United States Department of the Interior
Bureau of Land Management

Winnemucca Field Office
Winnemucca, Nevada

January 2000

Draft Environmental Impact Statement Marigold Mine Expansion Project

BLM MISSION STATEMENT

The Bureau of Land Management is responsible for the stewardship of our public lands. It is committed to manage, protect, and improve these lands in a manner to serve the needs of the American people for all times.

Management is based upon the principles of multiple use and sustained yield of our nation's resources within a framework of environmental responsibility and scientific technology. These resources include recreation, rangelands, timber, minerals, watershed, fish and wildlife, wilderness, air and scenic, scientific, and cultural values.

BLM/WN/PL-00/003+1610

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
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U.S. Department of the Interior
1849•1999

In Reply Refer To:
1793/3809
(NV-932.8)
(NV-020)

February 11, 2000

Dear Reader:

Enclosed for your review and comment is the Draft Environmental Impact Statement for Glamis Marigold Mining Company's Marigold Mine, prepared by the Bureau of Land Management (BLM), Winnemucca Field Office.

The Draft Environmental Impact Statement is based on the plan of operations submitted to the BLM under 43 Code of Federal Regulations 3809. This Draft Environmental Impact Statement analyzes the direct, indirect and cumulative impacts associated with continued mining and expansion of the Red Rock and Top Zone pits, mining of two new pits (5-North and 8-North), new heap leach facility, heap leach pad expansion, new waste rock dumps, waste rock dump expansion, tailing impoundment and/or new tailing impoundment, miscellaneous ancillary facilities and exploration disturbance. The plan of operations and technical reports in support of the plan are available for review at the BLM office in Winnemucca.

The BLM is interested in your review and comment on the adequacy and accuracy of this document. Public comments will be accepted during a 60-day comment period. Written comments on the Draft Environmental Impact Statement must be postmarked by April 10, 2000, and should be sent to: **Gerald Moritz, EIS Project Manager, Bureau of Land Management, Winnemucca Field Office, 5100 E. Winnemucca Boulevard, Winnemucca, Nevada 89445.**

In addition, public meetings to accept verbal comments are scheduled for the following dates, times, and locations. <u>All meetings will start at 7:00 P.M.</u>

March 8, 2000	Battle Mountain Field Office, 50 Bastian Road, Battle Mountain, Nevada
March 9, 2000	Winnemucca Field Office, 5100 E. Winnemucca Blvd., Winnemucca, Nevada

A Final Environmental Impact Statement (FEIS) will be prepared that will consider the comments received during the public review and comment period. This FIS may be in an abbreviated format; therefore, you should retain this Draft as a reference. For additional information, please contact Gerald Moritz at the above address or at (775) 623-1500.

Sincerely,

Terry A. Reed

Terry A. Reed
Field Manager

DRAFT
ENVIRONMENTAL IMPACT STATEMENT
MARIGOLD MINE EXPANSION PROJECT

Lead Agency:	U.S. Department of the Interior Bureau of Land Management Winnemucca Field Office
Project Location:	Humboldt County, Nevada
Comments on this EIS Should be Directed to:	Gerald Moritz EIS Project Manager Bureau of Land Management Winnemucca Field Office 5100 East Winnemucca Blvd. Winnemucca, NV 89445 (775) 623-1500
Date Draft EIS Filed with EPA:	February 11, 2000
Date by Which Comments Must Be Received by the BLM:	April 10, 2000

ABSTRACT

Glamis Gold, Inc./Rayrock Mines, Inc., doing business as Glamis Marigold Mining Company (GMMC) proposes to construct new facilities and expand existing gold mining operations at the Marigold Mine in Humboldt County, Nevada. The mine is located on public and private lands near Interstate Highway 80 approximately 13 miles northwest of Battle Mountain and approximately 40 miles southeast of Winnemucca.

The proposed Marigold Mine Expansion Project would disturb approximately 462 acres of private land and 255 acres of BLM-administered public land, for a total of 717 acres. The proposed project would include: expansion of two pits and development of two new pits; expansion of two waste rock dumps and development of two new waste rock dumps; addition of lifts to three existing heap leach cells, addition of one cell to an existing leach pad, and development of a new heap leach facility; expansion of the tailings impoundment and construction of a new tailings impoundment; haul roads, solution ponds, growth media stockpiles, exploration drill pads and access roads, and diversion channels; and realignment of a public access road (Buffalo Valley Road) and power line. The Proposed Action would extend the mine operations an additional 5 years through 2006.

This draft environmental impact statement analyzes the environmental effects of the Marigold Mine Expansion Project, the 8-South Partial Pit Backfill Alternative, and the No Action Alternative.

Responsible Official for EIS:

Terry A. Reed
Field Office Manager
Winnemucca Field Office

SUMMARY

PROPOSED ACTION

Glamis Marigold Mining Company (GMMC) proposes to construct new facilities and expand existing gold mining operations in Humboldt County, Nevada. The mine is located on public and private lands near Interstate Highway 80 (I-80) approximately 13 miles northwest of Battle Mountain and approximately 40 miles southeast of Winnemucca, Nevada. GMMC has been operating the Marigold Mine since 1988. Historical mining in the proposed project vicinity dates back to 1927. To date, approximately 1,349 acres have been disturbed.

A Plan of Operations Amendment and Reclamation Plan for the proposed Marigold Mine expansion was submitted to the Bureau of Land Management (BLM) in August 1998. Current mine facilities consist of a series of pits, waste rock dumps, a heap leach pad and associated processing plant, a tailings impoundment, access and haul roads, and ancillary facilities. The proposed Marigold Mine Expansion Project would disturb approximately 462 acres of private land and 255 acres of BLM-administered public land, for a total of 717 acres. The proposed project would include: expansion of two pits and development of two new pits; expansion of two waste rock dumps and development of two new waste rock dumps; addition of lifts to three existing heap leach cells, addition of one cell to an existing leach pad, and development of a new heap leach pad; expansion of the tailings impoundment or construction of a new tailings impoundment; haul roads, solution ponds, growth media stockpiles, exploration drill pads and access roads, and diversion channels; and realignment of a public access road (Buffalo Valley Road) and power line. The Proposed Action would extend the mine operations an additional 5 years, through 2006. Reclamation and monitoring would continue through 2016.

ALTERNATIVES

This environmental impact statement (EIS) analyzes the direct, indirect, cumulative, and residual environmental impacts of the Proposed Action, 8-South Partial Pit Backfill Alternative, and the No Action Alternative. The alternatives are described in the following sections.

8-South Partial Pit Backfill Alternative

The 8-South Partial Pit Backfill Alternative would include the backfilling of the existing 8-South Pit with waste rock originating from the proposed 8-North Pit. This alternative would eliminate the need to construct the 8-North Waste Rock Dump (85 acres) thereby decreasing total disturbance to 632 acres.

No Action Alternative

Under the No Action Alternative, currently permitted operations at the Marigold Mine would cease after 2001, with final reclamation extending 10 years beyond closure. Additional minerals in the project area would remain undeveloped, and no construction or expansion of mine pits, waste rock dumps, heap leach pads, tailings impoundment, or other ancillary facilities would occur.

IMPORTANT ISSUES AND IMPACT CONCLUSIONS

A small number of issues were raised during scoping for this EIS. Public scoping meetings were held in Battle Mountain and Winnemucca, Nevada, on October 6 and 7, 1998, respectively. Additional issues were identified by resource specialists during the preparation of the EIS. These issues along with their impact conclusions are presented below. Impact conclusions include the implementation of mitigation measures that have been identified. These measures are presented in detail in Chapter 3.0 of this EIS for each affected resource.

Water Resources and Geochemistry

Issue: Formation of a pit lake as a result of mine development and impacts to wildlife from degraded water quality.

Conclusion: The construction and development of the 8-North Pit would not occur unless the price of gold is $400 per ounce or greater. If the pit is developed, it would only be mined to a depth that would not intercept groundwater; no pit lake would form. The 8-South Pit may have a 10-foot deep lake approximately 30 years after mining. If a pit lake forms, it would be seasonal and the water may contain elevated levels of arsenic and mercury.

Issue: Impacts to surface water and groundwater levels resulting from pit dewatering and groundwater use for mine operations.

Conclusion: Based on the evaluation of historic and current groundwater level data within the project vicinity, hydrologic impacts to springs or intermittent creeks located in the project vicinity are not anticipated. Springs and intermittent creeks located in the project vicinity would not be affected since the water source for the springs and intermittent creeks is not hydrologically connected with the bedrock aquifer. No pit dewatering is anticipated during mining. Water used for the proposed mine operations would be obtained from the Lone Tree Mine and supplemented with the water from water supply wells in the project vicinity. The source of water for the water supply wells is the bedrock aquifer, whereas the source of water for the springs and intermittent creeks is an alluvial aquifer and surface flows resulting from runoff.

Issue: Long-term stability of diversion channels.

Conclusion: The diversion channels would be designed and constructed to accommodate a 100-year storm event.

Issue: Degradation of surface water from heap leach expansion and tailings impoundment.

Conclusion: Perennial streams and springs do not exist within the project area. Intermittent creeks exist within the project area and convey water only during seasonal snowmelt or heavy precipitation events. Heap leach facilities and the tailings impoundment would be designed to contain potential contaminants (e.g., cyanide solution). These facilities would be closed systems with no release of solutions to areas outside the facilities. Therefore, no impacts to surface water are expected.

Issue: Degradation of groundwater quality.

Conclusion: Geochemical testing indicates that waste rock from the mine does not have a potential to generate acid seepage. Seepage from waste rock dumps may be elevated in arsenic and mercury, but would not be expected to reach groundwater due to the low permeability of the soil and the depth to groundwater (about 50 feet or greater). The current tailings remediation plan at the existing tailings impoundment is expected to reduce seepage to groundwater and keep any impacts to groundwater within State drinking water standards. A new tailings impoundment may be constructed if the 8-North and 5-North

Pit deposits are mined. This impoundment would be lined and would be a zero discharge facility.

Air Quality

Issue: Cumulative impacts to air quality.

Conclusion: The annual and 24-hour contributions from the mine sources would not cause the air quality in the region to degrade below National or State ambient air quality standards.

Vegetation Resources

Issue: Loss of wetland or riparian areas resulting from the construction of the diversion structures.

Conclusion: Wetlands or riparian areas would not be affected within or adjacent to the project area.

Issue: Potential long-term impacts to the Humboldt River and wetlands near its terminus.

Conclusion: The project area does not include perennial creeks or rivers. Therefore, no impacts to the Humboldt River or wetlands located adjacent to the river would be affected by mine expansion. Potential impacts to groundwater and surface water would be limited to the mine site and immediate vicinity.

Issue: Minimize the spread of noxious weeds.

Conclusion: GMMC has committed to the use of certified weed-free seed for reclamation and the control or eradication of any weed infestations during mine operation and reclamation.

Issue: Utilize native species in reclamation seed mixes.

Conclusion: The proposed seed mixes to be used during reclamation would consist primarily of native species. Native species would dominate the reclamation seed mix and non-native species would dominate the interim seed mix. These mixes were developed as a result of past and current revegetation studies and successful reclamation conducted at the mine site.

Issue: Reclamation of the proposed tailings impoundment.

Conclusion: GMMC has committed to reclaim the proposed tailings impoundment area after mining operations cease. After reclamation has been completed, the area would be monitored for several years to evaluate reclamation success.

Wildlife and Fisheries Resources

Issue: Wildlife habitat disturbed or lost.

Conclusion: No riparian habitat would be affected. Loss of upland habitat would not exceed 717 acres. The value of habitat lost would be low to moderate, due to the proximity of the project to past and present disturbances and activities and the availability of native habitats in the surrounding region. Approximately 656 acres of disturbed habitat would be reclaimed.

Issue: Loss of mule deer winter range.

Conclusion: A total of 717 acres of mule deer winter range would be removed for the life of the project.

Issue: Direct mortalities, habitat fragmentation, and animal displacement.

Conclusion: Direct mortalities would be limited. Incremental habitat fragmentation would occur and terrestrial wildlife would be displaced for the life of the project.

Issue: Impacts to resident and migratory birds.

Conclusion: Potential effects to breeding birds (e.g., passerines, raptors) could occur from incremental habitat loss, disturbance to nesting habitat, and increased noise and human presence, particularly from mine exploration activities. These impacts would be minimized by the applicant committed protection measures. Effects to upland game birds would be minor, based on relative habitat value, bird species occurrence, and committed protection measures.

Issue: Measures to prevent wildlife exposure to cyanide solutions on heaps, in solution channels, and ponds should be developed.

Conclusion: Potential impacts from cyanide ingestion would be low, since bird netting would be installed over the solution ponds.

Special Status Species

Issue: Potential impacts to special status species.

Conclusion: With the exception of sensitive bat species, no sensitive plant or wildlife species would be affected. The implementation of the committed environmental protection measures would minimize impacts to sensitive bats.

Range Resources

Issue: Loss of available grazing land and interference in ranch management activities resulting from the construction of the range perimeter fence.

Conclusion: Construction of the range perimeter fence would remove 5,762 acres of rangeland available for grazing resulting in the temporary loss of 288 animal unit months. A permanent loss of 6 animal unit months would result after mine reclamation.

Issue: Construction of the diversion structures may affect water available for livestock.

Conclusion: Segments of Trout and Cottonwood Creeks located within the project area have intermittent flows and are used by livestock as seasonal water sources. The construction of the diversion structures would alter the configuration of these creeks. However, these creeks would still be available for seasonal use by livestock during mine operation. In addition, Ames and Mud springs are located within the general vicinity of the intermittent creeks and would continue to provide water sources for livestock during mine operation.

Land Use and Access

Issue: Proposed realignment of the Buffalo Valley Road and responsibility for long-term maintenance.

Conclusion: Construction and maintenance of the proposed road realignment would be coordinated with Humboldt County and the BLM.

Issue: Proposed realignment of the power line and coordination of construction activities with Sierra Pacific Power Company (SPPCo).

Conclusion: If realignment is required, GMMC would pursue ROW applications with SPPCo and the BLM.

Issue: Increased traffic on haul and access roads.

Conclusion: Average daily traffic volumes on local roadways, including I-80, are not expected to change significantly from current levels as a result of the proposed project.

Issue: Legality of mine claims within the project area.

Conclusion: GMMC complies with the BLM Instruction Memorandum No. 98-154, as the proposed mine expansion would not exceed the legal limit of 5 acres of mill site claims for each associated lode claim.

Aesthetics (Visual and Noise Resources)

Issue: Visual contrasts with elements of the characteristic landscape in exceedence of BLM Visual Resource Management (VRM) objectives.

Conclusion: The Proposed Action and the 8-South Partial Pit Backfill Alternative would result in moderate contrasts with existing forms, lines, and textures of the characteristic environment as a result of the construction of the new heap leach facility and expansion of the waste rock dumps. These contrasts would exceed VRM objectives during the life of mining. If proposed reclamation efforts were successful, visual contrasts would be reduced to acceptable levels within 10 years of the reclamation period.

Cultural Resources, Ethnography, and Paleontology

Issue: Direct physical disturbance of cultural resources or traditional use sites that are listed on or are eligible to the National Register of Historic Places or are protected under state or other Federal statutes.

Conclusion: Environmental protection measures involving cooperation between GMMC, the BLM, the State Historic Preservation Officer, and the Advisory Council on Historic Preservation would be implemented if cultural resources are discovered or affected during construction or operation activities. Based on the protection measures, proper steps would be taken to evaluate the quality of the resource, to determine whether the loss is acceptable, and to mitigate losses that are not acceptable. Known sites in the project area would be avoided by mining and exploration activities. No traditional use sites have been identified in the mine area.

Issue: Impacts to significant paleontological resources.

Conclusion: Significant fossil-bearing formations have not been identified in the project area to date. Committed environmental protection measures designed to reduce impacts to previously unidentified paleontological resources that may be located during the mine expansion would be implemented.

AGENCY-PREFERRED ALTERNATIVE

In accordance with the National Environmental Policy Act, Federal agencies are required by the Council on Environmental Quality (40 Code of Federal Regulations 1502.14) to identify their preferred alternative for a project in the Draft EIS, if a preference has been identified, and in the Final EIS prepared for the project. The preferred alternative is not a final agency decision; it is rather an indication of the agency's preliminary preference. The alternative identified below is the BLM's preferred alternative at the Draft EIS stage in the environmental review process. This preference may be changed based on the agency and public comments that are received on this Draft EIS. As indicated above, an agency-preferred alternative also will be presented in the Final EIS. The BLM's preference at this time considers all information that has been received and reviewed relevant to the proposed project. The agency-preferred alternative is the 8-South Partial Pit Backfill Alternative as described in the EIS with all appropriate mitigation.

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1.0 INTRODUCTION

Glamis Gold, Inc./Rayrock Mines, Inc., doing business as Glamis Marigold Mining Company (GMMC), has submitted a *Plan of Operations* (POO) *Amendment and Reclamation Plan (No. N26-88-005P)* for the Marigold Mine Expansion Project (MMC 1998) to the Winnemucca Field Office of the Bureau of Land Management (BLM). GMMC prepared the amended plan for review and approval by the Nevada Department of Environmental Protection (NDEP) and the BLM. GMMC also is operating under Reclamation Permit (No. 0108), Water Pollution Control Permit (NEV88040), and the Air Quality Operating Permit (AP1041-0158).

GMMC proposes to construct new facilities and expand existing gold mining operations in Humboldt County, Nevada. The existing mining operation consists of multiple open pits and precious metal processing facilities, which are located approximately 3 miles south of Valmy, Nevada (Maps 1-1 and1-2). The mine is located on public and private lands approximately 13 miles northwest of Battle Mountain and approximately 40 miles southeast of Winnemucca. GMMC has been operating the Marigold Mine since 1988.

1.1 Mine History

Mining activities began in the project area in 1927 when three claims were staked. The area covered by these claims would later be named the Marigold Mine. Three additional claims were staked in the general vicinity of the Marigold Mine in 1930. In 1936, these claims were purchased by The Marigold Mines, Incorporated, and additional claims were staked in the mine vicinity in 1940.

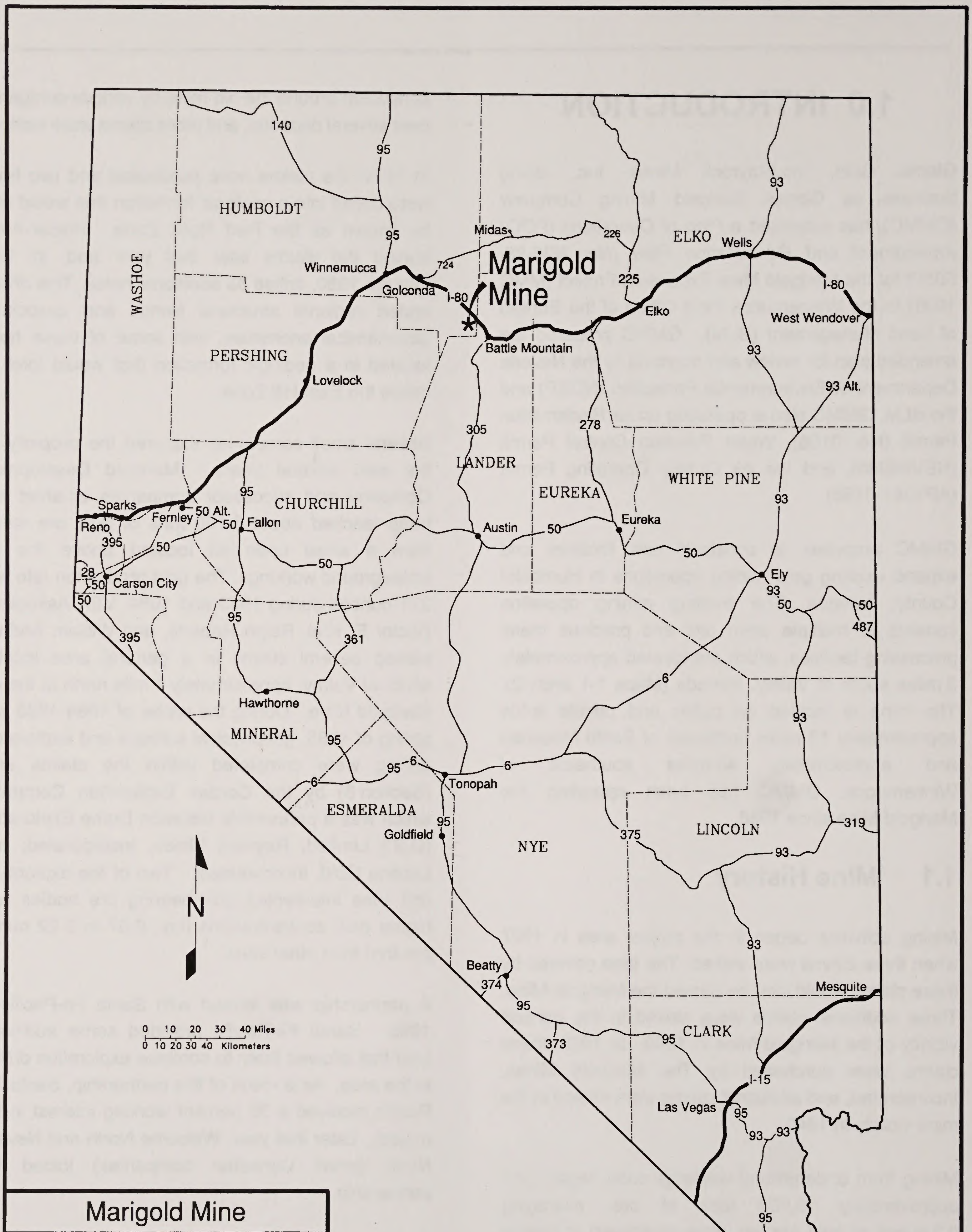
Mining from underground workings soon began, and approximately 10,000 tons of ore, averaging 0.2 ounce of gold per ton, were processed at nearby smelters until operations ceased during World War II. The claims were held by a number of different owners after 1943. Sporadic exploration activities were conducted around the old mine by various companies over several decades, and more claims were staked.

In 1979, the claims were purchased and two holes were drilled into a geologic formation that would later be known as the Red Rock Zone. Placer-Amex leased the claims later that year and, in 1979 through 1980, drilled 38 additional holes. This drilling tested regional structural trends and associated geochemical anomalies, with some of these holes located in a geologic formation that would later be called the East Hill Zone.

Several small companies explored the property for the next several years. Marigold Development Company and successor companies crushed and heap leached about 3,100 tons of gold ore mined from a small open pit located above the old underground workings. The gold production rate was 271 ounces during 1983 and 1984. VEK Associates (Victor E. Kral, Ralph Roberts, and William Andrus) staked several claims in a general area located south of Valmy, approximately 1 mile north of the old Marigold Mine. During the winter of 1984-1985 and spring of 1985, geophysical surveys and exploratory drilling were completed within the claims area (Section 8) by the Cordex Exploration Company, which was a partnership between Dome Exploration (U.S.) Limited; Rayrock Mines, Incorporated; and Lacana Gold, Incorporated. Two of the exploration drill sites intersected gold-bearing ore bodies with higher gold concentrations (i.e., 0.07 to 0.22 ounce per ton) than other sites.

A partnership was formed with Santa Fe-Pacific in 1986. Santa Fe-Pacific provided some additional land that allowed them to continue exploration drilling in the area. As a result of this partnership, Santa Fe-Pacific received a 30 percent working interest in the project. Later that year, Welcome North and Nevada North (small Canadian companies) joined the partnership.

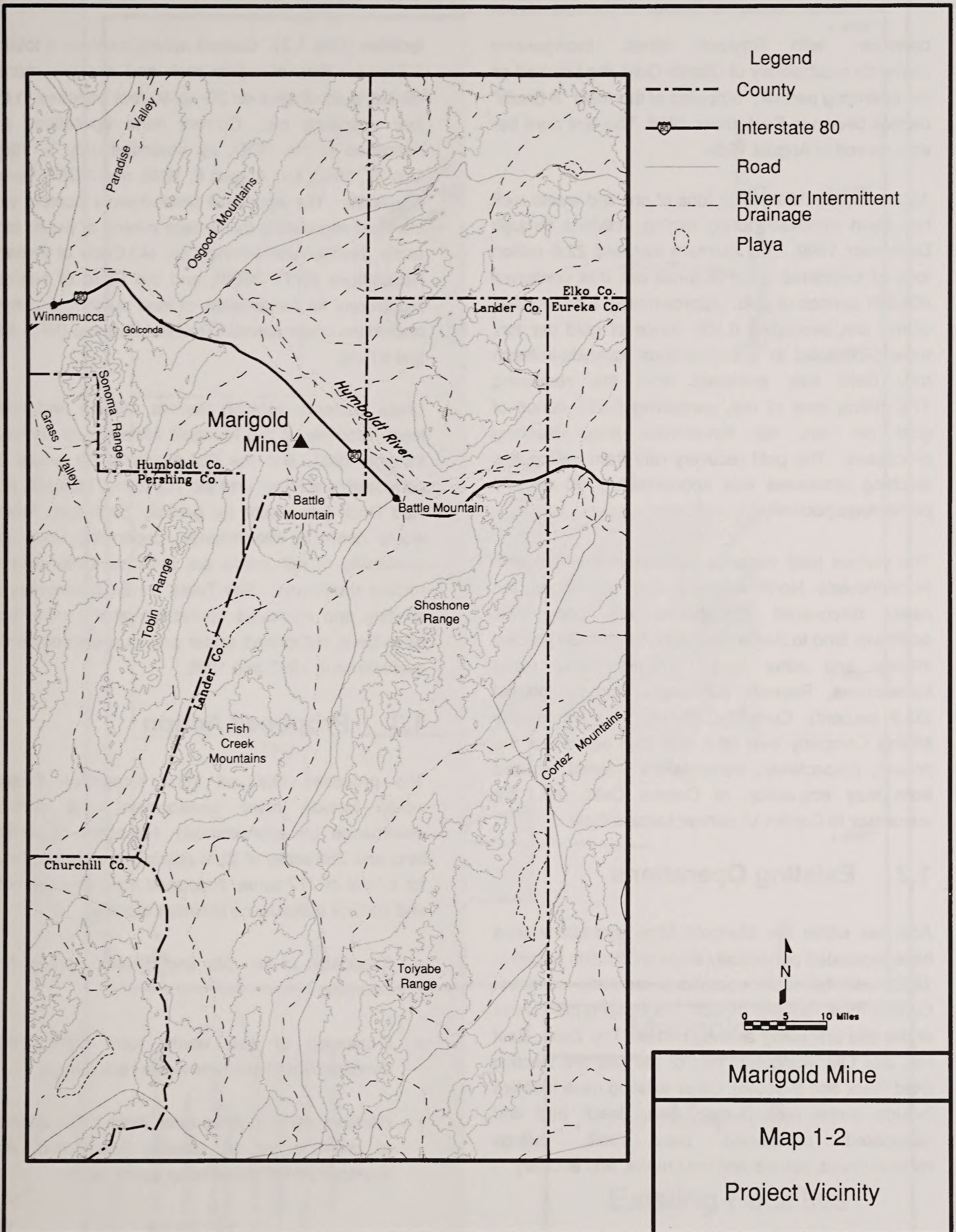
Following additional drilling and completion of a feasibility study, the decision was made in March 1988 to develop a mine and mill/heap leach



Marigold Mine

Map 1-1

Project Location


Legend
County
Interstate 80
Road
River or Intermittent Drainage
Playa
Paradise Valley
Osgood Mountains
Winnemucca
Golconda
Sonoma Range
Grass Valley
Marigold Mine
Humboldt River
Humboldt Co.
Pershing Co.
Battle Mountain
Battle Mountain
Elko Co.
Lander Co.
Eureka Co.
Tobin Range
Shoshone Range
Lander Co.
Fish Creek Mountains
Cortez Mountains
Churchill Co.
Toiyabe Range
N
0 5 10 Miles
Marigold Mine
Map 1-2
Project Vicinity

operation, with Rayrock Mines, Incorporated (currently a subsidiary of Glamis Gold, Inc.) named as the operating partner. Stripping of the main "8 South" deposit began in September 1988. The first doré bar was poured in August 1989.

Approximately 124 million tons of ore and waste rock has been removed during mining activities through December 1999. This estimate included 22.6 million tons of combined leach-plus-mill ore that contained 905,981 ounces of gold. Approximately 5 million tons of mill ore, averaging 0.108 ounce of gold per ton, were processed in a conventional cyanide-in-leach mill. Gold was extracted from the remaining 17.6 million tons of ore, containing 0.021 ounce of gold per ton, via run-of-mine heap leaching processes. The gold recovery rate from milling and leaching processes was approximately 90 and 70 percent, respectively.

The various joint ventures purchased the Welcome North/Nevada North interests and exchanged the newly discovered Stonehouse ore body plus additional land to Santa Fe-Pacific for their 30 percent interest and other lands. Shortly after these transactions, Rayrock purchased Dome's interest (33.3 percent). Currently, GMMC and Homestake Mining Company own 66.7 and 33.3 percent of the project, respectively. Homestake's interest resulted from their acquisition of Corona Gold, Inc., the successor to Cordex VI partner Lacana Gold.

1.2 Existing Operations

Activities within the Marigold Mine operations area have expanded periodically since production began in 1988, and full-scale operations currently continue. Current mine facilities include five existing pits. Three of the pits are being actively mined (Top Zone, East Hill, and Old Marigold). Two of the pits are inactive (Red Rock and 8-South). Other existing mine facilities include waste rock dumps, heap leach pad and associated processing plant, mill, tailings impoundment, access and haul roads, and ancillary facilities (Map 1-3). Current mining involves a total of 1.7 million tons of waste rock and ore per month; mining is conducted on 20- to 40-foot benches in the four operating pits. Current mine operations are described in the POO, as amended July 3, 1997, May 27, 1998, and August 6, 1998, and *NDEP Permit No. 0069*. The approved amendments comply with the BLM regulations for surface mining of public land under the General Mining Law (43 Code of Federal Regulations [CFR] 3809), and the State of Nevada regulations for reclamation of land subject to mining operations under Nevada Revised Statutes (NRS 445 and 519A).

Under currently existing permits, mining and heap leach activities at the Marigold Mine would continue through 2001, and the Old Marigold Pit would be completely backfilled and the Top Zone, East Hill, and Red Rock pits would be partially backfilled. Milling would continue intermittently, depending upon the availability of mill grade ore and the scheduling of routine shutdowns. See Table 1-1 for a summary of existing and approved operations at the mine that have been authorized under previous environmental evaluations in 1997 and 1998.

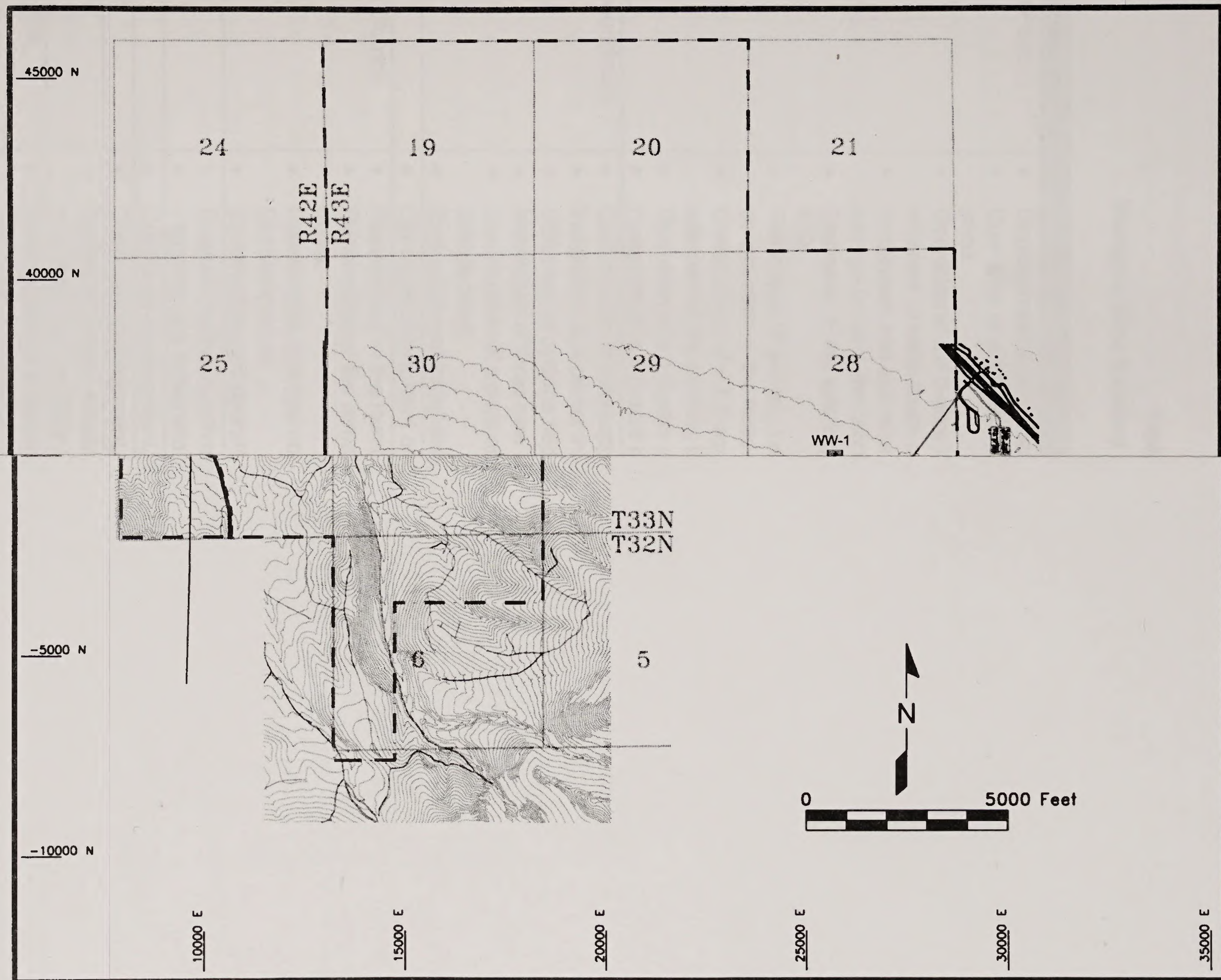
1.3 Proposed Action

The proposed Marigold Mine Expansion Project would include mine development and surface disturbance on approximately 462 acres of private land and 255 acres of BLM-administered public land, for a total of 717 acres. Proposed mine development and surface disturbance activities include:

- Expansion of two pits and development of two new pits;
- Expansion of two waste rock dumps and development of two new waste rock dumps;
- Addition of lifts to three heap leach cells, addition of one cell to an existing leach pad, and development of a new heap leach facility;

LEGEND

- GROWTH MEDIA STOCKPILES
- PROCESS FACILITIES
- FACILITIES, HAUL ROADS, "INFILL" AREAS, ETC.
- SURFACE WATER DIVERSIONS
- GMMC PROPERTY LINE
- EXISTING PERMIT BOUNDARY
- WW FRESH WATER SUPPLY WELL



Marigold Mine

Map 1-3

Existing Facilities

operation, with Rayrock Mines, Incorporated (currently a subsidiary of Glamis Gold, Inc.) named as the operating partner. Stripping of the main "8 South" deposit began in September 1988. The first doré bar was poured in August 1989.

Approximately 124 million tons of ore and waste rock has been removed during mining activities through December 1999. This estimate included 22.6 million tons of combined leach-plus-mill ore that contained 905,981 ounces of gold. Approximately 5 million tons of mill ore, averaging 0.108 ounce of gold per ton, were processed in a conventional cyanide-in-leach mill. Gold was extracted from the remaining 17.6 million tons of ore, containing 0.021 ounce of gold per ton, via run-of-mine heap leaching processes. The gold recovery rate from milling and leaching processes was approximately 90 and 70 percent, respectively.

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1.2 Existing Operations

Activities within the Marigold Mine operations area have expanded periodically since production began in 1988, and full-scale operations currently continue. Current mine facilities include five existing pits. Three of the pits are being actively mined (Top Zone, East Hill, and Old Marigold). Two of the pits are inactive (Red Rock and 8-South). Other existing mine facilities include waste rock dumps, heap leach pad and associated processing plant, mill, tailings impoundment, access and haul roads, and ancillary facilities (Map 1-3). Current mining involves a total of 1.7 million tons of waste rock and ore per month; mining is conducted on 20- to 40-foot benches in the four operating pits. Current mine operations are described in the POO, as amended July 3, 1997, May 27, 1998, and August 6, 1998, and *NDEP Permit No. 0069*. The approved amendments comply with the BLM regulations for surface mining of public land under the General Mining Law (43 Code of Federal Regulations [CFR] 3809), and the State of Nevada regulations for reclamation of land subject to mining operations under Nevada Revised Statutes (NRS 445 and 519A).

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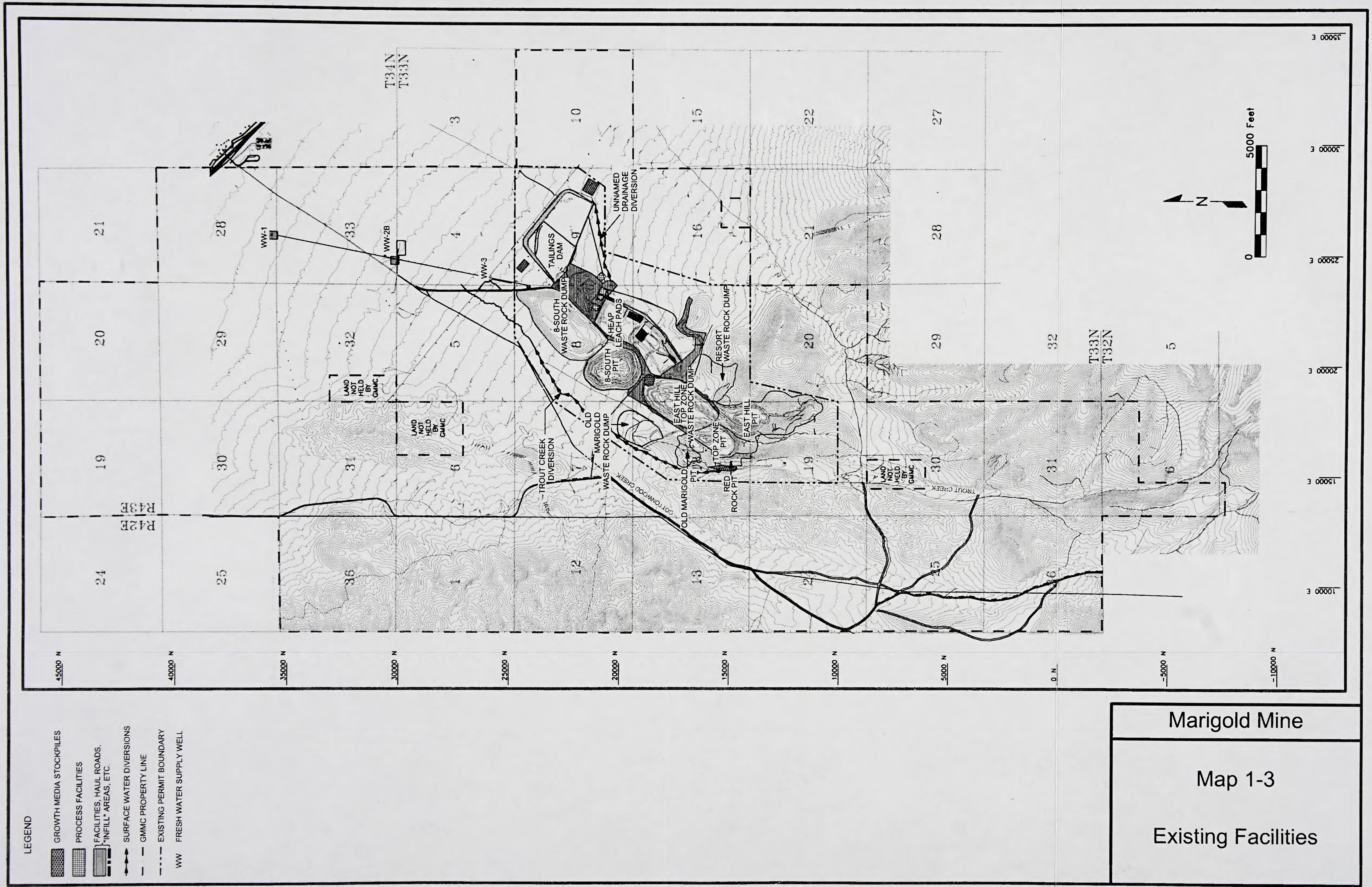
1.3 Proposed Action

The proposed Marigold Mine Expansion Project would include mine development and surface disturbance on approximately 462 acres of private land and 255 acres of BLM-administered public land, for a total of 717 acres. Proposed mine development and surface disturbance activities include:

- Expansion of two pits and development of two new pits;
- Expansion of two waste rock dumps and development of two new waste rock dumps;
- Addition of lifts to three heap leach cells, addition of one cell to an existing leach pad, and development of a new heap leach facility;



Marigold Mine

Map 1-3

Existing Facilities

Table 1-1
Marigold Mine Existing and Approved Facilities

Mine Component	Activity
Heap Leach Pads	• Ongoing operation of heap leach cell #3 and all other cells. • Operation of a 1.0-acre storm water pond, adjacent to the existing pregnant pond. • Operation of a 0.6-acre hydrocarbon-contaminated soils bioremediation facility, adjacent to heap leach cell #8. • Installation and operation of an overflow diversion ditch from the storm water storage pond to the tailings pond. • Extension of the existing heap leach pad by approximately 20 acres; cells #9 and #10. • Relocation of existing Leach Pad Monitoring Ports No. 9 and No. 10, prior to construction of the heap leach extension. • Construction of a 1.5-acre heap leach detoxification rinse water storage pond adjacent to the existing barren pond. • Operation of a 1.5-acre pregnant pond. • Operation of a 1.5-acre barren pond.
Tailings Impoundment	• Construction of interceptor ditches at base of tailings dam on disturbed ground. • Installation of a center interior berm with a ring dike water reclaim system. • Utilization of cyclone separators to segregate tailings fractions in the pond. • Installation of three new monitoring ports, TDOH No. 18, 19, & 20. • Construction of a permanent containment dike on the southeast side of the tailings pond. • Evaluation and installation of an in-situ tailings dewatering well.
Mill	• Continued intermittent or continuous operation of mill.
Waste Rock Dumps	• Reclamation of the lower tier of Top Zone waste rock dump. • Reclamation of the remaining 27 acres of disturbance on the 8-South waste rock dump. • Construction and operation of an approximate 55-acre waste rock dump at the Old Marigold pit. • Construction and operation of an approximate 70-acre Resort waste rock dump.
8-South Pit	• Gradual decline in active mining operations. • Sampling and exploration activities to be conducted in 1997 through 2001.
East Hill Pit	• Continued development, with possible partial backfilling of the northern portion.
Top Zone Pit	• Continued development, with possible partial backfilling of the northern portion.
Red Rock Pit	• Continued limited development, with backfilling of the northern portion with waste rock from the Top Zone and Red Rock (south) pits.
Old Marigold Pit	• Development of a 24-acre pit to be subsequently backfilled with waste rock from Top Zone pit development.
Ancillary Facilities	• Topsoil stockpiles - 20 acres at various locations. • Haul roads - 60 acres throughout the project area. • Water supply system - 3 water supply wells and the Lone Tree Water Line. • Exploration - continued exploration and ore body delineation. • Miscellaneous facilities - 3.6 acres

- Expansion of the existing tailings impoundment, construction of a second tailings impoundment, expansion of haul roads, two solution ponds, growth media stockpiles, exploration drill pads and access roads, and diversion channels; and

- Realignment of a public access road (Buffalo Valley Road) and a power line.

The Proposed Action would extend the mine operations an additional 5 years, through 2006. This environmental impact statement (EIS) is prepared in compliance with the National Environmental Policy Act (NEPA), and in accordance with BLM Handbook H-1790-1 and Nevada State Office Instruction Memorandum NV-90-435 on analysis of cumulative impacts.

This EIS considers the quality of the human environment based on the physical impacts to public and private lands that may result from mining activities at the Marigold Mine. The proposed mining activities located on public lands are subject to review and approval by the BLM pursuant to the Federal Land Policy and Management Act of 1976 (FLPMA) and subsequent surface management regulations (43 CFR, Subpart 3809). These activities and their approval by the BLM pursuant to the FLPMA constitute a Federal action and are thus subject to NEPA. The BLM has determined that the proposed project constitutes a major Federal action and that an EIS would be necessary to fulfill NEPA requirements. The BLM-Winnemucca Field Office is the Federal lead agency.

1.4 Purpose of and Need for the Proposed Action

GMMC proposes to expand mining operations at the Marigold Mine for the purpose of extracting economically recoverable gold reserves known to exist adjacent to existing pit areas in an environmentally compatible manner. GMMC has identified the following economically driven project objectives:

- Expand processing facilities within the project area to maintain the current rate of production;

- Extract economically recoverable gold that exists in the project area;

- Operate and reclaim the project area in an efficient, environmentally conscientious, and safe manner; and

- Meet or exceed Federal, state, and local regulations for the protection of human health and safety and the environment.

The project need is reflected by the demand for gold identified in national and global markets.

1.5 Relationship to BLM and Non-BLM Policies, Plans, and Programs

The BLM has the authority and responsibility to manage the surface and subsurface resources on public lands within its charge. GMMC's use of public land in the Winnemucca District requires conformance with BLM's surface management regulations (43 CFR 3809), as well as various statutes, including the FLPMA, as amended. The BLM must review GMMC's plans for development to ensure the following:

- Adequate provisions are included to prevent unnecessary or undue degradation of Federal lands and to protect the non-mineral resources of the Federal lands;

- Measures are included to provide for reclamation of disturbed areas; and

- Compliance with applicable state and Federal laws is achieved.

The BLM's Sonoma-Gerlach Resource Area Management Framework Plan contains no constraints that conflict with the Proposed Action. Management activities for the Proposed Action area are identified as livestock grazing, wildlife habitat, and recreation. Mineral resource development conforms with the Resource Area Management Framework Plan, which states: "Make public lands and Federally owned minerals available for the exploration and development of mineral and material commodities."

BLM has reviewed GMMC's POO relative to the legal limitation on millsite claim acreages, per BLM Instruction Memorandum (IM) No. 98-154 (August 17, 1998). GMMC complies with the IM, as the proposed mine expansion would not exceed the legal limit of 5 acres of millsite claims for each associated lode claim. All GMMC mining claims are lode claims. Lode claims within the GMMC property are described in Table 1-2, and mining claim locations are presented in Map 1-4.

1.6 Authorizing Action

A Notice of Intent (NOI) to prepare the EIS was published in the Federal Register on August 31, 1998. The NOI invited public scoping comments to be sent to the BLM through November 16, 1998. Public meetings were held in Battle Mountain and Winnemucca, Nevada. A total of 5 members of the public attended the Battle Mountain meeting on October 6, and 12 members of the public attended the Winnemucca meeting on October 7. Comments recorded during these meetings are available in the BLM's Winnemucca Field Office. Eight written comment letters were received by the BLM within the public comment period. One additional comment letter was received on December 18, 1998.

In addition to the EIS, implementing the proposed project or alternatives would require authorizing actions from other Federal, state, and local agencies with jurisdiction over certain aspects of the proposed project. Table 1-3 lists the required permits or approvals and the responsible regulatory agency.

1.7 Organization of the Environmental Impact Statement

This EIS follows the Council on Environmental Quality (CEQ) recommended organization (40 CFR 1508.9): Chapter 1.0 provides descriptions of the Proposed Action, relevant history of the project vicinity, purpose of and need for the Proposed Action, the environmental review process, applicable regulatory requirements and coordination, and organization of the EIS; Chapter 2.0 describes the Proposed Action and alternatives; Chapter 3.0 describes the affected environment, environmental consequences, cumulative impacts, mitigation and monitoring, and residual adverse impacts; Chapter 4.0 summarizes consultation and coordination for preparation of the EIS; Chapter 5.0 presents the list of preparers and reviewers; and Chapter 6.0 is a list of references. Copies of supporting documents are on file in the BLM's Winnemucca Field Office and the BLM Nevada State Office in Reno.

Table 1-2
Mining Claims Summary

Name Of Claim	BLM Serial Number	Owner	Owned/ Leased	Location
Bonz 1 Bonz 3 Bonz 5 Bonz 7 Bonz 9-18 Bonz 21-30 Rebonz 2 Rebonz 4 Rebonz 6 Rebonz 8 Rebonz 19-20 Rebonz 31 Rebonz 32	371610 371612 371614 371616 371618- 371627 371630- 371639 487422 487423 487424 487425 487426- 487427 487428 524363	Roby Exploration Company	Owned	T33N, R42E, Sec. 12
Mary 1-36	358968- 359003	Roby Exploration Company	Owned	T33N, R43E, Sec. 4
Mary 73-90 HS 123-134, 134A	359040- 359057 400277- 400289	Roby Exploration Company	Owned	T34N, R43E, Sec. 28
Private	N/A	Newmont Gold Corporation	Leased	T33N, R43E, Sec. 5, 6, 7, 13, 25, 31
Private	N/A	Newmont Gold Corporation	Leased	T34N, R43E, Sec. 13, 29, 31, 33
Cot 37-72 Cot Fractions 1-9	275732- 275767 361164- 361172	VEK/Andrus Associates	Leased	T33N, R43E, Sec. 8
Cot 73-76 Cot 75A-76A	342068- 3452071 371559- 371560	VEK/Andrus Associates	Leased	T32N, R43E, Sec. 6
Cot 1-36	271972- 272007	VEK/Andrus Associates	Leased	T33N, R42E, Sec. 36
Private	N/A	Roby Exploration Company	Owned	T33N, R43E, Sec. 9
Remary 237-272 Remary Fraction	454876- 454911 552228	Roby Exploration Company	Owned	T33N, R43E, Sec. 16
Private	N/A	Roby Exploration Company	Owned	T33N, R43E, Sec. 17
Red 1801A-1834A	678030- 678063	Donald Decker and Suzanne Decker	Leased	T33N, R43E, Sec. 18
Private	N/A	University of Nevada, Reno	Leased	T33N, R43E, Sec. 19
Red 39-50 Red 201-224	56187- 56198 271665- 271668	Donald Decker and Suzanne Decker	Leased	T33N,R43E, Sec. 20

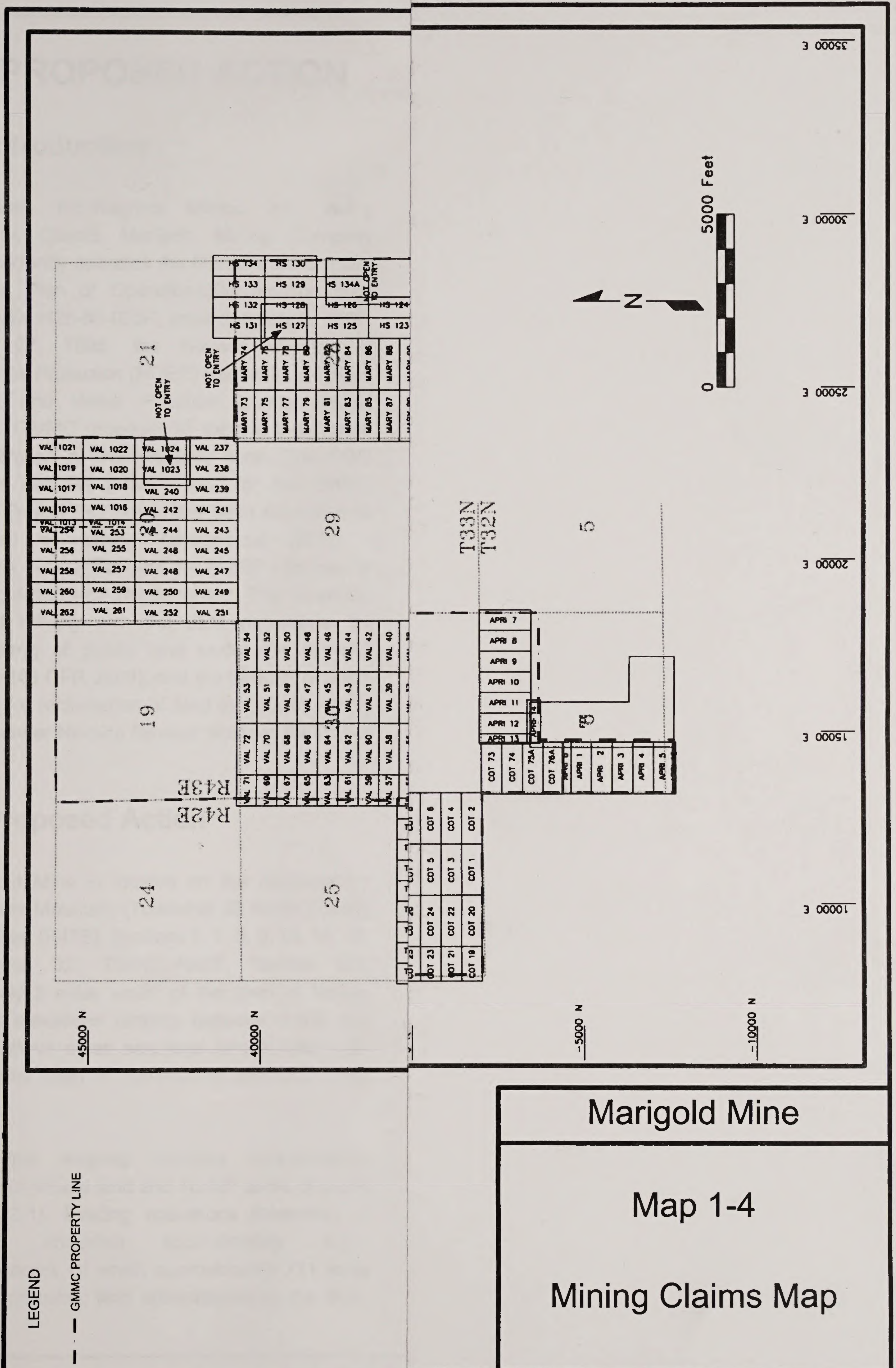
Table 1-2 (Continued)

Name Of Claim	BLM Serial Number	Owner	Owned/ Leased	Location
Red 21-38 Red 52-69 Red 23A and 24A	48409-48426 56199-56216 552226-552227	Donald Decker and Suzanne Decker	Leased	T33N, R43E, Sec. 30
Red 601-628	271689-271716	Donald Decker and Suzanne Decker	Leased	T33N, R43E, Sec. 6
Kit 1-36	365642-365677	Donald Decker and Suzanne Decker	Leased	T33N, R42E, Sec. 24
Private	N/A	Roby Exploration Company	Newmont Owned	T33N, R43E, Sec. 31
Apri 1-13 Apri 14 Apri 15	371561-371573 519580 552229	Roby Exploration Company	Owned	T32N, R43E, Sec. 6
Val 37-72	297572-297607	VEK/Andrus Associates	Leased	T34N, R43E, Sec. 30
Val 237-262 Val 1013-1024	361136-361161 600391-600402	Roby Exploration Company	Owned	T34N, R43E, Sec. 20
Val 1-18 Val 19-31	297554-297571 347463-347475	VEK/Andrus Associates	Leased	T34N, R43E, Sec. 32
SAR 37-72	373649-373684	Euro-Nevada Mining Corporation, Inc.	Leased	T33N, R43E, Sec. 10
Tyler 1-36	371574-371609	Roby Exploration Company	Owned	T34N, R42E, Sec. 36

N/A = Not applicable.

Table 1-3
Major Permits and Approvals Required for the Marigold Mine Expansion Project

Permit/Approval	Granting Agency
Approval of Plan of Operations, Rights-of-Way Permits	Bureau of Land Management
Clean Water Act Section 404 Permit	U.S. Army Corps of Engineers
Explosives Permit	Bureau of Alcohol, Tobacco, and Firearms
Air Quality Operating Permit	Nevada Department of Conservation and Natural Resources, Division of Environmental Protection, Bureau of Air Quality
Surface Disturbance Permit (Air Quality)	Nevada Department of Conservation and Natural Resources, Division of Environmental Protection, Bureau of Air Quality
Water Pollution Control Permit	Nevada Department of Conservation and Natural Resources, Division of Environmental Protection, Bureau of Mining Regulation and Reclamation
Reclamation Permit	Nevada Department of Conservation and Natural Resources, Division of Environmental Protection, Bureau of Mining Regulation and Reclamation
Permit to Appropriate Water and to Construct Impoundments	Nevada Department of Conservation and Natural Resources, Division of Water Resources
Industrial Artificial Pond Permits	Nevada Department of Conservation and Natural Resources, Division of Wildlife
Solid Waste Mining Site Class III Waiver	Nevada Department of Conservation and Natural Resources, Division of Environmental Protection, Bureau of Solid Waste
General Discharge Permit (Storm Water, Septic Systems)	Nevada Department of Conservation and Natural Resources, Division of Environmental Protection, Bureau of Water Pollution Control
Hazardous Materials Storage Permit	State of Nevada, Fire Marshal Division
EPA ID Number	U.S. Environmental Protection Agency
Liquefied Petroleum Gas License	Nevada Board for the Regulation of Liquefied Petroleum Gas
Radioactive Material License	Nevada State Health Division
Radio Station License	Federal Communications Commission
Special Use Permit	Humboldt County Regional Planning Commission



Marigold Mine

Map 1-4

Mining Claims Map

Table 1-3
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Surface Disturbance Permit (Air Quality)	Nevada Department of Conservation and Natural Resources, Division of Environmental Protection, Bureau of Air Quality
Water Pollution Control Permit	Nevada Department of Conservation and Natural Resources, Division of Environmental Protection, Bureau of Mining Regulation and Reclamation
Reclamation Permit	Nevada Department of Conservation and Natural Resources, Division of Environmental Protection, Bureau of Mining Regulation and Reclamation
Permit to Appropriate Water and to Construct Impoundments	Nevada Department of Conservation and Natural Resources, Division of Water Resources
Industrial Artificial Pond Permits	Nevada Department of Conservation and Natural Resources, Division of Wildlife
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Hazardous Materials Storage Permit	State of Nevada, Fire Marshal Division
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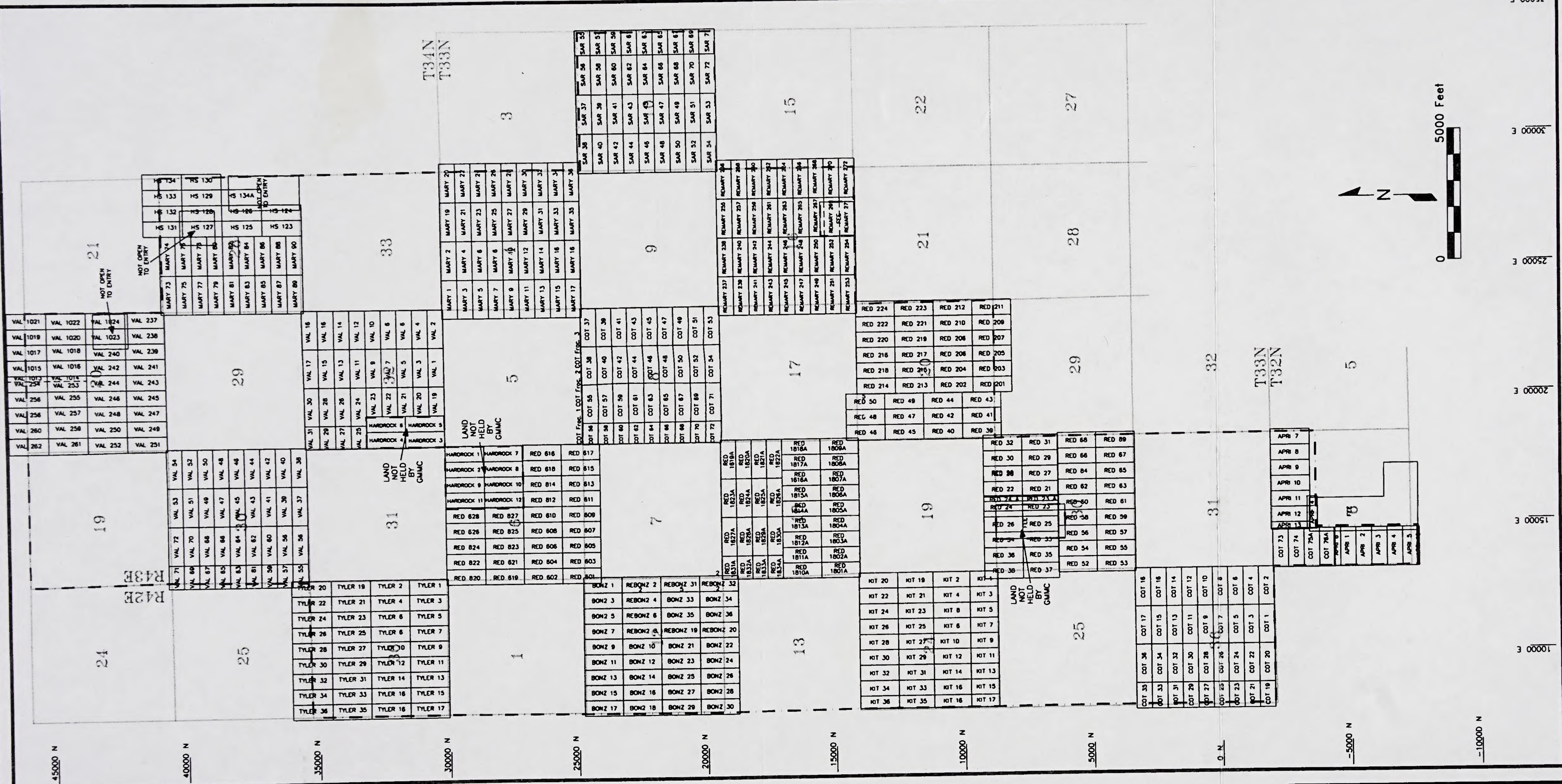
Liquefied Petroleum Gas License	Nevada Board for the Regulation of Liquefied Petroleum Gas
Radioactive Material License	Nevada State Health Division
Radio Station License	Federal Communications Commission
Special Use Permit	Humboldt County Regional Planning Commission



Marigold Mine

Map 1-4

Mining Claims Map

LEGEND

— — GMMC PROPERTY LINE

2.0 PROPOSED ACTION

2.1 Introduction

Glamis Gold, Inc./Rayrock Mines, Inc., doing business as Glamis Marigold Mining Company (GMMC), currently operates the Marigold Mine under the existing Plan of Operations/Reclamation Plan (POO/RP) No. N26-88-005P, amended July 3, 1997, and May 27, 1998; the Nevada Division of Environmental Protection (NDEP) Reclamation Permit No. 0108; and Water Pollution Control Permit NEV88040. GMMC proposes to expand the current mining operation at the Marigold Mine. The POO Amendment and RP (MMC 1998) for the GMMC Expansion Project has previously been submitted to the Bureau of Land Management (BLM) - Winnemucca Field Office and the NDEP - Bureau of Mining Regulation and Reclamation. The amended plan would comply with the BLM regulations for surface mining of public land under the General Mining Law (43 CFR 3809), and the State of Nevada regulations for reclamation of land subject to mining operations under Nevada Revised Statutes (NRS 445 and 519A).

2.2 Proposed Action

The Marigold Mine is located on the northwestern flank of Battle Mountain (Township 33 North [T33N], Range 43 East [R43E], Sections 5, 7, 8, 9, 16, 17, 18, 19, 20, and 32; T34N, R43E, Section 32), approximately 3 miles south of the town of Valmy, Nevada, at elevations ranging between 4,600 and 5,800 feet above mean sea level (amsl) (Map 1-2). The mine has been in commercial operation since 1988.

GMMC's total property includes approximately 8,320 acres of private land and 10,480 acres of public land (Map 2-1). Existing operations (described in Section 1.2) comprise approximately 1,349 disturbance acres, of which approximately 711 acres are located on public land administered by the BLM, and approximately 638 acres are on private land (see Table 2-1). There is no State of Nevada-administered property within the project area of operations. However, there is private land owned by the University of Nevada, Reno, a state institution. Surface disturbance of that land is included in the private land category.

The proposed Marigold Mine Expansion Project would disturb approximately 462 acres of private land and 255 acres of BLM-administered public land, for a total of 717 acres (see Table 2-2). The proposed project would include expansion of two pits and development of two new pits; expansion of two waste rock dumps and development of two new waste rock dumps; addition of lifts to three existing heap leach cells, addition of one cell to an existing leach pad, and development of a new heap leach facility; expansion of the existing tailings impoundment; and construction of a second tailings impoundment; construction of haul roads, solution ponds, growth media stockpiles, exploration drill pads and access roads, diversion channels; and realignment of a public access road (Buffalo Valley Road) and power line. The Proposed Action would extend the mine operations a maximum of 5 years through 2006.

This proposed disturbance represents the ultimate footprint of each facility based on $400/ounce gold. However, all pits, except the proposed 8-North Pit, have reserves that can be economically recovered at less than $400/ounce gold prices. Therefore, the actual disturbance for all of the facilities is likely to be less than proposed unless gold prices rebound, as the 134 acres associated with the proposed 8-North Pit and waste rock dump would not be feasible with gold prices below $400/ounce.

A summary of the existing and proposed surface disturbance is presented in Tables 2-1 and 2-2, respectively. The layout of the existing facilities is illustrated in Map 1-3. Surface ownership is presented in Map 2-1, and the layout of proposed facilities is illustrated in Map 2-2.

Table 2-1
Acres of Existing Permitted Disturbance

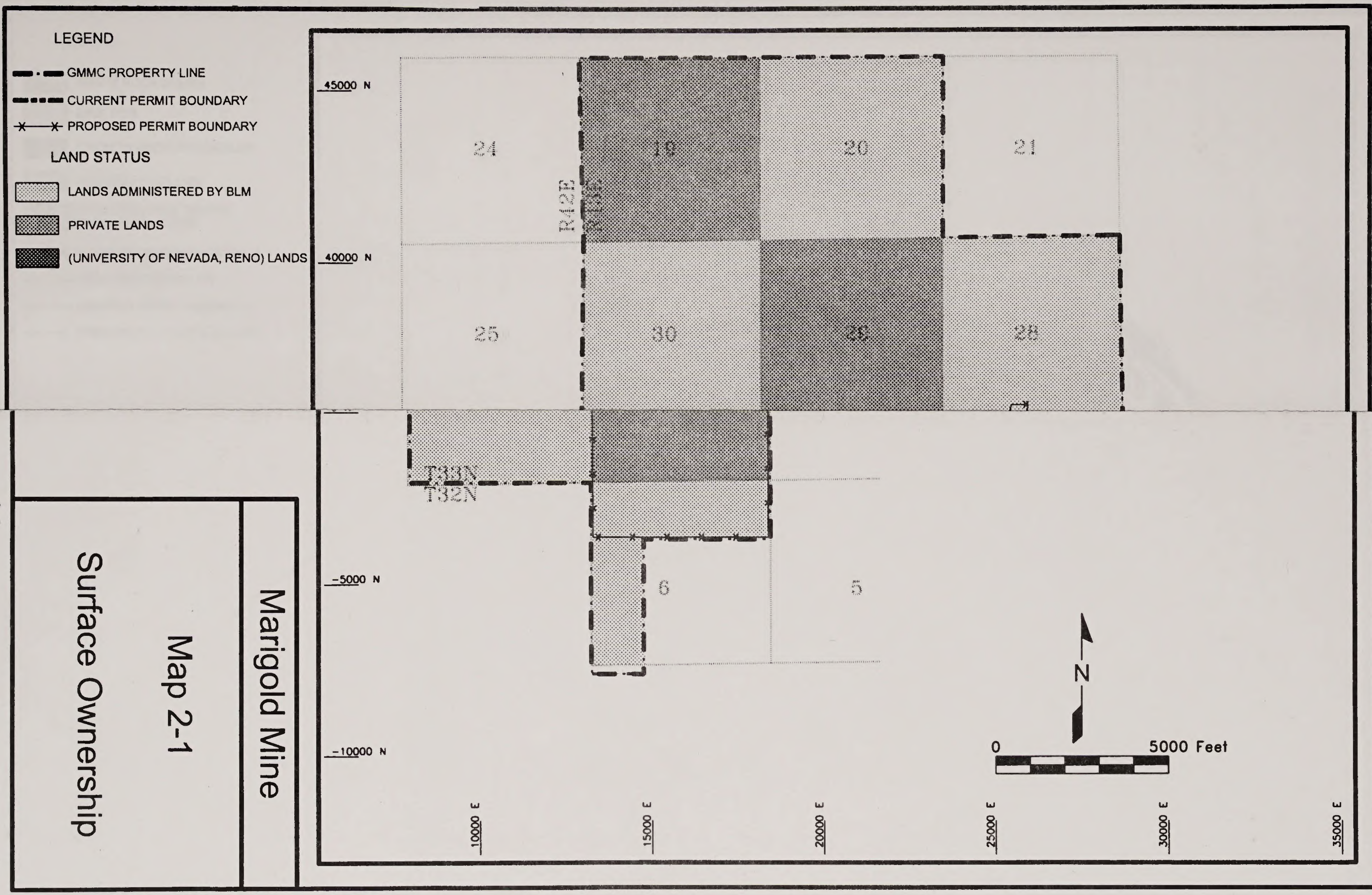
Facility	Public Land	Private Land	Total
Pits	272	132	404
Waste Rock Dumps	292	148	440
Heap Leach Pads	56	74	130
Crushing/Mill/Plant Facilities	35	17	52
Tailings Impoundment	0	180	180
Process Ponds	5	0	5
Storm Water Ponds	1.5	1.5	3
Growth Media Stockpiles	5	15	20
Haul Roads/Access Roads	22	38	60
Water Supply System	4	9	13
Diversion Ditches/Creek Diversions	~0.1	3	3
Exploration Drill Pads and Roads	17	20	37
"Infill"/Miscellaneous Areas	1.5	0.5	2
Total Disturbance	711	638	1,349

Table 2-2
Estimated Acres of New Disturbance Under the Proposed Action

Facility	Public Land	Private Land	Total
Pits	52	79	131
Waste Rock Dumps	120	164	284
Heap Leach Pads	0	78	78
Crushing/Milling/Plant Facilities	0	1	1
Tailings Impoundment	0	54	54
Process Ponds	0	2	2
Storm Water Ponds	0	3	3
Growth Media Stockpile	5	23	28
Haul Roads/Access Roads	14	14	28
Diversion Ditches/Creek Diversions	14	17	31[1]
Exploration Drill Pads and Roads[2]	0	5	5
"Infill"/Miscellaneous Areas	50	22	72
Total Disturbance	255	462	717

[1]Total acreage is based on the following: 5N Cottonwood Creek – 10 acres; SW Heap Diversion – 13 acres; and 8N Trout Creek – 8 acres.

[2]Exploration disturbance locations have not yet been precisely determined, but the majority is anticipated to occur on private land.



Marigold Mine

Map 2-1

Surface Ownership

Table 2-1
Acres of Existing Permitted Disturbance

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[1]Total acreage is based on the following: 5N Cottonwood Creek – 10 acres; SW Heap Diversion – 13 acres; and 8N Trout Creek – 8 acres.

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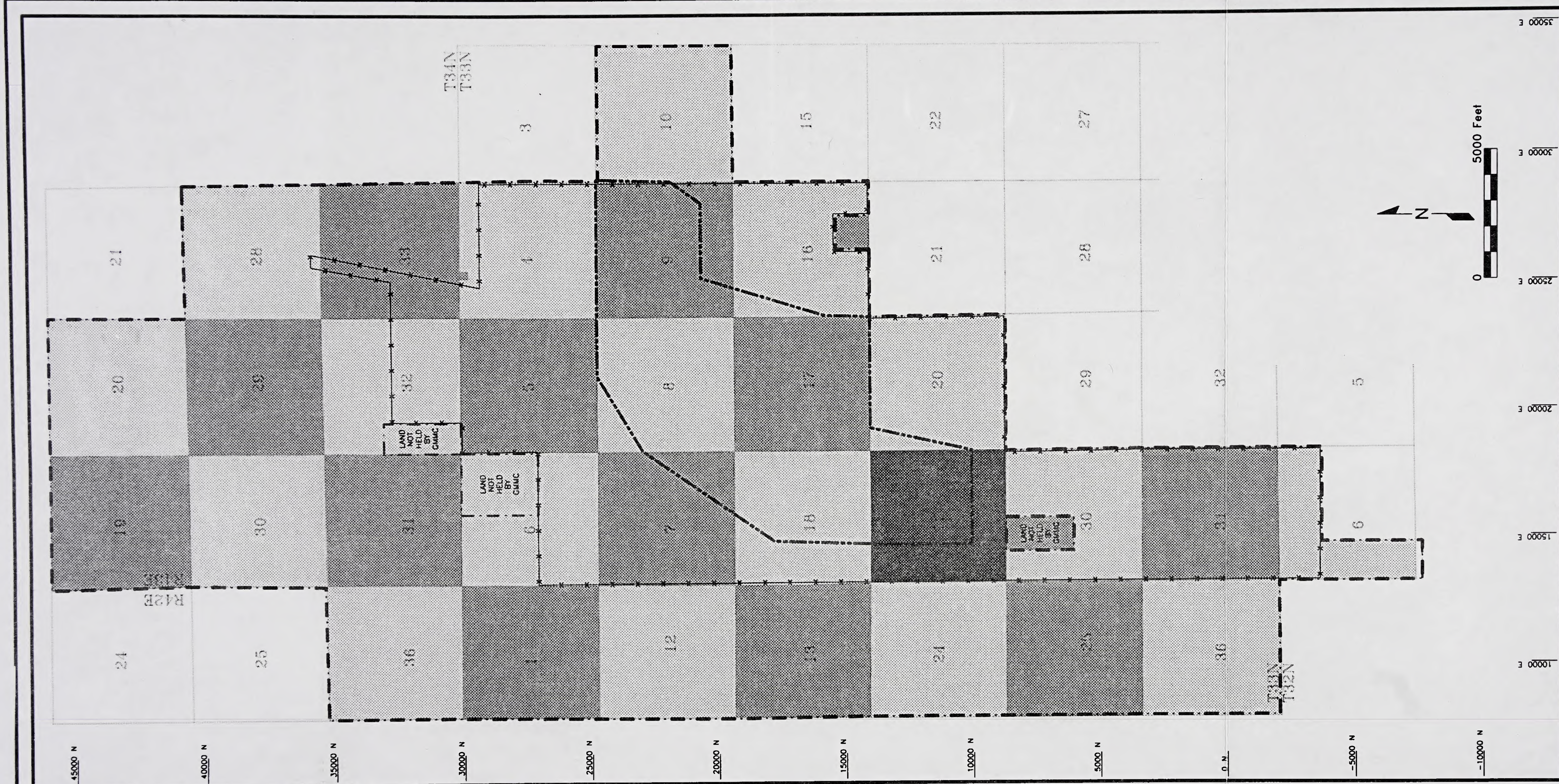
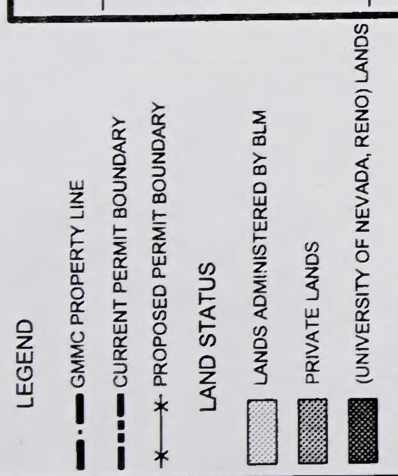
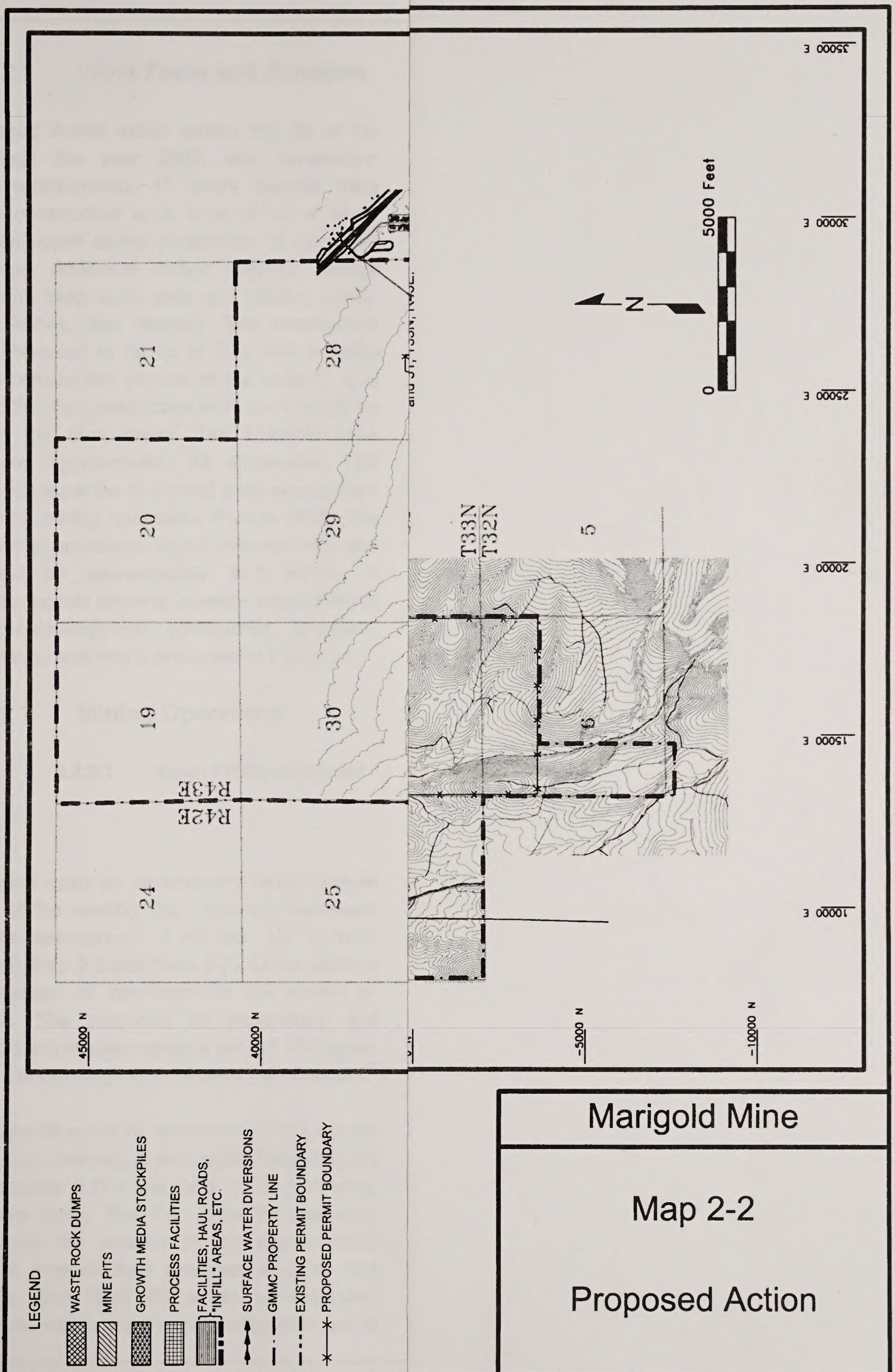




Marigold Mine

Map 2-1

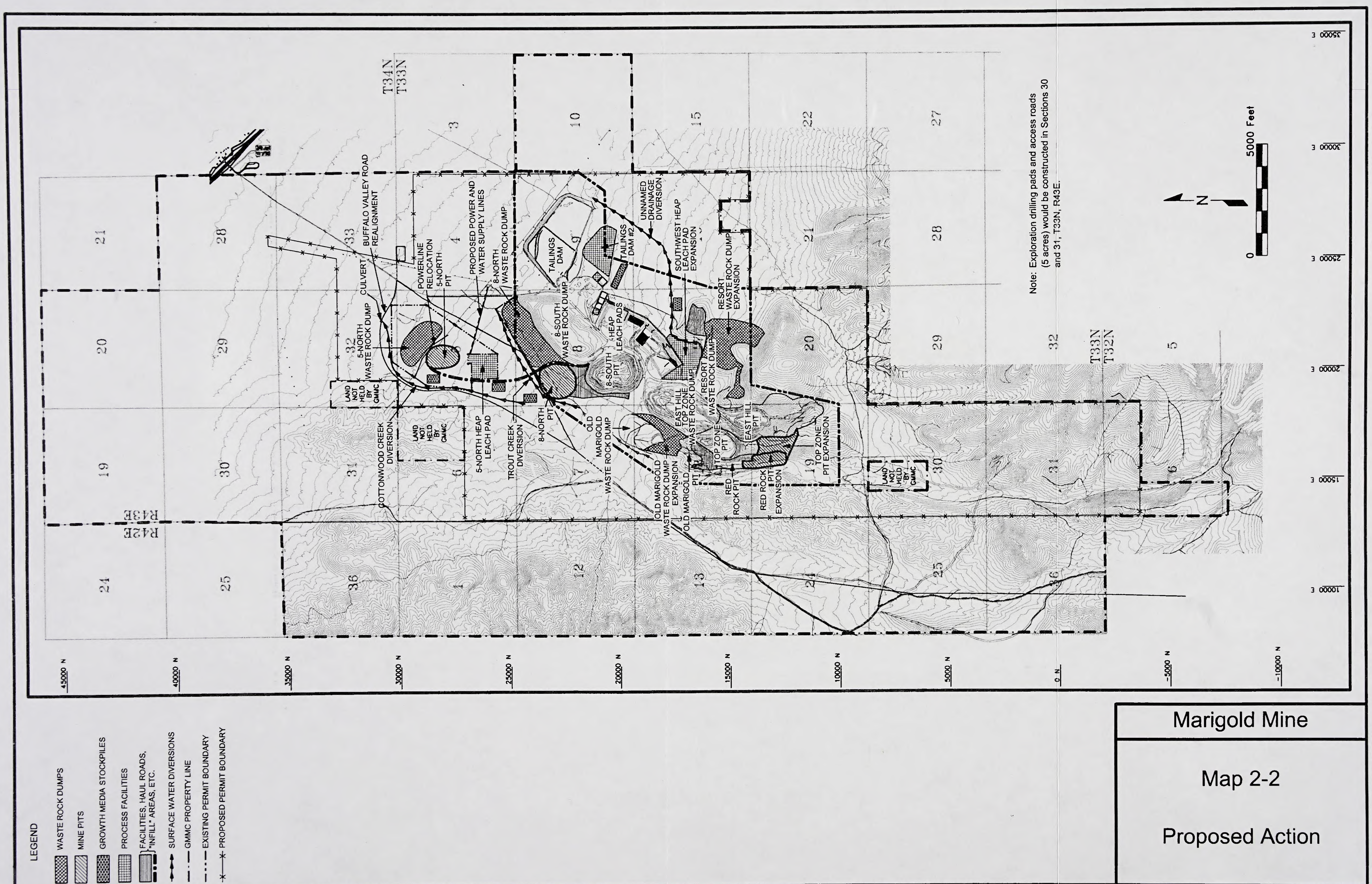
Surface Ownership



Marigold Mine

Map 2-2

Proposed Action



Marigold Mine

Map 2-2

Proposed Action

2.2.1 Work Force and Schedule

The Proposed Action would extend the life of the mine through the year 2006, with reclamation extending approximately 10 years beyond mine closure. A construction work force of 30 or fewer would be employed during construction of expanded facilities (e.g., additional carbon columns, tailings impoundment, heap leach pads and solution ponds, diversion ditches, and fences). The construction payroll is estimated to be up to $288,000 annually during the construction phases of the project. It is anticipated that the construction work force would be hired from the local areas. The Marigold Mine currently has approximately 83 employees. This number is not expected to exceed peak employment of 113 during mining operations through 2006. The average annual operations payroll between 1999 and 2006 would be approximately $4.5 million. A conceptual schedule showing possible sequencing of principal pre-development, construction, operation, and reclamation activities is presented in Figure 2-1.

2.2.2 Mining Operations

2.2.2.1 Open Pit Development

Open Pits

The proposed open pit development would include expansion of the existing Top Zone and Red Rock pits and the development of two new pits (5-North and 8-North) (Map 2-2 and Table 2-2). Cross sections of the proposed pit developments are shown on Figure 2-2. The proposed pit expansions and development would encompass a total of 131 acres. Pit benches would range from 20 to 40 feet in width.

The Top Zone Pit would be expanded 29 acres to the south. The final dimensions and depth of the pit would be approximately 4,770 feet long, 1,100 feet wide, and 760 feet deep. The Top Zone Pit expansion would deepen the existing pit by approximately 60 feet to a final pit floor elevation of 4,740 feet (amsl). The Red Rock Pit would be expanded 24 acres to the south. The final pit configuration would be approximately 1,400 feet long, 800 feet wide, and 420 feet deep. The Red Rock Pit expansion would deepen the existing pit by 120 feet to a final pit floor elevation of 4,980 feet (amsl).

Development of the proposed 5-North Pit would result in a surface disturbance of 29 acres. The pit would be located approximately 0.5 mile north of the existing operation. The maximum pit dimensions and depth would be approximately 1,500 feet long, 850 feet wide, and 280 feet deep, with a final pit floor elevation of 4,450 feet (amsl). The proposed 8-North Pit would be located just north of the existing 8-South Pit and would result in a surface disturbance of 49 acres. The proposed pit would have maximum dimensions of 1,940 feet long, 1,900 feet wide, and 420 feet deep. The final pit floor elevation would be approximately 4,480 feet (amsl). The development of the 8-North Pit would be dependent on gold prices being at or above $400 per ounce.

Drilling and blasting procedures currently implemented for pit development at GMMC's existing operation also would be utilized for pit development under the Proposed Action. Ore and waste rock would be drilled on approximately 14-foot centers using diesel-powered rotary hammer drills. The drill holes would be charged with an ammonium nitrate/fuel oil mixture by means of a truck-mounted mixing/dispensing unit. Blasting would occur during the daylight hours and would be in compliance with applicable safety standards. Usually, one blast would occur each day at mid-day or late afternoon. Material would be mined on 20- to 40-foot benches. Unconsolidated gravels and growth media that do not require drilling and blasting would be ripped with a dozer, as required, for removal. Slope angles in the open pits would range from 34 to 55 degrees depending on the pit and specific locations within the pit.

2.2.2.2 Surface Water Diversions

Diversions of Trout Creek, Cottonwood Creek, and one unnamed drainage would be required under the

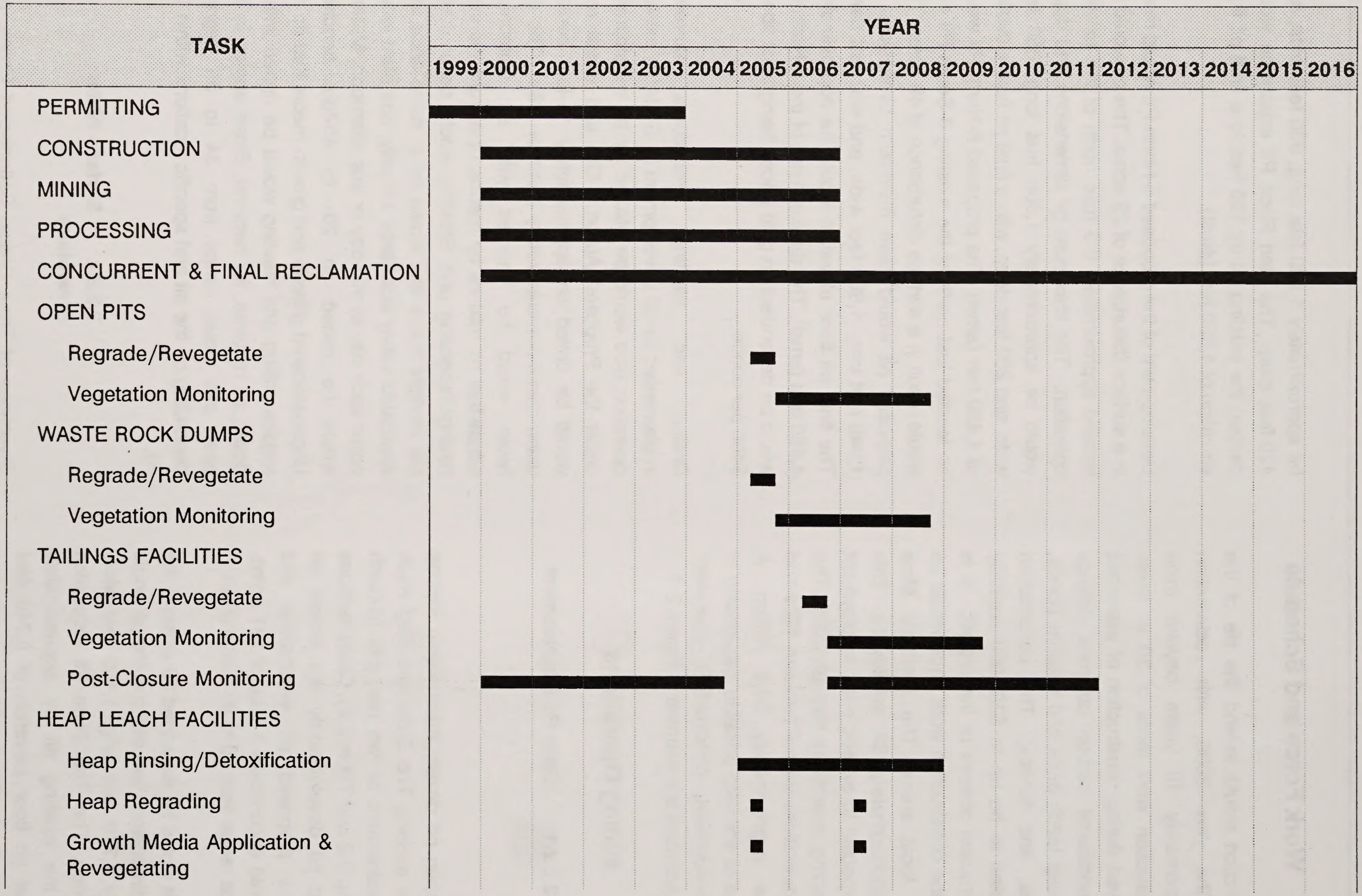


Figure 2-1. Project Schedule.

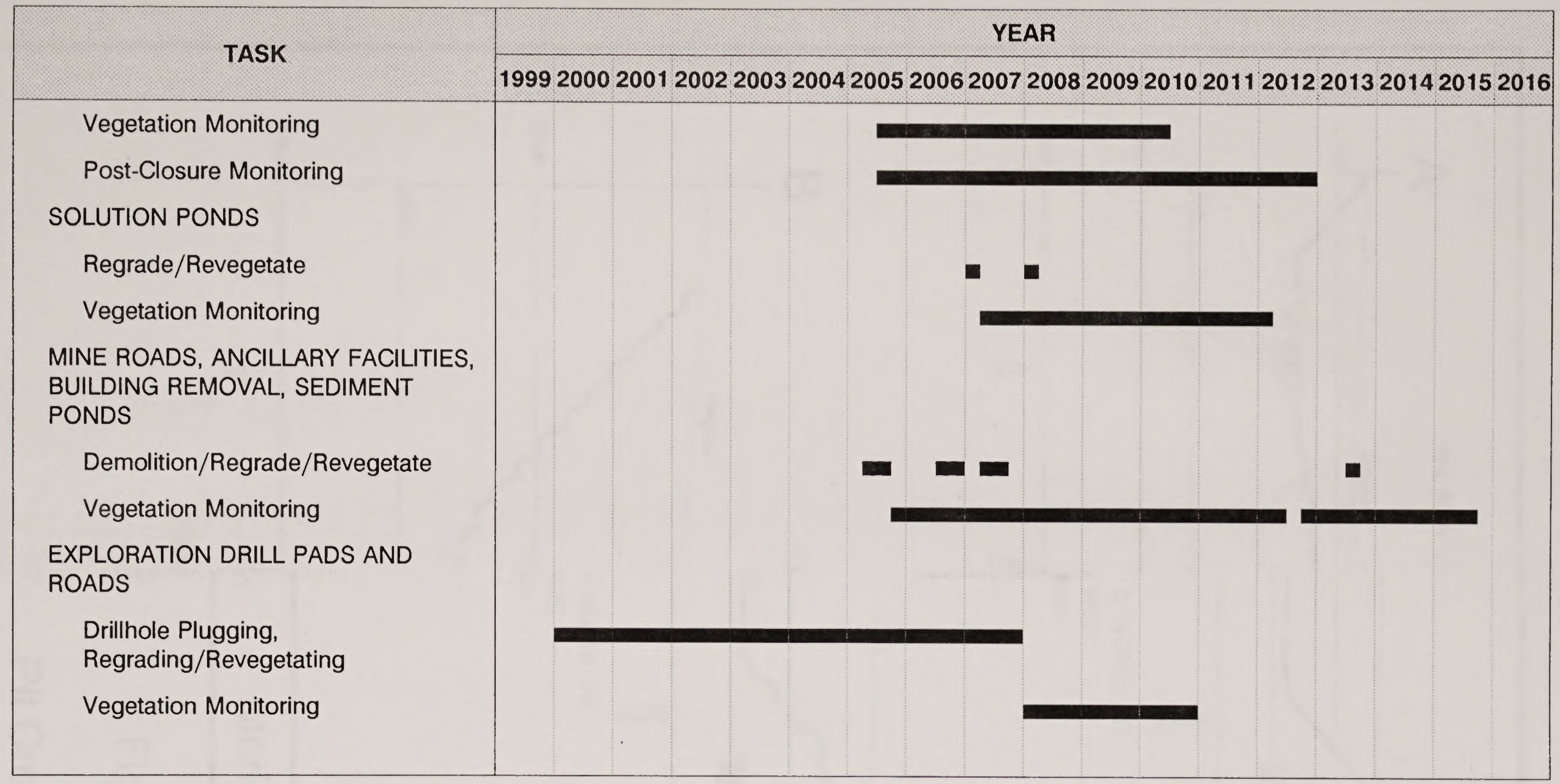
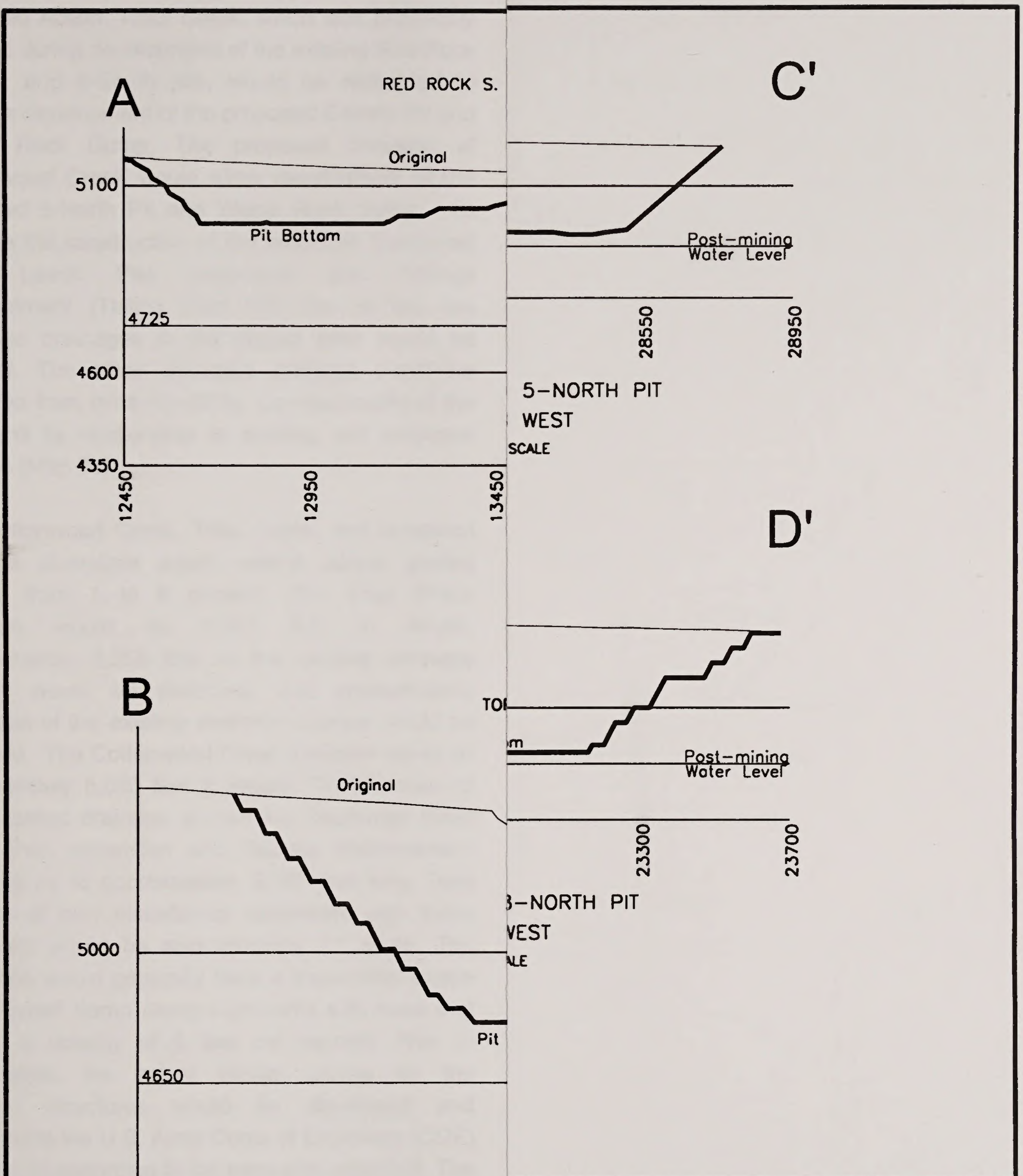


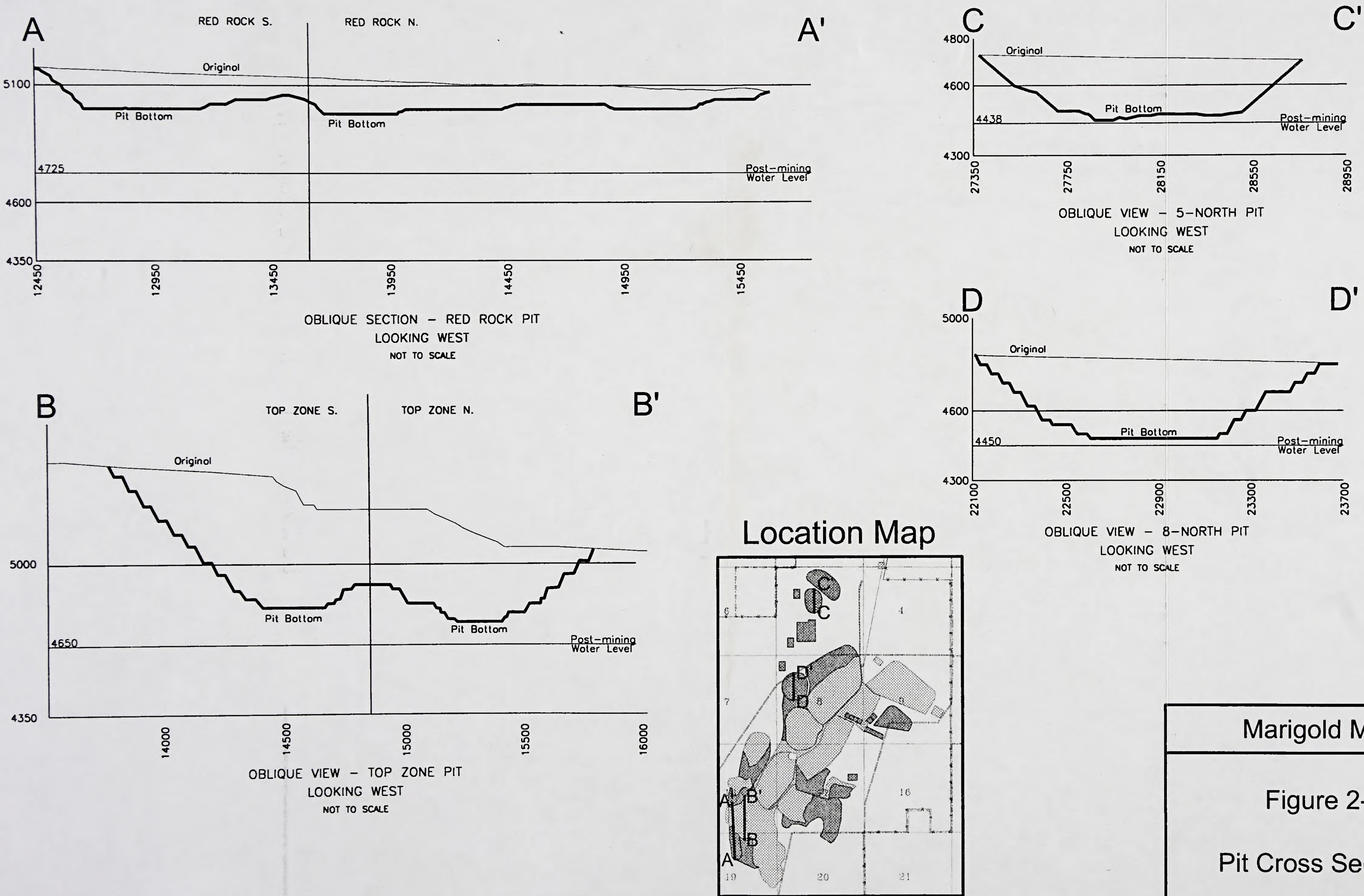
Figure 2-1. Project Schedule.



