester, and Hickey 1978).

The area of native riparian communities is difficult to separate from the matrix of irrigated croplands and urban development along the San Juan River. Individual polygons of each type are small and often transitory, due to land development, river channel migration, and changes in agricultural land use. Using recent 7.5-minute USGS orthophotoquads, native riparian plant communities were estimated to occupy approximately 10% of the floodplain readily identifiable as vegetation type 6 (riparian and irrigated cropland). This percentage times the type 6 total was used to approximate the total native riparian area in regions of comparison.

Rare, threatened, and endangered plants are by definition difficult to inventory and assess. Although PNM has searched for Sclerocactus mesa-verdae on the NMGS site, the ROWs and other project components have not been searched for those rare species most likely to occur. The best available data on these species is in the New Mexico Heritage Program, which was consulted. See the Threatened and Endangered Species Technical Report for detailed information.

Although total sulfur dioxide (SO_2) and nitrogen oxides (NO_x) emissions from NMGS are predicted in the Air Quality Technical Report, the location and effects of acid deposition are poorly known. Vulnerable areas of relatively acid soils in mountains northeast of NMGS could be identified, but its effect relative to existing cation reservoirs and natural input are unknown.

2.4 BASELINE 1 VERSUS BASELINE 2

Regional vegetation inventories and total acreages of vegetation used for the regional base for comparison presented here assume Baseline 1 conditions. Because Baseline 2 conditions are not different at the scale of the inventory, no additional tables are presented assessing project impacts against Baseline 2.

3.0

AFFECTED ENVIRONMENT

3.1 INTRODUCTION

The vegetation of all regions of comparison was inventoried from small-scale regional and local vegetation maps (cited in Section 2.3) using the regional vegetation classification presented in Section 3.2. The NMGS site was treated in greater detail during the on-site visits. Both sites were inventoried with higher resolution classifications, presented in Sections 3.3 and 3.6, respectively. All plant cover figures refer to the area of community canopy cover expressed as a percentage of ground area (Daubenmire 1959 gives a cogent and practical description of how to estimate plant cover in the field). Because community cover can vary appreciably from year to year, it is used in this report only as a relative measure to help the reader visualize and interpret various vegetation types.

3.2 REGIONAL VEGETATION TYPE CLASSIFICATION

The following vegetation classification was used to inventory the pipeline corridors, transmission corridors, and the regional vegetation surrounding all project components:

- Type 1 - Ponderosa pine, oak, and pinyon pine woodlands
- Type 2 - Sand wash and saline lowland
- Type 3 - Badland and steep slopes
- Type 4 - Shrubland - grassland
- Type 5 - Juniper savannas, pinyon-juniper woodlands
- Type 6 - Irrigated cropland and true riparian

3.2.1 Vegetation Type 1

Type 1 broadly describes a variety of vegetation communities found above the pinyon-juniper zone. This zone is wetter and more productive than the pinyon-juniper zone and is a woodland of open-grown trees, tall shrubs, and grassland. Ponderosa pine (Pinus ponderosa), pinyon pine (Pinus edulis), and oaks (Quercus gambelii and Quercus sp.) are the dominant woody species, with junipers (Juniperus monosperma, J. osteosperma, J. scopulorum), skunkbush (Rhus trilobata), sagebrush (Artemisia tridentata and A. nova), and mountain mahogany (Cercocarpus montanus) often present. Common grasses include blue grama (Bouteloua gracilis), western wheatgrass (Agropyron smithii), and junegrass (Koeleria cristata). The Bureau of Land Management (1977) indicates that the average vegetation canopy ground cover in this type is about 30 per cent.

Ponderosa-pinyon-oak woodlands are found only on alternate transmission corridor T4 where it crosses Mesa Chivato. In this area, Ponderosa pine and oaks are on slopes above 7500 feet elevation, with grasslands on the flat mesa top. Small, isolated stands of montane conifers can occur on north-facing slopes and in canyons, and occasionally aspen (Poupulus tremuloides) are found along drainages. Average annual precipitation ranges from 12 to 16 inches per year.

3.2.2 Vegetation Type 2

Vegetation Type 2 includes sand washes reworked by intermittent stream flow, nearby sand dunes, and saline lowland sites. These three types of sites were mapped together as one type because they are found adjacent to one another as a natural topographic unit. Portions of Type 2 and Type 6 are unique in having a water table within reach of plant roots.

Sand washes in intermittent stream beds are dominated by annuals such as cocklebur (Xanthium strumarium) and ragweed (Ambrosia sp.). These plants are green throughout the summer because of the shallow water table wetted by subsurface flow. Plant canopy cover ranges from almost 0 to over 50 percent of ground area. Moving uphill out of the stream channel, a series of higher and drier old floodplain terraces are crossed which are transitional to saline sites or sand dunes.

Small areas of active or stabilized dunes can be found on the downwind side of larger, more active sand washes. Salt-cedar (Tamarix pentandra), Indian ricegrass (Oryzopsis hymenoides), and spiny muhly (Muhlenbergia pungens) are common on this habitat. Cover values are not available for this subtype.

Sites with heavy saline/alkaline soils make up the largest part of vegetation Type 2. The major plant communities on these sites are an alkali sacaton-galleta grassland (Sporobolus airoides - Hilaria jamesii) and a tall shrubland dominated by black greasewood (Sarcobatus vermiculatus) and four-wing saltbush (Atriplex cancescens). The alkali sacaton-galleta grasslands are typically species poor, consisting of the one or two grasses, occasional short saltbushes (Atriplex obovata), Russian thistle (Salsola kali), and sometimes seepweed (Suaeda sp.). Greasewood is typically found close to drainages, and is tallest (over 6 feet) where it has contact with ground water tables. Greasewood understories can be grassy (alkali sacaton/galleta grass), shrubby (Atriplex nuttallii or A. obovata), or bare with a variable cover of annuals such as Indian wheat (Plantago purshii) and Russian thistle. Four-wing saltbush can grow with greasewood or by itself on saline soils (BLM 1978) with understories similar to those beneath greasewood and mixed canopies. Other plants found in greasewood and four-wing saltbush understories include blue grama, western wheatgrass, bottlebrush squirreltail (Sitanion hystrix), sand dropseed (Sporobolus cryptandrus), shadscale (Atriplex confertifolia), broom snakewood (Gutierrizia sarothrae), and various cacti. In this type the vegetation provides an average of 30 to 35 percent ground cover (BLM 1977).

The sand wash/saline lowland type is found throughout the project area, but is best developed along larger ephemeral channels.

3.2.3 Vegetation Type 3

The badlands and steep-slope vegetation type is also found throughout the project area. It is used to describe the very erosive, low-productivity lands found on clay-silt badlands weathering from the Fruitland-Kirtland shales and on steep scarps not covered by pinyon-juniper. Plant species common in this habitat are similar to those of level uplands (shrub-grass Type 4 below), but the vegetation type is distinguished by the very low density of plants. Individual plants are restricted to favorable microsites where more soil and water collect. Common species include blue grama, junegrass, galleta, alkali sacaton, red threeawn (Aristida longiseta), sandhill muhly (Muhlenbergia pungens), Indian ricegrass, sand dropseed, big sagebrush (Artemisia tridentata), four-wing saltbush and shadscale, broom snakeweed, Russian thistle, buckwheats (Eriogonum sp.), and occasional one-seed junipers (Juniperus monosperma). Average vegetation cover ranges between 7 and 13 percent (BLM 1977).

The majority of this type is found in the northwestern and western portions of the project area, where the Fruitland and Kirtland formations are exposed and the precipitation is less than elsewhere in the project area.

3.2.4 Vegetation Type 4

Type 4, the shrubland-grassland vegetation type, includes shortgrass, degraded shortgrass (broom snakeweed), and sagebrush-grass subtypes. These different subtypes are characterized by similar productivities and aerial photo signatures and were therefore combined.

The big sagebrush subtype occurs mainly in the northeastern portion of the project area. Here it forms a vegetation zone between grassland and juniper. Unlike the grasslands, it is apparently restricted to relatively moist (greater than 9 inches annual precipitation) sites having deep, nonalkaline soils (BLM 1978). Although the type is dominated by big sagebrush, other species of sagebrush are found in association or as local dominants, including black sagebrush (A. arbuscula subsp. nova), Bigelow sagebrush (A. bigelovii), sand sagebrush (A. filifolia), and silver sagebrush (A. cana). Understory composition is quite varied because of the range of soil types and the large project area which is a transition from Great Basin communities in the north to great plains and desert grassland elements in the southeast. Range improvement projects involving the destruction of sagebrush and the planting of forage grasses (most notably crested wheatgrass, Agropyron cristatum) have also added to the great variety in composition and condition within this subtype.

Because of this wide range of conditions, only a general description of sagebrush-grass understories is presented here. Blue grama is the most abundant understory grass (averaging about 20 to 30 percent of total cover) with western wheatgrass, galleta grass, crested wheatgrass, and alkali sacaton common but less abundant. Grasses of lesser importance include sand dropseed, bottlebrush squirreltail (Sitanion hystrix), Indian ricegrass, and purple threeawn (Aristida purpurea). Broom snakeweed is usually present. Greasewood, rabbitbrush (Chrysothamnus sp.), winterfat (Eurotia lanata), and prickly pear (Opuntia sp.) are present on some sites. Common forbs include Russian thistle, wooly Indianwheat (Plantago purshii), pigweed (Amaranthus sp.), buckwheats (Eriogonum sp.), goosefoot (Solidago sp.). Bureau of Land Management (1977) indicates that the average vegetation cover in this subtype ranges from about 10 to 30 percent.

Grasslands and degraded grassland (dominated by broom snakeweed) comprise the most important subtype within the shrub-grass vegetation type, in terms of area covered and forage production. This grassland type is essentially southern plains shortgrass, with desert grassland elements (Bouteloua eriopoda, black grama) in the southern part of the project area. In general, the grasslands are found on coarser soils below 6500 feet elevation and less than 10 inches per year of precipitation.

The three most abundant grasses in this subtype are alkali sacaton, blue grama, and galleta grass. Alkali sacaton dominates saline/alkaline sites. Indian ricegrass is most common on sandy sites, with galleta grass, blue grama, alkali sacaton, sand dropseed, giant dropseed (Sporobolus giganteus), and purple threeawn. Uplands with loamy or finer-textured soils are dominated by blue grama and galleta grass, with western wheatgrass, bottlebrush squirreltail, ring muhly (Muhlenbergia torreyi), spike muhly (M. wrightii), and many of the previously mentioned grasses as associates. Small amounts of halophytic shrubs (winterfat, four-wing saltbush, shadscale) can be present on heavy-soiled or saline sites. Grasslands degraded by overgrazing of domestic livestock are typically dominated by broom snakeweed, with lesser amounts of Green's rabbitbrush (Chrysothamnus greenei), blue grama, and galleta present. Total average vegetation cover in the Rio Puerco area was about 20 to 30 percent for shortgrass, and about 30 percent for the broom snakeweed type, according to the BLM (1977).

3.2.5 Vegetation Type 5

Vegetation Type 5 is the juniper and pinyon-juniper type. This includes the drier, sparse juniper savannas and the higher elevation, wetter pinyon-juniper woodlands. Type 5 is intermediate in elevation and precipitation between the shrub-grass (Type 4) and the Ponderosa/pinyon pine/oak (Type 1) zones. The trees in this "pigmy forest" are limited by water, and are thus short (6 to 30 feet tall) and widely spaced. Typically, juniper and pinyon-juniper communities are found on ridges, slopes, breaks, and mesa tops where soils are shallow, coarse, and not saline.

At lower elevations, junipers are sparse and widely scattered. Understories are grassland or sagebrush-grass communities described previously.

At higher elevations, pinyon pine codominates the canopy with one-seeded juniper, and the productivity of both the trees and understory is notably greater. Rocky Mountain juniper (J. scopulorum) and species from the "mountain shrub" life zone become important. Shrub species include Utah serviceberry (Amelanchier utahensis), Gambel oak (Quercus gambellii), mountain mahogany, cliffrose (Cowania stansburiana), bitterbush (Purshia tridentata), and skunkbush (Rhus trilobata). BLM (1977) indicates the total vegetation cover for this type averages between about 20 to 30 percent.

3.2.6 Vegetation Type 6

Vegetation Type 6 includes nonsaline irrigated croplands and true riparian communities. These are the most productive vegetation types in the project area and occur only along the San Juan River or on Navajo Indian Irrigation Project lands. The natural riparian vegetation along the San Juan River is the rarest vegetation type in the project area, the most productive, and also most directly limiting to big game (especially deer) abundance. Canopy coverage figures are not available for native riparian communities near Farmington. Additional information for this vegetation type is presented in Section 3.4.2.

3.3 NEW MEXICO GENERATING STATION

Inventory of the region of comparison surrounding the NMGS site using the regional vegetation classification of Section 3.2 is presented in Table 1. Three regional vegetation types were present.

3.3.1 Site Classification and Description

The 2400-acre NMGS site was inventoried in greater detail using nine subtypes classified and mapped on the site (Map 1). These types were based on the Description of the Environment, New Mexico Generating Station (PNM 1980b), and a September 1981 site reconnaissance by Woodward-Clyde Consultants. While these seven community types are based on natural, recurring patterns of vegetation and soils, they represent only existing vegetation, and should not be confused with classifications based on climax or potential plant communities (such as SCS range sites).

The sand wash and saline lowland regional vegetation type (Type 2) is represented by six subtypes:

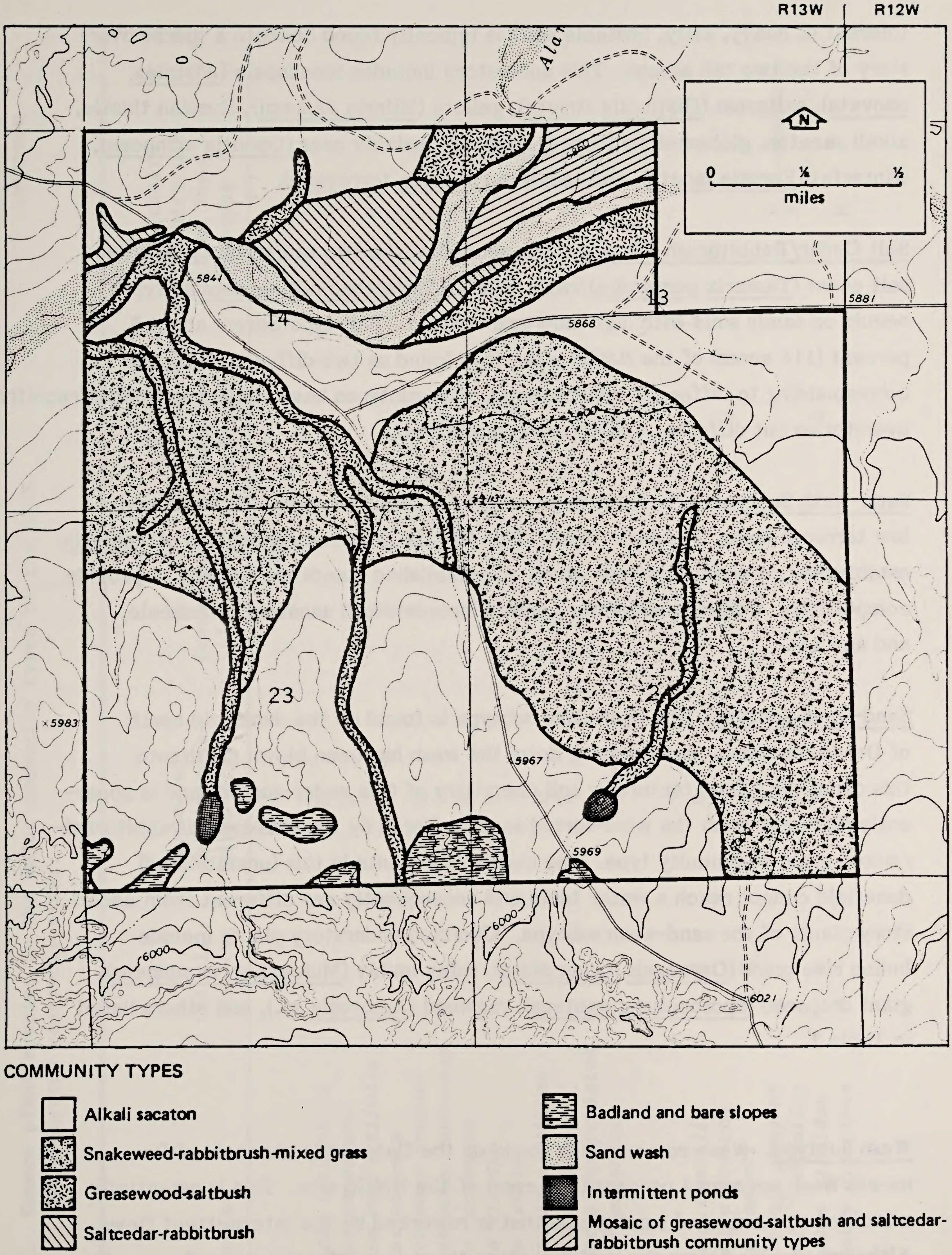
- Greasewood/four-wing saltbush subtype
- Salt cedar/rabbitbrush subtype
- Sand-wash subtype
- Sand-dune subtype
- Wash community subtype
- Annual weed and seep barrens

Greasewood/Four-wing Saltbush Subtype. The greasewood (Sacrobatus vermiculatus)/four-wing saltbush (Atriplex canescens) type is present as a narrow ribbon along intermittent small drainages and gullies, and in broader bands on banks along larger washes. This type covers about 8 percent of the site (194 acres). Soils are varied and patchy due to continual reworking by intermittent stream flow. Soil texture is usually heavier than the salt cedar/rabbitbrush type (below), but can range from heavy silts and clays to light loams. These soils are consistently saline/alkaline and subirrigated. An understory

Table 1. AREA, BY VEGETATION TYPE, IN REGION* SURROUNDING NMGS SITE, RESERVOIRS, AND T5

	Vegetation Type			
	2	3	4	
	Sand Wash and Saline Lowland	Badlands and Steep Slopes	Shrublands and Grasslands	Total
Acres (thousands)	34.4	42.6	172.0	249.0
Square miles	53.8	66.6	268.8	389.1
Percent of total	13.8	17.1	69.1	

*Regional base of comparison is defined by a 10-mile radius from the NMGS site boundary.



Map 1. VEGETATION OF THE PROPOSED PLANT SITE

tolerant of heavy, salty, unstable soils is typically found beneath a sparse overstory of the two tall shrubs. This understory includes broadscale (Atriplex obovata), saltgrass (Distichlis stricta), galleta (Hilaria Jamesii), Russian thistle, alkali sacaton, globemallow (Sphaeralcea sp.), prickly pear (Opuntia erinacea), winterfat (Eurotia lanata), and seepweed (Suaeda torreyana).

Salt Cedar/Rabbitbrush Subtype. The second of the two tall shrub types, the salt cedar (Tamarix pentandra)/rabbitbrush (Chrysothamnus nauseosus) type, occurs on sandy soils with high moisture content. This type covers about 5 percent (114 acres) of the NMGS site. It is found as two different subtypes corresponding to different environments. The subtypes have similar salt cedar/rabbitbrush overstories but different understory composition.