Marigold Mine

Figure 2-2

Pit Cross Sections



Marigold Mine

Figure 2-2

Pit Cross Sections

Proposed Action. Trout Creek, which was previously diverted during development of the existing Red Rock (North), and 8-South pits, would be rediverted to facilitate development of the proposed 8-North Pit and Waste Rock Dump. The proposed diversion of Cottonwood Creek would allow development of the proposed 5-North Pit and Waste Rock Dump. To facilitate the construction of the proposed Southwest Heap Leach Pad expansion and Tailings Impoundment (Tailing Dam #2), one of the two unnamed drainages in the project area would be diverted. The other unnamed drainage would be protected from mine run-off by the topography of the area and its relationship to existing and proposed facilities (Map 2-2).

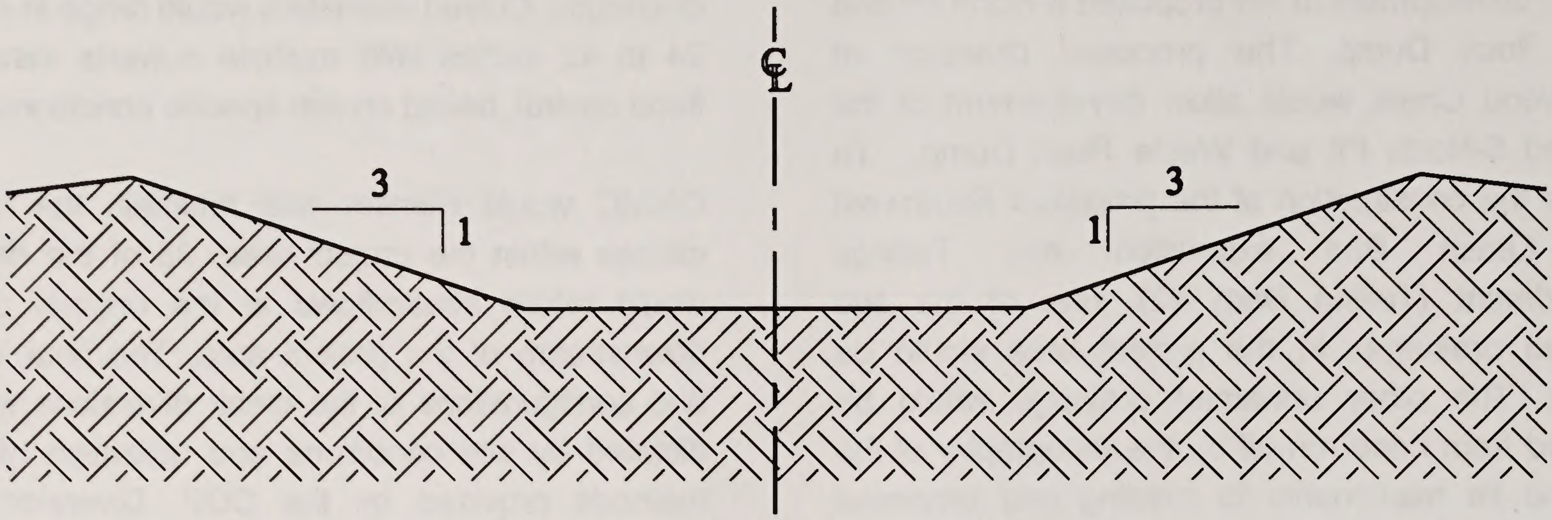
The Cottonwood Creek, Trout Creek, and unnamed drainage diversions would extend across grades ranging from 1 to 8 percent. The Trout Creek diversion would be 6,300 feet in length. Approximately 2,255 feet of the existing drainage channel would be disturbed, and approximately 3,690 feet of the existing diversion channel would be realigned. The Cottonwood Creek diversion would be approximately 8,050 feet in length. The diversion of the unnamed drainage around the Southwest Heap Leach Pad expansion and Tailings Impoundment would be up to approximately 9,300 feet long. Total acreage of new disturbance associated with these diversions would be approximately 31 acres. The diversions would generally have a trapezoidal shape and armored riprap along alignments with flows that exceed a velocity of 4 feet per second. Prior to construction, the actual design criteria for the diversion structures would be developed and submitted to the U.S. Army Corps of Engineers (COE) for approval according to the mine plan schedule. The D50 (i.e., average diameter) for the riprap would be based on the design criteria as specified by the COE for each sub-basin and for the appropriate event (e.g., 100-year storm, etc.). Based on preliminary flow estimates, the diversion of the unnamed drainage would be constructed with a 6-foot base, a 4-foot depth, and 3 horizontal (H) to 1 vertical (V) sideslopes (Figure 2-3). The diversions would be modified to best accommodate the anticipated 100-year, 24-hour storm event with respect to the local grades and hydraulic conditions. Culverts would be installed at road crossings, as needed, during realignment of the drainages. Culvert diameters would range in size from 24 to 42 inches with multiple culverts installed for flood control, based on site-specific conditions.

GMMC would monitor and maintain the diversion ditches within the project area. All of the diversions would return streamflows to the original channels downstream of the project area. The final locations and configurations of the creek diversions would be dictated by site conditions and utilization of proven methods provided by the COE. Diversion of the creeks would require a 404 permit from the COE.

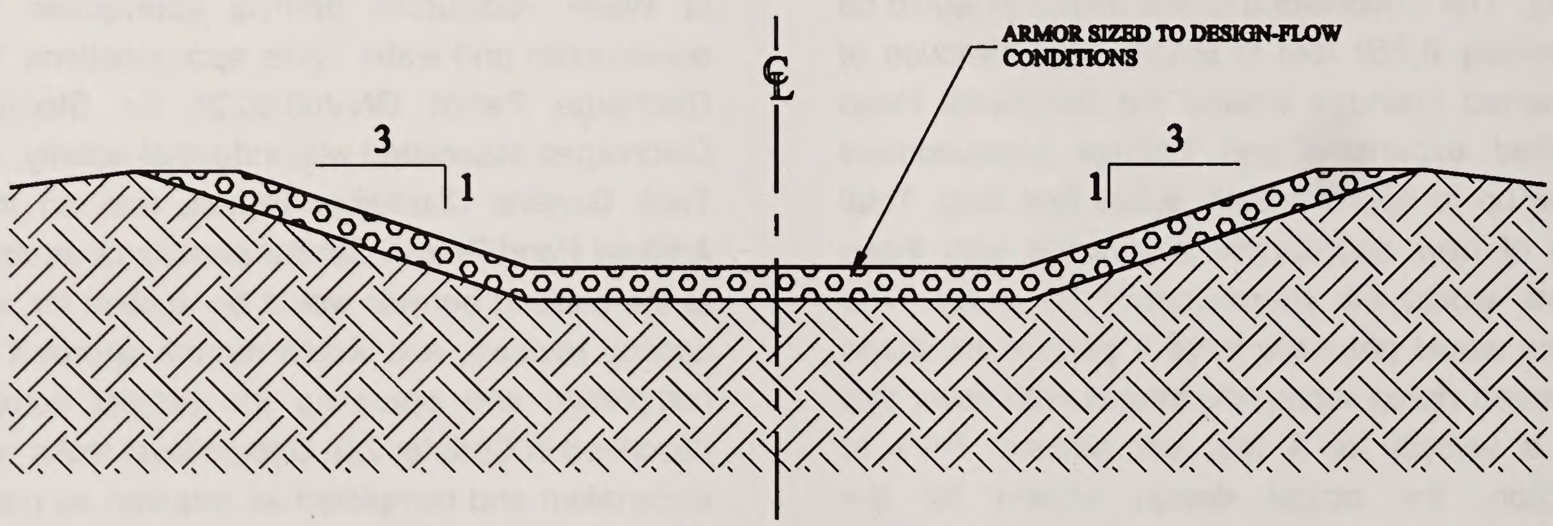
Water-related permits for the existing project components have been approved by appropriate state and federal agencies. In summary, these include the Plan of Operations and Reclamation Plan (No. 0108), Nationwide Permit Number 26 (dredge and fill activities in waters of the U.S.), Nevada Water Pollution Control Permit NEV88040, Nevada Division of Water Resources permits appropriate to dam construction and water rights appropriations, General Discharge Permit GNV0022225 for Storm Water Discharges associated with industrial activity, a Septic Tank General Discharge Permit, and an Industrial Artificial Pond Permit. Similar permits or amendments to the existing permits would be applied for, undergo agency reviews, and would require approval prior to completing and operating the project components described in Chapter 2.0. Design-level tasks would be undertaken and completed as required as part of the permit applications and would be reviewed by agency personnel for adequacy and made available for public comment prior to permit approval. A draft closure plan, including emergency response and spill prevention aspects, is required for the operation by the State of Nevada, and it must be finalized prior to closure of the operation.

2.2.2.3 Loading and Hauling

Blasted ore and waste rock would be loaded by hydraulic loader onto 85- to 90-ton capacity haul



TYPICAL EARTHEN CHANNEL
VELOCITY < 4 FT/S
(Dimensions to accommodate the design flow plus freeboard)



TYPICAL REINFORCED CHANNEL
VELOCITY > 4 FT/S
(Dimensions to accommodate the design flow plus freeboard)

Marigold Mine

Figure 2-3

Typical Creek Diversion Cross Sections

Not to scale

trucks. The haul trucks would transport the mined material to the heap leach facilities, waste rock dumps, or a storage area located adjacent to the ore crushing plant, as applicable.

2.2.3 Roads

Approximately 28 acres of disturbance would be associated with access roads, haul roads, and public access road relocation.

2.2.3.1 Access Roads

Access roads would be constructed for the proposed tailings impoundment, 5-North Pit, 8-North Pit, Resort Waste Rock Dump expansion, any additional appurtenant structures and facilities necessary for operation of the site, and to allow the continuation of exploration activities. Approximately 1 mile of access roads, with an associated new land disturbance of 3.5 acres, would be required to accommodate project expansion.

Access roads would generally be two-way thoroughfares with adequate size to safely accommodate mine traffic utilizing optimum widths based on the largest anticipated vehicle size. The access roads would consist of recompacted native materials exposed during clearing and grubbing operations. In-situ native materials, which are not suitable for the intended sustained design traffic, would be augmented with suitable on-site native materials to enhance road-bed performance.

2.2.3.2 Haul Roads

Approximately 1.3 miles of haul roads, with an associated 11.8 acres of new disturbance, would be constructed to connect the proposed 5-North and 8-North pits with existing and proposed waste rock dumps and ore processing facilities (Map 2-2). Haul roads would be constructed in conformance with Mine Safety and Health Administration (MSHA) regulations. Traffic direction signs (i.e., right-hand and left-hand traffic) would be posted for all haul roads. In general, haul roads would be approximately 75 feet wide to accommodate two-way haul truck traffic. Haul roads would be crowned to allow drainage of water off the road surface. Roads would be graveled, with limited cut-and-fill in steep terrain. Culverts would be installed under the haul road at required locations. The roads would be continually maintained to ensure safety and efficiency and to minimize dust emissions.

2.2.3.3 Public Access Road Relocation

One public access road (i.e., Buffalo Valley Road), which crosses the project area near the proposed 5-North and 8-North pits, would be realigned to facilitate development and construction of the proposed project expansion (Map 2-2). This 2.1-mile realignment would be 50 feet wide and have an associated land disturbance of 12.7 acres. Road construction would be in accordance with applicable county permit requirements.

2.2.4 Waste Rock

2.2.4.1 Waste Rock Dumps

Two existing waste rock dumps would be expanded, and two new waste rock dumps would be developed. These dumps would result in 284 acres of new disturbance and would accommodate a total of approximately 56.5 million tons of waste rock (Map 2-2, Table 2-2).

The two existing waste rock dumps proposed for expansion include the Old Marigold Waste Rock Dump and the Resort Waste Rock Dump. The currently approved 55-acre Old Marigold Waste Rock Dump would be expanded to the south by an additional 41 acres and would accommodate 15 million tons of waste rock. The existing 70-acre Resort Waste Rock Dump would be expanded 103 acres to the east and would accommodate approximately 16.7 million tons of waste rock.

The two new waste rock dumps include the 5-North Waste Rock Dump and the 8-North Waste Rock Dump. The proposed 5-North Waste Rock Dump would be located to the north-northeast of the proposed 5-North Pit. It would encompass 55 acres and accommodate 8.3 million tons of waste rock. The 8-North Waste Rock Dump would be located northwest of the existing 8-South Waste Rock Dump, encompass 85 acres, and would accommodate 16.5 million tons of waste rock.

Waste rock would be deposited within the waste rock dumps by end-dumping the material on the active bench faces at the angle of repose. In general, the dump faces would be at the angle of repose, with an average bench height of approximately 40 feet. The 8-North Waste Rock Dump would be constructed with 50- to 60-foot lifts. Progressive lifts would be constructed in a similar manner with a sufficient setback to provide an overall slope of 3H:1V to allow for decommissioning and final reclamation.

2.2.4.2 Pit Backfill

Partial backfilling of the Top Zone, 8-North, and 5-North pits would remain as an option, as opposed to waste rock dump construction, as allowed by sequential mining. Backfilling within the pits would reduce the need for additional out-of-pit waste rock dump capacity and would provide for partial reclamation of the open pits. However, for the purposes of this analysis and permitting, sufficient surface waste rock dump capacity is provided for in the Proposed Action, in the event that some or all backfill options cannot be accommodated by the mining sequence.

The proposed partial backfilling of the Red Rock Pit (South) would provide more efficient access during mining and would ensure the stability of the west high wall and the proposed Trout Creek diversion required for pit development. The final dimensions of the proposed Red Rock Pit backfill along the west wall would be approximately 50 feet high, 200 feet wide, and 600 feet long, and would accommodate approximately 530,000 tons of waste rock.

To ensure that the overburden used to backfill any of the pits does not have the ability to degrade waters of the state, any material to be placed in the pits would be characterized for its potential to generate acid and/or release metals. Testing would include both the Acid Base Accounting (ABA) and Meteoric Water Mobility Procedure (MWMP), and if necessary, kinetic testing. Materials determined from these tests to have the potential to generate acid or release metals to surface water or groundwater would not be placed in the pits and would be subject to a material management plan, as necessary. As discussed in Section 2.2.18, Environmental Protection Measures and Monitoring, this plan would provide for blending and/or encapsulation of the sulfide waste rock with oxide material in a waste rock dump. These measures would minimize the potential for generation of acid rock drainage, thereby minimizing the potential impact on surface water and groundwater.

2.2.5 Heap Leach Facilities

2.2.5.1 Heap Leach Design and Construction

Additional lifts would be added to three existing heap leach cells (Cells 1, 2, 10), one new cell (Cell 11) would be constructed adjacent to the existing heap leach facility (Southwest Heap Leach Pad expansion), and one new heap leach facility (5-North) would be constructed adjacent to the proposed 5-North Pit (Map 2-2, Table 2-3). The proposed expansions would increase the current heap leaching capacity at the site by approximately 19.5 million tons.

Approximately 588,000 tons and 592,000 tons of leachable ore would be added to the existing heap leach cells (i.e., Cells 1 and 2, respectively). The addition of this ore would increase the height of the cells by 80 feet. These cells would be raised in conjunction with the construction of Cell 10, which has previously been approved. Cell 10 would be increased over the previously approved height to 150 feet. Additionally, existing heap leach Cell 8 would be raised 20 feet in conjunction with construction of the proposed Southwest Heap Leach Pad expansion. This would increase the capacity of

Table 2-3
Existing and Proposed Heap Leach Facilities

Heap Leach Cell or Facility	Maximum Height (feet)	Existing Capacity (million tons)	Proposed Additional Capacity (million tons)	Total Capacity (million tons)
1	160	1.9	0.6	2.5
2	160	2.4	0.6	3.0
3	160	2.6	1.1	3.7
4	160	2.8	0.2	3.0
5a	160	2.5	0.5	3.0
5b	160	2.6	0.4	3.0
6	160	2.5	0.5	3.0
7	120	2.7	0.8	3.5
8	120	2.0	1.4	3.4
2 & 3 Infill	140	1.0	0	1.0
9	150	1.6	0	1.6
10	150	1.0	0	1.0
11 (Southwest Expansion)	80	0	11.3	11.3
12 (5-North)	40	0	2.1	2.1
TOTAL		25.6	19.5	45.1

Cell 8 by 1.4 million tons. Cells 3, 4, 5a, 5b, 6, and 7 would all receive additional leachable ore totaling 3.5 million tons. This would be accomplished by additional stacking within the previously permitted heights within the areas between cells.

The proposed Southwest Heap Leach Pad expansion would be constructed in a gently sloping area south of, and adjacent to, existing heap leach Cell 8. The expansion would add one cell (Cell 11) to the currently approved heap leach facility. The pad for this cell would extend over a 48-acre area. The cell would have an 11.3-million-ton capacity and a maximum height of approximately 80 feet. The proposed expansion of the existing heap facility would service all mining except the proposed 5-North Pit.

The proposed 5-North Heap Leach Pad would be constructed in a gently graded open area south of the proposed 5-North Pit. This facility would have a 30-acre footprint, a maximum height of approximately 40 feet, and a 2.1-million-ton capacity. The facility would service mining in the proposed 5-North Pit.

The heap leach piles would be developed with run-of-mine ore stacked in 15- to 20-foot lifts. Each lift would be placed at the natural angle of repose. The top of each lift would be cross-ripped to a depth of 4 feet, and solution distribution lines would be placed on the prepared surface. The leach pads would be designed with a two-liner system consisting of either the following: a double-sided textured 60 mil high density polyethylene (HDPE) geomembrane overlying a compacted 12-inch layer of low permeability (1 x 10-6 cm/sec) soil liner; or a double-sided textured 60 mil HDPE geomembrane overlying a geosynthetic clay liner (GCL). Other geomembranes may be utilized as approved by NDEP. All construction design and installation would be consistent with the requirements of the Bureau of Mining Regulation and Reclamation's (BMRR) Water Pollution Control Permit. A field quality control program would be implemented during construction that includes membrane seam testing and seam welding equipment inspection. Progressive lifts would be constructed in a similar manner with a sufficient setback to provide an overall slope of 3H:1V to allow for decommissioning and final reclamation.

2.2.5.2 Solution Ponds/Collection System

Cyanide solution would be applied to the heaps using spray or drip irrigation systems. The total solution flow rate, including the proposed expansions, would be approximately 2,000 gallons per minute (gpm). The cyanide solution would percolate through the ore to the leachate collection system, which would gravity feed to a collection ditch. The collection ditch would be lined with a synthetic liner placed over a compacted clay base that would have a hydraulic conductivity of 10-6 centimeters per second (cm/s) or lower. Flow reporting to the collection ditch would be directed, via HDPE pipes, to the pregnant solution ponds (Figure 2-4).

The 1-acre pregnant pond and 1-acre barren pond proposed for the 5-North heap leach solution collection system would be constructed with a primary 100-mil HDPE liner over a secondary 60-mil HDPE liner above a compacted clay base. The ponds would be designed to hold the working volume of solution while maintaining a 2-foot freeboard following a 25-year, 24-hour storm event. As a result, the ponds would each have a capacity of approximately 1.2 million gallons with a 2-foot freeboard. These ponds would be covered with 1-inch mesh bird exclusion netting, attached to cables and to tie-downs off the edge of the liner. In addition, fencing that meets Nevada Division of Wildlife (NDOW) requirements would be installed around the solution ponds, solution channels, and solution overflow ponds to prevent access by wildlife and livestock (see Section 2.2.14).

The leachate collection system for the proposed Southwest Heap Leach Pad expansion would utilize the existing fluid management system, process ponds, and appurtenant infrastructure previously established for the existing heap leach cells. Pregnant solutions would be pumped to carbon columns where gold would be adsorbed onto the carbon (see Section 2.2.7, Process Area). The solution would then gravity feed to the barren pond for subsequent reuse in the heap leach process.

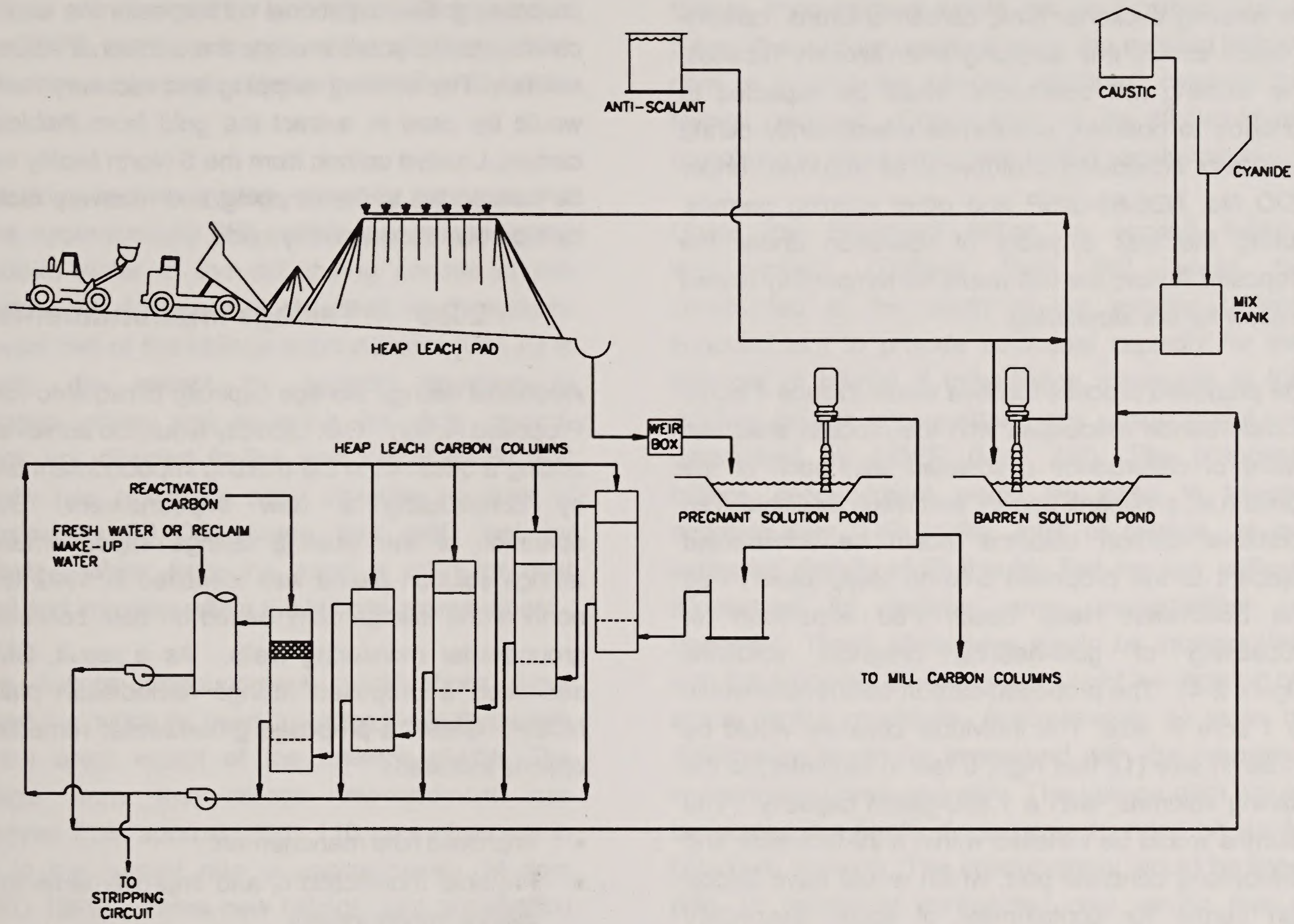
Minor leakage of pregnant solution has been reported from an existing pregnant solution pond that would be used during the operation phase of the Proposed Action; this leakage has been contained to prevent off-site contamination. GMMC would continue to coordinate with NDEP and BLM regarding their solution remediation activities to contain and prevent off-site movement of pregnant solution.

2.2.5.3 Leach Pad Leak Detection/Collection System

Leak detection/collection systems would be installed between the two HDPE liners in the proposed pregnant and barren ponds. The leak detection systems would be designed to provide containment and collection of leaks through the primary liner. The leak detection/collection systems would be designed based on NDEP regulations.

2.2.6 Ore Crushing Plant

High-grade ore mined from the pits would be crushed at the existing crushing facility in preparation for milling. The existing crushing facility includes a jaw crusher, cone crusher, coarse and fine ore stockpiles, and conveyers and screens for transfer and sizing, as previously approved under POO No. N26-88-005P and other existing permits. Ore crushing operations are expected to be discontinued during the 3-year scheduled shutdown of the mill that would occur during the first years of operation under the Proposed Action (see Section 2.2.7). During this period, ore would be stockpiled for processing. After this 3-year period, the milling operations would be reactivated and run continuously for the remainder of the project life. The ore crushing plant would be periodically utilized for crushing and screening of material for construction projects.



Not to scale

Marigold Mine
Figure 2-4
Heap Leach Circuit with Carbon Columns

2.2.7 Process Area

Crushed ore would be transferred to the existing grinding circuit, which utilizes a rod mill and a ball mill to further reduce rock size. Ore, to which lime and cyanide would be added, would be processed utilizing the existing thickener tank, carbon columns, carbon-in-leach circuit, and stripping and recovery facilities. The existing mill operations would be expected to continue to operate, sometimes intermittently during periods of scheduled shutdowns, as approved under POO No. N26-88-005P and other existing permits. During the first 3 years of operation under the Proposed Action, the mill would be temporarily closed to allow for ore stockpiling.

The proposed process facilities would include 4 acres of disturbance associated with the process area and 1 acre of disturbance associated with each of the ponds (i.e., pregnant, barren, and leach facilities). Ten additional carbon columns would be constructed adjacent to the proposed 5-North Heap Leach Pad and Southwest Heap Leach Pad expansion for processing of gold-bearing pregnant solutions (Figure 2-4). The proposed carbon column site would be 1 acre in size. The individual columns would be similar in size (12 feet high, 8 feet in diameter) to the existing columns, with a 1,000-gallon capacity. The columns would be installed within a 20-foot-wide and 60-foot-long concrete pad, which would have 2-foot-high berms for containment of spills. Secondary containment would be provided by the adjacent barren pond. The cyanide and caustic bulk storage tanks also would be installed on a concrete pad surrounded by berms. In addition to the carbon columns, one steel bin (capacity: 20,000 gallons) used to store sodium cyanide and one steel silo (capacity: 20,000 gallons) used to store lime/caustic soda would be constructed in the process area. Other processing chemicals would be periodically delivered to the process area in plastic drums or barrels.

Gold-bearing pregnant solutions from the proposed 5-North Heap Leach Pad would be pumped to the new carbon column system where the gold would be adsorbed onto the carbon (Figure 2-4). The adsorption plant would process gold-bearing pregnant solution at a rate of 1,000 gpm. Barren solution would gravity drain to the barren pond for re-use in the heap leach circuit. Gold-bearing pregnant solutions from the proposed Southwest Heap Leach Pad expansion would be pumped to existing carbon columns for processing. Five additional carbon columns would be constructed to accommodate the additional volume of solution. The existing stripping and recovery facilities would be used to extract the gold from the loaded carbon. Loaded carbon from the 5-North facility would be transported to the stripping and recovery facilities by a carbon transfer utility truck.

2.2.8 Tailings Impoundments

Additional tailings storage capacity is required for the Proposed Action. This capacity would be achieved by adding a 5-foot lift to the existing impoundment and/or by constructing a new impoundment. During operation of the existing tailings impoundment, a tailings solution plume was identified in 1992 to the north of the tailings dam, based on data collected in groundwater monitoring wells. As a result, GMMC submitted a proposed tailings remediation plan to NDEP. GMMC's proposed groundwater remediation options included:

- Improved fluid management
- Physical modifications and improvements to the tailings impoundment
- Expanded groundwater monitoring wellfield
- In-situ tailings impoundment dewatering well
- Tailings solution chemical treatment

A tailings solution pumpback system (TSPS) was installed in 1988 in the tailings impoundment. Since the identification of the tailings plume in 1992, the efficiency of the TSPS has been improved to decrease the release of tailings solution to the vadose zone. In 1996, a separator dike was constructed along the western and northern portions of the tailings impoundment to 1) facilitate operations, 2) improve fluid management, and 3) limit contact of the tailings solution with the western and northern portions of the dam. A second dike was constructed to divide the impoundment into two cells and to improve fluid management. A sump was installed within the divider dike as a collection point for the tailings reclaim water to reduce the hydraulic head, thereby reducing the leak from the tailings dam, and to control the location where the fluid enters the tailings impoundment. The sump has not changed the quantity of water pumped by the TSPS, but it has improved the efficiency of the system, and it intercepts solution before it reaches the tailings dam.

The tailings reclaim system currently captures and returns approximately 350 gallons per minute (gpm) of reclaim water to the mill during periods of mill operation and 150 gpm to the heap leach system. The west cell of the tailings impoundment (Cell A) is currently dry except for periodic irrigation of vegetative cover and spraying for dust control. Tailings are directed to the east cell (Cell B) that currently has a surface pond covering an area of approximately 80,000 square feet (400 feet by 200 feet). Water from the pond is used for dust control and irrigation within the tailings impoundment.

These tailings impoundment modifications have reduced the hydraulic head, lowering the leakage rate and the areal extent of the leakage plume. The seepage from the tailings impoundment has decreased from approximately 110 gpm observed in 1992 to the current rate of approximately 34 gpm (GMMC 1999). Three new tailings dam observation holes (TDOHs) or monitoring wells (TDOH numbers 18, 19, and 20) were installed within the existing well field to improve the monitoring system and to replace wells made obsolete by regional dewatering.

As a result of these modifications to the tailings impoundment and the associated groundwater monitoring system, NDEP has not required GMMC to implement the remaining options in their proposed tailings remediation plan. Should groundwater monitoring indicate expansion of the plume, these options would be considered for future implementation.

Studies, including tailings characterization and dewatering options, are currently being conducted for the existing tailings impoundment to evaluate the feasibility of expanding the existing impoundment. If the remediation measures described above are successful, construction of the proposed second tailings impoundment would not be required, and a 5-foot lift would be constructed on the existing tailings dam to provide the needed additional capacity for tailings disposal. Construction of the lift would be completed in accordance with NDEP requirements.

Under the Proposed Action, a second tailings impoundment (Tailings Dam #2) would be constructed to the south of the existing tailings impoundment to provide additional capacity for the disposal of tailings if remediation measures of the existing tailings impoundment are unsuccessful, as determined by NDEP (Map 2-2). The proposed tailings impoundment would be sized to handle approximately 0.82 million tons of tailings, at an estimated density of 23.5 cubic feet per ton, without allowances for reclaim water management or freeboard. These allowances would be incorporated with the proposed 37-foot gross height, as dictated by actual mining conditions. Approximately 54 acres of disturbance would be associated with the proposed impoundment area and dam. The tailings dam would be located in a gently sloping area founded on stable colluvium deposits. The impoundment would be lined with 12 inches of compacted clay, which has a saturated hydraulic conductivity of 5.0 x 10-7 cm/s. If the clay material on site cannot be compacted to meet this specification, a synthetic liner (60 or 80 mil) would be used. The inside walls of the dam would have a 3-foot compacted clay liner. The facility would be constructed as a zero discharge facility. The leak detection system has not yet been designed, but the facility would be approved by the State and meet state specifications before construction. Design specifications for the impoundment, as well as leak detection and collection pumpback system, would be developed in accordance with State of Nevada requirements.

2.2.9 Growth Media Stockpile Areas

Prior to construction of the proposed mine pits, waste rock dumps, roads, heap leach pads, and tailings impoundment, growth media would be stripped and stockpiled for subsequent use in reclamation. To accommodate the anticipated volume of growth media that would be salvaged, five new growth media stockpiles would be developed (Map 2-2). The stockpiles would cover approximately 5 acres and would be located west of the proposed 5-North Pit, northwest of the proposed 8-North Pit, southwest of the proposed 5-North Heap Leach Pad, and east of the proposed Southwest Heap Leach Pad expansion. An 8-acre growth media stockpile also would be established to the south of the proposed tailings impoundment. Growth media stockpiles would be seeded to minimize wind and water erosion and invasion by noxious weeds.

2.2.10 Storm Water Control

Storm water surface flows would be routed away from the project area by installation of new diversion ditches (see Section 2.2.2.2). Diversion ditches would be constructed to accommodate flow resulting from a 100-year storm event. Storm water that accumulates in the pits during operations would be pumped to existing process facilities or storm water ponds. Tailings reclaim water from the existing and proposed impoundments would be pumped to the mill for reuse in gold recovery operations. Runoff from the waste rock dumps, due to extreme meteoric events, would generally be directed via the haul road to diversion ditches and eventually to the storm water ponds. Storm water would be managed as process solutions if they contact solutions containing cyanide. Design criteria for storm water management is addressed in the facility design. Storm water would be stored in the storm water storage pond located adjacent to the existing solution ponds and would be utilized for dust suppression, process water, or irrigation for reclaimed areas.

Two additional storm water ponds would be constructed under the Proposed Action (Map 2-2). One 1-acre pond would be constructed adjacent to the proposed 5-North Heap Leach Pad. A 2-acre pond would be constructed in conjunction with the proposed Southwest Heap Leach Pad expansion.

Access roads would be graded to promote positive drainage to adjacent side ditches for storm water removal. Best Management Practices (BMPs) would be used to limit erosion and sediment transport on steeper grades. None of the proposed access roads would cross any perennial or intermittent streams. Culverts would be installed for crossing significant drainage swales, and low water crossings would be utilized on non-significant topographic rilles and gullies.

2.2.11 Water Supply

Reclaim water from the tailings impoundment and storm water run-off from mine facilities are currently recycled to the extent possible for use in leaching, milling, and dust suppression. The use of recycled water would continue in order to minimize the amount of fresh water needed for the operation. Fresh water for the existing operation is currently supplied by an interconnect with the Lone Tree Mine water supply line and three water supply wells located within the mine area. Through a cooperative agreement with the Lone Tree Mine and subsequent BLM approval (BLM 1997 [Resort Project EA]), the interconnect to the supply system serving Lone Tree's Trenton Canyon facility can supply approximately 90 to 95 percent of the processing water requirements, up to an additional 1,000 gpm. The well system is capable of providing approximately 425 gpm. The existing fresh water supply systems and the continued use of recycled water would supply sufficient water for the existing and proposed operations.

2.2.12 Electric Power

The northeast portion of the proposed 5-North Pit development, as currently planned, would extend into the Sierra Pacific Power Company (SPPCo) right-of-way (ROW) (NEV-066891) that contains a 120-kilovolt (kV) power line. A power line realignment would be required to avoid the area proposed for development. GMMC would pursue obtaining permission from SPPCo for realignment of the power line and the necessary ROW applications. The 60-foot height of the line would allow sufficient safety margin for mining personnel and equipment. GMCC would inform SPPCo of the proposed blasting techniques that would be used in the northern portion of the pit. Controlled blasting in the pit would not produce flying debris that could damage the line. Power distribution for the 5-North facilities would come from the existing power line at the Water Supply Well #3 located in Section 5 (T33N, R43E).

2.2.13 "In Fill" Areas

"In fill" areas, totaling approximately 72 acres, would be located in between the proposed and/or existing project facilities. These areas would be used for access between facilities. In addition, portions of the "in fill" areas could be used as laydown yards for storage of extra pipe, culverts, and other non-hazardous items. No hazardous materials would be stored in the "in fill" areas, unless properly stored and contained. These proposed "in-fill" areas include a 30-acre area between the existing 8-South Pit and the proposed 8-North Pit, a 22-acre area southeast of the proposed Southwest Heap Leach Pad extension, and a 20-acre site located west of the existing Top Zone Pit.

2.2.14 Security and Fencing

Security in the project area would be the responsibility of GMMC. The security system would include direct security measures, supported by employees involved in the day-to-day operation. Persons entering and leaving the area would be required to gain clearance through a gate located near the entrance to the mine site. A three-strand barbed wire fence exists along the current permit boundary. Additional chain link fencing and electronic gates prevent unauthorized access to the mill area, administration building, and shop facilities. The proposed permit boundary would be partially enclosed with a BLM-approved range control fence (i.e., four-strand barbed wire fence). Fencing that meets Nevada Division of Wildlife (NDOW) requirements would be installed around the solution ponds, solution channels, and solution overflow ponds to prevent access by wildlife and livestock; this fencing currently surrounds existing process ponds and channels. Any monitoring wells located outside the fenced area would be clearly marked and locked. Additional fences or controls would be installed as necessary.

2.2.15 Fire Protection

Range fires detected within the project vicinity would be reported to GMMC's Safety Supervisor. The Safety Supervisor would report the range fire to the BLM and adjacent landowners. Support equipment available to fight range fires includes three water trucks with hose, a fire trailer equipped with two 100-pound extinguishers, hoses, nozzles, and fittings. In addition, fire suppression systems are installed on all haul trucks, loaders, drills, and dozers.

2.2.16 Exploration Drilling Pads and Access Roads

Exploration drilling activities would continue under the Proposed Action. The objectives of the drilling program would be to identify new ore reserves and to provide support data for short- and long-term mine planning. Drilling would be conducted within the proposed permit boundary, primarily south of the project facilities in T33N, R43E.

Drill pads, when used, would typically be 40 feet wide by 40 feet long. Access roads to the drill pad sites would be approximately 20 feet wide with an operating width of 12 feet. Existing roads would be used, where possible, to minimize new disturbance. New roads would only be constructed when existing roads or overland travel would not provide safe, efficient access.

In steep terrain, growth media from drill pads and roads would be stripped and stockpiled for use during reclamation activities. Each drill pad would be constructed with two mud pits; one would be used for settling of the drill cuttings, and the second would be used for settling of the mud solids. A berm would be constructed on the downhill side of each drill pad to provide containment and prevent runoff from the drill pad area.

2.2.17 Hazardous Materials and Wastes

2.2.17.1 Reagent Transport and Storage

No changes to the chemicals utilized, or the approximate quantities transported and stored on-site, would occur under the Proposed Action. All process chemicals and petroleum products would continue to be handled and disposed of in accordance with applicable Nevada and MSHA laws and regulations. Information and permits pertaining to the management, use, and storage of hazardous materials are provided in Table 2-4. The hazardous materials utilized at the mine are handled pursuant to manufacturers' Material Safety Data Sheets (MSDS) and applicable regulations. Transportation and handling of chemicals are conducted by licensed carriers and properly trained workers. All vehicles and containers carry the appropriate placards. All chemicals would continue to be transported to the mine by licensed commercial carriers on public roadways in accordance with applicable regulations. Routes used to transport chemicals include I-80 and the Buffalo Valley Road. Chemicals are stored at the existing facilities and protected from the elements. Petroleum fuels are stored in aboveground tanks and surrounded with a containment structure to accommodate at least 110 percent of the volume of the largest tank within the containment area. Most of the storage tanks are double-walled. The tanks are located in compacted clay basins with a clay berm covered by waste rock. The concrete-lined floor and walls of the mill have the capacity to contain 150 percent of all fluids contained in the mill. Chemicals used in the mill are stored nearby in concrete-lined basins with concrete side walls and capacity for 125 percent of the largest container.

GMMC has been issued a Hazardous Materials Permit by the State Fire Marshal Division, Hazardous Materials Section. The issuance of this permit is contingent on GMMC meeting the State standards for hazardous material storage and containment. If required, additional spill containment facilities would be installed to reduce the probability of a significant release.

A Hazardous Material Spill and Emergency Response Plan has been prepared for the existing mine facilities in accordance with the State of Nevada regulations governing the design, construction, operation, and closure of mining operations (Nevada Administrative Code 445A.242 through 445A.243).

2.2.17.2 Spill Prevention and Emergency Response

The chemicals and petroleum products utilized by and consumed at the Marigold Mine are not expected to change as a result of the Proposed Action (Table 2-4). Of the chemicals stored and utilized on-site, sodium cyanide, muriatic acid (hydrochloric acid), and sodium hydroxide are hazardous substances that are listed in 40 CFR 302.4 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (including The Emergency Planning and Community Right-to-Know Act); and the hazardous substances appendices of the Superfund Amendments and Reauthorization Act (SARA). CERCLA provides a framework for Federal response to the release of hazardous substances. For purposes of emergency response planning under SARA, Title III, a threshold planning quantity and reportable quantity are established for each hazardous substance. In conformance with these regulations, GMMC has developed and implemented an Emergency Response Plan for the Marigold Mine. Implementation of this plan would continue under the Proposed Action. These plans provide for the tracking

Table 2-4
Hazardous Materials Summary

Chemical Name	Use	Typical Rate of Use	Typical Amount Stored	Storage Method	Waste Management/ Disposal	Hazardous Characteristic	Amount per Load
Sodium cyanide	Process facility	2,240,000 lbs/yr	120,000 lbs	Steel bins	Spent	Poison	29.6 tons
Sodium hydroxide	Process facility	1,800,000 lbs/yr	150,000 lbs	Plastic barrels	Spent	Corrosive	24.3 tons
Lime	Process facility	2,184,000 lbs/yr	84,000 lbs	Steel silo	Spent	Corrosive	42 tons
Muriatic acid	Process facility	6,500 lbs/yr	3,000 lbs	Steel silo	Spent	Corrosive	30 gal
Betz liquid flocculent	Process facility	5,500 lbs/yr	2,750 lbs	Plastic drums	Spent	Corrosive	11,250 gal
Betz antiscale	Process facility	20,000 lbs/yr	15,000 lbs	Plastic drums	Spent	Corrosive	11,250 gal
Phosphonic acid	Process facility	1,500 lbs/yr	800 lbs	Plastic drums	Spent	Corrosive	800 lbs
Propane	Office, lab, process facility, truck shop	191,000 gal/yr	12,000 gal	Pressurized steel tank	Spent	Flammable	11,250 gal
Diesel	Truck stop	1,050,000 gal/yr	40,000 gal	Steel tank	Spent	Flammable	11,000 gal
Gasoline	Truck stop	104,000 gal/yr	10,000 gal	Steel tank	Spent	Flammable	10,000 gal
Antifreeze	Truck stop	800 gal/yr	400 gal	Tote (bulk container)	Recycle	Poison	400 gal
Acetylene	Truck stop	22,900 lbs/yr	440 lbs	Pressurized cylinders	Spent	Explosive	2 cylinders
Oxygen	Truck stop	20,800 lbs/yr	400 lbs	Pressurized cylinders	Spent	Explosive	2 cylinders
Ammonium nitrate/ fuel oil (ANFO)	Mine	2,500 tons	30 to 40 tons	Steel silo	Spent	Explosive	35 to 37 tons
Various explosives	Mine	15,000 lbs/yr	15,000 lbs	Bags	Spent	Explosive	7.5 tons

and required reporting of hazardous substances used on-site as well as provide a system for prevention, discovery, notification, and safe cleanup of all spills or discharges that may impact the environment.

Materials that are classified as hazardous for transportation purposes are regulated by the U.S. Department of Transportation (USDOT) per 49 CFR 172.101. The USDOT hazardous materials list includes hazardous substances regulated under CERCLA, as well as other types of chemicals. In addition to the hazardous substances described above, transportation of ammonium nitrate, Class A explosives, diesel fuel, cement, and calcium oxide (lime) must comply with USDOT hazardous materials packaging and labeling requirements. All chemicals would continue to be stored and handled in accordance with the manufacturer's recommendations and state regulations. The MSDSs for all chemicals used at the mine site would continue to be kept at locations that are accessible to the employees.

2.2.17.3 Waste Management

Non-hazardous solid waste generated at the Marigold Mine would continue to be disposed of in the approved Class III landfill located on the south side of the 8-South Waste Rock Dump in accordance with State and Federal regulations. No hazardous wastes, liquid wastes, or petroleum products would be disposed of at the site. The landfill would continue to be inspected weekly to ensure that only non-hazardous solid waste is deposited in the landfill.

GMMC currently recycles all used oil, solvents, antifreeze, and batteries through licensed contractors. Bio-remediation of soils impacted by occasional spills of petroleum hydrocarbons is currently permitted on-site by the State of Nevada, Department of Conservation and Natural Resources, Bureau of Mining Regulation and Reclamation. All lavatory wastes would continue to be disposed of in the existing septic systems.

2.2.18 Environmental Protection Measures and Monitoring

Environmental protection measures and monitoring for the Proposed Action would include sediment control, waste rock characterization, pit lake study (8-North Pit), spill prevention sampling and monitoring, stability of facilities, wildlife and livestock protection, air quality dust control, cultural/ paleontological resource protection, and an employee environmental education program.

2.2.18.1 Sediment Control

Sediment control would be provided by a combination of Best Management Practices (BMPs) at each facility. The heap leach and chemical/petroleum storage areas would be contained in an exclusionary berm. The petroleum fueling area also has its own concrete containment pad for incidental spills. The tailings and waste rock dumps would have storm water diversion ditches to prevent runoff from entering the facilities. The waste rock dumps would be reclaimed concurrently to reduce sediment loss. This would include ripping compacted surfaces to increase permeability to the vegetation root zone. Stream diversions would be armored where flow velocities exceed approximately 4 feet per second, dependent on channel material.

2.2.18.2 Waste Rock Characterization

Waste rock samples would be submitted quarterly for analysis as required by the NDEP Bureau of Mining Regulation and Reclamation. Waste rock analyses would include MWMP, ABA analysis, and heavy metal and general chemistry analyses as outlined in the site's Water Pollution Control Permit. Analyses would be reported quarterly to the NDEP and BLM. If the ABA tests exceed the NDEP and BLM criteria, then kinetic testing (humidity cell tests) would be performed.

To date, waste rock analyses have indicated very little potential for acid generation due to the low sulfide content of the waste rock. If waste rock analyses were to indicate the material had the potential to generate acid, that portion of the waste rock would be subject to a BLM-approved materials management plan (i.e., Sulfide Waste Management Plan). The plan would provide for blending and/or encapsulation of the sulfide waste rock in oxide material at one of the out-of-pit waste rock dumps. A minimum blending ratio of 3:1 acid-neutralizing to acid-generating material would be used. A minimum depth of 20 feet of oxide material would be used to encapsulate unblended sulfide material, and a minimum depth of 15 feet would be used to encapsulate blended material. These measures would reduce the potential for generation of acid rock drainage, thereby reducing the potential impact on surface and groundwater.

2.2.18.3 Spill Prevention Sampling

<u>Storm Water Discharge</u>

Storm water discharge samples would be collected from drainages exiting the project's permitted boundary from areas of exposed waste rock materials. Samples would be analyzed for the effluent parameters listed in 40 CFR 440.104(d)(1). Monitoring data would be reported to the NDEP on an annual basis.

<u>Groundwater Monitoring</u>

Groundwater samples would be collected from the tailings dam monitoring wells on a quarterly basis. The samples would be analyzed for the constituents specified in the site's Water Pollution Control Permit. Monitoring data would be submitted to the NDEP on a quarterly basis.

<u>Production Wells</u>

Samples would continue to be collected from the site's fresh water production wells on an annual basis. The samples would be analyzed for the constituents specified in the site's Water Pollution Control Permit. Monitoring data would be submitted to the NDEP on an annual basis.

<u>**Process Solutions**</u>

Monitoring samples would be collected and analyzed from the leach pad monitoring ports and the leach pad collection ditch leak sumps on a quarterly basis. Samples from the pregnant ponds, barren ponds, storm water ponds, tailings liquor, and tailings reclaim water would be collected and analyzed annually. These process solutions would be analyzed for the constituents specified in the site's Water Pollution Control Permit. Quarterly reporting of results would be made to the NDEP. Additionally, weekly flow rates for the tailings dam interceptor ditch sumps, leach pad leak detection sumps, pregnant pond and barren pond leak detection sumps, and storm water pond leak detection sumps would be documented and reported.

2.2.18.4 Stability of Facilities

Waste rock dumps and heap leach facilities would be designed to ensure stability during operation and post-closure. Stability modeling results for the heap leach pads and waste rock dumps would be included in the application for the NDEP Bureau of Mining Regulation and Reclamation permits. These facilities would be monitored on a regular basis during operations to identify any visible stability problems.

Expansion of the existing tailings facility under the Proposed Action would accelerate the seepage from the north end of the tailings if measures to control the seepage were not undertaken. GMMC has committed to controlling the seepage from the existing tailings and is working with the NDEP to protect groundwater quality north of the tailings impoundment.

2.2.18.5 Wildlife and Livestock Protection

To prevent access by wildlife and livestock, fencing that meets NDOW requirements would be installed around solution ponds, solution overflow ponds, and solution channels. The proposed permit boundary would be partially enclosed with a BLM-approved range control fence (four-strand barbed wire). Chain link fencing currently surrounds the process area. Any monitoring wells located outside the fenced area would be clearly marked and locked. Additional fences and controls would be installed as necessary. To date, GMMC has not experienced a wildlife mortality in the tailings facility.

Additional protection measures that have been incorporated into the operation for the protection of wildlife and livestock include: 1) installation of netting over solution channels and ponds to prevent access by birds and bats, 2) proper management of the Class III landfill, 3) formalized procedures for verbal and written reporting of wildlife mortalities to the NDOW, and 4) monitoring and managing cyanide concentrations of the process solutions.

GMMC has committed to contracting with a qualified biologist to conduct breeding bird surveys within suitable native habitats prior to ground disturbance, if construction activities were to occur from March through July. This survey would identify either breeding adult birds (i.e., by territorial defense behavior) or nest sites within the areas to be disturbed. If active nests are present, GMMC would then coordinate with the BLM to develop appropriate protection measures for these sites, which may include avoidance, construction constraints, buffer establishment, etc. An option to conducting breeding bird surveys would be to avoid ground disturbance activities between March and July, allowing construction to proceed outside of the breeding season without clearance surveys.

Expansion of the Red Rock Pit would directly impact the Red Rock Adit, which has been identified as bat habitat. GMMC would contract a qualified bat biologist, prior to the initiation of construction activities, to close the Red Rock Adit during the appropriate season (e.g., spring or fall) to prevent direct impacts to bats and encourage individuals to relocate to adjacent habitats. It is anticipated that the exclusion would occur during early fall after summer use of the adit has ceased and prior to the winter season. Prior to closure, the entrance/exit would be monitored at dusk, using appropriate survey methods to approximate the number of bats that are using the adit. A tally of bats exiting and entering the entrance would be made to provide an estimate of the number of bats inhabiting the adit. Based on site-specific conditions, the number of bats observed, and environmental factors, applicable techniques would be implemented to force the bats out of the Red Rock Adit. This closure would allow bats to leave the adit, but not return. Screening would remain on the entrance until permanent closure could be implemented. Permanent closure would consist of either mining the adit or backfilling the entrance to prevent bats from using the site in the spring.

2.2.18.6 Air Quality

GMMC has incorporated a number of measures into the existing operation to control the generation of PM_{10}. These measures also would be incorporated into the operation of the Proposed Action. To control fugitive dust, water or chemical stabilizers would be applied to haul roads, access roads, and at the tailings impoundment within the project area. Speed restrictions would be enforced to further minimize particulate emissions from roadways. Ongoing reclamation during the life of the operation, as project components are completed, would reduce the acreage of disturbed lands, thereby reducing fugitive dust. Enclosures, baghouses, and sprays currently control dust emissions from existing crushers, screens, and transfer points.

2.2.18.7 Cultural/ Paleontological Resources

Protection measures have been incorporated into the existing operation to prevent and minimize potential impacts to cultural and paleontological resources within the project area. These measures, identified below, also would provide protection of resources during development and operation of the Proposed Action.

- Employee and equipment access would be limited to minimize the potential for direct impacts to resources. Mine exploration and operations equipment would be prohibited outside of the proposed permit boundary, which would be clearly marked. Employee access to known archaeological and paleontological sites on private land in the vicinity of the mine would be limited.

- Known site locations would be avoided by exploration activities.

- Secondary effects to eligible sites resulting from road and drill pad construction and use would be minimized through the implementation of erosion control measures such as water bars, double sumps for drill water, and appropriate road design.

- If a previously undocumented archaeological site or subsurface components of documented sites are discovered during exploration, construction, operation, or reclamation activities, GMMC would cease activities in the area of the discovery until resources could be examined by a BLM-approved archeologist. If resources are identified as eligible for the National Register of Historic Places (NRHP), impacts would be mitigated through an appropriate treatment plan approved by the BLM, the State Historic Preservation Officer (SHPO), GMMC, and the Advisory Council, or through site avoidance.

- If significant fossiliferous deposits, specifically vertebrate fossil deposits, are located during exploration, construction, operation, or reclamation activities, paleontologists from the appropriate state or Federal agency would be notified, and measures would be taken to identify and preserve or avoid the fossils.

2.2.18.8 Employee Environmental Education Program

GMMC currently provides environmental education for its employees. This training includes information on management practices incorporated into the operation of the facility to minimize impacts to the environment and ensure compliance with environmental permit criteria. This program would be continued throughout the operation of the Proposed Action. GMMC also is developing an operator's Environmental, Health, and Safety Compliance Handbook, in addition to maintaining detailed compliance schedules.

2.2.19 Reclamation

GMMC proposes to increase the authorized surface disturbance at the Marigold Mine from approximately 1,349 acres to approximately 2,063 acres. Most of the disturbance associated with the Proposed Action would result from the development of the 5-North and 8-North pits and associated waste rock dumps, development of the 5-North Heap Leach Pad, expansion of the Old Marigold and Resort waste rock dumps and the Red Rock and Top Zone pits, expansion of the Southwest Heap Leach Pad, and development of the new tailings impoundment, and "in-fill" areas. Reclamation would be both concurrent and post-use, following the plans currently approved for and utilized by GMMC at the existing operation. Post-mining topography for the Proposed Action is presented in Map 2-3. A summary of reclamation acreages by project facility is presented in Table 2-5.

A detailed Reclamation Plan has been submitted as part of the BLM Plan of Operations and NDEP Reclamation Permit. The reclamation approach and procedures were developed based on the site-specific conditions at the mine site. These procedures were designed so that the mining-related disturbance would be reclaimed to a productive use similar to the

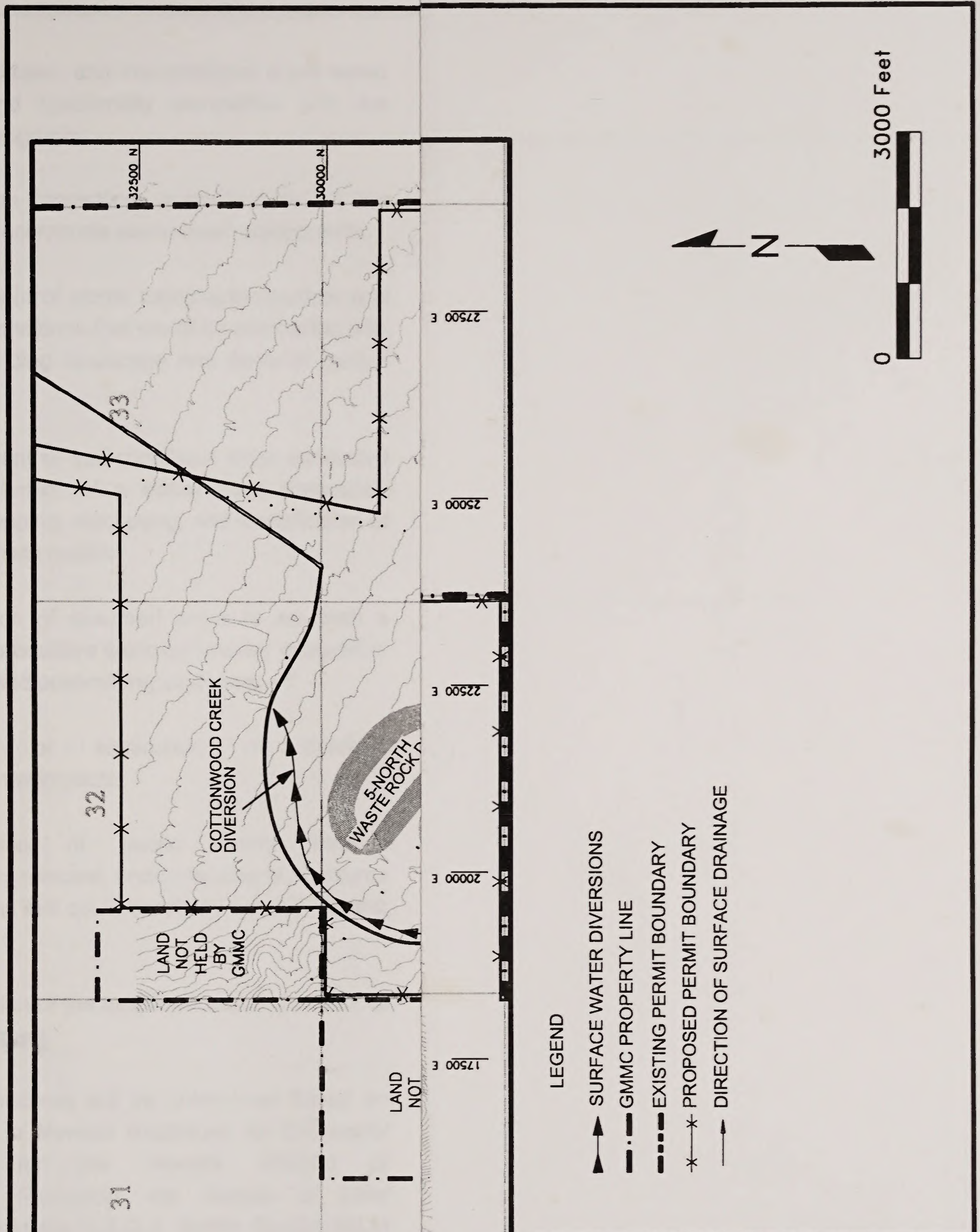
Table 2-5
Acreages Disturbed and Reclaimed After the Proposed Action

Facility	Disturbed Acres[1]			Reclaimed Acres		
	Public Land	Private Land	Total	Public Land	Private Land	Total
Pits	324	211	535	0	0	0
Waste Rock Dumps	412	312	724	412	312	724
Heap Leach Pads	56	152	208	56	152	208
Crushing/Mill/Plant Facilities[2]	35	18	53	35	8	43
Tailings Impoundment	0	234	234	0	234	234
Process Ponds	5	2	7	5	2	7
Storm Water Ponds	1.5	4.5	6	1.5	4.5	6
Growth Media Stockpiles	10	38	48	10	38	48
Haul Roads/Access Roads	36	52	88	22	39	61
Water Supply System	4	9	13	4	9	13
Diversion Ditches/Creek Diversions[3]	13	18	31	0	0	0
Exploration Drill Pads and Roads	17	25	42	17	25	42
"Infill"/Miscellaneous Areas	51.5	22.5	74	51.5	22.5	74
Total Acreage	**965**	**1,098**	**2,063**	**614**	**846**	**1,460**

[1]Total of currently permitted and proposed disturbances.

[2]Although these facilities are not proposed to be reclaimed, the reclamation bond includes full reclamation cost estimates for these facilities.

[3]Diversions will be permanent features as part of the stabilization at facilities.



Marigold Mine

Map 2-3

Post Reclamation Topography Under the Proposed Action

Table 2-5
Acreages Disturbed and Reclaimed After the Proposed Action

Facility	Disturbed Acres[1]			Reclaimed Acres		
	Public Land	Private Land	Total	Public Land	Private Land	Total
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Growth Media Stockpiles	10	38	48	10	38	48
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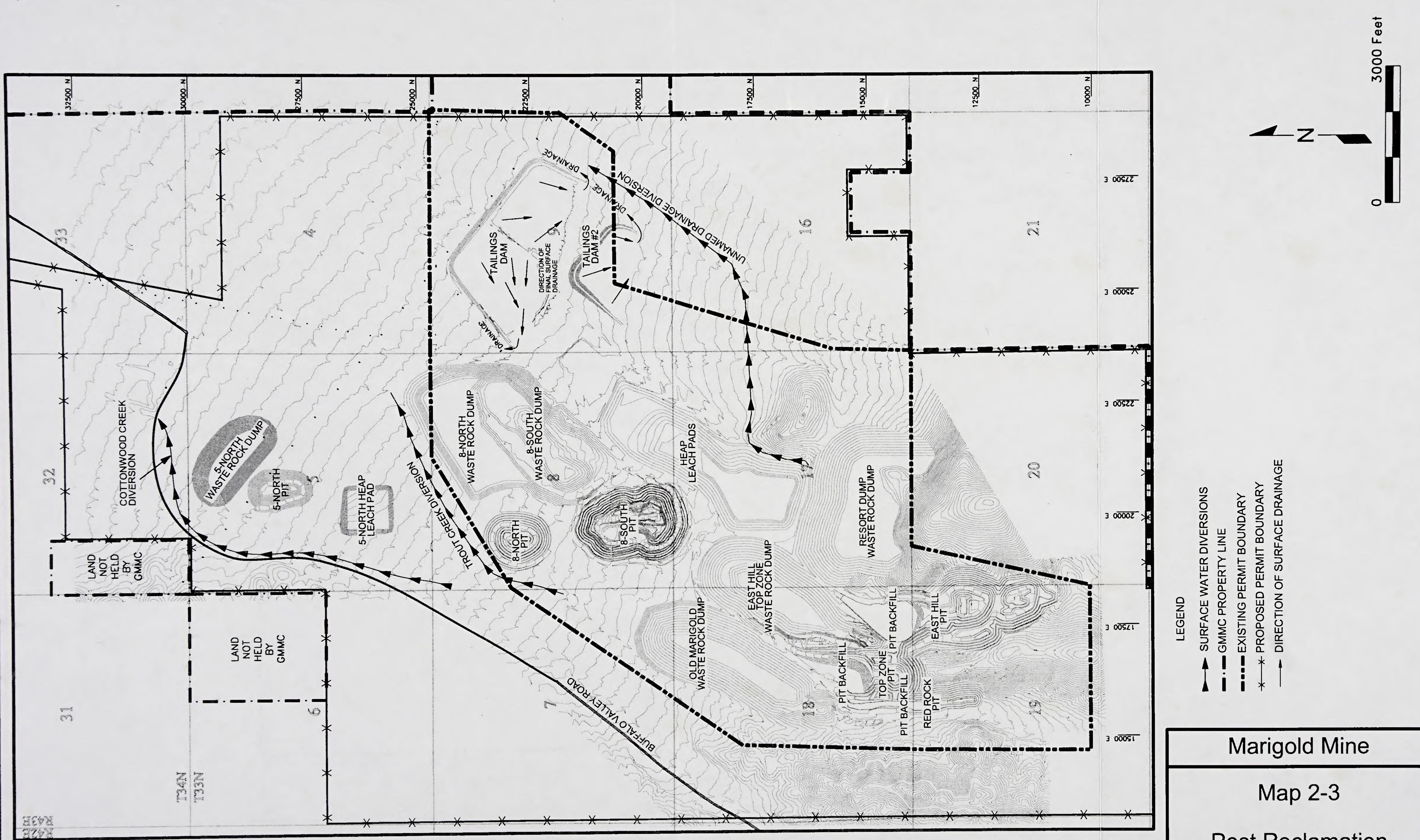


Marigold Mine

Map 2-3

Post Reclamation Topography Under the Proposed Action

pre-mining land uses, and the reclaimed areas would be visually and functionally compatible with the surrounding topography.

The reclamation procedures currently used at the Marigold Mine incorporate seven basic components:

- Establishment of stable topographic surface and drainage conditions that would be compatible with the surrounding landscape and serve to control erosion;
- Establishment of soil conditions most conducive to establishment of a stable plant community through stripping, stockpiling, and reapplication of suitable growth media;
- Revegetation of disturbed areas to establish a long-term productive biotic community compatible with proposed post-mining land uses;
- Reduction or elimination of potential environmental impacts;
- Consideration of public safety through stabilization, removal, and/or fencing of structures or landforms that could constitute a public hazard; and
- Consideration of the long-term visual character of reclaimed areas.

Revegetation success will be determined based on criteria outline in *Nevada Guidelines for Successful Revegetation for the Nevada Division of Environmental Protection, the Bureau of Land Management and the U.S.D.A. Forest Service* (BLM 1998).

2.2.19.1 Growth Media Stockpiling and Use

Prior to development of the facilities under the Proposed Action, suitable growth media would be salvaged and stored in the five growth media stockpiles (Map 2-2). Suitable alluvial material also would be used to supplement the growth media. The stockpiles would be seeded with an interim seed mix to minimize wind and water erosion or invasion of noxious weeds.

2.2.19.2 Grading and Stabilization

Following construction activity, slopes would be contoured in preparation for reclamation. Depending on the type of material, erodibility, and the practical considerations of the mining process, overall slope grades would range from near vertical to near-flat. After closure, the pit highwalls would be left in a stable configuration, subject to natural processes.

Final grading of cuts and fills in unconsolidated material would be conducted to create stable, undulating landforms to prevent pooling or ponding, and to blend with the surrounding undisturbed topography. Final grading would minimize erosion potential and additional surface disturbance, and would facilitate the establishment of post-mining vegetation.

2.2.19.3 Surface and Seedbed Preparation

Prior to growth media application, disturbed areas would be inspected for slope stability, topographic diversity, surface water drainage capabilities, and compaction. Compacted surfaces would be loosened and left in a rough condition by ripping, followed by disking or other mechanical manipulation. Tillage implements may be used as needed for all areas to be reclaimed that could safely be worked by surface equipment to create a friable surface with favorable bulk density. Other grading and stabilization would be performed to ensure long-term stability. Growth media would then be distributed over the prepared surface to a depth of 6 to 12 inches. Soil amendments would be applied as needed, and the surface disked, raked, or treated to incorporate the amendments into the top 4 to 6 inches of growth media.

2.2.19.4 Seed Mixtures and Rates

The proposed seed mixtures (Table 2-6) that would be used to revegetate disturbance areas are based on pre-mining vegetation and habitat types in the area, climatic and soil conditions of the project area, and seed availability. The final selection of seed mixes would depend on the results of site-specific reclamation studies and commercial availability of seed. Commercial seeds would be purchased from local sources, if possible.

Revegetation activities would be conducted in the fall to take advantage of winter moisture. On steep slopes and in rocky areas, broadcast seeding would be used for seed application. Drill seeding would be employed on level to gently sloping areas where coarse fragment content is low.

2.2.19.5 Shrub Plantings

Native shrub seedlings would be planted on the tailings impoundment surface following application of growth media. This would be conducted in conjunction with seeding. GMMC is currently conducting a reclamation shrub study on the existing tailings impoundment to determine which species can be established on the tailings.

2.2.19.6 Weed Control

Weed control measures would be implemented during vegetation establishment in order to limit the spread of noxious weeds and to ensure that the site is successfully reclaimed with desirable species. GMMC would coordinate noxious weed controls with the Nevada Department of Agriculture and the BLM, as appropriate. Noxious weed occurrences within the reclaimed areas would be reported to the BLM, and an appropriate eradication plan would be developed. If herbicides are used to control noxious weeds, the application rates and methods would conform to BLM standards thereby avoiding potential risks to human health.

2.2.19.7 Reclamation Schedule

Reclamation would be initiated when individual process components are no longer required for mine operations or when facilities are decommissioned and site closure begins. Removal of facilities, rough grading, and scarifying activities may occur at any time during the project. Concurrent reclamation of select disturbed areas has been performed and may continue at any time until mine closure. Post-mining reclamation would be initiated when ore reserves have been exhausted and mining operations cease.

Soil distribution and revegetation activities are limited by the time of year during which they can be effectively implemented. General scheduling of revegetation activities would include:

- Grading, drainage control, and maintenance that would be conducted year-round;
- Seedbed preparation in early fall just prior to reseeding; and
- Completion of seeding prior to winter in order to take advantage of winter and spring moisture.

Figure 2-1 outlines the anticipated revegetation schedule, which would be followed during the life of the mine and 10 years beyond mine closure to achieve the reclamation goals. Site conditions and/or yearly climatic variations may require modifications to the revegetation schedule.

2.2.19.8 Facility Reclamation

Reclamation procedures, as outlined in GMMC's currently approved POO/Reclamation Plan (RP) (Rayrock 1998) would be used for reclamation of the various components included in the proposed mine expansion. Reclamation of these facilities is discussed below.

Table 2-6
Proposed Seed Mixes[1]

Scientific Name	Common Name	Seeding Rate (PLS lbs/acre)[2]	
		Interim Seed Mix[3]	Reclamation Seed Mix
GRASSES			
Agropyron desertorum	Crested wheatgrass	7.0	2.0
Sitanion hystrix	Bottlebrush squirreltail	--	2.5
Oryzopsis hymenoides	Indian ricegrass	3.5	2.5
FORBS			
Sphaeralcea coccinea	Scarlet globemallow	--	0.5
SHRUBS			
Atriplex canescens	Fourwing saltbush	--	3.0
Atriplex confertifolia	Shadscale	3.5	3.0
Ceratoides lanata	Winterfat	--	0.5
Total lbs/acre		14.0	14.0

[1]Certified weed-free seed would be used.
[2]PLS = Pure live seed (pounds per acre).
[3]Soil stockpiles, road berms, and/or other temporary facilities.

Open Pit

The primary goal for reclamation of the open pits would be to ensure long-term stability of the final configurations. Pit walls would gradually ravel and sluff over time to the natural angle of repose for the individual rock types. Pit bottoms would be ripped and seeded to encourage absorption of precipitation. Reclamation of the near horizontal surfaces of the in-pit backfill would be similar to reclamation of the out-of-pit waste rock dumps. Growth media would be applied and the areas subsequently seeded with an appropriate seed mix. A perimeter berm with warning signs would be placed around the pits during reclamation with a sufficient setback to accommodate the projected, final pit crest.

Road beds in and around the pit areas and pit floors would be rebladed and ripped and/or scarified to prepare a seedbed or a surface for application of growth media; the area to be reclaimed would depend on engineering feasibility and safety considerations. The prepared surfaces would subsequently be seeded with an appropriate seed mixture.

Drainage Diversions

The proposed Trout Creek, Cottonwood Creek, and unnamed drainage diversions would remain in place after mining has been completed. These diversions have been designed to return the stream flows to the original channels downstream of the developed facilities and prevent water from accumulating in the pit bottoms. Remedial activities associated with these diversions is expected to include removal of any installed culverts, remedial earthwork, revegetation of disturbed areas, and armoring sections of the diversion channels with rock to reduce erosion, as needed. GMMC would monitor and maintain the diversion channels as part of the post-closure monitoring through 2015 to ensure that the long-term design criteria are met.

Waste Rock Dumps

Prior to reclamation, the waste rock dumps would be recontoured, regraded to slope angles of 3H:1V, and crowned to prevent water from ponding. Perimeters would be irregular to allow blending with the existing topography. Large boulders would be placed on the ridges or benches to provide wildlife habitat. All flat benches and other areas of the dump with recontoured slopes accessible by heavy machinery would be ripped and/or scarified to produce a rough surface for anchoring of reapplied growth media. Growth media would be applied to the sideslopes as well as the top surfaces of the waste rock dumps. These areas would be reseeded with an appropriate seed mixture.

__Ore Crushing and Processing Facilities__

Crusher and mill facilities would be decommissioned following the completion of ore processing. Equipment, electrical facilities, instrumentation, aboveground piping, miscellaneous fencing, and mobile and permanent structures would be removed from the site in accordance with appropriate Federal and state regulations. Foundations would be broken up and buried in place prior to growth media application and seeding.

__Heap Leach Pads__

Permanent closure of the heap leach facilities would require treatment of the spent heaps to neutralize the weak acid dissociable (WAD) cyanide available in the ore pile and to lower the pH. GMMC would utilize one of three methods for heap leach pad closure, depending upon results from rinse tests and MWMP tests to identify contaminants that would require neutralization in the heaps. These methods would include:

- A freshwater rinse with chemical neutralization and/or carbon filtration;
- An expanded freshwater rinse with bacterial neutralization and a passive bioreactor; and
- The Greenworld Science Method of heap closure.

Under the freshwater rinse with chemical neutralization method, neutralization would be accomplished by rinsing the heaps with fresh water. It is anticipated that the application rate of fresh water would be similar to the operational leaching rate of 2,000 gpm. Treatment of the rinseate would include chemical neutralization and/or carbon filtration. Rinsing of the heaps would continue until the rinsate is successfully neutralized as determined by the NDEP, Regulation Branch and BLM.

The neutralized heaps would be regraded to a final average slope of 3H:1V. Perimeter berms and ditches would be left intact and covered during regrading. All surface plumbing and exposed conduit would be removed and disposed of properly. The liner and drain pipes would be left in place under the stabilized heap. The heaps would be resurfaced with growth media and seeded with an appropriate seed mix.

The second method of heap leach neutralization, a freshwater rinse with bacterial neutralization is currently employed at the REN Mine in Nevada and could be utilized at the Marigold Mine. Under this alternative, the surface area of the leach pads would be expanded and collection ditches installed on the outside of the expanded pad areas. The expanded pad areas would be compacted, covered with low permeability natural materials, and a synthetic liner and leak detection/collection system would be installed to connect with the present liner and system. After the spent heaps have been sprayed with fresh water to reduce the level of cyanide, the heaps would be distributed over the expanded pads to facilitate an overall slope angle of less than 3H:1V. The heaps would be seeded with a reclamation seed mix (see Table 2-6) in order to promote bacterial growth and subsequently neutralize the heap. Periodic rinsing with fresh water would promote the vegetative and bacterial growth. A passive bioreactor, which acts similarly to a sewage treatment leach field, would be used to treat the rinseate. Periodic rinsing of the heaps would continue until the rinseate was successfully neutralized. Final reclamation of the neutralized heaps would proceed, as discussed above, pending BLM and NDEP review and approval.

The third potential heap leach pad closure method, the Greenworld Science Method, is currently in use at the Glamis Dee Gold Mine in Eureka County, Nevada. This method involves a proprietary chemical/nutrient treatment using a combination of alcohols, sugars, or fatty acids to create a reducing environment in the heap. The nutrients are injected into the heap subsurface, as soon as active heap operations have ceased, to deoxygenate the heap and form bio-reductive zones for the precipitation of reducible species from solution. Using this methodology, cyanide, nitrate/nitrites, and metal constituents can be altered or immobilized in the heap. After chemical treatment, the slopes would be reduced, and a 6-inch evapotranspiration cover composed of soil would be applied. The drain down solutions would be land-applied in a constructed leach field. The associated leach ponds would be closed and reclaimed. This treatment, combined with the soil cover, would ensure that drinking water standards would be met for all constituents except salts and total dissolved solids. These elements would be removed using a simple leach field unit process. The expanded freshwater rinse with bacterial neutralization and the Greenworld Science Method heap leach neutralization processes will require additional NEPA analysis to determine impacts and must be approved by both BLM and NDEP prior to the initiation of these neutralization methods.

After the leach pads have been drained, the pads would be rinsed for approximately 1 year. GMMC would be responsible for monitoring seepage control and effluent for up to 3 years, as directed by NDEP, to meet Nevada drinking water standards.

__Process Solution Ponds__

Reclamation of the process solution ponds and water storage ponds would consist of draining, removal or burial in place of the synthetic liners, reshaping, seedbed preparation, and seeding. Following evaporation of all liquid from the ponds, any sludges in the ponds would be analyzed using both the MWMP and the Toxicity Characterization Leaching Procedure (TCLP). If the results are within the limits as defined by each procedure, the synthetic liners would be folded around the evaporate and buried in-place.

All pond sites and ditches would be filled and recontoured to prevent ponding of runoff and allow for natural drainage. The pond areas would be graded and contoured to blend in with the natural topography. The prepared surfaces would be scarified and reseeded.

__Tailings Impoundment__

During operations, the proposed tailings dam slopes would be revegetated to minimize erosion of the structure. Revegetation would occur on the additional lift to be added to the existing impoundment dam and on any additional disturbance on the existing embankment. Growth media would be applied and work would be conducted concurrently (i.e., during the life of the facility).

Upon cessation of mining and after placement of waste rock and growth media on the tailings, any ongoing seepage would be continually pumped back to the tailings impoundment and used to promote the establishment of the vegetative cover and to control dust during the drying process. All remaining tailings solutions would be evaporated.

Drying of the tailings would be expedited by establishing a shrub cover to enhance evapotranspiration. Test plots would be constructed to determine if one or more of the following salt tolerant species can be established on the tailings: black greasewood (*Sarcobatus vermiculatus*), quailbush (*Atriplex lentiformis*), desert willow (*Chilopsis linearis*), or other species approved by the BLM. These species would be in addition to the species previously tested and established by GMMC on the existing tailings impoundment.

Tailings material would be analyzed using both MWMP and TCLP tests. If results meet regulatory requirements, the material would be stabilized in place. If not, an alternative closure plan would be developed with NDEP. The planned 3-year shutdown of the mill also would provide additional time to evaluate the tailings remediation program currently in place at the Marigold Mine.

Reclamation of the tailings impoundment would be conducted as follows:

- Diversion ditches installed during construction of the impoundment would be retained, or new ditches constructed, to prevent storm water run-on.

- All surface plumbing, dewatering sumps, and exposed conduits would be removed and disposed of appropriately. The impoundment liner and drain pipes would be left in place under the stabilized pond. Wells, would be plugged according to State of Nevada standards.

- The dam roadway surface and any excess dike material would be bulldozed onto the tailings pond area. The tailings surface would be regraded to allow positive drainage and prevent ponding. The tailings pond surface would be recontoured, where necessary, to allow drainage away from the tailings dam.

- The regraded pond surface would be covered with a minimum of 1 foot of waste rock to cover the tailings, followed by 6 inches of growth media. After placement of the growth media, the seedbed would be prepared and the surface seeded.

- In addition to broadcasting seed, native shrub seedlings would be planted after the seedbed had been prepared.

- Interceptor ditches at the base of the dam (consisting of buried 4-inch diameter pipe) would be end capped, and minor regrading would be conducted to ensure adequate burial of the pipe and the collection box.

- All ancillary equipment associated with the impoundment facility would be removed. Cement foundations would be broken up and buried in place.

- Tailings effluent captured by the TSPS would be used to control fugitive dust emissions from the tailings impoundment and to promote vegetation establishment within the tailings impoundment.

<u>**Roads**</u>

All roads within the project area would be ripped, scarified, and revegetated, following the completion of mining, unless designated as a county road. Roads would be contoured as near as possible to the surrounding terrain. All culverts and other water diversion structures would be removed and the natural drainage patterns restored. Water bars or other structures may be left in place to reduce any undue erosion. The prepared surfaces would be seeded with an appropriate seed mix.

<u>**Removal of Stored Fuels, Chemicals, and Blasting Supplies**</u>

Fuels, chemicals, and blasting supplies would be consumed prior to the end of mining, if feasible. Remaining inventories would be returned to vendors or removed and properly disposed of off-site.

<u>**Exploration Drill Hole Abandonment**</u>

All exploration drill holes completed after April 9, 1990, have been plugged according to standards stipulated by the NRS 534.421 through NRS 534.428. Any additional drill holes resulting from ongoing exploration also would be plugged according to these requirements.

<u>**Ancillary Facilities**</u>

Prior to decommissioning of mine facilities, GMMC would submit a detailed decommissioning plan to

NDEP for approval. Structures would be properly removed and/or buried. Following removal or burial, the ground surface would be recontoured, prepared, and seeded. Disposition of other project components on public grounds would consist of:

- Freshwater rinsing or active treatment of any piping which contained cyanide solutions;
- Concrete foundations would be broken-up and buried in place;
- Buried piping and conduits would be drained, rinsed, capped or sealed, as needed, and buried in place;
- Scrap metal, trash, and other non-hazardous debris would be placed in the existing Class III landfill or disposed of off-site at an appropriate facility; and
- All power lines and electrical systems not required for future post-mining use would be removed.

Facilities Not Reclaimed

The following components would not be subject to post-mining reclamation:

- Main access road from the Buffalo Valley Road;
- Certain buildings and structures located on private property in Section 9;
- Electric power lines or equipment necessary for post-mining uses; and
- Water lines or other utilities required for post-mining uses.

2.3 8-South Partial Pit Backfill Alternative

The 8-South Partial Pit Backfill Alternative would include the partial backfilling of the existing 8-South Pit with approximately 16.5 million tons of waste rock originating from the proposed 8-North Pit (Map 2-4). This alternative would eliminate the need to construct the 8-North Waste Rock Dump (85 acres) thereby decreasing total disturbance to 632 acres. In addition, the partial backfilling of the pit would eliminate the potential formation of a shallow pit lake after mine closure. A summary of total disturbance and reclamation acreages is presented in Table 2-7. Post-reclamation topography for the alternative is illustrated in Map 2-5. All other aspects of mine operation under this alternative would be the same as described for the Proposed Action.

2.4 No Action Alternative

Under the No Action alternative, currently permitted operations at the Marigold Mine would cease after 2001, with final reclamation extending 10 years beyond closure. Additional mineral resources in the project area would remain undeveloped, and no construction or expansion of mine pits, waste rock dumps, heap leach pads, tailings impoundment, or other ancillary facilities would occur. It is estimated that the seepage period for the existing tailings impoundment would be reduced by 3 to 5 years under this Alternative. A summary of reclamation acreages by project facility for the No Action Alternative is presented in Table 2-8. Post-reclamation topography for this alternative is illustrated in Map 2-6.

Table 2-7
Acreages Disturbed and Reclaimed After the 8-South Partial Pit Backfill Alternative

Facility	Disturbed Acres[1]			Reclaimed Acres		
	Public Land	Private Land	Total	Public Land	Private Land	Total
Pits	324	211	535	0	0	0
Waste Rock Dumps	343	296	639	343	296	639
Heap Leach Pads	56	152	208	56	152	208
Crushing/Mill/Plant Facilities[2]	35	18	53	35	8	43
Tailings Impoundment	0	234	234	0	234	234
Process Ponds	5	2	7	5	2	7
Storm Water Ponds	1.5	4.5	6	1.5	4.5	6
Growth Media Stockpiles	10	38	48	10	38	48
Haul Roads/Access Roads	36	52	88	22	39	61
Water Supply System	4	9	13	4	9	13
Diversion Ditches/Creek Diversions[3]	13	18	31	0	0	0
Exploration Drill Pads and Roads	17	25	42	17	25	42
"Infill"/Miscellaneous Areas	51.5	22.5	74	51.5	22.5	74
Total Acreage	**896**	**1,082**	**1,978**	**545**	**830**	**1,375**

[1]Total of currently permitted and proposed disturbances.

[2]Although these facilities are not proposed to be reclaimed, the reclamation bond includes full reclamation cost estimates for these facilities.

[3]Diversions will be permanent features as part of the stabilization at facilities.

LEGEND

- WASTE ROCK DUMPS
- MINE PITS
- GROWTH MEDIA STOCKPILES
- PROCESS FACILITIES
- FACILITIES, HAUL ROADS, "INFILL" AREAS, ETC.
- SURFACE WATER DIVERSIONS
- GMMC PROPERTY LINE
- EXISTING PERMIT BOUNDARY
- PROPOSED PERMIT BOUNDARY

Marigold Mine

Map 2-4

8-South Partial Pit Backfill Alternative

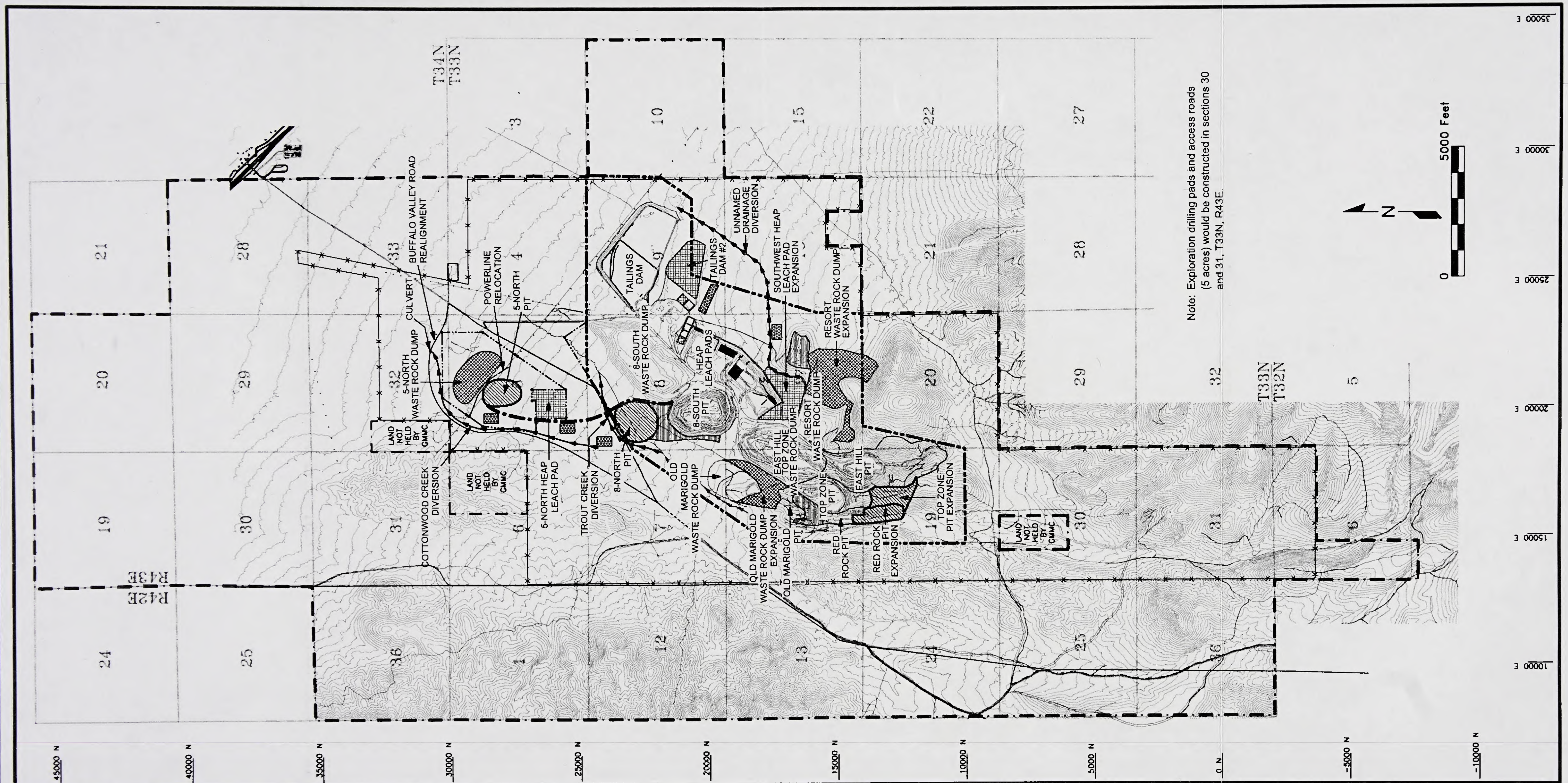
Table 2-7
Acreages Disturbed and Reclaimed After the 8-South Partial Pit Backfill Alternative

Facility	Disturbed Acres[1]			Reclaimed Acres		
	Public Land	Private Land	Total	Public Land	Private Land	Total
Pits	324	211	535	0	0	0
Waste Rock Dumps	343	296	639	343	296	639
Heap Leach Pads	56	152	208	56	152	208
Crushing/Mill/Plant Facilities[2]	35	18	53	35	8	43
Tailings Impoundment	0	234	234	0	234	234
Process Ponds	5	2	7	5	2	7
Storm Water Ponds	1.5	4.5	6	1.5	4.5	6
Growth Media Stockpiles	10	38	48	10	38	48
Haul Roads/Access Roads	36	52	88	22	39	61
Water Supply System	4	9	13	4	9	13
Diversion Ditches/Creek Diversions[3]	13	18	31	0	0	0
Exploration Drill Pads and Roads	17	25	42	17	25	42
"Infill"/Miscellaneous Areas	51.5	22.5	74	51.5	22.5	74
Total Acreage	**896**	**1,082**	**1,978**	**545**	**830**	**1,375**

[1]Total of currently permitted and proposed disturbances.

[2]Although these facilities are not proposed to be reclaimed, the reclamation bond includes full reclamation cost estimates for these facilities.

[3]Diversions will be permanent features as part of the stabilization at facilities.