Sand-Wash Subtype. The sand-wash subtype is found on sandy fill banks and low terraces along De-na-zin Wash. This fits the common conception of Tamarix establishing on moist alluvium where no established plants are present to provide competition. Common understory plants include alkali sacaton, broadscale, and annuals.

Sand-Dune Subtype. The sand-dune subtype is found on the dunefield north of De-na-zin Wash. Sand moving down the wash has been blown north into this dunefield. Sand texture or soil chemistry of this water-sorted sand is apparently different from the wind-sorted sands covered by the snakeweed/rabbitbrush-/mixed grass community type. The understory plants in this (unstabilized) dunefield cannot reach a water table and consequently are different from understory plants of the sand-wash subtype. Common understory plants include Indian rice grass (Oryzopsis hymenoides), spiny muhly (Muhlenbergia pungens), giant dropseed (Sporobolus giganteus), ragweed (Ambrosia sp.), and others listed in Table 2.

Wash Subtype. Wash communities found on the flat, sandy channels of De-na-zin Wash covered 4 percent (91 acres) of the NMGS site. This is essentially a braided streambed of sand grains that is reworked by the intermittent flows. Although usually dry on the surface, often there is substantial subsurface water available to plants. The portions of the channel flooded and reworked most

Table 2. Common plant species in the major community types of the NMGS and preferred reservoir sites.

Plant Species	Alkali Sacaton	Snakeweed-Rabbitbrush-Mixed Grass	Greasewood-Saltbush	Saltcedar-Rabbitbrush-Sand Wash Subtype	Saltcedar-Rabbitbrush-Sand Dune Subtype
SHRUBS					
Artemisia tridentata		M[1]			
Atriplex canescens		D	D		
Atriplex confertifolia					M
Atriplex obovata	S		D		
Chrysothamnus greenei		S			
Chrysothamnus nauseosus				D	D
Ephedra torreyana		S			
Ephedra viridis		S			
Eurotia lanata			M		
Gutierrizia sarothrae	M	D	M		
Lycium pallidum		S			
Sarcobatus vermiculatus			D		
Tamarix pentandra			M	D	D
GRASSES					
Bouteloua gracilis	M	D			
Distichlis stricta			D	S	
Hilaria jamesii	M	S	D		
Muhlenbergia pungens		S			D
Oryzopsis hymenoides		D			S
Sporobolus airoides	D	D	D	S	
Sporobolus giganteus					M

Table 2. Concluded

Plant Species	Alkali Sacaton	Snakeweed-Rabbitbrush-Mixed Grass	Greasewood-Saltbush	Saltcedar-Rabbitbrush-Sand Wash Subtype	Saltcedar-Rabbitbrush-Sand Dune Subtype
FORBS					
Ambrosia sp.		M		M	M
Eriogonum sp.		M			
Haplopappus nuttallii					M
Macherantherea sp.		M			M
Opuntia erinacea	M	M	M		
Psoralea lanceolata				S	S
Salsola kali	S	S	S		
Sphaeralcea sp.	M	M	M		
Suaeda torreyana	S		S		
Xanthium strumarium				M	

[1] D = Dominant
S = Subdominant
M = Minor

frequently are too unstable for perennial plants to survive and are occupied by annuals such as cocklebur (Xanthium strumarium) and ragweed (Ambrosia sp.). The increasingly stable, higher, and drier flood terraces upslope support a gradual transition into the salt cedar/rabbitbrush community type, or occasionally to the greasewood-saltbush type.

Annual Weed and Seep Barrens. The annual weed and seep barrens occur on the bottoms and sides of intermittent ponds dammed by gully plugs. These small gully-plug reservoirs are constructed to provide water for livestock, but they are often mudflats or completely dry, depending on recent precipitation. Inundation kills perennial plants, but during the mudflat stage an annual community dominated by cocklebur becomes established. This community type covers a total of less than 0.3 percent (6 acres) of the NMGS site.

The badlands and steep slopes regional vegetation type (Type 3) is represented by one subtype, the clay and shale barren subtype.

The clay and shale barrens, commonly called badlands, occupy approximately 2 percent (47 acres) of the proposed plant site but are a dominant landscape feature to the north. The shales, sandstones, and claystones weather as bare slopes devoid of soil and are thus so dry that only a very few plant species can establish and persist. Typically, the vegetation consists of small individual plants spaced several meters apart.

The shrub-grass regional vegetation type is represented by two subtypes at the NMGS site:

- Alkali sacaton grassland subtype
- Broom snakeweed/rabbitbrush/mixed grass subtype

Alkali-Sacaton Grassland Subtype. Alkali sacaton (Sporobolus airoides) grassland, one of the two subtypes, covers about 43 percent (1036 acres) of the proposed plant site. On alkaline, coarse, sandy loams, this community type can be a nearly pure stand of alkali sacaton, with lesser amounts of Russian thistle (Salsola kali), an annual weed whose abundance is controlled by precipitation. On heavier, more alkaline soils, saltbush (Atriplex obovata) is an increasingly abundant codominant, and seepweed (Suaeda torreyana) and Russian thistle are present in varying amounts. Broom snakeweed (Gutierriza sarothrae) is occasionally present, but not as abundantly or consistently as in the snakeweed-rabbitbrush-mixed grass community type. As Table 2 indicates, the alkali sacaton grassland is the more homogeneous and less diverse of the two shrub-grass subtypes. Total canopy cover, using the method of Daubenmire (1959), ranges from 5 to 20 percent of the ground area, and in general the type is less productive than the rabbitbrush/mixed grass subtype.

Broom Snakeweed/Rabbitbrush/Mixed Grass Subtype. The broom snakeweed (Gutierrizia sarothrae)/rabbitbrush/mixed grass subtype covers about 36 percent of the proposed plant site (901 acres). It is a variable type, occurring on upland sites that are deeper and sandier than sites of the alkali sacaton community type. Typically, these soils are wind-deposited sands and sandy loams. On the downwind side of ridges, such deposits are the deepest and coarsest in texture, and the vegetation is similar to that of a stabilized dune.

Four-wing saltbush (Atriplex canescens) and wolfberry (Lycium pallidum) are the usual tall shrubs on such sites. Beneath is an understory dominated by some of the following low shrubs and herbs: broom snakeweed, slender leaf rabbitbrush (Chrysothamnus greenei), Mormon tea (Ephedra viridis and Ephedra torreyana), spiny muhly (Muhlenbergia pungens), and Indian rice grass (Oryzopsis hymenoides). Level sites with finer-textured soils typically lack the wolfberry and have less four-wing saltbush, and their dominant grasses are blue grama (Bouteloua gracilis) and galleta grass (Hilaria jamesii). Information on less abundant species is found in Table 2.

Canopy cover in the snakeweed/rabbitbrush/mixed grass vegetation type ranges from 15 to 50 percent of ground area, and production is higher than in the alkali sacaton grassland type.

3.3.2 Agriculture and Natural Resources

There is no cultivated agriculture or forestry within the NMGS regional area defined by a 10-mile radius from the NMGS site. Grazing and browsing by domestic stock and wildlife, and Navajo use of native plants, are the only current and foreseeable agricultural uses of the region, considering water and climatic limitations. Indian use of native plants is discussed in the Cultural Resources Technical Report and the Social and Economic Conditions Technical Report.

Existing forage production in the region was assessed using the regional vegetation classification and inventory discussed above. Productivity averages for all six vegetation types are given below, even though only three of the vegetation types are found surrounding NMGS. These productivity estimates were developed using SCS literature, clipping estimates developed by the BLM Farmington District Office in 1980, and conversations with local resource managers of the BLM, USFS, SCS, and New Mexico State University. They are conservative estimates chosen to include range condition, steep slopes and other unusable acres, and years of below-average precipitation and forage production. Considering the fair to poor condition of much rangeland in the area, these stocking rates were chosen to permit an upward range trend (improving condition and production).

Vegetation Type 1, the Ponderosa pine/pinyon pine/oak type, averages roughly 20 acres per animal unit month (AUM) of usable forage produced. Portions of the type which are grassland or rolling woodlands can be more productive, but they are offset by many acres of ungrazable steep slopes, and woodlands with little understory production on coarse, shallow, and gravelly soils.

Vegetation Type 2, the sand wash, dune, and saline lowland type, averages about 16 acres per AUM under the above conditions. Dunelands and halophytic flats are the most productive subtypes, but are balanced by the roughly 30 percent of river wash in this type.

No AUM's were allotted from the badlands-steep slope vegetation type (Type 3). Cattle will not use steep slopes, and the minimal vegetation on both slopes and badlands is best used to slightly improve high erosion rates.

The shrublands and grasslands type averages 15 acres per AUM. The unallotted productivity is intended to improve conditions in areas of high broom snakeweed.

Type 5, consisting of juniper savannas and pinyon-juniper woodlands, averages 25 acres per AUM. Low-density tree canopies on relatively flat sites have the highest productivity understories. Woodlands on stony soils, steep sites, rock outcrops and breaks, and shrubby sites have much lower usable forage production.

The riparian communities and irrigated fields of Vegetation Type 6 are by far the most productive sites in the area. Forage production of riparian and overflow sites can be high (1-2 acres per AUM in grassy fields) to low under dense Russian olive or tamarisk canopies. An average of 3 acres per AUM was used. This figure is not relevant to hayfields, small grains, row crops, and orchards that occupy the vast majority of this type along the San Juan River.

Using the regional vegetation figures presented earlier and the forage production rates above, the NMGS regional area is calculated to produce an average of 13,617 usable AUM's per year.

3.4 WATER SUPPLY SYSTEM

3.4.1 <u>Regional Vegetation of P1, P2, and P3</u>

The regional base of comparison for each proposed pipeline corridor is defined as a 20-mile-wide zone centered on the proposed corridor. Vegetation in each region was mapped from the Vegetation Distribution Map (Map F) of the Star Lake-Bisti Regional Coal Environmental Statement (BLM 1978) and soil-vegetation maps of the Navajo Reservation (BIA 1972) using the classification presented in Section 3.2. Polygons planimetered from the resulting maps (scale roughly 1:506,880) were summed by vegetation type and are presented in Tables 3 through 5.

3.4.2 <u>Riparian Vegetation at Intake Locations</u>

The proposed and alternate water intake sites are situated in the San Juan River floodplain near Farmington and Bloomfield, respectively. Because

Table 3. AREA BY VEGETATION TYPE IN REGION SURROUNDING PROPOSED PIPELINE CORRIDOR P1 (20-mile-wide zone)

	2 Sand Wash and Saline Lowland	3 Badlands and Steep Slopes	4 Shrublands and Grasslands	5 Juniper and Pinyon-Juniper	6 Riparian and Irrigated Cropland	Total
Acres (thousands)	29.5	68.8	422.7	26.2	24.6	571.8
Square Miles	46.1	107.5	660.5	41.0	38.4	893.4
Percent of Total	5.2	12.0	73.9	4.6	4.3	

Table 4. AREA BY VEGETATION TYPE IN REGION SURROUNDING ALTERNATE PIPELINE CORRIDOR P2 (20-mile wide zone)

	2 Sand Wash and Saline Lowland	3 Badlands and Steep Slopes	4 Shrublands and Grasslands	5 Juniper and Pinyon-Juniper	6 Riparian and Irrigated Cropland	Total
Acres (thousands)	49.2	72.1	411.2	42.6	32.8	607.8
Square Miles	76.8	112.6	642.6	66.6	51.2	949.8
Percent of Total	8.1	11.9	67.7	7.0	5.4	

Table 5. AREA BY VEGETATION TYPE IN REGION SURROUNDING ALTERNATE PIPELINE CORRIDOR P3 (20-mile wide zone)

	2 Sand Wash and Saline Lowland	3 Badlands and Steep Slopes	4 Shrublands and Grasslands	5 Juniper and Pinyon-Juniper	6 Riparian and Irrigated Cropland	Total
Acres (thousands)	34.4	29.5	421.1	54.1	31.1	570.2
Square Miles	53.8	46.1	657.9	84.5	48.6	890.9
Percent of Total	6.0	5.2	73.9	9.5	5.5	

vegetation associated with perennial streams and rivers is unique in the region (less than 1 percent of regional area) and very important to game and livestock, vegetation of the San Juan floodplain and the proposed and alternate intake sites are examined in greater detail than other regional vegetation types.

The San Juan River floodplain varies in size and shape from a broad valley more than 1 mile wide to a narrow canyon floor between steep canyon walls. In recent years the floodplain has been severely affected by agricultural activities and water management practice (e.g., the construction of Navajo Dam).

The native flora of the San Juan floodplain has been severely affected by irrigation projects begun in the last quarter of the nineteenth century (USDI 1971). The development of agricultural communities such as Farmington (1876), Aztec (1890), and Bloomfield (1881) was facilitated by the initial efforts to use water from the San Juan River. Until approximately 1960, agricultural and urban developments were undertaken almost entirely within the river's floodplain, reducing the quantity of native vegetation (VTN Consolidated, Inc., and the Museum of Northern Arizona 1978).

Since 1960 the San Juan floodplain has been subjected to the effects of construction and operation of the Navajo Reservoir which now regulates river flow in the study area. In addition, numerous large-scale irrigation projects outside of the floodplain (i.e., Hammond, West Hammond, and Navajo Indian irrigation projects) remove large portions of the river's discharge. According to the U.S. Department of the Interior (1971), by 1965 agriculture accounted for 93 percent of the total water depletion in the San Juan/Colorado subregion. In 1980, 96,340 acres in San Juan County were irrigated entirely from surface water (New Mexico Crop and Livestock Reporting Service 1981).

Several studies have examined the basin's flora for purposes of establishing baseline inventories. The upper reach of the San Juan River basin was surveyed by the University of Utah in the late 1950s in response to the proposed construction of Navajo Dam (Flowers 1961 and Woodbury 1961).

The most comprehensive study to date was recently completed by VTN Consolidated, Inc., and the Museum of Northern Arizona (1978) for the U.S.

Bureau of Reclamation in response to the proposed Gallup-Navajo Indian Water Supply Project. That report details the historic and existing fish, terrestrial wildlife and habitat resources of the San Juan River and its floodplain from the Navajo Dam, New Mexico, to the river's confluence with the Colorado River near Clay Hills Crossing, Utah. VTN Consolidated, Inc., and the Museum of Northern Arizona (1978) mapped the vegetation associations on 22,134 acres of the floodplain between the Navajo Dam and the Hogback Diversion Dam, located just upstream of Shiprock, New Mexico. The intake sites would be located in this stretch of the San Juan River.

Agricultural lands were the most common vegetation association and accounted for 59 percent (13,074) acres of the total land cover in that reach of the floodplain. All agricultural lands in the floodplain depend on irrigation water from the river and no groundwater irrigation occurs in that stretch (VTN Consolidated, Inc., and the Museum of Northern Arizona 1978; New Mexico Crop and Livestock Reporting Service 1981). Agriculture in the basin is described more thoroughly below.

The second most common vegetation association in the San Juan floodplain between Navajo Dam and the Hogback Diversion Dam, in terms of total land cover, is a mixed riparian scrub type that covers 31.4 percent (6929 acres) of the floodplain. VTN Consolidated, Inc. and the Museum of Northern Arizona (1978) classified areas as mixed riparian scrub where "the composition of perennial vegetation did not fit into any one dominant type." The mixed riparian scrub type consists of willows (Salix), salt cedar (Tamarix pentandra), cottonwoods (Populus), Russian olive (Elaegnus angustifolia), common reed (Phragmites communis), and a variety of subdominant perennials and annuals.

A salt cedar association covers approximately 4.5 percent (986 acres) of the San Juan floodplain in the 1978 study area. Salt cedar is an introduced perrennial and, when conditions favor its growth, it will out-compete native vegetation and grow in large, continuous stands. VTN Consolidated, Inc., and the Museum of Northern Arizona (1978) found very few understory species in this association. In the San Juan floodplain, salt cedar is common along new sandbars, the mouth of tributary streams and rivers, and areas with high salt concentrations. Salt cedar has the largest areal extent of any single perennial species in the study area.

Marsh associations cover 3.6 percent (800 acres) of the San Juan floodplain in the 1978 study area. VTN Consolidated, Inc. and the Museum of Northern Arizona (1978) classified marshes as "any vegetation association containing elements of cattails (Typha), bulrushes (Scirpus), spike rushes (Eleocharis), or sedges (Carex), and growing in perennial wet soils." Typical marshes in the study area contained these species in addition to such indigenous marsh grasses such as redtop (Agrostis), slough grass (Beckmannia), salt grass (Distichlis), foxtail (Setaria), and squirrel-tail (Sitanion). VTN Consolidated, Inc. and the Museum of Northern Arizona (1978) classified marshes further and identified those that were permanent (year-round standing water) or temporary (seasonally wet), native marshes or nonnative marshes created through irrigation or runoff. The percentage of each of these types of marsh associations in the San Juan floodplain between Navajo Dam and Hogback Diversion Dam are listed in Table 6. Most marshes in the study area are man-made or sustained by agricultural runoff. Native marshes in the study area resemble those resulting from irrigation in terms of species composition and diversity, however, permanent marshes typically have a more diverse flora than temporary marshes.

VTN Consolidated, Inc., and the Museum of Northern Arizona (1978) defined a native marsh as "any marsh which is caused or maintained by natural sources of water, i.e., ground water seepage or direct inundation from the river." They further subdivided native marshes into ground water marshes and river overflow marshes. They defined ground water marshes as areas that "are formed by low depressions within the floodplain of the river which fall at or below the level of ground water and subsequently support populations of marsh-associated species." Although many of the marshes appear to be of natural origin, nearly all of those in the stretch between the Navajo Dam and the Hogback Diversion Dam appear to be at least partially supported by irrigation return water. VTN Consolidated, Inc. and the Museum of Northern Arizona (1978) found that several of the ground water marshes in the study area contained high salt concentrations. Halophytes commonly found in these salt marshes were salt grass (Distichlis stricta), alkali grass (Puccinellia pauciflora), alkali sacaton (Sporobolus airoides), saltbush (Atriplex), Russian thistle (Salsola kali tenuifolia), and spurge (Euphorbia).

VTN Consolidated, Inc., and the Museum of Northern Arizona (1978) defined river overflow marshes as "native marshes which are located adjacent to the

Table 6. ACREAGE AND PERCENT OF MARSH SUBTYPES IN THE SAN JUAN RIVER FLOODPLAIN BETWEEN NAVAJO DAM AND HOGBACK DIVERSION DAM, NEW MEXICO

Subtype	Total Acreage	Percent
Agricultural Marsh (man-made)		
Permanent	392	46
Temporary	90	11
Ground-Water Marsh	172	20
River-Overflow Marsh	135	16
Undetermined	11	7
TOTAL	800	100

Source: VTN Consolidated, Inc., and the Museum of Northern Arizona (1978).

river and are directly influenced by inundation during high river flow." These marshes are sufficiently close to the river to be flooded when the San Juan overflows its banks. The flora of these overflow marshes are similar to the ground water marshes, although the river overflow marshes tend to be in an earlier successional stage. Common marsh plants of the San Juan basin are listed in Table 7.