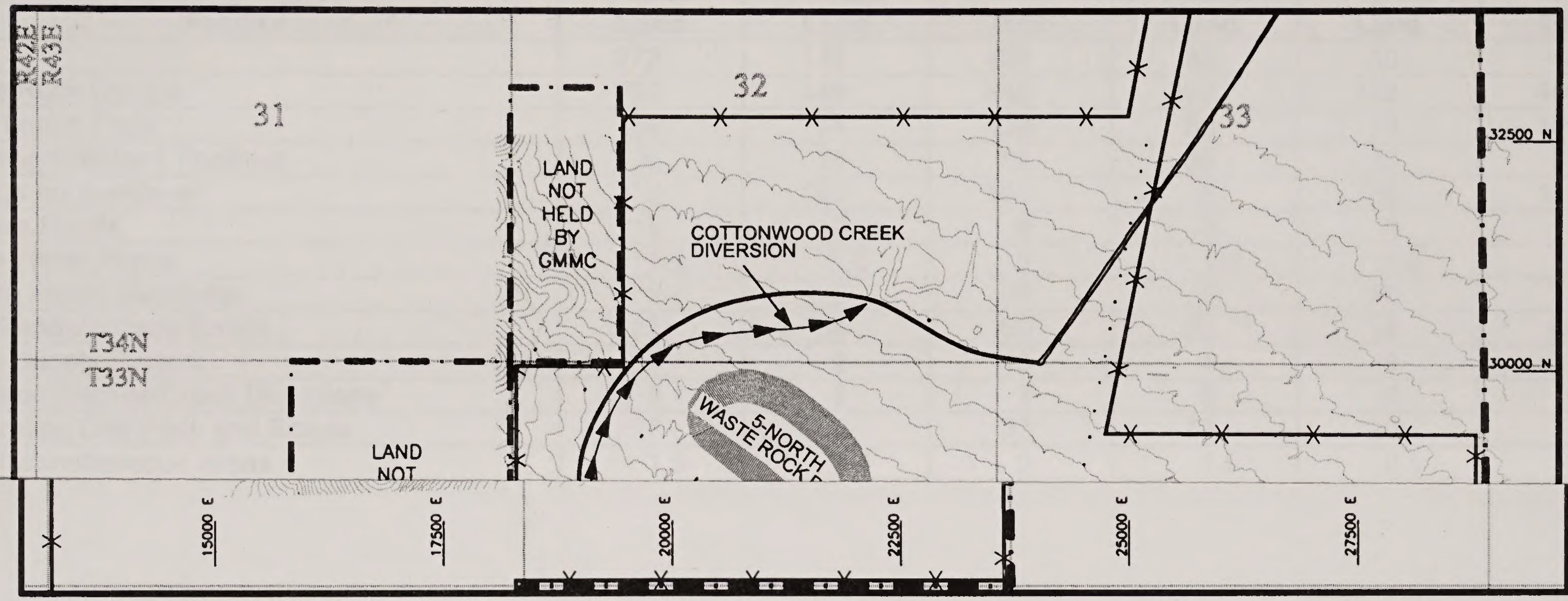
LEGEND

- WASTE ROCK DUMPS
- MINE PITS
- GROWTH MEDIA STOCKPILES
- PROCESS FACILITIES
- FACILITIES, HAUL ROADS, "INFILL" AREAS, ETC.
- SURFACE WATER DIVERSIONS
- GMMC PROPERTY LINE
- EXISTING PERMIT BOUNDARY
- PROPOSED PERMIT BOUNDARY

Marigold Mine

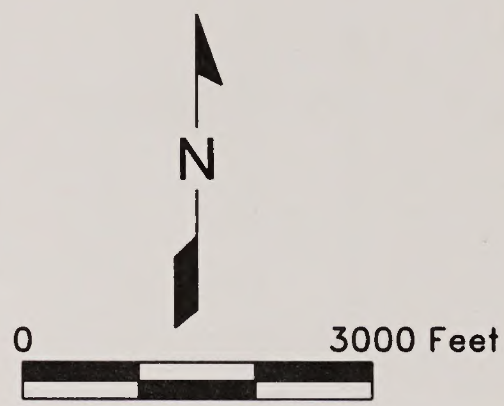
Map 2-4

8-South Partial Pit Backfill Alternative



LEGEND

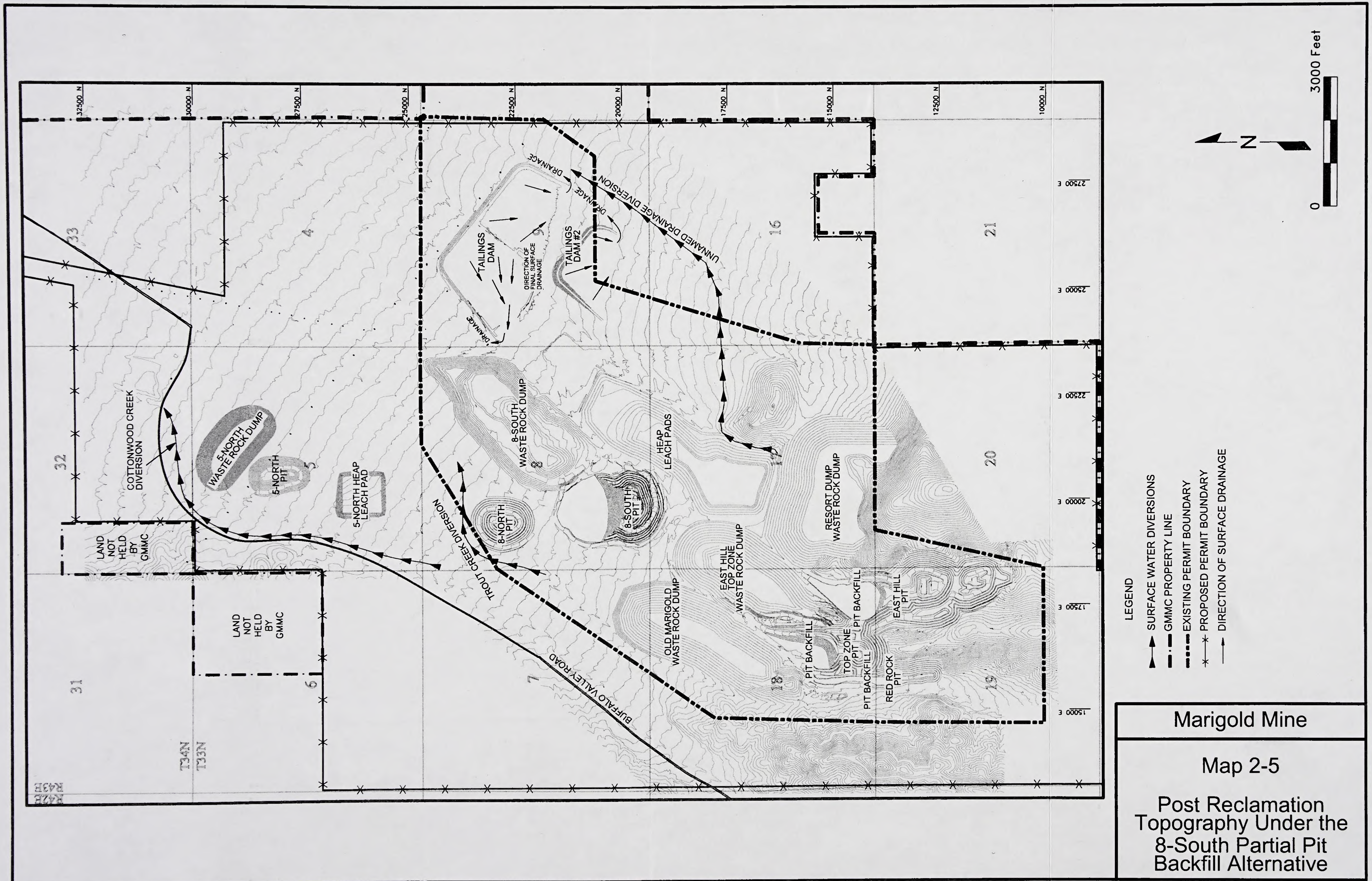
- SURFACE WATER DIVERSIONS
- GMMC PROPERTY LINE
- EXISTING PERMIT BOUNDARY
- PROPOSED PERMIT BOUNDARY
- DIRECTION OF SURFACE DRAINAGE



Marigold Mine

Map 2-5

Post Reclamation Topography Under the 8-South Partial Pit Backfill Alternative



Marigold Mine

Map 2-5

Post Reclamation Topography Under the 8-South Partial Pit Backfill Alternative

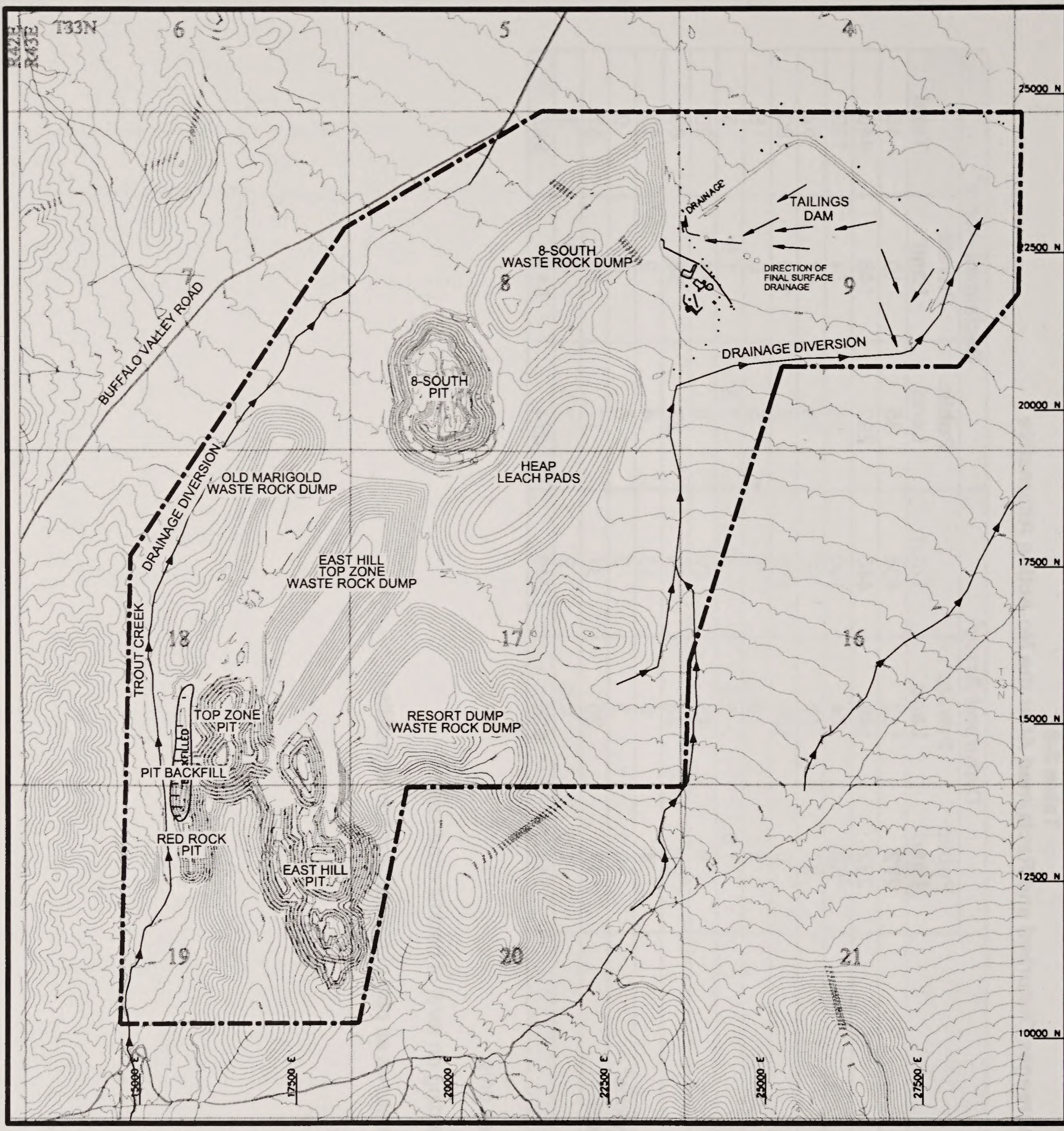
Table 2-8
Acreages Disturbed and Reclaimed After the No Action Alternative

Facility	Disturbed Acres[1]			Reclaimed Acres[2]		
	Public Land	Private Land	Total	Public Land	Private Land	Total
Pits	272	132	404	35	10	45
Waste Rock Dumps	292	148	440	292	148	440
Heap Leach Pads	56	74	130	56	74	130
Crushing/Mill/Plant Facilities	35	17	52	35	17	52
Tailings Impoundment	0	180	180	0	180	180
Process Ponds	5	0	5	5	0	5
Storm Water Ponds	1.5	1.5	3	1.5	1.5	3
Growth Media Stockpiles	5	15	20	5	15	20
Haul Roads/Access Roads	22	38	60	22	38	60
Water Supply System	4	9	13	4	9	13
Diversion Ditches/Creek Diversions[3]	~0.1	3	3	0	0	0
Exploration Drill Pads and Roads	17	20	37	17	20	37
“Infill”/Miscellaneous Areas	1.5	0.5	2	1.5	0.5	2
Total Acreage	**711**	**638**	**1,349**	**474**	**513**	**987**

[1]Currently permitted disturbances only.

[2]Actual acreage may vary depending on level of backfill conducted.

[3]Diversions will be permanent features as part of the stabilization at facilities.



LEGEND

SURFACE WATER DIVERSIONS

PROJECT BOUNDARY

DIRECTION OF SURFACE DRAINAGE

N

0 3000 Feet

Marigold Mine

Map 2-6

Post Reclamation Topography For the No Action Alternative

2.5 Alternatives Considered but Eliminated from Detailed Analysis

GMMC considered alternative sites for waste rock dumps and heap leach facilities. Based on condemnation drilling, haul distances, drainage patterns, and operational flexibility, these alternatives were eliminated from detailed analysis. These alternatives included:

- Relocation of 5-North Waste Rock Dump to east of the proposed 5-North Pit;
- Placement of waste rock from the 8-North Pit into the proposed 5-North Pit; and
- Complete backfill of pits.

Relocation of the 5-North Waste Rock Dump to an area east of the proposed 5-North Pit was not a viable alternative since potential mineral reserves were found in this area. Placement of the 5-North Waste Rock Dump in this area would preclude development of these potential reserves. These mineralized zones represent resources that may be economical to mine in the future when gold prices are higher or when extraction technology has advanced. Backfilling would cover these ore reserves and greatly decrease the economic feasibility of recovering this ore at a future date.

Placement of waste rock from the 8-North Pit into the proposed 5-North Pit was also not considered as a viable alternative due to increased hauling distances, health and safety issues, and a potential for increased disturbance over the Proposed Action. Backfilling the 5-North Pit with overburden from the 8-North Pit would entail the construction of a haul road, increase the haul distance by at least 1 mile, and add another haul grade. The haul road would extend from the southern end of the 8-North Pit to the northern end of the 5-North Pit. This would increase the haul distance by approximately 1 mile over the 8-South Partial Pit Backfill Alternative and by approximately 0.7 mile over the Proposed Action operations associated with the 8-North Waste Rock Dump. This haul road also would require crossing the Trout Creek diversion, which would increase design and construction costs. Haul trucks would have to descend into the 5-North Pit to dump, increasing the potential for accidents and fugitive dust and other air quality issues. The haul trucks would also need to ascend from the 5-North Pit, increasing the haul grade over that occurring under the Proposed Action. The increased hauling distance would increase the cost of production for 8-North ore, thereby reducing the tonnage of ore that could be economically extracted from the 8-North Pit.

In addition, the currently proposed mine plan schedule calls for the overburden stripping of 8-North while ore extraction is ongoing at 5-North. As a result, backfilling the 5-North Pit could not be initiated until the pit is mined out, at which time ore production from 8-North Pit would have started. Therefore, surface disposal of the bulk of the 8-North Pit waste rock would be necessary, resulting in the same level of disturbance as would occur under the Proposed Action.

As stated in the Proposed Action, the 8-North Pit would only be developed if the price of gold exceeds $400+ per ounce. If backfilling the 5-North Pit were required, as suggested under this alternative considered but eliminated, and the 8-North Pit were never developed, then the operator would be in noncompliance for not backfilling the 5-North Pit with material from a non-viable ore body.

Complete backfilling of all of the pits is also not a viable alternative for many of the reasons identified above. Complete backfilling would result in double hauling of waste rock and would still have generally the same level of surface disturbance as identified for the Proposed Action due to the sequencing required for pit mining and overburden removal. In addition, pit walls and floors have mineralized zones that may be economical to extract under different economic conditions or with new technologies that may be developed in the future. Backfilling of the pits would eliminate or reduce access to these reserves.

2.6 Interrelated Projects

Interrelated projects are defined for this EIS as those activities that have impacts which, when combined with impacts of the proposed project, could result in cumulative effects on the environment. Interrelated projects include past, present, and reasonably foreseeable future actions. Table 2-9 lists the past and present actions, Proposed Action, and reasonably foreseeable future actions in the Marigold Mine cumulative assessment area. Resource-specific cumulative assessment areas were developed for each resource, as appropriate, and are discussed under their respective sections in Chapter 3.0. The locations of interrelated projects are illustrated on Map 2-7. Descriptions of the projects are provided in the following sections.

As defined in 40 CFR 1508.7 (regulations for implementing NEPA), a cumulative impact is an impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or entity undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time. BLM Instruction Memo NV-90-435 specifies that impacts must first be identified for the proposed project before cumulative impacts with interrelated projects can occur.

Interrelated projects with the potential for cumulative impacts were identified based on the type of activity, geographic location, and time period. A brief description of these actions is provided in this section. The area of concern for cumulative impacts varies by resource, with impacts to certain resources being restricted to the actual area of disturbance. The cumulative assessment area for many resources encompasses an area within a few miles or less of the proposed project site. Exceptions are the cumulative assessment area for cultural resources (includes all major mining projects located between I-80 south to the county line and east from the Lone Tree area to I-80), socioeconomics (includes three-county area), and range/soils/vegetation resources (Battle Mountain Range).

2.6.1 Past and Present Actions

Historic activities in the area have primarily included mineral exploration and development, and livestock grazing. Mining activities have occurred throughout the area since gold was first discovered on a low ridge north of Trout Creek in 1927. Surface disturbance from historic mining operations in the area includes development of mine adits, shafts, open pits, waste rock piles, and other facilities.

There are approximately four exploration projects in the vicinity of the Marigold Mine. Exploration activities include drilling, trenching, and sampling and reclamation of the drill pads. Several mining operations also are located within the vicinity of the Marigold Mine (Map 2-7). Table 2-9 lists these mining and exploration operations, the operating company, disturbance acreage, and number of employees, when available. Four major mines (including Marigold Mine) are currently operating within 20 miles of the Marigold Mine, with an estimated total operations employment of approximately 589.

Mining activities include open pit mining, ore milling and processing, waste rock disposal, tailings disposal, and heap leaching. Recent mining activity has deepened open pits, necessitating installation of dewatering systems to prevent groundwater from entering them by lowering the groundwater table adjacent to the mine. Newmont's Lone Tree and Trenton Canyon mines are currently active (Table 2-9) and would continue to be active at the same period of time as the Proposed Action. The Valmy Power Station also is currently operating in the vicinity of the Marigold Mine.

2.6.2 Reasonably Foreseeable Future Actions

Mining operations within the cumulative impact assessment area that have been proposed or are in

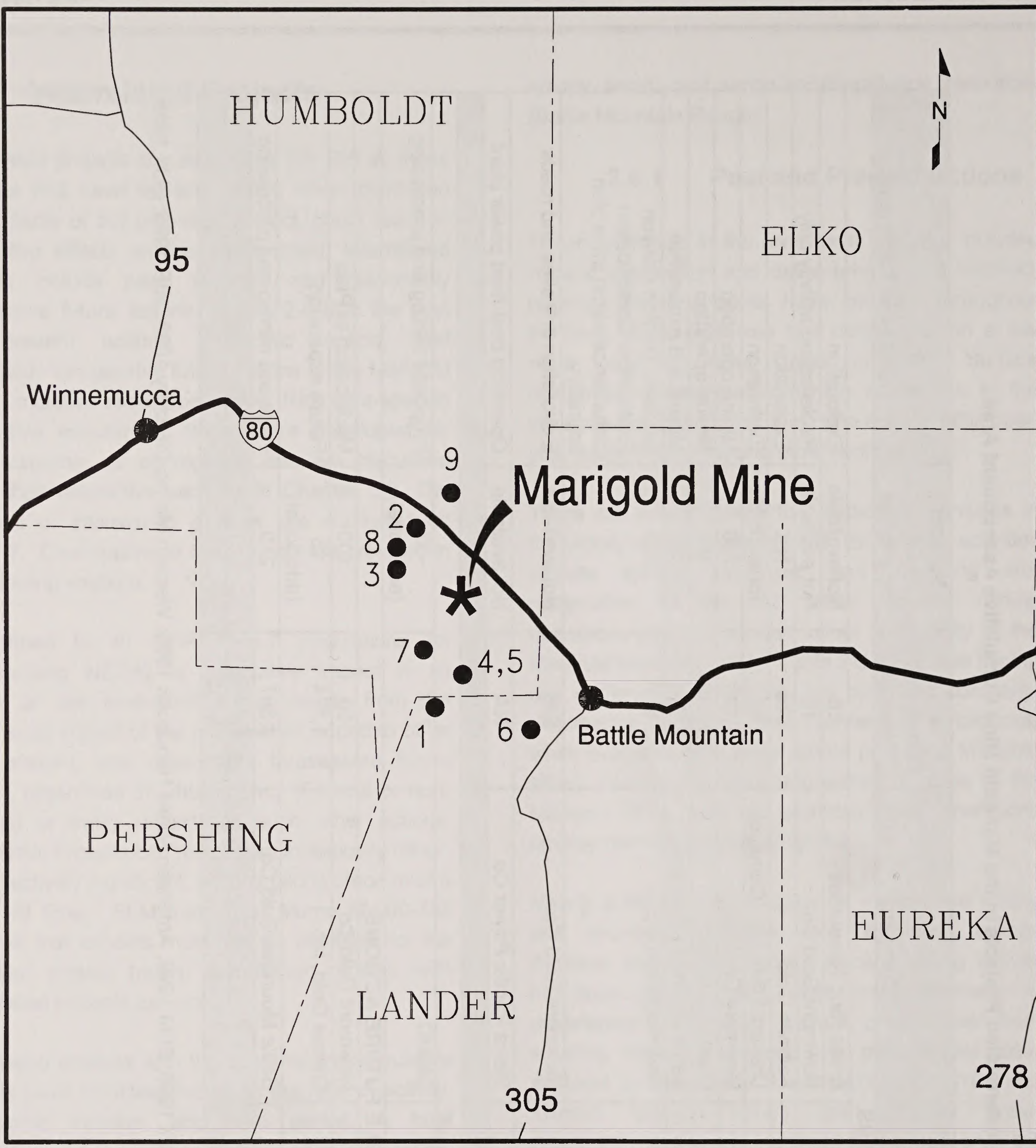
Table 2-9

Interrelated Projects in the Marigold Mine Cumulative Assessment Area

Facility Name	Company	Disturbance Acreage	Number Of Employees	Status or Comments
PAST AND PRESENT ACTIONS				
Brass Ring Exploration	Brass Ring Resources	18	Not available	Exploration
Buffalo Mountain Exploration	Newmont Gold Co.	18	Not available	Reclamation activity only
Buffalo Valley Mine	Fairmile Gold	146	NA	Exploration
Converse Exploration Project	Uranerz USA, Inc. (Cameco)	50	Not available	Exploration
Lone Tree Mine	Newmont Gold Co.	4,730	350	Mining operation
Marigold Mine	Glamis Gold, Inc.	1,349	83	Mining operation
Reona Project	Battle Mountain Gold Co.	2,704	20	Mining and exploration
Trenton Canyon Mine	Newmont Gold Co.	2,682	130	Includes Trenton Canyon Exploration Consolidation disturbance within mine plan boundary
Trenton Canyon Exploration Consolidation	Newmont Gold Co.	696	Not available	Exploration drill sites and roads
North Valmy Power Station	Sierra Pacific Power Co.	NA	Not available	Operating coal-fired power plant
Subtotal		12,393		
PROPOSED ACTION				
Marigold Mine	GMMC	717	~37 (additional)	Proposed mining and processing
REASONABLY FORESEEABLE FUTURE ACTIONS				
Lone Tree Mine	Newmont Gold Co.	50	100	Modification to Plan
Marigold Mine	Glamis Gold, Inc.	1,174	15 (additional)	Future expansion
Phoenix Project	Battle Mountain Gold Co.	4,387	210	Proposed mining and processing
Subtotal		**6,325**		
TOTAL		**19,435**		

Sources: Brown and Caldwell 1999; BLM 1999; American Mines Handbook 1999; Western Mining Directory 1998; JBR 1998; BLM 1998.

NA = Not applicable.



Legend

1 Buffalo Valley Mine
2 Lone Tree Mine
3 Buffalo Mountain Exploration
4 Trenton Canyon Mine
5 Trenton Canyon Exploration
6 Reona/Phoenix Project
7 Converse Exploration Project
8 Brass Ring Exploration
9 North Valmy Power Station

0 5 10 Miles
0 5 10 Kilometers

Marigold Mine

Map 2-7
Interrelated Projects

the review stage are listed in Table 2-9. Within the vicinity of the Marigold Mine, the Lone Tree Mine has been proposed for expansion, and the Phoenix Project has been proposed as an expansion of the Reona Project. Both projects are currently under review. The Phoenix Project would add approximately 210 operations personnel. Proposed dates of construction, operation, and closure are not currently known. These mines have been included in the cumulative assessment area for socioeconomic resources.

The disturbed area for present and reasonably foreseeable future mining activities in the region could be as high as approximately 18,700 acres (Table 2-9). Existing mines and exploration activities have disturbed or are permitted to disturb approximately 12,400 acres and future mining activity is projected to disturb another approximately 6,300 acres. Portions of active mines would likely be reclaimed concurrent with mining operations. Continued modification of existing mines, proposed new mines, and possibly closure of existing mines can be expected in response to changes in environmental, operational, and regulatory conditions, ore grade, operating costs, and the price of mineral commodities.

2.7 Summary Comparison of Impacts Between the Proposed Action, 8-South Partial Pit Backfill Alternative, and No Action Alternative

Table 2-10 summarizes and compares the environmental impacts between the Proposed Action, 8-South Partial Pit Backfill Alternative, and the No Action Alternative. Detailed descriptions of impacts are contained in Chapter 3.0. The summarized impacts include the implementation of mitigation measures presented as part of the resource discussions in Chapter 3.0.

2.8 Agency-Preferred Alternative

In accordance with the NEPA, Federal agencies are required by the Council on Environmental Quality (40 FR 1502.14) to identify their preferred alternative for a project in the Draft EIS, if a preference has been identified, and in the Final EIS prepared for the project. The preferred alternative is not a final agency decision; it is rather an indication of the agency's preliminary preference. The alternative identified below is the BLM's preferred alternative at the Draft EIS stage in the environmental review process. This preference may be changed based on the agency and public comments that are received on this Draft EIS. As indicated above, an agency-preferred alternative also will be presented in the Final EIS. The BLM's preference at this time considers all information that has been received and reviewed relevant to the proposed project.

The agency preferred alternative is the 8-South Partial Pit Backfill Alternative as described in this EIS with all appropriate mitigation. GMMC would be required to implement this alternative if they developed the 8-North Pit, based on a gold price of $400 per ounce. Material from the 8-North Pit would then be used to partially backfill the existing 8-South Pit. If the 8-North Pit were not mined, then GMMC would implement the Proposed Action with all appropriate mitigation.

Table 2-10
Comparisons of the Proposed Action, 8-South Partial Pit Backfill Alternative, and No Action Alternative

Resource Area	Proposed Action	8-South Partial Pit Backfill Alternative	No Action Alternative
Water Resources and Geochemistry	The proposed mine expansion would not impact wells, springs, or surface water flows within the project area. Loss of 1.3 acres of other waters of the U.S. 5,945 linear feet of Trout Creek would be diverted (2,255 feet of this would be modifications to the old diversion). 8,050 linear feet of Cottonwood Creek would be diverted. 475 gpm of groundwater would be needed for an additional 6 years.	Groundwater impacts would be the same as the Proposed Action. Loss of 1.3 acres of other waters of the U.S. Reduced potential for lake in 8-South Pit. Reduced length of Trout Creek diversion.	No impacts to water resources would occur as compared to the Proposed Action. Reduced tailings seepage period. No changes in Trout Creek and Cottonwood Creek diversions.
Geology and Minerals	320,000 ounces of gold would be permanently removed.	Same as the Proposed Action	Gold would be produced as presently permitted to year 2001.
Air Quality	The proposed expansion of the mine would result in additional emissions over the short-term. Modeling results indicate that maximum concentrations of PM_{10}, NO_2, CO, and SO_2 would not exceed Nevada or National Ambient Air Quality Standards. MMC would follow standard construction practices to minimize fugitive emissions and impacts to air quality. The project would comply with all existing air quality standards in Nevada.	Same as the Proposed Action	Impacts to air quality would continue at current levels through 2001. Fugitive emissions would decrease through the reclamation period.
Soils	Nine soil types (mapping units) and 717 acres would be disturbed. Soils would be salvaged during ground-disturbing activities.	Nine soil types (mapping units) and 632 acres would be disturbed. Soils would be salvaged during ground-disturbing activities.	No additional soils would be impacted. Reclamation could be completed sooner.

Table 2-10 (Continued)

Resource Area	Proposed Action	8-South Partial Pit Backfill Alternative	No Action Alternative
Vegetation Resources	Two vegetation communities totalling 717 acres would be disturbed. Areas that are not reclaimed (61 acres) would have a long-term loss of forage production.	Two communities totalling 632 acres would be disturbed. Areas that are not reclaimed (61 acres) would have a long-term loss of forage production.	No additional vegetation would be disturbed or removed. Reclamation and revegetation of existing disturbance would be completed sooner.
Wildlife and Fisheries Resources			
Wildlife habitat disturbed	717 acres would be disturbed.	632 acres would be disturbed.	No additional wildlife habitat would be disturbed.
Wildlife habitat not reclaimed	Portions of the pit areas (61 acres) would not be reclaimed.	37 acres would not be reclaimed in the 8-South Pit.	No additional wildlife habitat would be disturbed.
Mule deer winter range disturbed	717 acres would be disturbed; portions of the pit areas (61 acres) would not be reclaimed.	632 acres would be disturbed; portions of the pit areas (61 acres) would not be reclaimed.	No additional wildlife habitat would be disturbed.
Animal displacement and habitat fragmentation	Increased displacement and incremental habitat fragmentation from mine development.	Same as the Proposed Action.	No additional displacement or fragmentation.
Impacts to breeding birds	Incremental habitat loss; indirect disturbance.	Same as the Proposed Action.	No adverse effects to breeding birds.
Noise and human presence.	Slight increased noise and access from mine construction.	Same as the Proposed Action.	Increased noise and human access; would continue at the current level.
Special Status Species			
Loss of potential burrowing owl habitat.	674 acres of shadscale and sagebrush vegetation disturbed.	589 acres of shadscale and sagebrush vegetation would be disturbed.	No additional habitat would be disturbed.
Impacts to bats.	Displacement (Red Rock Adit) of bats and incremental habitat loss.	Same as the Proposed Action	No additional displacement or incremental habitat loss would occur.
Range Resources	Temporary loss of 288 animal unit months and permanent loss of 6 animal unit months.	Same as the Proposed Action.	No permanent loss of animal unit months would occur.

Table 2-10 (Continued)

Resource Area	Proposed Action	8-South Partial Pit Backfill Alternative	No Action Alternative
Land Use Authorizations and Access	255 acres of public lands currently used for grazing and dispersed recreation would be converted to mining activities. The land use would not result in the permanent disruption of existing rights-of-way or access to public lands in the mine vicinity.	186 acres of public lands currently used for grazing and dispersed recreation would be converted to mining activities. No permanent disruption to existing rights-of-way or public access would occur.	There would be no change from current uses in the project area.
Recreation	255 acres of public land would be temporarily removed from dispersed recreational use; however, adjacent public lands could be utilized. Developed recreational facilities in the region are not expected to be adversely impacted.	Same as the Proposed Action except 186 acres of public lands would be temporarily removed from dispersed recreational use.	Public lands within the project area would not be dedicated for mining and would remain available for dispersed recreational uses.
Aesthetics (Visual & Noise)	Visual contrast allowable for Visual Resource Management Class III lands within the mine site would be exceeded as a result of the new leach pads and waste rock dumps. Proposed reclamation would reduce the magnitude of most of these contrasts over time, ultimately resulting in Class III objectives being met within 10 years after the reclamation period. Noise from mine operations would be occasionally perceptible at the nearest sensitive receptor but would be well below recognized standards.	Visual resource impacts would be the same as the Proposed Action. Noise impacts would be the same as the Proposed Action.	Management guidelines for Visual Resource Management Class III lands would continue to be exceeded as a result of current mining operations and would be met only after the reclamation period. Project-related disturbance and construction would not occur. Existing noise levels would decrease as current mining activities are completed and reclamation of the site is completed.

Table 2-10 (Continued)

Resource Area	Proposed Action	8-South Partial Pit Backfill Alternative	No Action Alternative
Social and Economic Values	An average construction work force of 30 or less would be employed during the initial construction period (12 months). Up to 30 personnel (including construction work force) would be hired during the operational life of the mine, extending the employment and income benefits in the economy through 2006. Direct contributions to property tax, net proceeds tax, and sales taxes would increase, as would the indirect economic benefits of secondary employment, income, purchases of good and services, and resulting tax revenues. Mine closure in 2006 would result in a phasing out of employment, income, tax revenues, and other economic benefits. The primary communities affected would be Humboldt and Lander counties, Winnemucca, and Battle Mountain.	Same as the Proposed Action.	Mine closure in 2001 would result in the termination of the current employment of 89 operations personnel, and the associated direct and indirect economic benefits in local communities. Tax revenues would be phased out. Potential future economic benefits of mine operation would be foregone.
Hazardous Materials	Spills could be associated with truck deliveries of process chemicals and fuels. The number of chemical or fuel releases expected during project life is about .01. Emergency response actions would contain and cleanup any spill. Chemicals and fuels kept in storage would be contained, minimizing spill impacts.	Same as the Proposed Action.	Spill potential would be substantially reduced at the end of currently permitted mine operations.

Table 2-10 (Continued)

Resource Area	Proposed Action	8-South Partial Pit Backfill Alternative	No Action Alternative
Cultural Resources, Ethnography, and Paleontology	Indirect effects would occur to sites Cr-NV-22-6204 and –6205 (located in the APE), due to access road work. Indirect effects to sites Cr-NV-22-6235, -6246, -6247, -6248 (located outside APE) from access road work and exploration. No sites would be directly affected. No Tribal concerns regarding religious sites or traditional use areas have been identified. No impacts to paleontological resources are expected.	Same as the Proposed Action.	No cultural sites would be directly impacted. Erosional effects and illegal collecting would continue to occur. No impacts to paleontological resources are anticipated.

3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter describes the environment that would be affected by the proposed Marigold Mine Expansion Project and the direct and indirect impacts of the Proposed Action, 8-South Partial Pit Backfill Alternative, and the No Action Alternative. The baseline information summarized in this chapter was obtained from published and unpublished materials; interviews with local, state, and Federal agencies; and from field and laboratory studies in the project area. For resources such as soils and vegetation, the affected area was determined to be the physical location and immediate vicinity of the areas to be disturbed by the proposed project. For other resources such as water resources and geochemistry, air quality, wildlife and fisheries resources, social and economic values, and the transport of hazardous materials, the affected environment was more extensive. For each of the 14 categories of resources, the affected environment was defined by the potential environmental impacts of the Proposed Action.

The analysis of impacts from the Proposed Action and 8-South Partial Pit Backfill Alternative assumed the implementation of the Environmental Protection Measures that have been developed as part of the Proposed Action and are presented in Chapter 2.0. Potential mitigation and monitoring measures developed in response to anticipated impacts are discussed at the end of each resource section. All actions listed as potential mitigation measures have been developed by the BLM and are not part of the Proposed Action. These measures could be required by the BLM as a condition or stipulation of approval of the POO. Residual adverse impacts are those remaining following the implementation of the potential mitigation measures. A discussion of cumulative impacts is included for each resource. Descriptions of short-term uses compared to long-term productivity, irreversible or irretrievable commitments of resources, and energy consumption by the proposed project are provided at the end of the chapter.

The BLM's NEPA Handbook (H-1790-1) requires that all EISs address certain Critical Elements of the Human Environment. These critical elements are presented below along with the location in this chapter where the element is discussed. If the element does not occur within the project area and would not be affected, this is indicated below, and the element is not discussed further in the EIS. This elimination of nonrelevant issues follows the CEQ guidelines as stated in 40 CFR 1500.4.

- Air Quality - refer to Section 3.3.
- Areas of Critical Environmental Concern - none would be affected.
- Cultural Heritage - refer to Section 3.14.
- Prime or Unique Farmlands - none would be affected.
- Floodplains - none would be affected.
- Native American Religious Concerns - refer to Section 3.14.
- Special Status Species - refer to Section 3.7.
- Hazardous or Solid Wastes - refer to Sections 2.2.17 and 3.13.
- Drinking Water/Groundwater Quality - refer to Section 3.1.
- Wetlands and Riparian Zones – refer to Sections 3.1 and 3.5.
- Wilderness - none would be affected.
- Paleontological Resources - refer to Section 3.14.
- Environmental Justice – refer to Section 3.14.
- Wild and Scenic Rivers – none would be affected.
- Noxious Weeds – refer to Section 3.5.

3.1 Water Resources and Geochemistry

3.1.1 Affected Environment

3.1.1.1 Waste Rock Geochemistry

Mineralization at the Marigold Mine is hosted in four principal stratigraphic units: 1) Valmy quartzite and shale; 2) the Antler/Battle Sequence consisting of conglomerates, sandstones, limestones, cherts and shales; 3) the Havallah Formation quartzites, cherts, and limestones; and 4) Edna Mountain Formation primarily consisting of limestone and calcareous siltstone. In addition, overlying alluvium is removed and stockpiled as waste rock as the existing pits are developed and expanded. The mineralized rock contains disseminated and vein siliceous gold ore along with veins of barite and occasionally jarosite. Clay alteration accompanied by iron oxides (hematite, goethite, limonite) is common in the ore zones and the waste rock (non-mineralized but altered rock) that accompanies the ore. Each of the existing and proposed pits and pit expansions has a different proportion of lithologic types and alteration types. The amount of waste rock and percentages of waste rock types removed to date from existing mine pits is summarized in Table A-1 (see Appendix A).

The acid-base geochemistry of waste rock is important in assessing the potential for the rock to produce acidic seepage elevated in heavy metals due to infiltration of precipitation. Similarly, the reaction of waste rock to meteoric water is important in determining if infiltration of rain water or snow melt can mobilize metals without the generation of acidic seepage. GMMC has conducted quarterly sampling and analysis of waste rock previously placed at the mine for acid-generating potential (paste pH test and static acid-base accounting) and for potential mobilization of metals by infiltrating precipitation (meteoric water mobility procedure) as required by the NDEP. The paste pH test is a quick test that estimates the potential pit of waste rock exposed to weathering. The static acid-base accounting test (static test) is used to determine if rock is potentially acid-generating. The BLM criteria for identifying non-acid-generating rocks are: 1) the net neutralizing potential (NNP) must be 20 tons/kiloton (T/kT) or greater, and 2) the ratio of the neutralizing potential (NP) to the acid-generating potential (AGP) must be 3:1 or greater. If these criteria are not met, the rock may be considered potentially acid-generating, and a kinetic humidity cell test would be required to measure in the laboratory the level of acidity and metals that would be generated by the rock when exposed to water and air. These geochemical tests are summarized below.

<u>**Testing Methods**</u>

1) Paste pH Test. This is a simple field test to quickly estimate the potential pH that could be generated as a result of weathering of rock. The rock is crushed, finely ground, and mixed with deionized water to form a paste. The pH of the paste is measured. This test is a very rough guide to the potential pH of an effluent that could be generated by weathering of rock.

2) Static Acid-Base Accounting (Static ABA Test). In the static ABA test, the AGP of the rock is estimated from the amount of reactive sulfur in the rock. Pyrite is the most reactive sulfide found in both metal mines and coal mines, but other sulfides can generate acidic effluent in the presence of pyrite. Commonly, however, the acid-generating potential of a rock is based on the pyrite content and expressed as T/kT of equivalent calcium carbonate. The NP of a rock is based on the ability of the rock to neutralize acid in the laboratory. The principal acid-neutralizing minerals in mineralized and altered rocks associated with gold deposits are carbonate minerals, clays, and feldspars. The NP of the rock also is expressed as T/kT of calcium carbonate equivalent. The NNP of the rock is simply: NNP = NP – AGP. This value should be equal to or greater than 20 T/kT for the rock to be classified as non-acid-generating under the BLM's Acid Rock Drainage Policy (BLM 1996). Similarly, the NP/AGP should be 3:1 or greater for a rock to be classified as non-acid-generating. These criteria are sometimes waved by the BLM for rocks with low pyrite content (pyrite less than 0.5 percent). If these criteria are not met, the rock can be classified as potentially acid-generating, and a kinetic humidity cell test would be required to determine the acidity of the effluent generated when the rock is exposed to water and air.

3) Nevada Meteoric Water Mobility Procedure (MWMP). The MWMP test is a conservative test to estimate the level of metals that can be mobilized from crushed waste rock using simulated rainwater. The crushed rock is equilibrated with water in a closed container for a period of 24 hours. This simulates the effects from contact with rainwater. The resultant water is then analyzed for constituents of concern, usually the constituents specified in the state water quality standards. For Nevada, this list of constituents is contained in the Nevada Profile II elements. If one or more constituents exceed the water quality standards, then the placement of the waste rock and the reclamation of the waste rock pile are evaluated with emphasis on minimizing the infiltration of precipitation and reducing possible impacts to surface and groundwater if seepage should occur from the waste rock pile.

4) Kinetic Humidity Cell Test. This is a laboratory test that simulates the wetting and drying of waste rock that would occur as a result of weathering in a humid, temperate natural environment. In this test, crushed rock is moistened with deionized water for 3 days, dried for 3 days, and then flushed with deionized water. The acidity of the effluent and the level of metals in the effluent are then measured. This 7-day cycle is repeated for a minimum of 20 weeks. The change in acidity and metal loading of the effluent is plotted against time to estimate the long-term chemistry of the potential effluent from the waste rock.

__Data Collection__

GMMC has been collecting waste rock samples on a quarterly basis for testing since 1992. The static ABA test and the MWMP test have been routinely run on waste rock from each pit being mined, as required by the NDEP. Kinetic humidity cell testing has not been conducted because the waste rock sampled to date has been considered to be non-acid-generating by the NDEP. Tables A-2 and A-3 (see Appendix A) present a summary of the static ABA, paste pH, and MWMP data from GMMC's ongoing evaluation of waste rock. Static ABA tests are currently being conducted on waste rock from the proposed 8-North and 5-North Pit areas. Test results should be received by January 2000.

__Static ABA Test Results__

The results of previous static ABA tests at the Marigold Mine (Table A-2) can be grouped by rock type and by the pit from which the waste rock was generated. Evaluation of the data focused on pyrite content since rocks containing pyrite are the main reactive components in Marigold Mine ore and waste rock. These rock types and areas are described below. Only formations that require additional discussion regarding their acid-generating potential are identified below. See Tables A-2 and A-3 for a complete geochemical analysis of all formations.

Tailings Solids: These solids have pyrite generally below 1 percent, a pyritic NNP greater than 20 T/kT, and an NP/AGP of 3:1 or greater. They are thus classified as non-acid-generating based on pyritic sulfur. If total sulfur is used, some samples would fail one or both criteria for non-acid-generating because of the large percentage of unidentified sulfur. However, the low pyrite content (less than 1 percent) and the paste pH values of greater than 7.0 suggest than the existing tailings solids are non-acid-generating.

Leach Solids: These solids are the spent ore found in the existing leach pads. The pyrite content is generally less than 1 percent. The pyritic NNP and the NP/AGP ratio are variable due to the low neutralizing potential of these solids. Also, the total sulfur NNP and NP/AGP ratio are variable due to both the low neutralizing potential and the high percentage of unidentified sulfur. However, the low pyrite content and the paste pH values, that are generally greater than 7.0, suggest that these solids are not acid-generating.

8-South Waste Rock: This waste rock is a variable mixture of alluvium, Valmy Formation quartzites and shales, and the Antler/Battle Sequence carbonate-rich rocks. As shown in Table A-1 (Appendix A), alluvium was initially greater than 50 percent of the waste rock but declined to less than 20 percent by 1992. The Valmy Formation and the Antler/Battle Sequence have dominated the waste rock since 1992. The static ABA test results show that pyrite is generally less than 0.5 percent and total sulfur is less than 1.0 percent in the waste rock. The NNP is variable, but generally above 20 T/kT. The NP/AGP also is quite variable and can be below the guideline of 3:1. The paste pH is greater than 7.0. The paste pH coupled with the low pyrite content and an NNP generally around or greater than 20 T/kT suggests that waste rock from the 8-South Pit is not acid-generating.

Top Zone Waste Rock: Top Zone waste rock is mostly Valmy Formation quartzites and shales with minor additions from the Antler/Battle Sequence, as indicated in Table A-1 (Appendix A). The pyrite content is less than 0.5 percent and the total sulfur content also is less than 0.5 percent. The NNP is highly variable due to the low neutralizing capacity (NP) of the Valmy rocks and can be below 20 T/kT for both pyritic sulfur NNP and total sulfur NNP. Similarly, the NP/AGP is variable but generally greater than 3:1. The paste pH is above 8.0. The low pyrite content coupled with the paste pH above 7.0 suggests that Top Zone waste rock, which is mostly Valmy Formation with some Antler/Battle Sequence rocks, is not acid-generating.

East Hill North Waste Rock: East Hill waste rock is a mixture of Valmy, Antler/Battle, and Havallah rocks, with Valmy and Antler/Battle Sequence rocks being predominant. Total sulfur is less than 0.5 percent and pyrite is less than 0.1 percent. The NNP is highly variable for both the pyritic component and the total sulfur values. Because both pyrite and total sulfur are low, the variations in the neutralizing capacity of the waste rock (NP) controls the NNP and the NP/AGP ratio. Paste pH values are greater than 8.0. Thus, Valmy Formation quartzites and shales, the Antler/Battle conglomerates and limestones, and the carbonate rocks of the Havallah Formation from the East Hill North Pit are not considered to be acid-generating.

East Hill South Waste Rock: To date, all the waste rock from this pit is from the Valmy Formation with pyrite less than 0.1 percent and an NNP greater than 20 T/kT. This waste rock is not acid-generating according to NDEP and BLM guidelines.

Red Rock North Waste Rock: Red Rock North waste rock is composed mainly of Antler/Battle Sequence rocks with some Valmy Formation. Pyrite is again less than 0.1 percent and total sulfur is less than 0.5 percent. The NNP is variable and controlled by the acid-neutralizing capacity of the waste rock (NP) because of the low pyrite and total sulfur contents. The paste pH values are above 7.0. Waste rock from this pit is not considered to be acid-generating.

8-North Waste Rock. Waste rock from the proposed 8-North Pit would be comprised mainly of the Edna Mountain and the Havallah Formation lithologic units. Samples from the Havallah Formation sample contained 0.13 percent pyritic sulfur and had a low neutralizing capacity of 14 T/kT. The NNP was 9.9 T/kT and the ANP/AGP ratio was 3.4:1. The paste pH of 7.89 and the low pyrite content suggest that waste rock from this formation should not be acid-generating; however, the low neutralizing capacity of the rock suggests that there is a potential for acid generation if the sulfide content of the waste rock should rise due to mining of higher sulfide ore.

5-North Waste Rock. Waste rock from the 5-North Pit include the Antler Peak, Battle Formation, Edna Mountain, and Havallah Formation lithologies, as indicated by four samples taken from the proposed pit area. The Havallah Formation sample had a NNP of 18.3 and an ANP/AGP ratio of 8.3:1. The pyritic sulfur content of the sample was 0.08 percent. The paste pH was 7.81. Although the NNP was below the BLM guideline of 20 T/kT, the low pyrite content and the paste pH suggest this rock type would probably not be acid-generating as long as the pyrite content remains low.

__Nevada Meteoric Water Mobility Procedure Test (MWMP) Results__

The results of MWMP tests on existing Marigold Mine waste rock are provided in Table A-3 (Appendix A) and are summarized below. The effluent from these laboratory tests was analyzed for Nevada Profile II constituents, as required by the NDEP. Nevada water quality standards for the Profile II constituents are presented in Table 3-1.

Tailings Solids: Tailings solids show consistent exceedence of drinking water and aquatic life standards for WAD cyanide. Similarly, arsenic and mercury show consistent exceedence of all water quality standards. Molybdenum shows exceedence of the aquatic life standard. Other metals may show an exceedence in a few samples, but generally are within Nevada water quality standards.

Leach Solids: Leach solids show frequent exceedence of drinking water standards for arsenic and mercury. Occasionally, the aquatic life water quality standard is exceeded. Other metals are within Nevada water quality standards.

8-South Waste Rock: Waste rock from the 8-South Pit shows exceedence of the Nevada drinking water standard for arsenic; however the stock water standard for arsenic is generally not exceeded. Similarly, mercury shows exceedence of drinking water and aquatic life standards, but stock water standards are generally not exceeded. Other metals are within Nevada state water quality standards. Waste rock from this pit is a mixture of alluvium, Valmy Formation, and the Antler/Battle Sequence rocks.

Top Zone Waste Rock: The Top Zone Pit waste consistently exceeds all water quality standards for arsenic. Both Valmy rocks and the Antler/Battle Sequence rocks from this pit have elevated arsenic values. Fluoride occasionally exceeds the stock water standard and mercury occasionally exceeds the drinking water standard for waste rock from this pit. Other metals are within Nevada state water quality standards. Top Zone waste rock is mostly Valmy Formation quartzites and shales.

East Hill Waste Rock: Waste rock from the East Hill Pit (North and South) commonly exceeds Nevada drinking water standards for total dissolved solids (TDS), chloride, and sulfate. Arsenic levels consistently exceed drinking water standards and often exceed all other standards. Molybdenum levels exceed the State aquatic life water quality standards. Other metals are within Nevada state water quality standards. East Hill waste rock is a composite of Valmy, Antler/Battle Sequence rocks, and Havallah Formation rocks.

Red Rock North Waste Rock: Waste rock from the Red Rock North Pit meets drinking water standards and all other water quality standards for all metals except arsenic. Red Rock waste rock is composed mainly of Antler/Battle Sequence with some Valmy rocks.

8-North Waste Rock. Samples of potential waste rock from the proposed 8-North Pit include the Antler Peak and Havallah Formation lithologic units. Both units showed an exceedence of the Nevada stock water standard for fluoride, and there is a potential that State drinking water standards for mercury and selenium could be exceeded.

5-North Waste Rock. Samples of potential waste rock from the proposed 5-North Pit include Antler Peak, Battle Formation, Edna Mountain, and Havallah Formation lithologic types. The Battle Formation, Edna Mountain, and Havallah rocks showed exceedences of the Nevada drinking water standard for mercury (Appendix A-3). The Antler Peak sample showed an exceedence of the State drinking water standard for selenium.

Table 3-1
Nevada Water Quality Standards

Parameter[2]	Drinking Water Standards[1]			Nevada Agriculture		Aquatic Life	
	EPA Primary	EPA Secondary	Nevada	Irrigation	Stock Water	1-hour Average	96-hour Average
Aluminum		.05 to 0.2					
Antimony	0.006						
Arsenic	0.05		0.05		0.2	0.36 As (III)	0.19 As (III)
Barium	2	2	2	0.1			
Beryllium	0.004						
Boron				0.1	5	0.55	0.55
Cadmium	0.005		0.005	0.75	0.05	"3"[6]	"3"
Chloride		250	250(400)[3]	0.01	1500		
Chromium	0.1		0.1		1	.016 Cr (VI)	.0011 Cr (VI)
Copper	[4]	1		0.1	0.5	"3"	"3"
Cyanide (WAD)[5]	0.2		0.2	0.2		0.022	0.0052
Fluoride	4	2			2		
Iron		0.3		1		1.0	1.0
Lead	[4]		0.05	5		"3"	"3"
Magnesium		150					
Manganese		0.05					
Mercury	0.002		0.002	0.2	0.01	0.0024	0.000012
Nickel	0.1		0.0134			"3"	"3"
Nitrate (as N)	10		10	0.2	100	90 (w)[7]	90 (w)
pH		6.5-8.5	5.0-9.0		5.0-9.0	6.5 – 9.0	6.5 – 9.0
Selenium	0.05		0.05	4.5-9.0	0.05	0.02	0.005
Silver						"3"	"3"
Sulfate		250	250(500)[3]	0.02			
TDS		500	500(1,000)[3]		3000		
Thallium	0.002		0.013				
Zinc		5			25	"3"	"3"

[1]More stringent of EPA and Nevada Drinking Water Standards for each parameter is applicable in Nevada.
[2]Units are mg/l unless noted. SU = standard units; TDS = Total dissolved solids.
[3]Indicates numbers in ( ) are mandatory secondary standards for public water supply.
[4]Action level for copper is 1.3 mg/l; action level for lead is 0.015 mg/l.
[5]WAD = Weak Acid Dissociable.
[6]"3"= Numbers dependent on hardness; see NAC 445.1339 for equations.
[7](w) = refers to warm water and (c) is for cold water. No letter designation indicates no temperature requirements.
Source: Nevada (1995) LCB File No. R128-95, Amendment to NAC 445.144; U.S. EPA Drinking Water Regulations and Health Advisories, February 1996.

The results of the MWMP tests show a consistent pattern for waste rock at the Marigold Mine. Effluent from existing waste rock is elevated above State drinking water standards for arsenic, mercury, and often molybdenum and is frequently elevated above State aquatic life and stock water standards for arsenic. The East Hill pits have waste rock that produces an effluent that exceeds State drinking water standards for TDS, chloride, sulfate, and arsenic. This suggests that if water should contact waste rock at the Marigold Mine, either through infiltration of precipitation into a waste rock dump or through infiltration of a backfilled pit with a pit lake, then the resulting effluent water could be elevated in arsenic and mercury above most Nevada water quality standards. Molybdenum, TDS, chloride, and sulfate may be elevated, depending on the origin of the waste rock.

3.1.1.2 Surface Water Resources

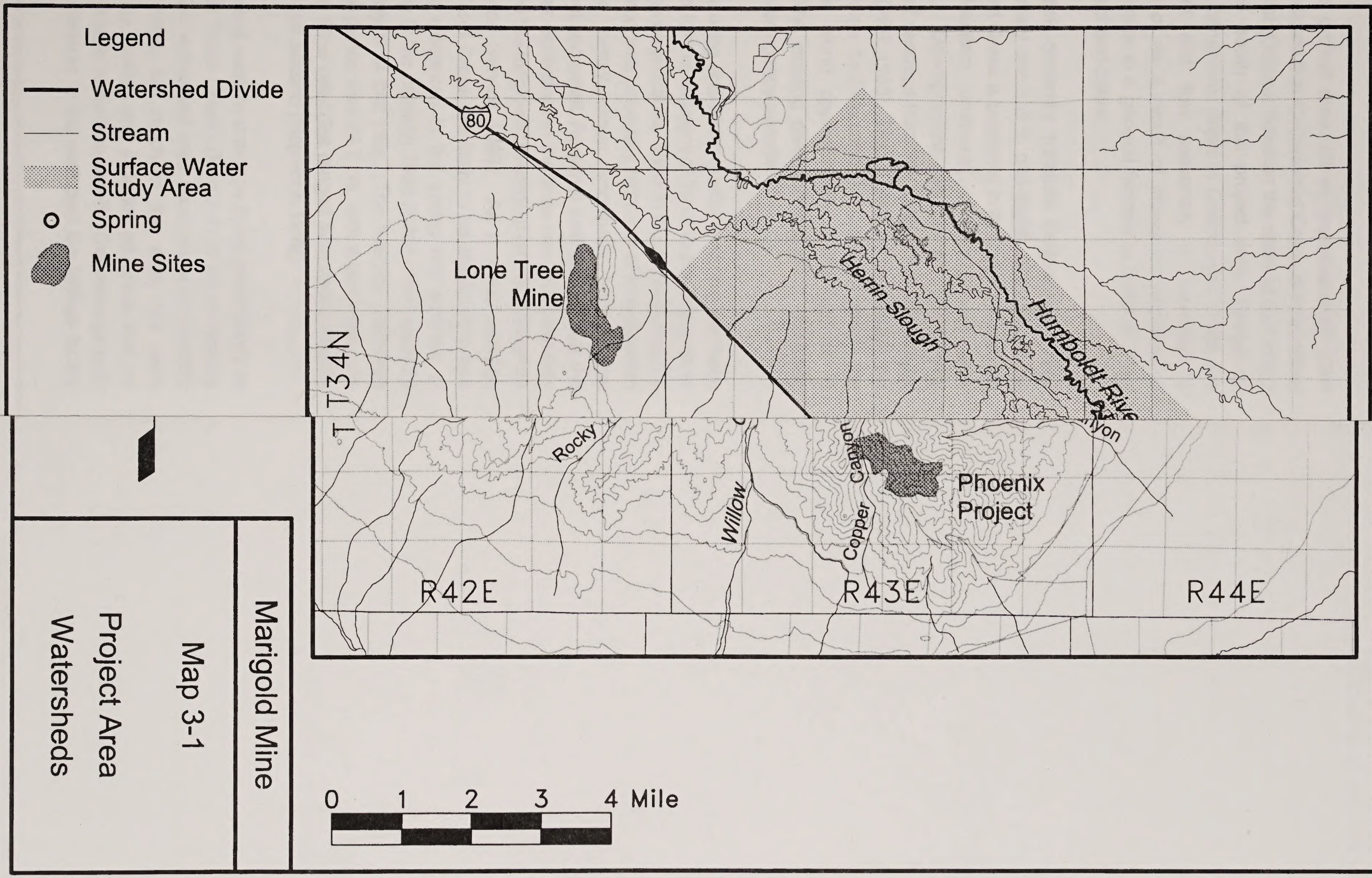
<u>Surface Water Quantity</u>

Average annual precipitation in the area ranges from 6 to 8 inches along the valley floors and foothills, with greater amounts (up to 15 inches) occurring at higher elevations on Battle Mountain (Nevada Department of Conservation and Natural Resources 1964). Mean annual precipitation at the town of Battle Mountain is approximately 7.8 inches (National Climatic Data Center 1999). Most of the precipitation occurs as winter snow. The average annual evaporation from lake surfaces in the locale is approximately 45 inches, with approximately 35 inches evaporating between May and October (National Oceanic and Atmospheric Administration [NOAA] 1982). Annually, the evapotranspiration rate in the area approximates the precipitation rate (Eakin and Lamke 1966).

The project area lies within the Reese River Basin (Nevada Hydrographic Basin 59), which is a sub-basin in the south-central part of the Humboldt River Basin. Tributary streams drain generally northward from canyons on Battle Mountain onto relatively flat alluvial fans. Flows disperse and infiltrate into the fans; the remaining channel system eventually drains to the Herrin Slough, which is located approximately 5 miles northeast of the project facilities. Herrin Slough is a channel feature that drains northwestward across the floodplain deposits of the Humboldt River. After paralleling the river for several miles, the slough meets the river at a confluence approximately 7 miles north of the existing project facilities.

Flows in the Humboldt River vary widely from year to year as a result of changes in precipitation, agriculture water use, transpiration by native vegetation, and flow gains or losses from aquifers. The average annual flow in the river at Battle Mountain is approximately 400 cubic feet per second (cfs). The high flow months are typically May or June, which have long-term average flows of approximately 1,000 cfs. The highest recorded average flow for June is approximately 5,800 cfs, which occurred in 1952. Low flow months extend from September through February, with September typically having the lowest average flow rates. The long-term average September flow at Battle Mountain is approximately 25 cfs. The river often goes dry for several days or weeks during the low flow months (U.S. Geological Survey [USGS] 1999). Losses in flow typically occur downstream of Palisade (approximately 15 miles downstream of Carlin) as a result of agricultural withdrawals, evapotranspiration, and groundwater recharge. With regard to water rights, the river system is over-appropriated, with more demand from the stream water than there is supply.

Two named and two unnamed drainages are located within the Marigold Mine project area (see Map 3-1). The westernmost drainage is Cottonwood Creek, which has a watershed area of approximately 14 square miles. The Cottonwood Creek channel trends generally northward from higher elevations on Battle Mountain and passes through the western part of the project area. Upon leaving the foothills and reaching the major alluvial fan system, it turns northeastward past the existing mining facilities toward the river. No data measurements are available regarding the duration or magnitude of flows in Cottonwood Creek or their chemical characteristics



Marigold Mine

Map 3-1

Project Area Watersheds

The results of the MWMP tests show a consistent pattern for waste rock at the Marigold Mine. Effluent from existing waste rock is elevated above State drinking water standards for arsenic, mercury, and often molybdenum and is frequently elevated above State aquatic life and stock water standards for arsenic. The East Hill pits have waste rock that produces an effluent that exceeds State drinking water standards for TDS, chloride, sulfate, and arsenic. This suggests that if water should contact waste rock at the Marigold Mine, either through infiltration of precipitation into a waste rock dump or through infiltration of a backfilled pit with a pit lake, then the resulting effluent water could be elevated in arsenic and mercury above most Nevada water quality standards. Molybdenum, TDS, chloride, and sulfate may be elevated, depending on the origin of the waste rock.

3.1.1.2 Surface Water Resources

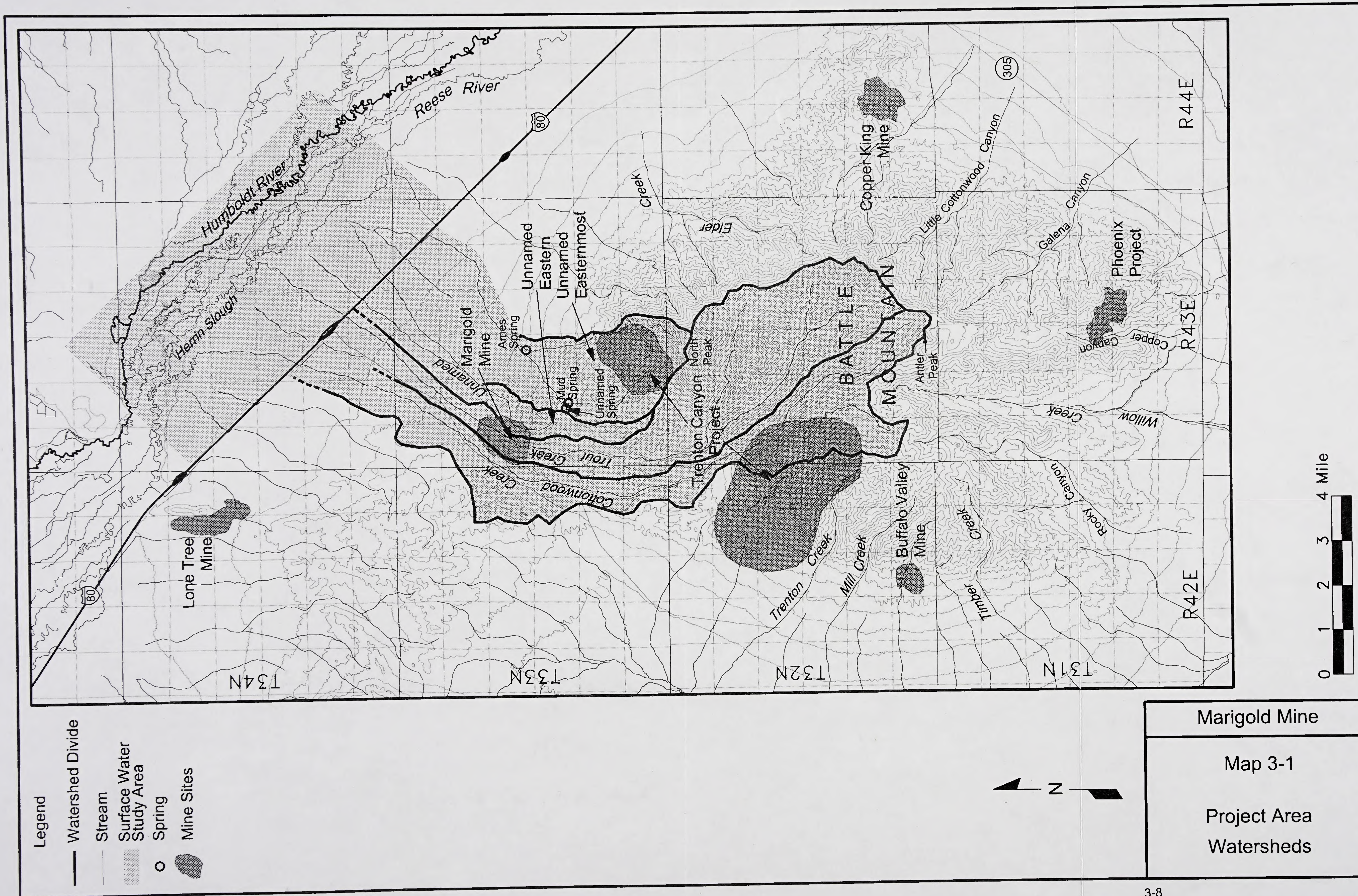
Surface Water Quantity

Average annual precipitation in the area ranges from 6 to 8 inches along the valley floors and foothills, with greater amounts (up to 15 inches) occurring at higher elevations on Battle Mountain (Nevada Department of Conservation and Natural Resources 1964). Mean annual precipitation at the town of Battle Mountain is approximately 7.8 inches (National Climatic Data Center 1999). Most of the precipitation occurs as winter snow. The average annual evaporation from lake surfaces in the locale is approximately 45 inches, with approximately 35 inches evaporating between May and October (National Oceanic and Atmospheric Administration [NOAA] 1982). Annually, the evapotranspiration rate in the area approximates the precipitation rate (Eakin and Lamke 1966).

The project area lies within the Reese River Basin (Nevada Hydrographic Basin 59), which is a sub-basin in the south-central part of the Humboldt River Basin. Tributary streams drain generally northward from canyons on Battle Mountain onto relatively flat alluvial fans. Flows disperse and infiltrate into the fans; the remaining channel system eventually drains to the Herrin Slough, which is located approximately 5 miles northeast of the project facilities. Herrin Slough is a channel feature that drains northwestward across the floodplain deposits of the Humboldt River. After paralleling the river for several miles, the slough meets the river at a confluence approximately 7 miles north of the existing project facilities.

Flows in the Humboldt River vary widely from year to year as a result of changes in precipitation, agriculture water use, transpiration by native vegetation, and flow gains or losses from aquifers. The average annual flow in the river at Battle Mountain is approximately 400 cubic feet per second (cfs). The high flow months are typically May or June, which have long-term average flows of approximately 1,000 cfs. The highest recorded average flow for June is approximately 5,800 cfs, which occurred in 1952. Low flow months extend from September through February, with September typically having the lowest average flow rates. The long-term average September flow at Battle Mountain is approximately 25 cfs. The river often goes dry for several days or weeks during the low flow months (U.S. Geological Survey [USGS] 1999). Losses in flow typically occur downstream of Palisade (approximately 15 miles downstream of Carlin) as a result of agricultural withdrawals, evapotranspiration, and groundwater recharge. With regard to water rights, the river system is over-appropriated, with more demand from the stream water than there is supply.

Two named and two unnamed drainages are located within the Marigold Mine project area (see Map 3-1). The westernmost drainage is Cottonwood Creek, which has a watershed area of approximately 14 square miles. The Cottonwood Creek channel trends generally northward from higher elevations on Battle Mountain and passes through the western part of the project area. Upon leaving the foothills and reaching the major alluvial fan system, it turns northeastward past the existing mining facilities toward the river. No data measurements are available regarding the duration or magnitude of flows in Cottonwood Creek or their chemical characteristics



Marigold Mine

Map 3-1

Project Area Watersheds

within the project area. Other measurements (JBR 1996a) indicate that Cottonwood Creek is intermittent to perennial (October flows on the order of 0.07 cfs) 2 to 3 miles south of the project area. Based on observed conditions, flows in Cottonwood Creek are intermittent and flow seasonally in response to snowmelt or as a result of infrequent precipitation events, similar in a general fashion to those in Trout Creek described below.

Trout Creek generally parallels Cottonwood Creek approximately one-half to one-eighth of a mile to the east. Trout Creek is perennial in its upper reaches on Battle Mountain upstream of the project area boundary. Downgradient reaches are intermittent, because of seepage from the channel into the deeper alluvium (JBR 1998). Trout Creek flows through the existing mine facilities and is diverted through the operations along approximately 1,700 feet of its length. The existing diversion system is approved under earlier agency permits.

Flow monitoring and water quality sampling has been conducted for the segment of Trout Creek that passes through the project area. Flow in the creek during the 1998 season was unusually high and of long duration due to a heavy winter snowpack and lengthy subsequent snowmelt. Regional data confirm that the snow water equivalent in the area was approximately three times the long-term average (Natural Resources Conservation Service 1999). As a result, average flows in Trout Creek are likely to be significantly less than were measured in the spring and summer of 1998. Flow in the creek in 1998 lasted from March 23 through July 6 of that year. The average discharge during that period was 29.7 cfs, with a peak flow rate of 55.5 cfs. Flow velocities ranged from approximately 3 to 6 feet per second (Hepworth 1999).

The unnamed eastern drainage (lying immediately to the east of Trout Creek) (Map 3-1) is an ephemeral system. The watershed area occupies approximately 4 square miles, but much of this area has been disturbed by mining and includes pit areas that no longer contribute to surface runoff. The drainage path has been diverted to the east past the tailings facility in Section 9, T33N, R43E. No stream discharge or water quantity data are available for this drainage (JBR 1998).

The unnamed easternmost drainage in the Marigold Mine vicinity (Map 3-1) has a watershed area of approximately 8 square miles, with headwaters in the North Peak area of Battle Mountain. As it opens onto the alluvial fan system, this ephemeral system disperses into a network of numerous small drainages with no distinct streambed evident over most of the fan surface in the project area. In the extreme eastern part of Section 16, T33N, R43E, and diagonally across Section 10, T33N, R43E, a small channel system does occur. Although portions of this watershed lie within the current project area, no disturbance is planned to occur within it (JBR 1998).

Three springs are located within the unnamed easternmost drainage area. Mud Spring and an unnamed spring approximately 800 feet to its northwest lie within the project boundary in Section 20, T33N, R43E. Ames Spring lies outside of the project area in the southwest quarter of the southeast quarter, Section 16 T33N, R43E. There are no other identified surface water features within the project boundary or nearby.

Surface Water Quality

State water quality standards are shown in Table 3-1. Water quality data for samples retrieved from Trout Creek in the spring and summer of 1998 are subsequently shown in Table 3-2. Sampling results indicate that water quality upstream and downstream of the site is generally within Nevada drinking water standards, and is within state agricultural standards. Manganese and iron, which have drinking water standards based on discoloration and taste as opposed to health, are exceeded both upstream and downstream of the site. These constituents show increase in concentration from upstream to downstream. The causes of this are currently unknown.

Table 3-2
Trout Creek Water Quality [1]

Analysis (mg/L unless otherwise specified)	March 1998 Upstream[2]	March 1998 Downstream[3]	May 1998 Upstream	May 1998 Downstream	July 1998 Upstream	July 1998 Downstream
pH	8.06	8.06	8.01	8.10	8.48	8.24
TDS	161	160	155	155	186	196
Alkalinity as $CaCO_3$	98.6	98.8	82.8	83.2	135	144
Bicarbonate	98.6	98.8	82.8	83.2	129	144
Carbonate	<1.0	<1.0	<1.0	<1.0	6.7	<1.0
Hydroxide						
Total Cl	13.6	13.9	10.2	9.8	18.0	20.2
Total F	0.4	0.3	0.2	0.2	0.4	0.4
NO_2+NO_3-N	0.15	0.16	0.10	0.09	<0.02	<0.02
Total Sulfate	31.3	31.2	19.8	19.8	34.7	37.7
Total As	0.005	0.008	0.004	0.011	0.005	0.005
Dissolved As	0.003	0.003	0.002	0.002	0.006	0.006
Total Ba	0.086	0.116	0.081	0.124	0.066	0.151
Dissolved Ba	0.041	0.045	0.044	0.045	0.071	0.113
Total Cd	<0.002	<0.002	***0.005***	0.003	<0.002	<0.002
Dissolved Cd	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Total Ca	25.9	28.7	19.3	20.1	31.7	33.2
Dissolved Ca	27.9	26.7	20.9	20.5	35.5	36.4
Total Cr	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008
Dissolved Cr	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008
Total Cu	0.004	0.013	0.012	0.013	<0.004	<0.004
Dissolved Cu	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Total Fe	***2.49***	***4.32***	***1.95***	***2.92***	0.048	***0.763***
Dissolved Fe	0.066	0.078	<0.019	0.024	<0.019	<0.019
Total Pb	0.008	0.006	0.004	0.004	0.003	0.003
Dissolved Pb	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Total Mg	9.34	10.0	6.31	6.65	10.8	11.4
Dissolved Mg	9.72	9.28	6.55	6.38	12.3	12.5
Total Mn	***0.093***	***0.132***	***0.071***	***0.089***	<0.001	0.019
Dissolved Mn	0.004	0.004	0.002	0.003	0.002	0.004
Total Hg	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Dissolved Hg	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Total K	1.8	2.9	2.5	2.8	2.0	3.4
Dissolved K	1.6	2.2	<1.5	2.5	2.0	3.7
Total Se	<0.002	<0.002	<0.002	0.002	<0.002	0.002
Dissolved Se	<0.002	<0.002	0.002	<0.002	<0.002	.0.003
Total ag	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Dissolved ag	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Total Na	21.1	20.5	18.5	18.7	26.6	29.2
Dissolved Na	22.7	21.7	20.6	19.9	29.4	33.0
Total Zn	0.033	0.039	0.034	0.037	<0.004	0.006
Dissolved Zn	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Total WAD Cyanide	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

[1]Results shown in bold italics meet or exceed water quality standards shown in Table 3-1.
[2]Upstream = opposite Red Rock Pit.
[3]Downstream = mine access road near 8-South Waste Rock Dump.
Source: Marigold Mining Company 1998.

Surface water quality monitoring was conducted at Cottonwood Creek approximately 2.0 miles south of the Marigold Mine in Section 25 (BLM 1998). This monitoring indicated that state water quality standards for aquatic and agricultural uses were met for all constituents during the 2-year monitoring period. No exceedences were identified (BLM 1998).

Waters of the United States

Waters of the United States (U.S.) are defined as: 1) all waters that are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters that are subject to the ebb and flow of the tide; 2) all interstate waters including interstate wetlands; 3) all other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds; the use degradation or destruction of which could affect interstate or foreign commerce, including any such waters: i) that are or could be used by interstate or foreign travelers for recreational or other purposes; or ii) from which fish or shellfish are or could be used for industrial purposes by industries or foreign commerce; or iii) that are used or could be used for industrial purposes by industries in interstate commerce; or iv) all impoundments of waters otherwise defined as waters of the U.S. under the definition; or v) tributaries of waters as described above; or vi) the territorial seas; or vii) wetlands adjacent to waters (other than waters that are themselves wetlands) as described above; and viii) not prior coverted cropland (33 CFR 328[a] and 40 CFR 230.3[s]).

Waters of the U.S., including wetlands, subject to Section 404 of the Clean Water Act were partially delineated in the project area in 1993 (Gibson and Skordal 1993). Approximately 3.7 acres of waters of the U.S. were delineated, and approximately 2.82 acres of these waters were determined to have been previously impacted by mining activities within the project area, mostly due to the existing Trout Creek diversion. A Nationwide Permit as authorized pursuant to 33 CFR Part 330 Appendix A (26) authorizes discharges of dredged or fill material into waters of the U.S. under certain conditions. Where more than one acre but less than 10 acres of waters of the U.S. would be lost, notification-level activities may be permitted by the COE. Appropriate permits have been approved for past activities on the project area (COE 1993), and would be sought for future disturbances to waters of the U.S.

The 1993 survey did not extend over the entire proposed mine expansion area, but provided sufficient information to allow additional assessments to be made. Given the information presented in the earlier report, a total of 9.7 acres considered to be waters of the U.S. occurs within the current project area overall. Approximately 1.3 acres of waters of the U.S. would be disturbed by the Cottonwood Creek diversion, bringing the total disturbed acreage of waters of the U.S. up to 4.12 acres for the entire project area. GMMC has committed to completing the delineations of Waters of the U.S. prior to any disturbance in the areas. All appropriate plans and permits also would be approved prior to disturbance.

3.1.1.3 Water Rights

Table 3-3 indicates the water rights, sources, and usage in the project vicinity. A number of the rights, particularly the oldest certificated rights for irrigation or mining, occur several miles from the project boundary.

3.1.1.4 Groundwater Resources

The project area lies south of the Humboldt River in an area that has received extensive hydrologic study related to mine dewatering and the Valmy Power Station production water use. Studies related to mine dewatering and groundwater hydrology have been conducted in the area for the Lone Tree Mine by Hydrologic Consultants, Inc. (HCI 1994, 1996a, 1996b, 1996c). Studies related to water sources for the North Valmy Power Station were mainly conducted by Guyton and Associates (Guyton 1976a,

Table 3-3
Water Rights in the Project Vicinity

Owner	Application	Point of Diversion (Legal Description)	Filing Status	Source	Diversion Rate (cfs)[1]	Use	Annual Duty (af[2]; Mg[3])
F. Marker	2216	T32N, R43E	Certificated	Trout Creek	0.1661	Irrigation	61.84 af
C.Marker	2324	T33N, R43E, Sec. 30	Certificated	Trout Creek	0.1496	Irrigation	65.04 af
A. Marker	2513	T33N, R43E, Sec. 16	Certificated	Desert Spring	0.10	Irrigation	40 af
Buffalo Valley Mines, Inc.	2621	T32N, R42E, Sec. 26	Certificated	Mill Canyon Spring	0.16	Mine	0
F. Marker	3282	T32N, R42E, Sec. 12	Certificated	Cottonwood Creek	0.3273	Irrigation	160 af
F. Marker	01898	T32N, R42E, Sec. 12	Vested	Cottonwood Creek	---	Irrigation	132 af
G.C. Partee, Trust	10701	T33N, R43E, Sec. 31	Certificated	Trout Creek	0.05	Mine	0
Venturacci Ranch	V03744	T33N, R43E, Sec. 32	Vested	Willow Creek	1.00	Stock	0
Venturacci Ranch	V04636	T33N, R42E, Sec. 20	Vested	Ames Spring Mud Spring	0.50	Stock	0
Marigold Mining Co.	58020	T33N, R43E, Sec. 4	Permitted	Underground		Mine	8 well rights
Marigold Mining Co.	58021	T33N, R43E, Secs. 4/8	Permitted	Underground		Mine	commingled:
Marigold Mining Co.	58022	T33N, R43E, Sec. 8	Permitted	Underground		Mine	not to exceed
Marigold Mining Co.	58023	T34N, R43E, Sec. 28	Permitted	Underground		Mine	828.64 Mg/yr
Marigold Mining Co.	58024	T34N, R43E, Sec. 33	Permitted	Underground		Mine	combined duty.
Marigold Mining Co.	51463	T34N, R43E, Sec. 28	Permitted	Underground		Mine	
Marigold Mining Co.	51884	T34N, R43E, Sec. 33	Permitted	Underground		Mine	
Marigold Mining Co.	51886	T33N, R43E, Sec. 4	Permitted	Underground		Mine	
Santa Fe Pacific Gold Corp.	60606	T32N, R43E, Sec. 7	Permitted	Underground	0.11	Other	60 af
Newmont Gold Co.	62320		Permitted	Underground			

[1]cfs = cubic feet/second.
[2]af = acre feet.
[3]Mg = million gallons.
Source: Nevada Division of Water Resources 1998, Glamis Marigold Mining Company 1999.

1977a, 1977b, 1977c). Groundwater studies related to the Marigold Mine include the evaluation of water supply wells by Water Management Consultants, Inc. (WMC 1992) and an evaluation of Lone Tree Mine dewatering on water levels in the Marigold Mine area (WMC 1994). Three water wells (WW1, WW2, and WW3) currently supply 450 gpm to the Marigold Mine (see Map 3-2). All three are screened in bedrock and alluvium. Evaluations of the existing tailings impoundment hydrology and seepage from the tailings to groundwater at the Marigold Mine have been completed by WMC (1993, 1994) and Hydro-Engineering (1995).

Conceptual Hydrologic Model

The project area lies within the Humboldt River drainage in north-central Nevada. Groundwater recharge in the vicinity of the project is derived from infiltration of precipitation in the bedrock highlands, infiltration of stream flow during periods of high flow in the late spring and during storms, from the Humboldt River, and from deep interbasin flow along faults and in carbonate bedrock. The Humboldt River loses approximately 8 cfs as it flows from the town of Battle Mountain northwestward across the project area (BLM 1995). Recharge from infiltration of precipitation in the bedrock highland areas is difficult to quantify because of the variable nature of fracturing in the bedrock and the considerable range in slope steepness and vegetative cover in the highland areas. However, an isotopic study for the water sources at the nearby Lone Tree Mine has shown that the bedrock highlands are an important source of groundwater in the project area. Recharge from precipitation on the valley floors is probably low due to the semiarid nature of this part of Nevada and the ability of the native vegetation to evapotranspire the water back to the atmosphere.

Discharge of groundwater is more difficult to estimate in the project area. Groundwater can come to the surface as springs and the abundance of springs in the highland areas and along the base of the highland areas suggest that this is an important source of groundwater discharge. Domestic, agricultural, and industrial use of groundwater is high in the project area. Shallow alluvial groundwater is used for crop irrigation. Most of this irrigation, however, is north of the Humboldt River. The North Valmy Power Station removes about 2,000 gpm of alluvial groundwater from the south side of the Humboldt River between the power plant and the town of Battle Mountain (WMC 1994). The town of Battle Mountain is permitted for up to 4,107 acre-feet per year (2,545 gpm) of groundwater for municipal use (Guyton 1977a). Many open-pit gold mines in this part of northern Nevada remove groundwater through dewatering, with subsequent discharge of the groundwater to the surface or to the Humboldt River. Dewatering rates are often in the range of tens of thousands of gpm. The Lone Tree Mine is the only mine on the south side of the Humboldt River within the study area that is currently dewatering. Its dewatering rate in 1994 was 23,000 gpm. The average dewatering rate for 1999 was 36,000 gpm (BLM 1995). The Humboldt River is a natural groundwater sink because it lies in a topographic valley between many highlands as it traverses the project area. However, hydrologic studies of the river and monitoring of stream gauges indicate that it loses water to the alluvium across the project area, suggesting that it is not currently a source of groundwater discharge during most of the year. The other source of groundwater discharge is interbasin flow. This deep groundwater flow has not been quantified for the project area, but is a major source of groundwater discharge from many of the basins of Nevada.

In the vicinity of the Marigold Mine and the Battle Mountain area, groundwater occurs in three principal types of aquifers: 1) alluvial aquifers in the basin sediments and sediments shed from the highlands, mainly Battle Mountain; 2) bedrock groundwater in the Valmy, Antler/Battle Sequence, and Havallah formations; and 3) groundwater in major fault zones. Exploration drilling has not identified any highly permeable fault zones in the Marigold Mine area and therefore, faults are not discussed. However, faults containing water, such as the Wayne fault zone, are known from the Lone Tree area. Alluvial groundwater and bedrock groundwater flow to the north and northwest from the Battle Mountain area toward the Humboldt River. Groundwater in fault zones is more difficult to quantify and the direction of movement of groundwater in faults is uncertain.

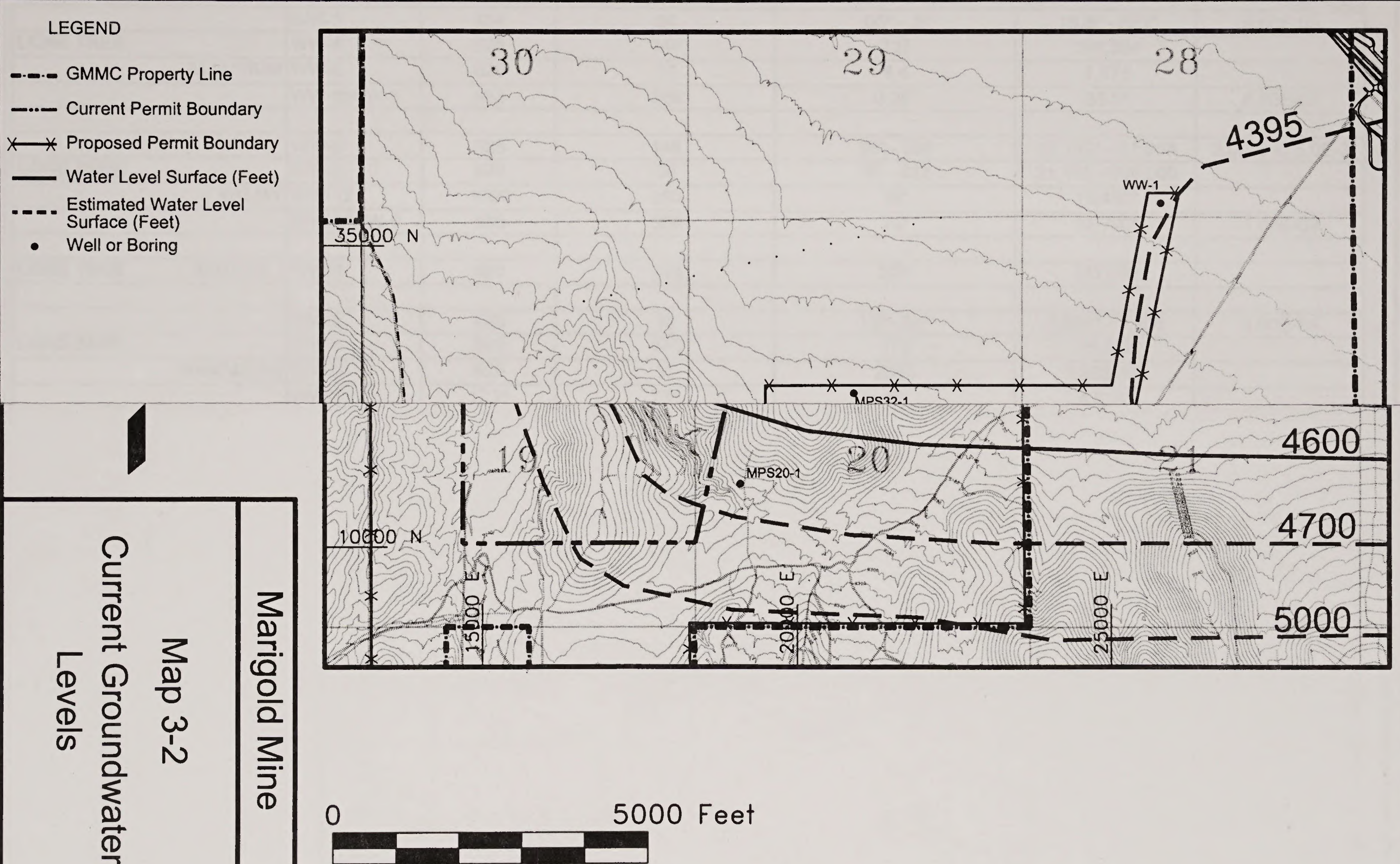
Alluvial Groundwater. The alluvial hydrostratigraphy of the project area and vicinity consists of three principal components: 1) an upper alluvial layer that interacts with the Humboldt River, 2) lake beds that date from the Pleistocene that often act as aquitards preventing the movement of water between the upper and lower alluvial layers, and 3) a lower alluvial layer that can be up to 2,000 feet thick in the project area and contains waterbearing coarse gravel zones intermixed with less permeable finer-grained beds (Guyton 1977a). The upper alluvial layer is found throughout the project area and has been hydraulically evaluated for permeability at the Lone Tree Mine (HCI 1994). Table 3-4 presents a summary of the permeability of the various hydrostratigraphic units in the Marigold – Lone Tree area. The upper alluvial layer ranges in thickness from a few feet to about 200 feet and has a hydraulic conductivity that ranges from less than 1.0 foot/day to around 4.0 feet/day.

The Pleistocene lake beds can be on the order of 5 to 100 feet thick in the vicinity of the Humboldt River (Guyton 1977a). These lake beds may be present in the Marigold Mine area as a thick tan clay found at depths ranging from 85 to 320 feet in the production water wells (WMC 1992). Here the lake beds are 30 to 175 feet thick and lie above the bedrock in the northern part of the mine area. The lake beds have a low permeability and act as an aquitard separating the upper and lower alluvial layers (Guyton 1977a).

The lower alluvial layer is found beneath the Humboldt River and is the principal source of water for the Valmy Power Plant. The permeability of this hydrostratigraphic unit varies considerably and ranges up to a few hundred feet per day. Water is derived from thick zones of gravel and sand that are interbedded with silts and clays.

In the vicinity of the Marigold Mine, especially to the north of the mine between Section 5, T33N, R43E and the town of Valmy, the upper alluvial layer contains water. Immediately north of the tailings impoundment, the water table in the alluvial aquifer is currently around 4,400 feet (amsl) (Map 3-2). For the most part, saturation in the alluvial aquifer is fairly uniform from the mine area to Valmy. However, production water well WW-2, which provides water to the mine, does contain dry alluvium. It is believed that the aquifer in the alluvium is mostly unconfined, but the presence of finer-grained beds locally can lead to local semi-confined conditions in the alluvial aquifer within and north of the mine area. Groundwater in the alluvial aquifer flows to the north and northwest.

Bedrock Groundwater. Bedrock groundwater occurs in the Valmy, Antler/Battle Sequence, and Havallah formations. In the mine area, bedrock groundwater has been intercepted in exploration drill holes. Table 3-5 summarizes the data on bedrock groundwater in the mine area. Bedrock groundwater flows generally from Battle Mountain northward toward the Humboldt River. Bedrock groundwater levels just south of the Marigold Mine in the Valmy formation have been measured at 5,050 feet (amsl). In the vicinity of the southern pits (Top Zone, Red Rock, East Hill) the bedrock groundwater has a potentiometric surface in the range of 4,500 to 4,700 feet (amsl) as shown on Map 3-2. In Section 8 in the vicinity of 8-South and 8-North pits, the bedrock groundwater has an estimated elevation of about 4,400 feet (amsl). In the vicinity of proposed 5-North Pit, the bedrock groundwater is estimated at 4,450 feet (amsl). Production water well WW-3, which is screened mainly in bedrock, has a water level of approximately 4,400 feet (amsl). These are current bedrock water levels. Historical evaluations of water levels at the Marigold Mine from 1992 to 1994 (WMC 1994) indicate that water levels in the alluvium and the bedrock have been dropping at a rate of about 7.0 to 7.5 feet per year. Existing pits and permitted pit expansions at the Marigold Mine are expected to remain dry, with the potential exception of the 8-South Pit, which may have a 10-foot deep pit lake during the



Marigold Mine

Map 3-2
Current Groundwater Levels

known from the Lone Tree area. Alluvial groundwater and bedrock groundwater flow to the north and northwest from the Battle Mountain area toward the Humboldt River. Groundwater in fault zones is more difficult to quantify and the direction of movement of groundwater in faults is uncertain.

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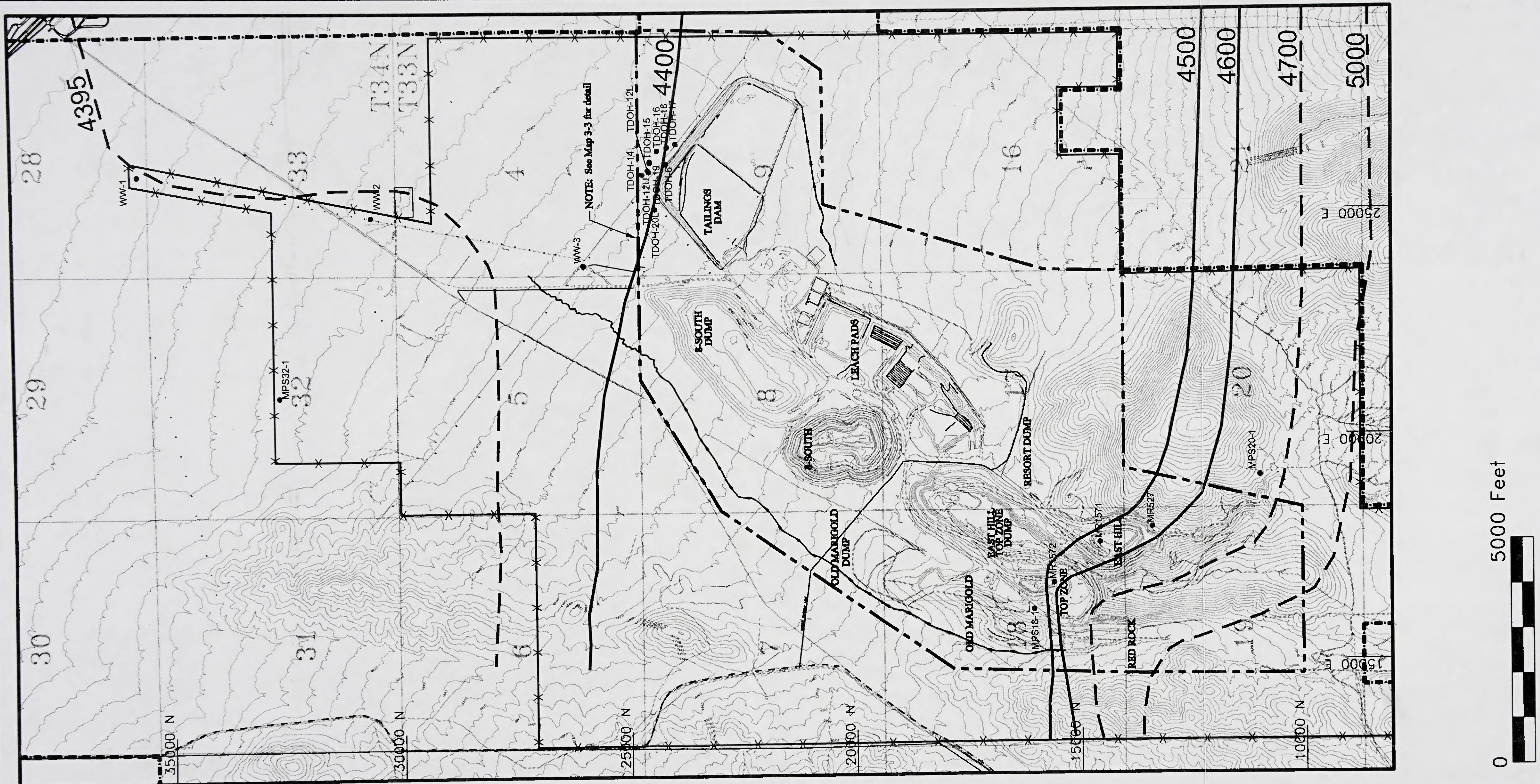


LEGEND

- GMMC Property Line
- Current Permit Boundary
- Proposed Permit Boundary
- Water Level Surface (Feet)
- Estimated Water Level Surface (Feet)
- Well or Boring

Marigold Mine

Map 3-2

Current Groundwater Levels

Table 3-4
Summary of Aquifer Tests Conducted for the Lone Tree and Marigold Mines

Hydrostatigraphic Unit	Tested Well	Well Depth (feet)	Initial Depth to Water (feet)	Hydraulic Conductivity (feet/day)	Transmissivity (feet squared/day)	Storage Coefficient
	WW-3	434	24	.05* - .5*	18.8* - 603*	6.00E-03
LONE TREE	WW-4	625	148	237	101,304	
ALLUVIUM	WW-5	620	50	4.4	1,876	
	WW-5/WW-6	655	308	0.08*	33.5*	6.00E-03
	WW-4	625	148	35* - 333	17,152* - 71,958	2.0E-6 to 5.0E-3
LONE TREE	WW-5	620	50	99 - 822	21,440 - 469,000	
VALMY	WW-12	1090	285	26*	18,492*	
	WW-5/WW-6	655	308	28*	24,790*	1.00E-03
LONE TREE ANTLER	WW-4	625	148	224	131,052	
	WW-2	593	73	13* - 14*	7,504* - 7,906	3.00E-03
LONE TREE	WW-4	625	148	173	96,882	
HAVALLAH	WW-5	620	50	2386	1,393,600	
	WW-13	1235	731	5*	4,958*	
	PMW-4,5,7		268-565		40 - 268	
	WW-5/WW-6	655	308	8.6*	7,718*	3.00E-03
LONE TREE	WW-4	625	148	68 - 202	39,128 - 294,800	6.0E-3 to 1.0E-2
WAYNE FAULT ZONE	WW-5	620	50	484 - 921(575)*	321,600*	3.0E-5 to 6.0E-2
	WW-5/WW-6	655	308	304*	294,800*	9.00E-03
MARIGOLD	WW-1	453	126	12 - 20 (102)*a	3,360 - 5,235	26,885
VALMY/BEDROCK	WW-2	600	204	5.8 (14 - 43)*a	1,611	4,086 - 12,112
	WW-3	700	283	1.6 (11 - 69)*a	652	4,502 - 27,683
	TDOH-12L			0.53	76.5	
	TDOH-12U			1	146	
ALLUVIUM	TDOH-15			4.2	607	
	TDOH-16			1.3	189	
	TDOH-17			0.14	20.9	

Notes: * indicates good data to support value
Source for Lone Tree data (BLM 1995, Table 3-18); Marigold data source (WMC 1992)
( )*a indicates hydraulic conductivity calculated from recovery data for Marigold wells

Table 3-5
Marigold Mine Monitor Well Water Levels

Well Name	Date Installed	Hydrologic Unit Screened	Initial Water Level (feet amsl)	Current Water Level		Average Annual Decline Since 1992 (feet/year)	Est. Pre-1992 Water Level (feet amsl)	Comments
				Date	Water Level			
BEDROCK WELLS								
MPS-18-1	12/16/97	Bedrock	4406.2	6/1/99	4391.3	9.9	4470	Pre-dewatering water level est. by extrapolating
								observed decline backwards for 8 years
MPS-20-1	2/25/98	Bedrock	4667.6	1998	dry	7.4*	4719.4	Pre-dewatering water level est. by extrapolating
								avg site decline back 7 years.
MR-527	4/7/93	Bedrock	4487.5		plugged	7.4*	4502.3	Pre-dewatering water level est. by extrapolating
								avg site decline back 2 years.
MR-1571	6/21/99	Bedrock	4561.9			7.4*	4621.1	Pre-dewatering water level est. by extrapolating
								avg site decline back 8 years.
MR-1572	6/21/99	Bedrock	4593.4			7.4*	4652.6	Pre-dewatering water level est. by extrapolating
								avg site decline back 8 years.
WW-1	3/10/88	Alluvial/Bedrock	4431.2	Nov-96	4395	7.3	4431.2	Initial water level preceeds Lone Tree dewatering. WW-1 is a production well
WW-2	1/30/89	Bedrock	4435.5	Nov-96	4392	8.4	4435.5	Initial water level preceeds Lone Tree dewatering. WW-2 is a production well
WW-3	3/21/89	Alluvial/Bedrock	4438	Jul-94	4410.4	6.2	4438	Initial water level preceeds Lone Tree dewatering. WW-3 is a production well
ALLUVIAL WELLS								
TDOH-6	12/14/92	Alluvial	4433.2	Dec-95	4421.9	6.7	4439.7	Pre-dewatering water level est. by extrapolating
								observed decline back 1 year fm 1992.
TDOH-12L	8/12/93	Alluvial	4428.5	6/10/98	4391.5	7.6	4443.7	Pre-dewatering water level est. by extrapolating
								observed decline back 2 years fm 1993.
TDOH-12U	9/14/93	Alluvial	4428.2	Nov-96	4404.7	7.4	4443	Pre-dewatering water level est. by extrapolating
								observed decline back 2 years fm 1993.
TDOH-15	9/14/93	Alluvial	4428	Jun-98	4404.7	4.9	4437.8	Pre-dewatering water level est. by extrapolating
								observed decline back 2 years fm 1993.
TDOH-16	9/14/93	Alluvial	4428	Jun-98	4398.2	6.3	4440.5	Pre-dewatering water level est. by

Table 3-5 (Continued)

Well Name	Date Installed	Hydrologic Unit Screened	Initial Water Level (feet amsl)	Current Water Level		Average Annual Decline Since 1992 (feet/year)	Est. Pre-1992 Water Level (feet amsl)	Comments
				Date	Water Level			
								extrapolating
								observed decline back 2 years fm 1993.
TDOH-17	9/14/93	Alluvial	4425.1	Jun-98	4394.4	6.5	4438.1	Pre-dewatering water level est. by extrapolating
								observed decline back 2 years fm 1993.
TDOH-18L	5/5/97	Alluvial	4395.8	Jun-98	4385.6	9.4	4451.5	Pre-dewatering water level est. by extrapolating
								observed decline back 7 yrs.
TDOH-19L	5/5/97	Alluvial	4395.2	Jun-98	4384.7	9.7	4452.5	Pre-dewatering water level est. by extrapolating
								observed decline back 7 yrs.
TDOH-20L	5/6/97	Alluvial	4396.4	Jun-98	4393.5	8.3	4445.5	Pre-dewatering water level est. by extrapolating
								observed decline back 7 yrs.
MPS-32-1	2/21/98	Alluvial	4375	1/5/99	4370.9	4.5	4406.9	Pre-dewatering water level est. by extrapolating
								avg.site decline back 8 years.

Note: 7.4* = average site water level decline. Applied to wells with no established water level decline rate. 1992 was chosen as reference year because this was year Lone Tree Mine began dewatering.

Source: Marigold Mine 1999.

winter months (see Table 3-6). Dewatering has not been needed at the existing Marigold Mine pits.

The hydraulic properties of the bedrock hydrostratigraphic units were evaluated at the Lone Tree Mine in preparation for a numerical groundwater model. These conductivity estimates are shown in Table 3-4. No aquifer tests have been run on bedrock aquifers in the vicinity of the existing Marigold Mine pits. Limited tests were run on the production water wells, which are screened mostly in bedrock (WMC 1992). These data are included in Table 3-4.

Groundwater Movement

Groundwater movement across the Marigold Mine can be inferred from the water table contours presented in Map 3-2. The contours were interpreted from monitor well water level data and represent an approximate “average” for water levels in the alluvial aquifer and the bedrock aquifer. Groundwater flows generally from the Battle Mountain highland north to northwestward toward the Humboldt River. Within about 2 miles of the Lone Tree Mine, dewatering has resulted in water movement to the northwest toward the Lone Tree Mine.

The alluvial aquifer water table shows a gradient that generally becomes more shallow northward from the mine area to the Humboldt River. The bedrock water table is more irregular. There appears to be a local high near the Top Zone and East Hill pits (see Map 3-2). The origin of this bedrock groundwater high is uncertain. With the possible exception of the groundwater in the Top Zone and East Hill pit areas, bedrock groundwater flows to the north through the Marigold Mine area following a gradient that rapidly becomes more shallow from south to north across the mine area.

Groundwater Quality

Monitor wells installed north of the existing tailings impoundment are the main source of groundwater quality data for the alluvial aquifer. The three production water wells are the main source of groundwater quality data for the bedrock aquifer. These water quality data are summarized in Table A-4 (see Appendix A). Wells installed for the North Valmy Power Station provide water quality data for the deep alluvial aquifer south of the Humboldt River.

Groundwater in the deep alluvial aquifer south of the Humboldt River is distinct in that it is primarily sodium bicarbonate-dominated water with elevated sulfate and chloride levels. Sodium ranges from approximately 40 to 630 mg/l. Calcium is below 40 mg/l. Sulfate ranges from 35 to 400 mg/l and chloride from 15 to 200 mg/l. The studies of Guyton (1977b) showed that the water quality becomes more saline with depth. TDS range from 200 to 1,700 mg/l. The temperature of the water is generally between 60 to 75°F, but some wells intercepted groundwater with temperatures ranging from approximately 80 to 115°F.

The water quality in the Marigold production wells and in the monitor wells to the north of the tailings impoundment is similar. These waters are calcium bicarbonate-dominated with a TDS in the range of approximately 200 to 450 mg/l. Sulfate ranges from as low as 8 mg/l to a maximum around 380 mg/l. Chloride is generally below 100 mg/l. The pH is between 6.2 and 7.84. In the production water wells, arsenic was elevated with values in the range of 0.03 to 0.07 mg/l. The similarity in water quality between the bedrock aquifer in the production wells and the alluvial aquifer to the north of the tailings impoundment suggests that these two aquifers probably communicate in the project area.

A small seasonal pit lake may form in the 8-South Pit about 30 years after cessation of mining at the Lone Tree Mine due to groundwater rebound. The existence of this potential pit lake is based on estimated post-mining water level projections across the Marigold Mine area from existing monitor wells. If this potential pit lake should form, it would exist in the winter months and probably evaporate during the summer. The water quality may be elevated in arsenic and mercury, based on the MWMP tests

Table 3-6
Pit Bottom Elevations and Pit Water Levels

Pit Designation	Mine Coordinate Range for Pit	Proposed Bottom		Bedrock Water Levels (Estimated Pre-1992 Levels) (feet amsl)	Bedrock Water Levels (Estimated Current Levels) (feet amsl)	Estimated Maximum Pit Lake Depth (feet)	Dewatering Required	Comments
		Plan (feet amsl)	Approved (feet amsl)					
5-N	26,000 - 29,000N 19,000 – 22,000E	4,450	Not Yet Approved	4,438	4,395	0	No	Based on WW-3. Water level 12 feet below pit bottom
8-N	22,000 - 25,000N 18,000 – 21,000E	4,470	Not Yet Approved	4,450 (based on interpreted contours)	4,400	0	No	Water level interpreted between MPS18-1 and TDOH (tailings) wells. Pit bottom to be at least 20 feet above pre-mining water level
8-S	19,000 - 25,000N 18,000 – 22,000E	4,440	4,440	4,450 (based on interpreted contours)	4,400	10	No	Pit lake possible, but not likely based on past history of dry pit during mining. Water level interpreted between MPS 18-1 and TDOH (tailings) wells
East Hill - North	13,000 - 15,000N 16,000 – 18,000E	4,700	4,700	4,600 –4,650 (estimated at 4,620)	4,562	0	No	Water level 50-100 feet below pit bottom based on MR 1571.
East Hill - South	12,000 - 14,000N 16,000 – 18000E	4,820	4,700	4,600 –4,650 (estimated at 4,620)	4,562	0	No	Water level 50-100 feet below pit bottom based on MR 1571.
Old Marigold	17,000 - 19,000N 15,000 – 17,000E	4,910	4,890	4,460	4,406	0	No	Based on MPS 18-1
Top Zone –North	15,000 - 18,000N	4,800	4,800	4,500-4,700 (estimated at 4,650)	4,593	0	No	Based on MR 1572
Top Zone – South	15,000 - 18,000E	4,740	4800	4,500-4,700 (estimated at 4,650)	4,593	0	No	Based on MR 1572
Red Rock - North	12,000 - 15,000N	5,000	4,920	4,700-4,750	4,600 – 4,700	0	No	Water level extrapolated from contoured data
Red Rock - South	15,000 - 16,000E	4,980	Not Yet Approved	4,700-4,750	4,600 – 4,700	0	No	

Source: Marigold Mine.

conducted by Marigold Mines on waste rock from the 8-South Pit.

Tailings Impoundment Hydrology

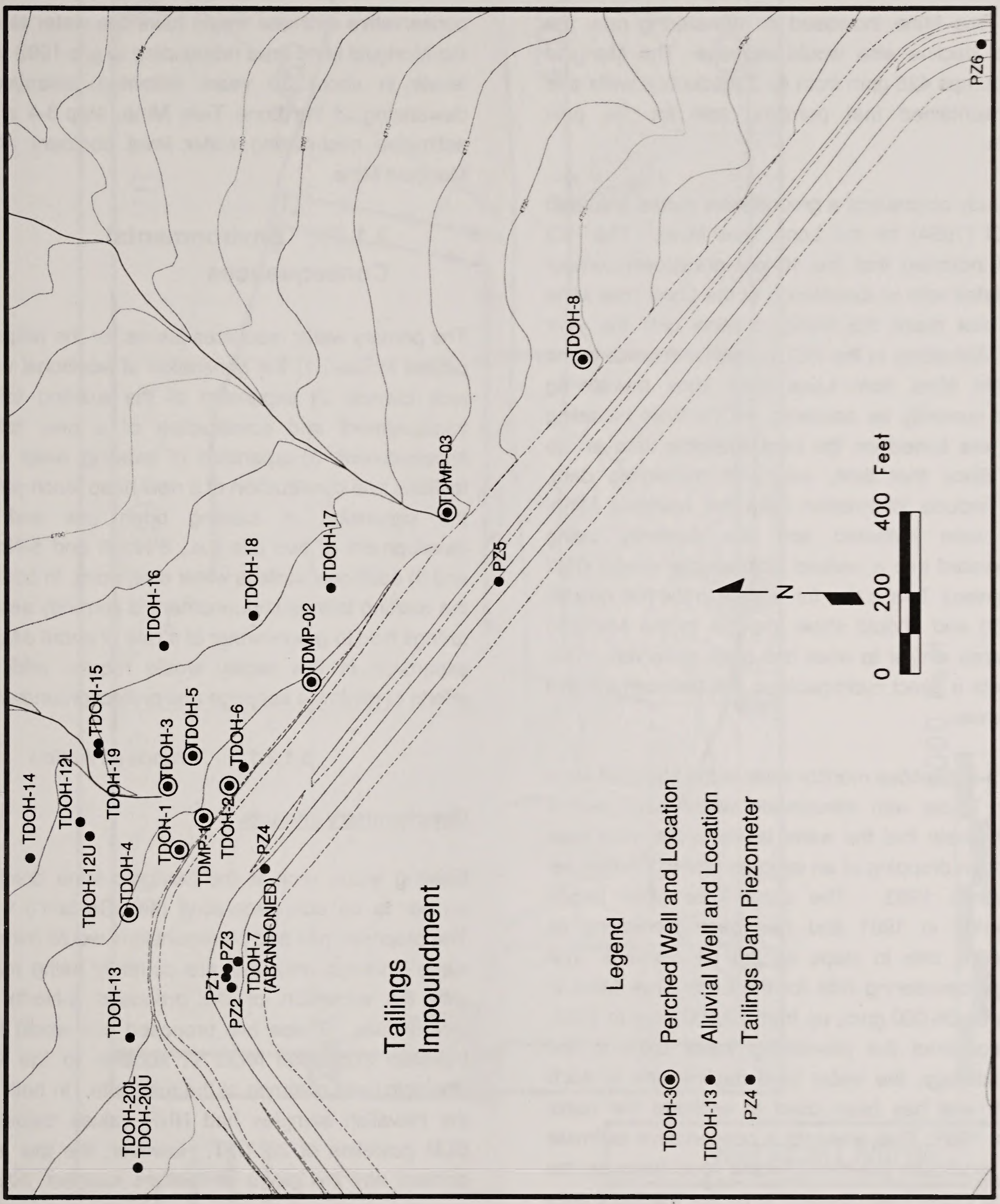
The Marigold Mine currently operates a tailings impoundment located in Section 9, T33N, R43E. This tailings impoundment was constructed in 1988 and is not lined with synthetic materials. Currently, the facility occupies about 180 acres, contains 196,500 cubic feet (or 31 percent of its permitted capacity) of stored tailings, and has a dam approximately 60 to 70 feet high. The facility has a 1-foot compacted clay base with 3 feet of compacted clay along the sides. The facility was constructed in accordance with State of Nevada requirements. In 1992 it was discovered that the tailings impoundment was seeping tailings fluid into the vadose zone near the decant tower on the northern side of the facility. Monitor wells were installed in the vadose zone and the alluvial aquifer north of the tailings to determine the extent of the seepage plume and monitor its impact on the alluvial aquifer.

Map 3-3 shows the location of the monitor wells. The solid dots represent alluvial wells or piezometers, while the open circles represent vadose zone, or perched, monitor wells. The seepage plume is generally elevated above the alluvial groundwater and represents a growing mound in the vadose zone. Table A-4 gives the water levels of the perched water, or seepage plume, and the depths to alluvial groundwater in the monitor wells. The seepage plume has reached alluvial groundwater at monitor well TDOH-12U. The pH of the seepage plume ranges from 6.2 to 7.5 and is somewhat more acidic than the alluvial groundwater (pH = 7.0 to 8.3). TDS is elevated in the seepage plume with values in the range of 500 to 1,000 mg/l. The alluvial groundwater has a TDS generally less than 400 mg/l. Chloride also is elevated in the seepage plume and ranges from around 200 to 400 mg/l, while chloride in the alluvial aquifer is below 100 mg/l. Sulfate is not elevated in the seepage plume and metals also are not elevated. WAD cyanide ranges from 0.01 to 0.15 mg/l, staying within the Nevada water quality standard of 0.2 mg/l. Thus the main constituents of concern are TDS and chloride. Although the seepage plume has reached alluvial groundwater at monitor well TDOH-12U, the water quality in that well is still within Nevada drinking water standards.

GMMC, in cooperation with the NDEP, has undertaken mitigation measures to stop the seepage from the north end of the tailings impoundment. The current seepage rate is about 34 gpm. Leakage initially observed in 1991 was estimated at 190 gpm. In 1992, monitoring indicated that the rate was 110 gpm. Marigold has installed dikes within the tailings to isolate the northern end of the tailings and has stopped using the northern part of the tailings to facilitate drainage of that section of the tailings. Although the seepage plume is expected to migrate northward through the vadose zone and continue to impact alluvial groundwater, the mitigation measures undertaken by Marigold are expected to reduce the amount of the seepage entering alluvial groundwater and prevent the seepage from elevating groundwater above state water quality standards. All seepage and the potentially impacted groundwater is within Marigold site boundaries and the alluvial groundwater is not used for domestic consumption.

Lone Tree Mine Dewatering and Water Level Declines at the Marigold Mine

Water levels in the Marigold production wells and the monitoring wells to the north of the tailings impoundment have been declining since about 1992. Over the past 5 years (1994-1999), water levels at Marigold have dropped an estimated 35.0 to 37.5 feet. In 1994, WMC (1994) completed a study of the water level declines from 1992 through 1994. This study was based on actual water level changes in the production water wells and the tailings monitor wells at the Marigold Mine. The study concluded that dewatering at the Lone Tree Mine was the cause of the water level declines. The study showed that water levels had been dropping at a rate of about 7.0 to 7.5 feet/year in the Marigold production wells (WW wells) and the tailings impoundment monitor wells (TDOH wells). The study concluded that when the



Source: WMC, 1994

Marigold Mine

Map 3-3

Location of Tailings, Wells, and Dam Piezometers

Lone Tree Mine increased its dewatering rate, the rate of decline also would increase. The Marigold Mine pumps 425 gpm from its 3 production wells and has maintained that pumping rate for the past 5 years.

This study contradicts a groundwater model prepared by HCI (1994) for the Lone Tree Mine. The HCI model indicated that the 10-foot drawdown contour associated with pit dewatering at the Lone Tree Mine would not reach the Marigold Mine until the year 2036. According to the HCI model, no impacts to the Marigold Mine from Lone Tree Mine dewatering should currently be occurring. HCI's 1994 modeling effort was based on the best available data at the time. Since that time, additional monitoring data, which include information from the Marigold Mine, have been collected and are currently being incorporated into a revised groundwater model (HCI in progress). This is due for release in the first quarter of 2000 and should show impacts to the Marigold Mine area similar to what has been observed. This suggests a direct hydrogeologic link between the two mine areas.

Table 3-5 identifies monitor wells in the Marigold Mine area. Those with established water level decline rates indicate that the water levels in the mine area have been dropping at an average rate of 7.4 feet per year since 1993. The Lone Tree Mine began dewatering in 1991 and has been increasing its dewatering rate in steps as the pit deepens. The average dewatering rate for the Lone Tree Mine in 1999 was 36,000 gpm, up from 23,000 gpm in 1994. To reconstruct the pre-mining water table in the Marigold area, the water level decline rate in each monitor well has been used to estimate the water level in 1991. This presents a conservative estimate of the maximum pre-mining water level because the effect of Lone Tree dewatering on the Marigold area probably did not begin until around 1994 (WMC 1994). It is evident from Table 3-4 that water levels have declined about 35 to 40 feet since 1991-1993. It can be expected that when the Lone Tree Mine ceases operations around the year 2006, the water table in the Marigold Mine area will rebound. A conservative estimate would have the water table in the Marigold Mine area rebounding to pre-1992 water levels in about 30 years following cessation of dewatering at the Lone Tree Mine. Map 3-4 shows estimated post-mining water level contours at the Marigold Mine.

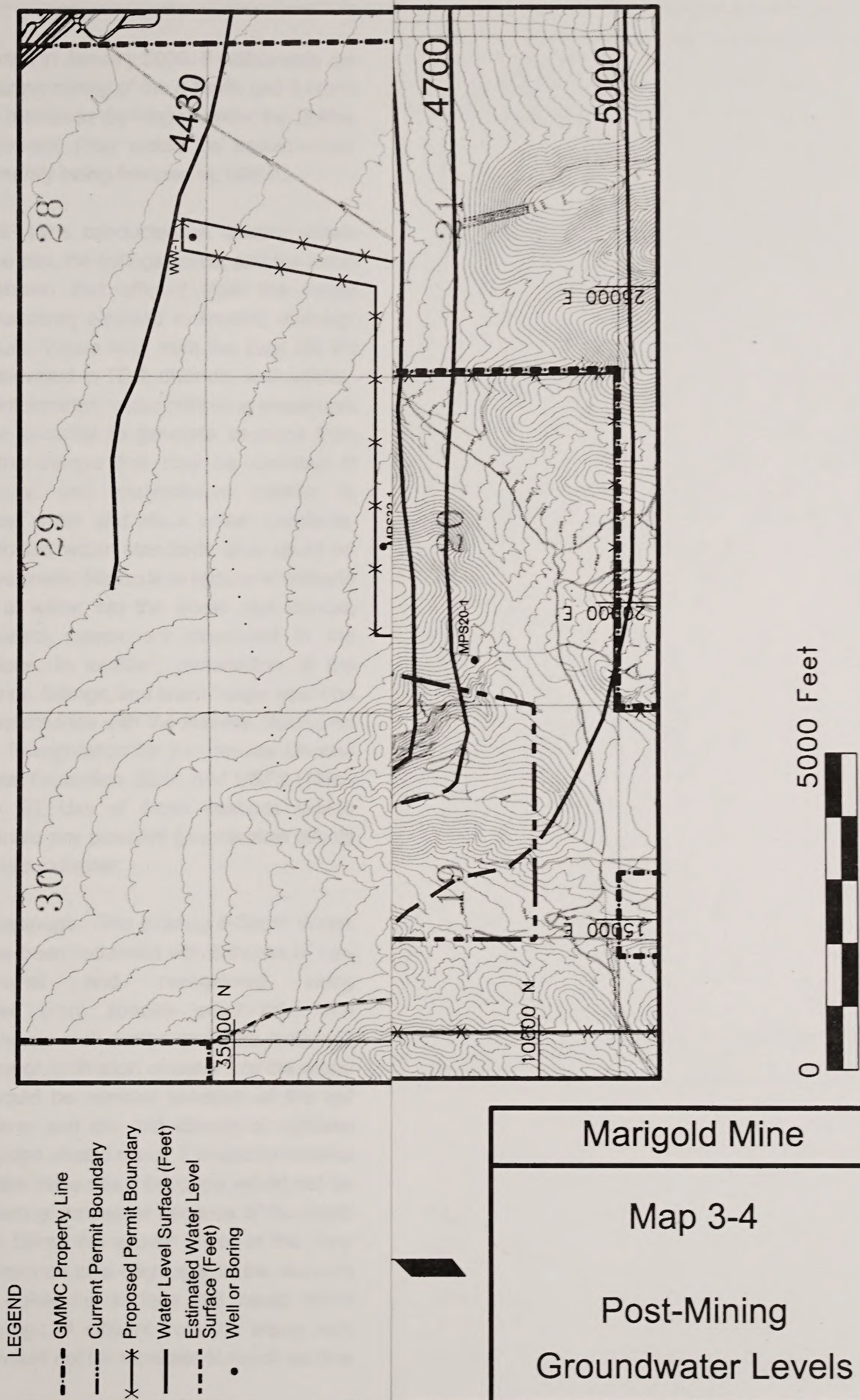
3.1.2 Environmental Consequences

The primary water resources issues for the proposed project include: 1) the generation of additional waste rock dumps; 2) expansion of the existing tailings impoundment and construction of a new tailings impoundment; 3) expansion of existing heap leach facilities and construction of a new heap leach pad; 4) the expansion of existing open pits and the development of two pits (i.e., 8-North and 5-North); and 5) additional surface water diversions. In addition, the existing tailings impoundment is currently seeping tailings fluid to groundwater at a rate of about 34 gpm; expansion of this facility would require additional efforts to minimize seepage and protect groundwater.

3.1.2.1 Proposed Action

<u>Geochemistry Impacts</u>

Existing waste rock at the Marigold Mine does not appear to be acid-generating (see Section 3.1.1.1). The proposed pits and pit expansions would mine the same lithologic units that are currently being mined, with the exception of the proposed 5-North and 8-North pits. These two proposed pits would mine Havallah Formation rocks in addition to the other lithologic units common at the mine site. In both pits, the Havallah samples had NNP values below the BLM guideline of 20 T/kT. However, the low pyrite content and the paste pH values suggest that the Havallah in these two proposed pits may not be acid-generating. Waste rock from the 8-North and 5-North pits could become acid-generating if the sulfide content were to rise above 0.5 percent due to mining of higher sulfide ore. Additional static ABA tests are currently being conducted on waste rock in the 8-North and 5-North pit areas. Results from these



Marigold Mine

Map 3-4

Post-Mining Groundwater Levels

Lone Tree Mine increased its dewatering rate, the rate of decline also would increase. The Marigold Mine pumps 425 gpm from its 3 production wells and has maintained that pumping rate for the past 5 years.

This study contradicts a groundwater model prepared by HCI (1994) for the Lone Tree Mine. The HCI model indicated that the 10-foot drawdown contour associated with pit dewatering at the Lone Tree Mine would not reach the Marigold Mine until the year 2036. According to the HCI model, no impacts to the Marigold Mine from Lone Tree Mine dewatering should currently be occurring. HCI's 1994 modeling effort was based on the best available data at the time. Since that time, additional monitoring data, which include information from the Marigold Mine, have been collected and are currently being incorporated into a revised groundwater model (HCI in progress). This is due for release in the first quarter of 2000 and should show impacts to the Marigold Mine area similar to what has been observed. This suggests a direct hydrogeologic link between the two mine areas.

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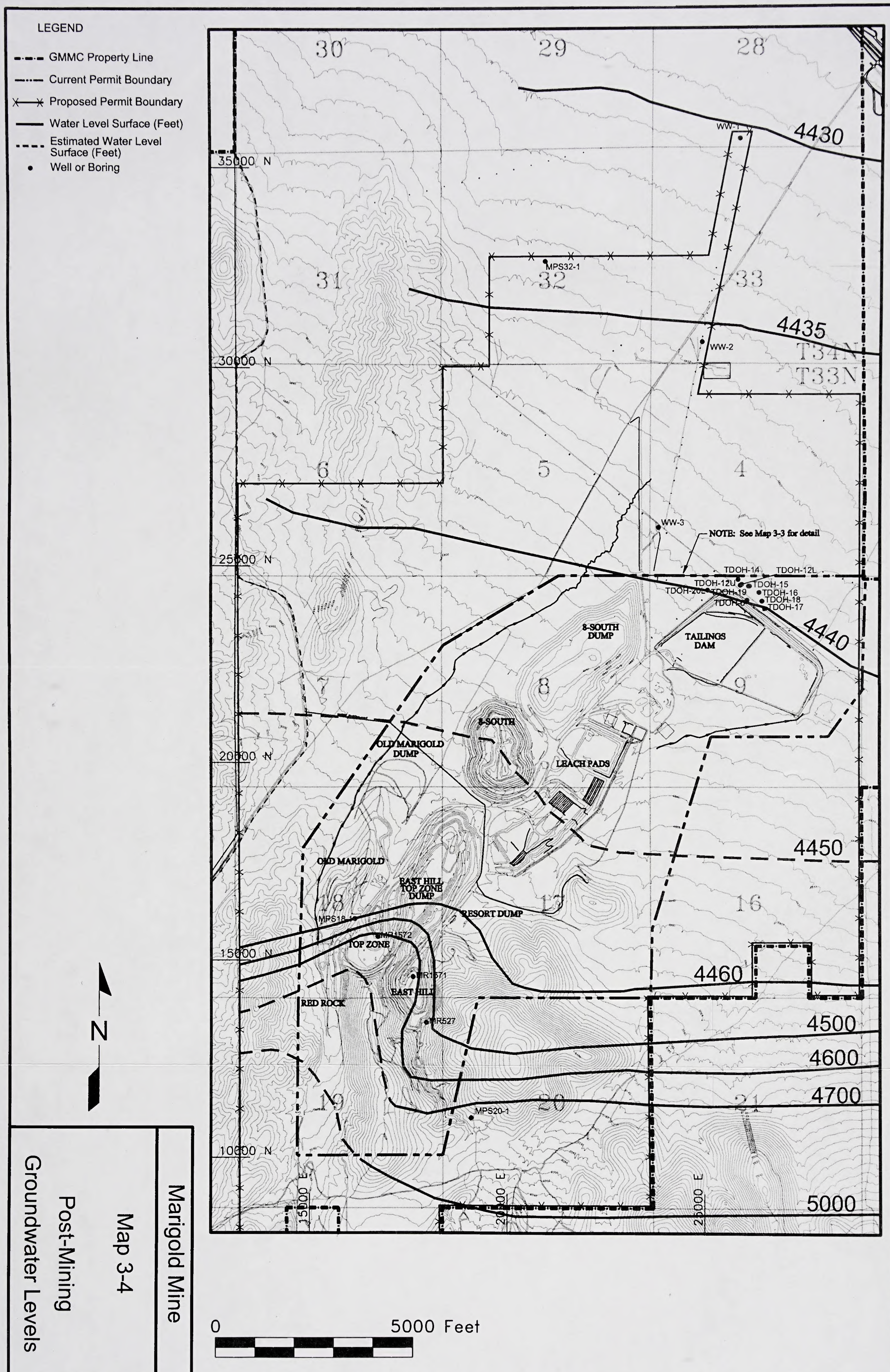


Marigold Mine

Map 3-4

Post-Mining Groundwater Levels

tests are expected in January 2000. If sulfide ores are encountered during mining of the 8-North and 5-North Pits, mitigation measures developed under the Sulfide Waste Management Plan would be implemented. This plan is currently being finalized by GMMC.

Nevada MWMP tests conducted on existing waste rock from all the pits, the tailings solids, and the leach solids have shown that effluent from the waste material is consistently elevated in arsenic, mercury, and molybdenum. Waste rock from the East Hill Pit also could be elevated in TDS, chloride, and sulfate. Based on this information, water infiltrating waste rock dumps has the potential to generate seepage from the base of the dumps that may be elevated in arsenic, mercury, and molybdenum relative to Nevada drinking water and stock water standards. Nevada aquatic life water standards also could be exceeded occasionally. Methods to reduce or mitigate the infiltration of water into the waste rock dumps, tailings, and leach heaps are discussed in the following sections. In addition, reclamation of the waste rock dumps, tailings, and leach heaps would be conducted in accordance with the *Nevada Guidelines for Successful Revegetation for the Nevada Division of Environmental Protection, BLM, and USFS* (1999) (see Appendix E). Use of these methods should reduce or eliminate any potential geochemical effects to surface and groundwater.

Waste Rock Seepage. The existing 8-South Waste Rock Dump has been reclaimed with 6 inches of run-of-mine material and revegetated using native/introduced plant species seed mix. The proposed new waste rock dumps would be reclaimed in a similar manner. Infiltration of water into the waste rock dumps would be minimal because of the soil amendment cover and the arid climate of northern Nevada. If seepage should occur, it would be minimal and limited to the mine site. Seepage would not be expected to reach groundwater because of the depth of groundwater below the alluvial cover at the mine site and the presence of a clay layer in the alluvium about 80 feet below the surface that would inhibit downward seepage of effluent from the waste rock pile. Seepage would not be expected to reach surface water diversions because the seepage rate would be low and the arid climate would act to evaporate any seepage that reaches the surface. The proposed 5-North Waste Rock Dump would be approximately 1,000 feet east of the Cottonwood Creek diversion and the proposed 8-North Waste Rock Dump would be approximately 150 feet east of the Trout Creek diversion. Thus, the proposed new waste rock dumps are not expected to result in environmental impacts to the mine site and vicinity.

Tailings Impoundment. The tailings solids at the Marigold Mine yield effluent elevated in WAD cyanide, arsenic, and mercury when subjected to the Nevada MWMP tests. The current tailings impoundment is leaking water at a rate of about 34 gpm at the north end near the decant tower. This rate is down from the seepage rate of 110 gpm in 1992 due to corrective action taken by GMMC. The seepage is elevated in TDS and chloride relative to Nevada drinking water standards and is elevated in background levels of these constituents in groundwater. To date, impacts to groundwater have been minimal because of the presence of approximately 150 to 200 feet of alluvial sediment between the impoundment and groundwater. This has slowed the migration of seepage to groundwater. GMMC has installed dikes and berms to isolate the northern portion of the tailings facility, which is leaking fluid to groundwater through the decant tower area. In addition, GMMC plans to dewater this isolated northern section of the tailings with a dewatering well. This should slow and eventually stop leakage of tailings fluid to groundwater. In the proposed expansion of the tailings, the isolated northern section of the tailings facility would not be used for additional tailings.

The proposed new tailings impoundment would handle tailings after the existing facility is filled to the permitted capacity. The new impoundment would be lined with a seepage capture system and seepage to groundwater is not expected to occur. The tailings impoundment would be drained and reclaimed with growth media at the end of mining.

Heap Leach Facility. The existing leach solids at the Marigold Mine have the potential to produce effluent elevated in arsenic and mercury when subjected to the Nevada MWMP tests. Leach solids provided by the proposed expansion would come from sources similar to those currently producing leach solids. Constituent levels in these solids are expected to be similar to those identified in the existing leach solids. Existing leach pads at the mine are lined with a seepage detection and capture system. The proposed new leach pad would have a similar liner system, as required by the State of Nevada, with the capacity to contain all process fluids and meteoric waters generated by 25-year, 24-hour storm events. Thus, seepage from the expansion of existing leach pads and the proposed new leach pad is not expected.

These pads would be drained, rinsed, and reclaimed according to Nevada regulations governing cyanide leach pads at the end of mining. This reclamation would involve heap rinsing, heap grading, the addition of growth media, and revegetation of the drained and rinsed pads. The rinse solutions would be diverted to ponds, and these ponds along with the process ponds would be reclaimed as required by Nevada Administrative Code 445.24386 and Code 445.14338. A permanent closure plan for the heap leach facility would be submitted to NDEP 2 years prior to closure. Long-term management of the heap leach draindown has not been analyzed and would require separate permit approval prior to closure.

The leach pads may be reclaimed using an alternative method that involves treatment of the leach pad with a proprietary mixture of chemicals and nutrients to enhance bacterial growth and precipitation of potentially adverse constituents. This method, known as the Greenworld method, is currently being evaluated at the Glamis Dee Gold Mine in Eureka County, Nevada. The Greenworld method could allow for potential contamination of groundwater through land application of a rinsate elevated in TDS and salts.

<u>Surface Water Impacts</u>

The primary issues related to surface water resources include the potential for degradation of the quality of waters of the State of Nevada; accelerated erosion, sedimentation, and resulting channel or watershed instability; reduction in flows as a result of groundwater pumping or drainage modification; impacts to riparian areas or wetlands; and impacts to water rights.

Best management practices and available control technologies would be specified and reviewed for the proposed project components as their design proceeds. At minimum, best management practices would include good housekeeping at the mill and storage facilities, preventative maintenance, periodic visual inspections of project components, material handling practices that minimize the exposure of pollutants to storm water, organized spill prevention and response procedures, sediment and erosion controls, and storm water controls. Each of these practices would be adapted to the facilities, processes, and personnel on the project area and carried out under a managed program of pollution prevention in accordance with state regulations and permits. Available control technologies include such features as double-lined process ponds, lined ditches and process facilities, containment walls or berms at the mill and at other process or storage facilities, leak detection systems water monitoring programs, and process facilities (including ponds, ditches and impoundments) designed to retain or withstand severe storm runoff events. These practices would prevent or minimize degradation of surface water resources.

Further detail regarding storm water management and erosion control, spill containment provisions, and component design features to control seepage and drainage for the existing site features are presented in the permit documents described in Section 2.2.2.2. These are on file and can be referenced at the Marigold Mine and the respective state and federal agency offices. Similar documentation and preparation is required and would be completed for the proposed components.

Impacts to surface water quality are expected to be minimal, given the proposed process solution controls and erosion and sediment controls. Monitoring data along Trout Creek to date suggest that the project has had minimal effect on surface water quality, and impacts have occurred (increased iron and manganese) are related mostly to aesthetic standards as opposed to health-derived standards. The causes of the increases in these constituent concentrations in a downstream direction are not currently known. Water monitoring and reporting programs are ongoing for the project, as is compliance with permit stipulations for storm water control, spill control, and process fluid containment.

The POO/RP for the proposed mine expansion discusses erosion control for slopes and other disturbed areas, road drainage, diversions around pits and process components, collection pond storage capacities, tailings impoundment storm-event design, and process facility containment features that would prevent or minimize disturbed area runoff and mitigate related potential impacts to surface water resources.

Other potential impacts to surface water resources may occur as a result of groundwater pumping and the effects of stream diversions. Both Cottonwood Creek and Trout Creek grade from intermittent toward ephemeral flow characteristics in the downstream direction as they traverse the project area and infiltrate into the deep fan alluvium toward the Humboldt River (see Map 3-1). Based on field studies, perennial reaches of these streams do not occur within the project area, but are restricted to the steeper reaches upstream on Battle Mountain. As discussed in the groundwater impact analysis portion of this chapter, mine dewatering is not anticipated to occur. Groundwater pumping is not expected to effect local surface water recharge sources or to create significant impacts to streamflows or spring flows.

The conceptual placement and design of stream diversions are described in Section 2.2.2 under Surface Water Diversions. The existing Trout Creek Diversion west of the Red Rock Pit (North and South) has previously been examined and approved in coordination with federal agencies including the COE (BLM 1997). The proposed modification to the existing Trout Creek diversion and the construction of the proposed Cottonwood Creek diversion would not be required for several years after initiation of the Proposed Action. During that time, the design and agency review process for these proposed features would be ongoing. Final design and associated mitigation measures would be subject to agency approval and permitting before the diversion activities occurred. Design of the diversions would follow standard engineering hydrologic and hydraulic design procedures and would be conducted under the supervision of a professional civil engineer registered in the state of Nevada. The channels would carry intermittent or ephemeral flows.

The conceptual design for the Cottonwood Creek diversion indicates that it would route flows around the proposed project components and return them to the stream channel at a point below the proposed disturbance. Given that standard design procedures and agency approval would be incorporated into the diversion design, and that Cottonwood Creek flows only occasionally along this reach, no impacts to surface water resources are anticipated.

Modification or construction of the diversions would disturb additional acreage of waters of the U.S. To date, no acreage of riparian or wetland habitat has been disturbed by existing diversion activities. Approximately 2.8 acres of waters of the U.S. have been previously disturbed by existing diversion construction. Site-specific field investigations have not been conducted to date for the additional areas under consideration, but data from the adjacent existing surveys and accompanying maps and aerial photos indicate that an additional area of approximately 1.3 acres of waters of the U.S. would be disturbed by proposed project activities. Adding this to the previous 2.8 acres disturbed, the total disturbed area of waters of the U.S. would be approximately 4.1 acres. This is well under the 10-acre limit set by Nationwide Permit 26. Prior to any disturbance in these areas, particularly Cottonwood Creek, detailed on-site studies would be completed and appropriate plans and permits would be approved.

Potential impacts to surface water rights in or near the project area are not anticipated as a result of mine construction and operation.

<u>Groundwater Impacts</u>

Groundwater impacts due to the Proposed Action would include: 1) the continued removal of groundwater for production water uses at a maximum rate of 475 gpm and 2) potential seepage from waste rock dumps.

Groundwater Withdrawal. The continued pumping of a maximum of 475 gpm of groundwater for production water uses would not be expected to produce any adverse impacts to groundwater flow or flow in nearby springs and seeps. The current production water wells draw water from both the alluvium and the bedrock and have had minimal impact on nearby groundwater resources. Therefore, no impacts to groundwater rights are anticipated.

Waste Rock Seepage. As discussed in Section 3.1.2.1, Geochemistry, no seepage from waste rock dumps is expected to reach groundwater; therefore, no additional effects to groundwater from the Proposed Action is anticipated.

Tailings. Continued use of the existing tailings facility would not involve the northern part of the facility that is currently seeping effluent elevated in chloride and TDS to groundwater. Mitigation measures taken by GMMC have reduced the seepage rate from the northern portion and are expected to prevent degradation of groundwater quality.

3.1.2.2 8-South Partial Pit Backfill Alternative

<u>Geochemistry</u>

This alternative would involve placement of waste rock from the 8-North Pit to the 8-South Pit, eliminating the need for the 8-North Waste Rock Dump expansion. This would reduce the potential for seepage from an additional waste rock dump in the event of prolonged wet weather in northern Nevada. Because seepage from the 8-North Waste Rock Dump could have elevated arsenic, mercury, and molybdenum as indicated by MWMP tests (Section 3.1.2.1), this alternative would provide a potential reduction in impacts associated with seepage, especially during prolonged wet weather.

The 8-South Pit bottom would be at or slightly below the projected post-mining water groundwater level after the water table has rebounded to its pre-mining levels. It is possible that an approximately 10-foot deep seasonal pit lake could form in the 8-South Pit after the groundwater table has rebounded (around the year 2035). Water in this lake could be elevated in arsenic and mercury. Partial backfill of the 8-South Pit would eliminate the pit lake; however, rain water infiltrating through the waste rock backfilled into the 8-South Pit could potentially create seepage to groundwater with elevated levels of arsenic, mercury, and molybdenum.

<u>Surface Water</u>

In general, the potential impacts for this alternative are the same as those described for the Proposed Action. However; without the need for the 8-North Waste Rock Dump expansion, the lower reach of the Trout Creek diversion would not need to be realigned. This would reduce the amount of additional disturbance of the existing Trout Creek diversion.

<u>Groundwater</u>

At this time, no hydrologic studies have been conducted to determine the potential impacts of a lake in the 8-South Pit. The lake, if it did form, would be seasonal. Impacts to groundwater flow from backfilling of the 8-South Pit with waste rock from the 8-North Pit would be minimal. Evaporation from the small, 10-foot pit lake that may form after complete rebound of the groundwater table would be low and not affect groundwater flow. Backfilling the pit to cover the pit lake would not be expected to affect groundwater flow.

3.1.2.3 No Action Alternative

Geochemistry

Under the No Action Alternative, the potential exists for the formation of a 10-foot deep seasonal pit lake in the 8-South Pit approximately 30 years after currently approved mining operations cease. Water in this lake could contain high levels of arsenic and mercury; however, the lake should be present only in the winter months.

Potential seepage from the waste rock dumps associated with mining of the 8-North and 5-North Pits would not occur. The existing tailings impoundment would be expanded under the current permit and remediation of seepage from the existing tailings impoundment would continue. Closure of existing leach pads would occur sooner than under the Proposed Action.

Surface Water

No additional diversions of Trout Creek and Cottonwood Creek would be required and disturbances to 1.3 acres of waters of the U.S. would not occur.

Groundwater

Removal of 475 gpm of groundwater used for milling operations would only continue through the currently permitted period approved for the existing operations. In addition, no rinsate water would be required beyond that needed for currently permitted leach pad operations.

3.1.3 Cumulative Impacts

Mining is the main industry in the Winnemucca area of northern Nevada. As discussed under Section 3.2 (Geology and Minerals), there are many gold mines currently operating or planned for the area between Winnemucca and Battle Mountain, Nevada. This area includes the Marigold Mine. The cumulative impact of all these open-pit gold mines is a substantial withdrawal of groundwater during mining to dewater the pits and then formation of pit lakes when the mines have ceased. The Marigold Mine would not contribute substantially to this cumulative water withdrawal since its total groundwater withdrawal rate would be minimal. Most of the pits would be dry.

The combined acreage of disturbance from the Proposed Action and other existing mining activities within or immediately adjacent to the Trout Creek and Cottonwood Creek watersheds is on the order of 2,700 acres (4.2 square miles). The combined Trout Creek and Cottonwood Creek watershed area is approximately 31 square miles. The disturbance within or immediately adjacent to the watersheds represents approximately 13 percent of their combined areas, a significant proportion. Other nearby mining projects, such as the Lone Tree Mine, Battle Mountain Gold Company's operations, and the Mule Canyon project, disturb additional lands and water resources in the vicinity. Of these, only the Lone Tree Mine discharges water to the Humboldt River (via Herrin Slough). With this exception, the proposed project and the other projects mentioned would have little effect on the Humboldt River due to their hydrologic setting (water occurrence or management approaches that do not create a direct hydraulic connection to the river), distance from the river, or because they do not require substantial mine dewatering and discharge.

A substantial amount of land disturbance has occurred in the Trout Creek and Cottonwood Creek watersheds as a result of exploration and mining activities. Several open-pit areas will essentially be withdrawn from contributing to surface runoff and streamflows. This is more significant in mountainous headwater areas upstream of the proposed project, where the majority of streamflow is generated and occurs. Most of the runoff generated on the project area is absorbed by porous alluvial deposits. Sub-basin streamflows, evapotranspiration and groundwater recharge are not likely to be significantly affected by the additional downgradient Marigold Mine disturbance. However, the amount of disturbance in these watersheds is a concern, and compliance with permitting requirements is essential in order to minimize flow and water quality impacts (including erosion and sedimentation).

The total acreage of waters of the U.S. within the cumulative impact area is not known; however, extensive stream channel networks are present in the area. It is likely that the disturbance to waters of the U.S. in the cumulative impact area is a small percentage (less than 10 percent) of the overall acreage. This would not significantly increase with the limited additional disturbance from the proposed project or alternatives. Additional surface water quality impacts would be insignificant, since the affected water quality parameters (based on current monitoring) are related to aesthetic standards, and almost all of the surface water from the upgradient watershed seeps into the alluvial fan system.

3.1.4 Potential Mitigation/Monitoring

No mitigation and monitoring above that discussed in Section 2.2.18, Environmental Protection Measures and Monitoring, is proposed for water resources and geochemistry.

3.1.5 Residual Adverse Impacts

No residual adverse impacts are expected from the Proposed Action. Seepage from waste rock dumps is not expected to reach groundwater and the tailings and heap leach facilities would be reclaimed to prevent seepage into the post-closure period. Water levels return to near pre-mining levels following mine closure.

3.2 Geology and Minerals

3.2.1 Affected Environment

The Marigold Mine is located in the Battle Mountain Mining District of north-central Nevada, approximately 40 miles east of Winnemucca and about 3.0 miles south of Valmy in Humboldt County, Nevada (Map 3-5). The mine has been operating since 1988 and consists of four open pits developed on siliceous gold ore along faults and fault intersections in the Valmy Formation and the Antler/Battle Sequence. The mineralization is epithermal in nature and the oxidized gold ore zones are mined and heap-leached for recovery of the gold. Milling is used on certain high-grade ore zones prior to leaching. Sulfide ore is currently not mined.

3.2.1.1 Regional Geological Setting

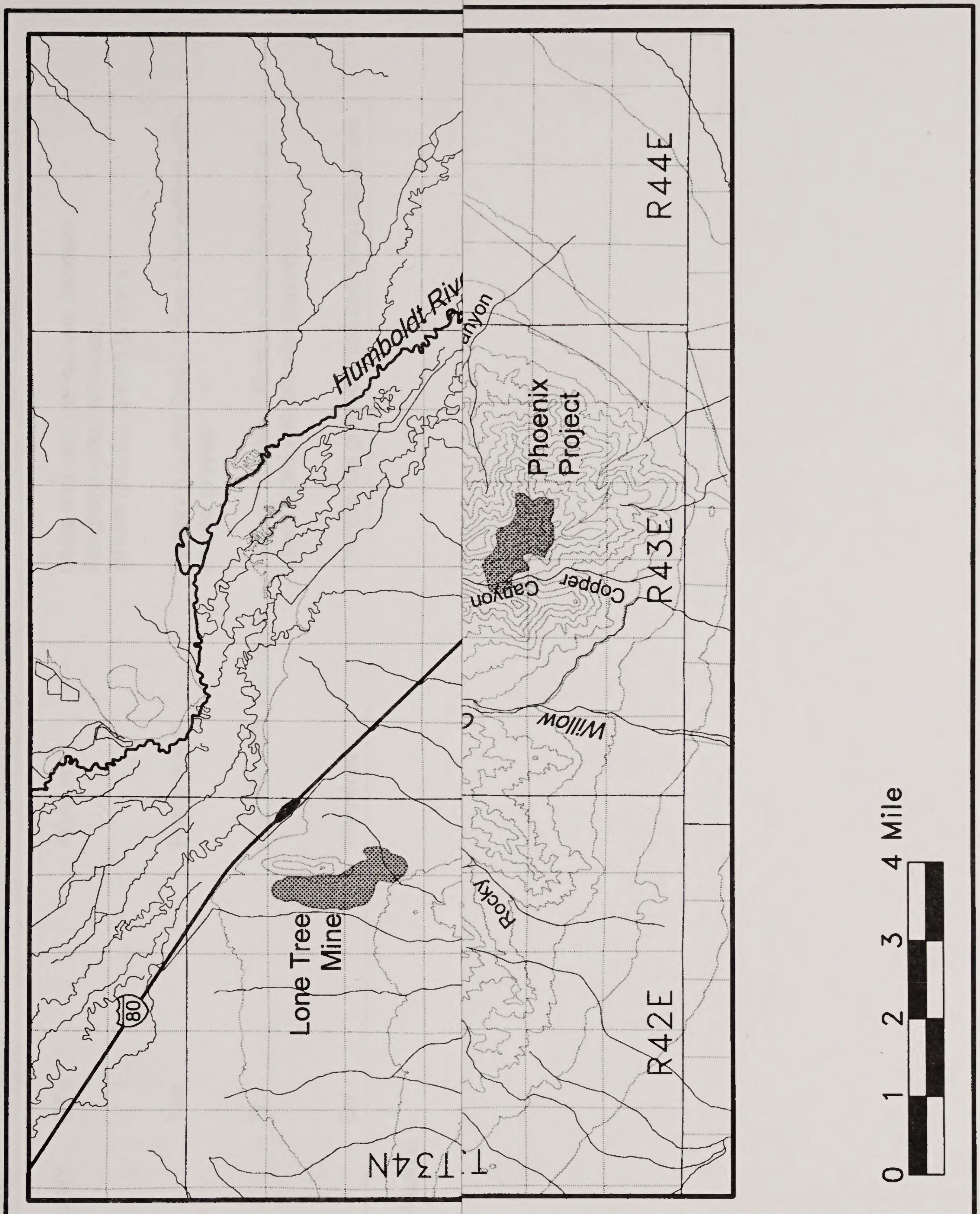
The Marigold Mine is located on the northwestern flank of the Battle Mountain Range. The Battle Mountain Range is part of the Basin and Range physiographic province of northern Nevada. The Marigold Mine lies within the drainage of the Humboldt River. This part of northern Nevada is characterized by large block uplifts separated by deep structural valleys that contain alluvial gravels and sands as well as old Pleistocene lake beds. These alluvial valleys can be up to 10,000 feet deep. North of the Marigold Mine, the valley alluvium is at least 2,000 feet deep. Bedrock in the uplifted blocks is commonly highly deformed Paleozoic quartzites, shales, cherts, and limestones. The Marigold Mine encompasses an area of deformed Paleozoic rocks transected by north-trending faults. Mineralization at the mine is surrounded by and frequently covered by alluvial fan sediments shed from the Battle Mountain Range.

The Battle Mountain Mining District has been an active area of exploration and mining since 1866. Principal commodities mined have been copper, gold, silver, lead and zinc. Mining prior to about 1980 has been concentrated on the south and east sides of Battle Mountain in Copper Canyon, Copper Basin, Galena Canyon, and Cottonwood Canyon (Map 3-5). Current mining on the east side of Battle Mountain is mainly in the area of the old Copper King Mine. Mining on the south side of Battle Mountain has been in the Copper Canyon area associated with the proposed Phoenix Project (Map 3-5). The Marigold Mine has been the principal mine on the north side of Battle Mountain since 1988. Recent gold discoveries in the district include the North Peak, Trenton, and Valmy deposits (BLM 1998). Along the west side of Battle Mountain, the Buffalo Valley gold mine has operated intermittently over the past 10 years. The Lone Tree gold deposit is located about 8 miles northwest of the Marigold Mine and has been in operation since 1990 (BLM 1995).

The ore deposits of the Battle Mountain district are hosted in Paleozoic quartzites, argillites, cherts, and limestones that have been folded and faulted during four major orogenic episodes. The Antler Orogeny of late Mississippian to early Pennsylvanian age is the major structural event responsible for deformation of most of the ore-bearing lithologic units in the mining district (Table 3-7). This was followed by a late Permian orogeny that affected areas to the west of Battle Mountain. This orogenic episode is preserved only in the Upper Plate rocks of the Battle Mountain area. During the Mesozoic, continued deformation to the west of Battle Mountain resulted in the Sonoma Orogeny and the Golconda Thrust, which brought rocks from western Nevada (Upper Plate rocks) eastward over the Lower Plate rocks already deformed by the Antler Orogeny. The Golconda Thrust is a major structural feature in the ore deposits of the Marigold Mine. During the Tertiary, Basin and Range faulting and uplift resulted in the formation of Battle Mountain. It was during this period of faulting, volcanism, and geothermal activity that the gold deposits of the Battle Mountain district were formed.

3.2.1.2 Stratigraphy

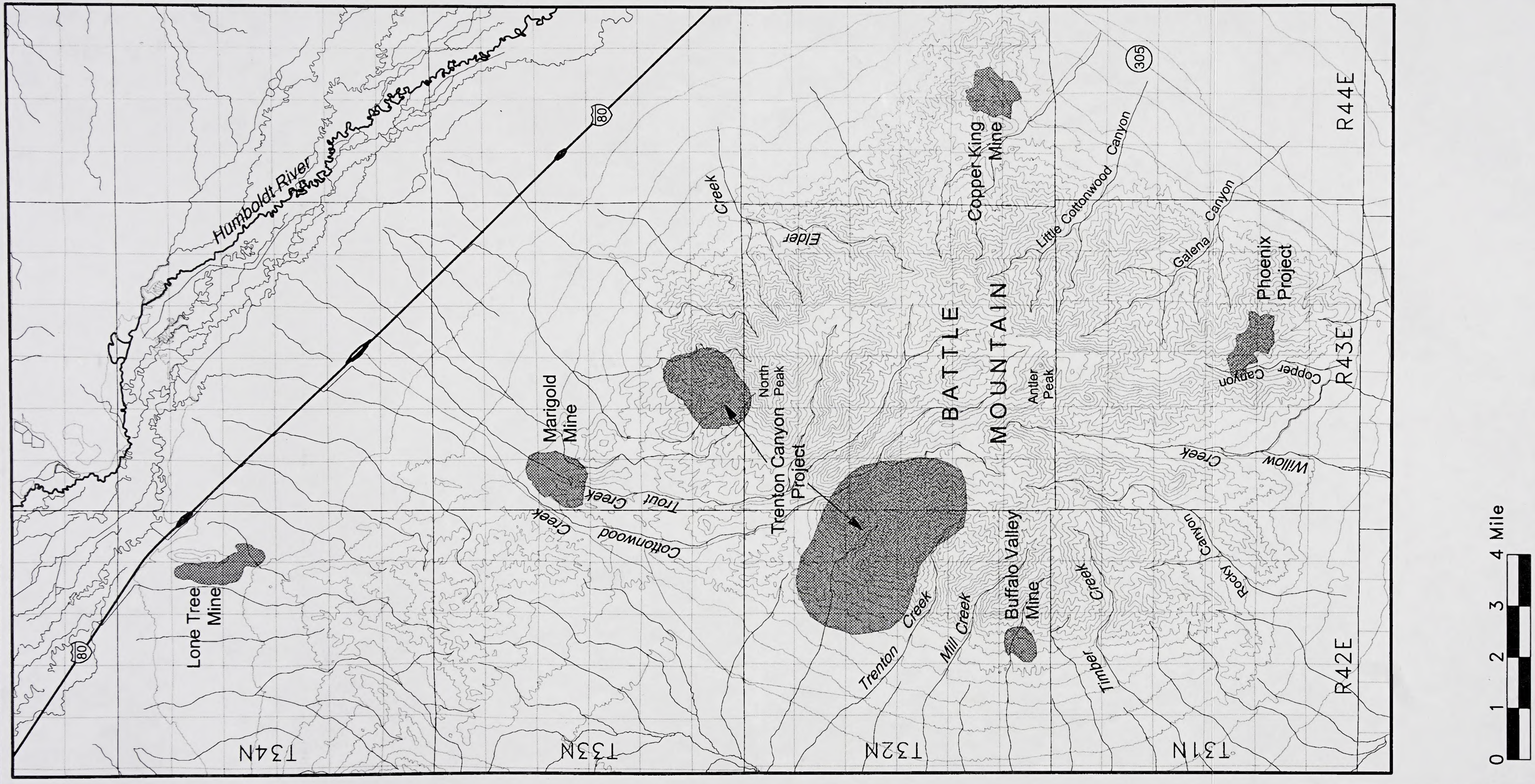
The stratigraphy of the Battle Mountain area is shown in Table 3-7. The general geology of the district and

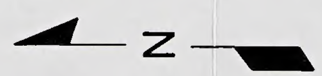


Marigold Mine

Map 3-5

General Location Map with Mines





Marigold Mine

Map 3-5

General Location Map with Mines

Table 3-7
Battle Mountain Area Stratigraphic Column

Geologic Time Period	Map Symbol	Thickness	Stratigraphic Unit	Description
TERTIARY- QUATERNARY	QTa		Alluvium	Older and younger alluvial deposits. Fanglomerates, terraces, stream gravels, bench gravels.
	Tba		Basalt flows	Tertiary basaltic flows. Often interbedded with alluvial gravels
	Tr		Rhyolite tuffs and flows	Tertiary rhyolite tuffs and some flows, often interbedded with alluvial gravels.
CRETACEOUS	Cd		Intrusives	Cretaceous granodiorite/monzonite intrusives.
PALEOZOIC - UPPER PLATE				
Pennsylvanian	Ph	10,500 feet	Havallah Formation	Interbedded quartzite, chert, argillite and limestone. Chert and quartzite most common lithologies.
	Cp	5,000 feet	Pumpernickel Formation	Interbedded quartzite, chert, argillite and greenstone. Argillite and greenstone most common lithologies.
PALEOZOIC - LOWER PLATE				
Permian	Pem	100 feet	Edna Mountain	Grey calcareous sandstone and shale with interbedded chert-pebble conglomerate.
Pennsylvanian	Cap	800 feet	Antler Peak Formation	Medium-dark gray bedded limestone /shaly limestone.
	Cb	700 feet	Battle Formation	Red-brown conglomerate with interbedded sandstone/shale.
			(Antler/Battle Sequence)	

Table 3-7 (Continued)

Geologic Time Period	Map Symbol	Thickness	Stratigraphic Unit	Description
Mississippian	Ch	3,000 feet	Harmony Formation	Greenish-brown micaceous sandstone with interbedded shale and limestone.
	Csc[1]	2,000 feet	Scott Canyon Formation	Chert, argillite, slate and limstone with interbedded greenstone. Highly deformed with complex folding,
Ordovician	Ov	3,000 feet	Valmy Formation	Interbedded quartzite, chert, argillite, slate, and greenstone. Complex folding. Massive quartzites. Variegated cherts and slates. Greenstones show pillow lava structure.
	Oc[1]	2,000 feet	Comus Formation	Interbedded chert, slate, and argillite. Variegated chert.

[1]These units are small and do not appear on the regional geology map due to scale.
Source: Roberts 1964.

surrounding areas is presented in Map 3-6. The Paleozoic stratigraphy of the project area can be divided into those units beneath the Golconda Thrust (Lower Plate rocks) and those units above the thrust (Upper Plate rocks).

Lower Plate Sequence

These units are Paleozoic quartzites, sandstones, cherts, argillites, limestones, and greenstones deformed by the Antler Orogeny. Principal units include the following (Roberts 1951):

- Comus Formation: Ordovician – chert and argillite
- Valmy Formation: Ordovician – quartzite, chert, argillite (ore bearing)
- Scott Canyon Formation: Mississippian – chert, argillite, limestone
- Harmony Formation: Mississippian – sandstone
- Battle Formation: Pennsylvanian – red-brown conglomerate (ore bearing)
- Antler Peak Formation: Pennsylvanian – limestone (ore bearing)
- Edna Mountain Formation: Permian – sandstone and conglomerate

These rocks were deformed by the Antler Orogeny and are complexly folded and sheared. The Battle Formation represents a period of clastic deposition after the Antler Orogeny was complete and before the onset of a less intense Permian orogeny. This is a major mapping unit in north-central Nevada. All Lower Plate units are highly deformed. The Valmy Formation is the principal host to gold mineralization at the Marigold Mine, the Trenton and Valmy deposits, and the Lone Tree Mine. In the area of the Marigold Mine, the Battle Formation and the Antler Peak Formation are grouped into a composite stratigraphic unit referred to locally as the Antler/Battle Sequence. This composite unit is mineralized in some of the pits at the mine.

Upper Plate Sequence

These units were thrust into place by the Golconda Thrust. These are Pennsylvanian units deposited in western Nevada in a basin separate from the one that contained the Paleozoic rocks of the Lower Plate Sequence. There are two principal stratigraphic units in the Upper Plate Sequence:

- Pumpernickel Formation: Pennsylvanian – quartzite, chert, argilllite
- Havallah Formation: Pennsylvanian – quartzite, chert, limestone

The Havallah Formation is a major stratigraphic unit in the Battle Mountain area and is the principal unit used to map the extent of the Golconda Thrust. The Pumpernickel Formation is often included with the Havallah Formation and not mapped separately, especially in maps published after 1990.

In the Late Cretaceous to early Tertiary periods (60 to 100 million years ago), many areas of western and central Nevada experienced the intrusion of plutons of granodiorite to quartz monzonite composition. These granitic magmas deformed the Paleozoic rocks and produced both alteration and mineralization of the rocks. Principal mineral deposits of this period of intrusive activity may have included the copper sulfide deposits found on the south side of Battle Mountain in the Copper Canyon area. Separating early Tertiary mineralization from the later middle Tertiary mineralization (30 to 45 million years ago) is often not possible because of the spatial overlap (both periods of mineralization along the same fault zone) and the resetting of isotopic clocks by the later mineralization.

During the Tertiary period, the Basin and Range underwent extensive faulting and volcanism. Rhyolite tuffs and basalt flows became interbedded with the alluvial fanglomerates that were developing as mountain ranges rose. Battle Mountain was formed surrounding areas is presented in Map 3-3. The Paleozoic stratigraphy of the project area can be divided into those units beneath the Comanche Thrust (Lower Plate rocks) and those units above the thrust (Upper Plate rocks).

Lower Plate Sequence

These units are Paleozoic quartzites, sandstones, cherts, argillites, limestones, and conglomerates deformed by the Antler Orogeny. Pertinent units include the following (Roberts 1951):

- Osgood Formation (Ordovician) – chert and argillite
- Valmy Formation (Ordovician) – quartzite, chert, argillite (ore bearing)
- Scott Canyon Formation (Mississippian) – chert, argillite, greenstone
- Harmony Formation (Mississippian) – sandstone
- Battle Formation (Pennsylvanian) – sandstone, conglomerate (ore bearing)
- Antler Peak Formation (Pennsylvanian) – limestone (ore bearing)
- Edna Mountain Formation (Permian) – sandstone and conglomerate

These rocks were deformed by the Antler Orogeny and are generally folded and faulted. The Battle Formation represents a period of clastic deposition after the Antler Orogeny was completed, and was in turn the result of a less intense Permian orogeny. This is a major mapping unit in north-central Nevada, and Lower Plate units are highly deformed. The Valmy Formation is the principal host to gold mineralization at the Marigold Mine, the Trenton and Valmy deposits, and the North Peak Mine. In the area of the Marigold Mine, the Battle Formation and the Antler Peak Formation are grouped into a composite stratigraphic unit referred to locally as the Antler Peak Limestone. This composite unit is [illegible] in some of the pits at the mine.

Upper Plate Sequence

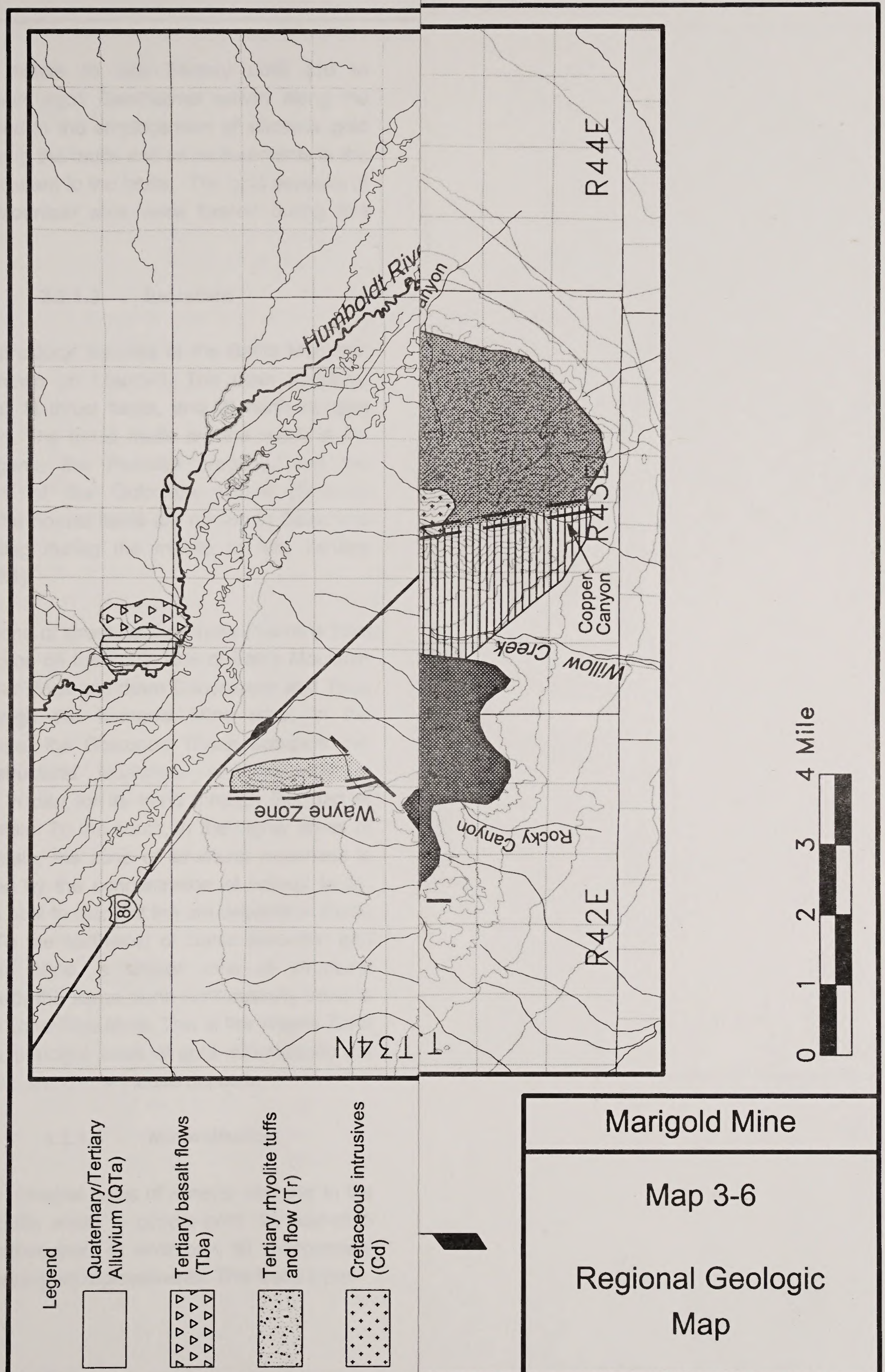
These units were thrust into place by the Golconda Thrust. These are the rightmost units [illegible] in western Nevada in a basin sequence from [illegible] and deformed [illegible] Permian [illegible] of the Upper Plate sequence. There are [illegible] units [illegible] in the Upper Plate sequence:

- Pumpernickel Formation (Pennsylvanian) – [illegible], [illegible]
- Havallah Formation (Pennsylvanian/Permian) – [illegible], [illegible]

The [illegible] [illegible] is a [illegible] [illegible] unit in the [illegible] [illegible] [illegible] used to [illegible] the [illegible] of the [illegible] [illegible]. The Pumpernickel Formation is [illegible] [illegible] with the Havallah Formation and not [illegible] [illegible] [illegible] in [illegible] [illegible] after [illegible].

In the Late Cretaceous (Laramide) [illegible] (70 million years ago), [illegible] [illegible] of [illegible] [illegible] [illegible] the [illegible] of [illegible] [illegible] or quartz monzonite composition. These [illegible] [illegible] the [illegible] and [illegible] [illegible] alteration and mineralization of the rocks. [illegible] of the [illegible] of [illegible] may have [illegible] the [illegible] [illegible] [illegible] on the south side of Battle Mountain in the Copper Canyon area. [illegible] [illegible] mineralization [illegible] [illegible] mineralization [illegible] to [illegible] million years and [illegible] [illegible] of the [illegible] [illegible] for [illegible] of mineralization along the [illegible] [illegible] and the [illegible] of [illegible] rocks by the [illegible] [illegible].

During the Tertiary period, the [illegible] [illegible] [illegible] [illegible] and [illegible]. [illegible] [illegible] and [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] Battle Mountain [illegible] [illegible].



Marigold Mine

Map 3-6

Regional Geologic Map

3.2 Geology and Minerals

surrounding areas is presented in Map 3-3. The Paleozoic stratigraphy of the project area can be divided into lower units beneath the Golconda Thrust (Lower Plate rocks) and those units above the thrust (Upper Plate rocks).

Lower Plate Sequence

These units are Paleozoic quartzites, sandstones, cherts, argillites, limestones, and greenstones deformed by the Antler Orogeny. Principal units include the following (Roberts, 1951):

- Osgood Formation: Ordovician – chert and argillite
- Valmy Formation: Ordovician – quartzite, chert, argillite (ore bearing)
- Leech Canyon Formation: Mississippian – chert, argillite, limestone
- Harmony Formation: Cambrian – sandstone
- Battle Formation: Pennsylvanian – [illegible] conglomerate (ore bearing)
- Antler Peak Formation: Pennsylvanian – limestone (ore bearing)
- Edna Mountain Formation: Permian – sandstone and conglomerate

These rocks were deformed by the Antler Orogeny and are complexly folded and sheared. The Battle Formation represents a period of [illegible] deposition after the Antler Orogeny was complete and before the onset of a later thrust, Permian orogeny. This is a major mineralizing unit in north-central Nevada. All Lower Plate units are highly deformed. The Valmy Formation is the principal host to gold mineralization at the Marigold Mine, the Trenton and Valmy deposits, and the Lone Tree Mine. In the area of the Marigold Mine, the Battle Formation and the Antler Peak Formation are grouped into a composite stratigraphic unit referred to locally as the Antler/Battle Composite. This composite unit is mineralized in some of the pits at the mine.

Upper Plate Sequence

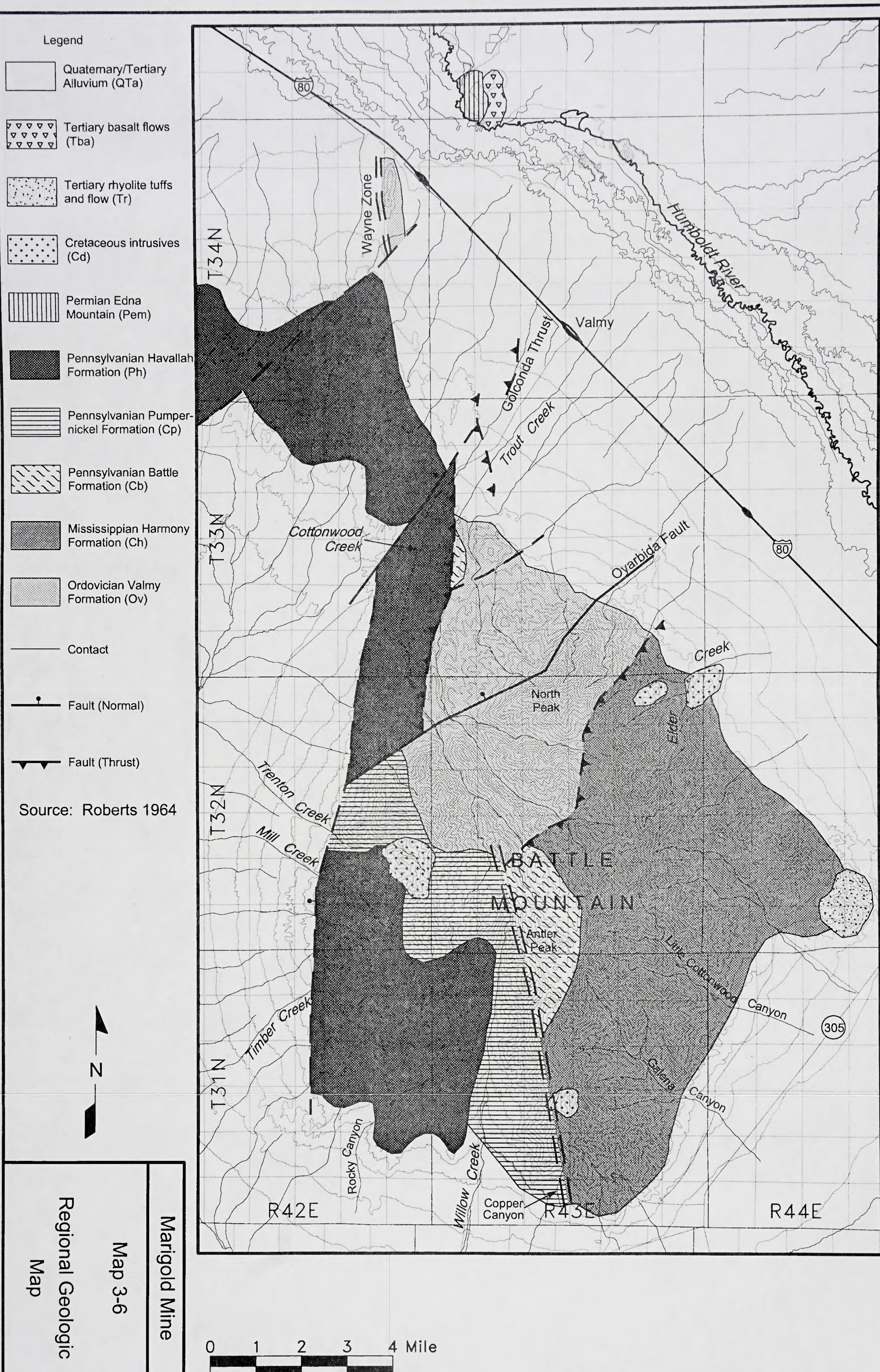
These units were thrust into place by the Golconda Thrust. Triassic and Pennsylvanian units that overlie the western Nevada [illegible] exposures [illegible] this unit and the Paleozoic rocks of the Upper Plate Sequence. These are the principal stratigraphic units in the upper plate sequence:

- Pennsylvanian formations: [illegible] – [illegible] sandstone
- [illegible] Formation: Pennsylvanian/Permian – [illegible] limestone

The [illegible] Formation is a [illegible] and [illegible] is [illegible] to [illegible] Golconda Thrust. The Pennsylvanian Formation is [illegible] with the [illegible] Formation and [illegible] [illegible] [illegible] [illegible] and does [illegible].

In the Late Cretaceous to early Tertiary period (40 to 100 million years ago), many areas in north-central Nevada experienced the intrusion of plutons of granitic rocks to quartz monzonite composition. Local igneous dikes intruded the Paleozoic rocks and resulted from alteration and mineralization of the rocks. Principal mineral deposits of this period of intrusive activity may have included the original [illegible] deposits located on the south side of Battle Mountain in the Copper Canyon area. Secondary and/or remineralization from the later middle Tertiary mineralization (30 to 45 million years ago) was not only a possible byproduct of the general uplifting, faulting, block, of minerals along the same fault zones and the reworking of previous rocks by the late mineralization.

During the Tertiary period, the Basin and Range environment generated faulting and occasional volcanic activity and calcite flow rocks emplaced over the area, [illegible] that were deposited as [illegible] [illegible] [illegible] [illegible] [illegible] is formed



Marigold Mine

Map 3-6

Regional Geologic Map

during the middle to late Tertiary uplift (10 to 25 million years ago). Geothermal activity along the fault zones led to the emplacement of siliceous gold ores both along the faults and as replacements in the rock units adjacent to the faults. The gold deposits of the Battle Mountain area were formed during this time.

3.2.1.3 Structure

The major structural features of the Battle Mountain area are shown on Map 3-6. The main structural features are: 1) thrust faults, and 2) north-trending normal faults. The thrust faults are the result of the Antler Orogeny, the Permian orogeny, and the emplacement of the Golconda Thrust (Sonoma Orogeny). The normal faults are related to Basin and Range faulting during the middle to late Tertiary (Roberts 1964).

There is a zone of structural weakness that runs from Copper Canyon on the south side of Battle Mountain through Antler Peak and down Cottonwood and Trout creeks through the Marigold Mine area. In the Marigold Mine, the Golconda Thrust occupies this zone of structural weakness and probably is responsible in part for its trend through this part of Battle Mountain. To the south, in the higher areas of Battle Mountain, the zone of structural weakness is characterized by the concentration of normal faults. This zone is host to many of the ore deposits in Battle Mountain. To the northwest of Battle Mountain and the Marigold Mine, a similar zone of structural weakness with the same north-northeasterly trend is found at the Lone Tree Mine. This is the Wayne Zone and it is the principal locus of gold mineralization at the Lone Tree and Stone House deposits.

3.2.1.4 Mineralization

There are 6 principal types of mineral deposits in the Battle Mountain area: 1) copper-gold, 2) lead-zinc-silver, 3) gold-copper, 4) antimony, 5) manganese, and 6) siliceous gold replacements. The first 5 types of deposits were known prior to the 1980s and are discussed by Roberts (1951). The siliceous gold deposits were discovered during the 1980s and 1990s and are the principal deposits of interest today in the Battle Mountain area.

The copper-gold deposits are found in Copper Canyon and consist of veins and replacement deposits with pyrite, pyrrhotite, arsenopyrite, and chalcopyrite. These are associated with the Cretaceous-early Tertiary intrusives. The lead-zinc-silver deposits also are associated with the intrusives and are mainly veins with minor replacements. They have the same mineralogy as the copper-gold deposits but with abundant galena and sphalerite. Oxidation of these deposits produces secondary copper minerals, such as malachite and azurite. This led to the discovery of the deposits by Native Americans, who in turn led early prospectors to the Battle Mountain area after the Civil War (1866).

The gold-copper deposits are bedded replacement deposits in calcareous rocks and contain pyrite, pyrrhotite, and chalcopyrite with common skarn minerals such as garnet and amphibole. The Carissa and Copper King mines, located along the south and east sides of Battle Mountain respectively, are deposits of this type. Antimony and manganese deposits are relatively minor and limited to a few areas.

The siliceous gold deposits were formed during the Tertiary along major faults and are principally replacement deposits. The Marigold Mine, the North Peak, Trenton, and Valmy deposits (Trenton Canyon Project), the Buffalo Valley Mine, and the Lone Tree Mine (Lone Tree and Stone House deposits) are examples of this type of mineralization. Only the Marigold Mine and the Lone Tree Mine have been continuously active. The Buffalo Valley Mine has had intermittent activity and the North Peak, Trenton, and Valmy (Trenton Canyon Project) deposits were discovered only a few years ago and are not in production (Roberts 1964).

3.2.1.5 Mining History

The most productive of the pre-1980 mines was the Copper Canyon mine (Wilden 1964). This mine opened in 1866 and by 1945 had produced nearly 400,000 tons of copper-gold ore from underground workings to the 500-foot level. Copper grades mined ranged from 1 to 4 percent with 0.1 oz/ton gold. Development continued after 1945 to the 700-foot level, where lead-zinc-silver ore was mined. The ore was located principally in the Battle Formation and lies between the major north-trending normal faults. Other mines in the Copper Canyon area that were productive included the Tomboy, the Independence, and the Nevada.

The Copper King mine in Copper Basin, on the east side of Battle Mountain, opened in the 1880s and has produced copper and gold from the Harmony Formation. The Carissa mine opened in 1937 and produced gold ore with grades ranging from 0.3 to 0.62 oz/ton gold. The gold is associated with copper carbonates.

Battle Mountain Gold's Fortitude deposit is located in Copper Canyon. The Phoenix Project expands the low-grade potential of the Copper Canyon deposits. The Buffalo Valley Mine produces oxide gold ore from the Havallah Formation along a range front fault that borders the western side of Battle Mountain. The ore is disseminated in altered and mineralized rock. The Lone Tree Mine lies along the Wayne zone and consists of siliceous gold veins and replacements in the Valmy Formation.

The Marigold Mine was discovered in 1985 and production began in 1988. The Marigold Mine produces oxide gold ore from siliceous gold replacements along fault/fracture zones within the Valmy Formation and the Antler/Battle Sequence near the Golconda Thrust. Currently, there are 4 open-pit operations on the property: 1) 8-South, 2) Top Zone, 3) East Hill, and 4) Red Rock. The mine encompasses about 18,800 acres of private and public land. During 1997, Marigold mined approximately 15 million tons of waste rock, 4.8 million tons of leach-grade ore, and 0.725 million tons of mill-grade ore from the 4 active open pits. Since startup in 1988, Marigold has produced 631,085 ounces of gold.

Except for the higher grade ore that requires milling before being sent to a leach pad, the ore mined in the 4 active pits at Marigold is oxide gold amenable to direct cyanide leaching. Current mining involves a total of 1.7 million tons of waste rock and ore per month; mining is conducted on 20- to 40-foot benches in the 4 operating open pits. All four pits are above the current water table. The existing tailings impoundment contains about 196,500 cubic feet of tailings and is unlined but contains a clay base. Current discharge of water to the tailings impoundment is about 470 gpm and is based on an average of 1,750 tons per day of ore delivered to the mill. All leach pads are lined in accordance with Nevada regulations governing leach pads used with cyanide heap leaching.

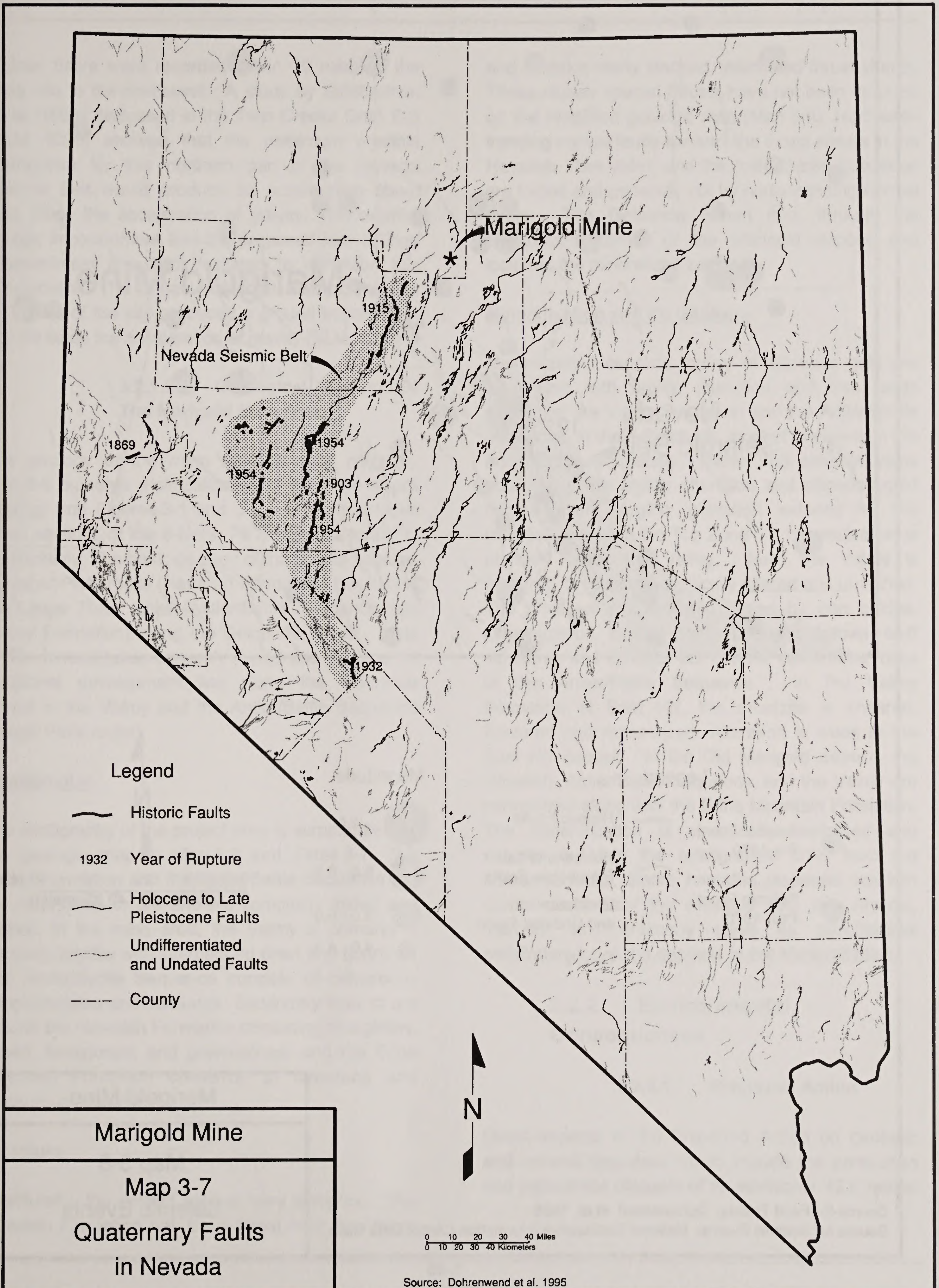
3.2.1.6 Oil, Gas, and Geothermal Development

No known oil, gas, or geothermal development has been identified in this portion of the Humboldt Basin.

3.2.1.7 Seismicity

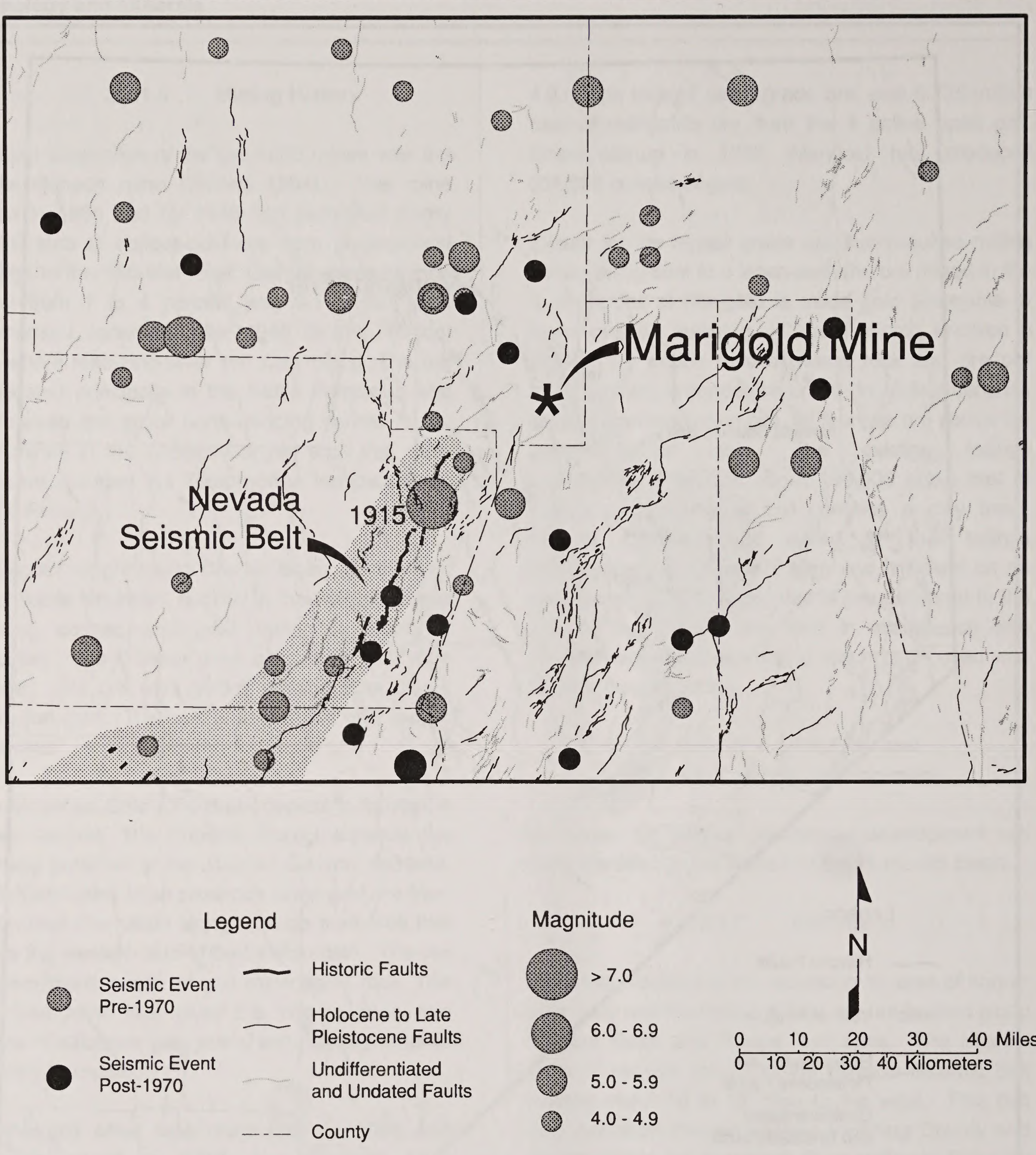
The Marigold Mine is not located in an area of known seismicity and the mine facilities are not located along a major Basin and Range fault zone. The nearest zone of seismic activity is the Nevada Seismic Belt located about 10 to 15 miles to the west. This belt runs northeast through eastern Pershing County and encompasses the Humboldt River Valley in Pershing County as well as Buena Vista Valley and Grass Valley. The belt runs west of the Lone Tree Mine and up toward the Twin Creeks Mine (Map 3-7).

The largest recorded earthquake near the Marigold Mine was a Richter Magnitude 7.8 located about 25 miles southwest of the mine along the Nevada Seismic Belt (Map 3-8). Two post 1970 seismic events with a magnitude around 4.0 to 5.0 on the



Marigold Mine

Map 3-7
Quaternary Faults
in Nevada



Source for Fault Traces: Dohrenwend et al. 1995
Source for Seismic Events: National Earthquake Information Center Data Base

Marigold Mine

Map 3-8

Seismic Events

Richter Scale were recorded within 20 miles of the mine site to the northwest. A study by Siddharthan et. al (1993) discussed in the Twin Creeks Draft EIS (BLM 1996) showed that the maximum credible earthquake for this northern part of the Nevada Seismic Belt would produce an acceleration about 0.48 times the acceleration of gravity. The existing tailings impoundment and the proposed new tailings impoundment are both designed to withstand this acceleration. The largest recorded earthquake with 100 miles of the site produced a ground acceleration of 0.09 times the acceleration of gravity (BLM 1996).

3.2.1.8 Geological Setting Of The Marigold Mine Area

The geology of the mine area is quite complex. Map 3-9 presents a simplification of the mine area's geology and Figures 3-1 and 3-2 are representative cross sections of the 8-North Pit and the 5-North Pit, respectively. The basic geology of the project consists of Upper Plate rocks (Havallah Formation) thrust over the Lower Plate rocks (Antler/Battle Sequence and Valmy Formation) along the Golconda Thrust. Most of the mineralization currently mined and planned for additional development lies along the Golconda Thrust in the Valmy and the Antler/Battle Sequence (Lower Plate rocks).

Stratigraphy

The stratigraphy of the project area is summarized on the geologic map in Map 3-9 and Table 3-7. The Valmy Formation and the Antler/Battle Sequence are the main hosts to ore and are complexly folded and faulted. In the mine area, the Valmy is primarily a siliceous argillite with interbedded chert and quartzite. The Antler/Battle Sequence consists of calcareous conglomerates and siltstones. Secondary host to ore include the Havallah Formation consisting of argillites, cherts, limestones, and greenstones, and the Edna Mountain Formation consisting of limestone and calcareous siltstone.

Structure

Structurally, the project area is very complex. The Havallah Formation has been thrust over the Valmy and contains many stacked, imbricated thrust sheets. These closely spaced thrusts have not been included on the simplified geologic map (Map 3-9). Northeast-trending normal faults transect the thrust sheets in the Havallah. The Valmy and the Antler/Battle Sequence are folded and generally cut by north-trending normal faults. The Golconda Thrust runs through the approximate center of the Marigold deposit and localizes the mineralized zones.

Mineralization and Pit Geology

Mineralization consists mainly of siliceous gold ore associated with argillic alteration and iron oxide staining of the Valmy Formation and the Antler/Battle Sequence. In the 8-South Pit, most of the ore is in the Antler/Battle Sequence. Barite and ankerite veins accompany the argillic alteration and siliceous gold mineralization. Argillic alteration extends to the Havallah rocks. In the Top Zone Pit, mineralization is primarily within the Valmy. Here the Valmy is fractured, brecciated, argillically altered and bleached. The siliceous ore is accompanied by iron oxides. Mineralization in the East Hill zone follows fault structures and spreads out into the calcareous rocks of the Antler/Battle Sequence. In the Valmy Formation at East Hill, the quartzite is sheared, fractured and mineralized. Alteration is weak in the East Hill deposit. In the Old Marigold deposit, the Havallah, Antler/Battle Sequence, and the Valmy are mineralized along with the Edna Mountain Formation. The mineralization is structurally controlled and extends out into the stratigraphic units from the numerous faults. Barite, hematite, jasperoid, and iron oxides accompany the siliceous gold ore. Arsenic, mercury, and antimony serve as geochemical pathfinders for all the deposits at the Marigold Mine.

3.2.2 Environmental Consequences

3.2.2.1 Proposed Action

Direct impacts of the Proposed Action on geologic and mineral resources would include the generation and permanent disposal of an additional 42.6 million [illegible] were recorded within [illegible] mile of the mine site to the northeast. A study by Sackmann et al. (1980) discussed in the Twin Creeks Draft EIS (BLM 1996) indicated that the maximum credible earthquake for the northern part of the Nevada [illegible] that would produce an acceleration [illegible] [illegible] the acceleration of gravity. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] of the site region is [illegible] of 0.08 times the acceleration of gravity (BLM [illegible]).

3.3.1.[illegible] Geologic Setting of The Sunnyside Mine Area

The geology of the mine area is [illegible] [illegible] [illegible] presents a simplification of the mine area [illegible] and Figures [illegible] and [illegible] are representative cross sections of the [illegible] North Pit [illegible] respectively. The basic geology [illegible] of Upper Plate rocks (Roberts Mountains [illegible]) [illegible] Lower Plate rocks [illegible] [illegible] Valley Formation along the Roberts [illegible] [illegible] [illegible] [illegible] additional development [illegible] along the [illegible] Thrust in the Valley and [illegible] Lower Plate rocks [illegible].

Stratigraphy

The stratigraphy of the project area is summarized on the geologic map in [illegible] and Figure [illegible]. The Valley Formation and the Antler/Sequence [illegible] the [illegible] of [illegible] and [illegible] located in the mine area, the Valley is primarily siliceous argillite with [illegible] chert and [illegible]. The Antler/Battle Sequence consists of [illegible] conglomerates and [illegible] Sequence [illegible] to include the Harmony Formation [illegible] [illegible] [illegible], limestones, and [illegible], and the Edna Mountain Formation [illegible] [illegible] [illegible] [illegible] [illegible].

Structure

[illegible] the [illegible] area is very [illegible]. The [illegible] Formation has been [illegible] [illegible] [illegible]

and Sawbuck, many sections, and [illegible] [illegible] [illegible]. These [illegible] [illegible] [illegible] [illegible] been [illegible] on the [illegible] geologic map (Figure [illegible]) [illegible] trending [illegible] [illegible] are [illegible] [illegible] in the [illegible]. The [illegible] and [illegible] [illegible] [illegible] and generally cut by north-trending [illegible] [illegible]. The [illegible] [illegible] [illegible] [illegible] the [illegible] of the [illegible] deposit and [illegible] [illegible].

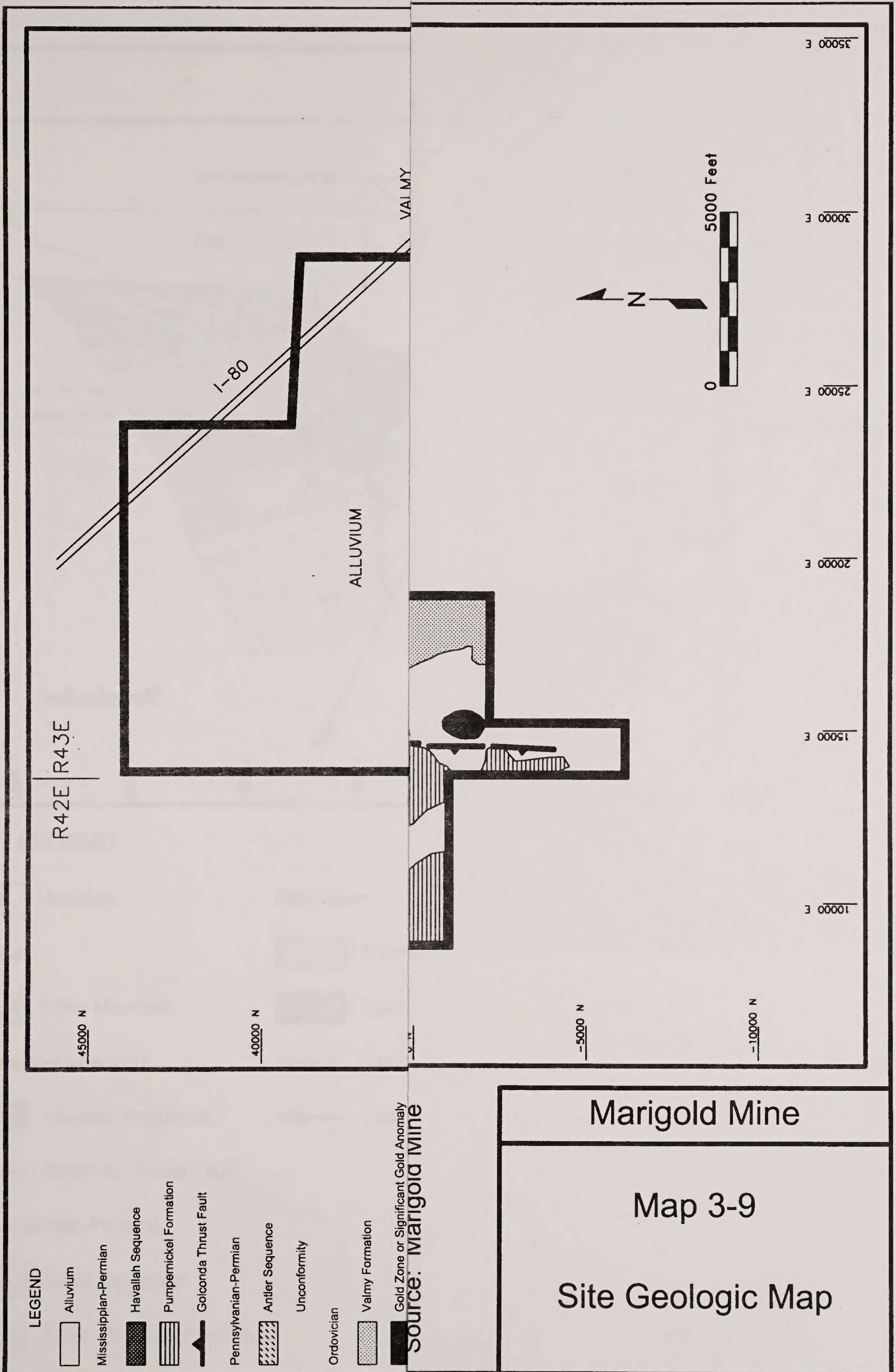
[illegible] [illegible] [illegible] of the [illegible]

[illegible] consists mainly of siliceous [illegible] and [illegible] [illegible] [illegible] and [illegible] [illegible] of the [illegible] [illegible] and the [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] the [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] the [illegible] [illegible] the [illegible] [illegible] primarily [illegible] [illegible]. [illegible] Valley is [illegible] [illegible] [illegible] [illegible] [illegible]. The [illegible] [illegible] by [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] of the Antler/Battle Sequence. In the Valley Formation at East Pit, the quartzite is [illegible] [illegible] and [illegible] alteration is [illegible] in the East Pit deposit. In the [illegible] [illegible] [illegible], the [illegible], [illegible] [illegible], and the [illegible] [illegible] [illegible] with the Edna Mountain Formation. The [illegible] in [illegible] of the deposit in the [illegible].