Approximately 1.1 percent (252 acres) of the San Juan floodplain in the 1978 study area is covered with a mature cottonwood association. According to VTN Consolidated, Inc. and the Museum of Northern Arizona (1978), the cottonwoods are a very important component of the perennial floodplain vegetation in the San Juan basin. In the vicinity of the proposed intakes at Farmington and Bloomfield, the Rio Grande cottonwood (Populus freemontii) is the dominant cottonwood species. The narrow-leaf cottonwood (Populus angustifolia), although common above Navajo Dam, is found infrequently in the study area. Seedling cottonwoods in the study area are mostly restricted to sandbars and the edges of the river, presumably because they are dependent on total immersion of their root system in water. VTN Consolidated, Inc. and the Museum of Northern Arizona (1978) reported that young-growth cottonwoods are generally found anywhere in the floodplain where their root system can penetrate to ground water. The seedlings and young-growth forms rarely occur in homogeneous stands, but, are more commonly found in mixed riparian scrub. Mature cottonwoods typically occur in groves with dense canopies.

The association with the least areal extent mapped by VTN Consolidated, Inc., and the Museum of Northern Arizona (1978) was the willow association. The coyote willow (Salix exigua) is the dominant species in this community, occupying 95 percent of the willow areas sampled by VTN. Two other willow species, (Salix amygdaloides) and (Salix lasiandra), occur less frequently in the basin. The largest willow stands in the study area occur along irrigation ditches and not along the river. Significant thickets of willows are rare, and willow associations cover only 0.4 percent (93 acres) of the floodplain between Navajo Dam and the Hogback Diversion Dam.

The proposed intake location is on the southern bank of the San Juan River near Farmington. This site is on an old floodplain about 10 to 20 feet above

Table 7. COMMON MARSH PLANTS COLLECTED OR OBSERVED FROM THE SAN JUAN RIVER FLOODPLAIN, NEW MEXICO

FAMILY Scientific Name	Common Name
ASTERACEAE	
Circium parryi	Parry thistle
Xanthium strumarium	Cocklebur
CHENOPODIACEAE	
Atriplex canescens	Four-wing saltbush
Atriplex hastata	Annual atriplex
Salsola kali tenuifolia	Russian thistle
CYPERACEAE	
Carex emoryi	Sedge
Carex vulpinoidea	Common sedge
Eleocharis macrostachya	Spike rush
Eleocharis palustris	Spike rush
Scirpus acutus	Three square
Scirpus americanus	Bulrush
Scirpus pallidus	Pallid bulrush
EQUISETACEAE	
Equisetum arvense	Meadow horsetail
Equisetum laevigatum	Smooth horsetail
Equisetum kansanum	Kansas horsetail
EUPHORBIACEAE	
Euphorbia glyptosperma	Little spurge
FABACEAE	
Melilotus officinalis	Yellow sweetclover
JUNCACEAE	
Juncus balticus	Baltic wiregrass
Juncus torreyi	Torrey rush
Juncoides spp.	Wood rush
POACEAE	
Agrostris alba	Redtop
Agrostis palustris	Marsh redtop
Beckmannia syzigachne	Slough grass
Distichlis stricta	Salt grass
Muhlenbergia aspirifolia	Dropseed muhly
Puccinellia pauciflora	Alkali grass
Setaria viridis	Green foxtail
Sitanion hystrix	Squirrel-tail
Sporobolus airoides	Alkali sacaton
TYPHACEAE	
Typha latifolia	Cattail

Source: VTN Consolidated, Inc., and Museum of Northern Arizona (1978).

the river level. The river is cutting into this elevated bank, thus leaving a very narrow zone of subirrigated and occasionally flooded land at the proper elevation to support riparian vegetation. This band is about 30 feet wide and is occupied by the mixed riparian scrub type, predominantly Russian olive. Uphill and behind it, the vast majority of the site is shrubland-grassland vegetation (Type 4).

The alternate intake site is upstream on the southern bank of the San Juan River near Bloomfield. The large sandbar island and a 60-foot-wide zone along the bank are covered by the mixed riparian scrub type, including sandbar willow, Russian olive, tamarisk, rabbitbrush, and cottonwood seedlings. The majority of the floodplain above the cutbank is irrigated fields with isolated large cottonwoods.

3.4.3 Proposed and Alternate Reservoir Sites

Vegetation on the proposed reservoir site was mapped and field-checked using the regional vegetation classification presented earlier. Results are presented in Table 8. Vegetation on the alternate reservoir site is summarized in Table 9.

3.4.4 Agriculture and Natural Resources

Agricultural lands irrigated by San Juan River water are the most important and productive lands in the 20-mile-wide region surrounding each pipeline corridor. Principal crops are hay, barley, corn, and apples (USDA and New Mexico Crop and Livestock Reporting Service 1981). There is no commercial forestry in the area, but sparse, dry juniper woodlands are marginal to unsuitable for firewood. Range grazing by domestic livestock and wildlife is a distant second to crop production in economic importance. Use of native plants by Navajo Indians is described in the Cultural Resources Technical Report and the Social and Economic Conditions Technical Report.

Pipeline P1. The proposed pipeline would cross no irrigated or cultivated lands.

Table 8. AREA OF VEGETATION TYPES PRESENT ON PROPOSED RESERVOIR SITE

	Vegetation Type			
	2	3	4	
	Sand Wash and Saline Lowland	Badlands and Steep Slopes	Shrublands and Grasslands	Total
Acres	27.3	51.1	561.6	640
Percent of Total	4.3	8.0	87.8	

Table 9. AREA OF VEGETATION TYPES PRESENT ON ALTERNATE RESERVOIR SITE

	Vegetation Type			
	2	3	4	
	Sand Wash and Saline Lowland	Badlands and Steep Slopes	Shrublands and Grasslands	Total
Acres	11.9	15.5	612.6	640
Percent of Total	1.9	2.4	95.7	

Forage production on native rangeland was calculated using the forage production averages developed earlier and applying them to the vegetation inventory summarized in Table 3. This yields an estimated 31,072 AUM's for the sum of Types 2, 4, and 5. Forage produced on the badlands and steep slopes of vegetation Type 3 is not allocated for grazing. Most of the 24,600 acres of vegetation Type 6 in the region of comparison are cropland and hayland, not grazing land. If roughly 10 percent of the Type 6 land is available for grazing and cover by domestic stock and wildlife, another 820 AUM's would be added, for a grand total of 25,420 AUM's produced in the region.

Pipeline P2. P2 crosses about 0.2 mile of irrigated cropland on the San Juan River floodplain, and 8.7 miles of land irrigated on the Navajo Indian Irrigation Project (NIIP).

Average annual production of usable forage in the region surrounding alternate pipeline corridor P2 was calculated using the vegetation information in Table 4 and the forage production averages developed earlier. Ten percent of the Type 6 vegetation was estimated to be native riparian communities usable for wildlife and domestic grazing. This yields an estimated total of 33,286 AUM's in the region per year.

Pipeline P3. This alternate corridor crosses the same 0.2 mile of irrigated cropland on the San Juan River floodplain as does alternate P2. Corridor P3 crosses no other irrigated cropland, including NIIP lands.

Estimated average annual usable forage production in the region was calculated by methods described above, using regional vegetation information from Table 5. Total regional forage production is 33,424 AUM's.

Region Surrounding Reservoir Sites, and NMGS. Vegetation of the region surrounding NMGS is summarized in Table 1. The region contains no irrigated land, cropland, or juniper woodland. Total estimated range forage production for the region is 13,617 usable AUM's per year.

3.5 TRANSMISSION SYSTEM

3.5.1 Regional Vegetation of T1, T2, T3, T4, and T5

The regional base for comparison around each prospective transmission line corridor is defined as a 20-mile-wide zone centered on the proposed corridor. Vegetation in each region was mapped from various sources (PNM 1980; Donart, Sylvester, and Hickey 1978) using the classification detailed in Section 3.2. Polygons planimetered from the resulting maps (scale roughly 1:506,880) were summed by vegetation type and are presented in Tables 10 through 13. Connector loop T5 is included in the NMGS region (Table 1).

3.5.2 Agricultural and Natural Resources

Forage for range grazing is the primary agricultural product in the two proposed and two alternate transmission corridor regions. Very few fields of irrigated grass or alfalfa haylands exist in some of the large tributaries of Chaco Wash. Individual fields are less than 10 acres. Pinyon-juniper and Ponderosa pine woodlands exist on proposed and alternate corridors, but these are low-productivity, steep, or other noncommercial sites.

Proposed Action: First 500-kV Line, Route T2. No irrigated haylands were observed on the proposed corridor T2 during a September 1981 overflight or on aerial photos of the corridor. The juniper and pinyon-juniper woodlands are noncommercial for timber harvest and marginal for firewood collection. Range forage production was calculated using the regional (20-mile corridor) vegetation type inventory presented in Table 10 and the forage production rates for those vegetation types presented in Section 3.3.2. Using these figures, mean annual forage production for the region surrounding the first proposed transmission line corridor is approximately 79,305 AUM's.

Proposed Action: Second 500-kV Line, Route T1. No irrigated haylands were observed in the 1-mile-wide proposed corridor T1 on aerial photos or during the September 1981 overflight. Juniper and pinyon-juniper woodlands in this

Table 10. AREA BY VEGETATION TYPE IN REGION SURROUNDING TRANSMISSION CORRIDOR T2

	1 Ponderosa and Pinyon Pine, Oak	2 Sand Wash and Saline Lowland	3 Badlands and Steep Slopes	4 Shrub-Grass	5 Juniper Savannas, Pinyon-Juniper	6 Riparian and Irrigated Cropland	Total
Acres (thousands)	3.7	73.4	58.7	1049.7	113.8	0	1299.3
Square Miles	5.7	114.7	91.8	1650.1	117.8	0	2030.1
Percent of Total	0.28	5.7	4.5	80.8	8.8		

Table 11. AREA BY VEGETATION TYPE IN REGION SURROUNDING TRANSMISSION CORRIDOR T1

	2 Sand Wash and Saline Lowland	3 Badlands and Steep Slopes	4 Shrub-Grass	5 Juniper and Pinyon-Juniper	Total
Acres (thousands)	69.7	80.7	1053.4	172.5	1376.3
Square miles	109.0	126.2	1645.9	269.5	2150.5
Percent of total	5.1	5.9	76.5	12.5	

Table 12. AREA BY VEGETATION TYPE IN REGION SURROUNDING ALTERNATE TRANSMISSION CORRIDOR T3

	1 Ponderosa and Pinyon Pine, Oak	2 Sand Wash and Saline Lowland	3 Badlands and Steep Slopes	4 Shrublands and Grasslands	5 Juniper and Pinyon-Juniper	6 Riparian and Irrigated Cropland	Total
Acres (thousands)	3.7	77.1	9.2	1165.3	80.7	0	1336.0
Square Miles	5.7	120.4	14.3	1820.8	126.2	0	2087.5
Percent of Total	0.27	5.8	0.69	87.2	6.0		

Table 13. AREA BY VEGETATION TYPE IN REGION SURROUNDING ALTERNATE TRANSMISSION CORRIDOR T4

	1 Ponderosa and Pinyon Pine, Oak	2 Sand Wash and Saline Lowland	3 Badlands and Steep Slopes	4 Shrublands and Grasslands	5 Juniper and Pinyon-Juniper	6 Riparian and Irrigated Cropland	Total
Acres (thousands)	143.1	60.6	3.7	1165.3	143.1	0	1515.8
Square miles	223.7	94.6	5.7	1820.8	223.7	0	2368.5
Percent of total	9.4	4.0	0.24	76.9	9.4		

regional area not suitable for commercial timber harvest, and are of low to marginal suitability for firewood collection. Range forage production was calculated using the regional vegetation information in Table 11 and the production rates described earlier. This yielded an estimated average of 81,483 AUM's produced in the 20-mile-wide region per year.

Alternate Transmission Route T3. Alternate T3 includes a corridor south of Chaco Wash, and miles 69 through 101 of corridor T2. The 10 to 20 acres of grass hay observed on recent aerial photos of Yellow Point Valley are the only agriculture in the 20-mile region centered on the proposed corridor. The lower elevation pinyon-juniper are noncommercial timber, marginally suitable for firewood. The Ponderosa pine-pinyon pine woodlands at higher elevations are more productive, but still mostly non-commercial sites. Range forage production for the region was calculated from regional vegetation information in Table 12 using the production rates derived earlier. Total average annual usable forage production for the region was estimated at 85,918 AUM's.

Alternate Transmission Route T4. Alternate route T4 crosses no cultivated or irrigated fields. Juniper and pinyon-juniper woodlands are as described above for other corridors. Corridor T4 and the region surrounding it differ from the other corridors in that it crosses higher elevation lands supporting Ponderosa pine, pinyon, and occasional Douglas fir and aspen (Table 13). The majority of these forest sites are noncommercial. Total average annual usable forage production in the region surrounding alternate corridor T4 is approximately 94,353 AUM's.

Proposed Action: Transmission Loop T5. Proposed transmission loop T5 crosses the shrubland-grassland, sand wash and saline lowland, and the badlands and steep slopes vegetation types west of the NMGS site. This short route is wholly within the NMGS region of comparison described in Table 1, Section 3.3. Total forage production for the region is 13,617 AUM's.

3.6 SPECIAL STATUS SPECIES

3.6.1 Introduction

Although the state of New Mexico does not have a list of species protected by state statute, the New Mexico Heritage Program maintains and updates files on the distribution and abundance of taxa rare in New Mexico. The BLM and other land management agencies develop lists of "species of concern" from Heritage information and contract research. These species are discussed below as "special status species." They have been recommended for special attention by either the New Mexico Heritage Program or the BLM Farmington District Office (Table 14).

3.6.2 Species Descriptions

Descriptions of distribution habitat requirements and relative abundance of species listed in Table 14 are given below.

Astragalus humillimus Gray (Leguminosae) is listed by the FWS (1980) as a category 1 status review species. The Mancos milkvetch was presumed extinct until its rediscovery west of Farmington by Paul Knight in 1981. At its only known location, this small perennial herb is found in pockets of sandy soil and colluvium below outcrops of tan sandstones of the Mesa Verde group. Mancos milkvetch may occur along sandstone scarps cut by the Chaco River or the San Juan River.

Astragalus micromerius Barneby (Leguminosae) is also called the Chaco Milkvetch. It has no federal status, but is a New Mexico endemic known only from San Juan, Rio Arriba, and McKinley counties. Small populations of 40 to 50 individuals are found on talus and colluvium from reddish-tan sandstones. Such local populations are typically isolated (40 to 50 miles) from the closest population.

Astragalus monumentalis Barneby (Leguminosae) has no common name. It is listed by FWS (1980) as a category 1 status review species. It is a perennial

Table 14. SPECIAL STATUS PLANTS

Species	Source[a]	General Location of Observed or Expected Occurrence: NMGS Plant Site	Water Supply System	Transmission System
GROUP 1[b]				
Astragalus humillimus	NMHP	—	x	x
Astragalus micromerius	NMHP,BLM	—	x	x
Astragalus monumentalis	NMHP	—	x	x
Abronia bigelovii	NMHP	—	—	T1,T2,T3
Astragalus deterior	NMHP	—	—	—
Astragalus fucatus	BLM	x	x	T4
Cryptantha paradoxa	NMHP	—	—	—
Pediocactus papyracanthus	NMHP	—	—	T1,T2,T3
Phacelia splendens	NMHP	x	x	x
GROUP 2[c]				
Androstephium breviflorum	BLM	x	x	x
Astragalus kentrophyta neomexicana	BLM	x	—	x
Astragalus oocalysis	NMHP	—	—	—
Mamillaria wrightii	NMHP	—	—	T1,T2,T3
Mitella pentandra	BLM	—	—	—
Muhlenbergia thurberi	BLM	x	x	—
Nama tenue	NMHP	—	—	—
Phacelia demissa demissa	NMHP	—	—	—
Wyethia scabra canescens	NMHP	x	—	—

Note: "x" indicates that a plant is not presently recorded within 2 miles of any component but it might be found there because apparently suitable habitat is present. Species known or very likely to occur within 2 miles of a project component are indicated by the component abbreviation (e.g., Astragalus fucatus is known or likely to occur within 2 miles of T4). Blanks indicate that species are not expected to be present near the component.

[a]Sources: NMHP = New Mexico Heritage Program
BLM = Bureau of Land Management

[b]Group 1 species are plants that have special management status because they are relatively rare in the project area and would be susceptible to potential impacts.

[c]Group 2 species are plants that are also of concern to management agencies and other organizations but are not as rare as Group 1 species and would not be as sensitive to potential impacts.

herb endemic to the four-corners area of Arizona, Utah, Colorado, and New Mexico. It was recently discovered at several stations west of Farmington on white sandstone outcrops. A. monumentalis could be in the Chaco area or associated with cliffs along the San Juan River.

Astragalus monumentalis is being reviewed by the Heritage Program as to its distribution, abundance, and threatened condition. There are a number of problems related to this taxon. The populations in question in the project area may well be Astragalus cottamii Welsh. The taxonomic relationship between A. monumentalis and A. cottamii is disputed (R. Barneby, N.Y. Botanical Garden, pers. comm. to NMHP). Barneby considers A. cottamii to be varietally distinct from A. monumentalis and plans to publish his findings soon. If populations of A. cottamii and A. monumentalis are considered as conspecific, then those populations found in the project area would be members of a local, but not rare, species.

The New Mexico Heritage Program plans to begin a study of this group of taxa in the spring of 1983, and findings will be made available to the BLM. There is at least one population within this species complex which may not represent either of these above-mentioned entities and also requires further research.

Abronia bigelovii Heimerl (Nyctaginaceae) is listed by FWS (1980) as a category 2 status review species. This species of sand verbena is found only in Santa Fe and Sandoval counties, New Mexico, and has very specific habitat requirements. At present it is abundant on its habitat. This species is a short, perennial herb apparently restricted to the gypsiferous sandstones of the Todillito formation. Although presently abundant on outcrops of this formation (New Mexico Heritage Program 1981), these outcrops are privately owned and may be mined for gypsum in the future. Outliers of the Todillito formation near transmission line corridors T1 and T2 could support populations of A. bigelovii.

Aletes sessiliflorus is both rare and endemic to the northwestern portion of New Mexico. There are at present five known populations of this plant. None of the known populations are large. It occurs on Jurassic sandstones, clays, and basaltic rubble. To date, surveys are not comprehensive, nor do they result in any definite conclusions about this plant's endangerment.

Astragalus deterior (Leguminosae) is listed by FWS (1980) as a category 1 status review species. Presently, the Cliff-palace milkvetch is known only from one location in Mesa Verde National Park. Its white sandstone habitat is found elsewhere in the Four Corners region, but so far there is no evidence of its occurrence in New Mexico.

Astragalus fucatus Barneby (Leguminosae, Hopi milkvetch) has no federal status. It is a Four Corners endemic found on sandy plains and washes between 4500 and 6200 feet in elevation. In New Mexico, it is known from San Juan and McKinley counties. Howell and McClintock (1960) cite Barneby in describing it as locally common in the San Juan and Little Colorado River drainages. The New Mexico Natural Heritage Program reports about 25 known populations, one of which is near transmission line T4.

Cryptantha paradoxa (A. Nels.) Payson, (Boraginaceae) has no federal status. It is found in the Four Corners region of Utah, Colorado, and New Mexico (San Juan County only). This distribution indicates it may be relatively common compared to other plants discussed, but very little is known about this species. Habitat information on this species is contradictory. The most specific habitat description comes from the New Mexico Natural Heritage Program, indicating "dry gypsum hills" as the most likely location.

Pediocactus papyracanthus (Engelm.) L. Benson, (Cactaceae) is listed by FWS (1980) as a category 1 status review species. It is found in north, central, and southern New Mexico; northwestern Arizona, and possibly Mexico. Despite its wide distribution, it is apparently being reduced by grazing, habitat modification, and collection (New Mexico Natural Heritage Program 1981). This small, round cactus is unique in having flat, soft spines rather than the stiff, pungent spines everyone associates with cacti. Its habitat is grasslands and gravelly hills. Apparently it is nearly impossible to discern when growing in blue grama clumps, and it is also palatable to cattle. It has been observed within 2 miles of proposed transmission corridors T1 and T2.

Phacelia splendens Eastwood (Hydrophyllaceae) has no federal status at this time. It is an annual known from only seven locations in southwestern Colorado, possibly adjacent Utah, and recently discovered west of Farmington. It is found in small isolated populations of 10-15 individuals on clay and shale badlands of the Mancos and Fruitland formations. This is the same habitat as Sclerocactus mesa-verdae.

The group of species reviewed are mentioned primarily to indicate their minimal biological relevance to the proposed project. Typically, these species are either sufficiently widespread, abundant, or remote so that the proposed project would have no meaningful affect on them. They are addressed to correct older and incorrect interpretations of these species in light of current knowledge.

Androstephium breviflorum Wats. (Liliaceae) has no federal status, but is on an older list of state level plants of concern at the Farmington BLM office. San Juan County is the southeastern extreme of its distribution, which also ranges to Colorado and California. A. breviflorum is apparently widespread.

Astragalus kentrophyta var. neomexicanus (Barneby) Leguminosae has the common name of New Mexico Kentrophyta. It has no federal status, but is a state endemic restricted to the five northwestern counties of New Mexico. Its habitat is on sandy soils near outcrops, and it apparently increases on disturbed soils. Its relative abundance in its range and success on disturbed soils indicate it is not becoming threatened. A previous study of threatened and endangered plants of the study area recommended it be removed from special consideration (Rangeland Resources International, Inc. 1978).

Astragalus oocalysis M.E. Jones, (Leguminosae) is known from two counties in southwestern Colorado and San Juan and Rio Arriba Counties in New Mexico. It has no federal status. This plant appears restricted to a higher elevation habitat that is not present near any proposed or alternate components.

Mammillaria wrightii Engelm. (Cactaceae) has no federal status. This small cactus is found from west Texas to Arizona, and possibly in Mexico. The possibility exists that it may be proposed for protected status in the future because cactus "collectors" are a threat capable of rendering local populations extinct. This cactus is likely found near or on proposed transmission line corridor T1.

Mitella pentandra Hook. (Saxifragaceae) has no federal status. It is a common bog and streamside plant of the northern Rockies. The 1977 collection by Bill Isaacs in northeastern New Mexico is a state record and the species southeastern range limit. The claimed collection of this species in 1977 at Crownpoint (Rangeland Resources International, Inc. 1978) has not been verified and is very dubious (New Mexico Natural Heritage 1981).

Muhlenbergia thurberi Bydb. (Graminae) is a relatively uncommon but widespread grass, ranging from west Texas across northern New Mexico into Arizona. Thurber muhly has no federal status, and is not known to be more common than when it was put on the New Mexico Heritage Program list of plants of state-level importance.

Nama tenue (Woot. and Standl.) Tides. (Hydrophyllaceae), has no federal status and is apparently restricted to a small area in Sierra County, New Mexico (Martin and Hutchins 1980). Its alleged collection at Lake Valley, New Mexico (Rangeland Resources International 1978) is dubious (New Mexico Natural Heritage Program 1981).

Phacelia demissa Gray (Hydrophyllaccae) has no federal status, and is a widespread species. This small annual ranges from southwestern Wyoming through Colorado and Utah to Arizona and possibly northwestern New Mexico. Even if the 1977 collection by Rangeland Resources north of Crown Point were verified, its significance to the proposed project would be minimal. Little information on the abundance of this species in other states can be found, but because of its widespread distribution it is presumed to not be threatened. Rangeland Resources International (1978) lists its habitat as sandy grasslands along sandstone outcrops.

Wyethia scabra Hook var. canescens W.A. Weber (Compositae) is a fairly widespread variety of a common plant. It has no federal status, and is of state interest because McKinley and San Juan Counties are the southeastern limit of its range (covering the Four Corners area). The New Mexico Heritage Program does not consider this species to be of management concern (B. Isaacs, NMHP, personal communication, 1982).

3.7 SUMMARY

Agency and public concern, as indicated in data collection plans and the significance criteria of Section 2.2, was greatest for riparian vegetation and those vegetation types relatively rare (less than 1 percent of region of comparison). Riparian vegetation is found in the regions of comparison around proposed intake and pipeline P1, and alternates P2 and P3. The Ponderosa pine, pinyon pine, and oak type (vegetation type 1) was found to be rare by the above definition in the regions of comparison around proposed transmission line T2 and alternate T3. The badlands and steep slope vegetation type (type 3) was found to occupy less than one percent of the comparison regions surrounding alternates T3 and T4.

Four special status species are known or suspected to grow near proposed or alternate project components.

4.0
ENVIRONMENTAL CONSEQUENCES

4.1 INTRODUCTION

Impacts projected for each major project component are divided into construction related impacts (both direct and indirect), and impacts anticipated from operation, maintenance, and abandonment of that component (both direct and indirect). Direct and indirect impacts are defined as:

- Direct effects - The loss of vegetation, species, etc., from direct destruction of or damage to individual plants or habitat. Typically, direct effects are construction related.

- Indirect effects - Impacts to vegetation and associated resources that are removed in time or space from direct impacts. Examples include potential effects of air pollution or acid rain on vegetation, and changes in streamflow that affect riparian vegetation.

Anticipated impacts to agriculture and natural resources and special status plants are also discussed.

A more complete description of impact significance criteria is presented in Section 2.2.

4.2 GENERAL CONSEQUENCES

4.2.1 Vegetation Removal and Damage/Short-Term

The most common impact due to construction of project components would be removal and damage of vegetation by construction activities. The majority of vegetation that would be destroyed consists of communities common in the region. Because most of the disturbance would be on linear corridors and the construction period in these areas would be relatively short (one year or less at a given location), the erosion and revegetation problems anticipated are not considered significant. Mitigation measures for surface disturbance are discussed in Section 5.0.

4.2.2 Vegetation Removal/Long-Term

Removal of vegetation for the life of the project at the proposed NMGS and other permanent facilities would constitute a long-term impact. Long-term indirect impacts may also occur, such as changes in dominance/composition of riparian vegetation in the San Juan River (Section 4.4).

4.3 NEW MEXICO GENERATING STATION

The following analysis is based on the assumption that all vegetation within the 2400 acre plant site would be disturbed or removed for the life of the project (40 years).

4.3.1 Construction

Direct Effects. Construction activities of the NMGS would remove or alter all vegetation in the 2400-acre site, and this area would not be returned to original condition within the 40-year life of the project. A comparison of vegetation removed with regional vegetation is found in Table 15.

No riparian vegetation was present at the NMGS site, and Table 1 shows that none of the types affected are rare (covering less than 1%) in the region of comparison. In Table 15 both types 2 and 4 would have about 1 percent of their regional area removed by NMGS, and more would be removed by construction of the reservoir, and T5. Types 2 and 4 are both common in northwestern New Mexico and are not limiting factors to the abundance of big game, other important species, or range use for domestic grazing. Although the loss of 2353 acres of types 2 and 4 on the NMGS site would be adverse and long-term, it would not be a significant impact to animal or plant habitat, game, or livestock production.

Table 15. REMOVAL OF VEGETATION ON NMGS SITE, EVALUATED AS PERCENTAGE OF REGIONAL VEGETATION, BY TYPE

Regional Vegetation Type	Acres	NMGS Community Types	Acres	NMGS Vegetation Removed (as % of type in region)
2 (sand wash and saline lowland)	34,400	Greasewood/four-wing saltbush, sand wash and dune, salt cedar/rabbitbrush	416	1.2%
3 (badlands and steep slopes)	42,600	Clay and shale barrens	47	0.11%
4 (shrublands and grasslands)	172,000	Alkali sacaton, snakeweed/rabbitbrush/mixed grass	1937	1.13%

No riparian or other rare plant communities were found on the NMGS site.

Indirect Effects. Construction activities on the NMGS site would remove vegetation from large areas of soil, which could be moved by water or wind erosion. Erosion control measures discussed in the project description would be necessary to prevent deposition on neighboring vegetation.

4.3.2 Operation, Maintenance, and Abandonment

Direct Effects. Operation of NMGS would not result in any additional direct impacts to vegetation, since no additional vegetation would be removed at the site.

Indirect Effects. Anticipated maximum short-term SO_2 and NO_2 concentrations in the NMGS region are reported in Table 16. These figures are preliminary results from computer models estimating total regional emissions including those from NMGS.

Most research investigating the effects of air pollutants on plants has investigated the short-term effects of large doses on crop plants and other economically important plants. Hill et al. (1974) studied the response of desert plants to 2-hour SO_2 and NO_2 doses. Many of the species studied are found in the NMGS region. They concluded that many of the species showed high resistance to injury from SO_2 and NO_2, and that most species did not show clear leaf damage below the 2-4 ppm range. Two species present in the NMGS area did show relative sensitivity to SO_2 and NO_2. Indian ricegrass (Oryzopsis hymenoides) and globe mallow (Sphaeralcea parviflora) were more sensitive, with globe mallow showing 20 percent leaf area death at 500 ppb, a level that could be exceeded in the NMGS region during very short periods (Table 16). Although present in the NMGS area, these two species are not dominant species. Thus short-term changes in regional vegetation composition and productivity are not expected.

Table 16. MAXIMUM CONCENTRATION OF SELECTED EMISSIONS (NMGS PLUS BACKGROUND) IN PROJECT REGION

Five Highest 24-Hour SO_2 Concentrations in the Vicinity of NMGS*

Rank	SO_2 $\mu g/m^3$	SO_2 ppb	TSP $\mu g/m^3$	NO_2 $\mu g/m^3$	NO_2 ppb
1	119	45.4	49.7	183	97.4
2	111	42.4	49.1	173	92.0
3	111	42.4	49.0	172	91.5
4	109	41.6	48.9	170	90.4
5	105	40.1	48.5	164	87.2

Five Highest 3-Hour Concentrations of SO_2 in the Vicinity of NMGS*

Rank	SO_2 $\mu g/m^3$	SO_2 ppb
1	419	160
2	408	156
3	405	155
4	391	149
5	387	148

*Located within 20 km of proposed plant site. These are preliminary model results; see Air Quality and Meteorology Technical Report for final figures.

The long-term effects of low SO_2 and NO_2 concentrations on plant vigor would be of greater concern than short-term effects. However, these types of SO_2 and NO_2-induced impacts are not well documented. White, Hill, and Bennett (1974) found that 2-hour exposure to low levels of SO_2 and NO_2 (150 ppb) caused a 7 percent lowering of the photosynthetic rate in alfalfa. Because these concentrations are expected in the areas surrounding NMGS, it appears likely that basic physiological processes of some species may be affected. However, eight years of observation for air pollutant damage to plants near the Four Corners and San Juan power plants by Hill et al. (1973, 1978) failed to detect any visible damage. Hill et al. systematically observed native vegetation and crop and garden plants, concentrating on species most sensitive to SO_2 and NO_x. Because pollution levels in the San Juan-Four Corners area were higher than those projected for the NMGS area, no pollution-caused changes in composition or production of native communities around NMGS are expected within 10 years.

Acid rain is increasingly recognized as a serious, cumulative air quality problem potentially causing irreversible reductions in terrestrial and aquatic productivity. East and northeast of the NMGS site, high-elevation watersheds on acidic parent rock are most vulnerable to acid removal of cations from soils and aquatic systems. Mountain landscapes of basic rocks are at a much reduced risk, and low-elevation basins have essentially no risk of reduced productivity from acid precipitation.

Data gaps which prevent a quantitative assessment of the acid rain threat to high-elevation forest lands northeast of NMGS are: (1) the total area of acidic rock exposed at high, runoff-producing elevations, (2) chemical composition of these parent rocks and existing soil chemistry, and (3) transport rate of alkaline dust from the San Juan Basin to acidic mountain landscapes. For example, many high elevation mountain soils of the basin and range region are neutral to mildly basic due to deposition of alkaline basin dust by wind (Southard 1978).

NMGS would contribute about 3% of the atmospheric acid (SO_2 and NO_x) generated in Utah, New Mexico, and Colorado in the year 2000 (Air Quality Technical Report).

This does not allow an evaluation of the regional cumulative effect on vulnerable Rocky Mountain landscapes, the local acidification effects in southern Colorado and northern New Mexico, or the relative contribution of NMGS to local acidification.

Total suspended particulates are predicted by the same computer model to increase about 13 percent (See Table 16) from the present background of 44 $\mu g/m^3$. The significance of this increase appears to be minimal, but again there is no literature with which to assess it.

4.3.3 Agriculture and Natural Resources

No forest products or croplands are present in the NMGS regional area. Using the forage production rates in Section 3.3.2, the 2400-acre NMGS site produces 155 AUM's per year. This range production would be lost for the entire 40-year life of the project. Using an approximate free market price of $7.50 per AUM (SCS 1981), this results in a total economic loss of $46,500 (1981 dollars) over the life of the project.

No critical range resources, such as riparian areas, dependable stock water, or exceptionally productive areas are located on the 2400-acre NMGS site.

4.4 WATER SUPPLY SYSTEM

Vegetation on all pipeline corridors, reservoirs, intakes, and pump stations was inventoried from orthophotoquads and 1:24,000 Bureau of Land Management soil vegetation maps using the classification described in Section 3.2. Linear intercepts of at least 0.1 mile were recorded by vegetation type and mileposts, then summed and reported by vegetation type. Intake and reservoir sites were examined in greater detail during field visits, and field notes were taken.

4.4.1 Proposed Intake, Pipeline, and Reservoir

Construction. Vegetation on rights-of-way, construction sites, etc., would be removed or damaged by construction activities. As a conservative estimate, the figures below assume that the total area of the intake site, pipeline ROWs, and reservoir site would be cleared of vegetation by construction activities. This is a worst-case analysis. The area of vegetation actually disturbed would be less.

The proposed pipeline ROW is 39.8 miles long and 90 feet wide, for a total area of 434.2 acres. The vegetation of this ROW is described by milepost in Table 17, and summarized by type in Table 18.

Table 19 adds acreages of vegetation types found on the other proposed water system components to the pipeline information in Tables 17 and 18.

Total acres of each vegetation type affected by proposed water system construction are compared to the surrounding region in Table 20. Information on regional area of vegetation types is taken from Table 3.

Table 20 shows that none of the vegetation types affected by construction of the proposed water supply system would be significantly affected.

If properly prepared and seeded, areas where vegetation was removed by construction activities should be revegetated by desirable perennial plants within 3 years after construction has ended. Complete similarity to adjacent undisturbed vegetation would take decades, but it is not always desirable due to the poor condition of much of the area's rangeland.

Operation, Maintenance, and Abandonment. Operation and maintenance would result in periodic disturbance to some vegetation for the life of the project (40 years). Most of the intake site booster stations and roughly half of the reservoir would become permanent structures, and a roughly 20-foot-wide access road on the pipeline ROW would be periodically bladed and driven. The total for these areas is between 400 and 500 acres. Referring to Table 20, it is clear that no vegetation type would be significantly affected.

Table 17. VEGETATION ALONG P1

	Vegetation Type				
Milepost	2 Sand Wash and Saline	3 Badland and Bare Slopes	4 Shrubland- Grassland	5 Juniper	6 Irrigated Cropland and Riparian
0.0 = river					
0.0 - 3.7	—	—	—	3.7	—
3.7 - 6.2	—	—	2.5	—	—
6.2 - 14.8	—	—	8.6	—	—
14.8 - 16.2	—	—	1.4	—	—
16.2 - 16.7	—	0.5	—	—	—
16.7 - 24.2	—	—	7.5	—	—
24.2 - 31.3	—	—	7.1	—	—
31.3 - 31.5	0.2	—	—	—	—
31.5 - 32.9	—	1.4	—	—	—
32.9 - 33.2	—	0.3	—	—	—
33.2 - 36.0	—	—	2.8	—	—
36.0 - 36.1	0.1	—	—	—	—
36.1 - 37.3	—	—	1.2	—	—
37.3 - 38.5	—	1.2	—	—	—
38.5 - 38.8	—	—	0.3	—	—
38.8 - 39.4	—	0.6	—	—	—
39.4 - 39.8	—	—	0.4	—	—
Total mileage: 39.8	0.3	4.0	31.8	3.7	—
Percent of total mileage	0.75%	10.1%	79.9%	9.3%	—

Table 18. LENGTH, AREA, AND RELATIVE ABUNDANCE OF VEGETATION TYPES ALONG PROPOSED PIPELINE CORRIDOR P1

Vegetation Type	2 Sandwash and Saline Lowland	3 Badland and Bare Slopes	4 Shrublands & Grasslands	5 Juniper and Pinyon-Juniper
Total Miles	0.3	4.0	31.8	3.7
Percent of Total ROW	0.75	10.1	79.9	9.3
Total Area (acres)	3.3	43.6	346.9	40.4

Table 19. AREAS OF VEGETATION TYPES IN PROJECT COMPONENTS OF PROPOSED WATER SUPPLY SYSTEM (in acres)

	Vegetation Type					
Component	2	3	4	5	6	Total Acres
Pipeline ROW	3.3	43.6	346.9	40.4		434.2
3 Booster Pumping Stations (300 x 150')			3.1			3.1
3 Pipeline Yarding Areas (2 acres each)			6			6.0
Intake	2.0		33		2.0	37.0
Reservoir	27.3	51.1	561.6			640.0
Total Acres	32.6	94.7	950.6	40.4	2.0	1120.3
Percent of Total	2.9	8.5	84.9	3.6	.2	

Table 20. VEGETATION AFFECTED BY PROPOSED WATER SUPPLY SYSTEM COMPARED TO REGIONAL VEGETATION

	Vegetation Type						
	1 Ponderosa and Pinyon Pine, Oak	2 Sand Wash and Saline Lowland	3 Badland and Steep Slopes	4 Shrublands and Grasslands	5 Juniper and Pinyon-Juniper	6 Irrigated Cropland and Riparian	Total
Acres in Region	0	29,500	68,800	422,700	26,200	24,600	571,800
Percent of Region		5.2	12.0	73.9	4.6	4.3	
Maximum Acres Disturbed by Proposed Water Supply System		33	95	951	40	2	1119
Percent of Type in Region		0.117	0.14	0.22	0.15	0	

Unique or Important Vegetation Types. Table 20 shows that none of the six vegetation types qualify as a unique vegetation type, since none totals less than 1 percent of the regional area. During overflights and site reconnaissance in September 1981, the most unique and important vegetation types were native riparian communities along the San Juan River. The importance of riparian areas to wildlife in arid regions is difficult to overestimate (Carothers 1977). Native riparian communities on the San Juan floodplain comprise roughly 10 percent of the area of vegetation Type 6 (Table 20) and thus probably make up less than 1 percent of the region surrounding the proposed water supply system.

The proposed intake site is located above one of the narrowest riparian banks on that stretch of the river. The total amount of native riparian vegetation lost would be about 2 acres (Table 19), less than 1 percent of the estimated native riparian in the region (2460 acres). For these reasons, the proposed water system would not significantly impact the riparian vegetation of the region.