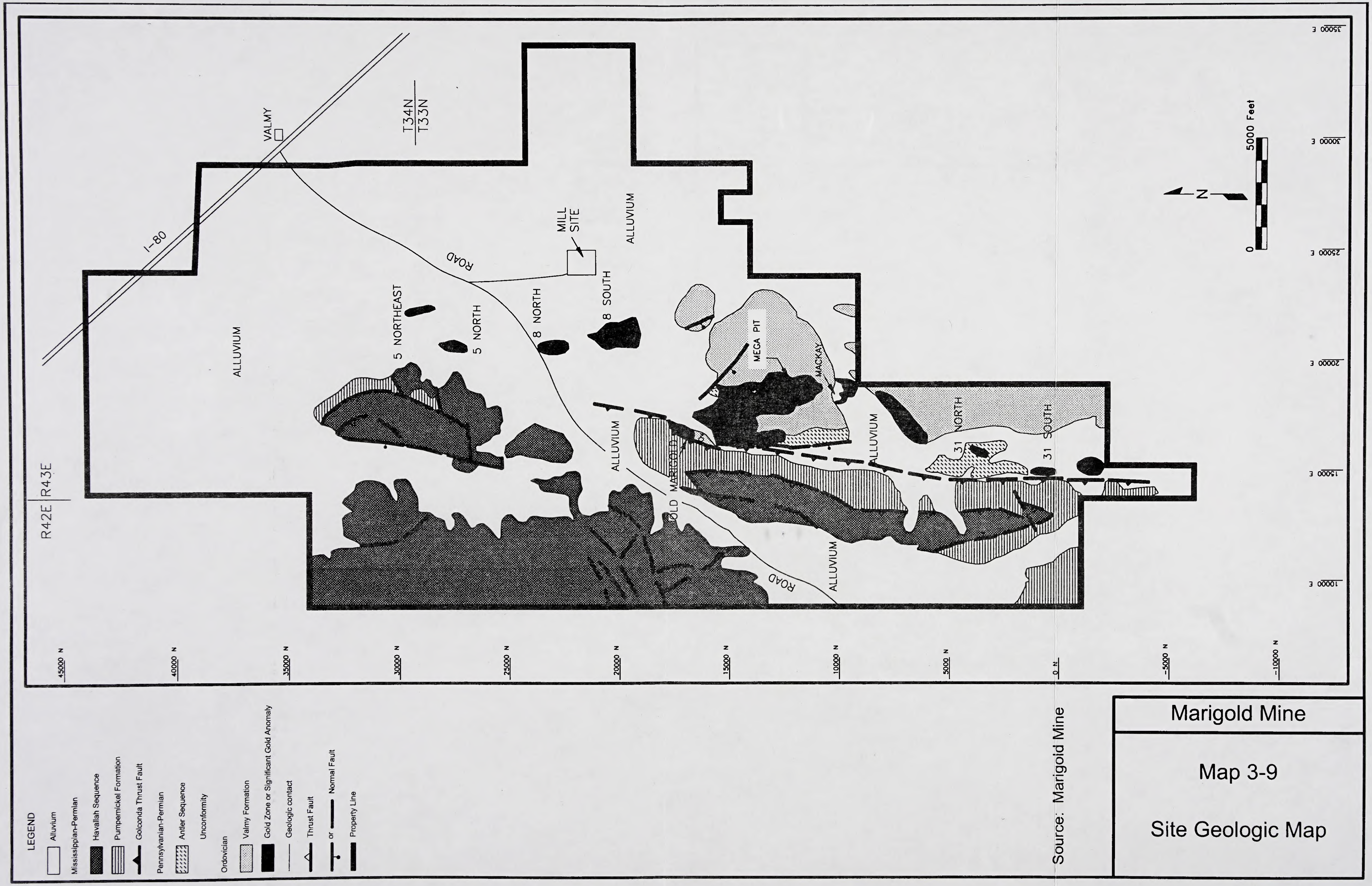
3.3.2 Environmental Consequences

3.3.2.1 Proposed Action

Direct impacts of the Proposed Action on geology [illegible] [illegible] [illegible] would include the [illegible] and [illegible] [illegible] of [illegible] additional [illegible] [illegible]



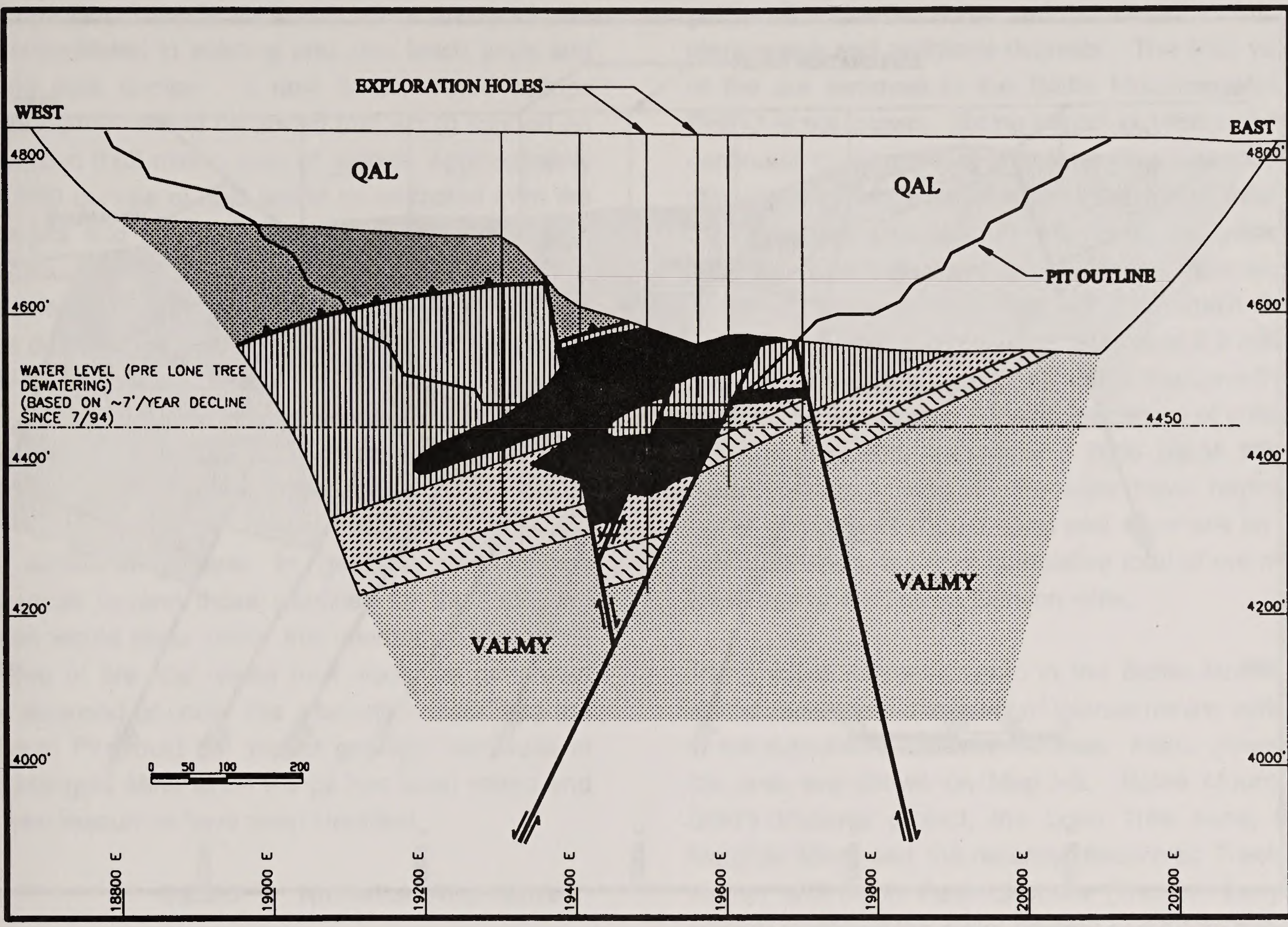
Marigold Mine
Map 3-9
Site Geologic Map
LEGEND
Alluvium
Mississippian-Permian
Havallah Sequence
Pumpernickel Formation
Golconda Thrust Fault
Pennsylvanian-Permian
Antler Sequence
Unconformity
Ordovician
Valmy Formation
Gold Zone or Significant Gold Anomaly
Source: Marigold Mine
R42E
R43E
I-80
VALMY
ALLUVIUM
45000 N
40000 N
-5000 N
-10000 N
10000 E
15000 E
20000 E
25000 E
30000 E
35000 E
N
0
5000 Feet



Marigold Mine

Map 3-9

Site Geologic Map



LEGEND

QAL Alluvium

Permian

Edna Mountain

Mississippian-Permian

Havallah Sequence

Golconda Thrust Fault

Pennsylvanian-Permian

Antler Sequence

Battle Mountain Formation

Ordovician

Valmy Formation

Gold Zone or Significant Gold Anomaly

Geologic contact

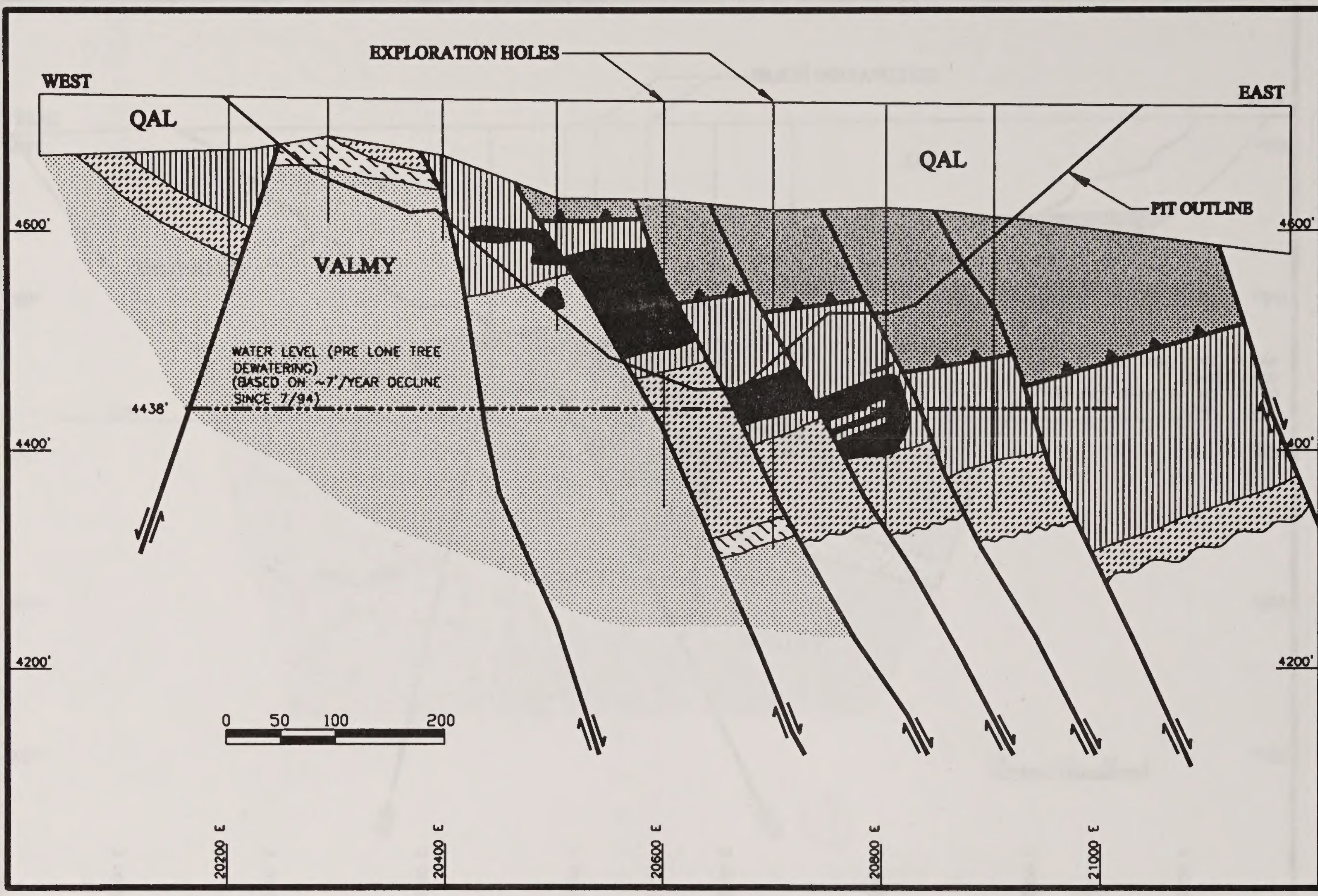
Fault

Source: Marigold Mine

Marigold Mine

Figure 3-1

Geologic Cross-Section for 8-North Pit



LEGEND

Symbol	Unit	Symbol	Unit
QAL	Alluvium		Ordovician
	Permian		Valmy Formation
	Edna Mountain		Gold Zone or Significant Gold Anomaly
	Mississippian-Permian		Geologic contact
	Havallah Sequence		Fault
	Golconda Thrust Fault		
	Pennsylvanian-Permian		
	Antler Sequence		
	Battle Mountain Formation		

Source: Marigold Mine

Marigold Mine

Figure 3-2

Geologic Cross-Section for 5-North Pit

tons of waste rock and 6.8 million tons of spent ore. The additional waste rock and spent ore would be accommodated in existing and new leach pads and waste rock dumps. A new 54-acre lined tailings impoundment would be added that would support an estimated 0.82 million tons of tailings. Approximately 320,000 ounces of gold would be extracted from the new pits and pit expansions. Condemnation drilling indicates that no known geologic resources would be impacted by the proposed new and expanded waste rock dumps, new and expanded leach pad, and the new tailings impoundment.

3.2.2.2 8-South Partial Pit Backfill Alternative

No additional impacts to geologic and mineral resources beyond those identified for the Proposed Action would occur under this alternative. The same volume of ore and waste rock would be generated and disposed of under this alternative. Backfilling the 8-South Pit would not impact geologic resources at the Marigold Mine since the pit has been mined and no new resources have been identified.

3.2.2.3 No Action Alternative

No impacts to geologic and mineral resources would occur under the No Action Alternative beyond what is currently occurring under existing and approved operations.

3.2.3 Cumulative Impacts

Surface mining affects geology and mineral resources by excavating, modifying, or covering natural topographic and geomorphic features and by removing mineral resources, thereby making these mineral resources unavailable for future use. The cumulative assessment area for geology and mineral resources is shown on Map 3-5 and includes the area from the Lone Tree Mine south to Battle Mountain Gold's Phoenix project. This is an area of current exploration and development of gold deposits.

Historically, this area has been mined for copper, gold, silver, with some minor development of manganese and antimony deposits. The total value of the ore removed in the Battle Mountain Mining District is not known. Mining began in 1866 and has continued to the present with intermittent periods of little or no mining alternating with periods of intense mining activity. Over 400,000 tons of copper-gold ore were removed from the Copper Canyon mine alone between 1866 and 1945. The Battle Mountain Gold complex to date has removed an estimated 2.2 million ounces of gold ore. It is estimated that the Lone Tree Mine will have removed 4.35 million ounces of gold by the time mining ceases around 2006 (BLM 1995). Other historical mines in the area have removed lesser amounts of copper, gold and silver ore on an individual basis, but their cumulative total of ore may equal that of the Copper Canyon mine.

The present interest in gold in the Battle Mountain district represents a renewal of intense mining activity in the cumulative assessment area. Major mines in the area are shown on Map 3-5. Battle Mountain Gold's Phoenix project, the Lone Tree Mine, the Margiold Mine, and the recently discovered Trenton, Valmy, and North Peak deposits (Trenton Canyon project) represent the major present and future mining impacts to the area. The Lone Tree Mine is expected to operate until around 2006 and remove about 555 million tons of ore and waste rock (BLM 1995). The Phoenix project is expected to remove an estimated 1.15 billion tons of ore and waste rock containing approximately 7 million ounces of gold. The Trenton Canyon project will remove an estimate 152 million tons of ore and waste rock from at least 3 separate deposits (BLM 1998). The Marigold Mine, when completed around 2006, will have removed an estimated 198.6 million tons of ore and overburden.

The primary geologic impact of mining is the permanent removal and loss of mineral resources. These resources are thus not available for future generations. Condemnation drilling is generally used to identify areas of no potential future economic value before waste rock dumps, tailings impoundments, and leach pads are constructed. The surface disturbances that remain after mining usually do not result in an additional loss of mineral resources to future generations. Operations at the Marigold Mine under the Proposed Action are expected to remove all mineral resources that can be economically extracted under currently available technology and at current and reasonable foreseeable market prices for gold.

3.2.4 Potential Mitigation/Monitoring

No additional mitigation or monitoring needs have been identified.

3.2.5 Residual Adverse Impacts

Adverse residual effects associated with the Proposed Action would include the generation and permanent disposal of approximately 57 million tons of waste rock and approximately 19.5 million tons of spent ore. Under the proposed project, these direct impacts would not be mitigated.

3.3 Air Quality

3.3.1 Affected Environment

The proposed Marigold Mine expansion project area is located near the east-central portion of the Great Basin. The surrounding terrain consists of alternating mountain ranges and sagebrush-covered valleys, with the mine site situated in Hydrographic Area 59, which also is the designated air basin. Mountains in the region of the mine site include highest peaks reaching elevations over 9,000 feet (amsl). Elevations in the project vicinity range from approximately 5,500 feet to over 7,500 feet (amsl).

Baseline meteorology, air quality, and dispersion conditions at the project site are characterized from ambient monitoring data taken during 1993-94 at nearby Lone Tree Mine, and from the Valmy Power Station located approximately 5 miles north of the project area. The climate in the project region is classified as semi-arid or steppe. Elevations below 5,000 feet receive the least amount of precipitation and are generally described as arid or desert climatic zones. The mountainous areas are significantly wetter receiving 11 to over 15 inches of precipitation annually. An arid climate is characterized by low rainfall, low humidity, clear skies, and relatively large annual and diurnal temperature ranges.

Because of the typically dry atmosphere, bright sunny days and clear nights occur frequently. Clear skies allow rapid heating of the ground surface during daylight hours and rapid cooling at night. Since heated air rises and cooled air sinks, winds tend to blow uphill during the daytime and downslope at night. This upslope and downslope cycle generally occurs in all the geographical features, including mountain range slopes and river courses. The larger the horizontal extent of the feature, the greater the volume of air that moves in the cycle. Complexity of the terrain features causes complex movements in the cyclic air patterns, with thin layers of moving air embedded within the larger scale motions. The lower-level, thermally driven winds are also embedded within larger scale upper wind systems (synoptic winds). Synoptic winds in the region blow predominantly west to east, are characterized by daily weather variations which enhance or diminish the boundary layer winds, and are significantly channeled by regional and local topography. Terrain features affect both wind speed and wind direction.

3.3.1.1 Climatology and Meteorology

Three important meteorological factors influence the dispersion of pollutants in the atmosphere: mixing height, wind (speed and direction), and stability. Mixing height is the height above ground within which rising warm air from the surface will mix by convection and turbulence. The degree to which pollutants are diluted in this mixed layer is determined by local atmospheric conditions, terrain configuration, and source location. Mixing heights vary diurnally, with the passage of weather systems, and with season. For the project area, the mean annual morning mixing height is estimated to be about 300 meters, but during the winter months the mean morning mixing height is about 220 meters (Holzworth 1972). The mean annual afternoon mixing height exceeds 2,400 meters.

Morning atmospheric stability conditions tend to be stable because of the rapid cooling of the layers of air nearest the ground. Afternoon conditions, especially during the warmer months, tend to be neutral to unstable because of the solar heating of the surface under clear skies. During the winter, periods of stable afternoon conditions may persist for several days in the absence of synoptic scale storm systems to generate higher winds with more turbulence and mixing. A high frequency of inversions at lower elevations during the winter can be attributed to the nighttime cooling and sinking air flowing from higher elevations to the low lying areas in the basins. Although winter inversions are generally quite shallow, they tend to be more stable because of reduced surface heating. The mine site is located at higher elevations and would experience fewer episodes with stagnant conditions than locations in lower valleys.

The proposed project is located at a latitude that places it within the belt of prevailing westerly winds that circle the globe around the earth's northern hemisphere. However, the mine site is located in complex terrain where the local winds are affected by topographic features.

High quality meteorological data are collected on a routine basis at the Valmy Power Station located about 5 miles north of the mine site. Winds were measured on a multi-level tower at 10, 50, and 100 meters at Valmy, and quarterly wind roses for the 10-meter level are shown in Figure 3-3. These data show the percentage of time that the wind blows from a particular direction. For the project site, the most frequently observed wind direction is from the northwest.

Wind speed has an important effect on area ventilation and the dilution of pollutant concentrations from individual sources. Light winds, in conjunction with large source emissions, may allow pollutants to accumulate and stagnate or move slowly to downwind areas. During stable conditions, downwind usually means down valley or toward lower elevations. Climatological data from the region (Winnemucca) indicate that the potential for air pollution episodes to last 5 or more days is nearly zero (Holzworth 1972). A potential air pollution episode is defined as a period of time with wind speeds less than 2 meters per second and mixing heights less than 1,000 meters.

Although weather conditions are not monitored at the mine site, average temperatures would be similar to those experienced at Lone Tree Mine located about 8 miles northwest of the Marigold mine and located at about the same elevation. At the Lone Tree mine site temperatures range from the 20s (°F) in January to mostly the 90s in July, although temperatures in excess of 100 are sometimes observed. Table 3-8 and Figure 3-4 depict maximum, average, and minimum temperatures at the Lone Tree mine during the period January 1993 through December 1994.

Summers are typically hot and dry except in the higher mountain ranges. Although precipitation is spread throughout the year, most of the annual precipitation will fall as snow during the winter months. The average annual precipitation is only about 9 inches at Winnemucca. Precipitation totals by month for Marigold Mine for the period from September 1993 through August 1999 are presented in Table 3-9. These on-site data indicate that the mine receives about the same or somewhat higher amounts than Winnemucca. Average relative humidity ranges from a low of 17 percent in the summer during the day to a high of 77 percent in spring during the night (NOAA 1990). Net evaporation exceeds precipitation in the project area.

3.3.1.2 Air Quality

Air quality is defined by the concentration of various pollutants and their interactions in the atmosphere. Pollution effects on human and environmental receptors have been used to establish a definition of air quality. Measurement of pollutants in the atmosphere is expressed in units of parts per million (ppm) or micrograms per cubic meter (μg/m3). Both long-term climatic factors and short-term weather fluctuations are considered part of the air quality resource because they control dispersion and affect concentrations. Physical effects of air quality depend on the characteristics of the receptors and the type, amount, and duration of exposure. Air quality standards specify acceptable upper limits of pollutant concentrations and duration of exposure. Air pollutant concentrations within the standards are generally not considered to be detrimental to public health and welfare.

The relative importance of pollutant concentrations can be determined by comparison with an appropriate national and/or state ambient air quality standard. National and state ambient air quality standards are presented in Table 3-10. An area is designated by

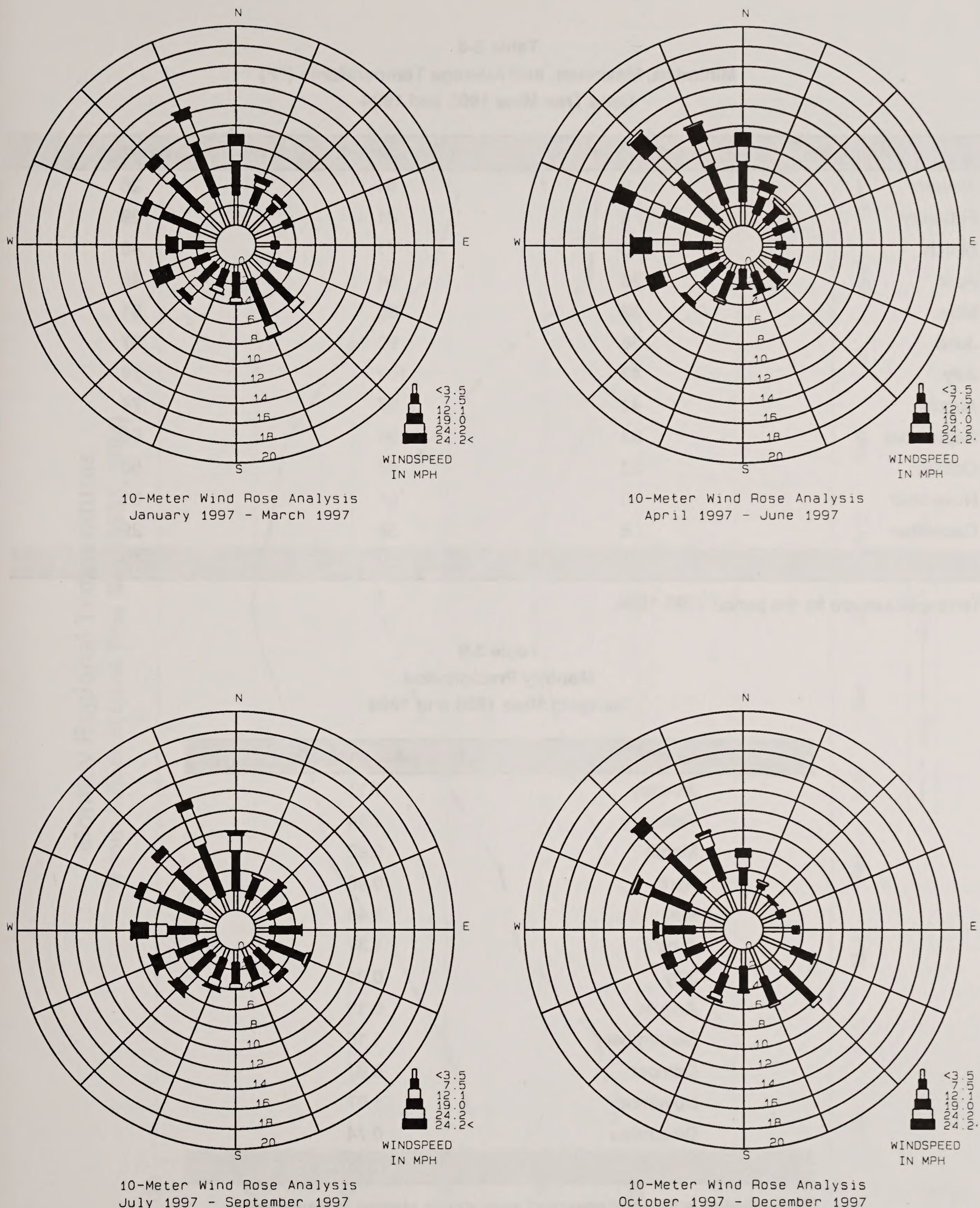


Figure 3-3. Valmy Wind Roses January - December 1997

Table 3-8
Minimum, Maximum, and Average Temperatures (°F)
Lone Tree Mine 1993 and 1994

Month	Minimum[1]	Maximum[1]	Average[1]
January	-9	54	25
February	0	61	29
March	15	71	45
April	26	84	49
May	33	88	61
June	38	95	67
July	42	101	74
August	42	97	74
September	33	94	65
October	22	83	50
November	0	64	31
December	6	58	29
Annual	21	79	50

[1]Temperatures are for the period 1993-1994.

Table 3-9
Monthly Precipitation
Marigold Mine 1998 and 1999

Month	Precipitation (inches)[1]
January	1.11
February	1.14
March	0.62
April	0.90
May	1.40
June	1.31
July	0.01
August	0.13
September	1.16
October	0.67
November	1.07
December	0.74
Total	10.26

[1]Precipitation is the total observed each month starting in September 1998 through August 1999.

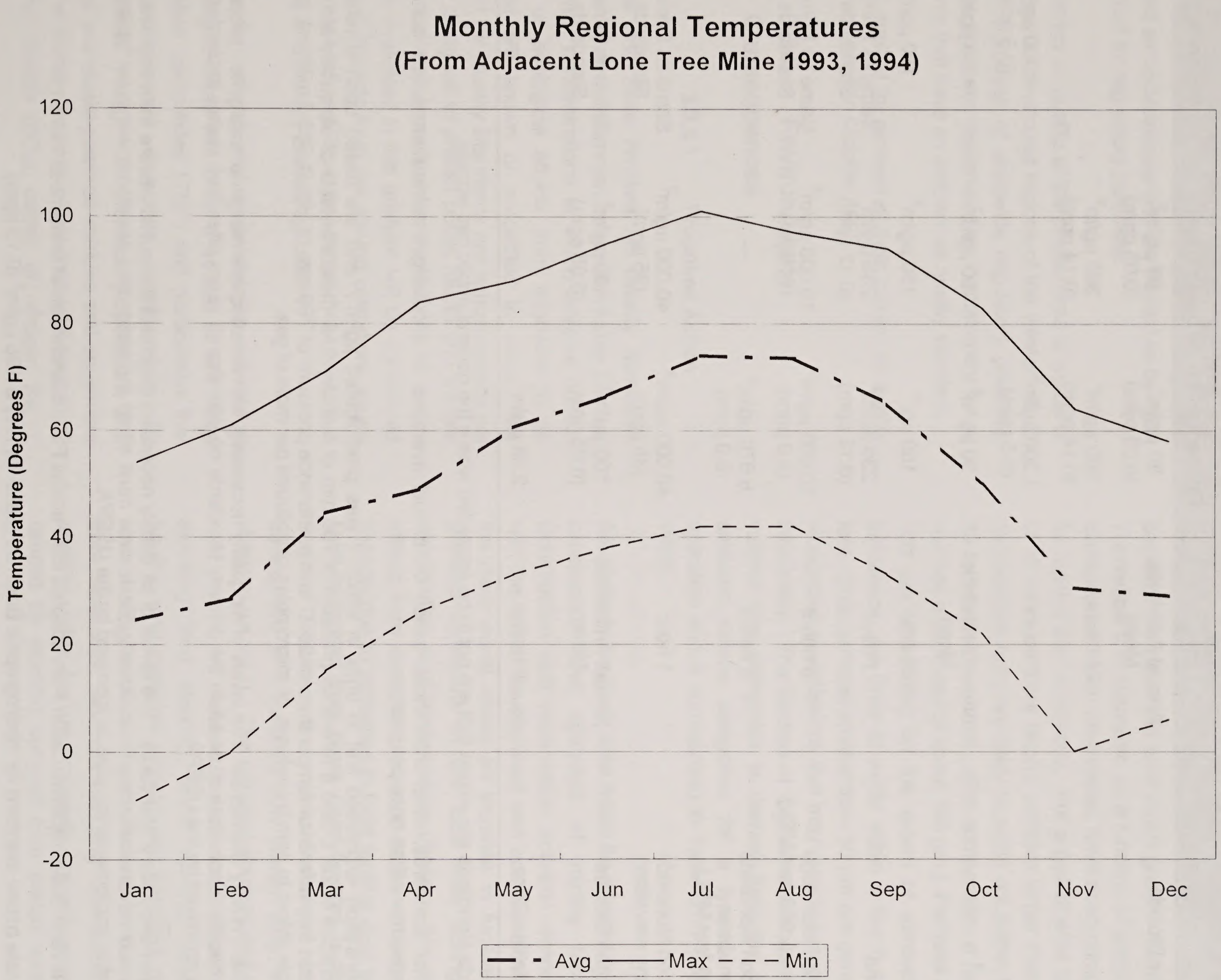


Figure 3-4. Marigold Mine Expansion Project Monthly Regional Temperatures

Table 3-10
National and State Ambient Air Quality Standards

Pollutant	Averaging Time	Nevada Standards[1] Concentration[3]	National Standards[2,3] Primary[4]	Secondary[5]
Sulfur Dioxide	Annual Arithmetic Mean	80 μg/m³ (0.03 ppm)	80 μg/m³ (0.03 ppm)	---
	24 hours	365 μg/m³ (0.14 ppm)	365 μg/m³ (0.14 ppm)	---
	3 hours	1,300 μg/m³ (0.5 ppm)	---	1,300 μg/m³ (0.5 ppm)
PM_{10}[6]	Annual Arithmetic Mean	50 μg/m³	50 μg/m³	50 μg/m³
	24 hour	150 μg/ᵐ	150 μg/m³	150 μg/m³
Ozone[7]	1 hour	235 μg/m³ (0.12 ppm)	235 μg/m³ (0.12 ppm)	Same as Primary Standards
Carbon Monoxide (below 5,000 feet MSL)	8 hours	10,000 μg/m³ (9.0 ppm)	10,000 μg/m³ (9 ppm)	Same as Primary Standards
Carbon Monoxide (at or above 5,000 feet MSL)	8 hours	6,670 μg/m³ (6.0 ppm)	---	---
Carbon Monoxide (at any elevation)	1 hour	40,000 μg/m³ (35 ppm)	40,000 μg/m³ (35 ppm)	Same as Primary Standards
Nitrogen Dioxide	Annual Arithmetic Mean	100 μg/m³ (0.05 ppm)	100 μg/m³ (0.05 ppm)	Same as Primary Standards
Crystalline Silica	8 hours	2.38 μg/m³	---	---

[1]Nevada standards are values that are not to be exceeded where the general public has access.

[2]National standards, other than those based on annual averages or annual geometric means, are not to be exceeded more than once per year.

[3]Concentration expressed first in units in which it was promulgated μg/m³, and are based upon a reference temperature of 25°C and a reference pressure of 760 mm of mercury. All measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 mm of Hg (1,013.2 millibar); ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.

[4]National Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health. Each state must attain the primary standards no later than 3 years after that state's implementation plan is approved by the USEPA.

[5]National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Each state must attain the secondary standards within a "reasonable time" after implementation plan is approved by the USEPA.

[6]The Nevada State Implementation Plan adopted the Federal PM_{10} Standard as of December 1991.

[7]The state ozone standard for Hydrographic Basin 90 (Lake Tahoe) is 195 μg/m³ (0.10 ppm).

the U.S. Environmental Protection Agency (USEPA) as being in attainment for a pollutant if ambient concentrations of that pollutant are below the National Ambient Air Quality Standards (NAAQS). An area is not in attainment if violations of NAAQS for that pollutant occur. Areas where insufficient data are available to make an attainment status designation are listed as unclassifiable and are treated as being in attainment for regulatory purposes.

The existing air quality of the project area is typical of the largely undeveloped regions of the western U. S. For the purposes of statewide regulatory planning, this area has been designated as in attainment for all pollutants that have an ambient air quality standard.

GMMC applied for renewal of their current air quality operating permit in October 1999.

3.3.2 Environmental Consequences

3.3.2.1 Proposed Action

National and State Ambient Air Quality Standards establish levels of common air contaminants that are the lowest concentrations at which adverse human health or ecological effects from exposure to air pollution are known or suspected to occur. The Ambient Air Quality Standards are concentrations set by law designed to protect public health and welfare from the air pollutants listed in Table 3-10. Air quality impacts evaluated in this analysis will be considered notable if impacts from the mining operations cause an increase of regulated pollutants that result in a violation of State or Federal regulations.

Construction, mining, and ore-processing activities at the Marigold Mine would be a source of both total suspended particulates (TSP) and particulates that have aerodynamic diameters smaller than 10 micrometers (PM_{10}). Ore processing operations and gasoline and diesel-powered vehicles and equipment would be primary sources of gaseous pollutants such as sulfur dioxide (SO_2), oxides of nitrogen (NO_2), carbon monoxide (CO), and volatile organic compounds (VOCs).

The air quality impact of a fugitive dust source depends on the quantity and drift potential of the dust particles released into the atmosphere. The larger dust particles settle out near the source, while fine particles are dispersed over much greater distances. Theoretical drift distances, as a function of particulate diameter and mean wind speed, have been computed for fugitive dust emissions. For a typical wind speed of 10 miles per hour (mph), particles larger than 100 micrometers (μm) are likely to settle out within 20 to 30 feet from the source. (For comparison, a human hair has a thickness of about 100 μm.) Particles 30 to 100 μm, depending on the extent of atmospheric turbulence, are likely to settle within a few hundred feet. Dust particles smaller than 30 μm are generally recognized as emissions that may remain suspended indefinitely. The fraction of fugitive emissions in the various size categories is derived from the major emission source categories for a typical mining operation and is summarized in Table 3-11 (USEPA 1985).

Air quality in the study area would be affected by both construction and operation of mining facilities. Construction and reclamation activities associated with the further development and eventual closing of the mine would cause an increase in fugitive and gaseous emissions in the local area during the construction and reclamation phases. Air quality effects from construction would result in temporary impacts due to increases in local fugitive dust levels. Dust generated from these open sources is termed "fugitive" because it is not discharged to the atmosphere in a confined flow stream (e.g., stack, chimney, or vent). The principal sources of fugitive dust would be related to construction activities, including land clearing, earth moving, scraping, hauling, and materials storage and handling; drilling and blasting; truck loading operations; wind erosion from stockpiles; and ore handling operations. In addition, other fugitive emissions impacts would be caused by mud/dirt carryout onto paved surfaces.

Table 3-11
Marigold Mine Expansion Project
Estimated Particle Size Distribution

	Diameter (μm)					
Process	<2.5	2.5-5.0	5.1 – 10.0	10.1 - 15.0	15.1 - 30.0	>30.0
Material Handling	0.13	0.10	0.13	0.12	0.25	0.27
Unpaved Roads	0.10	0.10	0.16	0.14	0.30	0.20
Composite	0.11	0.10	0.14	0.13	0.28	0.24

Source: USEPA 1998.

The additional surface loading would cause an increase in fugitive emissions during the lifetime of the construction project.

During construction and reclamation, vehicle exhaust emissions would be generated but such emissions are small compared to fugitive emissions from earth moving, hauling and other construction activities and would not affect regional air quality. Particulate levels from construction and reclamation activities would vary, and impacts would depend on the activity location and the daily wind and weather. These activities would require a surface disturbance permit from NDEP, which would require that appropriate measures be taken to limit fugitive dust emissions. While mitigation measures required by the NDEP Air Quality Bureau would reduce the amount of emissions from such activities, some level of fugitive dust emissions would be unavoidable due to the nature of the work. Although some impacts on air quality would inevitably occur during construction and reclamation, they would be transitory and temporary, limited in duration, and would end at the completion of that particular phase of the work. Once reclamation was completed, pollutant concentrations would return to background levels.

Air quality impacts due to emissions from mining operations would occur throughout the operational phase of the project. The primary pollutant would be fugitive dust particulates (TSP and PM_{10}) generated by the crushers, screens, conveyors, tailings impoundments, haul roads, and other processes. Other pollutants include NO_2, CO, and SO_2 from exhaust emissions from the vehicles, and other fuel burning equipment. Volatile organic compounds are emitted from fuel storage tanks.

All criteria pollutant emission rates (not including fugitive dust) are less than 250 tons per year (tpy); therefore, the mine is not a "major stationary source" as defined by the USEPA. Air pollutant sources are deemed "major" for Prevention of Significant Deterioration (PSD) purposes if their emissions exceed 250 tpy. The planned mine expansion would result in an increase of gaseous pollutants, but each type would be less than 2 tpy, well below the 250 tpy threshold for PSD. Emissions of particulates from all individual sources at the mine facilities would be less than 100 tpy and would not be classified as a major source under Title V of the Clean Air Act. Hazardous air pollutants (HAPs) emissions would be less than 10 tons per year for each individual pollutant and less than 25 tons per year for all HAPs combined.

The highest potential to emit for a criteria pollutant would be PM_{10} at 34.46 tpy. Total combined HAPs are projected to be 9.6 tpy. The highest individual HAP emission would be mercury; the estimated value is 2.09 tpy. These emission levels qualify the mine as a minor source of air contaminants. Fugitive emissions associated with the heap leach pads are expected to be near zero. Cyanide solution would be applied to the leach heaps using a drip irrigation system. Typically lime and caustic are used to maintain the cyanide at a high pH in solution and to minimize the formation of hydrogen cyanide (HCN). With the continued pH control of the process solution, HCN formation and the off-gas of HCN would be negligible; consequently, ambient HCN concentrations and resultant odors would be minimal.

Sources of fugitive dust and other pollutants include:

- Drilling and blasting
- Loading haul trucks
- Hauling ore/waste rock
- Truck dumps
- Primary and secondary crushers
- Conveyors, stackers and screens
- Leach pads
- Tailings impoundment
- Haul road maintenance
- Support vehicles
- Lime silo storage, loading and unloading
- Cement silo storage, loading and unloading
- Crucible furnace and carbon kiln
- Mercury retort
- Storage tanks
- Wind erosion of active and inactive disturbance areas, overburden, and ore stockpiles

Table 3-12 lists the total potential to emit for the various air pollutants from all point sources and fugitive sources at the mine in tons per year.

As part of the Air Quality Permit process, Marigold Mine conducted ambient monitoring for PM_{10} during the time period October 1991 through October 1992. The highest concentrations of PM_{10} were 84 $\mu g/m^3$ for the primary and 96 $\mu g/m^3$ for the collocated sampler recorded on June 11, 1992. These values are well below the 24-hour ambient air quality standard of 150 $\mu g/m^3$. The annual average concentration of PM_{10} was less than 30 $\mu g/m^3$, and this value is well below the annual standard of 50 $\mu g/m^3$.

The State of Nevada has previously granted air quality permits for the existing mine operations. The project would comply with all existing air quality standards in Nevada. In October 1999 GMMC applied for their 5-year air quality permit extension. The mine currently operates under NDEP Air Quality Operating Permit #AP1041-0158.

3.3.2.2 8-South Partial Pit Backfill Alternative

The impacts to air quality under the 8-South Partial Pit Backfill Alternative would be the same as those described in the Proposed Action.

3.3.2.3 No Action Alternative

Under the No Action Alternative, air emission levels would continue at the current levels through 2001. Fugitive emission levels would gradually decrease through the reclamation period.

3.3.3 Cumulative Impacts

The predicted maximum annual concentration of particulates at the point of closest public access beyond the mine property boundary would be less than Nevada's annual ambient air standard of 50 $\mu g/m^3$. The total cumulative 24-hour impact would not exceed the Nevada 24-hour ambient air quality standard of 150 $\mu g/m^3$. Other permitted and non-permitted sources of air pollution are included in background concentrations measured and predicted for the Marigold Mine. Cumulative air quality impacts in the vicinity of the mine would be very slight since the particulate concentrations would fall below 5 $\mu g/m^3$ within 1 mile of the facility. The annual and 24-hour contributions from the mine sources would not cause the air quality in the region to degrade below National or State ambient air quality standards.

3.3.4 Potential Mitigation and Monitoring

Air quality permits issued by NDEP require the operator to control emissions, including fugitive emissions, from sources at the mine site due to mining activities. GMMC would apply air pollution controls specified by the NDEP to reduce emissions

Table 3-12
Potential to Emit
(typ)

Pollutant	Point Sources	Fugitive sources	Total
PM_{10}	34.46	3714.87	3749.33
SO_2	0.005	0.004	0.01
CO	0.44	0.01	0.45
VOC	1.05	0.01	0.45
NO_2	1.73	0.06	1.80
HAP	2.99	6.60	9.60

during construction and operation of the mine. The control system for the crushing, screening, and conveying circuit would consist of dust collectors and fogging water sprays. Emissions from storage silos are controlled with filters or baghouses that eliminate approximately 99 percent of the potential emissions. GMMC has implemented "tackification" procedures for dust control (using corn syrup) at the existing tailings facility. Irrigation of reclamation plantings also is occurring using tailings impoundment water. Fugitive dust from all disturbed areas would be controlled using watering, chemical stabilization, or other controls approved by the Nevada Bureau of Air Quality. Therefore, additional mitigation measures and monitoring are not recommended.

3.3.5 Residual Adverse Impacts

There would be no residual adverse impacts to air quality from the planned expansion since reclamation would stabilize exposed soil and control fugitive dust emissions. As vegetation becomes established, particulate levels should return to what is typical for a dry desert environment. Once the disturbance ceases and wind erodible surfaces are reclaimed, air resources would return to pre-mining conditions.

3.4 Soils

3.4.1 Affected Environment

3.4.1.1 Detailed Study Area

The soils in the project area have formed in alluvial fan deposits or in colluvium and residuum from mixed rocks on hillslopes and crests. In the upland positions, soils are predominantly shallow and moderately deep over bedrock and are gravelly or cobbly. At higher elevations in the extreme southern part of the project area, cooler seasonal and mean annual soil temperatures prevail relative to the rest of the project area. At lower elevations, very deep gravelly soils occur on alluvial fan piedmonts and fan skirts. Highly sodic soils occur in the upper fan piedmont positions, and slightly to moderately saline soils occur at somewhat lower elevations on fan skirts and inset fans. Information regarding soils located in the project area and vicinity was primarily obtained from the reconnaissance (Order III) soil survey of eastern Humboldt County (Natural Resource Conservation Service [NRCS] 1998 [in progress]), and the detailed (Order II) soil survey conducted for the project area (JBR 1997).

A total of 12 soil mapping units occur in the EIS study area. Of these, nine are units from the detailed survey (JBR 1997), and three are reconnaissance survey units that occur outside the limits of disturbance for the Proposed Action (NRCS 1998 [in progress]). The detailed survey includes a unit that delineates existing and approved disturbance associated with previous projects. The occurrence and extent of soil mapping units is shown in Map 3-10.

The physical characteristics and suitability of the soils for reclamation use are summarized in Tables 3-13 and 3-14. Surface soils within the project area were evaluated for reclamation suitability. Threshold values for a soil's suitability as a growth media for reclamation use were based on the following parameters:

- Sodium adsorption ratio – greater than 46 (excess sodium);
- Electrical conductivity – greater than 16 mmhos/cm (excess salinity);
- pH – greater than 8.5 (high alkalinity);
- Soil texture - textures of clay, silty clay, sandy clay, (high clay content) sand, fine sand, very fine sand (high sand content);
- Coarse fragments – greater than 60 percent by weight (high coarse fragment content); and
- Erosion hazard for water or wind - severe.

Surface soils that exceeded these criteria were considered unsuitable for salvage and reclamation. Unsuitable soils have qualities that limit revegetation success and slope stabilization. If the volume of salvageable surface soil is insufficient for reclamation purposes, suitable alluvial material would be salvaged and stockpiled for reclamation activities.

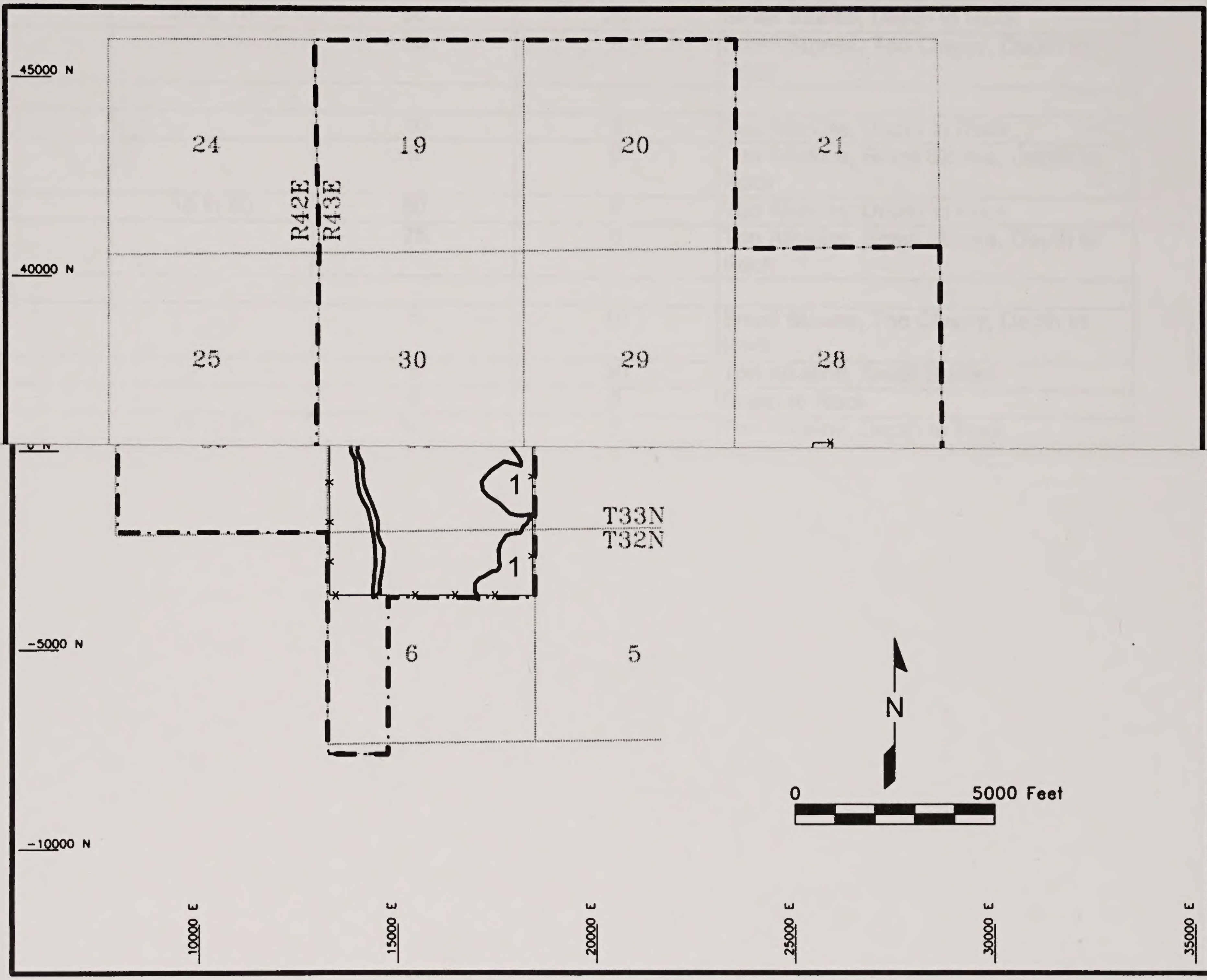
The Linrose-Roca association (Mapping Unit 1) occurs on higher hillslopes and crests in the extreme southern part of the study area. Slopes range from 20 to 70 percent. The Linrose soil is on north- and east-facing slopes and occupies about 50 percent of the unit. It is moderately deep and well drained. Typically the surface layer is dark grayish brown gravelly loam about 11 inches thick. The subsoil is pale brown very gravelly or extremely gravelly sandy loam about 17 inches thick over fractured chert bedrock. The Roca soil also occupies sideslopes, and makes up about 35 percent of the unit. It is moderately deep and well drained. Typically the surface layer is dark grayish brown gravelly silt loam 4 to 8 inches thick. The subsoil is brown very gravelly clay loam about 20 inches thick over fractured chert bedrock. Included with this mapping unit are about 10 percent Soughe soils and 5 percent Hoot soils, as described below. Based on suitability criteria, this unit has suitable reclamation materials to depths varying

LEGEND

PROPOSED FACILITIES
GMMC PROPERTY LINE
EXISTING PERMIT BOUNDARY
PROPOSED PERMIT BOUNDARY

SOIL TYPES

1 - Linrose-Roca Association
2 - Soughe-Hoot Association
3 - Soughe gravelly clay loam, 15 to 50 percent slopes
4 - Rose Creek sandy loam, 2 to 8 percent slopes
5 - Oxcorel clay loam, 2 to 8 percent slopes
6 - Hoot-Burrita Association



Source: JBR Environmental Consultants 1997

Marigold Mine

Map 3-10

Soil Types in the Project Area

3.4 Soils

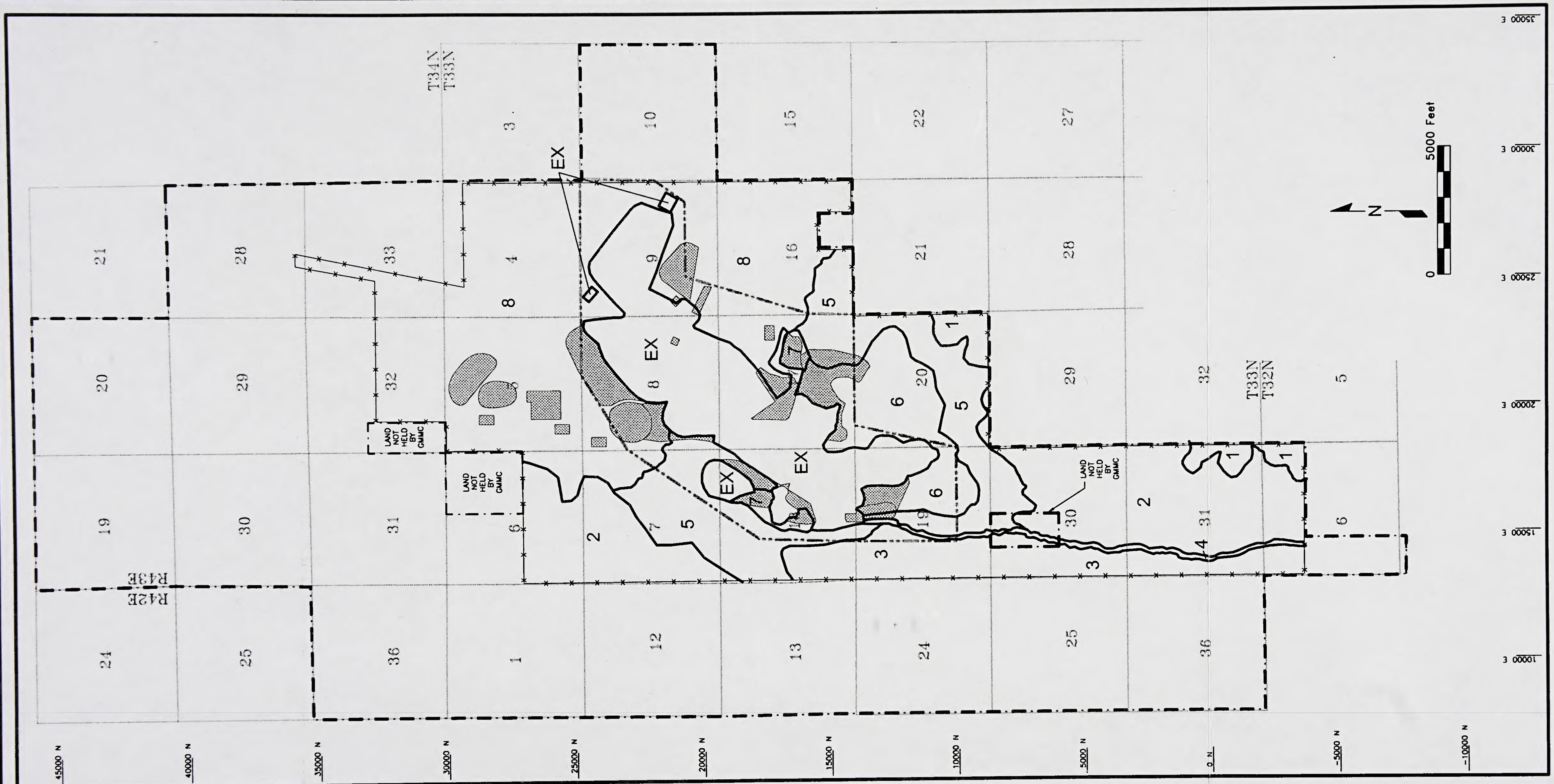
3.4.1 Affected Environment

3.4.1.1 [illegible] Activity Area

The soils of the project area have formed on alluvial fan deposits of [illegible] and [illegible] from [illegible] and [illegible]. In the [illegible] soils are [illegible] and [illegible] and are [illegible]. At [illegible] in the [illegible] part of the project area, [illegible] and [illegible] of the project [illegible]. [illegible] deep gravelly soils [illegible] on alluvial fan deposits [illegible] [illegible] and the [illegible] (NRCS [illegible]).

A total of 12 soil mapping units occur in the [illegible] study area. Of these, [illegible] soil units from the [illegible] survey (NRCS 1997), and [illegible] are [illegible] soil units that occur [illegible] the [illegible] of the Proposed Action (NRCS [illegible]). The detailed survey [illegible] and the [illegible] alternative [illegible] and approved [illegible] associated with [illegible] projects. The [illegible] and extent of soil mapping units is shown in Map 3-[illegible].

The physical and chemical characteristics of the soils for [illegible] are summarized in Tables 3-[illegible] and 3-[illegible]. [illegible] soils within the project area [illegible] evaluated for reclamation suitability. Therefore, [illegible] suitability [illegible] are [illegible].



LEGEND

- PROPOSED FACILITIES
- GMMC PROPERTY LINE
- EXISTING PERMIT BOUNDARY
- PROPOSED PERMIT BOUNDARY

SOIL TYPES

1 - Linrose-Roca Association
2 - Soughe-Hoot Association
3 - Soughe gravelly clay loam, 15 to 50 percent slopes
4 - Rose Creek sandy loam, 2 to 8 percent slopes
5 - Oxcorel clay loam, 2 to 8 percent slopes
6 - Hoot-Burrita Association
7 - Soughe-Burrita Association
8 - Whirlo very gravelly sandy loam, 0 to 2 percent slopes
EX - Existing and Approved Disturbance

Source: JBR Environmental Consultants 1997

Marigold Mine

Map 3-10

Soil Types in the Project Area

Table 3-13
Soil Materials Suitable for Reclamation[1]

Mapping Unit	Soil	Mapping Unit Slope (Percent)	Percent of Unit, by Soil	Suitable Salvage Depth, in.	Limits to Suitability
1	Linrose	20 to 70	50	20	Small Stones, Depth to Rock
	Roca		35	6	Small Stones, Too Clayey, Depth to Rock
	Inclusions				
	Soughe		10	0	Too Alkaline, Depth to Rock
	Hoot		5	6	Too Alkaline, Small Stones, Depth to Rock
2	Soughe	15 to 50	60	0	Too Alkaline, Depth to Rock
	Hoot		25	6	Too Alkaline, Small Stones, Depth to Rock
	Inclusions				
	Burrita		5	10	Small Stones, Too Clayey, Depth to Rock
	Panlee		5	30	Too Alkaline, Small Stones
	R. O.		5	0	Depth to Rock
3	Soughe	15 to 50	85	0	Too Alkaline, Depth to Rock
	Inclusions				
	Hoot		10	6	Too Alkaline, Small Stones, Depth to Rock
	R. O.		5	0	Depth to Rock
4[2]	Rose Cr	2 to 8	90	60	Possibly Too Alkaline in Upper 10"
	Inclusions				
	Oxcorel		10	6	Excess Sodium, Too Clayey
5[2]	Oxcorel	2 to 8	90	6	Excess Sodium, Too Clayey
	Inclusions				
	Alluvium		10	0	Too Sandy, Small Stones
6	Hoot	20 to 50	45	6	Too Alkaline, Small Stones, Depth to Rock
	Burrita		40	10	Small Stones, Too Clayey, Depth to Rock
	Inclusions				
	Soughe		5	0	Too Alkaline, Depth to Rock
	Panlee		5	15	Too Alkaline, Small Stones
	R. O.		5	0	Depth to Rock

Table 3-13 (Continued)

Mapping Unit	Soil	Mapping Unit Slope (Percent)	Percent of Unit, by Soil	Suitable Salvage Depth, in.	Limits to Suitability
7	Soughe	15 to 50	55	0	Too Alkaline, Depth to Rock
	Burrita		30	10	Small Stones, Too Clayey, Depth to Rock
	Inclusions				
	Hoot		10	6	Too Alkaline, Small Stones, Depth to Rock
	R. O.		5	0	Depth to Rock
8[2]	Whirlo	0 to 2	85	36	Too Alkaline, Small Stones
	Inclusions				
	Alluvium		10	0	Too Sandy, Small Stones
	Oxcorel		5	6	Excess Sodium, Too Clayey
EX	Existing Disturbance, Misc. Roads & Linear Features			0	

[1]Approximately 15 percent inclusions (soils other than the major components) occur in each unit.

[2]Mapping units 4, 5, and 8 overlie deep alluvial matrial that is probably suitable for salvage between depths of 10 to 50 feet (Zielinski 1999).

Table 3-14
Soil Characteristics and Reclamation Suitabilities [1]

Soil Series/Soil Mapping Unit Name [1]	Associated Mapping Unit(s) [1]	Dominant Associated Vegetation [1]	Surface Texture [1]	Suitable Soil Depth (in.)	Soil Limitations for Use as Growth Media	Susceptibility to Erosion [1]
Burrita	6, 7	Big sagebrush, rabbitbrush, bottlebrush squirreltail	Very gravelly fine sandy loam	10	Small stones, too clayey, depth to rock	Water: Slight Wind: Slight
EX[2]	EX	N/A	N/A	N/A	N/A	N/A
Hoot	2, 6	Shadscale, bud sagebrush, bottlebrush squirreltail	Very gravelly loam	6	Too alkaline, small stones, depth to rock	Water: Moderate Wind: Slight
Linrose	1	Black sagebrush, rabbitbrush, bottlebrush squirreltail, bluebunch wheatgrass	Loam	20	Small stones, depth to rock	Water: Severe Wind: Slight
Oxcorel	5	Shadscale, bud sagebrush, bottlebrush squirreltail	Gravelly clay loam	6	Excess sodium, too clayey	Water: Slight Wind: Moderate
Roca	1	Black sagebrush, rabbitbrush, bottlebrush squirreltail, bluebunch wheatgrass	Silt loam	6	Small stones, too clayey, depth to rock	Water: Moderate Wind: Slight
Rose Creek	4	Basin wildrye, big sagebrush, greasewood, rabbitbrush, cheatgrass	Fine sandy loam	60 [1]	Possibly too alkaline in upper 10 inches	Water: Slight Wind: Slight
Soughe	2, 3, 7	Shadscale, big sagebrush, bottlebrush squirreltail	Gravelly sandy clay loam	0	Too alkaline, depth to rock	Water: Slight Wind: Slight
Whirlo	8	Shadscale, big sagebrush, cheatgrass	Gravelly fine sandy loam	10	Too alkaline, small stones	Water: Slight Wind: Slight

[1] Source: JBR Environmental Consultants, Inc. 1998.
[2]EX = Existing disturbance.

between 6 (Roca component) and 20 inches (Linrose component). Both soils are limited by large percentages of gravel and shallow depths to bedrock. Below 6 inches, the Roca soil is poorly suited to reclamation uses due to high amounts of clay. Conducting salvage operations on this unit may be limited by steep slopes.

The Soughe-Hoot association (Mapping Unit 2) is on lower hillslopes and rock pediments. Slopes range from 15 to 50 percent. The Soughe soil is on foothill slopes and crests and occupies about 60 percent of the unit. It is shallow and well drained. Typically the surface layer is pale brown gravelly fine sandy loam about 5 inches thick. The subsoil is brown gravelly clay loam to a depth of about 14 inches over fractured bedrock. The Hoot soil is on the shoulders and summits of rock pediment ridges and occupies about 25 percent of the unit. It is shallow and well drained. Typically the surface layer is pale brown very gravelly loam about 6 inches thick. The subsoil is brown gravelly or cobbly clay loam to a depth of about 15 inches over fractured bedrock. Included in this mapping unit are about 5 percent Burrita soils as described below, 5 percent rock outcrop, and 5 percent moderately deep soils. Based on suitability criteria, this unit is poorly suited to use as growth media due to shallow depths to bedrock and high alkalinity. In addition, salvage operations on this unit may be limited by steep slopes.

The Soughe gravelly clay loam (Mapping Unit 3) is on the summits and dominantly east-facing sideslopes of lower foothills. Slopes range from 15 to 50 percent. The Soughe soil is shallow and well drained. Typically the surface layer is pale brown gravelly sandy clay loam about 3 inches thick. The subsoil is pale brown extremely gravelly sandy clay loam about 10 inches thick over fractured bedrock. Approximately 85 percent of the unit consists of Soughe gravelly clay loam. Included in this unit are about 10 percent Hoot very gravelly sandy clay loam soils similar to those described above and 5 percent rock outcrop. Based on suitability criteria, this unit is poorly suited to use as growth media due to shallow depths to bedrock and high alkalinity. In addition, salvage operations on this unit may be limited by steep slopes.

The Rose Creek sandy loam (Mapping Unit 4) formed in narrow alluvial deposits along the Trout Creek drainage. Slopes are 2 to 8 percent. The Rose Creek soil is very deep and poorly drained. Typically the surface layer is gray fine sandy loam or silt loam about 10 inches thick. The subsoil is grayish brown sandy loam to a depth of 40 inches or more over variegated very gravelly sand. Included in this mapping unit are about 10 percent Oxcorel soils, as described below. Based on suitability criteria, this unit is suitable from depths of 10 to 60 inches or more for use as growth media. The uppermost 10 inches of the soil are poorly suited to reclamation uses due to alkalinity, but if significantly deeper materials are salvaged this may be overcome by blending during salvage and regrading operations. This unit overlies deep alluvium, which may be suitable for salvage and re-use as growth medium. Areas containing highly alkaline materials to much greater depths may occur within the map delineations and should be avoided in salvage operations, if possible. In addition, this unit occurs in a narrow configuration, which may limit the ability of heavy equipment to salvage it effectively.

The Oxcorel clay loam (Mapping Unit 5) formed in alluvium on fan piedmonts. Slopes are 2 to 8 percent. The Oxcorel soil is very deep and well drained. Typically the surface layer is pale brown gravelly sandy loam about 5 inches thick. The subsoil is dark yellowish brown extremely gravelly clay loam about 30 inches thick overlying a light yellowish brown very gravelly sandy loam to a depth of 50 inches or more. The Oxcorel soil is strongly sodium-affected below a depth of about 5 inches. Included with this soil in mapping are 10 percent recent alluvial deposits along stream channels. Based on suitability criteria, this Oxcorel mapping unit is suitable to a depth of about 6 inches for use in a reclamation program. Below this depth, the near-surface soil materials are highly alkaline and poorly suited to use as growth media. This unit overlies deep alluvium, which may be suitable for salvage and re-use as growth medium.

The Hoot-Burrita association (Mapping Unit 6) occurs on foothill sideslopes. Slopes range from 2 to 50 percent. The Hoot soil is on the shoulders and summits of rock pediment ridges and occupies about 45 percent of the unit. It is shallow and well drained. Typically the surface layer is pale brown very gravelly loam about 6 inches thick. The subsoil is brown gravelly or cobbly clay loam to a depth of about 15 inches over fractured bedrock. The Burrita soil occupies sideslopes and is shallow and well drained. It occupies about 40 percent of the unit. Typically the surface layer is pale brown very gravelly fine sandy loam about 4 inches thick. The subsoil is light yellowish brown extremely gravelly clay loam to a depth of about 11 inches over fractured bedrock. Included in this mapping unit are about 5 percent Soughe soils as described above, 5 percent rock outcrop, and 5 percent moderately deep soils. Based on suitability criteria, this unit is suitable for use as a growth media to depths ranging between 4 inches (Hoot component) and 10 inches (Burrita component). Below these depths, alkalinity, large percentages of gravel, and shallow depths to bedrock limit the use of the soils as reclamation growth media. In addition, salvage operations on this unit may be limited by steep slopes.

The Soughe-Burrita association (Mapping Unit 7) is on foothill sideslopes and summits. Slopes range from 15 to 50 percent. The Soughe soil is on foothill crests and sideslopes and occupies about 55 percent of the unit. It is shallow and well drained. Typically the surface layer is pale brown gravelly sandy clay loam about 3 inches thick. The subsoil is pale brown extremely gravelly clay loam about 10 inches thick over fractured bedrock. The Burrita soil occupies sideslopes and is shallow and well drained. It occupies about 40 percent of the unit. Typically the surface layer is pale brown very gravelly fine sandy loam about 4 inches thick. The subsoil is light yellowish brown extremely gravelly clay loam to a depth of about 11 inches over fractured bedrock. Included with this unit in mapping are about 10 percent Hoot soils as described above and about 5 percent rock outcrop. Based on suitability criteria, this unit is suitable for use as growth media to depths ranging between 0 inch (Soughe component) and 10 inches (Burrita component). Below these depths, alkalinity, shallow depths to bedrock, and large percentages of gravel or clay limit the use of the soils as reclamation growth media. In addition, salvage operations on this unit may be limited by steep slopes.

The Whirlo very gravelly sandy loam (Mapping Unit 8) occurs on alluvial fan remnants on slopes that are nearly level to approximately 2 percent. It occupies about 85 percent of the mapping unit. The Whirlo soil is very deep and well drained. Typically the surface layer is pale brown gravelly fine sandy loam about 7 inches thick. The subsoil is pale brown very gravelly sandy loam about 30 inches thick over a light yellowish brown extremely gravelly loam sand to a depth of 60 inches or more. Included with this soil in mapping are 10 percent recent alluvial deposits along stream channels and 5 percent Oxcorel very gravelly clay loam. Based on suitability criteria, this unit is suitable for use as growth media to a depth of about 36 inches. Below this depth, highly alkaline layers and large percentages of gravel limit the suitability of the near-surface soil materials for use as a reclamation growth media. This unit overlies deep alluvial deposits, which also may be suitable for salvage and re-use as growth medium.

Mapping unit EX consists of existing and approved disturbance in the central part of the detailed survey area. Features include existing pits, process facilities, stockpiles, and waste rock dumps. In general, no salvageable native soil materials occur in these areas.

3.4.1.2 General Study Area

The soils in the general study area are similar to those described for the project area. Soils on foothill sideslopes are generally shallow or moderately deep over bedrock. Cooler mean annual soil temperatures occur at higher mountain elevations. Deeper soils occur in the depositional environments at toeslopes and on alluvial fans. Many of the soils throughout the region contain salt accumulations and large percentages of gravel. Gravel content generally decreases in the down-valley direction, with soils transitioning from sands to clays as distance increases from the mountain fronts.

3.4.2 Environmental Consequences

The primary soils issues for the Proposed Action and project alternatives are the suitability of available resources for use as growth media, and the potential for increased erosion and sedimentation. Direct and indirect effects to soils can occur as a result of the project, primarily from excavation and fill activities or from vegetation removal. The latter may expose the underlying soils to the erosive forces of wind and water, increasing the potential for accelerated erosion. Potential impacts to soil resources could occur from accelerated erosion as a result of vegetation removal and soil disturbance during project construction, operation, and the early phases of the reclamation program. Potential impacts to soils also include the loss of microbial populations, less desirable soil structure, and less desirable drainage characteristics and available water capacity for plant growth.

3.4.2.1 Proposed Action

The Proposed Action would disturb approximately 717 acres. Of this, approximately 59 acres involve disturbances such as growth media stockpile placement or construction of diversion ditches, which likely would not involve growth media salvage. An additional 55 acres involve existing disturbance from which available growth media has already been salvaged where it occurred during previously approved activities, or where variable amounts of disturbed materials exist that may be suitable for growth media use. Approximately 5 acres would be disturbed from ongoing exploration activities, the location of which has not been precisely determined. The remaining 598 acres are comprised of native soils, which have varying degrees of suitability for use as growth media.

Table 3-15 indicates the acreages of soil mapping units that occur on areas that would be disturbed under the Proposed Action. Salvage suitability and erosion hazards are indicated on Map 3-11. The volumes of suitable growth media that are potentially salvageable from the proposed disturbance areas are shown in Table 3-16. These estimates represent a maximum volume based on accepted growth media criteria for materials having moderate suitability or better (Soil Conservation Service 1983; JBR 1997a). Estimates do not account for limits on salvage operations based on the types of equipment used or local land surface conditions. Even without accounting for such factors, 10 to 20 percent less volume may be expected due to on-site soil variability and handling losses.

Table 3-16 indicates that approximately 1.7 million cubic yards of material may be suitable for salvage on the 598 acres of native soils that occur in the proposed project area. The actual amount that could reasonably be salvaged is somewhat less than this, due to the limitations of heavy equipment operating on steep slopes and losses in material transport. Assuming that 85 percent of the suitable volume is actually recoverable in salvage operations approximately 1.45 million cubic yards of material would be available for use as growth media during reclamation activities.

Approximately 717 acres of new disturbance would occur from the Proposed Action. Of this, approximately 131 acres are associated with new pit disturbance. Growth media may be replaced on approximately 70 acres of pit floors and ramps, and approximately 61 acres of pit areas would not receive growth media. Thus, approximately 656 acres of new disturbance would undergo growth media replacement. The available growth media volume (see Table 3-16) indicates that an average depth of approximately 20 inches of growth media from native soil resources could be restored on the 656 acres to be revegetated. With losses from salvage and transport resulting in 1.45 million cubic yards of available growth media, approximately 16 inches

Table 3-15
Native Soil Occurrence in Proposed Disturbance Areas

Mine Component	Soil Mapping Unit Extent (acres)[1]					Total
	4	5	6	7	8	
5-North Pit					29.4	29.4
8-North Pit					49.0	49.0
Red Rock Pit Expansion	1.0	5.7	12.2			18.9
Top Zone Pit Expansion			29.0			29.0
5-North Waste Rock Dump					54.6	54.6
8-North Waste Rock Dump					85.4	85.4
Resort Waste Rock Dump Expansion		25.2	74.2	4.0		103.4
Old Marigold Waste Rock Dump Expansion		23.3		17.7		41.0
5-North Heap Leach Pad					30.9	30.9
SW Heap Leach Pad expansion			0.2		15.7	15.9
Process Pond					1.6	1.6
Process Pond					1.2	1.2
Tailings Impoundment					49.2	49.2
Infill Area near 8-North Pit			7.3		22.4	29.7
Infill Area near Old Marigold Pit				8.7		8.7
Infill Area east of Southwest Heap Leach expansion				21.7		21.7
5-North Haul Road					28.0	28.0
Total						597.6

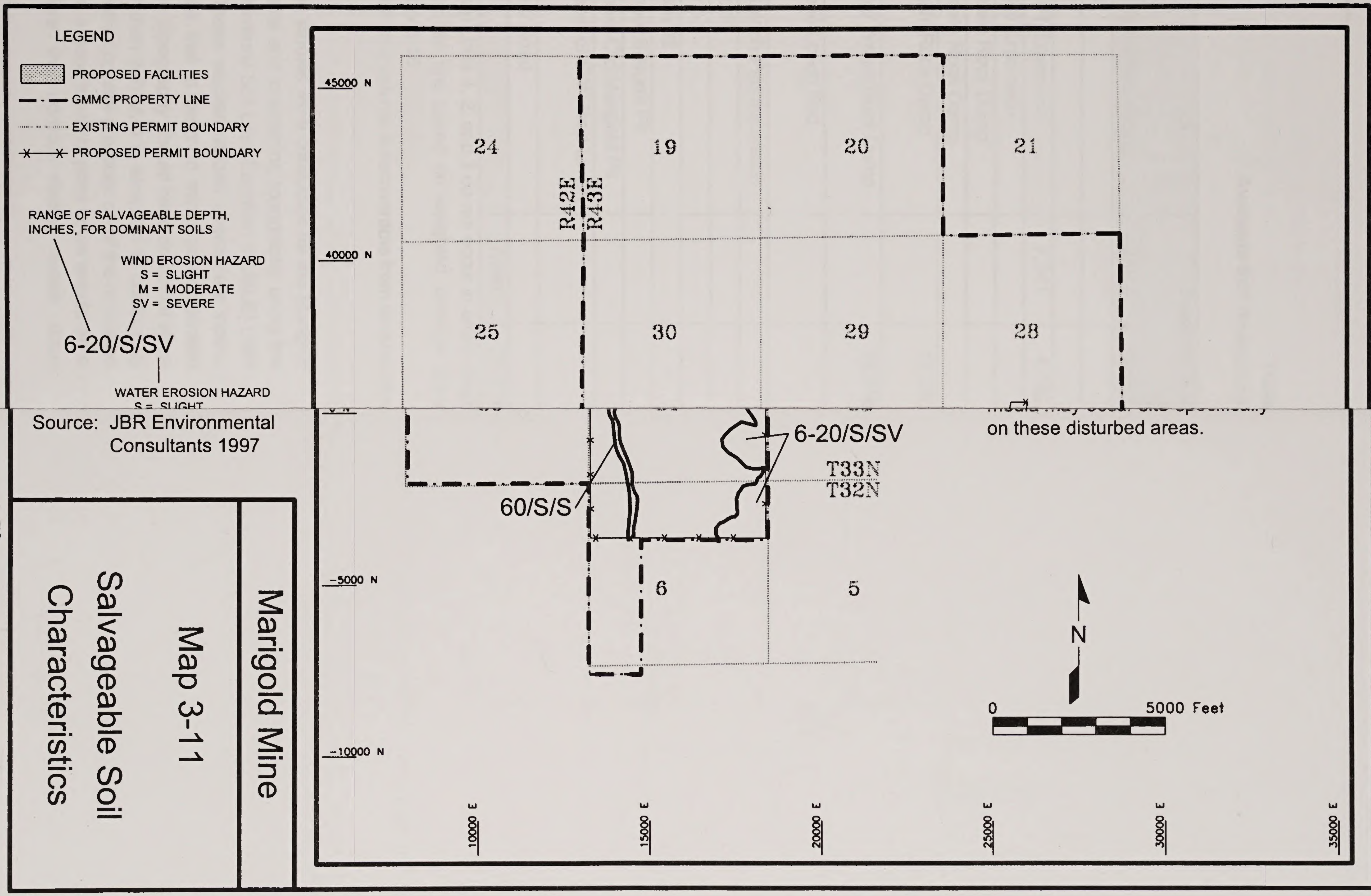
[1]Soil Mapping Units 1, 2, and 3 do not occur in areas proposed for disturbance.

could be restored on average. These figures could vary somewhat depending on actual growth media salvage and replacement locations.

The majority of material is available from Soil Mapping Unit 8, Whirlo very gravelly sandy loam, with the next dominant source being Soil Mapping Unit 6, Hoot-Burrita Association. These materials will be gravelly and possibly alkaline, as will much of the other material available on the site (see Table 3-14). In combination with deeper alluvial materials, there should be sufficient growth media of suitable quality to provide for the successful growth and establishment of adapted plant species in the reclamation program.

Given that there are substantial volumes of available growth media, a deeper replacement depth (12 to 18 inches) should be restored to the tailings surface to ensure the stabilization and revegetation of that site. In addition, the uppermost 1 or 2 inches of native soils could be avoided or not salvaged during clearing and grubbing activities to reduce the introduction of annual weed seeds on reclaimed surfaces. Sufficient volumes of suitable materials would still remain.

As shown in Table 3-14, a range of wind and water erodibility hazards exists on the site (JBR 1997a). The majority of salvageable growth media have slight susceptibility to erosion from water or wind.


LEGEND
PROPOSED FACILITIES
GMMC PROPERTY LINE
EXISTING PERMIT BOUNDARY
PROPOSED PERMIT BOUNDARY
RANGE OF SALVAGEABLE DEPTH, INCHES, FOR DOMINANT SOILS
WIND EROSION HAZARD
S = SLIGHT
M = MODERATE
SV = SEVERE
6-20/S/SV
WATER EROSION HAZARD
Source: JBR Environmental Consultants 1997
45000 N
40000 N
-5000 N
-10000 N
10000 E
15000 E
20000 E
25000 E
30000 E
35000 E
24
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28
6
5
R42E
R43E
T33N
T32N
6-20/S/SV
60/S/S
on these disturbed areas.
N
0
5000 Feet
Marigold Mine
Map 3-11
Salvageable Soil Characteristics

LEGEND

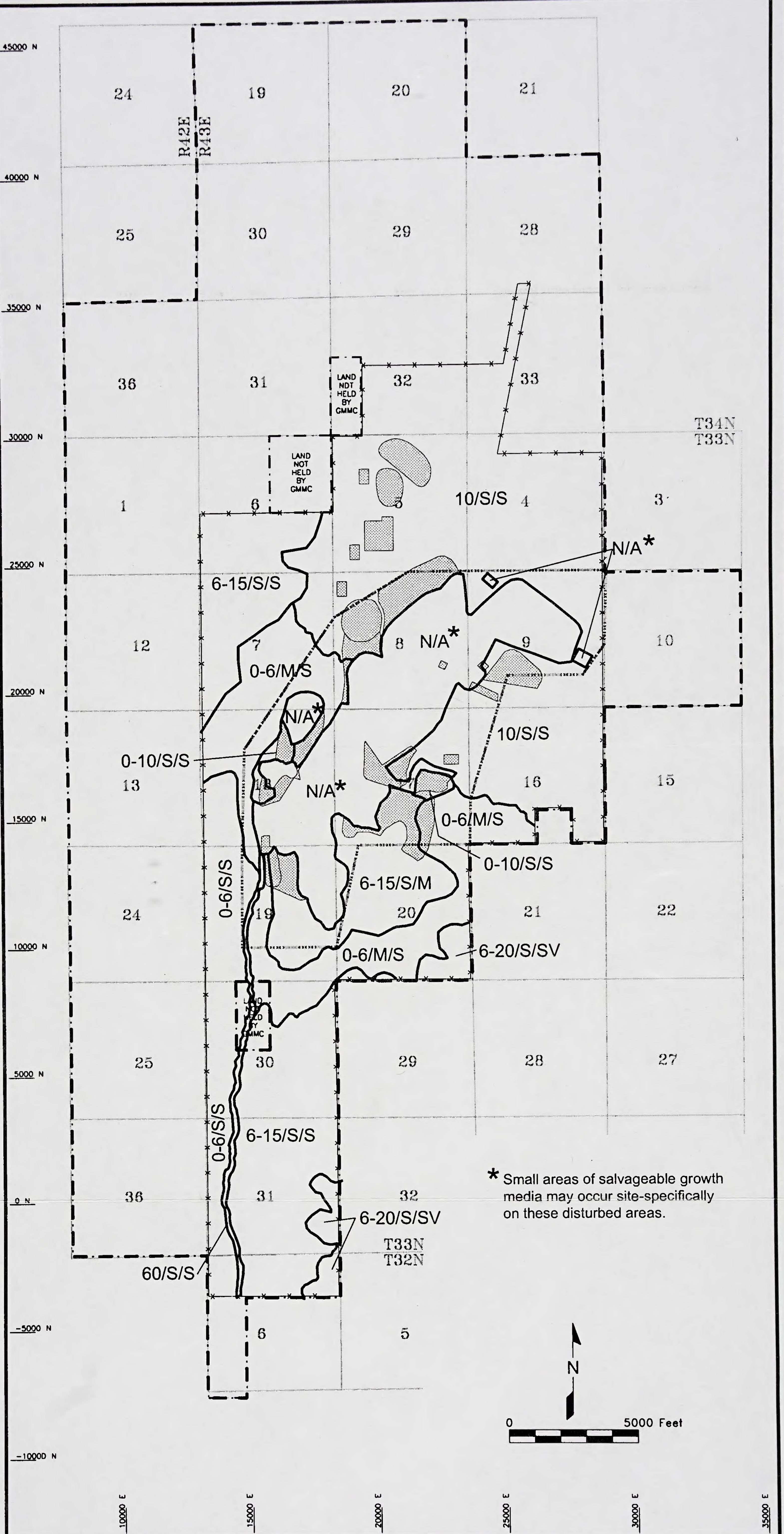
PROPOSED FACILITIES
GMMC PROPERTY LINE
EXISTING PERMIT BOUNDARY
PROPOSED PERMIT BOUNDARY

RANGE OF SALVAGEABLE DEPTH, INCHES, FOR DOMINANT SOILS

WIND EROSION HAZARD
S = SLIGHT
M = MODERATE
SV = SEVERE

6-20/S/SV

WATER EROSION HAZARD
S = SLIGHT
M = MODERATE
SV = SEVERE



Source: JBR Environmental Consultants 1997

Marigold Mine

Map 3-11

Salvageable Soil Characteristics

Table 3-16
Available Soil Resources for Use as Growth Media

Mine Component	Potential Soil Salvage Volume per Soil Type (bank cubic yards)[1]					Total
	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	
5-North Pit					122,137	122,137
8-North Pit					203,562	203,562
Red Rock Pit Expansion	7,341	4,160	12,219			23,720
Top Zone Pit Expansion			29,046			29,046
5-North Waste Rock Dump					226,827	226,827
8-North Waste Rock Dump					354,780	354,780
Resort Waste Rock Dump expansion		18,295	74,318	1,936		94,549
Old Marigold Waste Rock Dump expansion		16,916		8,552		25,468
5-North Heap Leach Pad expansion					128,369	128,369
SW Heap Leach Pad expansion			200		65,223	65,423
Process Pond					6,647	6,647
Process Pond					4,985	4,985
Tailings Dam #2					204,393	204,393
Infill Area near 8-North Pit			7,312		93,057	100,369
Infill Area near Old Marigold Pit				4,211		4,211
Infill Area east of SW Heap Leach expansion				10,502		10,502
5-North Haul Road					116,321	116,321
Total	7,341	39,371	123,095	25,201	1,526,302	1,721,310

[1]Soil Mapping Units 1, 2, and 3 do not occur in areas proposed for disturbance.

Note: Volumes are based on weighted average salvage depths from Table 3-14 and acreage figures from Table 3-15.
Additional volume is recoverable from deeper alluvial deposits underlying Mapping Units 4, 5, and 8.

Soil erosion studies were conducted for the Marigold growth media and postmining topography using the Revised Universal Soil Loss Equation (RUSLE) (JBR 1996b). These studies utilized appropriate inputs, and indicate that in order to minimize accelerated erosion, the topography should have an actual slope no steeper than 3H:1V; it is essential to contour rip or employ other control practices on of the reclaimed slopes, and a good stand of plant cover should be in place before the contour ripping wears down (generally about 2 to 4 years). If these conditions cannot be met, then additional erosion control practices should be implemented.

The Marigold Mine has conducted intensive (and ongoing) field trials to study growth media and revegetation practices. Revegetation success and bond release has been accomplished in accordance with state and federal revegetation guidelines (Cribley 1996). The Proposed Action includes salvage, protection, and re-use of suitable plant growth media, in addition to the following proposed measures (JBR 1998):

- Landscaping to create variable, irregular edges and surfaces on reclaimed features;
- Varying slope gradients to reduce energy from surface runoff;
- Direct-hauling topsoil for immediate reclamation use when possible;
- Redistributing soil in patches, particularly on north- and east-facing slopes, to encourage shrub growth and establishment;
- Varying soil depth on reclaimed surfaces to provide vegetation diversity; and
- Dust control measures to reduce soil losses in transport during salvage operations.

Assuming that proposed land stabilization efforts (including revegetation and post-reclamation monitoring) are successful as they have been in the past, there would be little or no accelerated erosion or sedimentation on the site. Soil productivity and physical characteristics would eventually be restored to a functional state as the post-mining ecosystem evolves over time. Based on these evaluations, long-term impacts to soil resources from the Proposed Action are not expected.

3.4.2.2 8-South Partial Pit Backfill Alternative

This alternative would have similar impacts as the Proposed Action, since the types of disturbance would be the same with regard to soil resources. Since less land would be disturbed from the elimination of the 8-North Waste Rock Dump (85 acres), the potential salvage volume would decrease by approximately 101,000 cubic yards (see Table 3-16). This alternative would disturb 85 fewer acres and 2 additional acres would be reclaimed.

The Amended POO indicates that approximately 260,400 cubic yards of growth media exists in current stockpiles (Rayrock Mines, Inc. 1998). If sufficient growth media was salvaged during construction of the 8-South Pit, then the potential growth media replacement would not be significantly affected. This is assumed to be the case, given the occurrence of soils in the 8-South Pit area and the growth media mitigation identified in an earlier Environmental Assessment (BLM 1988). However, if the 8-South Pit backfill would require growth media from the proposed project features, the resulting average replacement depth from the available native soil resources on the new disturbance (without salvage from the 8-North Waste Rock Dump) would then be estimated at 18 inches for the 658 acres to be reclaimed. If there were 15 percent less volume due to salvage and transport losses, then approximately 15 inches of growth media could be applied.

3.4.2.3 No Action Alternative

This alternative would not create any additional impacts to soil resources beyond those activities currently approved. The project area would be reclaimed using the approaches, materials, and standards of existing state and Federal permits and any applicable project stipulations.

3.4.3 Cumulative Impacts

The cumulative assessment area for soil resources includes the North Buffalo and Copper Canyon grazing allotments (approximately 203,000 acres) (Map 3-12). Past and present disturbances within the allotments include approximately 12,393 acres that were disturbed during mining and other development activities. This disturbance accounts for approximately 6 percent of the cumulative assessment area. Mine development and operation activities associated with the Proposed Action would result in the disturbance of 717 acres of soils or less than 1 percent of the cumulative assessment area. Reasonably foreseeable future projects identified in the cumulative assessment area would disturb approximately 6,325 acres of soils.

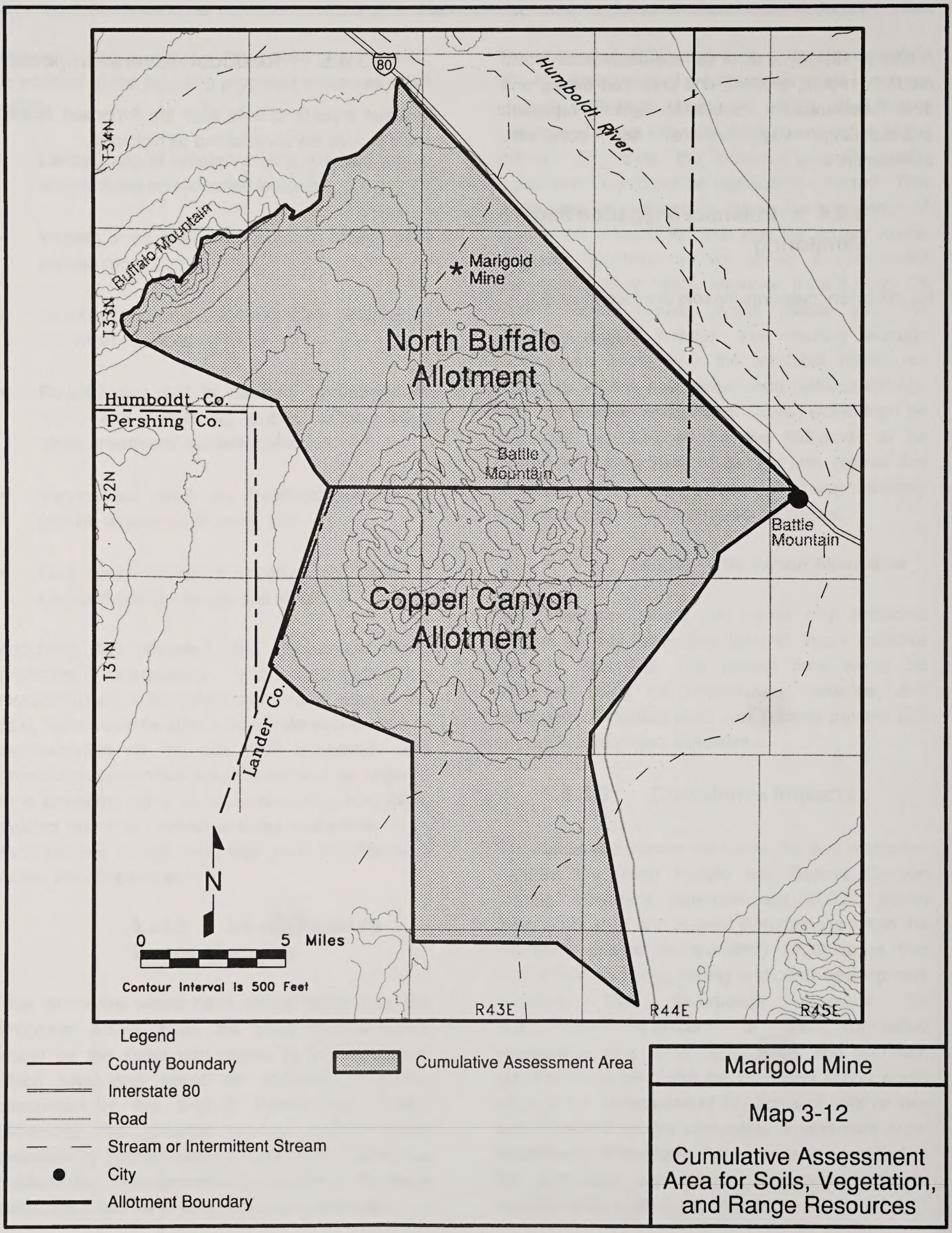
A total of 19,435 acres of surface disturbance would result from past, present, and proposed mining and other development activities, which represent approximately 10 percent of the cumulative assessment area.

3.4.4 Potential Mitigation and Monitoring

No mitigation measures for soils are recommended.

3.4.5 Residual Adverse Impacts

Residual impacts to soils after the Proposed Action would include the unreclaimed pit highwalls.


80
Humboldt River
T34N
T33N
T32N
T31N
Buffalo Mountain
Marigold Mine
North Buffalo Allotment
Humboldt Co.
Pershing Co.
Battle Mountain
Battle Mountain
Copper Canyon Allotment
Lander Co.
N
0
5 Miles
Contour Interval is 500 Feet
R43E
R44E
R45E
Legend
County Boundary
Interstate 80
Road
Stream or Intermittent Stream
City
Allotment Boundary
Cumulative Assessment Area
Marigold Mine
Map 3-12
Cumulative Assessment Area for Soils, Vegetation, and Range Resources

3.5 Vegetation Resources

3.5.1 Affected Environment

The project area is located in the Central Great Basin floristic region of the Intermountain physiographic region. This floristic region is characterized by mountain ranges trending north and south with large, extensive valleys located between the mountain ranges. This region covers about 30,250 square miles in central Nevada.

3.5.1.1 Vegetation

Site-specific vegetation studies were conducted in the project area during 1997 (JBR 1998). The baseline vegetation studies included the delineation of plant communities based on aerial photograph interpretation and on-site vegetation surveys. Vegetation sampling was completed at representative sites within these plant communities to determine species composition, forage production, and other vegetative parameters.

The project area is dominated by two major upland plant communities; the shadscale-cheatgrass community and the sagebrush-spiny hopsage community (Map 3-13). In addition, lands previously disturbed by mining occur in the project area. Small communities of greasewood-big sagebrush are found in the Ames Spring area. Limited riparian communities are associated with the spring sites; isolated riparian plant species occur along the southern portion of Trout Creek. Small, scattered populations of Utah juniper occur near the southernmost portion of the project area. The distribution of these communities is directly related to subtle differences in landscape position, aspect, soil texture, and soil moisture.

The shadscale-cheatgrass community is predominantly found in the northern half of the project area, which is characterized by gently sloping alluvial fans. The community also occurs on some south-facing foothills where green rabbitbrush occurs as a subdominant shrub. Other shrubs found in this community include budsage, rubber rabbitbrush, Nevada ephedra, horsebrush, and winterfat. Big sagebrush and spiny hopsage occur in areas with higher soil moisture. Where this community was previously burned, the amount of budsage has been greatly reduced, and the amount of cheatgrass is more prevalent. In addition to cheatgrass, other common perennial grasses include bottlebrush squirreltail, Sandberg bluegrass, Indian ricegrass, Thurber's needlegrass, and pine bluegrass. Characteristic perennial forbs include clasping pepperweed, scarlet globemallow, Indian paintbrush, Hooker balsamroot, and hawksbeard. The major soil series that supports the shadscale-cheatgrass community include Whirlo and Oxcorel gravelly to very gravelly, sandy loams, with an isolated community in the southern portion of the property supported by the Soughe-Hoot complex. Shrub cover ranges from less than one percent in the previously burned area to approximately 10 percent. Herbaceous cover ranges from approximately 12 to 30 percent.

The big sagebrush-spiny hopsage community is predominately found in the southern half of the project area, which is characterized by foothills and drainages associated with Battle Mountain. Shadscale and green rabbitbrush are subdominant shrubs that are locally abundant. Other shrubs in the community include greasewood, Nevada ephedra, budsage, winterfat, and horsebrush. The herbaceous cover is dominated by cheatgrass. Other prominent grasses include Sandberg bluegrass, bottlebrush squirreltail, Indian ricegrass, and pine bluegrass. Alyssum is the dominant forb, with scattered occurrences of rockcress, scarlet globemallow, hawksbeard, phlox, wild onion, and death camas. The major soils that support this community are the Linrose-Roca, Soughe-Hoot, Hoot-Barrita, and

3.5 Vegetation Resources

3.5.1 Affected Environment

The project area is located in the Central Great Basin [illegible] section of the Intermountain [illegible] region. The Great Basin [illegible] mountain ranges [illegible] valleys [illegible] ranges. The [illegible] within the [illegible] upland [illegible].

3.5.1.1 Vegetation

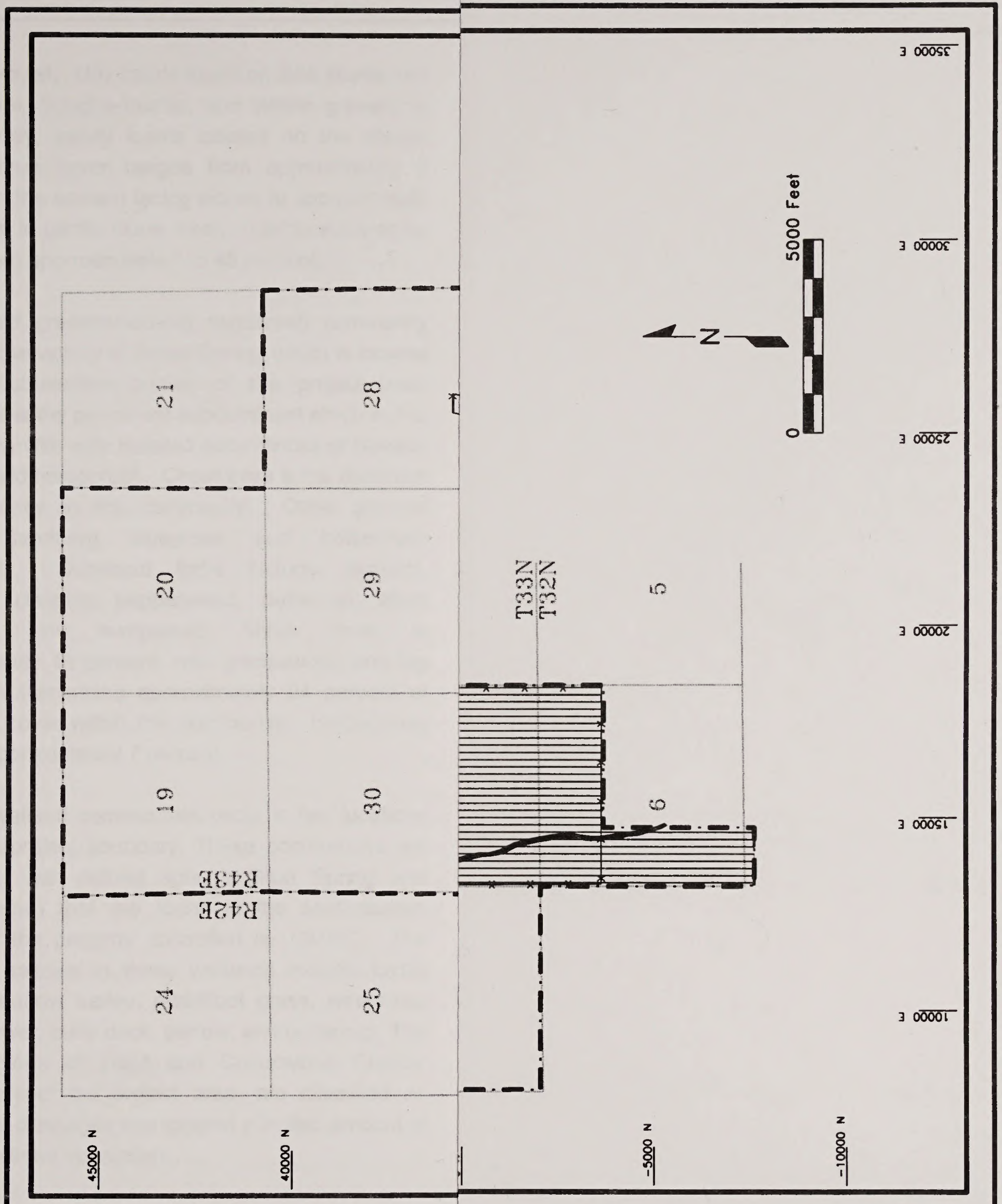
The [illegible] vegetation [illegible] project area during [illegible] during the [illegible] communities [illegible] vegetation types [illegible] species composition [illegible] vegetation.

The [illegible] area is dominated by [illegible] community and the [illegible] community [illegible] dominated by [illegible] in the [illegible] number of species [illegible] in the [illegible] Spring [illegible] associated with [illegible] Great Basin [illegible] species [illegible] period of the [illegible]. The distribution of these communities [illegible] slope, aspect [illegible] soils [illegible] texture and soil moisture.

Noxious Weeds

Plants [illegible] noxious [illegible] environments [illegible] disturbance [illegible]

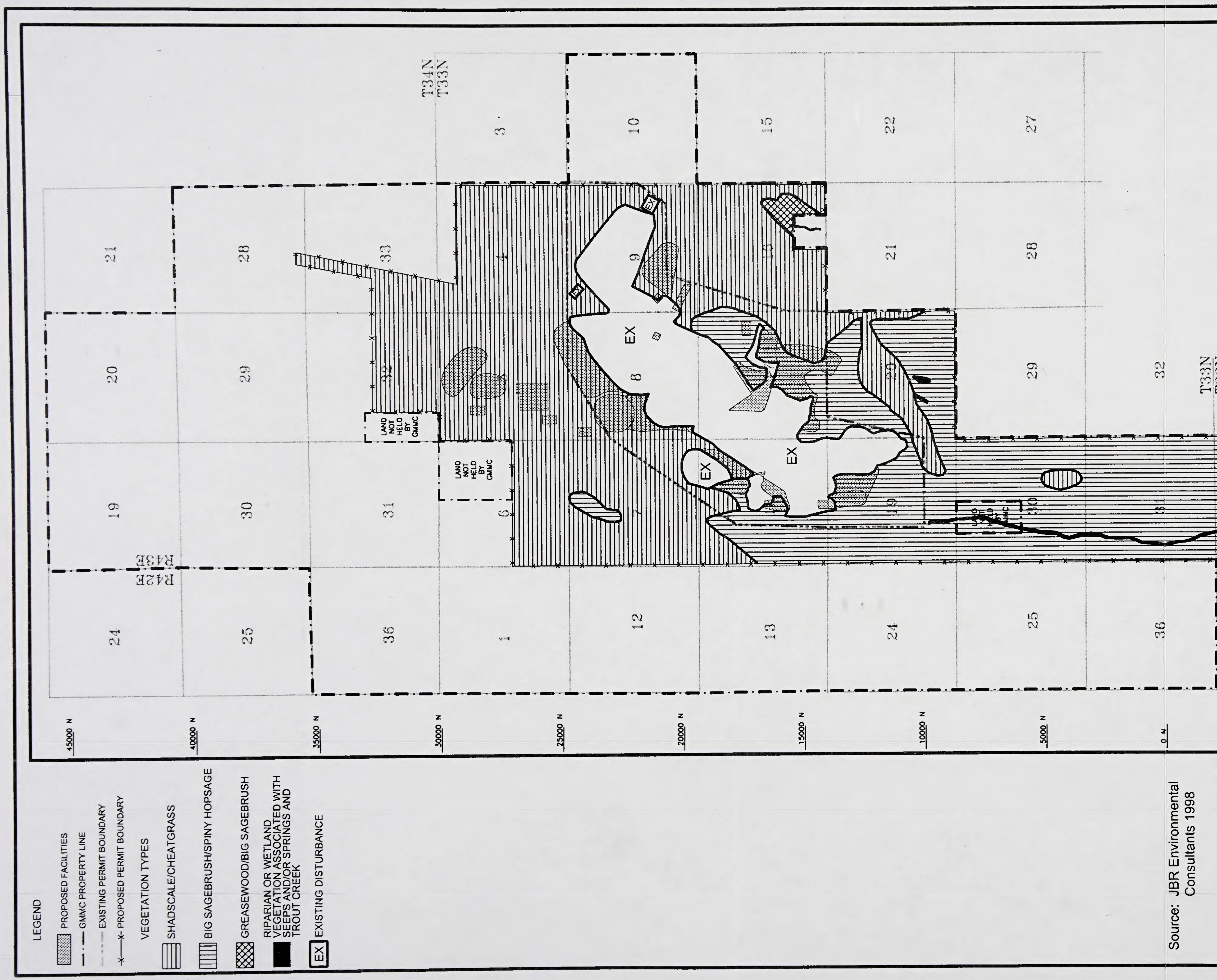
[illegible]



Marigold Mine

Map 3-13

Plant Communities Within the Project Area



Marigold Mine

Map 3-13

Plant Communities Within the Project Area

Soughe gravelly, clay loams found on side slopes and the Oxcorel, Soughe-Burrita, and Whirlo gravelly to very gravelly, sandy loams located on the alluvial fans. Shrub cover ranges from approximately 9 percent on the eastern facing slopes to approximately 16 percent in gentle slope areas. Herbaceous cover ranges from approximately 7 to 45 percent.

An isolated greasewood-big sagebrush community occurs in the vicinity of Ames Spring, which is located in the southeastern portion of the project area. Shadscale is the prominent subdominant shrub in this community, with only isolated occurrences of Nevada ephedra and horsebrush. Cheatgrass is the dominant grass species in the community. Other grasses include Sandberg bluegrass and bottlebrush squirreltail. Dominant forbs include alyssum, primrose, clasping pepperweed, buttercup, alkali dropseed, and sumpweed. Shrub cover is approximately 16 percent, with greasewood and big sagebrush comprising approximately 94 percent of the shrub cover within this community. Herbaceous cover is approximately 7 percent.

Riparian-wetland communities occur in two locations within the project boundary. These occurrences are associated with natural springs (Mud Spring and Ames Spring) that are found in the southeastern portion of the property controlled by GMMC. The dominant species in these wetlands include foxtail barley, meadow barley, rabbitfoot grass, wiregrass, monkeyflower, curly dock, yarrow, and buttercup. The lower portions of Trout and Cottonwood Creeks, which intersect the project area, are classified as intermittent drainages and support a limited amount of riparian-wetland vegetation.

Disturbed areas support a mixture of native vegetation associated with the shadscale-cheatgrass and big sagebrush-spiny hopsage communities and weedy species. Weedy species that are found in the project area include cheatgrass, tansy-mustard, tumblemustard, clasping pepperweed, halogeton, prickly lettuce, sumpweed, fiddleneck, and whitetop.

3.5.2 Environmental Consequences

3.5.2.1 Proposed Action

Proposed mine development and operation would disturb or remove a maximum of 674 acres of vegetation and approximately 43 acres of previously disturbed land. Of the 674 acres of vegetation to be removed or disturbed, approximately 502 acres would be shadscale-cheatgrass vegetation and approximately 172 acres would be sagebrush-spiny hopsage vegetation. No removal or disturbance of vegetation would occur within the greasewood-big sagebrush community. The removal of mature shrubs may be a long-term impact, since it could take up to 5 to 10 years after reclamation to establish mature shrubs in the project area. Based on reclamation studies that have been conducted for the existing operations, the growth rate of shrubs is very rapid and mature-sized shrubs would likely be established approximately 3 to 5 years after reclamation.

No removal or disturbance of vegetation would occur within the riparian-wetlands community as a result of mine development or operation. However, mine development and operation would result in the filling and excavation of 1.3 acres of other waters of the U.S. (i.e., small, intermittent drainages), which primarily support upland vegetation. Impacts to Waters of the U.S. are described in Section 3.1, Water Resources and Geochemistry.

Under the Proposed Action, vegetation would be removed during development or expansion of the waste rock dumps, pit areas, heap leach pads, haul road and access roads, realignment of the Buffalo Valley Road, and construction of water diversions, new solution and storm water ponds, and other proposed facilities. Existing vegetation at the proposed media stockpile sites would be buried by growth media. Disturbance also would include trampling of vegetation caused by the use of vehicles and heavy machinery.

GMMC has committed to coordinate with the NDEP and the BLM to minimize the spread of noxious weeds throughout the project area (Section 2.2.19, Reclamation). However, minor populations of weedy annual species, such as halogeton, Russian thistle, and cheatgrass may become established in localized areas. Weedy species rapidly invade disturbed areas and initially hinder the re-establishment of more desirable perennial grasses and forbs by competing with them for moisture during the initial years following disturbance or seeding. Under GMMC's current Reclamation Plan, noxious and invasive weed controls would be implemented during vegetation establishment to minimize competition from weedy species and maximize the establishment of desirable species.

Approximately 656 acres of the 717-acre proposed disturbance area would be reclaimed after mining operations have been completed. Portions of the pit areas (61 acres) would not be reclaimed. After mine closure, the pit highwall areas would be the only project components that would not be reclaimed. The stabilized, diversion channels would remain after the completion of mining, with flows reporting to the original channels downstream of the project area. Successful revegetation of disturbed land is anticipated to occur approximately 3 to 5 years after reclamation. Reclamation activities would consist of the grading of final slopes, ripping of compacted soil, application of growth media and/or soil amendments, and broadcasting of seed. The proposed seed mixtures that would be used for revegetation activities are provided in Table 2-6. After 3 to 5 years, the reclaimed plant communities would likely consist of adequate herbaceous plant cover with sufficient diversity to substantially reduce the potential for soil erosion and provide forage for use by livestock and wildlife.

3.5.2.2 8-South Partial Pit Backfill Alternative

Impacts to vegetation under the 8-South Partial Pit Backfill Alternative would be similar to those identified for the Proposed Action. However, this alternative would disturb 85 fewer acres and 2 additional acres would be reclaimed.

3.5.2.3 No Action Alternative

The additional disturbance of 674 acres of native vegetation and 43 acres of previously disturbed land would not occur under the No Action Alternative. Vegetation impacts would be to limited to ongoing, permitted mining and exploration activities. Reclamation activities, weed control, and subsequent revegetation would occur earlier under this Alternative, as compared to the Proposed Action.

3.5.3 Cumulative Impacts

The cumulative assessment area for vegetation resources includes the North Buffalo and Copper Canyon grazing allotments, which covers approximately 203,000 acres (Map 3-12). Past and present disturbances within the North Buffalo and Copper Canyon grazing allotment boundaries include approximately 12,393 acres that were disturbed during mining and other development activities. This disturbance accounts for approximately 6 percent of the cumulative assessment area. Mine development and operation activities associated with the proposed project would result in the disturbance or removal of 717 acres of vegetation or less than 1 percent of the cumulative assessment area. Future activities could effect 6,325 acres of vegetation.

A total of 19,435 acres of surface disturbance would result from past, present, and future mining and other development activities in the cumulative assessment area, which represents approximately 10 percent of the 203,000-acre cumulative assessment area. The loss of vegetation during development and operation activities would result in the loss of livestock and wildlife forage and protective cover for wildlife. The loss of mature shrubs would be minimal relative to the total acreage of sagebrush and shadscale communities that occur in the cumulative assessment area. The majority of the mining-related surface disturbance would be reclaimed after mine operations cease.

3.5.4 Potential Mitigation and Monitoring

Reclamation activities and weed control measures are included as part of the Proposed Action (Section 2.2.19, Reclamation) and would substantially reduce potential impacts to vegetation resources. All areas that are pre-stripped of vegetation and left fallow (not used within a 90-day period) will be seeded with the approved seed mixture in order to reduce erosion and deter establishment of noxious weeds.

3.5.5 Residual Adverse Impacts

Residual impacts to vegetation would include the permanent removal of vegetation from portions of the pit areas (61 acres). A long-term change in vegetation composition of 717 acres (i.e., mature shrub-dominated communities to grass- and forb-dominated communities) may occur as a result of the Proposed Action.

3.6 Wildlife and Fisheries Resources

3.6.1 Affected Environment

3.6.1.1 Aquatic Biology

Surface water in the project area is limited to two intermittent creeks and two isolated spring complexes. Both Cottonwood Creek and Trout Creek are classified as perennial streams in the higher elevations of the Battle Mountain Range. The intermittent portions of both creeks in the project area support little vegetation. Mud and Ames Spring complexes, located in or near the southeastern edge of the project area support a number of mesic-habitat plant species (JBR 1998).

In the upper reaches of Cottonwood Creek and Trout Creek, a viable brook trout fishery occurs where perennial flows are present and deep pools with dense willow cover provide suitable habitat for fish (BLM 1998). However, little riparian habitat and no fisheries are present in the lower reaches of Cottonwood and Trout Creeks within the project area (Lamp 1999).

3.6.1.2 Terrestrial Wildlife

<u>Habitat</u>

Wildlife habitat associated with the project area is limited to two dominant plant communities, the shadscale-cheatgrass community, which is found on gentle slopes and south-facing foothills at lower elevations, and the big sagebrush-spiny hopsage community, which occurs in the foothills and drainages at higher elevations, as described in Section 3.5, Vegetation Resources, and shown on Map 3-13. Overall habitat value for wildlife resources ranges from low to moderate, transitioning from the shadscale-cheatgrass community located in the northern half of the project area to the higher quality sagebrush-spiny hopsage community that occurs in the southern portion of the project area.

Overall water availability is the primary limiting factor for wildlife in the project region. The project area encompasses arid, upland habitats dissected by intermittent drainages, including Cottonwood Creek and Trout Creek. Although Cottonwood Creek and Trout Creek are perennial in the upper elevations of Battle Mountain, they become intermittent in the lower reaches of Battle Mountain within the project area. Both reaches are typically dry by May or June, depending on winter precipitation. The lower portions of these streams provide little available water and, consequently, support limited riparian habitat for wildlife forage and cover. Mud Spring and Ames Spring are located in or near the southeastern edges of the project area (JBR 1998). Comparatively, the streams and springs in the project area provide higher habitat value for wildlife than the surrounding areas, based on the amount of cover and forage availability, increased plant diversity, and additional moisture.

A number of surveys of both resident and migratory wildlife have been conducted in and adjacent to the proposed mine expansion area (JBR 1998). These studies examined the overall use of the area by terrestrial vertebrates and special status species. Representative wildlife species that may occur in the vicinity of the project are listed in Appendix B. Survey specifics pertaining to sensitive wildlife resources are discussed further in Section 3.7, Special Status Species.

<u>Game Species</u>

Mule deer, pronghorn, and mountain lion are the only big game species that are present within the Battle Mountain Range (BLM 1998). The project area lies within Unit 151 (Battle Mountains in Management Area 15). Mule deer habitat within and near the project area includes big sagebrush, low sagebrush, shadscale, and grassland communities. The limiting habitat component for mule deer in the Battle Mountain Range is summer range (NDOW 1999a; Lamp 1999). Mule deer winter range occurs in the foothills within the southern portion of the project area. This area is particularly valuable during severe winter periods when climatic conditions force deer to abandon the higher elevation shrub zones (BLM 1997). Although mule deer are limited on the mine site, surveys conducted by NDOW biologists have documented high levels of deer use on the lower slopes of the Battle Mountain Range near the project area during the spring season. Fawn production within Management Area 15 in the Battle Mountain Range has been increasing since 1994 (NDOW 1999a). Fawn production ranged from 38 fawns per 100 does in 1994 to 83 fawns per 100 does in 1998. The average fawn production since 1994 was approximately 61 fawns per 100 does (NDOW 1999a). No deer estimates were analyzed for individual units including Battle Mountains (NDOW 1999a). Water availability, forage quality, cover, and weather patterns typically determine the level of use and movement of deer through an area. As discussed above, water is the primary limiting factor for mule deer in the immediate project area, particularly near high quality forage, which somewhat restricts the distribution of resident deer populations.

Pronghorn have been observed in the vicinity of the project area during the last several years. It is not known if this is a re-establishing population or a temporary expansion due to the increased amount and type of vegetation in the area that has resulted from high precipitation levels in the last 3 to 4 years. Exact population numbers are not available.

Mountain lions occupy the higher elevations to the south of the project area, and are closely associated with the resident mule deer herd. Although mountain lions are known to occur in the Battle Mountain Range, the lion population near the immediate project area is likely low, due to the habitat types in and near the areas proposed to be disturbed by the project, the amount of human presence around the mine, and the limited extent of mule deer use recorded for the mine site (BLM 1997).

Upland game birds are not abundant, but may occupy portions of the project area. Sage grouse are discussed in Section 3.7, Special Status Species. Both mourning dove and chukar have been documented using the project area. Mourning dove is the most commonly observed game bird species within the project area, but only as a summer resident (JBR 1998). Chukar are most commonly observed using the waste rock dumps within the project area (NDOW 1999b). Valley quail have been observed along creeks near the project area (NDOW 1999b). Other game bird species found in the region are presented in Appendix B.

__Nongame Species__

Nongame species are widely distributed, occupying a variety of habitat types and elevations within the project region. Representative nongame mammals for the region are listed in Appendix B.

Nongame species include several bats that may occur in the project area. The scientific literature suggests that various bat species have become dependent on abandoned mines for roosting and hibernacula (BLM 1998). Caves and crevices also provide adequate shelter for roosts and hibernacula. Surveys that were conducted in 1997 and 1998 identified several bat species using the Red Rock Adit for roosting in spring, summer, and early fall. These species included Townsend's big-eared bats, pallid bats, long-legged myotis, and small-footed myotis (JBR 1998; BLM 1999). Although no myotis or other bat species were observed using the adit as a hibernaculum, during the 1997/1998 surveys and the adit does not have the characteristics preferred by bats for use as a hibernaculum, myotis are difficult to detect and individual bats could potentially use the adit in the winter. Other representative bats that could occur in the project region are listed in Appendix B.

Nongame birds encompass a variety of passerine and raptor species. Regional bird species are presented in Appendix B. Nongame birds include a diversity of neotropical migrants; birds that breed in North America and winter in the neotropical region of South America. These bird species are considered integral to natural communities, as they often act as environmental indicators.

Passerines or song birds occupy the entire range of habitats that occur within the project area. However, due to the higher level of plant diversity and structure, larger number of nest sites, and greater food base, the sagebrush/spiny hopsage community and small riparian areas located in the southern portion of the project area support a greater number of birds than the shadscale/cheatgrass community to the north.

A number of raptor species have been observed using the project area including golden eagles, red-tailed hawks, northern harriers, American kestrels, and great-horned owls (JBR 1998). Additional regional species could include the ferruginous hawk, Swainson's hawk, burrowing owl, and bald eagle, as discussed in Section 3.7, Special Status Species. Evidence of an old nest and foraging perches suggest that prairie falcons may have previously nested on a rock outcrop north of the Mud Springs area. In addition, a possible burrowing owl nest was recorded north of Ames Springs in 1997. Other nesting activity observed in the project area included several unoccupied stick nests that were presumably used by ravens prior to 1997, as evidenced by white-wash and feathers at the nest sites (JBR 1998). No habitat in or adjacent to the proposed mine expansion area would be considered suitable for accipiter nesting. However, Cooper's hawks have been documented within the Battle Mountain Range (BLM 1998). The northern goshawk is presented in Section 3.7, Special Status Species. A number of other raptor species may use the project area and its surrounding habitats for foraging and possibly nesting, although suitable breeding habitat is limiting. Appendix B lists the raptor species identified for the project region.

Other nongame species in the region would include common reptiles such as those described in Appendix B. Amphibians would be limited in the immediate project area, due to the lack of water sources; however, they could occur within the project region.

3.6.2 Environmental Consequences

3.6.2.1 Proposed Action

No impacts to aquatic resources would be expected from the proposed mine expansion activities. The proposed project would not directly affect any natural perennial water sources, since none are located within the proposed disturbance areas outlined by the project components. No indirect effects would be anticipated to the naturally occurring springs (i.e., Ames and Mud Springs), based on the analysis presented in Section 3.1, Water Resources and Geochemistry. Based on these factors, no direct or indirect impacts to terrestrial wildlife species associated with Cottonwood and Trout Creeks or Ames and Mud Springs would be anticipated. In addition, no potential off-site impacts to perennial water sources in the Battle Mountain Range or along the Humboldt River (i.e., cumulative assessment area) from groundwater drawdown have been identified.

The potential level of impacts to terrestrial species and their associated habitats generally depends on the temporal and spatial relationships of these resources with the proposed project components. Based on the available habitat types in the project area, their relative value to both resident and migratory wildlife, and historical use of the area, the overall effects to terrestrial wildlife from proposed mine expansion would be considered low to moderate. Direct impacts would include limited direct mortalities from mine development, habitat loss and encroachment into the Battle Mountain Range foothill region, incremental habitat fragmentation, and animal displacement. Indirect impacts would primarily encompass increased noise and expanded human presence.

Generally, mine development results in the loss of the less mobile species and the displacement of animals from the project area into adjacent habitats, which are typically assumed to be at or near their carrying capacities. Therefore, displaced animals would increase intraspecific competition and would be assumed to be lost from the population. Displacement of wildlife from project-related activities would primarily affect those species dependent on the transitional foothill zone located between the lower elevational shadscale community and the higher elevational habitats. However, the habitats in the project area that would be affected by mine expansion are not considered unique or uncommon and no effects to perennial water sources have been identified. The primary concern identified for terrestrial wildlife resources would be the incremental direct and indirect effects to native habitats in the region.

Implementation of the proposed project would result in the direct loss of a maximum of 674 acres of native vegetation and 43 acres of previously disturbed land, which support a limited amount of native vegetation and weedy species. The loss of the 674 acres of native vegetation would be considered a short-term impact during the life of the project until final site reclamation is completed. Of the 674 acres of native habitats that would be disturbed by the proposed project, 656 acres would be reclaimed, leaving 18 acres not reclaimed for post-mining use. The 18 unreclaimed acres would be considered a long-term and permanent habitat loss.

A total of 61 acres of the 717 acres of total disturbance would not be reclaimed and would be lost as wildlife habitat for the long term. This anticipated loss of deer winter range would be a small, incremental reduction in the amount of available winter range for the Battle Mountain population. This incremental loss would not be considered significant, however, based on the low overall habitat quality in the immediate mine area for resident mule deer, the degree of existing disturbance from past mining and exploration activities, and the amount of suitable winter range in the surrounding region that is available for wintering deer. No big game migratory or movement corridors would be affected by the proposed project. Impacts to mountain lions would be closely associated with the distribution of the mule deer herds and would, therefore, be expected to be low.

Generally, potential impacts to breeding birds from the proposed mine expansion would encompass possible direct loss of nests (e.g., crushing) or indirect effects (e.g., abandonment) from increased noise and human presence within close proximity to an active nest site. However, GMMC has committed to conducting breeding bird surveys within suitable native habitats prior to ground disturbance, if construction were to occur between March and July (see Section 2.2.18.5, Wildlife and Livestock Protection). If active nests are documented, GMMC also has committed to coordinating with the BLM to develop and implement appropriate protection measures to minimize effects to nesting birds. These measures could include avoidance, buffer zones, construction constraints, etc., and would be determined on a case-by-case basis. An option to these surveys would be clearing vegetation outside of the breeding season (March through July) to avoid impacting nesting birds, as presented in Section 2.2.18. Residual impacts to nesting birds that may occupy the project area would be limited to the incremental habitat loss associated with the mine expansion. This loss, however, would not be significant, given the amount of native habitats in the surrounding region, the lack of unique habitats or documented rare bird species in the project area, and the extent of the existing mining activity in the project area (i.e., reduced carrying capacity of the native habitats immediately adjacent to the mine).

Potential effects to upland game birds from mine development are expected to be low. The lack of known breeding sites (e.g., sage grouse leks) in the immediate project area, the limited amount of quality habitat in the proposed expansion area, and the maintenance of Ames and Mud Springs would aid in minimizing impacts to upland game birds. No direct or indirect impacts to perennial water sources within the higher elevations of the Battle Mountain Range are anticipated. Consequently, no impacts to nesting, foraging, or brooding game birds are anticipated.

Realignment of the existing 120-kV transmission line along the northern perimeter of the project area would not increase the potential avian strike hazard, due to the presence of the existing line. Collision potential is typically dependent on variables such as the location of high-use habitats (e.g., nesting, foraging, roosting), line orientation to flight patterns and movement corridors, species composition, visibility, and line design (Beaulaurier et al. 1982; Anderson 1978). No increased electrocution hazard would be anticipated for raptors attempting to perch on the structures. The configuration of transmission lines greater than 69-kV typically does not present an electrocution potential, based on conductor placement and orientation (APLIC 1996).

Impacts to high-profile species from increased human presence is typically proportional to the size of a construction and operational work force, overall land use and recreational demands, and other development and associated activities in the region. The construction work force for the proposed mine expansion would increase by 25 to 30 additional employees for the life of mine, as described in Section 3.12, Social and Economic Values. This anticipated increase in the number of mine personnel would not likely result in significant adverse effects to local wildlife resources. First, future noise levels would not be expected to increase substantially beyond existing levels, as presented in Section 3.11, Aesthetics, and since the mine is located near I-80, the potential for a large increase in vehicle-related mortalities would be limited to the immediate expansion area. Based on the location of these areas relative to roads and I-80, road kills would likely be minimal.

The increased number of personnel during mine construction could result in additional dispersed recreation (e.g., off-road vehicle use) along the Battle Mountain Range, possibly resulting in increased wildlife harassment. Although this level of use would be expected to be low, it would result in incremental effect within the region. Poaching is often the greatest adverse impact to wildlife from increased human presence (Streeter et al. 1979), particularly for big game species. However, other high-profile species are often harassed, including large raptors (e.g., eagles and buteos), predators (e.g., coyote), and roosting bats in caves and mine workings. Although these impacts could occur from the anticipated increase in construction personnel, the effects would be short-term and would be expected to return to current levels following mine development. Also, the environmental training for mine personnel committed to by GMMC in Section 2.2.18.8 would aid in minimizing these indirect effects to wildlife resources.

The EIS analysis examined the potential short- and long-term effects from both water quality and water quantity for wildlife resources. It was determined that the proposed project would not result in adverse impacts from degraded water quality or decreased water availability, as discussed below.

Short-term effects from water quality would be limited to the potential exposure of terrestrial wildlife to cyanide solutions used on-site. Sodium cyanide is lethal to wildlife, and recent information provided by the NDOW indicates that certain bat species exhibit a delayed influence from cyanide poisoning. These study results suggest that an increased number of bats may be affected by cyanide solutions than previously thought, and individuals may be succumbing to cyanide poisoning away from mine areas. Therefore, these mortalities would be less likely to be found and reported. As part of the proposed project, GMMC has committed to fencing and netting cyanide solution ponds and secondary containment structures to exclude wildlife from potentially lethal solutions. These measures are described in Section 2.2.18.5. Therefore, based on GMMC's committed protection measures, potential impacts to wildlife resources from cyanide ingestion would be low. These measures have been developed in accordance with the BLM's cyanide management policy and the NDOW's Industrial Artificial Pond Permit. GMMC also is required to report all wildlife mortalities to the BLM and NDOW, as required by the Federal and state approval and permitting processes (Section 2.2.18.5).

GMMC has committed not to mine the proposed 8-North Pit to a level that would intercept groundwater (see Section 2.2.2.1). Therefore, no effects to wildlife are anticipated from development of this pit. As discussed in Section 3.1, Water Resources and Geochemistry, a small seasonal pit lake may form in the 8-South Pit approximately 30 years after mining because of groundwater rebound. It is anticipated that the potential pit lake would primarily exist during the winter season and likely evaporate during the summer. The water chemistry analysis identified a potential elevation in future arsenic and mercury levels, based on the MWMP tests. Based on the small size of the lake (less than an acre) and its seasonality, no adverse, long-term effects to wildlife resources have been identified from the development of the 8-South Pit Lake.

No impacts to naturally occurring seeps or springs in or adjacent to the mine area would be anticipated by implementation of the proposed mine expansion (see Section 3.1, Water Resources and Geochemistry). Given the groundwater analysis, no effects to perennial surface water resources or the associated riparian vegetation in the vicinity of the mine (e.g., Battle Mountain, Humboldt River) have been identified. Therefore, no impacts to terrestrial wildlife species that are dependent on these sources would occur. The diversion of Cottonwood and Trout Creeks would not be expected to significantly affect native wildlife, based on the degree of existing mining disturbances present in the project area, the relative low value of these ephemeral drainages along their lower reaches, and the lack of riparian habitat in these lower elevations that may support a diversity of biota.

No additional impacts to natural resources would occur from the transport or use of hazardous chemicals associated with the proposed project. No incremental increase in the use of sodium cyanide, sodium hydroxide, or diesel fuel, as part of the proposed mine expansion would occur; therefore, no additional risks to wildlife and associated habitats would occur from a potential chemical spill during truck transport.

3.6.2.2 8-South Partial Pit Backfill Alternative

Overall impacts from implementation of the 8-South Pit Partial Backfill Alternative would parallel those described for the proposed project. This alternative would result in the direct loss of a maximum of 589 acres of native vegetation as compared to 674 acres for the proposed project. The loss of this acreage would be considered a short-term impact during the life of the project, until final site reclamation is completed. Partially backfilling the 8-South Pit would prevent a future pit lake from developing; therefore, possible exposure of native wildlife to chemicals of concern in the pit lake water would not occur.

3.6.2.3 No Action Alternative

Under the No Action Alternative, approximately 674 acres of native wildlife habitat would not be disturbed or lost, as under the proposed mine expansion. Additional habitat fragmentation and animal displacement would not occur, limiting the effects to natural resources to existing conditions. The levels of human use would remain the same as the current levels.

3.6.3 Cumulative Impacts

A cumulative effects analysis for terrestrial wildlife typically varies with the species, its associated habitat types, issue sensitivity, and the animal's mobility. The cumulative analysis focused on the historic mining and exploration activities and livestock grazing combined with the proposed project and future mining programs that are currently proposed.

The cumulative impact analysis focused on the regional wildlife resources and how they may be susceptible to the cumulative actions identified for this project. The analysis assumed that: 1) human use of the cumulative effects area would continue to increase with or without implementation of the proposed project, 2) wildlife habitats are currently at their respective carrying capacities in and adjacent to the proposed mine expansion area, and 3) the overall region has been previously affected by the historic and current mining activities.

No impacts to perennial water or aquatic resources were identified within the cumulative effects area, since no adverse effects to water resources would result from implementation of the proposed project. Cumulative effects to wildlife resources would be directly related to incremental habitat loss, fragmentation, and animal displacement that have primarily resulted from historic mining activities in the cumulative assessment area, forcing animals into smaller patches and limited distributions. Combined with these past effects, these resource issues also would be affected by the present and planned mining activities. Wildlife populations that occur in the cumulative effects area would continue to occupy their respective ranges and breed successfully, although population numbers may decrease relative to the amount of cumulative habitat loss and disturbance from the incremental development.

Overall cumulative impacts from the interrelated projects would parallel those discussed for the proposed project. The increased number of roads from mine exploration would improve human access into more remote areas. The work forces associated with mining construction and operation would increase traffic levels in the region, in addition to increasing the employees' exposure to the area. This exposure would typically result in additional human use of the region, increasing pressure on resident wildlife populations. Certain resources are more susceptible to impacts than others, such as riparian zones, seeps and springs, seasonal ranges, movement corridors, and active breeding sites (e.g., leks, raptor nests, brooding habitat). As stated for the proposed project, impacts to high-profile species are proportional to the increase in human presence, land use and recreational demands, and other regional development. The location of these natural resources, relative to the duration of the human disturbance, is pertinent to the degree or level of anticipated cumulative impacts.

3.6.4 Potential Mitigation and Monitoring

No additional mitigation measures have been developed for either aquatic or terrestrial wildlife resources, based on the environmental protection measures committed to by GMMC and outlined in Section 2.2.18.5, Wildlife and Livestock Protection, and Section 2.2.19.8, Facility Reclamation.

3.6.5 Residual Adverse Impacts

Residual effects to wildlife resources from the Proposed Action would include the short-term loss of 717 acres and long-term loss of native habitat associated with the unreclaimed portions of the pits (61 acres). Other residual impacts would include the incremental habitat loss and displacement of wildlife species. Increased human presence would continue to affect the overall distribution of wildlife.

Approximately 656 acres of disturbed habitat would be reclaimed after mining ceases. Approximately 61 acres of the Proposed Action disturbances would not be reclaimed.

3.7 Special Status Species

Special Status Species are those species for which State of Federal agencies afford an additional level of protection by law, regulation, or policy. Included in this category are Federally listed species that are protected by the Endangered Species Act (ESA), species of concern as identified by the U.S. Fish and Wildlife Service (USFWS), and species designated as state sensitive by the BLM. In addition, there is a Nevada State Protected Animal List (NAC 501.100 – 503.104) that BLM has incorporated, in part, into the BLM's sensitive species list.

As defined by the ESA, an endangered species is any species that is in danger of extinction throughout all or a significant portion of its range. A threatened species is any species that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range. Proposed species are those that are proposed in the Federal Register by the USFWS to be listed as threatened or endangered. Species of concern are taxa for which existing information indicates that listing may be warranted, but for which substantial biological information to support a proposed rule is lacking. Species of concern are not specifically afforded the same protection under the ESA as threatened or endangered species, but federal agencies are required to consider them in the agency's planning and decision making processes. The BLM also maintains a list of plant and animal species that are designated as sensitive for which population viability is a concern, as warranted by a downward trend in population numbers, density, or habitat conditions that would reduce a species existing distribution.

In accordance with the ESA, the lead agency in coordination with the USFWS must ensure that any action that they authorize, fund, or carry out would not adversely affect a Federally listed threatened or endangered species. In addition, it is currently BLM's policy that agency actions do not contribute to the Federal listing of any Federal candidate species, species of concern, or sensitive species, as threatened or endangered.

3.7.1 Affected Environment

The special status species identified by the USFWS (1999) and Nevada Natural Heritage Program (NNHP) (1998, 1999) for the project area and cumulative assessment area are listed in Table 3-17. Although a number of sensitive terrestrial and aquatic species occur in northern Nevada, few species have been documented for the immediate project area. In support of this document and previous mine expansions, baseline surveys have been conducted in and near the project area (BLM 1998; JBR 1998). The following discussions summarize known data for the special status species initially identified for the proposed project by the applicable agencies.

3.7.1.1 Plants

One BLM state sensitive species, the Elko rockcress, could potentially occur within or adjacent to the project area, based on this plant's habitat associations (Table 3-17). The Elko rockcress is typically associated with gently north-sloping, sagebrush-dominated habitats with a high moss/ cryptogamic cover over silty substrates (NNHP 1999). General habitat surveys conducted in 1997 recorded no special status species within the project area (JBR 1998). One state-sensitive plant species that has been documented in the vicinity of the project is the sand cholla cactus (JBR 1998) (Table 3-17). This cactus is typically associated with big sagebrush and shadscale. It is thought to be widely distributed and uncommon throughout its range (Mozingo and Williams 1980). All cacti and yucca species are protected by Nevada state law.

Nine additional species that were identified by the NNHP were considered but eliminated from the analysis based on the lack of suitable habitat, soil composition, geology, and elevational range of these species. These species included the Ophir rockcress, Goodrich biscuitroot, Nevada willowherb, windloving buckwheat, Lewis buckwheat, Nevada dune beardtongue, Tiehm beardtongue, obscure scorpion plant, and least phacelia.

Table 3-17
Special Status Wildlife Species
Identified for the Proposed Project

Common Name	Scientific Name	Federal Status[1]	Potential Occurrence in the Project Area and Vicinity[2]
PLANTS			
Elko rockcress	*Arabis falcifrucfa*	BLM	U
Sand cholla cactus	*Opuntiu pulchella*	State	R-V
BIRDS			
Bald eagle	*Haliaeetus leucocephalus*	FT	W, M
Peregrine falcon	*Falco peregrinus*	BLM	M
Golden eagle	*Aquila chrysaetos*	BLM	R
Swainson's hawk	*Buteo swainsoni*	BLM	R-V
Ferruginous hawk	*Buteo regalis*	BLM	R-V
Northern goshawk	*Accipiter gentillis*	BLM	R-V
Burrowing owl	*Athene cunicularia*	BLM	R
Sage grouse	*Centrocerus urophasianus*	BLM	R
MAMMALS			
Pygmy rabbit	*Brachylagus idahoensis*	BLM	R
Small-footed myotis	*Myotis ciliolabrum*	BLM	R
Long-eared myotis	*Myotis evotis*	BLM	U
Fringed myotis	*Myotis thysanodes*	BLM	U
Long-legged myotis	*Myotis volens*	BLM	R-V
Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	BLM	R
Pacific Townsend's big-eared bat	*Corynorhinus townsendii townsendii*	BLM	R
Spotted bat	*Euderma maculatum*	BLM	U

[1]FE = Federally endangered.
FT = Federally threatened.
BLM = BLM state sensitive species.
Currently protected by the BLM in Nevada under the BLM's state guidelines.
State = Protected by Nevada State law (NRS 527.060-120).

[2]R-V = Resident in Vicinity: this species has been documented in the project vicinity, which includes habitats surrounding the project area.
R = Resident: this species has been documented in the project area.
W = Winters: this species winters in the vicinity of the project area.
M = Migrates: this species is known to migrate through the project area.
U = Unknown: it is currently unknown whether this species occurs in the study area or vicinity; however, appropriate habitat is present.

3.7.1.2 Birds

The USFWS has downlisted the bald eagle to Federally threatened from endangered status (USFWS 1995). No bald eagle nesting habitat occurs in or near the project area; however, migrating eagles do move through the state, and wintering birds would occur within the appropriate winter habitats (e.g., Humboldt River corridor) from December through March. These habitats for wintering birds generally include open water and upland habitats for foraging. In addition to open water, other important habitat components for wintering eagles include suitable trees for diurnal perching and night roosting (Terres 1991; USFWS 1986). Bald eagle wintering habitat exists along the Humboldt River. Wintering birds may forage along the river, when open water permits. Eagle presence in the immediate project area would be infrequent and limited to occasional foraging in the upland habitats.

The American peregrine falcon was delisted as Federally endangered on August 25, 1999. The designated similarity of appearance provision of the Endangered Species Act for the arctic subspecies also has been removed (USFWS 1999). The peregrine falcon continues to be protected under the Migratory Bird Treaty Act and is considered a BLM state sensitive species. Nesting peregrine falcons prefer cliffs in proximity to water and typically forage in riparian zones where avian prey species (e.g., passerines, shorebirds) are abundant (USFWS 1984). Studies have reported that peregrines may travel up to 27 miles from occupied eyries to obtain prey (Enderson and Craig 1997). No eyries are known to occur in the vicinity of the project area. In addition, no primary foraging habitat (e.g., riparian zones) occur in the project area. Peregrine use of the project and cumulative assessment areas would be limited to migrating birds.

The golden eagle is a yearlong resident and is considered to be a common breeder throughout Nevada; however, eagle densities and nesting activity are greatest in the northern third of Nevada (NDOW 1985). Nesting golden eagles prefer suitable cliffs that overlook sagebrush flats, piñon-juniper forests, salt desert shrub, or other habitat capable of supporting a suitable prey base. Highest densities of nesting eagles are typically found along river systems where cliffs border the entire length of the river, and lower densities are found in piñon-juniper habitat and salt desert shrub communities (NDOW 1985). Wintering golden eagles tend to congregate in broad valleys interspersed with agricultural crop lands or sagebrush and desert shrub communities. Golden eagle nesting has been documented in the Battle Mountain area; however, suitable nesting habitat in the immediate project area is limited. No active eagle nests have been recorded within the Marigold Mine expansion area (BLM 1997).

The Swainson's hawk is a summer resident of Nevada and, like the golden eagle, is most abundant in the northern third of the state (NDOW 1985). The majority of documented breeding territories in Nevada have been located in agricultural valleys. Swainson's hawks nest in a wide variety of vegetative communities from 4,000 to 6,500 feet in elevation. Nest sites are primarily found in deciduous trees; however, nests also have been found in other vegetation types such as buffaloberry, serviceberry, and sagebrush (NDOW 1985). Although Swainson's hawks have been observed exhibiting territorial behavior along the Humboldt River (BLM 1995), no occupied territories or active nest sites have been documented within the project area.

The ferruginous hawk is a common breeder in many areas of Nevada. This species often nests in trees, on promontory points, rocky outcrops, cut banks, or on the ground (Terres 1991). Preferred breeding habitat in most of the state is scattered juniper forests at the interface between piñon-juniper and desert shrub communities that overlook broad valleys used for foraging (Herron et al. 1985). Although optimal habitat for ferruginous hawks does not exist in the project area, marginal nesting habitat may occur in the southernmost portion of the project area where isolated juniper trees are present (JBR 1998). No breeding activity has been observed in the project area.

The northern goshawk is an uncommon forest species that is a year-long resident, breeding in the mountains and wintering in the lower foothills and valleys (Herron et al. 1985). In Nevada, this species is generally associated with aspen stands and along perennial water sources (Herron et al. 1985). Although potential nesting habitat occurs in the Battle Mountain Range, no suitable habitat occurs in the project area.

The burrowing owl is an uncommon summer migrant that breeds in portions of Nevada. It is dependent on abandoned mammal burrows for nesting, typically foraging in open grasslands and sagebrush habitats. This owl feeds on insects and small rodents, taking some reptiles, amphibians, and small birds (Terres 1991). Suitable habitat (i.e., shadscale and sagebrush communities) for this species is present in the project area. Burrowing owls, including one family group, were recorded in shadscale/cheatgrass habitat within the project area north of Ames Springs in 1997 (JBR 1998).

Sage grouse are native to the Battle Mountain area, occurring in upland shrub communities at the upper elevations. Breeding occurs on open leks (or strutting grounds) and nesting and brooding occurs in upland areas and meadows in proximity to water. During winter, sage grouse often occupy wind exposed areas where sagebrush is available (e.g., drainages, southern or western slopes, or exposed mesa and ridges). Surveys conducted in 1994 and 1995 recorded sage grouse in upland habitats and riparian areas of the Battle Mountain Range (BLM 1998). In 1997, the NDOW located five leks on ridges in the upper elevations of the Battle Mountain Range (JBR 1998). Historic lek sites previously identified by the Battle Mountain Band Council of Te-Moak Tribe of Western Shoshone and the Duck Valley Shoshone-Paiute Tribe as occurring within the project area were visited by the NDOW to determine activity. However, the NDOW was unable to verify that any of the sites were still active (BLM 1998). Because sage grouse rely heavily on small meadows and stream courses for brood rearing, the southern portion of Cottonwood and Trout Creeks within the project area may provide suitable brooding habitat (JBR 1998; NDOW 1999a). However, the incidence of use by brooding sage grouse hens along the intermittent portions of the streams occurring in the project area would be low due to the lack of summer flow and riparian vegetation.

3.7.1.3 Mammals

The pygmy rabbit is distributed throughout the northern Great Basin. Habitat requirements for these small, burrowing rabbits include dense stands of big sagebrush or bitterbrush for both food and cover (Green and Flinders 1980), and deep, friable soils for their burrows (Wilde 1978). This species has an irregular distribution, limited to suitable sagebrush and rabbitbrush thickets (Dobler and Dixon 1990). Sagebrush is an important year-round forage for this rabbit. In Nevada, the pygmy rabbit also is considered a game species. Pockets of potential pygmy rabbit habitat occurs in the southern portion of the project area (JBR 1998); however, the potential for this species to occur on the project area is considered low, based on the associated habitat types.

The following background information on sensitive bats was summarized, using a variety of sources, including the *Bats of Nevada* (no date) and *General Life History of Nevada Bats* (no date). Potential presence in the project area is summarized from field surveys conducted in and near the project area (JBR 1998). Scientific names are provided in Table 3-17.

Several BLM sensitive bat species either occur or may occur in the project area. Federal and state agencies identified sensitive bat species, including the small-footed myotis, long-earred myotis, fringed myotis, long-legged myotis, Townsend's big-earred bat, and the spotted bat, as potentially occupying the appropriate habitat types in and near the project area. Rock outcrops, caves, mine shafts and adits, cliffs, trees, and buildings in the project region could provide day roost sites; caves and mines may be used for hibernacula, maternity roosts, or bachelor roosts. Surveys conducted in 1997 and 1998 identified bats using the Red Rock Adit in spring, summer, and early fall. Since no bats were observed during winter surveys, it is assumed that no hibernacula are currently used by resident bat species in the mine area. However, *Myotis* species are difficult to detect, and individual bats may be present during the winter period.

The small-footed myotis is a summer resident in Great Basin desert, shrub-steppe, and woodlands, with occasional reports in montane forests. This small bat inhabits rocky areas and forages for insects in clearings, near rocks, and over forests. It is known to hibernate in caves and mines, and summer roosts have been recorded in buildings and mines, under tree bark, and beneath rocks. Little is known of its reproductive biology (Arizona Game and Fish Department 1993; Colorado Division of Wildlife 1984; Fitzgerald et al. 1994). Small-footed myotis have been documented in the Battle Mountain area (BLM 1998). Guano deposition located in the Red Rock Adit located in the project area on September 9 and 10, 1998, suggested that the adit was used by a *Myotis* species (probably small-footed myotis) (JBR 1998).

The long-eared myotis is a summer resident in montane forests throughout Nevada, occupies mid-elevational piñon-juniper woodlands, and is dependent on perennial water sources within these woodlands. This species gleans insects (primarily small moths) over vegetation and open water while foraging. Individuals typically day roost singly or in small groups (Colorado Division of Wildlife 1984; Fitzgerald et al. 1994). Roost sites encompass buildings, hollow trees, caves, mines, rocky crevices, and other underground openings. Little is known about this species' use of hibernacula, but caves and mine adits and shafts support wintering bats, in addition to providing habitat for breeding populations. Species' data relative to Nevada also are lacking. This bat species has been documented within the Battle Mountain area (BLM 1998). The Red Rock Adit may provide potential roost sites for this bat species; however, no individuals were observed during the 1997 field surveys (JBR 1998).

The fringed myotis is a summer resident in the Great Basin and has been reported in woodlands throughout the state. It occupies habitats ranging between desert scrub communities to higher elevation woodlands. In Nevada, piñon woodland is one of the most commonly used plant communities. This species gleans small insects (mainly moths) from foliage during foraging. Nursery colonies and hibernacula are often located in mines, caves, and buildings. Roosts may be in caves, rock crevices, mines, and buildings. Males typically roost singly (Colorado Division of Wildlife 1984). This species is susceptible to human disturbance, particularly during the breeding season (Arizona Game and Fish Department 1993). Parallel to the long-eared myotis, the fringed myotis was not observed during the field surveys, but potential roost sites could occur within the abandoned shafts and adits within the project area.

The long-legged myotis is a summer resident from Great Basin woodlands to montane forests. This species gleans insects above woodlands, over ponds, and along riparian corridors (Colorado Division of Wildlife 1984). Individuals typically day roost singly or in small groups in buildings, rock crevices, and loose tree bark. Night roosts and hibernacula are often in caves and mines (Colorado Division of Wildlife 1984; Warner and Czaplewski 1984). No long-legged myotis was observed during the 1997 field surveys; however, potential roost sites could occur within the abandoned shafts and adits within the project area (JBR 1998). This myotis has been documented within the Battle Mountain area (BLM 1998).

The Townsend's big-eared bat is a year-round resident in Nevada. This species prefers caves, mines, and buildings that maintain stable temperatures and air flow for nursery colonies, bachelor roosts, and hibernacula (Colorado Division of Wildlife 1984). The Townsend's big-eared bat occupies habitats ranging among desert, piñon-juniper, other coniferous forests, broadleaf or deciduous forests, shrublands, and grasslands. This species gleans insects from foliage and forages and roosts singly and in colonies (Colorado Division of Wildlife 1984). This bat is highly susceptible to disturbance during hibernation; mortalities may result from as few as one disturbance during this critical period (Fitzgerald et al. 1994). Townsend's big-eared bats were observed in the Red Rock Adit in 1997 and 1998. The adit is less than 100 feet long with a shaft near the portal. The shaft is approximately 40 feet deep. Approximately six Townsend's big-eared bats were observed in this adit during the fall of 1997. On June 5, 1998, another Townsend's big-eared bat (male) was observed in a state of torpor within the same adit. An additional Townsend's big-eared bat was observed on September 9 and 10, 1998 (JBR 1998).

The spotted bat is rare throughout the western U.S. Although limited data are currently available on this species, the spotted bat is thought to occupy cold deserts and submontane zones, using hibernacula that maintain a constant temperature from September to May rather than migrate (Dalton et al. 1990). It also is believed that this bat forages nocturnally for insects over open water, marshes, and open woodlands, (e.g., piñon-juniper). This species has been reported roosting in horizontal rock crevices in cliffs, along washes, or in rock outcrops (Wai-Ping and Fenton 1989). The upper elevations along the southern portion of the project area may provide suitable habitat for the spotted bat; however, no individuals were observed during the 1997 surveys (JBR 1998).

3.7.2 Environmental Consequences

3.7.2.1 Proposed Action

No sensitive plant populations are known to occur in the project vicinity. A sensitive plant habitat survey was conducted within the project vicinity in 1997 (JBR 1998). Potential habitat for sensitive plant species was not observed during the survey. Therefore, impacts to sensitive plant species are not anticipated, as a result of mine construction and operation.

The impact analysis for sensitive wildlife resources focuses on the species identified in Section 3.7.1, Affected Environment, addressing only the applicable project components for each species discussed.

No impacts to wintering or migrating bald eagles would be expected from the mine development. Birds may forage near the Humboldt River and in the surrounding foothills. No suitable roosting habitat occurs in the project area, and potential foraging activities within the upland habitats located within the proposed disturbance areas would be expected to be sporadic. However, no direct impacts to these areas would be anticipated from the proposed expansion and operation of the Marigold Mine. No indirect impacts to bald eagles would be expected from increased noise or human presence in the vicinity of the mine, based on the incidental use of the area by wintering or migrating birds.

No impacts to the peregrine falcon would be anticipated from the proposed project. No active eyries occur in or near the project area, no riparian habitat that may support falcon prey would be impacted by the proposed mine expansion, and migrating birds would be infrequent in the project vicinity.

Potential impacts to the golden eagle or Swainson's hawks from the proposed mine expansion would be limited to the incremental habitat loss and associated reduction in prey availability in and near the disturbance areas. No suitable nesting habitat for either of these species occurs in the immediate project area, and no indirect effects (e.g., water drawdown, harassment of breeding individuals) to possible nesting areas in the vicinity of the project would be anticipated. The incremental impacts to available foraging habitat and resident prey populations would not be considered significant, based on the relative low habitat value of the native plant communities (i.e., shadscale-cheatgrass and sagebrush-spiny hopsage) that would be removed by the expansion activities, as compared to the vegetative communities that are located farther south toward Battle Mountain. No direct or indirect impacts to Ames or Mud Springs have been identified. These spring complexes provide higher quality foraging areas than the habitats located within the immediate mine area, as apparent by the signs of perching raptors on rock outcrops located near the spring sites.

Ferruginous hawks may be indirectly impacted by the proposed mine expansion activities. Although no known nest sites have been documented in the project area, breeding birds may be present near the southern perimeter of the mine area, where the vegetation begins to transition into the higher elevational woodland communities. Since ferruginous hawks are highly susceptible to disturbance during the courtship and incubation periods, mine expansion activities, that would occur within 0.5 mile of an active nest site could result in indirect effects to breeding birds from increased noise levels and increased human presence. In the event that an occupied territory or active nest site were within direct line of sight of the proposed mine expansion activities, adult birds may abandon a breeding territory or nest site, if noise levels or human presence were to exceed this species' tolerance threshold. The environmental protection measures committed to by GMMC in Section 2.2.18.5, Wildlife and Livestock Protection, would aid in minimizing these potential effects to breeding ferruginous hawks, if present. The commitment to conduct breeding bird surveys within suitable native habitats prior to the initiation of construction and to develop applicable protection measures, if warranted, would protect individual nest sites and breeding raptors in close proximity to the mine area. Residual impacts to this species would be the incremental habitat loss for foraging in and near the mine area from mine expansion.

No impacts to the northern goshawk would be anticipated from the proposed project. No direct or indirect impacts to breeding individuals would be anticipated, particularly since no impacts to surface water availability or associated riparian vegetation would occur from implementation of the proposed project. In addition, the vegetation in the project area is neither appropriate for goshawk nesting nor is it optimal for species' foraging.

Burrowing owls could be impacted by the proposed mine expansion, if present within or adjacent to the mine expansion area. Breeding birds were documented in the vicinity of the project (see Section 7.1.2), and the shrubland vegetation that would be disturbed by the proposed project is suitable for supporting breeding and foraging birds. Removal of a maximum of 671 acres of the shadscale-cheatgrass and sagebrush-spiny hopsage communities could directly affect the burrowing owl, if present. Surface disturbance would result in the loss of potential nesting habitat, and if the disturbance occurred during the breeding season, direct mortalities could occur to incubating adults or young owlets in the nest burrows. As discussed above for the ferruginous hawk, the environmental protection measures committed to by GMMC in Section 2.18.5, Wildlife and Livestock Protection, would aid in minimizing potential effects to breeding burrowing owls, if present in the project area. Habitat loss would be short-term (i.e., life of the mine) due to the relatively abundant shrubland habitats in the vicinity of the proposed project. Burrowing owls could inhabit the project area following mine reclamation (i.e., long term).

Potential impacts to the pygmy rabbit would be limited to the incremental loss of marginally suitable habitat along the southern perimeter of the proposed mine expansion area. Based on the low habitat quality of the vegetation that would be removed by project implementation and the relative availability of higher quality habitats in the vicinity of the project, this incremental loss of the shadscale-cheatgrass and sagebrush-spiny hopsage communities would not be considered significant.

Of the seven sensitive bats identified for the proposed project, the small-footed myotis and the Townsend's big-eared bat have been documented as occurring in the project area and the long-legged myotis has been recorded in the vicinity of the project (i.e., Battle Mountain area) (see Section 3.7.1.3). Based on available foraging and roosting habitat, other bat species also may occur (see Table 3-17).

Based on the proposed project, the Red Rock Adit would be directly affected by mine expansion. Townsend's big-eared bats have been documented using this adit (see Section 3.7.1.3). However, the environmental protection measures committed to by GMMC in Section 2.2.18.5, Wildlife and Livestock Protection, would aid in minimizing potential long-term effects to roosting bats. GMMC has committed to developing and implementing specific protection measures for roosting bats by initiating a plan to incrementally exclude bats from the Red Rock Adit during the appropriate seasonal and diurnal/nocturnal period. This closure would allow the bats to leave the adit but not return, thereby forcing the individuals to other underground features in the region. Although this measure would prevent the direct loss by crushing of bats upon the initiation of construction activities, the Proposed Action would result in incremental habitat loss for resident bats and possible indirect mortalities of individuals that could not relocate. However, this effect would be anticipated to be minimal, since the adit does not support large concentrations of bat species, the protection measure would protect individual bats from direct loss, and the availability of other potential roost sites along the Battle Mountain foothill region.

No other underground workings are known to occur within the project area. Therefore, no additional direct or indirect impacts to roosting bats (beyond those associated with the Red Rock Adit) would be anticipated from mine expansion activities.

3.7.2.2 8-South Partial Pit Backfill Alternative

Overall impacts to sensitive species from implementation of the 8-South Partial Pit Backfill Alternative would parallel those described for the proposed project. Habitat disturbance for sensitive species under this alternative would be 85 acres less than for the proposed project.

3.7.2.3 No Action Alternative

Under the No Action Alternative, the incremental habitat loss for the ferruginous hawk, burrowing owl, and pygmy rabbit would not occur. Incremental indirect impacts to roosting bats from mine expansion, increased noise, decreased air flow into hibernacula, or loss of roost site integrity would not occur. The exclusion of bats and loss of roosting habitat would not occur.

3.7.3 Cumulative Impacts

The incremental habitat loss within the cumulative assessment area would be parallel to that described for general wildlife in Section 3.6.3, Cumulative Impacts. The burrowing owl would be cumulatively affected by the past, present, and reasonably foreseeable future actions, based on overall habitat loss. However, it is impossible to quantify these impacts, since this species occurs sporadically throughout the region.

Other species that have likely been cumulatively affected by historic and ongoing mining activities would include nesting raptors. As the mine activities have expanded along Battle Mountain, breeding birds have moved farther from human disturbances, resulting in displacement and overall habitat fragmentation.

The presence of historic mining has likely improved the habitat for roosting bats. As the natural habitats have decreased for these sensitive bat species throughout the western U.S., bats have relocated into abandoned underground workings, using them for roost sites. However, potential cumulative impacts to bats would primarily involve additional exploration and mining activities that may result in loss of individuals, and the disturbance to roost sites either through direct impacts from noise, vibrations, and human presence or through indirect effects from future mining development.

3.7.4 Potential Mitigation and Monitoring

No additional mitigation measures have been developed for special status species, based on the environmental protection measures committed to by GMMC and outlined in Section 2.2.18.5, Wildlife and Livestock Protection.

3.7.5 Residual Adverse Impacts

No residual impacts would occur to Federally listed species identified for this project. Residual effects applicable to BLM state sensitive species would be limited to potential habitat loss for the burrowing owl.

3.8 Range Resources

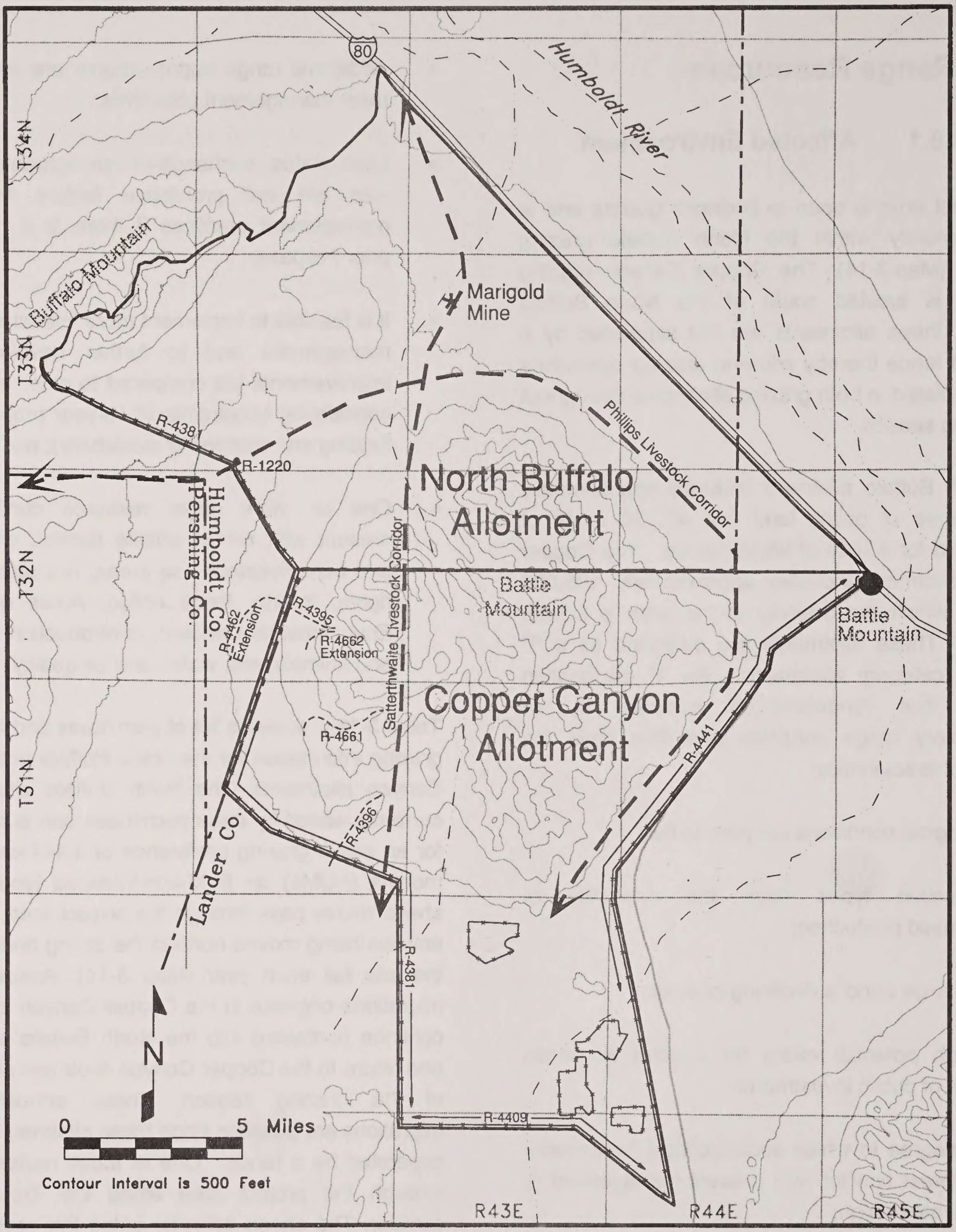
3.8.1 Affected Environment

The project area is open to livestock grazing and is located entirely within the North Buffalo grazing allotment (Map 3-14). The Copper Canyon grazing allotment is located south of the North Buffalo allotment; these allotments are not separated by a rangeland fence thereby allowing grazing operations to be completed in both grazing allotments throughout the grazing season.

The North Buffalo allotment includes approximately 56,320 acres of public land and 42,560 acres of private land for a total of 98,880 acres. The Copper Canyon allotment includes approximately 105,000 acres, of which the majority of the area is private property. These allotments are classified as a "I" (improve) category allotments. An "I" designation indicates that rangeland is currently in an unsatisfactory range condition and may have the following characteristics:

- Ecological conditions are poor to fair;
- Vegetation types have the capability of increased production;
- The range trend is declining or static;
- A high potential exists for positive economic return of public investments;
- The degree to which social/political controversy or interest conflict with present management is moderate to high;
- Resource management objectives are not being met (the allotment is in need of an allotment management plan or grazing system or major revisions are needed to an existing allotment management plan;
- Additional range improvements are required to meet management objectives;
- Land status, exchange-of-use agreements, and size are not prohibitive factors for future management practices if there is a history of prior trespass;
- It is feasible to implement more intensive grazing management and to further develop range improvements (as compared to other allotments considering constraints of 10-year projections of funding and manpower availability); and
- One or more major resource conflicts are present with critical wildlife habitat, wild horse and burro/livestock use areas, recreation, water rights, mining, lands action, Areas of Critical Environmental Concern, reintroduction of plants and animals, soil, water, and air quality.

Table 3-18 provides a list of permittees and important grazing information for the North Buffalo and Copper Canyon allotments. The North Buffalo allotment is currently leased by three permittees and is managed for an active grazing preference of 3,447 animal unit months (AUMs) on BLM-administered lands. Two sheep routes pass through the project area, with the animals being moved north in the spring and south in the late fall each year (Map 3-14). Annual sheep migrations originate in the Copper Canyon allotment, continue northward into the North Buffalo allotment, and return to the Copper Canyon allotment at the end of the grazing season. These annual sheep migrations are possible since these allotments are not separated by a fence. One of these routes passes through the project area along the Trout Creek corridor. The sheep operator using this route has a grazing permit that extends from March 1 to April 30 (405 AUMs) and from November 1 to February 28 (789 AUMs). The second sheep route passes through the southern portion of the project area, less than one mile north of Mud Spring. The operator using this route has a grazing permit that extends



Legend

County Boundary	Road
Interstate 80	Water Pipeline
Road	Well
Stream or Intermittent Stream	Livestock Corridor
City	
Allotment Boundary	

Marigold Mine

Map 3-14

Grazing Allotments and Range Improvements

Table 3-18
Livestock Grazing Permits for the North Buffalo and Copper Canyon Allotments

Grazing Allotment	Permittee	Kind of Livestock	Numbers of Livestock	Grazing Period and Dates	Percent on Public Land	Active Preference (AUMs)
North Buffalo	Badger Ranch	Cattle	255	3/1 – 2/28	5	153
	Ellison Ranching	Sheep	1,009	3/1 – 4/30	100	405
		Sheep	1,000	11/1 – 2/28	100	789
	Agri-Beef Company	Sheep	2,115	3/1 – 3/31	100	431
			2,115	11/1 – 2/28	100	1,669
Subtotal						3,447
Copper Canyon	Ellison Ranching Company	Sheep	300	3/1 – 4/30	100	120
		Sheep	335	11/1 – 2/28	100	264
	Badger Ranch[1]	Cattle	490	3/1 – 2/28	61	3,587
	Chiara Ranch[1]	Cattle	30	11/1 – 2/28	42	50
	Agri-Beef Company	Sheep	1,009	3/1 – 3/31	100	206
		Sheep	1,009	11/1 – 2/28	100	796
Subtotal						5,023
TOTAL						8,470

[1]Although there are separate ranches, the owner is common to both.
Source: JBR 1997a, 1999a.

from March 1 to March 31 (431 AUMs) and from November 1 to February 28 (1,669 AUMs). A third operator has a grazing permit to utilize 153 AUMs for yearlong cattle grazing within the project vicinity.

The Copper Canyon allotment involves four grazing permits held by three permittees. The Ellison Ranching Company, a sheep operation, holds one permit with an active preference for 384 AUMs, 100 percent of which is on public land. The Badger Ranch operations include approximately 61 percent public rangeland with an active grazing preference of 3,587 AUMs. The Chiara Ranch operations include approximately 42 percent public rangeland with an active grazing preference of 50 AUMs. The Agri-Beef Company operations occur entirely on public rangeland with an active grazing preference of 1,002 AUMs.

The North Buffalo and Copper Canyon allotments include 12 range improvements, none of which are located within the project area (Map 3-14). A description of these improvements is provided in Table 3-19. The majority of these improvements are perimeter fencing and spring/water development pipelines in the western portion of the Copper Canyon allotment. The remaining improvements are cattleguards.

Two prominent range sites occur in the project area including the shallow calcareous loam (8 to 10 inches of precipitation per year) and loamy (5 to 8 inches of

Table 3-19
Range Improvements for the North Buffalo and Copper Canyon Allotments

Grazing Allotment	Improvement Number	Name	Location
North Buffalo	R-4381	North Buffalo Fence	Township 33 North, Range 42 East, Section 32
	R-1220	Stock well	Township 33 North, Range 42 East, Section 32
Copper Canyon	594381	Copper Canyon Fence	Township 31 North, Range 42 East, Section 20
	594395	Mill Spring Improvement and Pipeline	Township 32 North, Range 42 East, Section 27
	594396	Rocky Spring Improvement and Pipeline	Township 31 North, Range 42 East, Section 24
	594409	Harry Canyon Division Fence	Township 29 North, Range 43 East, Section 9
	594441	Shoshone Highway 8A Fence	Township 30 North, Range 44 East, Section 5
	594661	Timber Canyon Pipeline	Township 31 North, Range 42 East, Section 1
	594662	Mill Creek Pipeline Extension	Township 32 North, Range 42 East, Section 27
	594384	Copper Canyon Cattleguard	Township 30 North, Range 42 East, Section 1
	594892	State Highway 305 Fence	Township 31 North, Range 44 East, Section 24
	594893	State Highway 305 Cattleguards	Township 31 North, Range 44 East, Section 24

Source: JBR 1997a.

precipitation per year) sites. Dominant species associated with the shallow calcareous loam site include black sagebrush, Thurber needlegrass, and Indian ricegrass. The average annual forage production is 350 pounds per acre per year. The loamy range site occurs at lower elevations, with common species including shadscale, bud sagebrush, bottlebrush squirreltail, and Indian ricegrass. Average annual forage production is 450 pounds per acre per year.

A three-strand barbed wire fence currently exists along the existing permit boundary, which excludes livestock from grazing within the mine area. Natural surface water sources, including springs and intermittent creeks, are available for use by grazing livestock in the project vicinity (see Section 3.1.1.2, Surface Water). Mud Spring is located less than 0.5 mile south of the proposed permit boundary and is a perennial water source utilized by grazing livestock on a seasonal basis. This spring was developed during the 1970s to improve water supply and quality. However, the improvements that were made to the spring have substantially deteriorated since that time as a result of heavy use by livestock. Ames Spring, which is a perennial spring, is located less than 0.1 mile south of the proposed permit boundary and also is utilized as a water source by grazing livestock on a seasonal basis. Perennial reaches of Cottonwood and Trout Creeks, which are located south of the project area, are also used as water sources by grazing livestock.

3.8.2 Environmental Consequences

3.8.2.1 Proposed Action

Impacts to rangeland resources resulting from the Proposed Action include: 1) temporary loss of AUMs from the construction of a range perimeter fence, 2) permanent loss of AUMs due to the direct loss of vegetation within the pit area, and 3) interference with range management activities.

The existing perimeter fence constructed along the current permit boundary has excluded approximately 2,638 acres of rangeland from livestock grazing. A new perimeter fence would be constructed along the proposed permit boundary, which would include an additional 5,762 acres of rangeland. Therefore, an additional 5,762 acres of vegetation would be temporarily unavailable for livestock grazing during mine development and operation. The average stocking rate for this allotment is 20 acres/AUM. Therefore, the exclusion of livestock from 5,762 acres of rangeland forage would result in the temporary loss of 288 AUMs, which would reduce the active grazing preference within the North Buffalo allotment to 3,159 AUMs for the life of the project. The loss of 288 AUMs represents less than 8 percent of the active grazing preference. A permanent loss of 131 acres of rangeland or 6 AUMs would result from pit expansion associated with the Proposed Action and the construction of a berm along the pit perimeter after mine closure and reclamation. Successful reclamation of and increased forage productivity associated with the waste rock dumps may partially compensate the loss of 6 AUMs.

Construction of the range perimeter fence may interfere with some seasonal movements of livestock. However, this minor interference would not restrict access to adjacent rangeland within the allotment during the life of the project. Ames and Mud Springs, which are used as livestock watering sources, would not be affected by potential groundwater drawdown associated with the 8-North Pit.

3.8.2.2 8-South Partial Pit Backfill Alternative

The proposed perimeter fence area for this Alternative would encompass the same additional acreage (5,762 acres) as for the Proposed Action. The temporary and permanent loss of AUMs would be the same as described for the Proposed Action.

3.8.2.3 No Action Alternative

Under the No Action Alternative, additional impacts to range resources would not occur from development and operation of the Proposed Action. Presently permitted mine and mineral exploration projects associated with the Marigold Mine has resulted in the exclusion of 2,638 acres of rangeland. This exclusion has resulted in the temporary loss of 132 AUMs, based on a average stocking rate of 20 acres per AUM.

3.8.3 Cumulative Impacts

The cumulative assessment area for range resources encompasses approximately 203,000-acre area including the North Buffalo and Copper Canyon allotments (Map 3-12). Past and present disturbances within these grazing allotments include approximately 12,393 acres of rangeland disturbed during previous mining and other development activities (i.e., miscellaneous mining activities). Mine development and operation activities associated with the proposed project would result in the disturbance or removal of 717 acres of rangeland. Reasonably foreseeable future projects identified in the cumulative assessment area would disturb approximately 6,325 acres of rangeland. Therefore, a total of 19,435 acres of rangeland would be disturbed or removed by past, present, and proposed activities. These disturbances have resulted in an estimated temporary loss of 972 AUMs and permanent loss of 97 AUMs based on an average stocking rate of 20 acres per AUM. It is assumed that the majority (i.e., 90 percent) of the mine-related surface disturbance would be reclaimed after mine operations cease.

3.8.4 Potential Mitigation and Monitoring

No mitigation measures for range resources are recommended.

3.8.5 Residual Adverse Impacts

Residual impacts of the Proposed Action for range resources would include the permanent loss of 6 AUMs. This total represents less than 1 percent of the total AUMs for the North Buffalo allotment.

3.9 Land Use and Access

3.9.1 Affected Environment

3.9.1.1 Land Use

Lands administered by the BLM comprise the majority of public lands in Humboldt County and account for approximately 70 percent of the county's land base (State of Nevada 1996). Private lands comprise approximately 20 percent of Humboldt County and generally are interspersed with public lands in a checkerboard pattern for a distance of 20 to 25 miles on either side of the Humboldt River. This land ownership pattern resulted from Congress deeding alternate sections of land (each section being 1 square mile) to the Central Pacific Railroad Company, which constructed the Trans-Continental Railroad through Nevada in the late 1860s. The remaining 10 percent consists of state, county, and other Federal lands. Surface ownership in the project area is shown in Map 2-1.

Public lands under BLM jurisdiction are managed for the multiple uses of range, forestry, watershed, mineral extraction, recreation, wilderness, and wildlife habitat. The project area is located within the BLM's Winnemucca District. The BLM's Sonoma-Gerlach Management Framework Plan (BLM 1982) indicates that land use within the project area is open for mineral exploration and development. One of the objectives in the plan is to make public lands and Federally owned minerals available for exploration and development of mineral and material commodities.

The project area is zoned M-3 (Open Land Use District) by Humboldt County for open space and provides a wide variety of rural land uses. Mineral extraction industries are recognized as an accepted use within this land classification. Mining is a principal permitted use within this zoning district and must comply with Article 10 of the Humboldt County Zoning Ordinance, which requires a Special Use Permit for operations located on private lands.

Land use within the project area primarily consists of mineral exploration and development, livestock grazing, and dispersed recreational use. GMMC has operated the Marigold Mine since 1988. The existing permit boundary encompasses approximately 2,688 acres of public and private lands, of which 1,098 acres are managed by the BLM. There are no State-administered lands within the GMMC property boundary; however, a section (approximately 640 acres) of private land is owned by the University of Nevada, Reno.

The project area is located within the 98,880-acre North Buffalo Grazing Allotment that includes both private and public lands. See Section 3.8, Range Resources, for a discussion of livestock grazing. Section 3.10, Recreation, contains a discussion of dispersed recreational use in the project area.

There are several other gold mines located in proximity to the project area. The Trenton Canyon Mine is located immediately to the south of the project area. The active Lone Tree Mine is located approximately 8 miles northwest of the Marigold Mine. The Sierra Pacific North Valmy Power Station is another major industrial development in the project vicinity; it is located approximately 5 miles to the north.

There are no residences within the project area; the nearest residences are located approximately 3 miles to the north in the town of Valmy.

3.9.1.2 Rights-of-Way

Interstate 80 lies to the east of the project area. A 120-kV transmission line passes through the project area. Other ROWs near the project area include a water supply line that serves the mine site. Map 3-15 depicts existing ROWs in and near the project area, and Table 3-20 provides additional information on the ROWs.

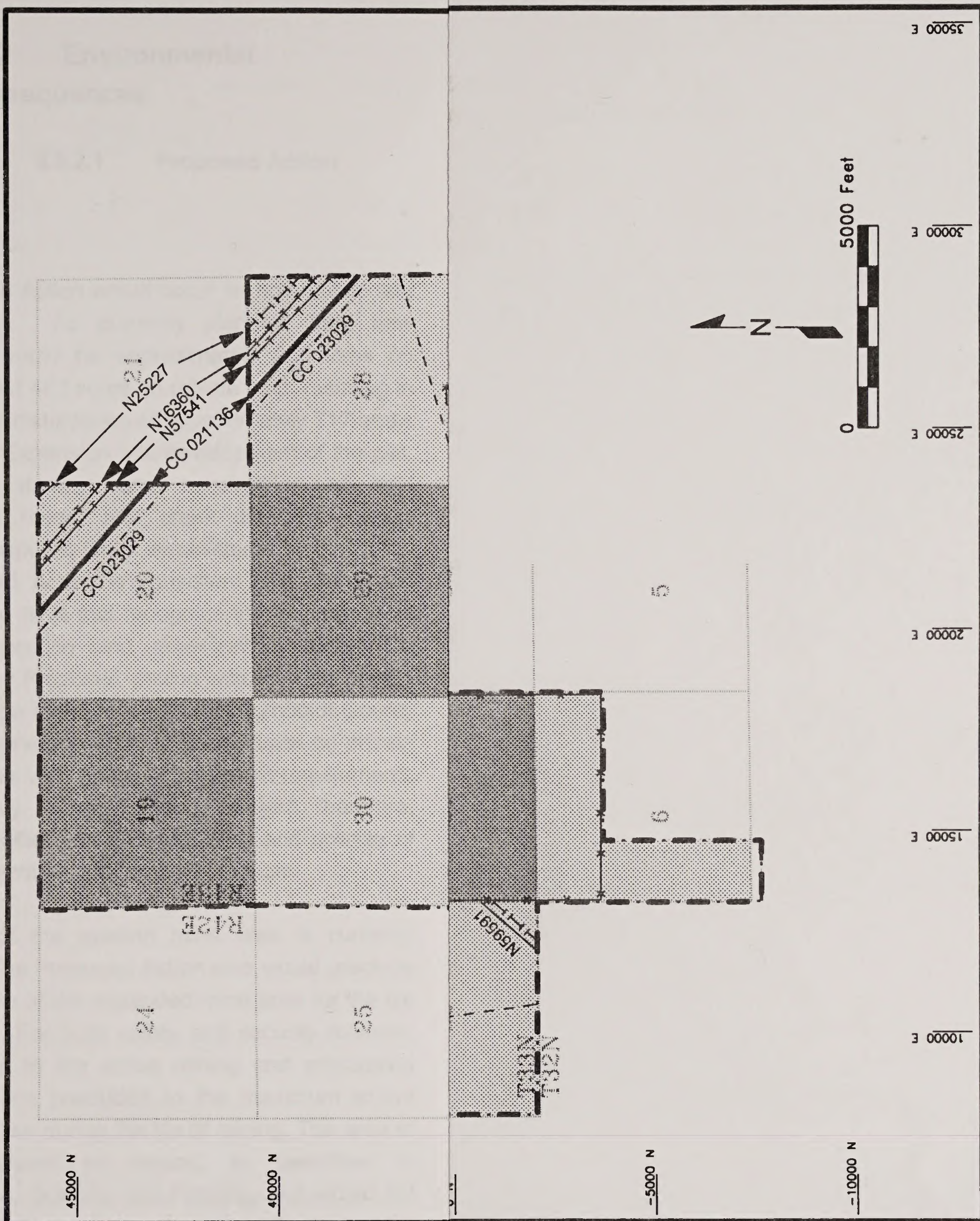
Table 3-20
Existing Rights-of-Way Within the Project Area

Serial Number	Type of Land Use	ROW Holder	Location	Width
N-25227	N. Valmy Station Power Line (23kV), Water Pipeline (18") and Patrol Road	Sierra Pacific Power Company	T34N, R43E, Sections 20 and 28	30 feet
N-16360	Telephone/Telegraph Line	Nevada Bell	T34N, R43E, Sections 20 and 28	10 feet
N-57541	Telephone/Telegraph Line	Nevada Bell	T34N, R43E, Sections 20 and 28	20 feet
CC-021136	Interstate 80	Nevada Department of Transportation	T34N, R43E, Sections 20 and 28	400 feet
CC-023029	Power line	Sierra Pacific Power Company	T34N, R43E, Sections 20 and 28	100 feet
Nev-066891	Power line (120kV)	Sierra Pacific Power Company	T34N, R42E, Section 36; T33N, R43E, Sections 4 and 10; T34N, R43E, Section 32	75 feet
Nev-058529	Power line (7.2kV)	Sierra Pacific Power Company	T34N, R43E, Sections 28 and 32	40 feet
N-59986	Power line (24.9kV)	Santa Fe Pacific	T33N, R42E, Sections 12, 24, and 36; T34N, R42E, Section 36	30 feet
N-59591	Water Pipeline (6") and Patrol Road	Santa Fe Pacific	T33N, R42E, Section 36 T33N, R43E, Section 30	Variable
N-59592	Water pipeline, road, and communication cable	Santa Fe Pacific	T33N, R43E, Section 6	100 feet

3.9.1.3 Access

Access to the project area is provided via I-80 and the unpaved Buffalo Valley Road, which is maintained by Humboldt County. A security gate at the entrance to the mine prevents unauthorized public access to the mine site. I-80 is the primary east-west highway in Nevada and connects Winnemucca, Battle Mountain, and destinations farther east with Reno and destinations farther west. The Buffalo Valley Road also provides access to the Trenton Canyon Mine and public and private lands farther to the southwest.

Traffic volumes on I-80 near the Valmy interchange average 5,780 vehicles per day (Nevada Department of Transportation 1996). No data exist for traffic volumes on Buffalo Valley Road, which provides access to the Marigold Mine. The Southern Pacific and Union Pacific railroads, which roughly parallel I-80 east of the project area, provide freight service to Winnemucca, Elko, and Reno. Amtrak passenger service also is provided at these stops.



LEGEND

GMMC PROPERTY LINE

CURRENT PERMIT BOUNDARY

PROPOSED PERMIT BOUNDARY

LAND STATUS

LANDS ADMINISTERED BY BLM

PRIVATE LANDS

(UNIVERSITY OF NEVADA, RENO) LANDS

ACCESS ROAD

INTERSTATE 80

PIPELINE

POWER LINE

Marigold Mine

Map 3-15

Existing Rights-of-Way Within the Project Area

Table 3-20
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Nev-066891	Power line (120kV)	Sierra Pacific Power Company	T34N, R42E, Section 36; T33N, R43E, Sections 4 and 10; T34N, R43E, Section 32	75 feet
Nev-058529	Power line (7.2kV)	Sierra Pacific Power Company	T34N, R43E, Sections 28 and 32	40 feet
N-59986	Power line (24.9kV)	Santa Fe Pacific	T33N, R42E, Sections 12, 24, and 36; T34N, R42E, Section 36	30 feet
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Marigold Mine

Map 3-15

Existing Rights-of-Way Within the Project Area

3.9.2 Environmental Consequences

3.9.2.1 Proposed Action

Land Use

The Proposed Action would occur on both public and private lands. As currently planned, total new disturbance would be approximately 255 acres on public land and 462 acres on private land, resulting in a total project disturbance of approximately 717 acres (Table 2-2). Expansion and development of the pits, waste rock dumps, and construction of haul roads/access roads, and creek diversions would require use of public lands administered by the BLM. The Proposed Action is consistent with plans and policies of the BLM that recognize the importance of mineral exploration and development within the project area. Proposed mining activities on private lands would be consistent with the Humboldt County Zoning Ordinance provided that expansion on private lands complies with Special Use Permit requirements of the County. The proposed project, therefore, would not conflict with adopted plans and policies of government entities that regulate land use.

Public use of the existing mine area is currently prohibited. The Proposed Action also would preclude any public use of the expanded mine area for the life of the mine. For both safety and security reasons, public access to the active mining and processing areas would be precluded to the maximum extent permitted by law during the life of mining. The area of operations would be fenced, as described in Section 2.2.14, Security and Fencing, and would not be accessible to the general public. Consequently, dispersed recreational use of lands within the proposed project area would be prohibited (Section 3.10.2.1 of Recreation).

The Proposed Action would be compatible with existing land use patterns and, therefore, would not result in adverse impacts to existing land uses. The proposed expansion would exclude grazing on approximately 5,762 acres of currently available rangeland in the North Buffalo Grazing Allotment as a result of the construction of the perimeter fence. The projected loss of animal unit months during mine operations and after the reclamation period is not expected to adversely affect the lessee (Section 3.8.2.1 of Range Resources).

Rights-of-Way

Mine expansion has the potential to change or modify administrative land use ROWs within the project area. All ROWs necessary to support operations at the Marigold Mine are in place and current. Construction of the 5-North Pit may necessitate realignment of the 120 kV power line operated by SPPCo. However, this realignment would occur on private land (Section 5, T33N, R43E) and would not affect ROWs maintained by the BLM on public lands. The realignment would be performed in coordination with SPPCo. Mine expansion would not affect major ROW easements, such as I-80.

Access

The proposed project is not expected to have an adverse impact on access to public and private lands in the study area. Construction of the 5-North Pit, Waste Rock Dump, and Heap Leach Pad would require realignment of the Buffalo Valley Road. The length of the reroute would be approximately 2.1 miles. GMMC would construct the new road on public and private lands immediately north and west of these facilities to ensure continued public access (Map 2-2). Construction of the new road segment would occur prior to the construction of mine facilities, during which time access would continue to be provided on the existing road, in order to allow uninterrupted public access to Buffalo Valley, Trout Creek, and the Trenton Canyon Mine. Prior to construction of the Buffalo Valley Road realignment, GMMC would obtain a right-of-way permit from the BLM for the portion of the road segment located on public land. GMMC would be responsible for maintenance activities for the realigned segment during mine operations and reclamation. After mine closure, GMMC would transfer the ROW to another responsible party, such as Humboldt County, BLM, or others interested in maintaining the public access. If the ROW cannot be transferred, GMMC would consider reclaiming the realigned portion of the road.

Average daily traffic volumes on local roadways, including I-80, are not expected to change significantly from current levels as a result of the proposed project. The expected increase in the mine work force (and associated daily community trips) would comprise only a small fraction of average daily traffic on the interstate. Further, the proposed project is not expected to result in a significant increase in truck traffic to or from the mine.

The closure, abandonment, and reclamation of the mine area would return disturbed lands to their pre-mining land use as rangeland, wildlife habitat, and dispersed recreation. Except for the open pits, all other areas would be reshaped and revegetated, and public access would be established. A combination of safety berms, fencing, and warning signs would be placed around the pit to prevent public access.

3.9.2.2 8-South Partial Pit Backfill Alternative

The 8-South Partial Pit Backfill Alternative would result in less disturbance than the Proposed Action. Specifically, this alternative would eliminate the need to expand the 8-North Waste Rock Dump, which under the Proposed Action would disturb 85 acres (69 acres of this disturbance would be on public lands). Consequently, total disturbance under this alternative would affect 632 acres, of which 186 acres would be located on public lands.

The 8-South Partial Pit Backfill Alternative would result in the removal of approximately 5,762 acres of currently available rangeland in the North Buffalo Grazing Allotment. Impacts to the lessee from the projected loss in AUMs is described in Section 3.8.2.2 of Range Resources.

3.9.2.3 No Action Alternative

Under the No Action Alternative, additional disturbance to lands within the project area would not occur. Access to undeveloped portions of the project area would be preserved, and the existing land uses would be maintained, including grazing on the North Buffalo Allotment.

3.9.3 Cumulative Impacts

No cumulative impacts to land use and access were identified as a result of the Proposed Action. Consequently, the Proposed Action would not contribute to cumulative land use and access effects. Cumulative impacts to livestock grazing are discussed in Section 3.8.3, Cumulative Impacts for Range Resources, and cumulative impacts to recreational resources are described in Section 3.10.3, Cumulative Impacts for Recreation.

3.9.4 Potential Mitigation and Monitoring

No land use or access impacts would require monitoring or mitigation measures.

3.9.5 Residual Adverse Impacts

Residual impacts to land use relate primarily to the success of the reclamation efforts. If, upon project completion, the affected land area were reclaimed such that former land uses could be reinstated, residual adverse effects would be minimal. However, if reclamation were unsuccessful, residual land use effects could occur.

3.10 Recreation

3.10.1 Affected Environment

No developed recreational facilities exist within proximity to the project area. The nearest developed facility is the Mill Creek Recreation Area, which is maintained by the BLM and located 24 miles south of Battle Mountain. The Mill Creek Recreation Area contains picnic facilities, camp sites, and restrooms. Other recreational opportunities include fishing, hiking, mountain biking, and geological sightseeing.

Dispersed outdoor recreation is the predominant type of recreation in the Winnemucca District. The BLM does not maintain current recreational use data for the pubic lands in the study area. Recreational use within the proposed expanded permit boundary is limited and includes off-road vehicle use and hunting. Dispersed recreational activities that occur in the mine vicinity include hunting of small game and deer, and fishing within Trout Creek. However, use of Trout Creek by anglers is extremely limited. Data maintained by NDOW indicate that angler use declined dramatically in the early 1980s (from a high of 240 anglers in 1980) to no use by 1992. This trend was largely a result of a 7-year drought that ended by 1992. The fishery on that segment of Trout Creek used by anglers was depleted; the NDOW does not stock Trout Creek (French 1999). Thus, data for the years 1992 through 1998 indicate no angler use of Trout Creek. Data on angler use are not maintained by NDOW for the nearby Cottonwood Creek.

Limited hunting occurs in the project area. The only big game species in the vicinity is mule deer. Other game species such as chukar, California quail, and mourning dove occur throughout the area as well. Data are not available to characterize hunter use in the project area or vicinity. Hunting for big game is regulated through a quota system established by NDOW. The quota system is oversubscribed each year for deer tags because demand far exceeds suppiy.

No designated wilderness areas or wild and scenic rivers exist within 60 miles of the project area. The closest Wilderness Study Area (WSA) is the China Mountain WSA, located approximately 18 miles southwest of the project area.

3.10.2 Environmental Consequences

3.10.2.1 Proposed Action

No parks, concentrated recreational use areas, designated wilderness areas, WSAs, or special recreation management areas would be directly impacted by the proposed mine expansion. The proposed expansion would withdraw additional lands previously available for dispersed recreationists during construction, operation, and reclamation activities. Recreational activities, such as hunting, would be prohibited within the mine site during the life of the project. Off-highway vehicle use would continue to be restricted at the mine site. Overall, the displacement of dispersed recreationists would be a minimal adverse impact since existing recreational use in the project area is extremely light, and the area has other abundant public, open-space lands available for dispersed recreational opportunities. Public access would not be restricted on public roads near the mine site. Although no specific recreational use data for public lands directly affected by the proposed project are available, the number of dispersed recreationists affected is expected to be minimal, and their displacement would not create overuse of other areas or degradation of the resource.

Hunting opportunities would not be affected by the proposed expansion. Impacts to mule deer populations within the project vicinity are expected to be minimal with the proposed expansion, while impacts to the availability of upland game species from hunting in the region is expected to be minimal (Section 3.6, Wildlife and Fisheries Resources). Consequently, a minor reduction to hunting opportunities in the project vicinity is expected. Given the diversity of public lands available locally for hunting, this impact would not be considered adverse.

The proposed expansion would not affect public access to Trout Creek. Existing access routes would remain open, even though the expanded permit boundary would encompass the Buffalo Valley Road. As described in Section 3.9.2.1 of Land Use and Access, access along the Buffalo Valley Road would be modified from construction of mine-related facilities; however, GMMC would reroute the access road to provide continued public access prior to removing the existing road alignment.

Developed recreational facilities within the region, such as the Mill Creek Recreation Area, are not expected to be adversely impacted by the increase in the construction and operation work force required for mine expansion. This is because developed recreational facilities in the region have the capacity to absorb the extra demand that could be placed on them, as a result of the increased work force.

The closure, abandonment, and reclamation of the mine area would return public lands to their pre-mining land use as rangeland, wildlife habitat, and dispersed recreation. Except for the mine pits, all other facilities would be revegetated and made available for public access. Thus, the potential exists for hunting opportunities on the mine site following mine closure and reclamation.

3.10.2.2 8-South Partial Pit Backfill Alternative

This alternative would generate impacts to recreational resources identical to those described for the Proposed Action.

3.10.2.3 No Action Alternative

Under the No Action Alternative, disturbance associated with the proposed project would not occur, and existing dispersed recreational opportunities on public lands within the mine area (hunting and off-road vehicle use) would continue to be available.

3.10.3 Cumulative Impacts

Cumulative development has adversely impacted big game populations as a result of habitat displacement as well as additional road construction and the associated increased public access, which is considered beneficial to hunting opportunities. Cumulative impacts to game populations are described in Section 3.6.3 of Wildlife and Fisheries Resources. The overall cumulative impact to recreational resources from past, present, and reasonably foreseeable future actions would be considered minimal because abundant public open space lands currently do, and would, remain available for dispersed recreational opportunities.

3.10.4 Potential Mitigation and Monitoring

Since no adverse impacts to recreational resources have been identified for the Proposed Action or 8-South Partial Pit Backfill Alternative, no mitigation or monitoring is recommended.

3.10.5 Residual Adverse Impacts

No residual adverse impacts are expected to result from implementation of the Proposed Action or 8-South Partial Pit Backfill Alternative.

3.11 Aesthetics

3.11.1 Affected Environment

3.11.1.1 Visual Resources

The BLM initiated visual resource management (VRM) to manage the quality of the landscape by minimizing impacts to visual resources resulting from development activities, while maintaining the effectiveness of all BLM resource programs. In determining VRM class designations, the inventory process considers the scenic value of the landscape, viewer sensitivity to the scenery, and the distance of the viewer to the subject landscape. These management classes identify various permissible levels of landscape alteration, while protecting the overall visual quality of the region (BLM 1986). Management classes are broken down into four levels (Classes I to IV), with Class I designated as most protective of the visual resources. The objectives of these classes vary from very limited management activity to activity that allows major landscape modifications (Table 3-21). Short-term (3 to 5 years) exceptions are allowed if VRM objectives are met in the long term (10 to 20 years).

The portion of the project area located within 3 miles of I-80 is located within a VRM Class III visual management landscape (Table 3-21). The remainder of the project area lies within a VRM Class IV area. These designations were created prior to the onset of mining activities at the site in 1988, and reflect the fact that the area is visible to thousands of motorists on I-80 each day.

Landscape character type is a unit of physiographic area having common characteristics of land forms, rock formations, water forms, and vegetation patterns. The study area and existing Marigold Mine are located in the Great Basin region of the Basin and Range Physiographic Province. Basin and Range landscapes in northern Nevada typically are characterized by broad, open basins bounded by isolated mountain ranges covered by piñon-juniper vegetation. This type of landscape allows for long viewing distances. The project area is located on the piedmont slopes of Battle Mountain and slopes toward the Humboldt River to the east. Elevation within the project area ranges from approximately 4,600 feet to 5,800 feet (amsl).

Battle Mountain forms the backdrop for views of the mine site from I-80 and the California Emigrant National Historic Trail. The squat geometric shapes of the existing heap leach facility and active waste rock dumps contrast strongly with natural forms of the foothills, which tend to be more rolling to rugged. Vegetation in the area, which consists mainly of sagebrush/shadscale and grasses, provides relatively uniform coverage on the alluvial slopes near the mine area, while shrub coverage on the slopes of Battle Mountain is irregular and patchy.

At present, the most dominant man-made features within the study area include I-80, the Valmy rest stop, the Valmy Power Station, and waste rock dumps associated with the Lone Tree Mine, which are readily apparent from I-80 near the Stonehouse Interchange. The Marigold Mine is viewed at a distance of at least 2.5 miles by motorists on I-80 and is not apparent to the casual observer. Upon close inspection, the squat geometric forms of the existing 8-South Waste Rock Dump and the tailings dam provide only minor contrast to the juniper-studded foothills of Battle Mountain. These facilities essentially screen views of other mine elements. Regional haze or low-lying clouds often obscure views of Battle Mountain throughout the year.

The objectives of the visual resources investigation are to identify and describe important visual resources that could be affected by the proposed mine expansion and related facilities. Important visual resources are defined for this study from key observation points (KOPs) where the maintenance of the surrounding visual environment is important to people's enjoyment of an area. Visual resources include landscapes in which viewers may travel, use for recreation, or reside where existing views may

Table 3-21
BLM Visual Resource Management Classes

Class	Description
I	The objective of this class is to preserve the existing character of the landscape. This class provides for natural ecological changes; however, it does not preclude very limited management activity. The level of change to the characteristic landscape should be very low and must not attract attention.
II	The objective of this class is to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color and texture found in the predominant natural features of the characteristic landscape.
III	The objective of this class is to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.
IV	The objective of this class is to provide for management activities, which require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements.

Source: BLM 1986.

potentially be affected by the proposed expansion or ancillary facilities.

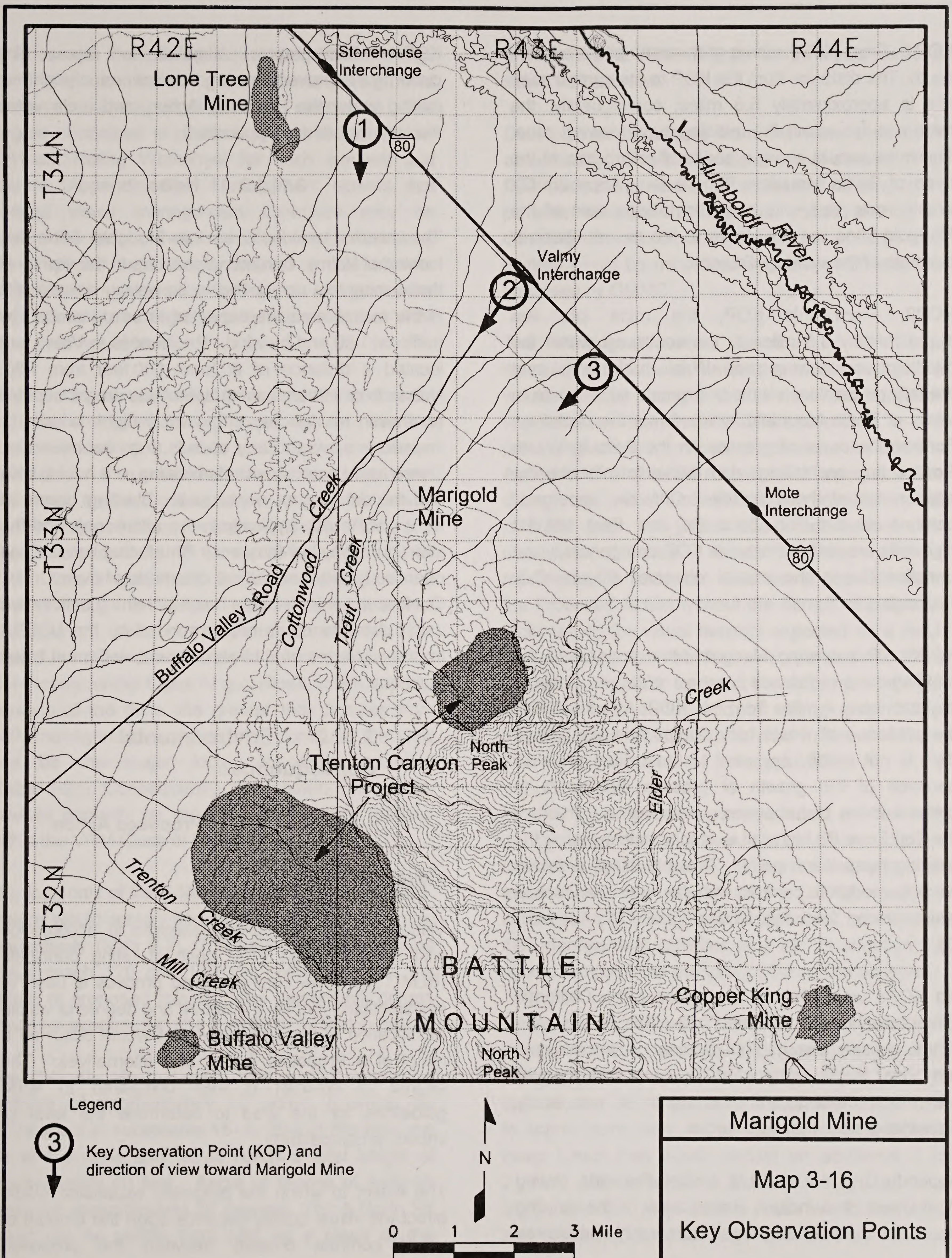
To assess the degree of visual contrast that would result from implementation of the proposed project, KOPs were selected from which changes to the characteristic landscape could be compared. KOPs are typically chosen along commonly traveled routes or at other likely observation points (BLM 1986).