In the short term, riparian vegetation depends on the minimum stream flow necessary to provide ground water to riparian vegetation growing on older, higher floodplains. In the long term, riparian vegetation is also dependent on peak stream flows. Seedlings of many riparian trees and shrubs can establish only on freshly deposited mud and sand of channel and point bars. Removing peak flows (natural floods) typically results in reduction or elimination of cottonwood and willow types that depend upon them for reproductive habitat. Release of an additional 48 CFS through Navajo Dam for NMGS use would cause increased low flows above the proposed intake compared to present conditions (Hydrology Technical Report). The percentage increase in low flows could enhance survival of riparian plants. Below the proposed intake, low flows would not be altered (Hydrology Technical Report), but peak flows would be decreased somewhat. Since peak flows would only be decreased by approximately 1.3%, it is unlikely that any changes in the replacement of woody riparian vegetation would occur due to the influence of NMGS water use. The 1.3% decrease in peak flows is based on peak flows of 3700 cfs measured at Farmington over the period 1963-1981 after construction of the Navajo Dam (USGS 1981) (WATSTORE). Peak flows of 3700 cfs are exceeded 10% of the time. During wet years, flows of 10,000 cfs may persist up to 7 days at a time (USGS 1981) (WATSTORE).

4.4.2 Alternate Pipeline P2, with Alternate (Bloomfield) Intake and Proposed Reservoir

Construction. It is conservatively assumed that all vegetation on rights-of-way, construction sites, etc., would be affected (removed, damaged, etc.). The area of vegetation actually disturbed should be less.

This pipeline ROW is 42.3 miles long and 90 feet wide, for a total area of 460.4 acres. The route crosses 8.7 miles of irrigated land in the Navajo Indian Irrigation Project, and 0.2 mile of irrigated cropland on the San Juan River floodplain. The narrow band of mixed riparian scrub bordering the river is included in the intake area. Vegetation in this ROW is presented by milepost in Table 21, and summarized by type in Table 22.

Table 23 adds the acreages of vegetation types found on the other components of this alternate water system. Total acres of each vegetation type affected by construction of the pipeline P2 alternate water system are compared with the surrounding region in Table 24. Information on regional area of vegetation types is taken from Table 4.

Table 24 shows that none of the vegetation types disturbed by construction would be significantly affected. Riparian vegetation is discussed below. Mitigation measures recommended for surface disturbance are discussed in Section 5.1.

Operation, Maintenance, and Abandonment. Areas from which vegetation would be removed for the life of the project would total between 410 and 510 acres. Data in Table 23 confirm that no vegetation types would be significantly affected.

Unique or Important Vegetation Types. Table 24 shows that none of the six vegetation types qualify as unique, since none totals more than 1 percent of the regional area. September 1981 overflights and site reconnaissance indicated that the regionally most important vegetation types were floodplain riparian communities along the San Juan River.

Table 21. VEGETATION ALONG P2

Milepost	2 Sand Wash and Saline	3 Badland and Bare Slopes	4 Shrubland-Grassland	5 Juniper	6 Irrigated Cropland and Riparian
	Vegetation Type				
0.0 = San Juan River					
0.0 - 0.3	—	—	—	—	0.3
0.3 - 0.7	—	—	0.4	—	—
0.7 - 0.9	—	—	—	0.2	—
0.9 - 1.3	—	—	0.4	—	—
1.3 - 1.5	—	—	—	0.2	—
1.5 - 2.0	—	—	0.5	—	—
2.0 - 2.2	0.2	—	—	—	—
2.2 - 5.5	3.3	—	—	—	—
5.5 - 6.3	—	—	0.8	—	—
6.3 - 13.0	—	—	—	—	6.7
13.0 - 13.8	—	—	0.8	—	—
13.8 - 14.1	0.3	—	—	—	—
14.1 - 14.5	—	—	0.4	—	—
14.5 - 15.0	—	0.5	—	—	—
15.0 - 16.7	—	—	—	—	1.7
16.7 - 17.0	—	—	—	—	0.3
17.0 - 18.1	—	—	1.1	—	—
18.1 - 18.3	0.2	—	—	—	—
18.3 - 26.5	—	—	8.2	—	—
26.5 - 31.7	—	—	5.2	—	—
31.7 - 34.0	—	—	2.3	—	—
34.0 - 34.3	0.3	—	—	—	—
34.3 - 35.7	—	1.4	—	—	—
35.7 - 38.5	—	—	2.8	—	—
38.5 - 38.6	0.1	—	—	—	—
38.6 - 39.8	—	—	1.4	—	—
39.8 - 41.0	—	1.2	—	—	—
41.0 - 41.3	—	—	0.3	—	—
41.3 - 41.9	—	0.6	—	—	—
41.9 - 42.3	—	—	0.4	—	—
Total mileage: 42.3	4.4	3.7	24.8	0.4	9.0*
Percent of total mileage	10.4%	8.7%	58.6%	0.94%	21.3%

*0.1 of natural riparian, 8.9 of irrigated cropland (8.7 NIIP).

Table 22. LENGTH, AREA, AND RELATIVE ABUNDANCE OF VEGETATION TYPES ALONG ALTERNATE PIPELINE CORRIDOR P2

	Vegetation Type				
	2	3	4	5	6
Total Miles	4.4	3.7	24.8	0.4	8.9
Percent of total ROW	10.4	8.7	58.6	0.94	21.3
Total Area (acres)	48.0	40.4	270.5	4.4	97.1

Table 23. AREAS OF VEGETATION TYPES IN PROJECT COMPONENTS OF ALTERNATIVE WATER SUPPLY SYSTEM, PIPELINE P2 (acres)

	Vegetation Type					
Component	2	3	4	5	6	Total Acres
Pipeline ROW	48.0	40.4	270.5	4.4	97.1	460.4
4 Booster Pumping Stations			3.1	1.0		4.1
4 Construction Yarding Areas			6.0	2.0		8.0
Intake			5.0		30.0	35.0
Reservoir	27.3	51.1	561.6			640.0
Total Acres	75	92	846	7	127	1148
Percent of Total	6.6	8.0	73.6	.64	11.1	

Table 24. VEGETATION AFFECTED BY ALTERNATE PIPELINE #2 WATER SYSTEM COMPARED TO REGIONAL VEGETATION

	Vegetation Type						
	1 Ponderosa and Pinyon Pine, Oak	2 Sand Wash and Saline Lowland	3 Badland and Steep Slopes	4 Shrublands and Grasslands	5 Juniper and Pinyon-Juniper	6 Irrigated Cropland and Riparian	Totals
Acres in Region	0	49,200	72,100	411,200	42,600	32,800	607,800
Percent of Region		8.1	11.9	67.7	7.0	5.4	
Maximum Acres Disturbed by Proposed Water Supply System		75	92	846	7	127	1,148
Percent of Type in Region		0.15	0.13	0.21	0	0.39	

The riparian vegetation at the alternate Bloomfield site is a wider band (totaling about 5 acres) than at the proposed Farmington site. The remaining 25 acres of type 6 land on the alternate intake site are irrigated fields. Using the same rationale and methods presented above, the regional riparian vegetation total was estimated at 3280 acres, less than 1 percent of the regional area. The 5 acres potentially removed on the Bloomfield alternate intake site are substantially less than 1 percent of the 3280 acres of riparian vegetation in the region. Riparian vegetation in the region would not be significantly affected by the Bloomfield alternate intake.

4.4.3 Alternate Pipeline P3, with Alternate (Bloomfield) Intake and Proposed Reservoir

Construction. This ROW is 48.6 miles long by 90 feet wide, for a total of 530.2 acres. Vegetation information on the ROW is presented by milepost in Table 25 and summarized by type in Table 26.

Information on vegetation disturbed by construction of all components of this alternative is shown in Table 27. Total acres of each vegetation type affected by construction of this alternate water supply system are compared to the surrounding region in Table 28. Information on regional vegetation in this table is taken from Table 5.

Table 28 shows that none of the vegetation types disturbed by the construction of this alternate water supply system would be significantly affected.

Operation, Maintenance, and Abandonment. Following the rationale presented above, areas from which vegetation would be removed for the life of the project would total between 410 and 520 acres. Table 26 confirms that such acreages would not affect any vegetation type.

Unique or Important Vegetation Types. Riparian vegetation on the alternate intake site has already been discussed.

Table 25. VEGETATION ALONG P3

Milepost	2 Sand Wash and Saline	3 Badland and Bare Slopes	4 Shrubland- Grassland	5 Juniper	6 Irrigated Cropland and Riparian
	Vegetation Type				
0.0 = Bloomfield intake					
0.0 - 0.3	—	—	—	—	0.3
0.3 - 1.2	—	—	0.9	—	—
1.2 - 1.6	—	—	—	0.4	—
1.6 - 2.2	—	—	0.6	—	—
2.2 - 2.7	—	—	—	0.5	—
2.7 - 7.0	—	—	4.3	—	—
7.0 - 7.6	—	—	—	0.6	—
7.6 - 10.8	—	—	—	3.2	—
10.8 - 11.4	—	0.6	—	—	—
11.4 - 11.5	0.1	—	—	—	—
11.5 - 12.0	—	0.5	—	—	—
12.0 - 12.3	—	—	—	0.3	—
12.3 - 13.0	—	—	0.7	—	—
13.0 - 13.3	—	—	—	0.3	—
13.3 - 13.8	—	—	0.5	—	—
13.8 - 14.1	—	—	—	0.3	—
14.1 - 14.3	—	—	0.2	—	—
14.3 - 16.0	—	1.7	—	—	—
16.0 - 19.1	—	—	3.1	—	—
19.1 - 24.0	—	—	4.9	—	—
24.0 - 24.1	—	—	—	0.1	—
24.1 - 25.2	—	—	1.1	—	—
25.2 - 26.2	—	—	—	1.0	—
26.2 - 26.3	—	—	0.1	—	—
26.3 - 26.5	0.2	—	—	—	—
26.5 - 28.2	—	—	1.7	—	—
28.2 - 28.6	—	—	—	0.4	—
28.6 - 28.8	—	—	0.2	—	—
28.8 - 29.0	—	—	—	0.2	—
29.0 - 29.6	—	—	0.6	—	—
29.6 - 30.0	—	—	—	0.4	—
30.0 - 30.1	—	—	0.1	—	—
30.1 - 30.2	—	—	—	0.1	—
30.2 - 31.1	—	—	0.9	—	—
31.1 - 31.3	—	—	—	0.2	—
31.3 - 31.8	—	—	0.5	—	—
31.8 - 33.2	—	—	—	1.4	—
33.2 - 35.5	—	—	2.3	—	—
35.5 - 36.1	—	—	0.6	—	—

Table 25. VEGETATION ALONG P3 (concluded)

	Vegetation Type				
Milepost	2 Sand Wash and Saline	3 Badland and Bare Slopes	4 Shrubland-Grassland	5 Juniper	6 Irrigated Cropland and Riparian
36.1 - 36.4	—	—	—	0.3	—
36.4 - 42.3	—	—	5.9	—	—
42.3 - 44.3	—	—	2.0	—	—
44.3 - 45.2	—	—	0.9	—	—
45.2 - 46.3	—	1.1	—	—	—
46.3 - 48.7	—	—	2.4	—	—
Total mileage: 48.7	0.3	3.9	34.5	9.7	0.3
Percent of total mileage:	0.6%	8.0%	70.8%	19.9%	0.6%

Table 26. LENGTH, AREA, AND RELATIVE ABUNDANCE OF VEGETATION TYPES ALONG ALTERNATE PIPELINE CORRIDOR P3

	Vegetation Type				
	2	3	4	5	6
Total Miles	0.3	3.9	34.5	9.7	0.2
Percent of total ROW	0.62	8.0	71.0	20.0	0.41
Total Area (acres)	3.3	42.5	376.4	105.8	2.2

Table 27. AREAS OF VEGETATION TYPES IN PROJECT COMPONENTS OF ALTERNATE WATER SUPPLY SYSTEM, PIPELINE P3 (acres)

	Vegetation Type					
Component	2	3	4	5	6	Total Acres
Pipeline ROW	3.3	42.5	376.4	105.8	2.2	530.2
4 Booster Pump Stations		1.0	3.1			4.1
4 Construction Yarding Areas		2.0	6.0			8.0
Intake			5.0		30.0	35.0
Reservoir	27.3	51.1	561.6			640.0
Total Acres	30.6	96.6	952.1	105.8	32.2	1217.3
Percent of Total	2.5	7.9	78.2	8.7	2.6	

Table 28. VEGETATION AFFECTED BY ALTERNATE WATER SUPPLY SYSTEM P3 COMPARED TO REGIONAL VEGETATION

	Vegetation Type						
	1 Ponderosa and Pinyon Pine, Oak	2 Sand Wash and Saline Lowland	3 Badland and Steep Slopes	4 Shrublands and Grasslands	5 Juniper and Pinyon-Juniper	6 Irrigated Cropland and Riparian	Total
Acres in Region	0	34,400	29,500	421,100	54,100	31,100	570,200
Percent of Region		6.0	5.2	73.9	9.5	5.5	
Maximum Acres Disturbed by Proposed Water Supply System		31	97	952	106	32	1,218
Percent of Type in Region		0.09	0.33	0.23	0.20	0.10	

4.4.4 Alternate Reservoir

Construction. Construction of the alternate reservoir at Section 6, T22N, R12W, would remove or damage 640 acres of vegetation. Vegetation types of this area were field mapped, and are summarized in Table 29. If areas stripped of vegetation are properly prepared and seeded, desirable perennial vegetation should be established within 3 years. Exact similarity to adjacent vegetation would take longer, and in some cases is not desirable due to poor range condition of existing vegetation.

Operation, Maintenance, and Abandonment. Roughly half of the 640-acre alternate reservoir site would have no vegetation for the life of the project. Removal of this vegetation for the life of the project would not result in a significant impact to vegetation.

Unique or Important Vegetation Types. The alternate site contains no unique vegetation or riparian types.

4.4.5 Agriculture

Proposed Intake, Pipeline, and Reservoir. The proposed water supply system would cross no cropland but would cross 40 acres of noncommercial juniper woodland. Rangeland impacts can be divided into short-term forage loss due to construction effects and long-term consequences of removing rangeland from production for the life of the project.

Short-term affects are assessed using the vegetation information in Table 18 and the forage production rates derived earlier. This results in an estimated 67.6 AUM's lost per year. Assuming this production would be lost for the 2 years of construction time and 3-year deferment from grazing to reestablish perennial vegetation, the total usable forage lost would be about 338 AUM's. At an estimated free market value of $7.50 per AUM, the total economic loss would be about $2535 (1981 dollars).

Table 29. AREA AND RELATIVE ABUNDANCE OF VEGETATION TYPES ON ALTERNATE RESERVOIR SITE

	Vegetation Type			
	2	3	4	
	Sand Wash and Saline Lowland	Badland and Steep Slopes	Shrublands and Grasslands	Total
Acres	11.9	15.5	612.6	640
Percent of total	1.9	2.4	95.7	

Long-term effects are limited to forage lost from land taken out of production for the life of the project. This was estimated at 450 acres which would produce about 23 usable AUM's per year. Assuming a 40-year project life, the additional economic loss of the long-term impact would be about 920 AUM's or $6900 (constant 1981 dollars).

Alternate Water Supply Systems. Impacts for the various alternate water supply system configurations are not meaningfully different from the proposed system evaluated above. Selection of the alternate intake site at Bloomfield would remove about 20 acres of irrigated fields and 5 acres of riparian for the 40-year project life. Choice of alternate pipeline corridor P2 would involve temporarily disturbing about 97 acres of land that is irrigated in the NIIP, but this would involve little crop loss if it were done during the winter. If annual cropland were disturbed, essentially no production would be lost. Disturbance of perennial crops (i.e., alfalfa) would involve a one-year production loss on 97 acres while the crop reestablishes. Alternative pipeline corridor P3 crosses more juniper woodland, but as mentioned before, this type is of marginal production for firewood. The alternate reservoir site is similar in vegetation and productivity to the proposed site. Ignoring influences on crop production and looking only at range production, impacts of any intake-pipeline-reservoir combination would vary no more than 15 percent from the AUM and dollar figures given above.

4.5 TRANSMISSION LINES

Vegetation on transmission line corridors T1, T2, and T3 was inventoried from 1:31,680 aerial photographs using the classification presented in detail in Section 3.2. Corridor T4 was inventoried from data in the Draft Environmental Statement, Proposed Four Corners-Ambrosia-Pajarito 500-kV Transmission Project (USDI 1980), using the same classification. Linear intercepts of at least 0.1 mile were recorded by vegetation type and mileposts, summed and reported by vegetation type.

Estimates of total area potentially affected by construction of each transmission line were made by adding areas of all individual components. Not all of this total would be disturbed; some would be damaged or affected by construction and related activities, a known portion would be removed, and the remainder relatively unaffected. Vegetation removed for the life of the project is also estimated.

None of the proposed or alternate corridors significantly impact any unique vegetation types (types making up less than 1% of the region) or riparian vegetation.

Estimates of temporary and permanent disturbance associated with switchyards and substations are given only for corridor T2.

4.5.1 Proposed Action: First 500-kV Line, Route T2

Construction. Vegetation would be removed by clearing and grading, and damaged by movement of vehicles and construction materials. Total area removed, damaged, and otherwise affected would not exceed 2572 acres.

The T2 ROW measures 101.0 miles by 200 ft. The vegetation of these 2448 acres is presented by milepost in Table 30 and summarized by type in Table 31.

Acreages potentially disturbed by other T2 components are shown in Table 32.

The total acreage potentially disturbed by vegetation type is reported in Table 33 and compared with vegetation of the region (20-mile-wide zone centered on corridor). Regional vegetation information is from Table 10.

Table 33 shows that none of the vegetation types present would be significantly impacted (at least 1 percent of regional type affected).

Table 30. VEGETATION ALONG T2

Milepost	Vegetation Type				
	2 Sand Wash and Saline	3 Badland and Bare Slopes	4 Shrubland-Grassland	5 Juniper	6 Irrigated Cropland and Riparian
0 = S edge of NMGS site					
0.0 - 0.2	—	—	0.2	—	—
0.2 - 0.8	—	0.6	—	—	—
0.8 - 4.8	—	—	4.0	—	—
4.8 - 4.9	—	—	0.1	—	—
4.9 - 5.0	—	—	—	0.1	—
5.0 - 9.7	—	—	4.7	—	—
9.7 - 9.8	0.1	—	—	—	—
9.8 - 10.7	—	—	0.9	—	—
10.7 - 12.3	—	—	1.6	—	—
12.3 - 15.7	—	—	3.4	—	—
15.7 - 15.8	0.1	—	—	—	—
15.8 - 16.7	—	—	0.9	—	—
16.7 - 16.8	0.1	—	—	—	—
16.8 - 17.1	—	—	0.3	—	—
17.1 - 17.2	0.1	—	—	—	—
17.2 - 19.6	—	—	2.4	—	—
19.6 - 23.9	—	—	4.3	—	—
23.9 - 24.3	0.4	—	—	—	—
24.3 - 24.8	—	—	0.5	—	—
24.8 - 24.9	0.1	—	—	—	—
24.9 - 27.7	—	—	2.8	—	—
27.7 - 30.8	—	—	3.1	—	—
30.8 - 31.1	0.3	—	—	—	—
31.1 - 32.4	—	—	1.3	—	—
32.4 - 32.6	0.2	—	—	—	—
32.6 - 35.4	—	—	2.8	—	—
35.4 - 35.8	0.4	—	—	—	—
35.8 - 36.2	0.4	—	—	—	—
36.2 - 37.2	—	—	1.0	—	—
37.2 - 37.5	0.3	—	—	—	—
37.5 - 43.0	—	—	5.5	—	—
43.0 - 43.1	0.1	—	—	—	—
43.1 - 43.8	—	—	0.7	—	—
43.8 - 47.5	—	—	3.7	—	—
47.5 - 47.8	0.3	—	—	—	—
47.8 - 48.5	—	—	0.7	—	—
48.5 - 48.6	—	—	—	0.1	—
48.6 - 50.1	—	—	1.5	—	—
50.1 - 50.2	—	—	—	0.1	—
50.2 - 50.3	—	—	0.1	—	—

Table 30. VEGETATION ALONG T2 (continued)

	Vegetation Type				
	2	3	4	5	6
Milepost	Sand Wash and Saline	Badland and Bare Slopes	Shrubland-Grassland	Juniper	Irrigated Cropland and Riparian
50.3 - 50.8	—	—	0.5	—	—
50.8 - 50.9	—	—	—	0.1	—
50.9 - 51.4	—	—	0.5	—	—
51.4 - 51.6	—	—	—	0.2	—
51.6 - 51.8	—	—	0.2	—	—
51.8 - 53.5	—	—	1.7	—	—
53.5 - 53.7	0.2	—	—	—	—
53.7 - 56.7	—	—	3.0	—	—
56.7 - 56.9	0.2	—	—	—	—
56.9 - 59.0	—	—	2.1	—	—
59.0 - 59.1	0.1	—	—	—	—
59.1 - 59.7	—	—	0.6	—	—
59.7 - 60.9	—	—	1.2	—	—
60.9 - 61.0	—	—	0.3	—	—
61.0 - 61.3	0.1	—	—	—	—
61.3 - 61.4	—	—	—	0.1	—
61.4 - 62.5	—	—	1.1	—	—
62.5 - 62.9	—	—	—	0.4	—
62.9 - 63.6	—	—	0.7	—	—
63.6 - 63.8	0.2	—	—	—	—
63.8 - 64.2	—	—	0.4	—	—
64.2 - 64.4	—	—	—	0.2	—
64.4 - 66.5	—	—	2.1	—	—
66.5 - 68.4	—	—	1.9	—	—
68.4 - 68.5	0.1	—	—	—	—
68.5 - 68.7	—	—	0.2	—	—
68.7 - 70.5	—	—	—	1.8	—
70.5 - 71.3	—	—	0.8	—	—
71.3 - 72.8	—	—	1.5	—	—
72.8 - 73.6	—	—	—	0.8	—
73.6 - 75.2	—	—	1.6	—	—
75.2 - 75.4	0.2	—	—	—	—
75.4 - 75.8	—	—	0.4	—	—
75.8 - 76.0	0.2	—	—	—	—
76.0 - 76.2	—	—	0.2	—	—
76.2 - 76.5	—	—	—	0.3	—
76.5 - 76.8	—	—	—	0.3	—
76.8 - 77.4	—	—	0.6	—	—
77.4 - 78.0	—	—	—	0.6	—
78.0 - 78.3	—	—	0.3	—	—
78.3 - 80.9	—	—	—	2.6	—
80.9 - 82.1	—	—	1.2	—	—
82.1 - 82.7	—	—	0.6	—	—

Table 30. VEGETATION ALONG T2 (concluded)

Milepost	2 Sand Wash and Saline	3 Badland and Bare Slopes	4 Shrubland-Grassland	5 Juniper	6 Irrigated Cropland and Riparian
	Vegetation Type				
82.7 - 83.3	---	---	---	0.6	---
83.3 - 84.4	---	---	1.1	---	---
84.4 - 84.5	---	---	---	0.1	---
84.5 - 85.1	---	---	0.6	---	---
85.1 - 86.8	---	---	1.7	---	---
86.8 - 92.6	---	---	5.8	---	---
92.6 - 92.7	---	---	---	0.1	---
92.7 - 92.9	---	---	0.2	---	---
92.9 - 94.1	---	---	---	1.2	---
94.1 - 94.9	---	---	0.8	---	---
94.9 - 95.1	---	---	---	0.2	---
95.1 - 96.6	---	---	1.5	---	---
96.6 - 97.4	---	---	0.8	---	---
97.4 - 98.2	---	---	---	0.8	---
98.2 - 98.7	---	---	0.5	---	---
98.7 - 99.2	---	---	---	0.5	---
99.2 - 100.2	---	---	---	1.0	---
100.2 - 101.0	---	---	0.8	---	---
Total mileage: 101.0	4.2	0.6	84.0	12.2	---
Percent of total mileage	4.2%	0.6%	83.2%	12.1%	---

Table 31. AREA AND RELATIVE ABUNDANCE OF VEGETATION TYPES FOUND IN TRANSMISSION LINE CORRIDOR T2

Vegetation Type	2 Sandwash and Saline Lowland	3 Badland and Steep Slopes	4 Shrublands & Grasslands	5 Juniper and Pinyon-Juniper
Total Miles	4.2	0.6	84.0	12.2
Percent of Total ROW	4.15	0.59	83.16	12.07
Total Acres	101.6	14.4	2036.2	295.5

Table 32. AREA BY VEGETATION TYPE IN OTHER COMPONENTS OF PROPOSED TRANSMISSION LINE T2

	Acres
Construction Storage and Yarding (probably Type 4)	30.0
Batch Plants (locations unknown, most likely located in Type 4)	10.0
NMGS Switchyard (Type 4)	37.9
Rio Puerco Station	
(Type 4)	43.0
(Type 5)	2.7
Total	123.6

Table 33. TOTAL VEGETATION (BY TYPE) POSSIBLY DISTURBED BY PROPOSED TRANSMISSION LINE T2, COMPARED WITH REGIONAL VEGETATION

	Vegetation Type						
	1 Ponderosa and Pinyon Pine, Oak	2 Sand Wash and Saline Lowland	3 Badland and Steep Slopes	4 Shrublands and Grasslands	5 Juniper and Pinyon-Juniper	6 Irrigated Cropland and Riparian	Total
Acres in Region	3700	73,400	58,700	1,049,700	113,800	0	1,299,300
Percent of Region	0.28	5.7	4.5	80.8	8.8		
Acres in T2 System	0	102	14	2157	299	0	2,572
Percent of type in region		0.14	0.03	0.21	0.26		

Public Service of New Mexico indicates that an estimated 541 acres would be cleared for construction purposes, then graded and reseeded. If done properly, adequate cover of desirable perennials should be obtained within 3 years. Return to original conditions would take longer, to over a hundred years in some woodlands. Return to predisturbance conditions is not always desirable if the previous vegetation was in poor condition. The main concern is a protective cover of desirable perennial species to minimize erosion and site deterioration. Appropriate mitigation measures are suggested in Section 5.1.

Operation, Maintenance, and Abandonment. PNM (1981) estimates that on 85 acres vegetation would be removed for the 40-year life of the project. The acreage of vegetation types in these areas is presented in Table 34.

4.5.2 Proposed Transmission Line T1

Construction. Maximum vegetation removed, damaged, or affected on the 107.3 mile by 200-foot ROW is presented by milepost in Table 35 and summarized by type in Table 36.

Forty acres would be disturbed by other project components: 30 acres for construction storage and yarding (location uncertain, probably Type 4) and 10 acres for five 2-acre batch plants (again, likely Type 4). The NMGS switchyard and the Rio Puerco Station are not included because they have already been described.

The total acreage potentially disturbed is reported by vegetation type in Table 37 and compared with vegetation of the region (20-mile-wide zone centered on corridor). Regional vegetation information is from Table 11.

Table 37 shows that none of the common regional types would be significantly affected by construction affects of proposed transmission line T1.

Public Service of New Mexico estimates that 550 acres of vegetation would be removed by construction activities, then graded and reseeded. If done properly, adequate cover of desirable perennials should be obtained within

Table 34. ACRES OF VEGETATION TYPES REMOVED FOR 40-YEAR LIFE OF TRANSMISSION LINE T2

	Vegetation Type		
	4	5	
	Shrublands and Grasslands	Juniper and Pinyon-Juniper	Total
NMGS Switchyard	37.9		37.9
Rio Puerco Station	43.0	2.7	45.7
Tower Area	1.4	.2	1.6
Total	82.3	2.9	85.2

Table 35. VEGETATION ALONG T1

Milepost	Vegetation Type				
	2 Sand Wash and Saline	3 Badland and Bare Slopes	4 Shrubland-Grassland	5 Juniper	6 Irrigated Cropland and Riparian
0.0 = Edge of NMGS site					
0.0 - 1.3	—	—	1.3	—	—
1.3 - 1.8	—	0.5	—	—	—
1.8 - 2.7	—	—	0.9	—	—
2.7 - 4.8	2.1	—	2.1	—	—
4.8 - 10.2	—	—	5.4	—	—
10.2 - 11.3	—	—	1.1	—	—
11.3 - 11.5	—	—	—	0.2	—
11.5 - 15.7	—	—	4.2	—	—
15.7 - 15.9	—	—	—	0.2	—
15.9 - 16.8	—	—	0.9	—	—
16.8 - 18.1	—	—	1.3	—	—
18.1 - 19.7	—	—	1.6	—	—
19.7 - 20.1	—	—	—	0.3	—
20.1 - 20.4	—	0.4	—	—	—
20.4 - 21.2	—	—	0.8	—	—
21.2 - 21.3	—	—	—	0.1	—
21.3 - 21.9	—	—	0.6	—	—
21.9 - 22.0	0.1	—	—	—	—
22.0 - 23.3	—	—	1.3	—	—
23.3 - 23.6	0.3	—	—	—	—
23.6 - 25.0	—	—	1.4	—	—
25.0 - 25.6	—	0.6	—	—	—
25.6 - 26.3	—	—	0.7	—	—
26.3 - 27.3	—	1.0	—	—	—
27.3 - 27.5	—	—	0.2	—	—
27.5 - 27.7	0.2	—	—	—	—
27.7 - 28.3	—	—	0.6	—	—
28.3 - 28.5	—	—	—	0.2	—
28.5 - 29.0	—	—	0.5	—	—
29.0 - 29.1	0.1	—	—	—	—
29.1 - 29.4	—	—	0.3	—	—
29.4 - 30.1	—	—	—	0.7	—
30.1 - 31.1	—	—	1.0	—	—
31.1 - 31.2	0.1	—	—	—	—
31.2 - 31.9	—	—	0.7	—	—
31.9 - 32.1	—	—	—	0.2	—
32.1 - 32.3	—	—	0.2	—	—
32.3 - 32.9	—	—	—	0.6	—
32.9 - 33.6	—	—	0.7	—	—
33.6 - 33.7	—	—	0.1	—	—

Table 35. VEGETATION ALONG T1 (continued)

	Vegetation Type				
Milepost	2 Sand Wash and Saline	3 Badland and Bare Slopes	4 Shrubland-Grassland	5 Juniper	6 Irrigated Cropland and Riparian
33.7 - 34.1	0.4	—	—	—	—
34.1 - 36.4	—	—	2.3	—	—
36.4 - 37.3	—	—	0.9	—	—
37.3 - 37.4	0.1	—	—	—	—
37.4 - 37.7	—	—	0.3	—	—
37.7 - 38.0	0.3	—	—	—	—
38.0 - 41.1	—	—	3.1	—	—
41.1 - 41.2	—	0.1	—	—	—
41.2 - 42.0	—	—	0.8	—	—
42.0 - 46.8	—	—	4.8	—	—
46.8 - 46.9	—	0.1	—	—	—
46.9 - 49.2	—	—	2.3	—	—
49.2 - 49.4	—	0.2	—	—	—
49.4 - 50.3	—	—	0.9	—	—
50.3 - 51.5	—	—	1.2	—	—
51.5 - 54.8	—	—	3.3	—	—
54.8 - 55.8	1.0	—	—	—	—
55.8 - 56.0	—	—	0.2	—	—
56.0 - 56.2	0.2	—	—	—	—
56.2 - 57.1	—	—	0.9	—	—
57.1 - 58.0	0.9	—	—	—	—
58.0 - 61.8	—	—	3.8	—	—
61.8 - 62.1	—	—	0.3	—	—
62.1 - 62.9	0.8	—	—	—	—
62.9 - 64.1	—	—	1.2	—	—
64.1 - 64.6	—	—	—	0.5	—
64.6 - 66.9	—	—	2.3	—	—
66.9 - 67.0	—	—	—	0.1	—
67.0 - 68.1	—	—	1.1	—	—
68.1 - 68.4	—	—	—	0.3	—
68.4 - 69.5	—	—	1.1	—	—
69.5 - 70.2	—	—	—	0.7	—
70.2 - 71.4	—	—	1.2	—	—
71.4 - 71.9	0.5	—	—	—	—
71.9 - 72.5	—	—	0.6	—	—
72.5 - 72.7	0.2	—	—	—	—
72.7 - 72.9	—	—	0.2	—	—
72.9 - 73.5	—	—	0.6	—	—
73.5 - 74.4	—	—	0.9	—	—
74.4 - 74.6	0.2	—	—	—	—
74.6 - 75.1	—	—	0.5	—	—
75.1 - 75.2	—	—	—	0.1	—
75.2 - 75.9	—	—	0.7	—	—

Table 35. VEGETATION ALONG T1 (concluded)

	Vegetation Type				
Milepost	2 Sand Wash and Saline	3 Badland and Bare Slopes	4 Shrubland-Grassland	5 Juniper	6 Irrigated Cropland and Riparian
75.9 - 76.4	—	—	—	0.5	—
76.4 - 78.2	—	—	1.8	—	—
78.2 - 78.4	—	—	—	0.2	—
78.4 - 78.6	—	—	0.2	—	—
78.6 - 78.7	—	—	—	0.1	—
78.7 - 79.6	—	—	0.9	—	—
79.6 - 79.7	0.1	—	—	—	—
79.7 - 81.5	—	—	1.8	—	—
81.5 - 82.2	0.7	—	—	—	—
82.2 - 83.3	—	—	1.1	—	—
83.3 - 83.6	—	—	—	0.3	—
83.6 - 85.5	—	—	1.9	—	—
85.5 - 89.6	—	—	4.1	—	—
89.6 - 89.9	—	—	—	0.3	—
89.9 - 90.1	—	—	0.2	—	—
90.1 - 90.7	—	—	—	0.6	—
90.7 - 90.9	—	—	0.2	—	—
90.9 - 91.8	—	—	—	0.9	—
91.8 - 92.7	—	—	0.9	—	—
92.7 - 93.4	—	—	—	0.7	—
93.4 - 94.0	—	—	—	0.6	—
94.0 - 94.4	—	—	0.4	—	—
94.4 - 94.7	—	—	—	0.3	—
94.7 - 95.1	—	—	0.4	—	—
95.1 - 95.6	—	—	—	0.5	—
95.6 - 99.5	—	—	3.9	—	—
99.5 - 99.6	—	—	—	0.1	—
99.6 - 99.9	—	—	0.3	—	—
99.9 - 100.0	—	—	—	0.1	—
100.0 - 103.5	—	—	—	3.5	—
103.5 - 105.3	—	—	—	1.8	—
105.3 - 105.6	—	—	0.3	—	—
105.6 - 106.8	—	—	—	1.2	—
106.8 - 107.3	—	—	0.5	—	—
Total mileage: 107.3	6.2	2.9	82.3	15.9	—
Percent of total mileage	5.8%	2.7%	76.7%	14.8%	—

Table 36. AREA OF VEGETATION TYPES ON TRANSMISSION LINE T1 ROW

Vegetation Type	2 Sandwash and Saline Lowland	3 Badland and Bare Slopes	4 Shrublands & Grasslands	5 Juniper and Pinyon-Juniper
Total Miles	6.2	2.9	82.3	15.9
Percent of Total ROW	5.8	2.7	76.7	14.8
Total Acres	150.9	70.2	1995.1	385.0
			ROW Total = 2601.2 Acres	

Table 37. MAXIMUM VEGETATION TYPE AREAS POTENTIALLY DISTURBED BY PROPOSED TRANSMISSION LINE T1, COMPARED WITH REGIONAL VEGETATION

	Vegetation Type						
	1 Ponderosa and Pinyon Pine, Oak	2 Sand Wash and Saline Lowland	3 Badland and Steep Slopes	4 Shrublands and Grasslands	5 Juniper and Pinyon-Juniper	6 Irrigated Cropland and Riparian	Total
Acres in Region	0	69,700	80,700	1,053,400	172,500	0	1,376,300
Percent of Region		5.1	5.9	76.5	12.5		
Acres in T1 System		151	70	2,035	385		2,641
Percent of type in region		0.22	0.09	0.19	0.22		

3 years. Return to original conditions will take longer, to over a hundred years in some woodlands. Return to predisturbance conditions is not always desirable because many areas are presently in poor condition. The main concern is a protective cover of desirable perennial species to minimize erosion and site deterioration. Mitigation measures are suggested in Section 5.1.

Operation, Maintenance, and Abandonment. PNM estimates that 1.7 acres of vegetation (tower areas) will be removed for the 40-year life of the project.

4.5.3 Transmission Line T3

Construction. Maximum vegetation removed, damaged, or affected in the 107.1-mile by 200-foot ROW is presented by milepost in Table 38 and summarized by type in Table 39.

Forty acres would be disturbed by other project components: 30 acres for construction storage and yarding (location uncertain - probably Type 4) and 10 acres for five 2-acre batch plants (again, likely Type 4). The NMGS switchyard and the Rio Puerco Station are not included because they have already been described.

The total acreage potentially disturbed is reported by vegetation type in Table 40 and compared vegetation of the region (20-mile-wide zone centered on corridor). Regional vegetation information is from Table 12.

Table 40 shows that none of the common regional types would be significantly impacted by construction affects of proposed transmission line T3.

PNM estimates that 540 acres of vegetation would be removed by construction activities, then graded and reseeded.