The study area is visible over an approximate 10-mile corridor along I-80. Maximum visibility of the study area and the existing mine occurs at the Valmy Interchange and at the Valmy rest stop, located approximately 2.5 miles northeast of the existing mine. The study area also is visible from the Buffalo Valley Road and a portion of the California Emigrant National Historic Trail.

The California Emigrant National Historic Trail is described in Section 3.14, Cultural Resources, Ethnography, and Paleontology. The Trail generally parallels I-80 about 1 mile farther north, from the Edna Mountain foothills to Battle Mountain. There is considerable interest by groups such as the Oregon-California Trails Association, Trails West, Inc., and the Nevada Commission on Tourism concerning development affecting viewsheds along the California Emigrant National Historic Trail (Dodd 1997). Most of the California Emigrant National Historic Trail has been marked, mapped, and described in detail. The Trail section from the Edna Mountain foothills to Battle Mountain has four trail markers and published diary accounts for each location (Helfrich and Hunt 1984).

For the purposes of this analysis, the following KOPs have been identified for this EIS. The location of the viewpoints and the direction of the view toward the study area are listed below and shown in Map 3-16.

1. Mile marker 213 on I-80 located approximately 1 mile southeast of the Stonehouse Interchange;
2. Mile marker 216 on I-80, the Valmy rest stop; and
3. Mile marker 218.4 on I-80.



Map 3-16

Key Observation Points

KOP1. From KOP1, views of the mine site are to the south. The distance from the KOP to the current mine site is approximately 5.5 miles; consequently, the mine site lies within the middleground viewing zone. The mine occurs along a series of rolling hills at the base of Battle Mountain (Figure C-1, Appendix C). Waste rock piles, pits, and the tailings dam of the Marigold Mine are not visible to the casual observer because of the viewing distance.

KOP2. From this KOP, the mine site lies approximately 3.5 miles to the southwest within the middleground viewing zone. Waste rock dumps and the tailings dam are visible but remain subordinate to views of Battle Mountain, which forms the backdrop. Further, the cover of grasses on the 8-South Waste Rock Dump and tailings dam serve to minimize the appearance of these facilities. Only the uppermost portions of the Top Zone Pit and East Hill Pit highwalls are visible from this KOP and generally are unnoticeable to the casual observer (Figure C-3, Appendix C).

KOP3. The existing Marigold Mine appears in the middleground distance zone and is located approximately 4 miles from this KOP. As with KOP2, the presence of waste rock dumps and the tailings dam is not readily apparent to the casual observer because of the growth of grasses that serve to conceal these disturbances. However, a portion of the Top Zone Pit highwall is readily visible as are the existing heap leach pads. These facilities create a weak to moderate contrast with the natural landscape when viewed from this KOP (Figure C-5, Appendix C).

No KOPs were chosen to represent the California Emigrant National Historic Trail. This is because KOPs chosen along I-80 represent viewpoints that are closer to the Marigold Mine; views from the trail are more distant, and the mine is not easily discernable from these distances.

Appendix C contains BLM Visual Contrast Rating Worksheets that include descriptions of the existing visual environment as viewed from each of the three KOPs. Photographic simulations representing currently approved mining operations, height of mining under the Proposed Action, and reclamation also are included in Appendix C.

3.11.1.2 Noise

The nearest residents to the Marigold Mine are located at Valmy. Current noise levels in the vicinity of these receptors are unknown; however, noise levels in the overall area are expected to be dominated by traffic on I-80 and by wind. Residences in Valmy are located a distance of at least 500 feet from I-80. Noises from current mining operations are perceptible at these residences only when light winds or inversions serve to carry sounds from the mine site. These noise sources include blasting, ore haul trucks, and the dumping of waste rock. Blasting occurs at least once a day (typically in the afternoon), and the short-duration, low-frequency “thud” that results can often be heard (and felt) at distances of over 1 mile. Outdoor noise levels as a result of mining activity are well below standards recommended by the USEPA for the protection of public health and welfare at these receptors.

3.11.2 Environmental Consequences

3.11.2.1 Proposed Action

Visual Resources

Visual impacts have been assessed in accordance with standard BLM VRM contrast rating principles (BLM 1986). The contrast rating process is used to systematically identify the nature and degree of visible modification to the landscape that would occur as a result of a Proposed Action and alternatives. The degree of contrast is then compared to VRM guidelines for the area to determine the level of impact or compatibility.

The extent to which the proposed expansion would affect the visual quality depends upon the amount of visual contrast created between the proposed facilities and the existing landscape elements (e.g., form, line, color, and texture) and features (e.g., land and water surface, vegetation, and structures). The degree of contrast is rated on a standardized Visual Contrast Rating Worksheet for each element and feature (Appendix C). Management actions that exceed visual management objectives may be required to reduce their overall contrast. Assessing the proposed expansion's contrast in this manner indicates the level of potential impacts and guides the development of mitigation measures so the VRM objectives would be met.

Major mining elements that have potential to contrast with the characteristic landscape include new and expanded open pits, waste rock dumps, and heap leach pads. The waste rock dumps and heap leach pad would be the most visually prominent features of the Proposed Action; the expanded Red Rock and Top Zone pits would not be visible from I-80. Under VRM Class III guidelines, the level of change to the characteristic landscape can be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Conversely, under Class IV guidelines, which apply to portions of the mine site greater than 3 miles from I-80, management activities may dominate the view and be the major focus of viewer attention (Table 3-21). Consequently, the following discussion focuses primarily on proposed new mining facilities within the VRM Class III designation.

The footprints of the 5-North and 8-North Waste Rock Dumps would occupy approximately 55 and 85 acres, respectively (Map 2-2). The height of these dumps would reach 120 and 150 feet, respectively, at the height of proposed mining. The waste rock dumps would be expanded in lifts from 50 to 60 feet in height.

The 5-North Heap Leach Pad would require a footprint of approximately 30 acres. It would be constructed in successive 15- to 20-foot lifts over the life of the mine and would reach a total height of approximately 40 feet. Angle of repose of each lift would be approximately 38 degrees. The 5-North Pit would not be visible from I-80 as a result of the 5-North Waste Rock Dump, which would serve to screen it from view.

Dust plumes originating from the mine area could occasionally be visible for distances of several miles. Dust could be generated as a result of blasting in the pit area, vehicular traffic on haul roads, and by the dumping of waste rock. The creation of large dust plumes would be minimized by wetting dirt roads as proposed by GMMC.

The following discussion describes in more detail those components of the proposed expansion that would result in changes to the visual landscape as viewed from the three KOPs described in the preceding section. Visual simulations included in Appendix C of this EIS depict the Proposed Action during the period of maximum potential visual contrast and 10 years after reclamation. The maximum potential visual contrast scenario represents the maximum disturbance possible under the Proposed Action without the benefit of proposed reclamation; the visual benefits expected as a result of reclamation have not been incorporated into these simulations in order to depict the maximum potential visual contrast at the end of mining (year 2006). Visual Contrast Rating Worksheets for each of these KOPs also are presented in Appendix C.

Overall, the proposed expansion would contrast with the existing forms, lines, and colors of the characteristic landscape. However, the proposed expansion at the end of mining (2006) would be consistent with VRM Class III objectives, which state that management activities may attract attention but should not dominate the view of the casual observer.

During mining closure activities, the waste rock dumps would be graded to eliminate the benches between lifts, reduce the side slopes to an approximate 3H:1V grade, and round-off waste rock to approximate more natural contours. The 5-North Heap Leach Pad would remain an additional 1 to 2 years, after which time it would be graded in a similar fashion. Mine access roads would be ripped and reseeded, and buildings and ancillary facilities would be removed and their foundations ripped and reseeded.

Reclamation activities proposed by GMMC are described in Section 2.2.19, Reclamation, and include slope grading and stabilization, the application of growth media, and the seeding of disturbed areas. Figures C-2, C-4, and C-6 in Appendix C depict anticipated conditions 10 years after reclamation begins under the proposed expansion. The grading of waste rock and heap leach slopes from angle of repose to approximately 3H:1V would create undulating slopes that would more closely approximate the appearance of natural slopes in the area. These efforts would reduce any moderate contrasts in land forms and lines associated with the proposed expansion to weak contrasts, that would not tend to attract the attention of the casual observer.

Revegetation practices at the Marigold Mine to date in such areas as the 8-South Waste Rock Dump have been extremely successful and have resulted in densities of grasses, forbs, and shrubs similar to those of adjacent undisturbed areas. Assuming the revegetation program for the proposed expansion meets with similar success, visual contrasts associated with all current and proposed mine disturbance would be greatly reduced over time. Within a few years, grasses, forbs, and shrubs on the waste rock dumps and leach pads would allow these areas to blend with the color and texture of the existing natural landscape, thereby eliminating any remaining contrasts associated with the proposed expansion. Therefore, visual contrasts associated with the proposed expansion would be reduced over time and would repeat the basic elements of form, line, color and texture found in the characteristic landscape. The reclaimed mine area would not attract the attention of the casual observer when viewed from any of the three KOPs used in this analysis. Consequently, the proposed expansion would conform to VRM Class III guidelines after the reclamation period.

Noise

Although the proposed expansion would perpetuate the types of noises that currently are generated by mining activity at the mine, it also would extend the overall life of the mine, during which time sensitive receptors would continue to experience mine-related noises throughout the day and night. Specifically, the proposed project would extend the life of current mining operations an additional 5 years, through the year 2006. Sound levels from mining activities during this period are expected to be similar to those that occur now; blasting would continue within the open pit during daylight hours and construction equipment (i.e., drills, bulldozers, loaders, and haul trucks) would operate 24 hours per day. Because mine expansion is not expected to significantly intensify sound levels, as compared to current mining operations, noise impacts to residents in Valmy would not be significant.

Blasting during the life of the proposed expansion would occur during daylight hours only, and noise experienced at any one site would be of very short duration (approximately 0.5 second). Blasting would occur below ground level and noise from blasting would largely be attenuated by the surrounding terrain. No changes in the size of charges used or method of detonation from the existing (on-going) blasting program are anticipated. Under the proposed expansion, blasting noise would continue an additional 5 years and could startle residents of Valmy even though such noise currently occurs, and would continue to occur, at regular intervals on a daily basis. The proposed expansion would represent only an increase in the duration over which currently ongoing noises would occur.

The proposed expansion is not expected to result in a long-term increase in traffic over current mining-related levels. Consequently, the proposed project would not contribute to an increase in noise along local roadways during the extended life of mining operations.

Noise levels associated with mine closure activities would not be expected to differ significantly from those described for mining operations, since the primary noise sources would be from the use of bulldozers and other heavy equipment; however, these noise-generating activities would only occur during daylight hours. Blasting would cease with mine closure.

Noise levels associated with mine reclamation activities would not be expected to differ significantly from those described for mining operations. As with mine closure, the primary noise sources from reclamation activities would be from the use of bulldozers and other heavy equipment. These noises would diminish over the reclamation period as site activities and related traffic diminish. After the reclamation period, noise in the vicinity of the mine site would return to pre-mining levels.

3.11.2.2 8-South Partial Pit Backfill Alternative

Implementation of the 8-South Partial Pit Backfill Alternative would result in visual contrasts that would be similar to those described for the Proposed Action. Construction of the 8-North Waste Rock Dump would not be necessary; all other mining facilities would appear as shown for the Proposed Action in Figures C-1, C-2, C-3, C-4, C-5, and C-6 in Appendix C. Therefore, some mine elements would result in moderate contrasts at the height of mining (e.g., 5-North Waste Rock Dump and Heap Leach Pad) and VRM objectives would be maintained, primarily as a result of the long viewing distance from each KOP.

Reclamation practices associated with this alternative would be identical to those described for the Proposed Action (Section 2.2.19, Reclamation). As with the Proposed Action, reclamation would all but eliminate any remaining visual contrasts associated with the mine expansion, and VRM objectives would be maintained.

Noise impacts associated with mine operations, closure, and reclamation under this alternative are not expected to differ from those described for the Proposed Action.

3.11.2.3 No Action Alternative

Under the No Action Alternative, currently permitted mining operations would continue through 2001, after which time the Marigold Mine would cease operations. The additional disturbance associated with the Proposed Action (expansion of the open pits, waste rock dumps, and the construction of a new heap leach pad and other mining-related facilities) would not occur within the project area. The visual environment at the end of current mining operations from each of the three KOPs would be similar to that depicted in Figures C-1, C-3, and C-5 in Appendix C. GMMC would be required to reclaim surface disturbances associated with its permitted operations.

Noise from current mining operations would continue under the No Action Alternative until 2001. Noise levels in the mine area would return to pre-mining levels after closure and reclamation activities were complete.

3.11.3 Cumulative Impacts

Cumulative effects to esthetic resources were considered for all past, present, and reasonably foreseeable future developments listed in Section 2.6, Interrelated Projects, that have the potential to be visible from either of the three KOPs identified in Section 3.11. These developments include the existing Lone Tree Mine and the recently approved Trenton Canyon Mine (Map 3-16).

The Lone Tree Mine is located approximately 5 miles north of the Marigold Mine in the vicinity of Lone Tree Hill. Several mine-related facilities (e.g. waste rock dumps, heap leach pads) are located within one mile of I-80 and tend to attract the attention of motorists. A waste rock dump associated with the Lone Tree Mine lies within the field-of-view of KOP 1 and dominates the view of motorists on I-80 near this location. This waste rock dump serves to completely block views of the Marigold Mine at locations further west on I-80, such as the Stonehouse interchange. The location of KOP 1 was chosen in order to represent the point at which facilities associated with the Lone Tree Mine no longer dominated views south to the Marigold Mine. Consequently the Lone Tree Mine does not appear in the photographs of existing conditions taken at KOP 1 (Figure C-1, Appendix C).

The Trenton Canyon Mine would be located along the northern and northwestern flanks of Battle Mountain, several miles south of the Marigold Mine (Map 3-16). The cumulative visual impact of the Trenton Canyon Mine, as viewed from KOPs 1, 2, and 3, is depicted for height of mining at the Marigold Mine in Figures C-1, C-3, and C-5 in Appendix C. As demonstrated by these simulations, disturbance associated with the Trenton Canyon Mine would be visible and could serve to attract the attention of motorists on I-80. The relative level of visual contrast created by the Trenton Canyon Mine would be stronger than that created by the expanded Marigold Mine; however, the Trenton Canyon Mine would be located entirely within a VRM Class IV area where the allowable levels of change to the characteristic landscape can be high (Table 3-21).

3.11.4 Potential Mitigation and Monitoring

No mitigation or monitoring needs were identified.

3.11.5 Residual Adverse Impacts

No residual adverse impacts were identified.

3.12 Social and Economic Values

3.12.1 Affected Environment

This section describes the social and economic conditions in the project area. The study area is determined by the areas where socioeconomic impacts potentially occur. The Marigold Mine is located in southern Humboldt County. Approximately 50 percent of current mine employees reside in or near Battle Mountain, in Lander County. Forty-eight percent of employees reside in or near Winnemucca (Humboldt County), and 2 percent reside in Elko (Elko County) (JBR 1999).

As determined by the employee residence pattern and the mine location, the analysis area for social and economic issues encompasses primarily Humboldt and Lander counties and the communities of Winnemucca and Battle Mountain. Issues discussed in this section include population; economy, employment, and income; housing and community services; and government and public finance. The following description of the affected environment was developed through review of existing literature and statistical data, and through direct contact with area representatives, and local, state, and Federal agencies.

3.12.1.1 Population And Demography

Humboldt and Lander counties are sparsely populated, rural counties. This area of Nevada has demonstrated a strong growth trend over the past two decades, largely in response to the growth in the mining industry. Table 3-22 shows population statistics for the study area from 1990 to 1998. Humboldt County population increased 22.3 percent during this period, or an average of 2.8 percent per year, to a 1998 population of 15,920 (Bureau of Business and Economic Research 1997; JBR 1999). Lander County population increased 11 percent during the period, or an average of 1.4 percent per year, to a 1998 population of 7,040. According to 1990 census data, 9.6 percent of Lander County's population was made up of minorities (non-whites). Humboldt County had 17.4 percent minorities, a relatively high number for Nevada due to the large number of Hispanics employed in agricultural labor. Age distribution in Humboldt County is similar to the pattern in the rest of the state and nation. The Lander County population is generally younger than the rest of the state and nation (Tri-County Development Authority 1996a, 1997).

Approximately 48 percent of Humboldt County's population resides in the town of Winnemucca, which had a 1998 population of 7,482 (Bureau of Business and Economic Research 1997). Winnemucca's population increased 21.1 percent from 1990 to 1998, or an average of 2.6 percent per year. The small community of Golconda, located 16 miles from Winnemucca, has an estimated population of 400 to 500. Approximately 64 percent of Lander County's population resides in the town of Battle Mountain, which had a 1998 population of 5,360. Battle Mountain's population increased 1.6 percent from 1990 to 1998, or an average of 0.2 percent per year.

Continued growth is anticipated for Humboldt and Lander counties through 2008, although growth rates are not expected to be as high as in the 1990 to 1998 period. Humboldt County's population is anticipated to increase 34.8 percent in the 10-year period from 1998 to 2008, or approximately 3.5 percent per year, to reach a 2008 population of 21,460. Lander County's population is anticipated to increase 16.5 percent in the 10-year period, or approximately 1.7 percent per year, to reach a 2008 population of 8,200 (Nevada Department of Administration 1999). However, these population forecasts may change as a result of fluctuations in gold prices and possible changes in employment at area mines.

Table 3-22
Study Area Population

	1990	1991	1992	1993	1994	1995	1996	1997	1998	Percent Change 1990-98	Average Annual Growth Rate 1990-98
Humboldt County	13,020	13,500	14,000	14,510	15,640	16,270	16,460	16,900	15,920	22.3	2.8
Winnemucca Division	6,180	6,560	6,640	6,910	7,170	7,380	7,890	8,140	7,482	21.1	2.6
Lander County	6,340	6,370	6,380	6,430	6,410	6,440	6,710	7,030	7,040	11.0	1.4
Battle Mountain Division	5,276	5,300	5,308	5,350	5,341	5,341	4,932	5,170	5,360	1.6	0.2

Source: Bureau of Business and Economic Research 1997; U.S. Department of Commerce 1991.

3.12.1.2 Economy, Employment, and Income

Overview of the Economy

The economies of Humboldt and Lander counties have historically depended on agriculture and mining. Winnemucca, in Humboldt County, developed around a trading post located at an important fording site on the Humboldt River for westward-bound pioneers on the California Emigrant Trail. In 1869, the Central Pacific Railroad further bolstered the area's economic growth. Winnemucca continued to be a major trade center for the area, and extended its role as a rest stop for travelers with the construction of I-80.

Mining, with its boom and bust history, has played a major role in the economy of the area since the first rushes for gold and silver occurred. In the early 1900s, the silver rush resulted in a significant influx of prospectors and related population growth. The most recent boom, associated with the development of Carlin-type gold deposits, peaked in the late 1980s, but continues today. The economies of Humboldt and Lander counties continue to be based primarily on the mining industry, and to a lesser extent on agriculture and tourism. A study conducted by the Economic Development Administration's University Center for Economic Development at the University of Nevada, Reno reported that over 56 percent of total economic activity in Humboldt County is created by the gold mining sector. Thus, while direct employment by the mining industry accounted for less than one-third of the labor force in Humboldt County, the industry provided over one-half of the economic activity and three-quarters of the income in the county (Tingley et al. 1993; Tri-County Development Authority 1996a).

This economic dependence on the mining industry makes the regional economy very vulnerable to external conditions, such as fluctuations in world metals demand and prices. This potential risk has been noted by local development authorities. Overall Economic Development Plans have been developed for both Humboldt and Lander counties to provide direction and support in developing other industries and economic activities in order to diversify the economy. Target industries for development include gaming/tourism, recreation, agriculture, geothermal resources, and industrial development (Tri-County Development Authority 1996a, 1997).

Agriculture continues to contribute to the base of economic activity in both Humboldt and Lander counties. In 1997, there were 76 farms and ranches in Lander County, encompassing 486,017 acres, and 218 farms and ranches in Humboldt County, encompassing 733,418 acres. Humboldt County is one of the leading agricultural counties in Nevada. The livestock industry plays an important role in both counties, with 21,000 head of cattle in Lander County and 63,000 in Humboldt County in 1998 (Nevada Department of Administration 1999).

Tourism has become increasingly important in the economy with the growth in the gaming industry, as is reflected in the recent increases in the services and trade sectors. These activities center around the urban areas of Winnemucca and Battle Mountain. The services and trade sectors, in general, require much lower skill levels for operation and, therefore, average wages are much lower in these sectors than in the mining sector. These sectors do contribute to regional economic diversity.

Employment and Income

Lander County and Humboldt County labor force, employment, and wage statistics are shown in Tables 3-23 and 3-24. Between 1993 and 1998, the Lander County labor force remained fairly constant, measuring 2,930 in 1998 (Research and Analysis Bureau 1991-1995; Employment Security Division 1999). The unemployment rate fluctuated, averaging around 9.5 percent. The Humboldt County labor force increased 11.3 percent in the 5-year

Table 3-23
Lander County
Labor Force Summary

	1993	1994	1995	1996	1997	1998	Percent of Employment 1998	Percent of Payroll 1997	Average Annual Pay 1997
Total Labor Force[1]	2,980	2,890	2,900	3,060	3,060	2,930	---	---	---
Unemployment	340	300	260	260	210	300	---	---	---
Unemployment Rate	11.4%	10.4%	9.1%	8.6%	6.9%	10.3%	---	---	---
Employment by Sector:[2]									
Mining	1,030	980	1,080	1,210	1,290	1,110	44.6	67.1	50,508
Construction	50	120	90	100	30	30	1.2	0.7	20,268
Manufacturing	40	40	40	40	40	40	1.6	2.2	49,036
Transportation, Communication, & Utilities	120	120	90	90	90	80	3.2	2.6	31,181
Wholesale and Retail Trade	320	410	430	470	460	400	16.1	6.7	14,299
Finance, Insurance, & Real Estate	30	30	30	30	30	40	1.6	0.6	16,221
Service Industries	290	230	220	240	230	190	7.6	3.9	15,258
Government	500	520	540	560	560	690	27.7	16.3	30,314
TOTAL, All Industries	2,380	2,440	2,510	2,740	2,740	2,490	100.0	100.0	35,883

[1]Reflects employment by place of residence.

[2]Reflects non-agricultural employment by place of employment.

Note: Numbers may not add to total due to rounding.

Source: Research and Analysis Bureau 1991-1995; Employment Security Division 1999.

Table 3-24
Humboldt County
Labor Force Summary

	1993	1994	1995	1996	1997	1998	Percent of Employment 1998	Percent of Payroll 1997	Average Annual Pay 1997
Total Labor Force[1]	7,880	7,870	8,030	8,390	8,770	8,570	---	---	---
Unemployment	480	460	350	340	350	560	---	---	---
Unemployment Rate	6.1%	5.8%	4.3%	4.1%	4.0%	6.5%	---	---	---
Employment by Sector:[2]									
Mining	2,090	2,075	2,305	2,490	2,450	2,010	25.9	45.4	48,518
Construction	370	369	414	570	550	390	5.0	6.4	30,493
Manufacturing	100	102	134	190	200	180	2.3	2.2	29,942
Transportation, Communication, & Utilities	300	305	335	370	400	410	5.3	6.1	40,983
Wholesale and Retail Trade	1,170	1,271	1,394	1,460	1,580	1,730	22.3	11.4	19,024
Finance, Insurance, & Real Estate	100	107	102	110	110	110	1.4	1.0	23,947
Service Industries	1,520	1,860	1,955	1,630	1,710	1,530	19.7	13.1	16,782
Government	1,230	1,163	1,130	1,300	1,370	1,410	18.2	14.3	30,378
TOTAL, All Industries	6,890	7,253	7,770	8,100	8,360	7,760	100.0	100.0	30,620

[1]Reflects employment by place of residence.

[2]Reflects non-agricultural employment by place of employment.

Note: Numbers may not add to total due to rounding.

Source: Research and Analysis Bureau 1991-1995; Employment Security Division 1999.

period from 1993 to 1997, and then declined 2.3 percent to a 1998 figure of 8,570. The unemployment rate fluctuated, averaging around 5.1 percent. The unemployment rates in both Lander and Humboldt Counties have been fairly high recently, measuring 10.3 percent and 6.5 percent, respectively, in 1998.

Non-agricultural employment by sector information is displayed in Tables 3-23 and 3-24. The most important non-agricultural employment sectors in Lander County are mining (44.6 percent of 1998 employment), government (27.7 percent), trade (16.0 percent), and services (7.6 percent) (Employment Security Division 1999). In the 6 years from 1993 to 1998, growth occurred primarily in the government sector. Mining employment increased slightly. In 1997, there were four major mining operations in Lander County, and mining provided approximately 45 percent of total county non-agricultural employment (Tri-County Development Authority 1999).

Humboldt County's distribution of non-agricultural employment by sector is similar to Lander County's, with slightly smaller portions attributable to mining (25.9 percent), and more to government (18.2 percent), trade (22.3 percent), and services (19.7 percent), reflecting the commercial activity in Winnemucca. Mining employment in Humboldt County provides approximately 29 percent of total county non-agricultural employment (Tri-County Development Authority 1999). Employment in most sectors increased from 1993 to 1997, and declined from 1997 to 1998 (Research and Analysis Bureau 1991-1995; Employment Security Division 1999). Current employment at the Marigold Mine totals 83 employees.

Average wages in the mining sector are the highest of any employment sector (Tables 3-23 and 3-24). The 1997 average annual pay in Lander County over all industries was $35,883, while the average pay in the mining sector was $50,508. Average annual pay in the manufacturing sector was $49,036, making it the second highest paid non-agricultural employment sector. Mining provided 67.1 percent of the total direct payroll earned in Lander County in 1997. Manufacturing provided only 2.2 percent (government was second highest, with 16.3 percent). Figures for Humboldt County were similar. Mining provided 45.4 percent of the total direct payroll earned in 1997, government 14.3 percent, and services 13.1 percent. Average annual pay over all industries is slightly lower in Humboldt County (at $30,620) than in Lander County (Employment Security Division 1999).

<u>**Indirect Contributions of Mining**</u>

As stated before, the total economic contribution provided by mining is greater than simply direct employment or wages. Mining industry employment supports secondary employment in other industries, particularly services, through the spending of workers' wages in the local economy, and also through the purchase of goods and services by mining firms. Secondary employment is calculated for the mining industry using a multiplier of 1.24 for rural settings in Nevada (Dobra 1988, 1989). For every direct job in the mining industry, 0.74 indirect jobs are created in the local economy, and 0.5 jobs are created in the large urban economies of the state, which serve as supply centers. This multiplier was determined by John Dobra, an economist at the University of Nevada, Reno, in 1988, and it has been used in numerous socioeconomic analyses for mines in Nevada. Using this multiplier, secondary employment in local communities supported by Marigold Mine direct employment is estimated to be 61. Most of these jobs occur in the services and trade sectors.

Mining, as an export industry, is an important income-generator for the state and has the largest earnings multipliers of any industry. The majority of the revenue from the sale of the product is spent within the state on wages, taxes, purchases of goods and services, and other production expenses. The total earnings generated through mining activity, as income cycles through the economy, can be estimated using a multiplier of 1.57 (Dobra 1989). This number applies to the amount spent directly on payroll (i.e., for every payroll dollar in the mining industry, an additional $1.57 in earnings is generated for other Nevadans in the form of wages and salaries, rents, interest, and business incomes). Using this multiplier, the $4.5 million in payroll (1998) at Marigold Mine is estimated to generate approximately $7.1 million in additional earnings throughout the state.

3.12.1.3 Housing and Community Services

Housing and community services are analyzed to the extent that they would be impacted by population changes generated by the proposed project. Based on the current employee residence distribution, the primary communities affected are Winnemucca and Battle Mountain. Residence of employees in other communities is negligible. This section describes the housing and basic public services available in these communities.

Housing

The 1990 U.S. Census reported that there were 5,044 total housing units in Humboldt County, with 506 of these units vacant (U.S. Department of Commerce 1991). The housing stock consisted of 2,421 single-family units, 502 attached and apartment units, and 2,121 mobile homes. Of the Humboldt County housing stock, 2,442 housing units were located in Winnemucca (1,413 single-family units, 442 attached and apartment units, and 587 mobile homes). The 1996 Overall Economic Development Plan Update for Humboldt County reports that between 1991 and 1995, 180 housing units were constructed in Winnemucca (Tri-County Development Authority 1996a). During the same period, 824 housing units were built in unincorporated Humboldt County, of which 42 were single-family units and 782 were mobile homes.

Demand for housing in Humboldt County has been very high for the past 10 years. In 1995, prices for homes in the Winnemucca area ranged from $37,500 to $199,000, with an average price of $110,000. Manufactured housing prices ranged from $25,000 to $132,000. Residential lots in the city ranged from $25,000 to $32,000 depending upon size and location. According to area realtors, there are 100 to 150 homes for sale in an average month, and listings are on the market from 60 to 120 days, depending on quality and price (JBR 1999).

The 1990 U.S. Census reported that there were 2,586 total housing units in Lander County, with 374 units vacant (U.S. Department of Commerce 1991). The housing stock consisted of 867 single-family units, 118 attached and apartment units, and 1,602 mobile homes. Housing in Lander County is primarily owner-occupied, and the majority of rental properties are mobile homes. In 1995, prices for homes in the Battle Mountain area averaged $55,000 to $65,000 (Tri-County Development Authority 1996b). On average, about 40 properties are for sale in a given week, and properties are on the market an average of 4 to 6 months (JBR 1999).

According to the 1990 Census, there were approximately 1,484 rental units in Humboldt County, with 871 rental units in Winnemucca (U.S. Department of Commerce 1991). In Lander County, there were 629 rental units, with 449 rental units in Battle Mountain. According to area realtors and property management personnel in 1996, the rental markets in the region are very limited (BLM 1996a). However, the housing market has loosened as the mining industry has reduced employment and population has slowed or even stabilized (JBR 1999). According to local realtors, the average monthly rent in the Winnemucca region for homes, apartments, or mobile homes in 1995 were $400 to $450 for 1-bedroom units, $450 to $500 for 2-bedroom units, and $500 and up for 3-bedroom units. According to a 1996 community profile of Lander County, the average rent for a 2-bedroom multi-family unit in Battle Mountain was $400 to $500 (Tri-County Development Authority 1996b).

Temporary housing in Humboldt County is concentrated in Winnemucca. There are an estimated 1,600 hotel/motel rooms in Winnemucca (Tri-County Development Authority 1996b). At least a third of these rooms are available for rental by the week (JBR 1995). Temporary housing in Lander County is concentrated in Battle Mountain. There are 8 hotels/motels in Battle Mountain, with approximately 386 rooms (Tri-County Development Authority 1997). Parking and hook-up services for recreational vehicles also are available in the project area. The busiest tourist season begins in June and ends in September. Weekend vacancy rates for temporary housing accommodations in Winnemucca during this period are frequently near zero (BLM 1996a).

Water Supply

It is estimated that 50 percent of Humboldt County households are served by either a public or private water company. The Winnemucca area is served by the city's water system. Two other water districts exist in the county. The remainder of the county utilizes water from individually drilled wells, developed springs, or localized non-community systems. The Winnemucca water system serves approximately 3,000 customers. The average demand is 3.0 million gallons per day (mgd), with a peak demand of 6.5 mgd during the summer months. Water is supplied by a system of four deep wells and one developed spring. Total storage capacity is 7.85 million gallons in several storage tanks. Current annual use on the system is approximately 2,500 acre-feet per year. A new 2,400-gallon per minute well went online in 1999 (JBR 1999). A recent study concluded that an ultimate build-out (full development) of the Winnemucca service territory would require approximately 11,205 acre-feet per year. It is estimated that the system is capable or nearly capable of providing this amount of water (Tri-County Development Authority 1996a).

Battle Mountain Water and Sewer provides water to approximately 4,000 people in the Battle Mountain area. The remainder of Lander County utilizes individually drilled wells or developed springs. The annual average demand in the Battle Mountain area is 1.0 mgd, and approximately 2.0 mgd in summer. Water is supplied by three wells that are currently operating at about half capacity. A fourth well is scheduled to be operational by 2000 (JBR 1999).

Wastewater Treatment

Approximately 66 percent of all Humboldt County households are connected to a wastewater treatment facility. Winnemucca has a wastewater treatment facility; two other small treatment facilities exist in the county. The remainder of the county utilizes individual septic systems. The Winnemucca facility has a 2.5 mgd capacity, and serves approximately 2,800 customers. The average flow in the system is 1.2 mgd. The collection system presently consists of three large and two small lift stations. Excess capacity exists in the system to serve additional customers; however, any development outside of the present service area would require construction of additional lines (Tri-County Development Authority 1996a; JBR 1999).

Battle Mountain Water and Sewer handles 430,000 gallons per day in sewage. All rural areas in Lander County utilize individual septic systems. The system has the capacity to handle approximately 1.2 mgd; service is presently operating at approximately 36 percent of capacity. Expansion plans under consideration include a SBR activator sludge plant and an additional pond, to handle increased population (Tri-County Development Authority 1996a, 1997; JBR 1999).

Solid Waste Disposal

In 1995, there were 10 rural landfills in Humboldt County. Most of these were scheduled to be closed by the end of 1997 due to recent changes in Federal and state regulations. A private operator currently directs the Winnemucca Area Solid Waste Management District, under contract with the City of Winnemucca and Humboldt County. The regional landfill is located 5 miles north of Winnemucca. The landfill is being permitted as a non-hazardous municipal solid waste landfill. The current site encompasses 240 acres and has a life expectancy of 40 years. Collection service in the Winnemucca area is provided by two private operators (Tri-County Development Authority 1996a; JBR 1999).

Solid waste disposal in the Battle Mountain area is provided at a Class III disposal site which has the capacity to process up to 20 tons of waste per day. Actual figures of present utilization at the facility are unavailable because process scales are not fully operational. At current disposal volumes, the facility is expected to be able to handle the area's waste disposal needs for the next 13 years (JBR 1999).

Schools

Winnemucca has 3 elementary schools, 1 middle school, 1 junior high school, and 1 high school, with a total capacity in 1995 of 3,965 students. Total enrollment for the 1998-1999 school year was 3,879. Enrollment increased an average of 5.2 percent from 1991 to 1998. However, in the past year, enrollment increased only 0.1 percent. The ratio of students to teachers has been 16 to 1 since 1994. Several of the schools are nearing capacity, and modular classrooms are utilized to accommodate additional students, where necessary. The high school, in particular, is very close to capacity. The Humboldt County School District recently completed construction of a new physical education facility at the high school, as part of a 4-year expansion, which will eventually include administrative offices, a media center, cafeteria, and 10 classrooms. This expansion will increase the capacity of the high school from 1,000 to 1,200 students (BLM 1996a; JBR Environmental Consultants, Inc. 1999).

The Lander County School District has 3 elementary, 1 junior high, and 1 high school, all located in Battle Mountain, with an additional elementary school and high school located in Austin. The total district enrollment in Battle Mountain schools in the fall of 1998 was 1,625 students. The ratio of students to teachers in 1998 was 17 to 1. Enrollment has fluctuated since 1986, with a general increase from 1986 to 1997, and decreases in the last 2 years. With the addition of a new elementary school in 1998, the district has increased capacity to accommodate additional students at the elementary school level (JBR 1999).

Law Enforcement and Fire Protection

Law enforcement in Humboldt County is provided by the Humboldt County Sheriff's Department, the Winnemucca Police Department, and the Nevada Highway Patrol. The Humboldt County Sheriff's Department provides police protection throughout Humboldt County. The sheriff's staff includes 20 deputies, 4 reservists, and 11 detention officers. In addition to law enforcement, the sheriff's department oversees the Humboldt County Detention Center, which has a current capacity of 61 inmates. The Winnemucca Police Department serves the City of Winnemucca, and additional areas, in cooperation with the Sheriff's Department, as necessary. The Winnemucca Police Department has a staff of 15 officers and 2 reservists. Currently the Department is in need of at least one additional officer to provide adequate urban protection. Law enforcement in Lander County is provided by the Lander County Sheriff's Department, based in Battle Mountain, with a staff of 17 officers. Lander County is building a new jail, which is scheduled to be completed in 1999. The new facility will have a capacity of 50, in comparison to a capacity of 7 in the present jail. The Nevada Highway Patrol maintains a substation in Battle Mountain with 5 officers (BLM 1996a; Tri-County Development Authority 1996b; JBR 1995 and 1999).

Fire protection in the region is provided by local, state, and Federal agencies. The Winnemucca City Fire Department, with 24 volunteers (2 of whom are Emergency Medical Technicians), handles all fires within Winnemucca city limits. The Winnemucca Rural Fire Department, with 25 volunteers (2 of whom are Emergency Medical Technicians), is responsible for an area of 230 square miles around the town of Winnemucca, and has a mutual aid agreement with the BLM. The Battle Mountain Volunteer Fire Department has 24 firefighters, 10 of whom are Emergency Medical Technicians, and owns 6 trucks equipped with first aid supplies. The department is generally responsible for the northern half of Lander

County, and has a mutual aid agreement with the BLM and Nevada Division of Forestry. The most common types of fires in the area are wildland fires. The departments also respond to accidents, structural fires, and hazmat incidents. The Nevada Division of Forestry is equipped to fight wildland fires. It is directly responsible for fighting fires on state lands, and assists local and Federal agencies under mutual aid agreements. Both the U.S. Forest Service and BLM provide fire fighting capabilities on Federal lands (BLM 1996a; Tri-County Development Authority 1996b; JBR 1995).

Medical Services

Medical services in Humboldt County are provided by the Humboldt General Hospital, located in Winnemucca. The hospital has 22 acute care beds and 30 long-term care beds, and services include an intensive care, obstetrics, coronary care, out-patient surgery, and emergency room. Several renovations and additions were completed in 1995, including a Skilled Nursing Facility. The hospital also manages Community Health and Home Health offices. The medical staff includes 3 family practice staff, 1 general practice staff, 6 family physicians, 1 surgeon, 1 internist, 25 registered nurses, and 11 licensed practical nurses. In addition, specialists make routine visits to provide additional services. Emergency transportation services are provided by the Humboldt County Volunteer Ambulance Corps, under the jurisdiction of the hospital. In 1997, an expansion of ambulance facilities was completed, including a conference room, additional bays, sleeping quarters, and an office for the EMS coordinator. Mental health services are provided by the Winnemucca Mental Health Center. Demand for services was high in 1995, with a 3- to 4-week waiting list; however, the opening of additional small offices in surrounding communities (Lovelock and Battle Mountain) in 1997 alleviated some of the pressure. Home Health Services of Nevada has an office in Winnemucca and provides at-home nursing care. Winnemucca also has 5 dentists and 2 physical therapists (BLM 1996a; Tri-County Development Authority 1996b; JBR 1995 and 1999).

Medical services in Lander County and Battle Mountain are provided primarily by the Battle Mountain General Hospital and Nursing Home. The hospital provides 24-hour services in emergency, laboratory, x-ray, teleradiology, respiratory therapy, acute care, and long-term care. In 1996, an expansion was completed which included a new patient wing with 23 beds (16 long-term care and 7 acute). In 1997, the second phase of the project was completed, which moved the clinic into the existing hospital's patient wing. The hospital staff of 63 members consists of medical doctors in family practice, internal medicine, emergency, teleradiology, and pathology, as well as medical technologists and technicians, physical and respiratory therapists, and numerous other nursing and administrative staff members. The Battle Mountain Medical Clinic offers services in family practice, internal medicine, and some minor surgery. Mental health services are provided by the Battle Mountain Mental Health Center, a sub-satellite of Winnemucca Mental Health Center. Home Health Services of Nevada has a location in Battle Mountain and provides skilled nursing care, home health aides, homemaker services, hospice care, physical therapy, medical social work, and speech therapy (JBR 1999).

3.12.1.4 Government and Public Finance

County Governments

Both Humboldt and Lander counties utilize a commissioner form of government; Humboldt has five elected commissioners and Lander has three. The counties administer many services, including fire protection, roads, recreational facilities, library, water supply, wastewater treatment, and planning for their respective jurisdictions. The county governments are primarily supported by ad valorem (property tax) and sales tax revenues. The counties also receive taxes on the net proceeds of mines, assessed at the same ad valorem rate as other property taxes within each respective taxing district. Net proceeds and property tax revenues provided for approximately 26.1 percent of Humboldt County total revenues in fiscal year 1994-95 and 40.7 percent of Lander County total revenues in fiscal year 1995-96. Intergovernmental sources, which are primarily composed of sales tax revenues, provided approximately 60.5 percent of Humboldt County revenues, and 59.3 percent of Lander County revenues. The largest expenditures for Humboldt County are public safety, general governmental functions, public works, and the judiciary, comprising a combined total of 77 percent of total county expenditures in the 1994-95 fiscal year. The largest expenditures for Lander County are public works, general governmental functions, public safety, and culture and recreation, comprising a combined total of 84 percent of total county expenditures in the 1995-96 fiscal year (Tri-County Development Authority 1996a, 1997).

Tax Revenues

Property taxes are determined from the assessed valuation of properties and the ad valorem tax rate. The assessed valuation is 35 percent of the estimated full value of the property. Trends in assessed valuation and taxable sales for Humboldt and Lander Counties are shown in Table 3-25. The total assessed valuation in Humboldt County in 1997 was $458,690,000, fluctuating in the previous 5 years. The total assessed valuation in Lander County in 1997 was $215,372,000, which also fluctuated in the previous five years. The ad valorem tax rate in Humboldt County ranged from $2.439 to $3.409 per $100 of assessed valuation in the 1994-95 fiscal year. The ad valorem tax rate in Lander County ranged from $3.01 to $3.28 per $100 of assessed valuation in the 1996-97 fiscal year. Higher rates are assessed within cities than in other areas of the counties (Tri-County Development Authority 1996a, 1997; Nevada Department of Administration 1999).

The assessed valuation of mining properties in Humboldt County was $245,514,000 in 1997, or more than one half of the county's total assessed valuation (Table 3-25). This value increased substantially in the previous 4 years, averaging 13.6 percent annual growth. The assessed valuation of mining properties in Lander County was $110,288,000 in 1997, or more than one-half of the county's total assessed valuation. This value increased by 39 percent over the 1996 assessed valuation of mining properties, but decreased in 2 of the previous 3 years. In addition to property taxes on real property, mines pay a net proceeds tax on minerals extracted. Net proceeds are calculated as the gross proceeds less allowable expenditures, and are taxed by the state's centrally assessed property tax division. This tax is currently $5 per $100 (if net is over $4 million). Counties receive revenues equal to their ad valorem rate where the mineral was produced, applied to the net proceeds, and the State of Nevada receives the balance. For example, in Lander County, the ad valorem rate is $3.01 per $100. Therefore, the county receives $3.01 for every $100 of net mining proceeds generated in the county. The state receives the balance of $1.99. Net proceeds taxes are distributed within counties the same way as other property taxes (Nevada Department of Administration 1999).

Taxable sales increased steadily in Humboldt County from 1993 to 1996, to a 1996 level of $400,494,000. Lander County's taxable sales decreased from 1993 to 1994, then increased an average of 28 percent per year from 1994 to 1996. Sales tax rates in Humboldt and Lander Counties in 1996 were both 6.50 percent, with 2.0 percent accruing to the state. The remaining portions accrue to local school support, and county and city government (Nevada Department of Administration 1999; Tri-County Development Authority 1996a, 1997).

Mining directly contributes to local government revenues through property tax payments on mining property, net proceeds taxes, and sales taxes on local purchases. Additionally, revenues are contributed through employees' spending of wages, which generates sales taxes, and payments on personal property. Marigold Mine has contributed to local government revenues in the above-described ways throughout its operational period. Direct contributions in 1998 are estimated at $141,000 in property taxes, and $450,000 in sales taxes (within the State of

Table 3-25
Trends in Assessed Valuation and Taxable Sales - Humboldt and Lander Counties

	FY 1992-1993	FY 1993-1994	FY 1994-1995	FY 1995-1996	FY 1996-1997
Humboldt County					
Taxable Sales	$282,901,000	$288,019,000	---	$400,494,000	---
Assessed Valuation	$474,371,000	$505,350,000	$544,309,000	---	$458,690,000
Assessed Valuation of Mining Properties	$148,953,000	$161,335,000	$175,182,000	$194,728,000	$245,514,000
Lander County					
Taxable Sales	$82,584,000	$78,378,000	$102,990,000	$128,268,000	---
Assessed Valuation	$156,637,000	$252,779,000	$244,630,000	$241,975,000	$215,372,000
Assessed Valuation of Mining Properties	$88,501,000	$81,221,000	$78,101,000	$79,318,000	$110,288,000

Source: Tri-County Development Authority 1996a, 1997.

Nevada) (Back 1999). Indirectly, employees' spending of wages has generated sales taxes and personal property taxes. From the 1998 payroll of $4.5 million, it can be estimated that approximately 70 percent of employees' wages (or $3.15 million) is disposable income, with a substantial portion spent locally on goods and services. Applying an average sales tax rate of 6.5 percent, this yields a maximum of $205,000 in sales tax revenues. Property taxes and net proceeds taxes accrue to the state and to Humboldt County. Sales taxes accrue to the state, Humboldt and Lander Counties, and cities within the region. Other benefits are contributed by the mining industry through secondary economic activities and employment generated by mining activity.

3.12.2 Environmental Consequences

3.12.2.1 Proposed Action

The Proposed Action would extend the life of the mine an additional 5 years, through 2006. Reclamation would continue until 2016. An average construction work force of 25 to 30 would be employed during the initial construction period (2000 to 2004). Current employment at the mine is approximately 83 employees. Peak employment is not expected to exceed 113 through 2006. The primary social and economic impacts of the proposed project would be the impacts of increases in the construction and operations work force and the associated effects on employment, income, and public finance. In addition, this section evaluates the continuation of economic benefits provided by the operation of the Marigold Mine, and the effects of eventual mine closure.

New employees hired for construction and operation are expected to be hired from local sources, and are not likely to induce noticeable changes in the level of public services available or required. The new employment during the construction and operations phases would benefit local communities by providing new income and resulting increases in purchases and sales taxes in the area. The mine expansion would provide for the on-going and increased community benefits of employment, income, and tax revenues for the state and local counties and cities. A reclamation work force of 13 employees would be maintained for the initial 2-year reclamation period; a minimal work force would be maintained for reclamation activities through 2016. With the phasing out of mine employment and the closure of the mine, income, tax revenues, and other economic benefits generated by mine operation would be discontinued.

As required by Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, the proposed project was evaluated for issues relating to the social, cultural, and economic well-being, and health of minorities and low income groups. Such issues are termed environmental justice issues, and none were identified for the proposed project. Social and economic impacts of the proposed project would not affect minority or low-income groups disproportionately.

<u>**Population and Demography**</u>

Construction/Operations. Approximately 30 or fewer additional employees would be hired for the construction and operations phases of the project. The total work force is not expected to exceed 113 employees during the construction and operational life of the mine. Construction would be intermittent but ongoing from 2000 through 2004. Therefore, some employees would be expected to work in both construction and operational capacities during this time. Local skilled labor is abundant as a result of recent layoffs at other mines, and local unemployment rates are relatively high. Therefore, local hiring is expected to comprise 100 percent of new employment, if possible, or approximately 30 or fewer workers (Back 1999).

Population increases could be induced by the secondary economic activity generated through construction and operations employment. In other words, the spending of workers' wages and purchases made by the mining company or contractors during the construction and operations phases would support additional jobs in other employment sectors. Because construction and operations would occur concurrently from 2000 through 2004, the standard multiplier developed for mine operations is used to estimate secondary employment generated during this period. A standard multiplier of 1.74, from John Dobra's The Economic Impacts of Nevada's Mineral Industry (1989), is used to estimate secondary employment (0.74 secondary jobs for every one operations job). Using this multiplier, an increase of 30 direct jobs could generate an additional 22 secondary jobs in the local economy. Secondary jobs associated with mine expansion are not likely to require outside recruitment because the area's labor supply is abundant, as reflected in the 1998 unemployment rates of 10.3 and 6.5 percent in Lander and Humboldt counties, respectively.

Direct and indirect employment during construction and operations activities would not be expected to induce population changes in the area due to the availability of local labor sources.

Reclamation. During the reclamation period, beginning in 2007, operations employment would be phased out. A work force of 13 employees would be maintained for reclamation activities from 2007 through 2009; a minimal work force would be maintained for reclamation activities through 2016. Population could begin to decline in the area beginning in 2007, if workers do not obtain work at other mines or in other suitable positions within a reasonable time period following lay-offs. The extent of the potential population changes are difficult to estimate, as it is highly dependent on the prevailing economic conditions and availability of work when employment is phased out.

<u>Economy, Employment, and Income</u>

The principal economic effects of the Proposed Action would be an increase in employment in Lander and Humboldt counties and additional mining operations employment of up to 30 employees through the year 2006. New income would be generated from the new construction and operations jobs, a significant portion of which would be spent in the local economy. Secondary jobs, primarily in the services and trade industries, would continue to be supported by mining employment in Humboldt and Lander counties. Additional secondary employment and income would be induced by the new construction and operations positions. Employment and income would be phased out during reclamation.

Construction/Operations. As the construction and operations work force would increase by 30 or fewer employees to approximately 113 workers at peak employment, the primary economic impacts associated with the proposed project would be an increase in economic, employment, and income benefits generated by the Marigold Mine. The current operations employment of 83 positions provides approximately 4 percent of Lander County mining employment, and 2 percent of Humboldt County mining employment. Using a multiplier of 0.74 ("Indirect Contributions of Mining", Section 3.12.1.2, Economy, Employment, and Income), estimated secondary employment of 22 positions would be supported by additional direct employment during construction and operations. These positions would occur primarily in the services and trade sectors and, because the area's local labor supply is abundant, it is anticipated that secondary employment would be supplied by local sources. Unemployment rates in Humboldt and Lander counties may be slightly reduced by new direct and indirect employment generated by construction and operation of the proposed project.

An average annual payroll of $4.5 million is estimated for the years 1999 through 2006. The projected average annual wage is approximately $45,000. The total payroll through the life of the project is estimated at $36 million. A standard multiplier of 1.57, from John Dobra's *The Economic Impacts of Nevada's Mineral Industry* (1989), is used to estimate the total earnings generated through mining activity, as income cycles through the economy ($1.57 in total earnings within the state for every mining payroll dollar). Applying this multiplier to the total payroll and benefits paid through the life of the project ($36 million) yields estimated total earnings of $56.5 million within the State of Nevada. These earnings are generated by the respending of workers' income, and direct purchases of goods and services by the mining company, both of which support secondary businesses and industries within the economy. Total purchases made by Marigold Mine through the life of the project are estimated at $37.8 million, with 100 percent of these purchases made within the State of Nevada, if possible.

Reclamation. Mine closure in 2007 would cause a reduction in Humboldt and Lander county total employment and a reduction in mining sector employment. Unemployment could temporarily increase, depending upon the amount and types of available work at the time of closure. The loss of mining employment in the county would represent a net income loss, as mining jobs typically pay the highest wages of any employment sector. The earnings generated by mining employment and the secondary effects of spending by workers and purchases of goods and services would be reduced through the reclamation period, and eventually terminate when all employment and mining activity cease.

<u>**Housing**</u>

Construction. No changes in housing demand are anticipated for the construction activities, as construction personnel are expected to be hired from existing local labor sources. Housing demand due to construction of the proposed project would remain roughly the same as current demand.

Operations. No changes in housing demand are anticipated for the operations phase, as personnel are expected to be hired from existing local labor sources. Housing demand due to operation of the proposed project would remain roughly the same as current demand.

Reclamation. Housing demand in the area could potentially decrease at the end of mine life. The extent of this decrease would depend upon how many workers locate alternate work following lay-offs and choose to remain in the area. If workers leave the area, housing demand would decrease, vacancy rates could increase, and housing costs in the area could decrease slightly. This would impact primarily Battle Mountain and Winnemucca, as 98 percent of current Marigold Mine employees reside in or near those two communities. Housing markets in other local communities would be affected only slightly.

<u>**Community Services**</u>

Construction. No impacts to community services would occur during the construction activities of the proposed project. Demand for services would continue at current levels.

Operations. No impacts to community services are expected to occur during operation of the proposed project. Demand for services would continue at current levels.

Reclamation. Demand for services could decrease during the reclamation period, depending on the number of workers who leave the area following lay-offs. The effects would be proportionate with the number of workers and their families who leave. If a large number leave the area, effects would be noticeable in Winnemucca and Battle Mountain. As workers leave the area, demand for utilities, law enforcement, fire protection, and medical services would decrease. This would be beneficial in reducing demand loads where systems of delivery are strained. It would be detrimental where additional demand supports the facility, such as a hospital. The number of school-aged children also would decrease, leading to more space in local schools. A negative impact of reduced population is that it decreases the tax base, which goes toward supporting public services and funding capital improvements.

<u>**Government and Public Finance**</u>

The primary impacts of the proposed project on public finance would be the benefits of increased sales taxes during construction and operation, the continuation of economic contributions provided by on-going operation of the mine, and the loss of tax revenues following mine closure.

Construction. During construction activities, additional sales taxes would be generated in the area from employees' spending of wages and contractors' purchases of goods and services. Sales taxes provide substantial revenues for both counties and cities, and portions also accrue to the State of Nevada. Indirect sales tax revenues would be greater than the direct amount as income cycles through the economy (i.e., money is respent on goods and services).

Operations. Continued operation of the Marigold Mine would provide for the on-going benefits of property tax, net proceeds tax, and sales tax revenues for Lander County, Humboldt County, and local city governments. Estimated property tax payments are $800,000 through the life of the project (Back 1999). Property taxes would accrue to Humboldt County. Mining currently provides a substantial tax base for Humboldt County, of which the Marigold Mine is a primary part. Mining properties currently provide for approximately 54 percent of total assessed valuation in Humboldt County. The assessed valuation of properties in the county has changed very little in since 1990, indicating that the tax base has remained essentially the same. Continued operation of the mines located in the county would provide stability in the tax base.

Net proceeds taxes also contribute significantly to county revenues. Together, net proceeds taxes and property taxes provide approximately 26 percent of Humboldt County revenues. Continued operation of the mine would continue this revenue source for the county. Projected net proceeds contributions from Marigold Mine are expected to total $400,000 through the life of the project (Back 1999). Portions of the net proceeds taxes would accrue to the State of Nevada.

Sales taxes would continue to accrue from workers' spending of wages in the local economy, and the mine's purchases of goods and services. Projected sales tax payments by the mine within the State of Nevada from 1999 through the end of the reclamation and monitoring period total $2.5 million. Projected payroll salaries and wages are $4.5 million per year from 1999 through 2006, and $36 million for the life of the project. If 70 percent of this is disposable income spent locally on goods and services, direct sales taxes of a maximum of $205,000 per year, or $1.6 million total, would result (utilizing a sales tax rate of 6.5 percent). Sales taxes provide revenues for the state, counties, and cities. Cities, in particular, are highly dependent upon sales tax revenues. A large portion of the sales tax revenues resulting from spending of payroll income would occur in the communities of Winnemucca and Battle Mountain, where most of the workers live and, therefore, spend their income. In addition, the continued support of commercial and residential activity in Winnemucca, Battle Mountain, and other local communities would continue to contribute to the tax base and provide property taxes for local cities and counties.

Reclamation. Beginning in 2007, with mine closure, tax revenues from the Marigold Mine would begin to decrease substantially. Humboldt County would experience significant reductions in property tax and net proceeds tax revenues. This could cause budget constraints and necessitate finding alternate sources of revenues or altering county budget expenditures. Sales tax revenues would decrease for Humboldt and Lander Counties, Winnemucca, Battle Mountain, and other local communities. The loss of these revenues would have negative impacts on local government entities.

3.12.2.2 8-South Partial Pit Backfill Alternative

The social and economic impacts of this alternative would be the same as those described for the Proposed Action.

3.12.2.3 No Action Alternative

Under the No Action Alternative, mine operations would cease after 2002. This would result in adverse social and economic impacts in the form of lost employment, personal income, tax revenue, and other economic benefits contributed by the Marigold Mine. The current employment of 83 operations workers would be discontinued, causing a loss of direct and indirect employment and income benefits in the local economy. A minimal staff would be maintained through the reclamation period. With mine closure, tax revenues would no longer be accrued from the mine, including property taxes, net proceeds taxes, and sales taxes. This would adversely impact the Humboldt County and Lander County governments, the communities of Winnemucca and Battle Mountain, and the local school districts, resulting in a loss of funding, and temporarily causing some budget constraints. Purchases of goods and services in the local economy would be reduced, and eventually discontinued. The future economic benefits of mine operation would not be obtained.

Workers would likely attempt to acquire work at other mines in the area, depending on the jobs available at that time. Unemployment rates would likely increase temporarily. If jobs were unavailable, the unemployed workers would either remain in the area, continuing their demands on community services, or would relocate to another area for employment. If many workers were forced to relocate, there would be a decrease in local populations, and an associated loss of economic activity, sales taxes, and reduced demand for housing and community services.

3.12.3 Cumulative Impacts

The cumulative assessment area encompasses those counties and communities wherein the social and economic impacts from regional development would be expected to occur. Given geographical and demographic characteristics, impacts from the Proposed Action would occur in Lander County, Humboldt County, Winnemucca, Battle Mountain, and to a lesser extent, other small communities near the mine site. These areas define the socioeconomics cumulative assessment area for the project.

Socioeconomic impacts resulting from reasonably foreseeable future actions would depend on the schedule and scope of potential new mining activities and any other large-scale development projects in the vicinity of the proposed project. Continued mining operations and expansions, in particular, may extend the types of beneficial and negative impacts similar to those described for the proposed project. In addition, the timing of mine closures also could compound the effects of mine shut-downs. The current major mining projects and reasonably foreseeable future projects, with their estimated employment numbers, are listed in Table 2-9 and illustrated on Map 2-7.

The cumulative assessment area has long been dependent on the mining sector for economic activity and employment. Likewise, it is the mining sector that has done much to define this region. Rapid growth over the last 15 years is largely attributable to the increased mining in the area. Cumulative impacts from mining, therefore, are not a new phenomenon. The impacts include a substantial infusion of economic resources, which has been beneficial. Mining has contributed substantially to the regional economic base, providing jobs, high wages, tax revenues, and indirect economic benefits. This has fueled economic expansion and helped to provide capital for infrastructure development in local communities, a foundation for further economic growth (BLM 1996a; Nevada Bureau of Mines and Geology 1991).

However, with the population growth attributable to mining, development pressures also have become apparent. Past cumulative impacts have resulted in a limited housing market, increased crowding in schools, and excess demand on some community facilities and services. The actual impacts experienced in an area largely depend on the relationship between the amount and timing of the housing or service demand, and the timing of the construction activity and tax revenues available that could fund the needed capital improvements or services expansions. Housing construction is often slow to respond to increased demand, sometimes with a lag time of several years between the initial demand, construction, and availability of additional housing units. In addition, the increased demand must be perceived as long-lasting for the developers to respond with additional construction. In the realm of public services, new projects can produce public revenue surpluses, but there is an initial lag of 1 to 2 years before the revenues are available for needed expenditures. Therefore, local governments may temporarily experience deficits.

Several issues have been identified in the cumulative assessment area, with respect to local housing markets and public services, that could be compounded by any increases in population induced by the reasonably foreseeable future actions. Specifically, 1) housing markets could be further impacted by increased mining activity, 2) law enforcement services in the area are currently short-staffed, and 3) many of the area schools are at or near capacity. In addition to the Marigold Mine expansion, the three reasonably foreseeable future actions identified on the list, the Phoenix Project, and the Lone Tree Mine Modification to Plan could further impact these resources by bringing new population to the area for construction and operations work forces. No definite schedules currently exist, so it is difficult to predict the extent of the cumulative impacts, if any.

The Phoenix Project would require 210 operations personnel. The Lone Tree Mine Modification would require approximately 100 employees. If these projects induce population increases at the same time that the Marigold Mine is employing its construction or operations work force, additional impacts to local housing markets and increased pressure on local law enforcement services and schools could occur. Additional impacts on the temporary housing market would increase the competition with tourists for hotel/motel rooms, recreational vehicle sites, and camping areas. Increased demands on local law enforcement agencies would reduce service levels for the current population and increase the pressure for additional funding for services. Increased school enrollments would require additional expenditures by local school districts and increase the pressure for new infrastructure in facilities that are reaching capacity.

Positive benefits also would be contributed by the cumulative mining projects. Lone Tree Mine is located in Humboldt County, and the Phoenix Project is located in Lander County. These projects would add to the mining employment and income in Humboldt and Lander counties and contribute to the tax base. These benefits would continue through the life of the mines. In addition, sales tax revenues would be further increased in local communities where workers reside (primarily Winnemucca and Battle Mountain).

Both present actions and reasonably foreseeable future actions can contribute to the scale of the impacts resulting from mine closure. Mine shut-down dates are highly subject to change as mines continue exploration and expansion activity, which can extend the mine life. If several mines in the cumulative assessment area close simultaneously or within a relatively short period of time from each other, the negative effects of unemployment, loss of income, decreasing population, and loss of tax base can be compounded. These cumulative impacts are speculative, however, given the high variability in mine lifetimes. In addition, prevailing economic conditions at the time, and the start-up of other mines have the potential to off-set these impacts.

3.12.4 Potential Mitigation and Monitoring

No mitigation and monitoring measures are recommended for social and economic resources.

The BLM can and does encourage local, county, and state governments or agencies to initiate discussions with the project proponent on the basis of the analysis presented in this EIS. The establishment of a dialogue based on mutual advantage and understanding, and a commitment to a shared responsibility for resolution of the potential impacts associated with project development, could lead to the preparation and implementation of mitigation measures which are advantageous to all parties.

3.12.5 Residual Adverse Impacts

Residual adverse impacts to housing and community services would be minor. The impacts associated with mine closure are largely unavoidable. The extent of these impacts would depend upon other economic activities in Humboldt and Lander counties, the development of the tax base, and prevailing economic conditions at the time of mine closure.

3.13 Hazardous Materials

3.13.1 Affected Environment

The potentially affected environment resulting from the presence of hazardous materials and waste includes air, water, soil, and biological resources. The environment could be affected in the event of an accidental release of hazardous materials or wastes during transportation to and from the project area or during storage and use at the project site.

GMMC currently transports process- and mining-related chemicals to the mine by truck from numerous locations within Nevada and surrounding states. All of the hazardous materials are transported along I-80, which is located adjacent to the Humboldt River both east and west of the site. The hazardous materials that are currently used at the site are listed in Table 2-4.

Hazardous Materials

The existing operations include transporting, handling, storing, using, and/or disposing of the following materials classified as hazardous by 49 CFR 172.101:

- Diesel fuel, gasoline, propane, petroleum oils, lubricants, ethylene glycol, acetylene, oxygen, and solvents used to operate and maintain equipment;
- Sodium cyanide, sodium hydroxide, calcium oxide (lime), hydrochloric acid, flocculent, and antiscalant used in the gold extraction processes;
- Ammonium nitrate and explosives used for blasting in the open pit; and
- Various by-products and chemicals classified as hazardous waste from the assay laboratory.

Of the chemicals cited above, sodium cyanide, sodium hydroxide, hydrochloric acid, and ethylene glycol are hazardous substances that also are listed in the 40 CFR 302.4 of the CERCLA and the appendices of the Superfund Amendments and Reauthorization Act. There are established reportable quantities for these chemicals, which apply to the reporting requirements associated with a release of each chemical. Petroleum products also have an established reportable quantity, but are excluded as hazardous substances under CERCLA Section 101(14). A summary of the CERCLA reportable quantities for those chemicals discussed above is presented in Table 3-26. The reportable quantity for petroleum products is 25 gallons released to the ground surface.

Transportation

Trucks are used to transport a variety of non-hazardous materials as well as hazardous materials to and from the project site. Based on their hazardous characteristics, volume, and number of deliveries, the materials of greatest concern are sodium cyanide, sodium hydroxide, and diesel fuel.

Sodium cyanide is considered to be the most hazardous material to be delivered to the site, due to the toxic nature of the chemical. Sodium cyanide is transported to the mill monthly in 59,000-pound loads and to the heap leach facility 2 times a month in 59,000-pound loads. Another potentially hazardous chemical delivery is that of corrosive sodium hydroxide, which is delivered every 10 days in 48,000-pound loads. Diesel fuel also is considered to be one of the most hazardous materials transported to the site. Although diesel is not among the most toxic of materials used at the site, it is delivered in the greatest quantity and frequency (two 10,000-gallon loads per week).

The sodium cyanide used at the site is supplied by FMC of Battle Mountain, Nevada, located approximately 17 road miles from the site. The

Table 3-26
CERCLA Reportable Quantities

Material	CERCLA Reportable Quantities (pounds)
Mercury	1
Sodium Cyanide	10
Sodium Hydroxide	1,000
Hydrochloric Acid	5,000
Ethylene Glycol	5,000
Solvents	10 – 5,000

sodium hydroxide is supplied by Sierra Chemical of Battle Mountain, Nevada, also located approximately 17 road miles from the site. Diesel fuel is supplied by Al Park Petroleum of Elko, Nevada, located approximately 104 road miles east of the site. Sodium cyanide, sodium hydroxide, and diesel fuel are transported directly to the mine site on I-80 from the east.

The risk of an accident involving deliveries of these three substances was evaluated using Hazardous Materials Transportation Risk Analysis (Rhyne et al. 1994). According to these national statistics, the average rate of truck accidents on a rural freeway resulting in a release of the contents is 0.12 accidents per million miles traveled. Using these statistics, the probability of a transportation accident resulting in a release of the three chemicals was evaluated over the proposed extended life of the project:

__Sodium Cyanide:__

190 truck deliveries x haul distance of 17 miles x 0.00000012 accidents per mile traveled = 0.0004 total releases

__Sodium Hydroxide:__

180 truck deliveries x haul distance of 17 miles x 0.00000041 accidents per mile traveled = 0.0013 total releases

__Diesel Fuel:__

550 truck deliveries x haul distance of 104 miles x 0.00000012 accidents per mile traveled = 0.007 total releases

The above analysis indicates that the probability of an accident over the extended life of the project, during the transport of any of these substances, would be low. There have been no releases of any of these substances during transportation and mine operation to date.

All hazardous substances are transported by commercial carriers or vendors in accordance with the requirements of Title 49 of the CFR. Carriers are licensed and inspected, as required by the Nevada Department of Transportation and the USDOT. Tanker trucks have a Certificate of Compliance issued by the Nevada Motor Vehicle Division. These permits, licenses, and certificates are the responsibility of the carrier. Title 49 of the CFR requires that all shipments of hazardous substances be properly identified and placarded. Shipping papers must be accessible and must include information describing the substance, immediate health hazards, fire and explosion risks, immediate precautions, fire-fighting information, procedures for handling leaks or spills, first aid measures, and emergency response telephone numbers.

In the event of a release off the project site, the transportation company would be accountable for response and cleanup. Each transportation company is required to develop a *Spill Prevention, Control, and Countermeasures Plan* to address the materials it would be transporting. Local and regional law enforcement and fire protection agencies also may be involved initially to secure the site and protect public safety. Title 49 of the CFR requires that the carrier notify local emergency response personnel, the National Response Center (for discharge of reportable quantities of hazardous substances to navigable waters), and the USDOT in the event of an accident involving hazardous substances.

Storage and Use

GMMC has developed an integrated *Emergency Response Plan* to address, among other things, release of fluids from mine facilities. Over the life of the project, the probability of minor spills of materials such as lime or oils and lubricants (from loading or unloading activities) is relatively high. The plan addresses the following items:

- Accidents/Medical Emergencies;
- Fires/Explosions;
- Chemical Releases (fluid management and spill control);
- Natural Disasters;
- Evacuation Plans;
- Power Failure/Outage; and
- Criminal Activities.

The section on chemical releases contains procedures for the control of leaks or spills of sodium cyanide (solid and liquid), caustic soda, hydrochloric acid, lime, anti-scalent, propane, diesel or gasoline, and other petroleum products. The section also contains the following:

- Fluid management plan describing the containment and leak detection systems to control and monitor process fluids at the facility;
- Monitoring plan describing the inspection of process areas for potential leaks and sampling of monitoring ports once per quarter to detect migration of process fluids from the mill, leach pads, tailings pond and other ponds;
- List of reportable quantities;
- Notification and reporting requirements; and
- Location and contents of spill kits and other protective equipment.

Operation in accordance with the *Emergency Response Plan* would assist in keeping spills localized and contained to allow for efficient clean up. GMMC has the necessary spill containment and cleanup equipment and trained personnel available at the site to quickly respond to minor releases.

Hazardous materials storage tanks have secondary containment sufficient to hold 110 percent of the volume of the largest tank within the containment system. Management of all tanks and vessels comply with manufacturer's recommendations, state and Federal regulations, and best management practices.

All hazardous substances are handled in accordance with applicable MSHA or Occupational Safety and Health Administration regulations (Titles 30 and 29 of the CFR). The hazardous substances to be used are handled as recommended on the manufacturer's MSDS. With the above-listed design features and operational practices in place, the probability of a major release occurring at the site is low.

In the event of a major or minor spill occurring on-site, GMMC would follow procedures presented in the *Emergency Response Plan* that establishes procedures for preventing, controlling, and reporting environmental releases within or from facilities located at the site. All spills, including transportation and loading/unloading related spills occurring on-site, are cleaned up or neutralized and reported, as required, to the Nevada Division of Emergency Management, the NDEP, the Nevada Bureau of Mining Regulation and Reclamation, the USEPA, the National Response Center, the BLM, the Humboldt County Department of Public Works, and Lander County Emergency Planning.

Disposal & Recycling. Non-hazardous solid waste generated on the site is disposed in an approved Class III on-site landfill. Used tires are either disposed in the landfill or recycled by the suppliers. Used equipment such as batteries, alternators, starter motors, etc. are recycled for remanufacture. Slag from GMMC's on-site lab is recycled at Just Refinery in Reno/Sparks, Nevada. Crucibles and cupels from the lab are sent to the U.S. Ecology hazardous waste landfill in Beatty, Nevada, for disposal. GMMC is a small quantity generator (SQE) of hazardous waste. Used petroleum products, antifreeze, and freon are transported off-site to approved recycling facilities.

Effects of a Release

The environmental effects of a release depend on what is released, how much is released, and where it is released. The accident/release statistics previously calculated assume a hazardous material, but do not address volume or location. Potential release scenarios could include a small amount of diesel fuel spilled during transfer operations at the site or the loss of several thousand gallons of sodium hydroxide, diesel fuel, or sodium cyanide into a drainage.

Sodium hydroxide spilled onto the ground or into a water body has the potential to cause severe short-term damage to localized terrestrial and aquatic habitats. A sodium hydroxide release into a stream or other water body could cause more severe effects, since it has the potential to migrate much farther from the immediate spill site, raise the pH of the water, and potentially result in a reduction in populations of aquatic invertebrates, amphibians, and fish. Base spills, such as sodium hydroxide, may be neutralized by acidic soils.

A release of diesel fuel in high concentrations would damage vegetation and, although unlikely, could ignite and result in a range fire. A spill into a water body would contaminate the water and sediment, possibly impacting local aquatic populations. Because cleanup actions would take place immediately, diesel contamination would not likely result in long-term increases in various hydrocarbons in soils, surface water, or groundwater.

The effects of a sodium cyanide release could be highly variable, much more so than a release of sodium hydroxide or diesel fuel, depending on the volume of the release, the location of the release (e.g., dry upland area, wet meadow area, or flowing stream area), the organisms exposed, and the chemical conditions at the release location. Sodium cyanide solution decomposes rapidly when in contact with the atmosphere and develops poisonous and flammable hydrogen cyanide gas. Environmental effects of a cyanide spill or leak would be limited in extent and time of contamination due to the rapid degradation of cyanide into benign elements when exposed to direct sunlight or oxygen.

A large-scale release of fuel, acid, base, or cyanide could have implications for public health and safety. The location of the release would again be the primary factor in determining its significance. A release in a populated area could have effects ranging from simple inconvenience during cleanup to potential loss of life. The probability of a release anywhere along a transportation route is very small; the probability of a release within a populated area is smaller; and the probability of a release involving an injury or fatality is smaller still. USDOT statistics show that between 1983 and 1992, in the State of Nevada, an average of 0.03 injuries or deaths occurred for each hazardous materials highway incident (USDOT 1993). Based on these statistics, it is not anticipated that a release involving severe effects to human health or safety would occur during the life of the project. None of the process chemicals or fuels to be used in large quantities are carcinogenic;

therefore, there would be no increases in cancer risk expected as a result of extension of the mining activity.

The release of a hazardous material or waste into a sensitive area (such as stream, wetland, or populated area) is judged to be highly unlikely. Again, depending on the material released, the amount released, and the location of the release, an accident resulting in a release could impact soils, water, biological resources, and people.

Response to a Release

Sodium hydroxide, diesel fuel, and sodium cyanide are designated as "hazardous substances" for purposes of the release reporting requirements of CERCLA (40 CFR Table 302.4). All releases of a "reportable quantity" of such hazardous substances must be reported to the National Response Center and the Nevada Division of Emergency Management. In addition, guidelines used by the NDEP require that areas affected by a release of cyanide be cleaned up until the concentration of cyanide in the soil is less than 0.2 milligram of cyanide per kilogram of soil. Releases of hazardous substances and petroleum products on public lands must be reported to the BLM. GMMC would comply with all provisions of Federal and state law and ensure that all releases of hazardous substances would be reported promptly and thoroughly cleaned up.

In the event of a release en route to the site, the transportation company is responsible for response and cleanup. Law enforcement and fire protection agencies also may be involved to initially secure the site and protect public safety.

Hazardous materials transporters are required to maintain an emergency response plan, which detail the appropriate response, treatment, and cleanup for a material spilled onto land or into water. Any cleanup would be followed by appropriate reclamation regarding the disturbed area, which could include replacing removed soil and seeding the area to prevent erosion, and the return of the land to its previous use.

3.13.2 Environmental Consequences

3.13.2.1 Proposed Action

The Proposed Action would extend the life of the mine, resulting in continuation of the current hazardous materials use practices through the year 2006.

The potential for impacts to the environment exists with the presence of hazardous materials and wastes at the site. Environmental impacts could result from an accidental release of hazardous materials or wastes during transport to or from the site or a release related to use or storage at the site. The criterion for evaluating potential impacts by hazardous materials and wastes is the risk of a spill and resultant impacts to sensitive receptors along transport routes or exposure pathways.

Since the transportation frequency and volume would not change with the Proposed Action, no incremental increase in the transportation or use of hazardous materials or wastes would occur. The only additional risks resulting from expansion of the mine is extending the life of the project.

As previously discussed, the proposed mine expansion would require continued use and storage of hazardous materials. If some of the chemicals used at the site were to enter the environment in an uncontrolled manner, there could be associated direct or indirect adverse environmental effects. The effects of a release would depend on the substance, quantity, timing, and location of the release. The event could potentially range from a minor petroleum spill on the project site where cleanup equipment is readily available, to a severe release of sodium cyanide solution during transport. Some of the chemicals could have immediate destructive effects on aquatic resources and water quality if a release were to enter a surface water body such as the Humboldt River. A hazardous material or waste release also could seep into the ground and contaminate the local groundwater. Depending on the proximity of such a release to populated areas or water supplies, the use of degraded water for human consumption could affect human health.

As discussed in Section 3.13.1, Affected Environment, over the proposed life of the project the likelihood of a release occurring during transport of hazardous materials to and from the site is low. The overall potential for a release of hazardous materials in association with transportation, storage, and use at the site also is considered to be low. Furthermore, the potential for a release that would result in significant adverse effects to human health or the environment is even lower.

3.13.2.2 8-South Partial Pit Backfill Alternative

The 8-South Partial Pit Backfill Alternative would result in the same impacts as described for the Proposed Action.

3.13.2.3 No Action Alternative

Under the No Action Alternative, the current hazardous materials transportation, storage, or use described for the Proposed Action would be discontinued after the year 2001.

3.13.3 Cumulative Impacts

Since the potential for accidents involving trucks delivering hazardous materials to the site is low, cumulative impacts resulting from continued shipment of hazardous materials to the Marigold Mine site is minimal. The cumulative effects of using and storing hazardous materials on the project site has been minimized by implementation of the *Emergency Response Plan*.

3.13.4 Potential Mitigation Measures

Additional mitigation measures, beyond the protection measures committed to by GMMC and discussed in Section 2.2.17, Hazardous Materials and Wastes, would not be needed.

3.13.5 Residual Adverse Effects

Residual adverse effects from the continued use of hazardous materials on the project site for the Proposed Action would depend on the substance, quantity, timing, location, and response involved in an accidental spill or release. Operation in accordance with the facility's *Emergency Response Plan* and prompt cleanup of spills minimizes the possibility of residual adverse effects due to hazardous materials.

3.14 Cultural Resources, Ethnography, and Paleontology

3.14.1 Affected Environment

3.14.1.1 Cultural Resources

The goal of cultural resource management is to maintain and enhance historic and prehistoric cultural resource values. Cultural heritage resources consist of prehistoric and historic archaeological deposits; structures of historic or architectural importance; and Native American traditional ceremonial, ethnographic, religious and burial sites. Prehistoric resources are physical locations with a cluster of features and/or artifacts that are a result of human activities occurring prior to written records. Historic resources are clusters of features and/or artifacts left by human activity occurring after written records were common.

Prehistoric properties found in the project area include lithic scatters, temporary camps, and isolated finds. Historic cultural resources in the project area are primarily related to mining and include trash middens and mine workings.

Analysis of cultural resources can provide valuable information on the cultural heritage of local peoples and regional populations. Cultural heritage resources are nonrenewable resources that are afforded protection by Federal, state, and local laws, ordinances, and guidelines. The following Federal legislation, policies, regulations, and guidelines have been enacted to protect cultural heritage resources and have been considered during review of the proposed project:

- The Antiquities Act of 1906 (PL 59-209) and the Archaeological Resources Protection Act of 1979 (PL-96-95).
- National Historic Preservation Act of 1966, as amended; Section 106 Compliance; 16 United States Code 470 et seq., and implementing regulations 36 CFR 800.
- American Indian Religious Freedom Act of 1978 (AIRFA).
- Native American Graves Protection and Repatriation Act of 1990 (NAGPRA).

<u>Cultural Setting</u>

The cultural setting discussion for the project region has been divided into prehistoric and historic periods, with the prehistoric period ranging from approximately 12,000 years before the present (BP) to the first arrival of Euroamericans.

Prehistoric Period. Archeologists divide the prehistoric period in the Great Basin region into the Pre-Archaic (approximately 12,000 BP to 7,000 BP) and the Archaic (approximately 7,000 BP to the first arrival of Euroamericans [approximately 150 BP]). Studies in the western and eastern portions of the Great Basin in the area now included in the state of Nevada indicate that human occupation occurred in the area as early as approximately 12,000 BP. Information for this time period is limited but suggests that the groups were small, very mobile, and may have relied on hunting in an environmental setting that was wetter and cooler than the present climate (Obermayr and Dugas 1996).

The Pre-Archaic lifestyle focused on big game hunting, utilization of smaller animals, and consumption of easily available and easily processed plant materials generally associated with the lacustrine/marsh environment present at the time (Obermayr and Dugas 1996). Pre-Archaic assemblages have been found near Valmy (located approximately 3 miles north of the project area), Rye Patch Reservoir, Susie Creek, and along the Utah-Nevada border at Smith Creek Cave. Isolated finds indicative of the Pre-Archaic tradition also have been found near Carlin (Newsome 1994).

The beginning of the Archaic period coincided with the onset of a warming and drying period in the region. The period has been subdivided into the Early, Middle and Late phases. The Early Archaic

(7,000 to 4,000 BP) is marked by the development of plant processing. Early Archaic period sites tend to be found in valley bottoms near permanent water sources and indicate seasonal occupation. Human presence in the vicinity of the proposed project was probably sparse during this time period (Obermayr and Dugas 1996).

Drier climatic conditions became more apparent in the Middle Archaic (4,000 to 1,200 BP) with resultant increased habitation in optimal areas. During the Middle Archaic, regional human adaptation to the climatic changes included a broadening of exploitation of the resource base and establishment of semi-permanent seasonal habitations within a home range. Consumption of plant foods and smaller animals was increased, groups generally became more mobile in response to seasonal resource dispersion and density, and long term storage of resources was developed. This was evidenced by wider site distribution, greater variability in assemblages, and the appearance of larger and more complex living structures and storage (Obermayr and Dugas 1996). During the Middle Archaic, use of upland settings appears to have increased and sites found in these areas are generally associated with resource procurement activities and forays (hunting, plant gathering and processing and wood gathering) (Skinner 1996; Miller et al. 1996).

The late Archaic (1,200 to 150 BP) was marked by the introduction of the bow and arrow and a continued use of a wide variety of ecozones and food sources. Pottery and horticulture were not developed in the region; instead populations made seasonal rounds relying on a great variety of fauna and flora with the emphasis changing from riverine to desert species. Sites at Rye Patch Reservoir, to the north and west of the project area, indicate that rabbits were highly utilized (Skinner 1996; Miller et al. 1996).

Sites in the vicinity of the project area that contain Archaic components include the Wagon Jack Shelter, Eastgate Cave, James Creek Shelter, the Carlin Basin sites, Danger Cave, Hidden Cave, Deer Creek Cave, South Fork Shelter, and the Triple T Shelter (Newsome 1994). Investigations to the north of the project area near Treaty Hill identified permanent Archaic-period winter camps with surrounding special activity camps for hunting and seed gathering and processing (Clay 1989).

Linguistic evidence suggests that Numic speaking people reached the area sometime between 1,000 to 1,300 AD. These people were the ancestors of the Paiute and Shoshone, who were living in the area at the time of the incursion of Euroamerican trappers, explorers, and settlers into the region (Clay 1989).

Historic Period. The first major contact between Euroamericans and the local native populations occurred in 1828, when Peter Skene Ogden, leader of a Hudson's Bay Fur Company trapping party, entered the study area. He trapped beaver just above modern-day Winnemucca and then proceeded downstream on the Humboldt River to the vicinity of Mill City, located north and west of the project area. Ogden made two more expeditions through the area in 1829 and produced a map of the Humboldt Basin. During the second expedition, his group encountered a large band of Native Americans in the area (Skinner 1996). From 1833 to 1834, Joseph Walker explored the Humboldt River area along an east to west route that would become the California National Historic Emigrant Trail (Clay 1989). This expedition was noteworthy for the first recorded armed conflict with the Native Americans of the region. This conflict resulted in the deaths of over 40 Indians. John Fremont explored the area in 1843-44 and again in 1845. The Humboldt River was named by Fremont in honor of geographer Baron Alexander von Humboldt (Harmon et al. 1988a). Expeditions usually left limited site evidence since they were of short duration and involved small groups of individuals.

Settlers bound for Oregon and California followed the trappers and explorers along the Humboldt River, north of the project area, beginning with the Bidwell-Bartleson party in 1841. The California Gold Rush saw over 197,600 emigrants and their livestock using the California National Historic Emigrant Trail route between 1849 and 1860. In the vicinity of the

Proposed Action, the California Trail route crossed south of the Humboldt River near Lone Tree Hill. The trail actually consisted of a series of trails often superimposed on each other. The emigrants often used areas away from the Trail for campsites, water and forage for stock, and to hunt. From the 1850s to 1915, the Stonehouse Station, a stage station, inn, and post office located approximately 6 miles northwest of the project area, provided meals and protection to travelers and emigrants along the Trail.

The presence of emigrant parties on their way to California often resulted in conflicts between the emigrants and the aboriginal groups in the area. The emigrants and their livestock had a significant effect on the Great Basin ecosystem. They depleted the available forage, polluted water, and consumed native food sources. This lead to resentment and privation among the native peoples, often causing them to attack emigrant parties. This furthered resentment and hostilities between the two groups (Harmon et al. 1988a; Skinner 1996; Miller et al. 1996).

Use of the California National Historic Emigrant Trail route (also known as the Humboldt Trail) decreased in the middle 1870s with the advent of low-fare passage on the transcontinental railroad (Skinner 1996; Miller et al. 1996). Site evidence of the Trail includes campsites, remains of wagons or other materials, remains of animals, gravesites, and trading posts (BLM 1995).

Mining interest began in north-central Nevada in the late 1850s with the discovery of mineral wealth near Dayton and Virginia City, Nevada. The Battle Mountain Mining District, which includes the Marigold Mine, was established in 1866 and remained relatively active until 1885. By 1870, 32 mines, a mill and 2 smelters operated in the District. These operations were generally located on the southeastern slopes of Battle Mountain, south of the project area, although historic mine sites have been located in the Marigold Mine area. The first records for the Marigold Mine were from 1938 and included a mining assessment that lists $600 in improvements to claims in the area, including a few hundred feet of crosscuts, drifts, buildings, and roads (Newson 1994; Obermayr and Dugas 1996).

Some of the early emigrants and miners stayed on in the region as ranchers and farmers. Agricultural settlement patterns were influenced by the distribution of the mines and the arrival of the railroad. Many of the early small farms supported the local mines. During the 1870s and 1880s, cattle ranching became a important economic factor along the Humboldt River and in the project region. Severe winters in 1889 and 1890 devastated the cattle industry and lead the remaining ranchers to reduce the size of their herds and begin feeding cattle during the winter. To produce hay for feed, irrigation systems were developed in the valleys. Sheep ranching increased during the 1890s to 1920s, since sheep were better able to withstand the harsh conditions. Ranching and farming remains include trash scatters from sheep camps, irrigation ditches, corrals, watering troughs, and fencelines (BLM 1995).

Mining resurfaced in the project vicinity in the early twentieth century with an emphasis on silver and copper, and the Battle Mountain Mining District boomed again.

<u>**Cultural Resources Identified in the Project Area**</u>

Maps 3-17 and 3-18 illustrate the Area of Potential Effect (APE) and the cumulative assessment area for cultural resources under the Proposed Action. The APE is defined as the area within the proposed permit boundary and generally includes a checkerboard of Federal and private lands that the proposed project mine would expand onto. The cumulative assessment area is bounded by I-80 and the county line. Maps 3-17 and 3-18 also depict the location of 12 cultural resource inventories that have occurred in areas associated with the APE or areas that lie outside but within 500 feet of the APE. Summaries of surveys conducted and sites identified are presented in Tables 3-27, and Table E-1 and E-2 in Appendix E. These inventories, which detail the results of intensive archaeological evaluations conducted within the area of this proposed project, are on file at the BLM offices in Winnemucca or Battle Mountain, Nevada. Only brief summaries and general location descriptions have been provided in the EIS to protect the confidentiality of the sites. Discussions concerning sites adjacent to the APE are included here because of the potential for the Proposed Action to create indirect effects on these sites.

The first cultural resources inventory identified as being conducted in the vicinity of the APE was a 1974 survey along a proposed Sierra Pacific Power Company 230-kV transmission line right-of-way. The inventory, outlined in BLM cultural resources (CR) report CR2-83, preformed by Rusco and Seelinger (1974) did not identify any sites within the APE. A second survey of material test areas was conducted in the project area by the Nevada Department of Highways in 1977 (BLM CR Report CR2-248). No sites were identified within or adjacent to the APE during this survey.

A Class III cultural resource inventory of the Marigold Mine complex was conducted by Basin Research Associates, Inc., in March of 1988 on behalf of Delta Environmental Consultants (BLM CR Report CR2-2236) (Harmon et al. 1988a). The inventory covered approximately 1,760 acres and resulted in the location and recordation of six cultural properties. Two of the properties were identified as prehistoric isolated finds. Three of the properties are small prehistoric sites (Cr-NV-22-4244, -4245, -4246) containing modified and unmodified chalcedony and basalt flakes. The sixth property located by the inventory represents the historic central area of the original Marigold Mine (Cr-NV-22-4247), which includes numerous roads, bore holes, shafts, construction and geological debris, and domestic refuse. The three small prehistoric sites and the historic Marigold Mine site are located within the APE. None of the cultural properties located by this inventory are eligible for inclusion in the NRHP with SHPO concurrence (Becker 1988).

In May and June of 1988, Basin Research Associates, Inc., conducted a supplemental Class III cultural resource inventory of an additional 2,000 acres of public and private land within the boundaries of the original Marigold Mine area (BLM CR Report CR2-2236 [Addendum]) (Harmon et al. 1988b). The supplemental inventory, conducted on behalf of Glamis Marigold Mining Company, resulted in the location and recordation of five additional cultural properties. Four of the properties were isolated finds. The remaining property is a small prehistoric site (Cr-NV-22-4362) containing lithic materials. Site Cr-NV-22-4362 is located within the APE and is not eligible for inclusion in the NRHP with SHPO concurrence (Becker 1988).

Personnel from Archaeological Research Services, Inc. conducted a Class III cultural resource inventory in April 1989 as part of the Trout Creek Project on behalf of Hecla Mining Company (BLM CR Report CR2-2294) (Clay 1989). During the inventory of approximately 1,280 acres, ARS recorded 30 previously unrecorded prehistoric properties. Twenty–three of the properties are small sites or isolated finds, and the other seven sites are large lithic scatters. Five of the lithic scatter sites contain less than 75 items, no temporally diagnostic artifacts, no obvious depth or features, and no distinctive spatial patterning. The other two large sites are a seasonal camp and a silicified siltstone quarry area. Of these 30 sites, none are located in the APE and two are located within 500 feet of the APE (Cr-NV-22-4698, -4699). None of the sites are recommended by the BLM as eligible for inclusion in the NRHP; the SHPO has concurred with these recommendations (James 1989).

Frank Johnson with Environmental Management Associates conducted a Class III archaeological inventory of approximately 835 acres in the vicinity of the Proposed Action in July and August of 1990 (BLM CR Report CR2-2384). The survey included inventory of a proposed waste dump and leach pad area, exploration pits, and a proposed haul road, access road and a utility right-of-way. The inventory identified nine previously unrecorded properties. None of the properties were located in the proposed APE and none of the properties were eligible to the NRHP with SHPO concurrence (James 1990).

LEGEND

GMMC PROPERTY LINE

CURRENT PERMIT BOUNDARY

PROPOSED PERMIT BOUNDARY
(AREA OF POTENTIAL EFFECT)

EXISTING FACILITIES

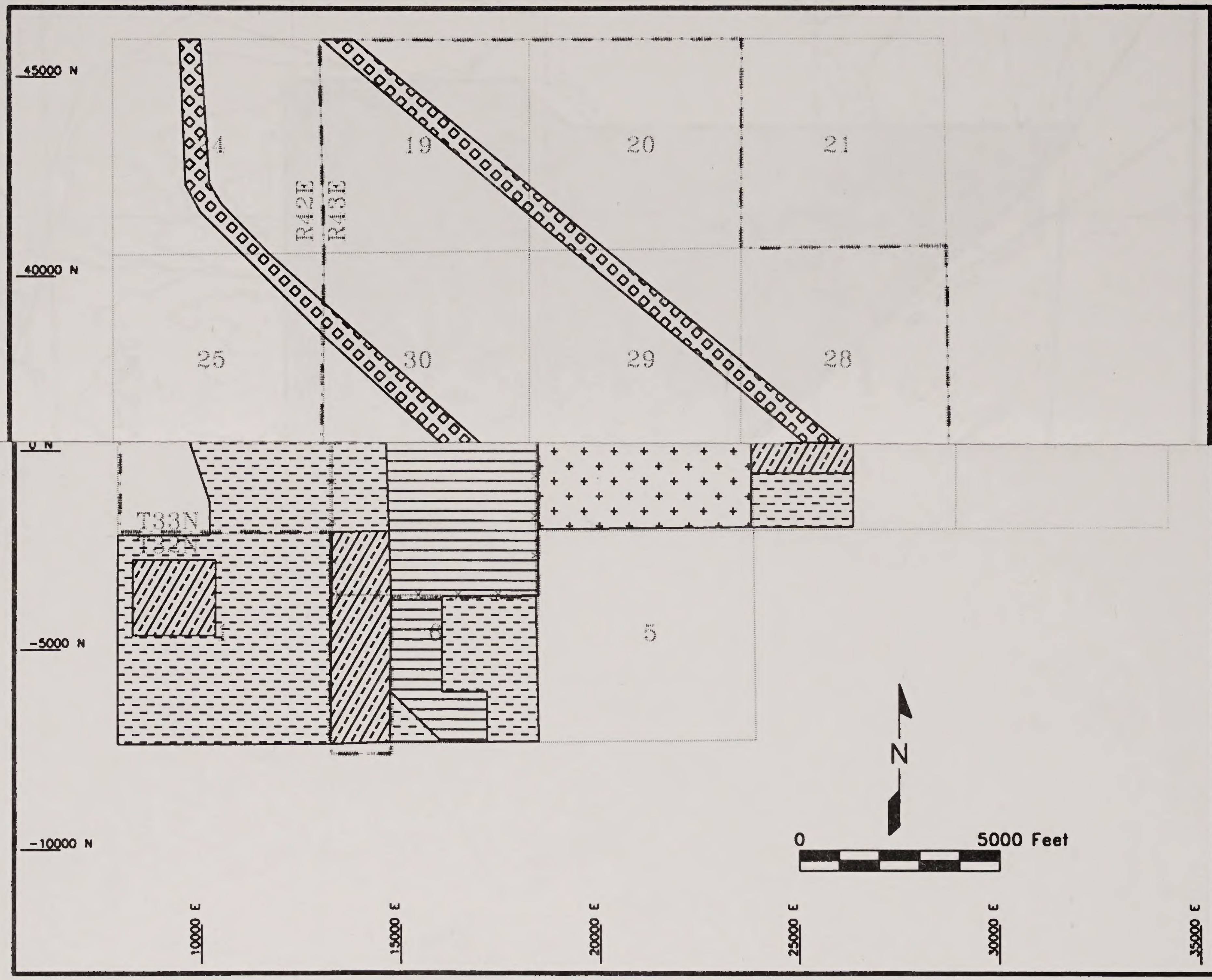
PROPOSED MINE OPERATIONS

LAND STATUS

Rusco and Seelinger 1974
(CR2-83)

Wallof and Cunningham 1977
(CR2-248)

Harmon et al. 1988
(CR2-2236)



Marigold Mine

Map 3-17

Cultural Resource Inventories in the Area of Potential Effect

in Winnemucca or Battle Mountain, Nevada. Only brief summaries and general location descriptions have been provided in the EIS to protect the confidentiality of the sites. Discussions concerning sites adjacent to the APE are included here because of the potential for the Proposed Action to create indirect effects on these sites.