Table 38. VEGETATION ALONG T3

Milepost	2 Sand Wash and Saline	3 Badland and Bare Slopes	4 Shrubland-Grassland	5 Juniper	6 Irrigated Cropland and Riparian
	Vegetation Type				
0.0 = SE corner of switchyard					
0.0 - 0.5	—	—	0.5	—	—
0.5 - 1.0	—	0.5	—	—	—
1.0 - 3.0	—	—	2.0	—	—
3.0 - 3.2	0.2	—	—	—	—
3.2 - 5.7	—	—	2.5	—	—
5.7 - 5.9	—	0.2	—	—	—
5.9 - 6.0	—	0.1	—	—	—
6.0 - 6.9	0.9	—	—	—	—
6.9 - 7.5	—	—	0.6	—	—
7.5 - 7.8	—	0.3	—	—	—
7.8 - 12.8	—	—	5.0	—	—
12.8 - 13.8	1.0	—	—	—	—
13.8 - 14.4	—	—	0.6	—	—
14.4 - 17.6	—	—	3.2	—	—
17.6 - 17.9	—	—	0.3	—	—
17.9 - 18.1	—	0.2	—	—	—
18.1 - 18.9	—	—	0.8	—	—
18.9 - 19.7	—	0.8	—	—	—
19.7 - 20.1	—	—	0.4	—	—
20.1 - 20.3	—	0.2	—	—	—
20.3 - 20.8	—	—	0.5	—	—
20.8 - 21.9	—	1.1	—	—	—
21.9 - 23.4	—	—	1.5	—	—
23.4 - 26.4	—	—	3.0	—	—
26.4 - 26.5	—	0.1	—	—	—
26.5 - 31.4	—	—	4.9	—	—
31.4 - 36.7	—	—	5.3	—	—
36.7 - 38.9	—	—	2.2	—	—
38.9 - 47.0	—	—	8.1	—	—
47.0 - 54.2	—	—	7.2	—	—
54.2 - 60.1	—	—	5.9	—	—
60.1 - 61.8	—	—	1.7	—	—
61.8 - 62.9	—	—	1.1	—	—
62.9 - 63.1	—	—	—	0.2	—
63.1 - 66.8	—	—	3.7	—	—
66.8 - 67.1	—	—	—	0.3	—
67.1 - 69.1	—	—	2.0	—	—
69.1 - 69.3	—	—	0.2	—	—
69.3 - 69.5	—	—	—	0.2	—
69.5 - 70.2	—	—	0.7	—	—
70.2 - 70.3	—	—	—	0.1	—
70.3 - 70.4	—	—	0.1	—	—
70.4 - 70.6	0.2	—	—	—	—

Table 38. VEGETATION ALONG T3 (concluded)

	Vegetation Type				
Milepost	2 Sand Wash and Saline	3 Badland and Bare Slopes	4 Shrubland-Grassland	5 Juniper	6 Irrigated Cropland and Riparian
70.6 - 71.0	—	—	0.4	—	—
71.0 - 72.0	—	—	—	1.0	—
72.0 - 72.6	—	—	0.6	—	—
72.6 - 73.1	0.5	—	—	—	—
73.1 - 73.2	—	—	0.1	—	—
73.2 - 75.6	—	—	—	2.4	—
75.6 - 76.6	—	—	—	1.0	—
76.6 - 77.4	—	—	0.8	—	—
77.4 - 78.9	—	—	1.5	—	—
78.9 - 79.7	—	—	—	0.8	—
79.7 - 81.3	—	—	1.6	—	—
81.3 - 81.5	0.2	—	—	—	—
81.5 - 81.9	—	—	0.4	—	—
81.9 - 82.1	0.2	—	—	—	—
82.1 - 82.3	—	—	0.2	—	—
82.3 - 82.6	—	—	—	0.3	—
82.6 - 82.9	—	—	—	0.3	—
82.9 - 83.5	—	—	0.6	—	—
83.5 - 84.1	—	—	—	0.6	—
84.1 - 84.4	—	—	0.3	—	—
84.4 - 87.0	—	—	—	2.6	—
87.0 - 88.2	—	—	1.2	—	—
88.2 - 88.8	—	—	0.6	—	—
88.8 - 89.4	—	—	—	0.6	—
89.4 - 90.5	—	—	1.1	—	—
90.5 - 90.6	—	—	—	0.1	—
90.6 - 91.2	—	—	0.6	—	—
91.2 - 92.9	—	—	1.7	—	—
92.9 - 98.7	—	—	5.8	—	—
98.7 - 98.8	—	—	—	0.1	—
98.8 - 99.0	—	—	0.2	—	—
99.0 - 100.2	—	—	—	1.2	—
100.2 - 101.0	—	—	0.8	—	—
101.0 - 101.2	—	—	—	0.2	—
101.2 - 102.7	—	—	1.5	—	—
102.7 - 103.5	—	—	0.8	—	—
103.5 - 104.3	—	—	—	0.8	—
104.3 - 104.8	—	—	0.5	—	—
104.8 - 105.3	—	—	—	0.5	—
105.3 - 106.3	—	—	—	1.0	—
106.3 - 107.1	—	—	0.8	—	—
Total Mileage: 107.1	3.2	3.5	86.1	14.3	—
Percent of total mileage	3.0%	3.3%	80.4%	13.4%	—

Table 39. AREA OF VEGETATION TYPES ON ROW OF ALTERNATE TRANSMISSION LINE T3

Vegetation Type	2 Sandwash and Saline Lowland	3 Badland and Bare Slopes	4 Shrublands & Grasslands	5 Juniper and Pinyon-Juniper
Total Miles	3.2	3.5	86.1	14.3
Percent of Total ROW	3.0	3.3	80.4	13.4
Total Acres	77.9	85.7	2087.5	347.9

Table 40. MAXIMUM VEGETATION TYPE AREAS POTENTIALLY DISTURBED BY PROPOSED TRANSMISSION LINE T3, COMPARED TO REGIONAL VEGETATION

	Vegetation Type						
	1 Ponderosa and Pinyon Pine, Oak	2 Sand Wash and Saline Lowland	3 Badland and Steep Slopes	4 Shrublands and Grasslands	5 Juniper and Pinyon-Juniper	6 Irrigated Cropland and Riparian	Total
Acres in Region	3,700	77,100	9,200	1,165,300	80,700	0	1,336,000
Percent of Region	0.27	5.8	.69	87.2	6.0		
Acres in T3 System	0	78	85	2,126	347	0	2,636
Percent of type in region		0.10	0.92	0.18	0.43		

Operation, Maintenance, and Abandonment. Public Service of New Mexico estimates that 1.7 acres of vegetation would be removed (for tower bases) for the 40-year life of the project.

4.5.4 Transmission Line T4

Construction. Maximum vegetation removed, damaged, or affected in the 127.4-mile by 200-foot ROW is presented by milepost in Table 41 and summarized by type in Table 42.

Forty acres would be disturbed by other project components: 30 acres for construction storage and yarding (location uncertain - probably Type 4) and 10 acres for five 2-acre batch plants (again, likely Type 4). The NMGS switchyard and the Rio Puerco Station are not included because they have already been described.

The total acreage potentially disturbed is reported by vegetation type in Table 43 and compared to vegetation of the region (20-mile wide zone centered on corridor). Regional vegetation information is from Table 13.

Table 43 shows that none of the common regional types would be significantly impacted by construction affects of proposed transmission line T4.

Public Service of New Mexico estimates that 647 acres of vegetation would be removed by construction activities, then graded and reseeded.

Operation, Maintenance, and Abandonment. Approximately 2 acres of vegetation would be lost (to tower bases) for the 40-year life of the project.

Alternative Locations of Rio Puerco Station

At this time three alternative locations for the Rio Puerco Station are under consideration. Although exact locations have not been proposed, all

Table 41. VEGETATION ALONG T4

	Vegetation Type					
Milepost	1 Ponderosa and Pinyon Pine, Oak	2 Sand Wash and Saline	3 Badland and Steep Slopes	4 Shrubland-Grassland	5 Juniper	6 Irrigated Cropland and Riparian
0.0 = NMGS						
0.0 - 0.2	—	—	0.2	—	—	—
0.2 - 0.9	—	—	—	0.7	—	—
0.9 - 4.0	—	—	3.1	—	—	—
4.0 - 72.0	—	—	—	68.0	—	—
72.0 - 74.4	—	—	—	—	2.4	—
74.4 - 76.6	—	—	—	2.2	—	—
76.6 - 96.2	19.6	—	—	—	—	—
96.2 - 103.0	—	—	—	—	6.8	—
103.0 - 107.0	—	—	—	4.0	—	—
107.0 - 111.0	—	—	—	—	4.0	—
111.0 - 116.0	—	—	—	5.0	—	—
116.0 - 116.7	—	0.7	—	—	—	—
116.7 - 124.7	—	—	—	8.0	—	—
124.7 - 127.2	—	—	—	—	2.5	—
127.2 - 127.4	—	—	—	0.2	—	—
Total mileage: 127.4	19.6	0.7	3.3	88.1	15.7	—
Percent of total mileage	15.4%	0.57%	2.6%	69.2%	12.3%	—

Table 42. AREA OF VEGETATION TYPES ON RIGHT-OF-WAY OF ALTERNATE TRANSMISSION LINE T4

Vegetation Type	1 Ponderosa and Pinyon Pine, Oak	2 Sand Wash & Saline Lowland	3 Badland and Steep Slopes	4 Shrublands & Grasslands	5 Juniper & Pinyon-Juniper
Total Miles	19.6	0.7	3.3	88.1	15.7
Percent of Total ROW	15.4	0.54	2.6	69.2	12.3
Total Acres	475.6	16.7	79.9	2135.5	379.9

Table 43. MAXIMUM VEGETATION TYPE AREAS POTENTIALLY DISTURBED BY PROPOSED TRANSMISSION LINE T4, COMPARED TO REGIONAL VEGETATION

	Vegetation Type						
	1 Ponderosa and Pinyon Pine, Oak	2 Sand Wash and Saline Lowland	3 Badland and Steep Slopes	4 Shrublands and Grasslands	5 Juniper and Pinyon-Juniper	6 Irrigated Cropland and Riparian	Total
Acres in Region	143,100	60,600	3,700	1,165,300	143,100	0	1,515,800
Percent of Region	9.4	4.0	0.24	76.9	9.4		
Acres in T4 System	476	17	80	2,136	380	0	3,089
Percent of Type in Region	0.33	0.03	2.2	0.18	0.27		

three appear to be in large, flat expanses of vegetation type 4, shrublands and grasslands. Selection of one of these alternate sites instead of the proposed site would redirect the last few miles of each transmission line corridor. This would cause trivial changes in the maximum acres of each type potentially disturbed as reported above. Changes in acres actually disturbed would be even smaller.

4.5.5 Proposed Transmission Loop T5

The T5 loop corridor would cross 4 miles between the western boundary of the NMGS site and its junction with the Four Corners-Ambrosia-Pajarito transmission line.

Construction. Vegetation along a line down the center of the proposed T5 corridor is presented in Table 44. Table 45 summarizes acres potentially disturbed by vegetation type.

Calculations of maximum area temporarily disturbed by construction were based on a 400-foot total width, twice the width of single transmission line ROWs. The maximum area of vegetation removed or damaged by construction totals 194 acres, and is compared with the vegetation of the comparison region in Table 46 below. As Table 46 shows, construction of T5 would affect a small portion of vegetation types 3 and 4 in the region. Combined impacts of the NMGS reservoir and T5 on the region are considered in Section 4.6.4.

No rare or unusual vegetation or riparian communities were observed in the T5 corridor.

The short-term impacts of construction on the shrubland and grassland type should be of short duration (less than 3 growing seasons), if areas are properly reclaimed and replanted. Surface disturbance to badlands would be long-term because of the poor soil water and soil chemistry conditions typical of badlands.

Table 44. LONGITUDINAL VEGETATION TRANSECT OF T5

Milepost	Vegetation Type 3 Badland and Steep Slopes	Vegetation Type 4 Shrublands and Grasslands
0.0 = NMGS West Boundary	-	-
0.0 - 0.2	0.2	
0.2 - 0.9		0.7
0.9 - 4.0	3.1	
Total Mileage	3.3	0.7
Percent of Total Mileage	82.5%	17.5%

Table 45. MAXIMUM AREA AND RELATIVE ABUNDANCE OF VEGETATION TYPES REMOVED OR DISTURBED BY CONSTRUCTION OF T5

	Vegetation Type 3 Badland and Steep Slopes	Vegetation Type 4 Shrublands and Grasslands
Total Miles	0.7	3.3
Percent of ROW	17.5	82.5
Total Acres	34	160

Table 46. MAXIMUM VEGETATION TYPE AREAS POTENTIALLY DISTURBED BY T5 COMPARED WITH REGIONAL VEGETATION

	Vegetation Type			
	2 Sand Wash and Saline Lowland	3 Badland and Steep Slopes	4 Shrublands and Grasslands	Total
Acres in Region	34,400	42,600	172,000	249,000
Percent of Region	13.8	17.1	69.1	
Acres in T5	0	34	160	194
Percent of Type in Region		0.1	0.1	0.08

Operation, Maintenance, and Abandonment. The only area taken out of production for the life of the project are tower bases, which would total less than one acre. No indirect impacts on vegetation are expected.

4.5.6 Agriculture and Natural Resources

Transmission corridors T1, T2, T3, T4, and T5 have no cultivated agriculture on the transmission line ROW and associated disturbed areas. The T1, T2, T3, and T4 ROWs would cross low-productivity juniper and pinyon-juniper woodlands, but these are at best marginal firewood sites, not commercial timber. Only T4 crosses higher elevation forest lands supporting ponderosa pine on slopes and outcrops. Isolated patches of ponderosa pine are classified as non-suitable (low productivity) commercial forest, producing less than 20 cubic feet of wood per acre per year.

Range impacts are evaluated below for each transmission line in terms of AUM's removed on a short term and long term basis. These estimates are based on vegetation information in Section 3.5.1 and 4.5, and forage production averages from Section 3.3.2.

Proposed Transmission Line T2.

Construction. A minimum estimate of AUM's lost by construction related activities is based on the anticipated 541 acres to be cleared and revegetated. Using a weighted average of 16 acres per AUM, this comes to 34 AUM's lost per year. Estimating a one year construction period, and 3 years of grazing deferral after reseeding this totals 135 AUM's lost during the 4-year period. AT $7.50 per AUM (1981 price), the economic loss is approximately $1014.

A maximum estimate of construction related forage losses assumes no grazing use of the entire corridor for 4 years. Using the vegetation inventory of the T2 system (Table 33) and production rates in Section 3.3.2, this estimate totals 649 AUM's or $4864.

Operation, Maintenance, and Abandonment. Table 33 reports the vegetation lost for the 40-year life of the project. This vegetation produces an estimated 5.6 AUM's per year for a 40-year total of 224 AUM's or $1681.

Unique Vegetation. No unique vegetation types (excluding those defined by T&E Plants), important range areas or riparian areas were observed in the T2 corridor.

Proposed Transmission Line T1.

Construction. Using methodology presented above and vegetation information in Table 37, the minimum construction related forage loss for the four-year period is estimated at 138 AUM's ($1031). The maximum estimate is 642 AUM's ($4815).

Operation, Maintenance, and Abandonment. A total of 1.7 acres of vegetation would be lost for the 40-year life of the project. This totals approximately 4 AUM's ($32).

Unique Vegetation. No unique vegetation types (excluding those defined by T&E Plants), important range areas or riparian areas were observed in the T1 corridor.

Alternate Transmission Line T3.

Construction. Using methodology presented above and vegetation information in Table 40, the minimum construction related forage loss for the four-year period is estimated at 135 AUM's ($1013). The maximum estimate is 642 AUM's ($4815).

Operation, Maintenance, and Abandonment. Approximately 4 AUM's ($32) would be lost from the 1.7 acres of vegetation removed for the 40-year project life.

Unique Vegetation. No unique vegetation types (excluding those defined by T&E Plants), important range areas or riparian areas were observed in the T3 corridor.

Alternate Transmission Line T4.

Construction. The T4 right-of-way crosses isolated stands of noncommercial Ponderosa pine. Trees would be removed in the 200-foot ROW for construction activities, and the wood would presumably be put to use. Future trimming of trees regenerated in the ROW to prevent their interference with transmission lines would keep trees below commercial harvest size. But this would have no economic impact in noncommercial forest.

Using methodology presented above and vegetation information in Table 43, the minimum construction related forage loss for the four-year period is estimated at 162 AUM's ($1213). The maximum estimate is 762 AUM's ($5712).

Operation, Maintenance, and Abandonment. Approximately 5 AUM's ($38) would be lost from the 2.0 acres of vegetation removed for the 40-year project life.

Unique Vegetation. No unique vegetation types (excluding those defined by T&E Plants), important range areas or riparian areas were observed in the T4 corridor. Small montane riparian zones along intermittent streams were observed in the Mesa Chivato area and could be affected if transmission line towers are placed in these areas. This impact is not considered significant. If towers are sited to avoid these small areas, then no direct impacts would occur to the riparian vegetation crossed.

Proposed Transmission Loop T5.

Construction. Using methods described above and vegetation information from Table 45, the maximum construction-related forage loss for the four-year period is estimated at 43 AUM's, or roughly $320 (1981 dollars). A minimum estimate of land area disturbed is not available from PNM.

Operation, Maintenance, and Abandonment. Because the area lost for the life of the project is so small (strictly tower bases, area not estimated by PNM but less than 1 acre), long-term forage loss is insignificant (2 AUM's, $17).

Unique Vegetation. No unique vegetation types (excluding those defined by T&E plants), important range areas, or riparian areas were observed in the T5 corridor.

4.6 COMBINED IMPACTS TO NMGS REGION

Previous analyses of proposed project components near NMGS were compared to the NMGS region of comparison individually. Here they are combined in two groups; temporary impacts (removal of vegetation for three years or less) and permanent impacts (removing vegetation for the 40-year project life).

4.6.1 Temporary Impacts

Temporary construction impacts, i.e., acres disturbed or removed, are given in Table 47.

4.6.2 Permanent Impacts

Vegetation eliminated for the life of the project (40 years) is given in Table 48. The amounts of vegetation removed for the life of the project are not considered significant because: (1) these are dominant types in the San

Table 47. COMBINED TEMPORARY (3 years or less) VEGETATION LOSSES IN THE NMGS REGION OF COMPARISON (acres)

	Vegetation Type			
	2 Sand Wash and Saline Lowland	3 Badland and Steep Slopes	4 Shrublands and Grasslands	Total
T5		34	160	194
Proposed Reservoir	13	25	281	319
Total	13	59	441	513
Area in NMGS Region (acres)	34,400	42,600	172,000	249,000
Percent of Regional Type Disturbed	0.04	0.14	0.26	0.2

Table 48. COMBINED PERMANENT (40 years) VEGETATION LOSSES IN THE NMGS REGION OF COMPARISON (acres)

	Vegetation Type			
	2 Sand Wash and Saline Lowland	3 Badland and Steep Slopes	4 Shrublands and Grasslands	Total
NMGS	416	47	1,937	2,400
Proposed Reservoir	13	25	281	319
T5	0	0	1	1
Total	429	72	2,219	2,720
Area in NMGS Region	34,400	42,600	172,000	249,000
Percent of Regional Type Removed	1.25	0.17	1.29	1.01

Juan Basin and are reduced by a very small amount at this scale, (2) antelope and livestock production is limited more by management and water availability than small increases or decreases in forage of common habitats. The Wildlife and Aquatic Biology Technical Report (Section 4.2.2) cites forage competition with sheep, water, and poaching as the main factors limiting antelope abundance. Controlling trespass sheep grazing, animal distribution, and turnon-turnoff dates are more important to antelope populations than minor changes in regional habitat. Similarly, large increases in livestock productivity and range condition are more easily achieved through better control of animal distribution and timing than direct expansion of the forage base. Thus, viewing the San Juan Basin as a whole, the 40-year loss of habitat due to the project appears slight due to the potential increases in animal production and vegetation condition possible through better management.

4.7 SPECIAL STATUS SPECIES

Based on available data, four of the species designated special status are expected to occur on or near project components. If any are encountered in an area that would be subject to surface disturbance, impacts would occur, depending on the species' distribution and degree of disturbance. Impacts could include direct destruction or erosion of soils supporting rare plants.

4.8 SUMMARY

Permanent (40-year) and temporary (3-year) disturbances of all proposed and alternate project components are summarized in Table 49. Estimates of temporary (construction) impacts are the maximum estimates assuming disturbance of total right-of-way area, which is more likely for pipelines than transmission lines.

Based on available information, none of the vegetation types found in Section 3.8 to be unique or important in their regions of comparison would be significantly impacted by project components.

Table 49. SUMMARY OF ACRES DISTURBED BY VEGETATION TYPE AND PROJECT COMPONENT

Component	Vegetation Type 1 Ponderosa and Pinyon Pine, Oak	2 Sand Wash and Saline Lowland	3 Badland and Steep Slopes	4 Shrublands and Grasslands	5 Juniper and Pinyon Juniper	6 Irrigated Cropland and Riparian	Total
NMGS	0	416	47	1937	0	0	2400
P1 and Intake	0	3 (2)	10 (34)	113 (276)	9 (31)	2	137 (343)
P2 and Intake	0	11 (37)	9 (31)	68 (216)	2 (5)	52 (75)	142 (364)
P3 and Intake	0	1 (2)	10 (36)	92 (299)	24 (82)	30 (2)	157 (421)
Proposed Reservoir	0	13 (13)	25 (25)	281 (283)	0	0	319 (321)
Alternate Reservoir	0	6 (6)	8 (8)	306 (306)	0	0	320 (320)
T1	0	(151)	(70)	2 (1995)	(385)	0	2 (2601)
T2 and Rio Puerco Station	0	(102)	(14)	82 (2037)	3 (295)	0	85 (2448)
T5	0	0	(34)	1 (160)	0	0	1 (194)
T3	0	(78)	(86)	2 (2088)	(348)	0	2 (2600)
T4	(476)	(17)	0	2 (2214)	(380)	0	2 (3087)

Note: Numbers in parentheses are acres temporarily disturbed; numbers not in parentheses are acres removed for the 40-year project life.

5.0
SUGGESTED MITIGATION

5.1 DIRECT EFFECTS

Local direct impacts could be mitigated in the following ways:

- Construction should be supervised to minimize the area of vegetation removed and disturbed.

- Vegetation not cleared, but damaged by construction machinery, deposition of eroded soil, or other construction related effects can recover rapidly if root crowns remain intact. Where disturbance to soil and plant roots is greater, reseeding should be done with a minimum of soil movement.

- Areas cleared of vegetation should be graded to minimize percent slope, and also have soil restored as much as possible. Contour furrows, traps, and other structures to minimize wind and water erosion, and maximize water collection and infiltration should be employed.

- After proper seedbed preparation, areas should be replanted. Seed mixtures should contain shrubs, forbs, and native and exotic grasses. Seed mixtures should be specialized for a particular precipitation zone, yet be diverse enough to establish cover on the variety of soil types encountered. Both cool and warm season grasses should be included.

- Seeded ground should be covered with native hay or straw mulch to reduce evaporation. Mulch should be disked into the ground to prevent it from blowing away.

- The temporary pipeline supplying construction water along the pipeline ROW should be left in place to irrigate and establish the reseeding. In this area and precipitation zone, natural precipitation is sufficient to germinate seeds and establish seedlings only 10-20 percent of the time (Alden 1982). Minimal supplemental irrigation during the critical period of seedling emergence can increase this success ratio to nearly 100 percent. While the cost of irrigation along powerlines and other remote, linear components is prohibitive, water should be used where available.

- Revegetated areas should be monitored yearly to assess revegetation success, and replanted if seeds germinate but fail to establish. Seeds may remain viable in the soil for several years if rainfall is not sufficient for germination.

- Surveys should be conducted for those special status plants that are most likely to be affected: Pediocactus papyracanthus, Abronia bigelovii, Phacelia splendens, and Aletes sessiliflorus.

5.2 INDIRECT EFFECTS

- Use buses or vans to transport workers from population centers to and from the job. Reducing the presence of private vehicles will reduce ORV use and consequent destruction of vegetation and erosion.

- Baseline studies of soil and water chemistry of high-elevation landscapes sensitive to acidification (northeast of project area) are necessary to measure future acid rain impacts.

6.0 UNAVOIDABLE ADVERSE IMPACTS

6.1 NMGS SITE

A total of 2400 acres of vegetation and associated production would be lost for the 40-year project life.

6.2 WATER SUPPLY SYSTEM

Approximately 456 acres of vegetation (including 2 acres of riparian) would be lost for the 40-year project life, and a maximum of 664 acres would be temporarily disturbed for 4-7 years, depending upon revegetation success.

6.3 TRANSMISSION SYSTEM

Outside the NMGS boundary, approximately 88 acres of vegetation and associated production would be lost for at least the life of the project (40 years). A maximum of 5090 acres would be temporarily disturbed for 4-7 years, depending upon revegetation success.

6.4 SPECIAL STATUS SPECIES

No impacts to special status species can be predicted based on available information, although several species could be impacted, depending upon final location of centerlines relative to species distributions. Impacts identified by on-the-ground surveys can potentially be mitigated.

7.0 RELATIONSHIP BETWEEN THE SHORT-TERM USE OF THE AFFECTED ENVIRONMENT AND LONG-TERM PRODUCTIVITY

Areas where vegetation is removed for short-term construction purposes would be vulnerable to wind and water erosion, which could greatly reduce long-term productivity by reducing the site quality. Such long-term losses could be prevented by proper erosion control while the soil is bare, and by using well-designed revegetation plans. Soils stripped of vegetation for permanent project components would be substantially modified by earth moving. After the abandonment of the NMGS plant site, soil would be significantly changed by the addition of ash, clay, and gravel, by erosion of biologically active topsoil, or by extinction of soil microbes. Because of these factors, vegetation similar to that originally occupying the site may not be reestablished. But, because the site would be generally level and comprised on generally sandy soils, it should be possible to establish some kind of protective vegetation cover.

Another issue that could affect long-term productivity would be acid rain deposited on high-elevation granite landscapes northeast of NMGS. However, since baseline conditions for acid precipitation are unknown and because the potential for contribution to acid precipitation due to NMGS cannot be estimated, the effects on long-term productivity cannot be quantified.

8.0
IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Because vegetation is a renewable resource, no irreversible or irretrievable commitments are anticipated.

9.0
COMPARISON OF ALTERNATIVES

9.1 WATER SUPPLY SYSTEM

9.1.1 Proposed Versus Alternate Intake

The proposed intake location near Farmington would remove less riparian vegetation and cropland than the Bloomfield alternate.

9.1.2 Water Pipeline: Proposed P1 versus P2 and P3

The proposed P1 route would be the shortest (least total area disturbed), disturbs the least amount of riparian and agricultural land, and has the highest percent of its route in the shrublands-grasslands type. While P1 would cross only a few yards of riparian vegetation and no cropland, P2 would cross 0.1 mile of riparian vegetation and 8.9 miles of cropland irrigated by the NIIP project. P3 would cross 0.2 mile of riparian and irrigated cropland on the San Juan River floodplain.

Regarding T & E and special status species, all three routes have similar potential of affecting *Sclerocactus mesa-verdae* or *S. whipplei heilii*. No populations are known on the three routes at this time.

9.1.3 Reservoir

No meaningful differences in vegetation, rare species, or range values exist between the proposed and alternate reservoir locations.

9.2 TRANSMISSION SYSTEM

Alternate T4 would have the greatest impacts of the four corridors because it is the longest (disturbing the most area), and it is the only one that would disturb higher elevation habitats, which are relatively rare in the state. Corridor T4 may impact *Astragalus fucatus*, a special status species.

Proposed transmission routes T1 and T2 and alternate T3 are not significantly different. All three are similar lengths, affect similar totals of the four vegetation types crossed, and have similar potential impacts on special status species. Near their southern termini, T1, T2, and T3 could affect *Pediocactus papyracanthus*, *Mamillaria wrightii*, and *Abronia bigelovii*.

None of the four transmission corridors would cross irrigated or cultivated croplands. T4 would be the only corridor to cross forest land, but commercial value in this area is very low.

POSSIBLE NEW TOWN

7.3 TRANSMISSION SYSTEM

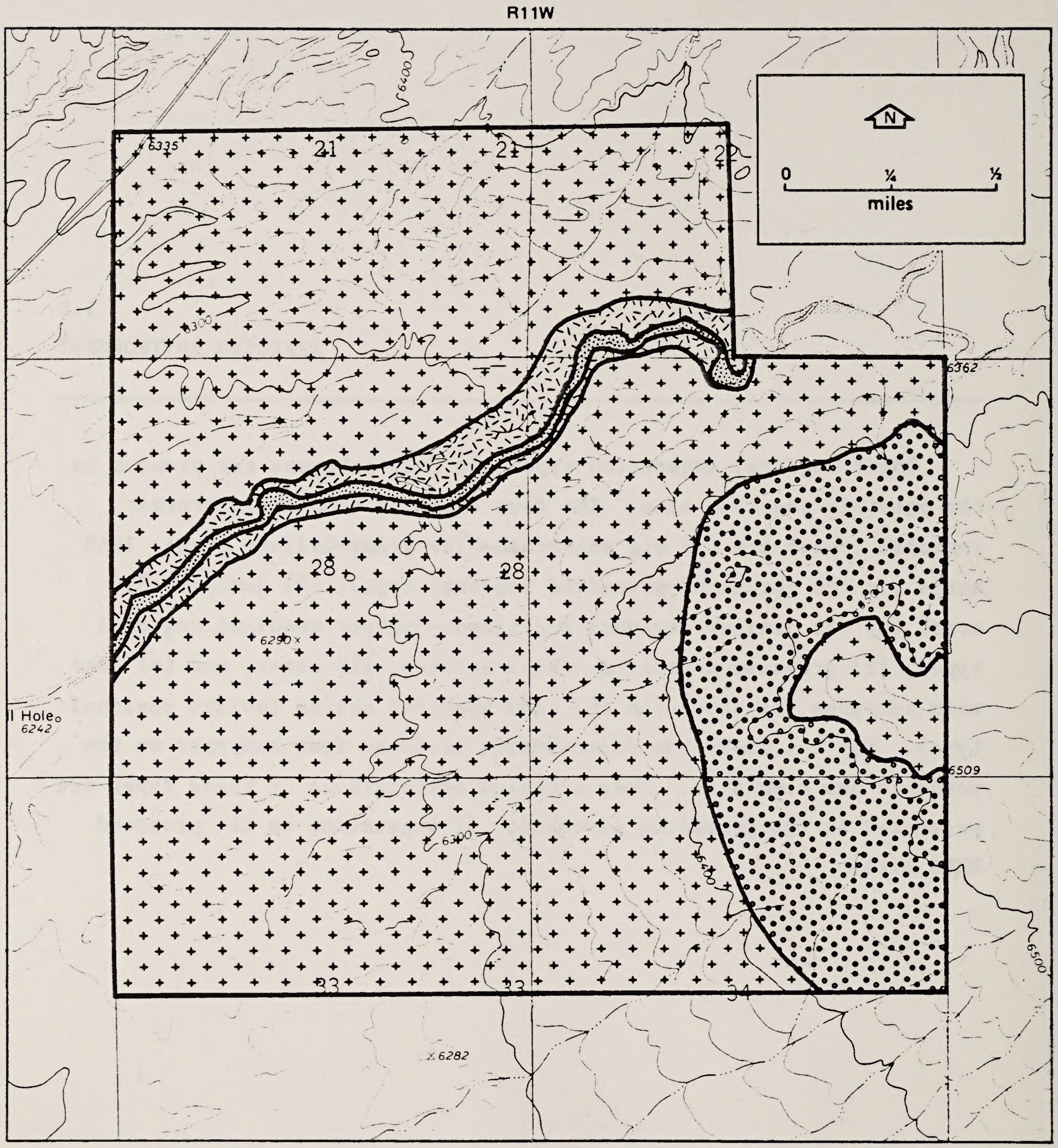
Alternate T4 would have the greatest impacts on the [illegible] corridor because it is the longest (traversing the most area), and it is the only one that would [illegible] which are relatively pure [illegible]. Alternate T4 may impact [illegible]

Proposed transmission routes T1 and T2 are adjacent to [illegible] not significantly different. [illegible] four [illegible] T4 would affect [illegible]

None of the [illegible] corridors would [illegible]. T4 would be the only corridor to cross [illegible] value in this area is very low.

1.0
AFFECTED ENVIRONMENT

Three regional vegetation types and four subtypes are present on the possible new town site. The four subtypes (and their broader, regional types) are (1) big sagebrush-blue grama-galleta grass, 1850 acres (in the shrubland-grassland regional type); (2) juniper, 399 acres (in the juniper savannas and pinyon-juniper woodland regional type); (3) greasewood-galleta-alkali sacaton, 117 acres; and (4) sand wash subtypes, 34 acres (in the sand wash and saline lowland regional type). Map 1-1 shows the distribution of these four subtypes on the possible new town site. More detailed descriptions of these types are presented in the preceding discussion of vegetation on the proposed NMGS site.



COMMUNITY TYPES

Source: Woodward-Clyde Consultants, September 1981

- Big sagebrush-blue grama-galleta
- Greasewood-galleta-alkali
- Sand wash
- Juniper

Map 1-1. VEGETATION OF THE POSSIBLE NEW TOWN SITE

2.0

ENVIRONMENTAL CONSEQUENCES

Direct effects of construction would include removal or damage to approximately 2400 acres of vegetation and increased erosion rates. Removal or damage to existing vegetation would not be considered significant because the vegetation types removed or damaged are common throughout the San Juan Basin and therefore do not constitute a unique resource. Construction activities that would remove vegetation from large areas of soil would also result in increased water and wind erosion in impacted areas. Erosion impacts of the possible new town should be compared against the relatively high background rate of natural soil movement in this area, and not against a zero erosion goal.

Indirect impacts would include physical damage to vegetation and soils from ORV use and foot traffic. Impacts would occur in areas with jeep trails and denuded slopes and banks. Typically, vegetation would be removed or greatly degraded in small, isolated areas by such use, rather than a general, extensive decline in condition. A second possible indirect impact would be the creation of small wetland areas along previously intermittent drainages made perennial by municipal water discharge. A third potential indirect impact would be the harvest of juniper for firewood. Since juniper is the only source of firewood in the area, adult trees could be locally eliminated by firewood collectors.

GLOSSARY

Acid precipitation - refers to precipitation with pH lower than 5.6. Precipitation is naturally somewhat acidic (with a pH of about 5.6) because of the dissolution of atmospheric carbon dioxide to form carbonic acid. Precipitation with a pH lower than 5.6 is indicative of pollutants other than CO_2 causing the acidity. Sulfuric, nitric and to a lesser extent, hydrochloric acid contribute to the lower pH values of acid precipitation. It is generally recognized that fossil fuel combustion forms precursors to acid precipitation, although its importance is not clear.

Alkaline (soil) - soil having a pH above 7.0, the opposite of acidic soils. While mildly alkaline soils (pH 7.2-8.2) containing calcium are typical of arid landscapes and relatively productive, strongly alkaline soils with a pH above 8.2 are a management problem due to low plant cover and productivity, poor soil structure, erosiveness, and sensitivity to physical disturbance.

Animal Unit Month (AUM) - the amount of forage required to sustain the following grazing equivalents for one month: one cow, .75 horse, one elk, five sheep, five goats, five deer, or five antelope.

Category 1 status review species - those (plant) species which are officially recognized by the U.S. Fish and Wildlife Service as high priority candidates for federal threatened and endangered status, but have not yet been formally proposed.

Category 2 status review species - species that are lower priority candidates for federal threatened and endangered listing than Category 1, due to lack of biological information.

Condition (ecological) - the present state of vegetation of a site in relation to the climax (natural potential) plant community for that site. It is an expression of the relative degree to which the kinds, proportions, and amounts of plants in a plant community resemble that of the climax plant community for the site. Condition is basically an ecological rating of the plant community.

For rangelands, Soil Conservation Service methodology is used to define and assess condition. Four classes are used to express the degree to which the composition of the present plant community reflects that of the climax. They are:

Range condition class	Percentage of present plant community that is climax for the range site
Excellent	76-100
Good	51-75
Fair	26-50
Poor	0-25

Cool season plant - a plant which makes the major portion of its growth during late winter, early spring, and again in the fall (during the cool season).

Cover - the proportion of the ground surface under live aerial parts of plants or the combined aerial parts of plants as viewed from directly overhead.

Endangered species - any species that is in danger of extinction throughout all or a significant portion of its range (PL 93-20-5, Endangered Species Act, 1973).

Ephemeral stream - a stream that flows only in direct response to precipitation in the immediate watershed or in response to the melting of a cover of snow and ice, and that has a channel bottom that is always above the local water table. Most of the drainages in the study area are ephemeral drainages.

Grazing capacity - the maximum livestock stocking rate possible without inducing damage to vegetation or related resources such as watershed. This incorporates such things as suitability of the range to grazing as well as proper use that can be made of each and all the plants within the area. Normally expressed in terms of acres per animal unit month (ac/AUM) or sometimes referred to as the total AUMs that are available in any given area such as an allotment. Areas that are unsuitable for livestock use are not computed in the grazing capacity. This may or may not be the same as the actual stocking rate.

Impact(s) - the effect(s) of a proposed or alternate project action upon some portion of the existing environment.

Intermittent stream - a stream running for longer periods than an ephemeral stream, but not perennial.

Mitigation - those measures taken to reduce or eliminate undesirable project impacts. Typically they include alterations in project design, construction, and habitat reconstruction.

Perennial stream - a stream or part of a stream that flows continuously during all of the calendar year as a result of ground-water discharge or surface runoff. This is in contrast to intermittent stream and ephemeral stream.

Production (biological) - the dry weight of organic matter created by living organisms in a specified unit area. For vegetation, this is typically expressed as grams per square meter, pounds per acre, etc. Productivity is a rate of production over time, typically per year.

Region of comparison - an arbitrary comparison area around project components, used to examine projected impacts in a broader environmental perspective. Defined as the area within a 20-mile-wide corridor centered on linear components (transmission lines or pipelines) or within a 10-mile radius of the NMGS boundary.

Riparian - relating to or living on the bank of a river or stream. Riparian vegetation can occur as isolated patches along larger intermittent streams, but in this area is usually found only along perennial streams and rivers. Riparian plants require a ground-water table within their root zones.

Saline soil - a non-sodic soil containing sufficient soluble salts to impair its productivity but not containing excessive exchangeable sodium. (This name was formerly applied to any soil containing sufficient soluble salts to interfere with plant growth.)

Site - (1) A specific location, such as "the NMGS site" or (2) a set of environmental conditions (in this report, a combination of soil and precipitation conditions that dictate which plants will survive" (e.g., "shallow, sandy site").

Special status species - plants rare in the study area and of management concern, but not designated in the U.S. Fish and Wildlife Service Section 7 threatened and endangered consultation process.

Threatened species - any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range (PL 93-205, Endangered Species Act, 1973).

Vegetation subtype - a more specific classification/inventory unit developed on site for more accurate inventory of the NMGS and New Town sites.

Vegetation type - the broadest, most general vegetation classification/inventory unit in this report. A total of six types are used to describe vegetation in the regions of comparison around all project components. Types are ecological, based not only on similarity of plant communities, but also on the land form, soil, and climatic features which control vegetation.

Warm-season grass - a grass that makes most of its growth from July to September, and is relatively inactive during the cooler parts of the growing season.

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