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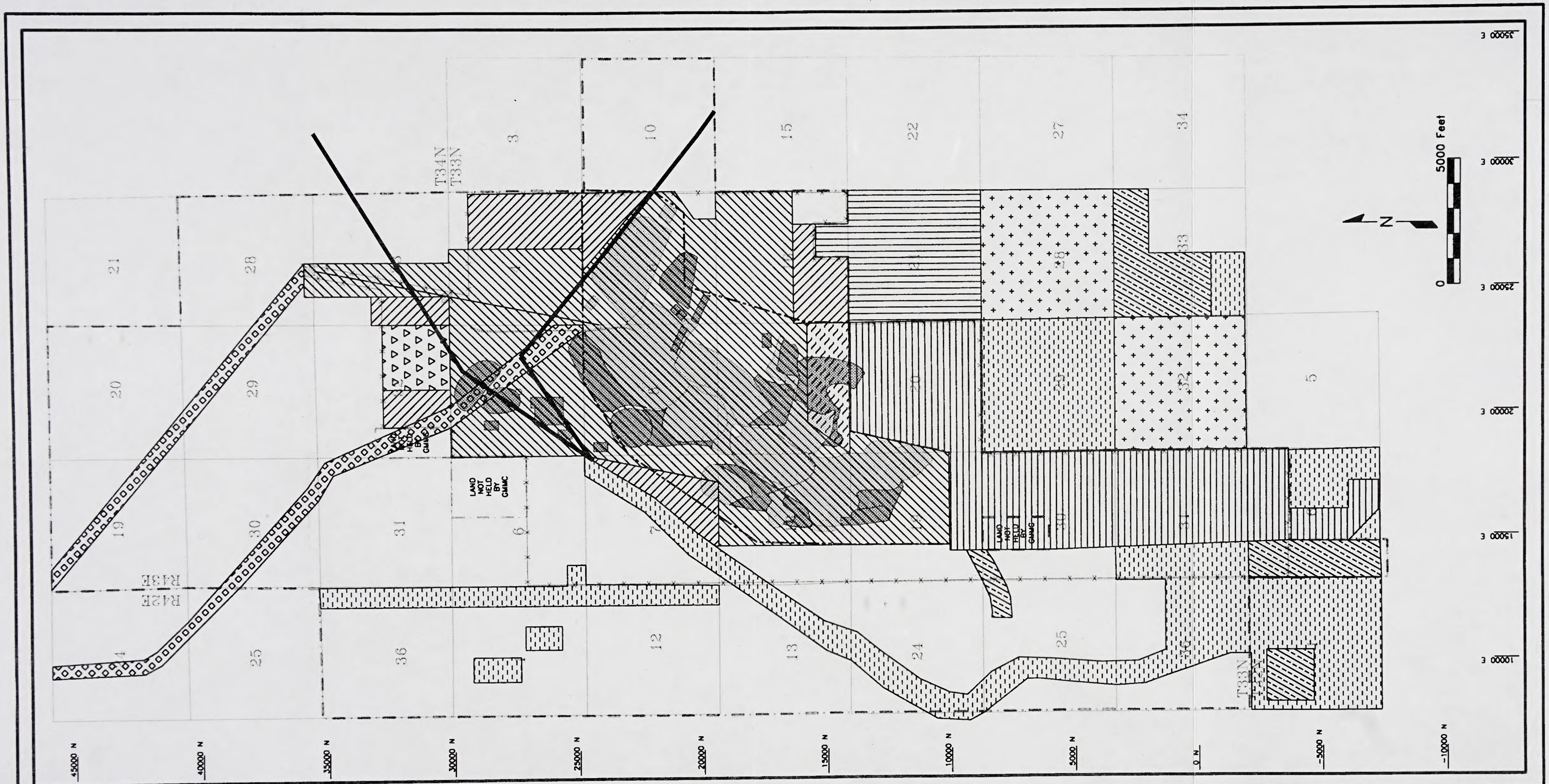
A Class III cultural resource inventory of the Marigold Mine complex was conducted by Basin Research Associates, Inc., in March of 1988 on behalf of Delta Environmental Consultants (BLM CR Report CR2-2236) (Harmon et al. 1988a). The inventory covered approximately 1,760 acres and resulted in the location and recordation of six cultural properties. Two of the properties were identified as prehistoric isolated finds. Three of the properties are small prehistoric sites (Cr-NV-22-4244, -4245, -4246) containing modified and unmodified chalcedony and basalt flakes. The sixth property located by the inventory represents the historic central area of the original Marigold Mine (Cr-NV-22-4247), which includes numerous roads, bore holes, shafts, construction and geological debris, and domestic refuse. The three small prehistoric sites and the historic Marigold Mine site are located within the APE. None of the cultural properties located by this inventory are eligible for inclusion in the NRHP with SHPO concurrence (Becker 1988).

In May and June of 1988, Basin Research Associates, Inc., conducted a supplemental Class III cultural resource inventory of an additional 2,000 acres of public and private land within the boundaries of the original Marigold Mine area (BLM CR Report CR2-2236 [Addendum]) (Harmon et al. 1988b). The supplemental inventory, conducted on behalf of Glamis Marigold Mining Company, resulted in the location and recordation of five additional cultural properties. Four of the properties were isolated finds. The remaining property is a small prehistoric site (Cr-NV-22-4362) containing lithic materials. Site Cr-NV-22-4362 is located within the APE and is not eligible for inclusion in the NRHP with SHPO concurrence (Becker 1988).

Personnel from Archaeological Research Services, Inc. conducted a Class III cultural resource inventory in April 1989 as part of the Trout Creek Project on behalf of Hecla Mining Company (BLM CR Report CR2-2294) (Clay 1989). During the inventory of approximately 1,280 acres, ARS recorded 30 previously unrecorded prehistoric properties. Twenty–three of the properties are small sites or isolated finds, and the other seven sites are large lithic scatters. Five of the lithic scatter sites contain less than 75 items, no temporally diagnostic artifacts, no obvious depth or features, and no distinctive spatial patterning. The other two large sites are a seasonal camp and a silicified siltstone quarry area. Of these 30 sites, none are located in the APE and two are located within 500 feet of the APE (Cr-NV-22-4698, -4699). None of the sites are recommended by the BLM as eligible for inclusion in the NRHP; the SHPO has concurred with these recommendations (James 1989).

Frank Johnson with Environmental Management Associates conducted a Class III archaeological inventory of approximately 835 acres in the vicinity of the Proposed Action in July and August of 1990 (BLM CR Report CR2-2384). The survey included inventory of a proposed waste dump and leach pad area, exploration pits, and a proposed haul road, access road and a utility right-of-way. The inventory identified nine previously unrecorded properties. None of the properties were located in the proposed APE and none of the properties were eligible to the NRHP with SHPO concurrence (James 1990).



Marigold Mine

Map 3-17

Cultural Resource Inventories in the Area of Potential Effect

Legend

River or Intermittent Drainage

Powerline

Cumulative Effects Area for Cultural Resources

Source for Base Map: BLM, 1998

Marigold Mine

Map 3-18

Cumulative Assessment Area for Cultural Resources

Table 3-27
Cultural Resource Inventories Completed Within or Adjacent to Marigold Mine's Area of Potential Effect (APE)

BLM Report Number	Report Title	Reference	Number of Sites Recorded in the APE (Sites may be Duplicated between Inventories)	Comments
CR2-83	Archaeological Reconnaissance Along Proposed 230KV Transmission Line Right-of-Way of Sierra Pacific Power Co. Part 1. Tracy to Valmy, Nevada	Rusco & Seelinger 1974	0 (?)	Not able to locate complete report
CR2-248	Survey of Material Test Areas South of Valmy, Nevada EA #70820	Wallof and Cunningham 1977	0	
CR2-2236	A Cultural Resources Inventory of the Marigold Mine Project, Humboldt County, Nevada	Harmon et al. 1988a	4 (0 are eligible)	
CR2-2236 (Addendum)	Preliminary Report Of Field Investigations for a Supplement to a Cultural Resources Inventory of the Marigold Mine Project	Harmon et al. 1988b	1 (0 are eligible)	Supplement to CR2-2236
CR2-2294	Cultural Resource Inventory of the Trout Creek Project, Humboldt County, Nevada	Clay 1989	0	
CR2-2384	The Stonehouse Mine Project: A Cultural Inventory of Approximately 835 Acres in Humboldt County, Nevada for Marigold Mining Company	Johnson 1990	0	
CR2-2612	Cultural Resource Inventory of 1880 Acres South of the Marigold Mine, Humboldt County, Nevada	Newsome 1994	10 (1 is eligible; 7 are not eligible; 1 site has one component as eligible and one component as not eligible); and 1 site requires additional data collection before NRHP status can be finalized	

Table 3-27 (Continued)

BLM Report Number	Report Title	Reference	Number of Sites Recorded in the APE (Sites may be Duplicated between Inventories)	Comments
CR2-2681	A Class III Inventory of 685 Acres Within the Trenton Canyon Project Study Area of Santa Fe Pacific Gold Corporation, Humboldt County, Nevada	Dugas 1995	2 (1 is eligible, 1 is not eligible)	
CR2-2632	A Cultural Resources Inventory in the Trenton Canyon Area, Humboldt and Lander Counties, Nevada	Obermayr & Dugas 1995	12 (4 are eligible, 8 are not eligible)	
CR2-2686	A Class III Inventory of Section 21, T33N, R43E for the Trenton Canyon Project, Humboldt County, Nevada	Dugas 1996	1 (requires additional data collection before NRHP status can be finalized)	
CR2-1256	A Cultural Resource Inventory of 187 Acres for the Marigold Mine Rock Dump Project near Valmy, Humboldt County, Nevada	Crosland & Prince-Mahoney 1996	0	
CR2-1316	A Cultural Resource Inventory of 690 Acres for the Marigold Mine Project Near Valmy, Humboldt County, Nevada. (This report has not been reviewed by the BLM)	Martin-Moore 1997	0	

A Class III cultural resources inventory of 1,880 acres south of the Marigold Mine was conducted by P-III Associates (BLM CR Report CR2-2612) (Newsome 1994) for a proposed expansion of the Marigold Mine Project onto private land and land administered by the BLM. As a result of the inventory, 14 cultural resource sites were identified. These included five prehistoric sites, six historic sites and three sites with both historic and prehistoric components. Ten of the 14 cultural resource sites recorded are located within the APE boundary (Cr-NV-22-6085, -6086, -6087, -6088, -6089, -6090, -6091, -6092, -6093, -6094). Of these ten sites, Cr-NV-22-6085, -6086, and -6091 are prehistoric lithic scatters containing numerous chert and obsidian tool fragments, and Cr-NV-22-6087, -6088, -6089, -6092, and -6093 are historic trash scatters containing jars, glass fragments, cans, and tobacco tins. The remaining two sites (Cr-NV-22-6090 and 6094) contain both prehistoric lithic and historic trash scatter. The prehistoric component of Site Cr-NV-22-6094 was identified as eligible for inclusion in the NRHP under Criterion d by the BLM. The SHPO concurred that the historic component was eligible to the NRHP (see Appendix C for a discussion on cultural site eligibility criteria) (Baldrica 1994). The remaining sites within the APE boundary, as well as the historic component of site Cr-NV-22-6094, were originally recommended by the BLM as not eligible for inclusion in the NRHP. The SHPO concurred with all of the recommendations with the exception of site Cr-NV-6090; final determination is pending on further archaeological investigation of the site (Baldrica 1994). In 1995, reevaluation of Site Cr-NV-22-6085 by Obermayr and Dugas (1995) (BLM CR Report CR2-2632[P]) resulted in a new recommendation by the BLM of eligibility to the NRHP. In 1996, the SHPO concurred with the new recommendation and the site is now eligible to the Register (Baldrica 1996a).

In September and November 1994 and April, June, and July of 1995, Intermountain Research conducted a cultural resource inventory (BLM CR Report CR2-2632[P]) in the Trenton Canyon area (Obermayr and Dugas 1995, revised 1996). This Class III survey encompassed approximately 10,221 acres in both Humboldt and Lander Counties. The inventory also included approximately 13.0 miles of potential pipeline, power line, and access road corridors extending from the Trenton Canyon Mine area to the Lone Tree Mine. The inventory identified eight prehistoric lithic scatter sites (previously identified sites Cr-NV-6085, -6086; newly identified sites Cr-NV-6199, -6204, -6205, -6235, -6239, -6240), and four historic sites (previously identified Cr-NV-6088 and -6089; newly identified Cr-NV-6251and -6252) located within the APE boundary. Sites Cr-NV-22-6085, -6199, -6204, and -6205 are eligible for inclusion on the NRHP with SHPO concurrence (Baldrica 1996a). The SHPO concurred with the BLM's determination that sites Cr-NV-22-6086, 6235, 6239, and 6240 are not eligible for inclusion to the NRHP (Baldrica 1996a). Historic sites Cr-NV-22-6088, 6089, 6251, and 6252 consist of trash debris, and were recommended as ineligible for inclusion to the NRHP with concurrence from the SHPO (Baldrica 1996a). The survey identified six sites located within 500 feet of the APE. These included Cr-NV-22-6195, -6196, -6242, -6246, –6247, and –6248. Sites Cr-NV-22-6195, -6246, -6247, and –6248 have been determined eligible to the NRHP with SHPO concurrence (Baldrica 1996a). Sites Cr-NV-22-6196 and –6242 are ineligible to the NRHP with SHPO concurrence (Baldrica 1996a).

As part of the Trenton Canyon Mine Project, Class II and Class III archaeological surveys were conducted by Intermountain Research in October 1995 on 685 acres of public and private lands distributed among nine parcels located on the northwestern and western slopes of Battle Mountain (BLM Report CR2-2681[P]) (Dugas 1995). Under the Class II survey, approximately 56 acres of 40 percent slopes or greater were surveyed using transects approximately 300 feet apart. The remaining acreage was surveyed to Class III standards using transects approximately 90 feet apart. The inventory discovered six previously unrecorded prehistoric archaeological sites. Six previously recorded sites adjacent to the surveyed parcels were also relocated. Two of the 12 sites identified, Cr-NV-6263 and –6085, are located within the APE boundary. Cr-NV-6263 is a sparse scatter of historic and modern debris adjacent to Trout Creek. This site was recommended by the BLM as not eligible for inclusion in the NRHP with SHPO concurrence (Baldrica 1996). Previously recorded Site Cr-NV-6085, a sparse and diffuse scatter of lithic material, was originally identified and recommended as not eligible to the NRHP by Newsome (1994) with SHPO concurrence (Baldrica 1994). Based upon additional information collected during the 1995 inventory by Obermayr and Dugas (1995), the SHPO determined that site Cr-NV-6085 is eligible for inclusion in the NRHP under Criterion "d" and that the site should be protected due to its location within 100 feet of the Trenton Canyon Project (Baldrica 1996b). One site, Cr-NV-22-6264, is located within 500 feet of the APE boundary. This site is eligible to the NRHP with SHPO concurrence (Baldrica 1996b).

On behalf of the Trenton Canyon Project, a Class III archaeological survey was conducted in December 1995 by Intermountain Research on approximately 680 acres of private land located on the northern slopes of Battle Mountain (BLM Report CR2-2686[P]) (Dugas 1996). The inventory discovered four previously unrecorded prehistoric archaeological sites. One previously recorded site (Cr-NV-22-6090), adjacent to the survey parcel, was revisited. Of the located sites, Sites Cr-NV-22-6090 is the only site located within the APE boundary. Three sites, Cr-NV-6375, -6376 and –6377 are located within 500 feet of the APE boundary. Cr-NV-22-6090 was previously recommended by the BLM as not eligible for inclusion to the NRHP (Baldrica 1994) and that recommendation was repeated as part of this inventory; SHPO concurrence is pending. The prehistoric component of Cr-NV-22-6376 was recommended as eligible for inclusion to the NRHP with concurrence from the SHPO (Baldrica 1996c). Sites Cr-NV-22-6375 and -6377 were found ineligible to the NRHP with SHPO concurrence (Baldrica 1996c).

In April 1996, JBR completed a Class III inventory of a 187-acre parcel proposed for a rock dump at the Marigold Mine (BLM CR-1256CN). No sites were identified during this survey (Crosland and Prince-Mahoney 1996).

In July and August 1997, JBR conducted a Class III inventory of five parcels totaling 690 acres for Marigold Mine (BLM CR2-1316). No sites were identified for this survey (Martin-Moore 1997).

In summary, five NRHP-eligible sites (Cr-NV-22-6085, -6094, -6199, -6204, -6205) and one unevaluated site (CrNV-22-6090) have been identified as lying within the APE. Site Cr-NV-22-6090 has been determined ineligible to the NRHP by the BLM; final determination is pending from the SHPO. Six NRHP-eligible or unevaluated sites (Cr-NV-22-6376, -6246, -6264, -6195, -6247, -6248) have been identified as lying within 500 feet of the APE.

3.14.1.2 Ethnography and Native American Consultation

The ethnographic background for the APE is generally the same for the area of cumulative effect. The issues and information identified below include data from literature and discussions with Western Shoshone and Paiute groups (Battle Mountain Band Council, the Duck Valley Shoshone-Paiute Business Council, the Te-Moak Tribe, the Fort McDermitt Tribal Council, and the Winnemucca Colony Tribal Council).

Setting

The project area is located near the traditional boundary between the Northern Pauite and the Western Shoshone, which is generally considered to be at Iron Point about 20 miles north-northwest of the project area (Newsome 1994). The project area lies in the region of the Makuhadokado or Pauida tuviwarai/Pauide tuviwarai Pauites and the White Knife or Tosawihi group of the Western Shoshone (Newsome 1994). The Tosawihi appear to have been the predominant group utilizing resources in the project area. The White Knife Shoshone are named for the white chert tool stone found at the Tosawihi Quarries located about 40 miles northeast of the project area. The White Knives wintered around Battle Mountain and generally inhabited the area bordering Rock Creek. The Western Shoshone and Northern Pauite interacted in the boundary area, intermarrying to some extent and conducting some cooperative hunts, although hostilities between the two groups were reported, generally related to "woman stealing" (Clay 1989; Newsome 1994).

These groups maintained a semi-nomadic lifestyle that corresponded to the availability of floral and faunal subsistence resources on a seasonal basis and involved seasonal movement between different vegetation zones and exploitation of a wide variety of food resources. Hunting of large and small game, including antelope, rabbit, waterfowl and rodents; fishing using nets, harpoons, and weirs; and gathering of grass seed, roots, berries, and pine nuts provided subsistence (Mires and Kautz 1993). The size and structure of the groups fluctuated in response to the availability and abundance of food resources. During winter, extended family groups gathered near caches of piñon nuts that had been gathered during the fall. Movement in winter was minimized and camps were maintained in areas with plentiful food resources, commonly along rivers, or near cached supplies of nuts, seeds, dried meat or other foods. Groups of Western Shoshone wintered on the Humboldt River, both above and below the project area (Obermayr and Dugas 1996). Wintering camps located near the project area included one at Tonomudza (Greasewood Point) near Battle Mountain, one at Bohowia (Sagebrush Pass) near Iron Point, and one at Pagowe near Stonehouse. Pagawi also was identified as a center for rabbit drives. This location is found approximately 7 miles north of the project area (Harmon et al. 1988a). The groups separated into nuclear families in the spring and foraged until fall when they gathered together in camp groups to perform communal hunts and gather pine nuts (Newsome 1994).

In the late 1800s the Duck Valley Reservation in northern Nevada was established and many Western Shoshone relocated there over the years. Small parcels of Federal lands were also set aside in 1900 as "Indian colonies" in areas such as Elko and Battle Mountain (Obermayr and Dugas 1996).

Native American Consultation

This section summarizes the process to gather information from Native Americans potentially affected by the proposed expansion of the Marigold Mine. A complete report (*Marigold Mine Native American Consultation Summary Report* [ENSR 1999]) detailing the information gathering process has been prepared and is available at the BLM office in Winnemucca, Nevada. Copies of the summary report also have been provided to representatives of the Native American groups interviewed during the process.

The process was conducted to comply with Federal and state laws that apply to resources with traditional and/or religious significance to Native Americans. The following laws either provide resource protection and/or require Native American consultation: the National Environmental Policy Act, Federal Land Policy and Management Act of 1976, American Indian Religious Freedom Act, Religious Freedom Restoration Act, Archaeological Resources Protection Act, Native American Graves Protection and Repatriation Act of 1990 (PL 101-601), Nevada Indian Burial Protection legislation, and National Historic Preservation Act of 1966, (PL-89-665, as amended). Under the National Historic Preservation Act, Federal undertakings must be assessed to determine if historic properties, traditional cultural places, or use areas will be affected by a proposed undertaking.

Consultation was initiated with notification letters outlining the proposed mine expansion. Notification letters and requests for comments were sent by the BLM in March 1999 to the Battle Mountain Band Council of the Te-Moak Tribe of Western Shoshone, Duck Valley Shoshone – Paiute Business Council, Te-Moak Tribe of Western Shoshone, Fort McDermitt Tribal Council, and Winnemucca Colony Tribal Council. These tribal groups were identified as having affiliations with the proposed project area. No previously identified traditional use or religious sites used by these groups were located within the proposed project area during literature searches conducted at the Battle Mountain and Winnemucca BLM offices by the BLM's cultural resources contractor.

The notification letters summarized the proposed action and requested input from the tribal groups. Following issuance of these letters, an informational meeting concerning the proposed action was requested by and arranged with the Battle Mountain Band. No additional comments related to the notification letters have been received as of the date of this report.

BLM and GMMC presented an informational meeting to the Battle Mountain Band on the proposed action on May 27, 1999, in Battle Mountain, Nevada. Attendees included Les Boni and Regina Smith (BLM); Gary Back (EMA); Henry Reed and Karen Jury (GMMC); Battle Mountain Band Council members Lydia Johnson, Clarence Andreozzi, Paul Snooks, and Daniel Raymond; Band Environmental Coordinator Bernice Lalo; and Battle Mountain Band member Ed Holley.

Concerns identified during the meeting included questions regarding: reclamation activities that would be conducted; whether reclamation would include reintroduction of native plants and wildlife; control of noxious weeds and non-native species; the potential for pit lakes; subsurface water pumping and subsidence related to the pumping; air quality; cumulative effects related to water pumping; employment of Native Americans at the mine; transportation of hazardous materials; and emergency response plans. Specific comments are discussed in Section 3.14.2.1 of this EIS. A request for information on and access to archaeological studies related to the project was made by Bernice Lalo during the meeting. After the meeting, BLM provided the Battle Mountain Band Council with a copy of a prototype agreement to share confidential information on cultural resources with Native Americans; no response resulted from this letter.

During the meeting, a request for a mine tour was made. The Marigold Mine tour was held on July 28, 1999. Henry Reed, the environmental coordinator with GMMC, led the tour. Les Boni and Regina Smith with the Winnemucca BLM office also attended, along with Polly Quick (project ethnographer), Bernice Lalo (Battle Mountain Band environmental coordinator), and her assistant, Lester Decker; Chris Sewell (Western Shoshone Defense Project, Crescent Valley who attended at the request of Carrie Dann); Erickson Hooper of the Duck Valley Shoshone-Paiute Tribe; and Battle Mountain Band members Florine Maine, Delbert Holley, and Evangeline Holley.

Concerns identified during the tour included: revegetation; loss of springs; loss of cultural sites; disturbance to the earth and the religious significance of the land; effects to vegetation, wildlife, and air quality; the possibility that there were toxic sediments created by the mine; and review of archeological site information. Detailed descriptions of issues identified during the mine tour are provided in Section 3.14.2.1 of this EIS. No cultural sites, traditional use areas, or other sites of special significance to Native Americans were identified during the mine tour. However, according to Florine Maine, Battle Mountain peoples historically traveled through the mine area and camped at Mud Springs on their way to pinenut collecting areas.

After the meetings and tour, BLM requested and was placed on the Battle Mountain Band Council agenda; however, before that date, a meeting was requested by the Battle Mountain Band Council to review the material prior to taking it to the community. The timing for this meeting is still being determined. The BLM sent follow-up letters making a final request for meetings, comments and/or input in September and October 1999 to the Battle Mountain Band Council.

Follow-up telephone contacts were made throughout the process by the BLM and the BLM's ethnography contractor to identify tribal governments and individuals that wanted more information and to set up meetings and a tour of the mine site. Although opportunities to make comments on the proposed mine project were provided during these calls, individuals chose to provide comments during the meeting and tour.

3.14.1.3 Paleontology

Paleontological resources or fossils are the physical remains, impressions, or traces of plants or animals from past geologic ages. Paleontological resources are important mainly for their potential to provide scientific dating information, information on the evolutionary history of plants and animals, and information on paleoenvironments and paleoclimates. The significance or sensitivity of a fossil resource is subjective and based generally upon the type of fossil material, its uniqueness, and its association with other fossil resources. Vertebrate fossils are generally considered to be the most significant; however, occurrences of invertebrates, plants, and other diagnostic fossils also can provide valuable information.

The BLM is mandated by the following Federal regulations to evaluate paleontological sensitivity on lands being considered for project approval:

- The Historic Sites Act of 1935 (P.L. 74-292; 49 Stat. 666, 16 U.S.C. 461 et seq.);
- NEPA (P.L. 91-190; 31 Stat. 852, 42 U.S.C. 4321-4327); and
- The Federal Land Policy and Management Act of 1976 (P.L. 94-579; 90 Stat. 2743, U.S.C. 1701-1782).

The BLM also has recently released a *draft* Paleontology Program Manual and Handbook (March 11, 1998), which establishes a classification system for ranking paleontological areas for potential for noteworthy occurrences of fossils.

In summary, the BLM handbook states that public lands may be classified based on their likelihood to contain fossils, using the following criteria:

- *Condition 1* - Areas that are known to contain fossil localities. Consideration of paleontological resources will be necessary if available information indicates that fossils are present in the area.
- *Condition 2* - Areas with exposures of geological units or settings that are likely to contain fossils. The presence of geologic units from which fossils have been recovered elsewhere will require an assessment of these same units if they occur in the area of consideration.
- *Condition 3* - Areas that are very unlikely to produce fossils based on their surficial geology, e.g., igneous or metamorphic rocks, extremely young alluvium, colluvium, or aeolian deposits.

In keeping with the historical policies adopted by the Department of the Interior and the BLM, these classification guidelines apply primarily to vertebrate fossils. However, the BLM indicates that where noteworthy occurrences of invertebrate or plant fossils are known or expected, the same procedures should be followed.

Review of paleontologic literature and BLM maps in the Winnemucca Field Office, which locate areas of potential and significant paleontological importance, indicated that the project area lies in Condition 2 and Condition 3 areas. Although fossils have been found in the project vicinity, no established fossil-collecting localities or significant deposits have been previously identified in the project area.

A classification system similar to that used by the BLM was proposed by the Society of Vertebrate Paleontology in 1995 for use in defining the paleontological sensitivity of geological formations. This system includes the following paleontological categories:

High Potential. Rock units from which vertebrate or significant invertebrate fossils or significant suites of plant fossils have been recovered are considered to have a high potential for containing significant nonrenewable fossiliferous resources. These units include, but are not limited to, sedimentary formations and some volcanic formations, which contain significant nonrenewable paleontologic resources anywhere within their geographic extent, and sedimentary rock units temporally or lithologically suitable for the preservation of fossils...

Undetermined Potential. Specific areas underlain by sedimentary rock units for which little information is available are considered to have undetermined fossiliferous potential. Field surveys by a qualified vertebrate paleontologist to specifically determine the potentials of the rock units are required before programs of impact mitigation for such areas may be developed.

Low Potential. Reports in the paleontological literature or field surveys by a qualified vertebrate paleontologist may allow determination that some areas or units have low potentials for yielding significant fossils. These deposits generally will not require protection or salvage operations.

Using this classification system and the BLM's system, the major sequences of rocks in the project area, which are Paleozoic marine sedimentary rocks, were evaluated for paleontological potential (see Section 3.2.1, Geology, for a description of the general geology of the area). The major potential fossil-bearing lithostratigraphic units that outcrop in the immediate project area include the Valmy Formation, the Pumpernickel Formation (which is often combined with the Havallah), the Havallah Formation, the Antler Peak Limestone and Battle Formations, Quaternary Gravels, and alluvial deposits. Several other formations, including the Harmony and Edna Formations, do not outcrop in the project area but are present at depth. A description of the geologic formations in the project area is provided in Section 3.2, Geology and Minerals.

The Valmy Formation is Ordovician and contains a large percentage of marine clastic rocks (quartzite, chert) and volcanic materials (greenstone) suggesting that the environment of deposition may have been in or near a volcanic archipelago (Roberts 1964). Interfingerings of limestone lenses found in the formation often contain invertebrate fossils, including trilobites and graptolites (BLM 1997). The study of graptolites (extinct colonial marine organisms), that were collected immediately south of the project area indicate an Early and Middle Ordovician age for the formation (BLM 1997; Roberts 1964; Willden 1964). Various species of graptolites, including Didymograptus, Climacograptus, Glyptograptus, Orthograptus, and Dicellograptus, have been recorded in the Valmy Formation immediately adjacent to the study area (Roberts 1964). Graptolites, which are abundant and not considered a significant resource, are often used as a diagnostic tool in biostratigraphic analysis (correlating the ages of rock units using fossils). This formation is identified as having a low potential for yielding significant fossil deposits.

The Pumpernickel Formation consists of shale, chert, and greenstone with some limestone, sandstone, and pebbly congolomerate. Radiolaria, sponge spicules, and fossilized invertebrate tracks produced by helminthoidal worms, gastropods, and crustaceans have been found in the chert present in the formation (Roberts 1964). Pennsylvanian conodonts, small tooth-like remains of marine organisms, have been found in the Pumpernickel Formation at Battle Mountain (BLM 1997). Conodonts also are used extensively in biostratigraphic analysis. They, however, are also abundant and are not considered to be a significant paleontological resource. Fusulinids fossils also have been found in the formation. These microscopic planktonic foraminifera resemble grains of wheat and also place the age of the Formation sometime in the Pennsylvanian (BLM 1997; Roberts 1964). This formation is also considered to have a low potential for yielding significant fossil deposits.

The Jory Member of the Havallah Formation is located within the project area. This unit, which is the lower member of the formation, is composed of sandstone and interbedded minor amounts of conglomerate, shale, and chert. Middle

Pennsylvanian to Early Permian fusuliniids were found in the Havallah Formation immediately northwest of the proposed mine area (Roberts 1964). Occurrences of crinoid fragments in outcrops of the Havallah Formation have also been identified in the area (BLM 1995). These fossils are not considered to be significant and the paleontological significance for this formation is low.

The Antler Peak Limestone and the Battle Formation are generally Middle to Late Pennsylvanian in age and are included in the Antler Sequence. The Antler Peak Limestone consists of thick extensive limestone units. The Battle Formation is composed mainly of conglomerates and sandstone with thin limestone beds (Roberts 1964). Limestone beds found in the Antler Sequence are well-sorted and contain well-rounded quartz grains, indicating deposition in a moderately high energy near shore environment that would not be conducive for large shell concentrations or mobile invertebrates (JBR 1998). Brachiopods, conodonts, stromatoporoids (primitive sponge-like colonial organisms), corals, syringoporoids, chonetids, and fusulinids have been found in the Antler Peak Limestone in other localities. Fusulinids, stromatoporoids, and other primitive faunal species such as Gondolella, Streptognathodus, Icriodus, Triticites, an unidentified Hydrozoan, and Bradyina have been identified in the Battle Formation (Roberts 1964). Corals of Pennsylvanian to Permian age have been identified in the Antler Sequence near the Marigold Mine (BLM 1995). All of these fossils have been found within this unit in other localities approximately 5 to 6 miles south of the project area and are generally common (Roberts 1964; JBR 1998). Although formations in the Antler Sequence contain proportionally higher numbers and varieties of fossils relative to other formations in the area, these fossils are generally common and the paleontological significance for this formation is considered to be low.

Quaternary Older and Younger Alluvium deposits within the project area generally consist of gravels in a sandy and clayey matrix. Older Alluvium deposits appear to have been deposited through a series of mudflows. Younger Alluvium was formed during dissection of alluvial fans in the Quaternary period and may contain stream, dune, and lake deposits. Vertebrate fossils have been found within loosely consolidated sand and silt associated with Quaternary Lake Lahontan alluvium near Rye Patch Reservoir, approximately 30 to 40 miles west of the project area (BLM 1997). No vertebrate fossils have been identified within the proposed mine permit boundary in Quaternary Alluvium deposits; however, fragments of Quaternary vertebrate fossils from either a horse or camel were collected in alluvium in Section 30, south of Marigold Mine's existing permit boundary and west of the Valmy Deposit (BLM 1995; BLM 1998). The erosional and depositional nature of the alluvial deposits makes it difficult to predict the potential for fossil occurrences. Any fossils that may be located within the alluvium could have been transported long distances from their original depositional area. The paleontological significance for these units would be considered low to undetermined.

3.14.2 Environmental Consequences

3.14.2.1 Proposed Action

<u>Cultural Resources</u>

Discussions of project impacts are limited to sites within the APE deemed to be significant or eligible for inclusion on the NRHP or sites that have Federal and/or state protection under other statutes. In order to be considered eligible for the NRHP, a cultural resource must be a district, site, building, structure, or object that retains its integrity of location, design, setting, materials, workmanship, feeling, and association, and satisfies at least one of the four significance criteria defined in 36 CFR part 60.4. (Appendix D - Cultural Resources Significance Criteria Definitions). Reports detailing the results of intensive archaeological evaluations in the mine area are on file at the BLM offices in Winnemucca and Battle Mountain, Nevada. Only brief descriptions and general location descriptions are provided in the EIS to protect the confidentiality of the sites.

Five eligible sites (Cr-NV-22-6085, -6094, -6199, -6204, -6205) and one unevaluated site (Cr-NV-22-6090) lie within the APE. These six sites could be directly affected by proposed project exploration activities; however, GMMC has agreed to avoid these sites during its exploration activities (see Section 2.2.18.7, Cultural and Paleontological Environmental Protection Measures). Avoidance of the sites should reduce or eliminate any potential effects to known sites that may occur as a result of the Proposed Action.

Cultural resource surveys have not been completed in several portions of the APE, including the southern half of Section 6, the northwest quarter of Section 7, the southeast corner of Section 9, and portions of the western one-third of Sections 18, 19, and 30 in Township 33 North, Range 43 East. Modifications to the access road in Section 6 are planned as part of the proposed project and exploration could occur in Section 30. Construction of a drainage diversion is planned adjacent to the unsurveyed portion of Section 9. Since cultural surveys have not been completed in these areas, it is not clear whether significant sites could be affected by the proposed activities in these areas. Cultural surveys would be required in previously unsurveyed portions of Sections 6, 9, and 30 prior to any ground disturbing activities to determine if significant cultural sites could be impacted in these locations.

Indirect impacts to eligible sites Cr-NV-22-6204 and -6205 located within the APE could occur during ground-disturbing activities associated with realignment and operation of the access road. The sites could be more susceptible to vandalism and casual collecting. Changes in topography due to road construction also could result in indirect impacts to cultural resources due to alteration of the amount or patterns of erosion. Improvements in access in the area, particularly in the vicinity of the access road and proposed exploration areas could indirectly impact sites Cr-NV-22-6235, -6246, -6247, and -6248 located outside of the APE.

Indirect impacts to sites would be reduced by implementing the environmental protection measures identified in Chapter 2.0. These measures would include employee education programs, avoidance of known sites, boundary marking, and erosion control measures and reclamation on access and exploration roads. The employee education program would inform employees of the value of cultural resources and the penalties associated with violation of antiquities laws. Boundary marking could consist of distinctly marking the mine permit boundary in the vicinity of the eligible sites and restricting equipment use beyond this boundary. Implementation of the erosion control measures in access and exploration roads and reclamation of these roads following project completion would reduce secondary effects to eligible sites from erosion. These measures would reduce, but not completely eliminate the potential for indirect effects from the Proposed Action.

If previously undocumented sites or subsurface components of documented sites are discovered within the project area during construction and operation, GMMC has agreed to halt construction in the area until the site could be analyzed by a professional archaeologist; as outlined in the environmental protection measures identified in Section 2.2.18. If the previously unidentified resources are determined eligible for the NRHP or protected under other state and Federal statues, impacts would be mitigated through an appropriate data recovery program agreed upon by the BLM, the SHPO and, if necessary, the Advisory Council on Historic Preservation.

Prior to initiation of any disturbance on-site, a Section 106 consultation between the BLM and the SHPO must be completed, as required under 36 CFR 800. Section 106 consultation with the Nevada SHPO regarding the project's effect on cultural resources is currently being conducted. The Section 106 process would be completed prior to the approval of the project (36 CFR 800.3c).

Native American Concerns

Information gathering efforts as part of the Native American consultation requirements under NHPA and NEPA included notification and follow-up letters, phone calls, an informational meeting, and a mine tour. Tribal organizations contacted included the Battle Mountain Band Council, the Duck Valley Band of Western Shoshone, the Te-Moak Tribe, the Fort McDermitt Band of Western Shoshone, and the Winnemucca Colony.

The following concerns were identified by tribal members during the informational meeting and the mine tour. No written comments have been received. Responses to concerns also are provided below:

1. Tribal representatives were concerned about reclamation seed mixes and the loss of native vegetation. They requested that reclamation seed mixes include native plants and plants that would support wildlife, particularly "rock chucks" or yellow-bellied marmots, and that prostrate kochia not be included in the reclamation seed mix. Winterfat, or white sage, and blue sage should be included in the seed mix.

   Response: Reclamation seed mixes for the mine site have been modified to include native species, including winterfat, and to exclude kochia. See Section 2.2.19 of the EIS (Reclamation).

2. Tribal representatives were concerned about imported and invasive plants at the mine site. They expressed concern that noxious or invasive weeds would outcompete native plants during and after reclamation. They also were concerned that non-native vegetation, such as tamarisk and Russian olive, has not been removed from other areas. Tribal representatives suggested that studies on weedy and non-native species, such as Kochia scoparia and European grasses, should be conducted to determine how invasive they are.

   Response: GMMC has committed to controlling noxious and invasive weeds in the mine area, as described in Section 2.19.6 (Weed Control).

3. Tribal members were concerned about the loss of wildlife habitat in the mine area. Florine Maine said that sage grouse and other game are no longer present. Erickson Hooper said that people are afraid to bring game home to eat for fear that it may be contaminated. Tribal members were concerned that existing mine operations have contributed to the abandonment of the historic sage grouse lek near the 8-South Pit and that the current activity has contributed to disuse of the area.

   Response: Impacts to wildlife and loss of wildlife habitat related to the Proposed Action are discussed in Section 3.6 of this EIS. The BLM's post-reclamation land use goal for the mine area is to restore the area to native wildlife habitat use and associated plant communities. Procedures for implementing these goals are discussed in Section 2.2.19 (Reclamation).

4. "Rock chucks" or marmots were once found in the vicinity of the mine area in hills near Cottonwood Creek, but they currently are not present at the mine site. Tribal members would like to see rock chucks and vegetation that would support them reintroduced to the mine area following reclamation.

   Response: See response to Concern Number 3.

5. Tribal representatives were concerned about odors from the mine operations. They indicated that cyanide from leaching operations at Battle Mountain Gold can be smelled at Argenta Point and that noxious odors emanate from the Lone Tree Mine at night. No mitigation recommendations were identified.

   Response: Text discussing the potential for odor release from the Marigold Mine expansion has been added to Section 3.3 (Air Quality) of the EIS. Because leach heaps would be drip irrigated, odors should not be a concern with the proposed operations.

6. Tribal representatives indicated that subsidence along Interstate 80 had occurred as a result of groundwater pumping at Lone Tree. They feel that groundwater pumping is adversely affecting the area and are concerned about the potential effects that could occur as a result of groundwater pumping associated with Marigold Mine operations. They also are concerned about water loss and related water rights. Bernice Lalo suggested a cumulative impact study related to groundwater pumping. Tribal representatives requested pumping figures from local mines.

   Response: A limited volume of groundwater (approximately 475 gpm) would be pumped by GMMC for use under the proposed action; water used at the mine would come from the Lone Tree Mine operations. Impacts to water rights or to springs or intermittent creeks in the project area are not anticipated. Effects from groundwater pumping are discussed in Section 3.1 of the EIS.

7. Tribal representatives asked about the number of Native American workers at the mine. Tribal representatives also suggested that the mines should hire an environmental/cultural liaison.

   Response: According to mine representatives, GMMC currently does not have a policy in place that emphasizes hiring Native American workers; however, they estimated that approximately 1 to 3 Native Americans are currently employed at the mine. Although no additional work force is expected to be needed under the proposed mine expansion, GMMC representatives agreed to look into the possibility of hiring more Native Americans in the future.

8. Bernice Lalo expressed concerns regarding transportation of chemicals used at the mine and the potential for a hazardous materials spill. She wondered if an Emergency Response Plan was in place and expressed concern that the Battle Mountain Band is often not notified when accidents/spills occur.

   Response: GMMC indicated that there is no local emergency response team although the mine has a trained HazMat team on site. An Emergency Response Plan is currently in place at the mine site. Discussions regarding hazardous materials and transportation are found in Section 3.13 of the EIS (Hazardous Materials). No impacts related to chemical transportation are anticipated as a result of the Proposed Action.

9. Tribal members are concerned about air pollution from cyanide evaporating from the leach pads and from dust created by mine operations. Erickson Hooper said that game will not forage in the area due to the dust on the grasses from mine operations. Tribal members said that when mining stops and the dust is gone, the wildlife would return.

   Response: Fugitive dust emissions and potential effects from cyanide are discussed in Section 3.3 of the EIS (Air Quality). No substantial effects to air quality are anticipated as a result of the Proposed Action.

10. Tribal members are concerned that sediment that is washed from the waste rock dump areas may be toxic.

    Response: Release of sediments from the waste rock dumps is not anticipated as a result of the Proposed Action. Reclamation efforts and controls, as described in Section 2.2.19 (Reclamation), should prevent deterioration of groundwater as a result of the Proposed Action.

11. Tribal members want to review archeological information for the area.

Response: BLM confidentiality agreements conflict with the Tribe's need to pass on information about their cultural tradition. Tribal member(s) will meet with BLM archeologists to review relevant information or look for an acceptable alternative.

Environmental Justice

Since publication of Executive Order 12898, Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations in the Federal Register on February 11, 1994 (59 FR 7629), BLM has been developing a strategy for implementing the order. Currently, BLM relies on the environmental Justice Guidance Under the national Environmental Policy Act prepared by the Council on Environmental quality, in implementing EO 12898 in preparing NEPA documents.

EO 12898 requires identifying and addressing disproportionately high and adverse human health or environmental effects on minority populations and low-income populations. These requirements were addressed in preparing the Marigold Mine EIS by 1) ensuring broad distribution of public information on the Proposed Action through a public scoping process, and 2) conducting specific consultations with Native American communities (see Section 3.14.1.2).

The intent of the environmental justice guidance is to prevent discriminatory placement of projects in and around minority populations in comparison to non-minority communities. In the case of the Marigold Mine Project, the project is driven by the location of ore bodies, and BLM does not have the option of choosing another location for the project. In addition, no low-income or minority populations are located in the immediate mine area.

The baseline social and economic characteristics of the project area are discussed in Section 3.12.1. The project area population is predominantly Caucasian (approximately 83 percent in Humboldt County; 90 percent in Lander County) with minorities constituting approximately 17 and 10 percent of the County populations, respectively (U.S. Census 1990). The two Native American communities in these two counties are 1) the Winnemucca Colony, located on the edge of the town of Winnemucca in Humboldt County, approximately 30 miles to the northwest of the Marigold Mine Project area, and 2) the Battle Mountain Colony, located about 10 miles east of the project area near the town of Battle Mountain in Lander County. When Europeans first arrived in the region, the Battle Mountain region was a boundary area between the Northern Paiutes and Newe (the ancestors of the Western Shoshone). The modern colonies are descendant communities of these aboriginal groups.

There is relatively little economic opportunity on the Winnemucca and Battle Mountain reservations. At Battle Mountain, one source of tribal income is a smoke shop/convenience store, and a newly formed tribal business, the Battle Mountain Filter Service Company, which cleans filters for nearby mines and employs three full-time employees (Tiller 1996). New mining activity in the area may increase business for this tribal enterprise. Section 3.12.2 of the Draft EIS documents that the Marigold Mine Project would have insignificant economic and social impacts within the context of current conditions within Humboldt and Lander counties.

No significant adverse impacts that might differentially affect minority or low-income populations have been identified for most of the analyzed environmental factors. Because the local minority Native Indian communities are culturally affiliated with many archaeological sites, human remains, and traditional cultural places within the region, effects on these resources may represent differential levels of impacts to these local minority groups. Effects on such cultural resources are being considered in compliance with numerous laws in addition to NEPA and are addressed in Section 3.14.2.1 of this EIS.

Paleontology

In addition to Federal requirements for protection of paleontological resources as identified in

Section 3.14.1.3, the Society of Vertebrate Paleontology (SVP) has developed standard guidelines for the assessment and mitigation of adverse impacts to nonrenewable paleontological resources (Reynolds 1995). Notably the SVP defines protection of paleontologic resources to include:

a. Assessment of the potential for property to contain significant nonrenewable paleontologic resources, which might be directly or indirectly impacted, damaged, or destroyed by development, and

b. Formulation and implementation of measures to mitigate adverse impacts, including permanent preservation of the site and/or permanent preservation of salvaged materials in established institutions."

The project area has been evaluated for paleontological significance. Fossils occur in formations that are found in the project area; however, none of these occurrences are considered significant based upon rating techniques used by the Federal government and the SVP. Fossils previously found in the project area are common or have been transported outside of their original context area.

Significant fossil-bearing formations have not been identified in the areas of proposed project construction or operation; however, because fossils are usually buried, their locations cannot be confirmed until excavation or drilling occurs. If significant fossil deposits are located during construction or mine activities, Rayrock has committed to contacting the proper authorities and preserving or avoiding the area as discussed in Section 2.2.18, Environmental Protection Measures.

Potential indirect impacts could result from improved access to fossil-bearing formations via improved access routes, including construction of exploration roads. Implementation of the environmental protection measures identified in Section 2.2.18 would reduce, but not eliminate impacts to paleontological resources. Following mine closure, indirect impacts are expected to be slightly reduced with the decrease in human activity in the area.

3.14.2.2 8-South Partial Pit Backfill Alternative

Cultural Resources

Impacts to cultural resources from the 8-South Partial Pit Backfill Alternative would be similar to those identified for the Proposed Action. No cultural resources have been identified in the 8-North Waste Rock Dump area.

Native American Concerns

Impacts to areas of concern to Native Americans from this alternative should be similar to those identified under the Proposed Action.

Environmental Justice

Impacts should be similar under this alternative to those identified under the Proposed Action.

Paleontology

Impacts to paleontological resources from the 8-South Partial Pit Backfill Alternative would be similar to those identified for the Proposed Action.

3.14.2.3 No Action Alternative

Cultural Resources

Under the No Action Alternative, impacts to cultural heritage resources from mine expansion and exploration would not occur. Continued erosional effects and illegal collecting would continue to occur at a rate similar to what is currently taking place in the area.

Native American Concerns

Under the No Action Alternative, no impacts to Native American heritage resources would happen beyond those currently occurring as identified in Section 3.14.1, Affected Environment.

Environmental Justice

Under this No Action Alternative, no impacts beyond those currently identified as occurring would happen.

Paleontology

Under the No Action Alternative, no impacts to paleontological resources would happen beyond those currently occurring as identified in Section 3.14.1, Affected Environment.

3.14.3 Cumulative Impacts

3.14.3.1 Cultural Resources

As depicted in Map 3-18, the cumulative assessment area for cultural heritage evaluation includes the area from I-80 south to the county line.

Past, present and reasonably foreseeable future actions (RFFAs) within the cumulative assessment area that have involved or could involve effects to cultural resources include the Buffalo Valley Mine and Exploration Projects, the Lone Tree Mine Project, the Trenton Canyon Mine and Exploration Consolidation Projects, the past and present Marigold Mine Projects, the past and future Phoenix Mine Projects, the Converse Exploration Project, and the Brass Ring Exploration Project (see Table 2-9).

Including surveys completed within the proposed APE, 49 cultural resource inventories associated with past, present, and RFFAs have been conducted in the cumulative assessment area. These inventories have identified a total of 402 known cultural sites. These included 48 sites that are eligible to the Register with SHPO concurrence, 221 sites not eligible to the Register with SHPO concurrence, and 133 unevaluated sites that require concurrence from the SHPO or additional data collection.

The majority of past disturbance in the cumulative assessment area has consisted of historic mining operations or associated activities; they have in turn impacted an unidentified number of prehistoric and proto-historic sites. Historic and existing projects in the area have impacted at least 19 percent of the known cultural sites within the cumulative assessment area. This includes 21 sites previously affected by the Trenton Canyon Project, including 4 eligible sites, and 27 sites affected by the Lone Tree Mine Project, including 3 eligible sites (BLM 1995, 1998). Existing operations at the Phoenix Mine have impacted 27 sites, including at least 6 eligible sites. In addition, proposed activities at the Phoenix Mine could disturb 44 to 71 more sites.

Past operations at the Marigold Mine appear to have disturbed or destroyed three sites (Cr-NV-4244, -4245, and -4247). The proposed project may directly impact one eligible site. This equates to less than 1 percent of the total number of sites identified within the cumulative assessment area.

Current disturbances, including ongoing Marigold Mine operations, have been subject to cultural heritage resource protection laws. The majority of the areas have been surveyed to Class III standards for cultural heritage resources, and, in the case of current work, sensitive sites were avoided or impacts were mitigated. All mitigation actions associated with the proposed project would be in accordance with established guidelines and a project-specific treatment plan. between GMMC, BLM, the SHPO, and, if necessary, the Advisory Council on Historic Preservation (ACHP).

Future mining or other ground-disturbing activities within the cumulative assessment area could impact NRHP-eligible or unevaluated sites. As directed by law, cultural heritage resource inventories and consultations would be conducted for any projects involving public lands, and impacts would be avoided or mitigated, as appropriate. Additional cultural inventories and consultations required for future expansions would add to the information base for cultural heritage resources within the cumulative assessment area. Compliance with Sections 106 and 110 of the NHPA would result in evaluation and mitigation or development of treatment plans for impacts to significant properties identified during the inventories for future actions and also would increase the overall knowledge of cultural heritage resources in the cumulative assessment area.

In any Federal undertaking, direct impacts to cultural heritage resources would be considered. Even with mitigation, physical destruction of sites could still occur in the future, and there could be a permanent loss of some cultural heritage sites. Permanent loss of sites also has occurred within the areas disturbed by past and present actions. Indirect impacts, such as vandalism and illegal collecting, have and could occur to cultural heritage resources through increased access and development, as a result of past, present, and future activities. Indirect effects to cultural resources by existing and future actions may be reduced, but not eliminated by implementing environmental protection measures or mitigation, such as those identified in this EIS.

3.14.3.2 Native American Concerns

Disturbance to traditional lifeway values and the cultural identity of Native Americans and other ethnic groups have occurred as a result of developments associated with past projects and previous actions in the region. No Native American religious or traditional use areas have been currently identified within the Proposed Action area; so consequently, the Proposed Action would not contribute cumulatively to effects to traditional use or religious areas that have occurred under other actions.

3.14.3.3 Paleontology

No impacts to significant paleontological resources were identified as a result of the Proposed Action. Consequently, the Proposed Action would not contribute to cumulative impacts to paleontological resources.

3.14.4 Potential Mitigation and Monitoring

Issue: Cultural surveys have not been completed in Sections 6, 7, 9 and 30 of Township 33 North, Range 43 East. Impacts to cultural resources can not be identified for these areas without surveys. If surveys indicate that significant cultural sites are present in these areas, appropriate mitigation should be implemented if direct disturbance is identified.

<u>Measure C-1</u>: Class III cultural surveys would be conducted in previously unsurveyed areas of Section 6, 7, 9, 18, 19, and 30 that could experience direct and indirect effects from the Proposed Action. If significant sites are identified that could be impacted, an appropriate treatment plan would be developed with the BLM and the SHPO.

<u>Effectiveness</u>: Surveys and appropriate mitigation, including treatment plans, would reduce, but not eliminate impacts to cultural resources in the surveyed areas.

<u>Application</u>: This measure would apply to the Proposed Action and the 8-South Partial Pit Backfill Alternative.

3.14.5 Residual Adverse Impacts

Direct and indirect impacts to NRHP eligible sites or other Federally or state-protected sites on Federal, state, or GMMC property would be prevented or reduced as provided for under the mitigation measures identified above. Residual impacts to cultural heritage resources, such as vandalism or illegal collecting, however, could result in the permanent loss of site context and traditional use, and could potentially result in the loss of information and artifacts.

No effects to significant paleontological resources have been identified as a result of the Proposed Action; therefore, no residual adverse effects are anticipated. No traditional cultural use localities or religious sites have been identified to date in the Proposed Action area; therefore, no residual adverse effects are anticipated for Native American issues.

3.15 Relationship Between the Local Short-Term Uses of the Human Environment and the Maintenance and Enhancement of Long-Term Productivity

Short-term is defined as the life of the proposed project through closure and reclamation (2016). Long-term is defined as the future beyond reclamation. Many of the impacts associated with the Proposed Action would be short-term and would cease following successful reclamation. Long-term soil and vegetation productivity under the Alternative is expected to be generally the same as under the Proposed Action. Soils, vegetation, and range resources would be lost in the unreclaimed pit areas (61 acres).

3.16 Irreversible/Irretrievable Commitment of Resources

Construction and operation of the proposed project would result in either the irreversible or irretrievable commitment of certain resources. Irreversible is a term that describes the loss of future options. It applies primarily to the effects of use of nonrenewable resources, such as minerals or cultural resources, or to those factors, such as soil productivity, that are renewable only over very long periods of time. Irretrievable is a term that applies to the loss of production, harvest, or use of natural resources. For example, livestock forage production from an area is lost while an area is serving as a mining area. The production lost is irretrievable, but the action is not irreversible. If the use changes and the mine is reclaimed, it is possible to resume forage production. Irreversible and irretrievable impacts of the Proposed Action are summarized in Table 3-28.

Table 3-28
Irreversible/Irretrievable Commitment of Resources - Proposed Action

Resource	Irreversible Impacts	Irretrievable Impacts	Explanation
Water Resources and Geochemistry	No	Yes	Water that is removed during the life of the project and used for mine operations would not be available for other uses.
Geology and Minerals	Yes	Yes	Mineral resources that are mined would no longer be available for future production.
Air Quality	No	No	Emissions from the project would not deteriorate the existing air quality in the project vicinity.
Soils	No	No	Soils from the pits, waste rock dumps, heap leach pads, tailings impoundment, and other mine facilities would be salvaged as growth media for use in reclamation.
Vegetation Resources	Yes	Yes	Irreversible impacts to vegetation would result in the unreclaimed pit areas (61 acres).
Wildlife and Fisheries Resources	Yes	Yes	Wildlife habitat would be irreversibly lost in the unreclaimed pit areas (61 acres).
Special Status Species	Yes	Yes	About 674 acres of potential habitat (shadscale and sagebrush vegetation type) for the burrowing owl would be irretrievably lost until after reclamation. Bat habitat would be removed at the Red Rock Pit.
Range Resources	Yes	Yes	Unreclaimed pit areas (61 acres) would be irreversibly lost for livestock grazing. There would be an irretrievable loss of public land available for livestock grazing, (about 5,762 acres, or 288 animal unit months) until reclamation is sufficient to restore productivity and allow this activity to resume. Forage production is expected to recover in the long-term following reclamation, with a loss of 6 animal unit months.
Land Use and Access	No	No	There would be no irreversible impacts to access; public access patterns would be maintained.

Table 3-28 (Continued)

Resource	Irreversible Impacts	Irretrievable Impacts	Explanation
Recreation	No	Yes	The loss of the unreclaimed pit areas (61 acres) would minimally affect recreation. There would be an irretrievable loss of land available for dispersed recreational opportunities until reclamation is sufficient to allow dispersed recreational activities to resume.
Aesthetics	No	Yes	Impacts to visual resources would be eliminated through successful reclamation procedures.
Social and Economic Values	No	Yes	The eventual loss of employment, tax revenues, and other economic benefits following mine closure would be considered temporary over the long-term, as other sources of employment and tax revenues would likely be obtained.
Hazardous Materials	No	No	A spill of hazardous materials into a sensitive resource, such as a stream or wetland, is not expected during the life of the project. If a spill did occur, impacts could last for several months or years, but would not be considered irreversible. Remediation of a spill would be initiated immediately and would be expected to mitigate most impacts.
Cultural Resources, Ethnography	Yes	Yes	Disturbance of cultural sites would result in the permanent loss of site context. Continued mine operation has an adverse effect on traditional values of local Native American groups.
Paleontology	No	No	No disturbance to paleontological resources is expected. If paleontological resources are encountered they would be avoided where possible. If avoidance is not possible, irreversible and irretrievable impacts would result.

4.0 CONSULTATION AND COORDINATION

4.1 Public Participation

The public participation program for this EIS includes the following components.

Two public scoping meetings were held for the EIS, one on October 6, 1998 and one on October 7, 1998, in Battle Mountain and Winnemucca, respectively. Public scoping comments for the EIS were received through December 18, 1998.

To date, nine written comment letters have been received by the BLM. The public scoping meeting comments were summarized and addressed in the EIS Preparation Plan. The following are the key scoping issues for the Marigold Mine Expansion Project.

- Water quality impacts associated with heap leach expansion and pit lakes;
- Impacts from dewatering and water use;
- Cumulative impacts to water sources, air quality, vegetation, and wildlife;
- Impacts to visual resources;
- Reclamation and revegetation using native species;
- Impacts to wetlands and riparian areas;
- Impacts associated with stream diversions;
- Impacts to sensitive biological resources;
- Wildlife exposure to cyanide solutions;
- Reduction in availability of grazing land and water access for livestock;
- Control of noxious weeds;
- Potential traffic impacts associated with construction and operation of the proposed project;
- Legality of mining claims;
- Pit backfilling alternatives; and
- Relocation of county road and power line.

4.2 Draft Environmental Impact Statement Preparation

In preparing the Draft EIS, the BLM communicated with and received input from many Federal, state, and local agencies, as well as other organizations and individuals. The following is a list of those who provided input:

Federal Government Agencies

U.S. Department of Commerce, Bureau of the Census
U.S. Fish and Wildlife Service (Reno)

State Government Agencies/Universities

Nevada Bureau of Mines and Geology
Nevada Department of Administration
Nevada Department of Conservation and Natural Resources, Nevada Division of Wildlife (Elko, Winnemucca)
Nevada Department of Conservation and Natural Resources, Division of Historic Preservation and Archaeology
Nevada Department of Employment, Training, and Rehabilitation-Research and Analysis Bureau and Employment Security Division
Nevada Department of Taxation
Nevada Natural Heritage Program (Carson City)
Nevada State Demographer's Office, Bureau of Business and Economic Research

Local Governments/Agencies

Tri-County Development Authority

4.3 Draft Environmental Impact Statement Review

Approximately 380 copies of the Draft EIS were distributed by mail to various government agencies, organizations, and individuals. A listing of the agencies, organizations, and individuals who received copies of the Draft EIS in December 1999 is presented below.

Agencies, Organizations, and Individuals Who Received Copies of the Draft Environmental Impact Statement

Government Agencies

Commander, National Training Center – Ft Irwin, CA
HQ-USAF/LEEV - Bolling AFB - Washington, DC
Office of the Deputy A/S of the USAF; Environmental, Safety, Occupational Health - Washington, DC
U. S. Army Corps of Engineers - San Francisco, CA; Reno, NV
U. S. Department of Energy; Office of Environmental Compliance (EH-23) - Washington, DC
U.S. Department of Transportation, Environmental Division – Washington, DC
U. S. Environmental Protection Agency, Region IX - San Francisco, CA
U.S. Environmental Protection Agency, NEPA Compliance Division, EIS Filing – Washington, DC
USDA, Forest Service - Winnemucca, NV
USDA/NRCS Rangeland Mgmt./Resource Specialist - Winnemucca, NV
USDI/Bureau of Indian Affairs - Elko, NV
USDI/Bureau of Land Management - Reno, NV; Elko, NV; Carson City, NV; Las Vegas, NV; Ely, NV; Battle Mountain, NV; Tonopah, NV; Cedarville, CA; Ridgecrest, CA; Denver, CO; Washington, DC
USDI/Bureau of Land Management, National Applied Resource Science Ctr. - Lakewood, CO
USDI/Bureau of Reclamation – Denver, CO
USDI/Fish and Wildlife Service - Washington, DC; Portland, OR; Reno, NV
USDI/Minerals Management Service - Washington, DC
USDI/MMS-RMP - Denver, CO
USDI/National Park Service - Washington, DC
USDI/Natural Resources Library - Washington, DC
USDI/Office of Environmental Policy & Compliance - Washington, DC
USDI/Office of Public Affairs - Washington, DC
USDI/Office of Surface Mining - Washington, DC
USDI/USGS - Denver, CO; Carson City, NV; Reston, VA

State Agencies

Nevada Bureau of Mines and Geology – Reno, NV
Nevada Department of Transportation - Winnemucca, NV
Nevada Div. of Environmental Protection, Bureau of Mining Regulation and Reclamation - Carson City, NV
Nevada Division of Minerals - Carson City, NV
Nevada Division of State Lands - Carson City, NV
Nevada Division of Wildlife - Reno, NV; Fallon, NV; Winnemucca, NV; Elko, NV
Nevada State Engineer, Division of Water Resources - Carson City, NV
State Historic Preservation Office - Carson City, NV
State of Nevada Clearinghouse - Carson City, NV
State of Nevada Dept. of Conservation & Natural Resources - Carson City, NV
State of Nevada Governor's Office - Carson City, NV
State Planning Coordinator, State of Nevada, Dept. of Administration - Carson City, NV

Local Agencies

Attorney – Battle Mountain, NV
City of Winnemucca - Winnemucca, NV
Elko County Commissioners – Elko County, NV
Elko County Library - Elko, NV
Eureka Branch Library – Eureka, NV
Eureka County Commissioners – Eureka, NV
Eureka County Deputy District Attorney – Eureka, NV
Eureka County Public Works – Eureka, NV
Humboldt County Commissioners - Winnemucca, NV
Humboldt County Library - Winnemucca, NV
Humboldt River Basin Water Authority - Carson City, NV; Winnemucca, NV
Lander County Commissioners - Battle Mountain, NV 89820
Lander County District Attorney – Battle Mountain, NV

Lander County Library - Battle Mountain, NV
Lovelock Water District – Lovelock, NV
Pershing County Commissioners - Lovelock, NV
Pershing County Library - Lovelock, NV
Pershing County Water District - Lovelock, NV
Winnemucca City Manager - Winnemucca, NV

Elected Officials

Honorable John Marvel, State Assemblyman - Battle Mountain, NV; Carson City, NV
Honorable Dean Rhoads, State Senator - Carson City, NV; Tuscarora, NV
Honorable Richard Bryan - Washington, DC
Honorable James Gibbons - Reno, NV
Honorable Harry Reid - Reno, NV
Honorable Paul Vesco, Mayor - Winnemucca, NV

Tribal Organizations

Battle Mountain Band Council of the Te-Moak Tribe of Western Shoshone - Battle Mountain, NV
Duck Valley Shoshone – Paiute Business Council - Owyhee, NV
The Te-Moak Tribe of Western Shoshone – Elko, NV
Fort McDermitt Tribal Council - McDermitt, NV
Nevada Indian Environmental Coalition - Reno, NV
Winnemucca Colony Tribal Council - Winnemucca, NV
Western Shoshone History Preservation Society - Elko, NV
Western Shoshone National Council - Duckwater, NV
Western Shoshone Defense Project – Crescent Valley, NV
Western Shoshone Resources, Inc. – Reno, NV
Yomba Shoshone Tribe – Austin, NV

Organizations

Animal Protection Institute of America - Sacramento, CA
Audubon Society, Lahontan Chapter - Reno, NV
Center for Urban Affairs and Policy Research - Evanston, IL
Citizen Alert, Native American Program - Reno, NV
Colorado State University Libraries - Fort Collins, CO
Desert Research Institute - Reno, NV
Indigenous Affairs International Work Group - Copenhagen DENMARK
Institut fuer Bergbau - Federal Republic of Germany
La Puente Gem and Mineral Club - La Puente, CA
LASER, Inc. - Gridley, CA
McGill University, Department of Geography - Montreal, Quebec CANADA
Mineral Policy Center - Washington, DC
National Wildlife Federation - Portland, OR
National Wildlife Federation - Washington, DC
Nature Conservancy - Reno, NV
Natural Resources Defense Council – San Francisco, CA; Washington, DC
Nevada Building and Construction Trades Council - Portland, OR
Nevada Cattlemen's Association - Elko, NV
Nevada Mining Association - Reno, NV
Nevada Outdoor Recreation Association - Carson City, NV
Nevada Woolgrower's Association - Elko, NV
Santa Clara Valley Gem and Mineral Society - San Jose, CA
Sierra Club, Great Basin Group - Reno, NV
Sierra Club, Toiyabe Chapter - Reno, NV
Sierra Club Legal Defense Fund - Denver, CO
Southwest Center for Biological Diversity - Tucson, AZ
SWRIC – Albuquerque, NM
Trout Unlimited, Sagebrush Chapter - Reno, NV
University of Nevada - Reno, NV
University of Nevada Libraries - Reno, NV
University of Nevada, Reno, Mackey School of Mines - Reno, NV
Wild Horse Organization Assistance – Reno, NV
Wild Horses Commission – Carson City, NV
Wildlife Society, Nevada Chapter - Elko, NV
Women in Mining - Winnemucca, NV

Industries/Businesses

Agri Beef Company - Boise, ID; Golconda, NV
AILA – New York, NY
Alpha Analytical, Inc. – Sparks, NV
American Assay Labs - Sparks, NV
Ballard Spahr Andrews & Ingersoll - Denver, CO
Battle Mountain Bugle – Battle Mountain, NV

BHP Copper – Tucson, AZ
Concerned Citizen for Responsible Mining – Ontario, OR
Cordex Exploration Company - Reno, NV
Cortez Gold Mine – Beowawe, NV
Dames & Moore - Lompac, CA
Death Valley Gateway Gazette – Pahrump, NV
Echo Bay Minerals Company, McCoy Mine - Battle Mountain, NV
Elko Free Press - Elko, NV
Ellison Ranching Company, Spanish Ranch - Tuscarora, NV
Emmons & Associates, Inc. – Salt Lake City, UT
Environmental Management Associates – Reno, NV
Environmental Strategies, Inc. – Denver, CO
Filippini Ranching Co. – Battle Mountain, NV
Geological and Environmental Consulting – Three Forks, MT
Getchell Gold, Getchell Mine - Golconda, NV
Goldfield Mining Corp. – Golden, CO
Greystone - Englewood, CO
Happy Creek Land and Cattle Company - Elko, NV
Hecla Mining - Coeur d'Alene, ID
Holme, Roberts & Owen - Denver, CO
Homestake Mining Company – San Francisco, CA
Humboldt Sun – Winnemucca, NV
Hycroft Mine - Winnemucca, NV
Independence Mining Co. – Elko, NV
Independence Mining Corp. – Englewood, CO
JBR Environmental Consultants – Reno, NV; Springfield, UT
Kinross Sleeper Mine - Winnemucca, NV
Mineral Policy Center – Bozeman, MT
Muys & Pensabene, P.C. - Washington, DC
Nevada Gold Mining Inc. - Winnemucca, NV
Nevada Mining Association – Reno, NV
Newmont Gold Company - Carlin, NV
Newmont Gold Company, Twin Creeks Mine – Golconda, NV
Newmont Mining Corporation - Denver, CO
PTI Environmental Services - Bellevue, WA
Pacific Southwest Bioservices - National City, CA
Parsons Behle & Latimer - Salt Lake City, UT
Phelps Dodge Corporation - Lincoln, MT; Phoenix, AZ
Placer Dome – Golconda, NV
Planning Information Corp. – Denver, CO
Public Lands Foundation – Arlington, VA
Sage Engineering - Reno, NV
Sheep Creek Ranch – Carlin, NV
Sierra Pacific Power Company - Reno, NV
Steffen Robertson and Kirsten - Reno, NV
The Industrial Company – Carson City, NV
The Ranch House – Crescent Valley, NV
WESTEC - Reno, NV
Western States Mineral Corporation - Reno, NV

Individuals

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Monica Antonovich – Reno, NV
Hale Bailey – Carlin, NV
Dan Banghart – Elko, NV
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Dirf Benford – Crescent Valley, NV
Mark Bennett – Battle Mountain, NV
Scott Benson - Laramie, WY
Mark Blair – Elko, NV
M. Bradley – Reno, NV
Joy K. Brandt – Austin, NV
George Brown - Mead, WA
Joe Brown – Reno, NV
Robert Brown - Manteca, CA
Brian Buck - Sandy, UT
John Bunch – Elko, NV
Ralph Bunch – Elko, NV
John Burrows – Elko, NV
Gregg Bush – Elko, NV
Gail Callan – Portland, OR
Jay Callisto – Verdi, NV
Anthony Cardinalli – Reno, NV
Jack Cardinalli – Carson City, NV
John C. Carpenter – Elko, NV
Ken Carson – Battle Mountain, NV
Larry Carson – Battle Mountain, NV
Joel Casburn – Zephyr Cove, NV
Rocky Chase - Beatty, NV
James Chavis – Elko, NV
Jack Chesney – Sparks, NV
Vic Chevillon – Reno, NV
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John Etchegaray – Eureka, NV
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Don and Eddyann Filippini - Battle Mountain, NV
John and Billie Filippini, Beowawe, NV
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Jack Fullenwider - Golconda, NV
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Jeff Green – Sandy, UT
Tom C. Griswold – Crescent Valley, NV
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Roger Johnson - Winnemucca, NV
Scott Johnson - Sparks, NV
Walter Johnson – Austin, NV
Bruce Johnston – Gearhart, OR
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Helen Irene Jones – Reno, NV
Jerry Jones – Elko, NV
Tilman Jones – Austin, NV
W. C. Jones – Golden, CO
Doris Kaesz – Los Angeles, CA
Conrad and Doris Kersch – Stagecoach, NV
Paul Kersnowski - Lovelock, NV
Ann Kersten – Sparks, NV
Jeanne King - Battle Mountain, NV
Rick Lassen – Reno, NV
Nathan Lauritzen – Battle Mountain, NV
Tony and Nancy Lesperance – Elko, NV
Jon Liechty – Bloomington, IN
Marrianna Lipe – Crescent Valley, NV
Gregg Loptien – Sparks, NV
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Terry Munson – Elko, NV
Tom Myers - Reno, NV
Tina Nappe - Reno, NV
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Discipline	Name	BLM Office Location
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Assistant Project Manager/Geology and Minerals	Jeff Johnson	Winnemucca
Water Resources/Geochemistry	Craig Drake	Winnemucca
	Tom Olsen	Reno
Soils/Vegetation Resources/Special Status Plants	Michael Zielinski	Winnemucca
Wildlife and Fisheries Resources/Special Status Wildlife	Duane Crimmins	Battle Mountain
Range Resources	Steve Bell	Battle Mountain
Land Use and Access	Ken Detweiler	Winnemucca
Recreation	Barb Kelleher	Winnemucca
Aesthetics	Mike Bilbo	Winnemucca
Hazardous Materials	Steve Brooks	Winnemucca
Cultural Resources/ Ethnography/Paleontology	Regina Smith	Winnemucca

5.2 ENSR EIS Team

Discipline	Name	Degree(s) and Experience
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NEPA Document Review	Valerie Randall	B.A. Urban Studies 21 years experience
Assistant Project Manager/ Vegetation Resources/Range Resources/Special Status Plants	Jon Alstad	M.S. Range Science; B.S. Animal Science; A.A. Liberal Arts; 11 years experience
Groundwater and Geochemistry/Geology and Minerals	Bob Berry	Ph.D. Geochemistry B.S. Geology Prof. Degree Hydrogeology 21 years experience
Surface Water/Soils	Jim Burrell (Riverside Technology, inc.)	M.S. Civil Engineering B.S. Forest Management 18 years experience
Air Quality	Vince Scheetz	M.S. Systems Management B.S. Mathematics 24 years experience
Wildlife and Fisheries Resources/Special Status Wildlife Species	Lori Nielsen	B.S. Wildlife Ecology/ Management; 14 years experience
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16 years experience

5.2 ENSR EIS Team (Continued)		
Discipline	**Name**	**Degree(s) and Experience**
Ethnography/Native American Consultation	Kim Munson	M.S. Cultural Anthropology B.S. Cultural Anthropology and Archeology 5 years experience
	Polly Quick (International Technology Corporation)	Ph.D. Anthropology M.A. Anthropology B.A. Anthropology 22 years Experience
AutoCAD/EIS Maps	Ana Vargo (ESA Consultants, Inc.)	M.S. Geology B.S. Geology 8 years experience
Document Production/Coordination	Sue Coughenour	15 years experience

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ABBREVIATIONS

µm	micrometers
$\mu g/m^3$	micrograms per cubic meter
ABA	acid-base accounting
AGP	acid generating potential
AIRFA	American Indian Religious Freedom Act of 1978
amsl	above mean sea level
ANP	acid neutralizing potential
APE	Area of Potential Effect
AUM	animal unit month
BLM	Bureau of Land Management
BMP	Best Management Practices
BP	before present
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
cm/s	centimeters per second
CO	carbon monoxide
EIS	environmental impact statement
°F	degrees Fahrenheit
FLPMA	Federal Land Policy and Management Act of 1976
gpm	gallons per minute
HAP	hazardous air pollutant
HCI	Hydrologic Consultants, Inc.
HDPE	high density polyethylene
I-80	Interstate 80
IM	Instruction Memorandum
KOP	Key Observation Point
kV	kilovolts
mg/l	milligrams per liter
mgd	million gallons per day
MMC	Marigold Mining Company
MSDS	Material Safety Data Sheets
MSHA	Mine Safety and Health Administration
MWMP	Meteoric Water Mobility Procedure
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Grave Protection and Repatriation Act of 1990
NDEP	Nevada Department of Environmental protection
NDOW	Nevada Division of Wildlife
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act of 1986
NNP	net neutralizing potential
NO_2	oxides of nitrogen

NOAA	National Oceanographic and Atmospheric Administration
NOI	Notice of Intent
NP	neutralizing potential
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NRS	Nevada Revised Statute
PM_{10}	particulate matter with an aerodynamic diameter of 10 microns or less
POO	Plan of Operations
PSD	Prevention of Significant Deterioration
RFFA	reasonably foreseeable future action
ROW	right-of-way
SARA	Superfund Amendments and Reauthorization Act
SHPO	State Historic Preservation Officer
SO_2	sulfur dioxide
SPPCo	Sierra Pacific Power Company
SVP	Society of Vertebrate Paleontology
TCLP	Toxicity Characterization Leaching Procedure
TDS	total dissolved solids
T/kT	tons/kiloton
tpy	tons per year
TSP	total suspended particulate
USCOE	U.S. Army Corps of Engineers
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound
VRM	Visual Resource Management
WAD	weak acid dissociable
WMC	Water Management Consultants
WSA	Wilderness Study Area

GLOSSARY

Alluvium	A general term for all detrital deposits resulting from the operations of modern rivers, including the sediments laid down in riverbeds, floodplains, lakes, and fans at the foot of mountain slopes and estuaries.
Ambient (air)	The surrounding atmospheric conditions.
Aquifer	A stratum of permeable rock, sand, etc, which contains water. Water source for a well.
Archaeology	The science that investigates the history of peoples by the remains belonging to the earlier periods of their existence.
Artifact	Any object showing human workmanship or modification especially from a prehistoric or historic culture.
Attenuate	To lessen, decrease, reduce a concentration.
Clean Water Act	Federal Water Pollution Control Act, as amended.
Contrast	The effect of a striking difference in the form, line, color, or texture of an area being viewed.
Cultural resources	Any site or artifact associated with cultural activities.
Endangered species	Any species in danger of extinction throughout all or a significant portion of its range. This definition excludes species of insects that the Secretary of the Interior determines to be pests and whose protection under the Endangered Species Act of 1973 would present an overwhelming and overriding risk to man.
Environment	The surrounding conditions, influences, or forces that affect or modify an organism or an ecological community and ultimately determine its form and survival.
Erosion	The group of processes whereby earth or rock material is loosened or dissolved and removed from any part of the earth's surface.
Fault	A fracture or fracture zone along which there has been displacement of the sides relative to one another parallel to the fracture.
Floodplain	That portion of a river valley, adjacent to the river channel, built of sediments and inundated with water at least once every 100 years.
Geology	The science that relates to the earth, the rocks of which it is composed, and the changes that the earth has undergone or is undergoing.

Habitat	A specific set of physical conditions that surround a single species, a group of species, or a large community. In wildlife management, the major components of habitat are considered to be food, water, cover, and living space.
Historic context	Planning document that is used as a cultural resources management tool. It groups information about related important cultural resources based on a specific theme, geographic limits, and chronology with the purpose of providing subsequent identification and framework for evaluation of the eligibility or significance of resources located at a later time in the same area. Historic contexts aid in planning and evaluating future cultural research.
Hydraulic Conductivity	The rate at which a porous medium can transmit water (units of length/time).
Hydrology	The science that relates to the water of the earth.
Impact	A modification in the status of the environment brought about by the Proposed Action.
Intrusive rock	Igneous rock formed within surrounding rock as a result of magma intrusion.
Jurisdictional waters	Areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.
Landform	A term used to describe the many types of land surfaces that exist as the result of geologic activity and weathering, e.g., plateaus, mountains, plains, and valleys.
Mil	1/1000 inch
Mineralization	Process by which minerals are introduced into a rock, resulting in an economically valuable or potentially valuable deposit.
One-hundred-year flood	A flood with a magnitude that may occur once every 100 years. A 1-in-100 chance of a certain area being inundated during any year.
Paleontology	The science that deals with the life of past geological ages through the study of the fossil remains of organisms.
Paleozoic	Span of time from end of Precambrian to beginning of Mesozoic ranging from about 570 million to 250 million years ago.
Particulate(s)	Minute, separate particles, such as dust or other air pollutants.
pH	The measure of acidity or basicity of a solution.

Physiographic province	Region in which all parts have similar geologic structure and climate and whose landforms differ significantly from those of other regions.
Project Area	The area in the immediate vicinity of the Marigold Mine Expansion Project.
Raptor	A bird of prey.
Region	A large tract of land generally recognized as having similar character types and physiographic types.
Right-of-way	Strip of land over which the powerline, access road, or maintenance road would pass.
Riparian area	A form of wetland transition between permanently saturated wetlands and upland areas. These areas exhibit vegetation or physical characteristics reflective of permanent surface or subsurface water influence. Lands along, adjacent to, or contiguous with perennially and intermittently flowing rivers and streams, glacial potholes, and the shores of lakes and reservoirs with stable water levels are typical riparian areas. Excluded are such sites as ephemeral streams or washes that do not exhibit the presence of vegetation dependent upon free water in the soil.
Sedimentary rock	Rock resulting from consolidation of loose sediment that has accumulated in layers.
Seismicity	The likelihood of an area being subjected to earthquakes. The phenomenon of earth movements.
Species	A group of individuals of common ancestry that closely resemble each other structurally and physiologically and in nature interbreed producing fertile offspring.
Stratigraphy	Form, arrangement, geographic distribution, chronologic succession, classification, and relationships of rock strata.
Tectonics	Large-scale structural features of the upper part of the earth's crust.
Tertiary	Span of time between 65 and 3 to 2 million years ago.
Threatened species	Any species likely to become endangered within the foreseeable future throughout all or a significant part of its range.
Transmission line	An electric power line operating at a voltage of 69 kilovolts or greater.
Transmissivity	A measure of the amount of water that can be transmitted horizontally by a porous medium (units of length2/time).
Uplift	Structurally high area in the crust produced by an upthrust of rocks.

Visual Resource Management	Classification of landscapes according to the kinds of classesof structures and changes that are acceptable to meet established visual goals (BLM designation).
Wetlands	Areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. BLM Manual 1737, Riparian-Wetland Area Management, includes marshes, shallow swamps, lakeshores, bogs, muskegs, wet meadows, estuaries, and riparian areas as wetlands.
Wind rose	A wind rose is a graphical representation of wind direction and wind speed frequencies.

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APPENDIX A

WATER RESOURCES AND GEOCHEMISTRY SUPPLEMENTAL DATA

Table A-1
Marigold Mine Waste Rock Amounts and Percentages

Report Year	Sample Date	Location	Geologic Unit	Foundation Tons	Geologic Unit % Annual Basis	Tests Conducted	Comments
1988							
		8 South Waste	Alluvium	3,625,360	100	NA	Mining initiated Sept. 1988
			1988 Total Waste	3,625,360			
1989							
		8 South Waste	Alluvium	10,866,384	76	NA	
			Havallah Form.	1,944,793	14	NA	
			Antler/Battle Seq.	1,137,308	8	NA	
			Valmy Form.	274,138	2	NA	
			1989 Total Waste	14,222,623			
1990							
		8 South Waste	Alluvium	7,568,496	65	NA	
		8 South Waste	Havallah	1,298,161	11	NA	
		8 South Waste	Antler/Battle Seq.	1,998,134	17	NA	
		8 South Waste	Valmy Form.	456,523	4	NA	
		Top Zone	Valmy Form.	343,033	3	NA	
			1990 Total Waste	11,664,347			
1991							
	01/07/92	8 South Waste	Alluvium	6,239,752	57	MWMP, AGP	1st characterization required
		8 South Waste	Havallah	1,182,719	11		
		8 South Waste	Antler/Battle Seq.	1,764,941	16		
		8 South Waste	Valmy Form.	1,185,171	11		
		Top Zone Waste	Valmy Form.	560,329	5	MWMP, AGP	
			1991 Total Waste	10,932,912			
1992							
1st Q	03/27/92	8 South Waste	Alluvium	627,140	18.9	MWMP, AGP	MWMP @ 6/15, AGP @ 7/21
		8 South Waste	Havallah	171,616	5.2		
		8 South Waste	Antler/Battle Seq.	39,803	1.2		
		8 South Waste	Valmy Form.	159,886	4.8		
		Top Zone Waste	Valmy Form.	562,360	17.0	MWMP, AGP	MWMP @ 6/15, AGP @ 7/21
2nd Q	06/15/92	8 South Waste	Alluvium	16,979	0.5	MWMP Only	
		8 South Waste	Havallah	22,727	0.7		
		8 South Waste	Antler/Battle Seq.	223,665	6.8		
		8 South Waste	Valmy Form.	137,701	4.2		
		Top Zone Waste	Valmy Form.	455,753	13.8	MWMP Only	

Source: Marigold Mine

Table A-1
Marigold Mine Waste Rock Amounts and Percentages

Report Year	Sample Date	Location	Geologic Unit	Foundation Tons	Geologic Unit % Annual Basis	Tests Conducted	Comments
3rd Q	11/23/92	8 South Waste	Havallah	10,816	0.3	AGP Only	
		8 South Waste	Antler/Battle Seq.	101,588	3.1		
		8 South Waste	Valmy Form.	153,741	4.6		
		East Hill	Valmy Form.	5,816	0.2		
		Top Zone Waste	Valmy Form.	198,562	6.0	AGP Only	
3rd Q	12/02/92	8 South Waste				AGP Only	
		Top Zone Waste	Valmy Form.			AGP Only	
4th Q	02/03/93	8 South Waste	Havallah	13,768	0.4	MWMP Only	MWMP @ 2/3
		8 South Waste	Antler/Battle Seq.	108,185	3.3		
		8 South Waste	Valmy Form.	137,923	4.2		
		Top Zone Waste	Valmy Form.	161,810	4.9	MWMP Only	MWMP @ 2/3
4th Q	02/11/93	8 South Waste				AGP Only	
		Top Zone Waste				AGP Only	
	All Q's		1992 Total Waste	3,309,839			
1993							
	All Q's	8 South Waste	Composited Q	809,595	16	MWMP, AGP	
	All Q's	Top Zone Waste	Composited Q	1,406,591	28	MWMP, AGP	
	3rd & 4th Q's	East Hill Waste	Composited Q	2,791,539	56	MWMP, AGP	
	All Q's		1993 Total Waste	5,007,725			
1994							
	Annual Composites	8 South Waste	Valmy	151,877	2	MWMP, AGP	New format
			Antler/Battle	404,631	5	MWMP, AGP	
		Top Zone Waste	Valmy	1,373,033	19	MWMP, AGP	
		East Hill Waste	Havallah	398,072	5	MWMP, AGP	
			Valmy	3,317,270	45	MWMP, AGP	
			Antler/Battle	707,685	10	MWMP, AGP	
		Red Rock	Antler/Battle	1,044,851	14	MWMP, AGP	
	All Q's		1994 Total Waste	7,397,419			

Source: Marigold Mine

Table A-1
Marigold Mine Waste Rock Amounts and Percentages

Report Year	Sample Date	Location	Geologic Unit	Foundation Tons	Geologic Unit % Annual Basis	Tests Conducted	Comments
1995							
	Annual Composites	East Hill	Havallah	543,557	13	MWMP, AGP	
			Antler/Battle	1,358,894	33	MWMP, AGP	
			Valmy	373,147	9	MWMP, AGP	
		Red Rock	Antler/Battle	475,237	12	MWMP, AGP	
			Valmy	155,545	4	MWMP, AGP	
		Top Zone	Valmy	1,169,849	29	MWMP, AGP	
	All Q's		1995 Total Waste	4,076,229			
1996							
	Annual Composites	East Hill	Antler/Battle	661,811	7	MWMP, AGP	
			Valmy	3,750,265	42	MWMP, AGP	
		Top Zone	Antler/Battle Seq.	365,450	4	MWMP, AGP	
			Valmy Form.	4,201,678	47	MWMP, AGP	
	All Q's		1996 Total Waste	8,979,204			
1997							
	Annual Composites	Top Zone	Valmy	5,701,801	66	MWMP, AGP	
			Antler/Battle	1,241,504	14	MWMP, AGP	
		East Hill North	Valmy	889,061	10	MWMP, AGP	
		East Hill South	Valmy	765,975	9	MWMP, AGP	
	All Q's		1997 Total Waste	8,598,341			
1998							
	Annual Composites	Old Marigold					
		East Hill North					
		East Hill South					
		Top Zone North					
		Top Zone South					
	All Q's		1998 Total Waste				

Source: Marigold Mine

Table A-2
Marigold Mine
Static Acid-Base Accounting Analyses

SAMPLE	SULFUR CONTENT: PYRITIC SULFUR (%)	SULFUR CONTENT: SULFATE SULFUR (%)	SULFUR CONTENT: UNIDENT SULFUR (%)	TOTAL SULFUR (%)	AGP (T/kT CaCO3): PYRITIC SULFUR	AGP (T/kT CaCO3): TOTAL SULFUR	ANP (T/kT CaCO3)	NNP (T/kT CaCO3): PYRITIC SULFUR	NNP (T/kT CaCO3): TOTAL SULFUR	ANP/AGP: PYRITIC SULFUR	ANP/AGP: TOTAL SULFUR	PASTE pH
TAILINGS SOLIDS												
Tailing Solids (F346-02A) 1/14/92	0.01	0.03	-0.01	0.04	0.3	1.2	334	333.7	332.8	1113.33	278.33	
Tailing Solids (G071-02B) 4/28/92	0.04	-0.01	-0.01	0.04	1.2	1.2	61.3	60.1	60.1	51.08	51.08	
Tailings Solids (G303-04A) 12/2/92	0.01	0.02	-0.01	0.03	0.3	0.9	49	48.7	48.1	163.33	54.44	
Tailings Solids (Monitor Lab 1493)						30.9	196		165.1		5.34	9.02
Tailing Solids (H006-04A) 2/11/93	0.01	0.04	0.96	1.01	0.3	3.03	20.4	20.1	17.37	68.00	6.73	
Tailings Solids (1st) (SVL E42468A) 7/12/93						15	19.7		4.7		0.31	9.52
Tailings Solids (2nd) (SVL E42469) 7/12/93						9.4	23.4		14		1.49	9.65
Tailings Solids (3rd) (SVL E52347) 12/2/93	0.89	0.02	0.69	1.6	26.7	48	119	92.3	71	4.46	2.48	8.58
Tailings Solids (4th) (SVL E52348) 12/2/93	0.64	0.05	0.85	1.54	19.2	46.2	118	98.8	71.8	6.15	2.55	8.63
Tails Comp-1 (SVL E76071) 2/5/94						25	173		148		5.92	8.64
Tails Comp-2 (SVL E76072) 12/5/94						25.2	172		146.8		5.83	8.86
LEACH SOLIDS												
Top Zone Leach (G071-02B)4/28/92	0.14	-0.01	-0.01	0.14	4.4	4.4	29.7	25.3	25.3	6.75	6.75	
8 South Leach (G071-02B) 4/28/92	0.15	-0.01	1.36	1.51	4.7	47.2	25.4	20.7	-21.8	5.40	0.54	
8-South Leach (G303-04A) 12/2/92	0.01	0.05	1.9	1.96	0.3	61.2	15.3	15	-45.9	51.00	0.25	
Top Zone Leach (G303-04A) 12/2/92	0.01	0.05	-0.01	0.06	0.3	1.8	7.4	7.1	5.6	24.67	4.11	
Top Zone Leach (Monitor Lab 1493) 6/17/92						3.34	10.2		6.86		2.05	8.33
8-South Leach (Monitor Lab 1493) 6/17/92						21.3	127		105.7		4.96	8.27
8-South Leach (H006-04A) 2/11/93	0.03	0.08	-0.01	0.11	0.9	3.3	32.8	31.9	29.5	36.44	9.94	
Top Zone Leach (H006-04A) 2/11/93	0.03	0.04	-0.01	0.07	0.9	2.1	45	44.1	42.9	50.00	21.43	
8-South Leach (1st) (SVL E42464) 7/12/93						0.6	20.1		19.5		32.50	8.15
8-South Leach (2nd) (SVL E42466) 7/12/93						19.2	30		10.8		0.56	7.74
8-South Leach (3rd) (SVL E52340) 12/2/93	0.17	-0.01	2.04	2.21	5.1	66.3	148	142.9	81.7	29.02	2.23	8.17
8-South Leach (4th) (SVL E52341) 12/2/93	0.48	-0.01	1.25	1.73	14.4	51.9	204	189.6	152.1	14.17	3.93	8
Top Zone Leach (1st) (SVL E42470) 7/12/93						0.3	6		5.7		19.00	8.62
Top Zone Leach (2nd) (SVL E42472) 7/12/93						0.8	10.4		9.6		12.00	8.12
Top Zone Leach (4th) (SVL E52346) 12/2/93	0.15	0.03	0.01	0.19	4.5	5.7	18.1	13.6	12.4	4.02	3.18	7.91
East Hill Leach (1st) (SVL E52434) 12/2/93	0.75	0.24	0.59	1.58	22.5	47.4	101	78.5	53.6	4.49	2.13	8.12

Table A-2
Marigold Mine
Static Acid-Base Accounting Analyses

8 SOUTH WASTE	SULFUR CONTENT				AGP (T/kT CaCO3)		ANP (T/kT CaCO3)	NNP (T/kT CaCO3)		ANP/AGP		PASTE pH
SAMPLE	PYRITIC SULFUR (%)	SULFATE SULFUR (%)	UNIDENT SULFUR (%)	TOTAL SULFUR (%)	PYRITIC SULFUR	TOTAL SULFUR		PYRITIC SULFUR	TOTAL SULFUR	PYRITIC SULFUR	TOTAL SULFUR	
8-South Waste (F346-02A) 1/14/92	0.02	0.04	-0.01	0.06	0.6	1.8	19.6	19	17.8	32.67	10.89	
8-South Waste (G071-02B) 4/28/92	0.12	-0.01	-0.01	0.12	3.8	3.8	60.2	56.4	56.4	15.84	15.84	
8-South Waste (G303-04A) 12/2/92	0.01	0.06	-0.01	0.07	0.3	2.1	442	441.7	439.9	1473.33	210.48	
8-South Waste (Monitor Lab 1493) 6/17/92						2.19	129		126.81		57.90	8.32
8-South Waste (H006-04A) 2/11/93	0.02	0.04	-0.01	0.06	0.6	1.8	86	85.4	84.2	143.33	47.78	
8-South Waste (1st) (SVL E42465) 7/12/93						4.4	63.3		58.9		13.39	8.73
8-South Waste (2nd) (SVL E42465) 8/3/93						1.5	22.9		21.4		14.27	8.01
8-South Waste (3rd) (SVL E52342) 12/2/93	0.66	-0.01	0.07	0.73	19.8	21.9	38.8	19	16.9	1.96	1.77	7.89
8-South Waste (4th) (SVL E52343) 12/2/93	0.74	-0.01	0.56	1.3	22.2	39	121	98.8	82		2.10	7.92
8-South Valmy (SVL E76062) 12/5/94						0.3	36.7		36.4		121.33	7.71
8-South Antler (SVL E76063) 12/5/94						0.3	548		547.7		1825.67	8.46
8-South Battle (SVL E76064) 12/5/94						2.1	36.4		34.3		16.33	8.57
TOP ZONE NORTH WASTE												
Top Zone Waste (F346-02A) 1/14/92	-0.01	0.01	-0.01	0.01	-0.3	0.3	4.3	4.6	4	-14.33	14.33	
Top Zone Waste (G071-02B) 4/28/92	0.44	-0.01	-0.01	0.44	13.8	13.8	30.7	16.9	16.9	2.22	2.22	
Top Zone Waste (G303-04A) 12/2/92	0.01	0.1	-0.01	0.11	0.3	3.3	10.2	9.9	6.9	34.00	3.09	
Top Zone Waste (Monitor Lab 1493) 6/17/92						4.38	12		7.62		1.74	8.66
Top Zone Waste (H006-04A) 2/11/93	0.03	0.02	-0.01	0.05	0.9	1.5	41	40.1	39.5	45.56	27.33	
Top Zone Waste (1st) (SVL E42471) 7/12/93						1.4	15.9		14.5		10.36	9.35
Top Zone Waste (2nd) (SVL E42473) 7/12/93						0.3	10		9.7		32.33	8.52
Top Zone Waste (3rd) (SVL E52344) 12/2/93	0.06	0.01	-0.01	0.07	1.8	2.1	23.7	21.9	21.6	13.17	11.29	8.13
Top Zone Waste (4th) (SVL E52345) 12/2/93	0.04	0.01	-0.01	0.05	1.2	1.5	19.6	18.4	18.1	16.33	13.07	7.81
Top Zone Valmy (SVL E76065) 12/5/94						0.3	7.1		6.8		22.67	8.44
Top Zone Valmy (1995) (SVL 144632) 6/4/97	0.01	-0.01	-0.01	0.01	0.3	0.3	4.9	4.6	4.6	16.33	16.33	
Top Zone Antler (1996) (SVL 144633)	0.03	0.01	-0.01	0.04	0.3	1.2	404	403.7	402.8	1346.67	336.67	
Top Zone Valmy (1996) (SVL 144634)	0.05	0.04	-0.01	0.09	1.6	2.8	12.2	10.6	9.4	7.63	4.36	
Top Zone Antler (1997) (SVL 158910)	0.01	0.05	-0.01	0.06	0.3	1.8	372	371.7	370.2	1240.00	206.67	
Top Zone Valmy (1997) (SVL 158911)	0.01	0.02	-0.01	0.03	0.3	0.9	372	371.7	371.1	1240.00	413.33	

Table A-2
Marigold Mine
Static Acid-Base Accounting Analyses

TOP ZONE WASTE	SULFUR CONTENT				AGP (T/kT CaCO3)		ANP (T/kT CaCO3)	NNP (T/kT CaCO3)		ANP/AGP		PASTE pH
SAMPLE	PYRITIC SULFUR (%)	SULFATE SULFUR (%)	UNIDENT SULFUR (%)	TOTAL SULFUR (%)	PYRITIC SULFUR	TOTAL SULFUR		PYRITIC SULFUR	TOTAL SULFUR	PYRITIC SULFUR	TOTAL SULFUR	
Top Zone South Waste Antler (6/4/97)	0.03	0.01	-0.01	0.04	0.9	1.2	404	403.1	402.8	448.89	336.67	
Top Zone South Waste Valmy (6/4/97)	0.05	0.04	-0.01	0.09	1.5	2.7	12.2	10.7	9.5	8.13	4.52	
Top Zone South Waste Valmy (11/19/97)	0.01	0.05	-0.01	0.06	0.3	1.8	372	371.7	370.2	1240.00	206.67	
Top Zone South Waste Antler (11/19/97)	0.01	0.02	-0.01	0.03	0.3	0.9	10.2	9.9	9.3	34.00	11.33	
EAST HILL NORTH WASTE												
East Hill Waste (3rd) (SVL E52349) 12/2/93	-0.01	0.08	-0.01	0.08	0.3	2.4	39.7	39.4	37.3	132.33	16.54	8.1
East Hill Waste (4th) (SVL E52350) 12/2/93	0.06	0.03	-0.01	0.09	1.8	2.7	45.4	43.6	42.7	25.22	16.81	8.14
East Hill Havallah (SVL E76066) 12/5/94						1	56		55		55.00	8.95
East Hill Valmy (SVL E76067) 12/5/94						0.3	4.9		4.6		15.33	8.36
East Hill Antler (SVL E76068) 12/5/94						0.3	690		689.7		2299.00	8.95
East Hill Havallah (1995) (SVL 144627) 6/4/97	0.05	0.05	-0.01	0.1	1.6	3.2	40.3	38.7	37.1	25.19	12.59	
East Hill Antler (1995) (SVL 144628) 6/4/97	0.01	0.03	-0.01	0.04	0.3	1.2	703	702.7	701.8	2343.33	585.83	
East Hill Valmy (1995) (SVL 144629) 6/4/97	0.01	-0.01	-0.01	0.01	0.3	0.3	5.8	5.5	5.5	19.33	19.33	
East Hill Antler (1996) (SVL 144630) 6/4/97	0.01	0.02	-0.01	0.03	0.3	0.9	563	562.7	562.1	1876.67	625.56	
East Hill Valmy (1996) (SVL 144631) 6/4/97	-0.01	-0.01	-0.01	0.01	0.3	0.3	1.8	1.5	1.5	6.00	6.00	
East Hill N Valmy (1997) (SVL 158908) 11/19/97	-0.01	-0.01	-0.01	0.01	0.3	0.3	6	5.7	5.7	20.00	20.00	
EAST HILL SOUTH WASTE												
East Hill S Valmy (1997) (SVL 158909) 11/19/97	0.04	0.05	-0.01	0.09	1.3	2.7	37.8	36.5	35.1	29.08	14.00	
RED ROCK NORTH WASTE												
Red Rock Battle (SVL E76069) 12/5/94						0.3	488		487.7		1625.67	9.3
Red Rock Antler (SVL E76070) 12/5/94						0.3	150		149.7		499.00	9.07
Red Rock Antler (1995) (SVL 144635) 6/4/97	0.06	-0.01	-0.01	0.06	1.9	1.9	526	524.1	524.1	276.84	276.84	
Red Rock Valmy (1995) (SVL 144636) 6/4/97	-0.01	-0.01	-0.01	0.01	0.3	0.3	8.9	8.6	8.6	29.67	29.67	

Table A-2
Marigold Mine
Static Acid-Base Accounting Analyses

SAMPLE	SULFUR CONTENT				AGP (T/kT CaCO3)		ANP (T/kT CaCO3)	NNP (T/kT CaCO3)		ANP/AGP		PASTE pH
	PYRITIC SULFUR (%)	SULFATE SULFUR (%)	UNIDENT SULFUR (%)	TOTAL SULFUR (%)	PYRITIC SULFUR	TOTAL SULFUR		PYRITIC SULFUR	TOTAL SULFUR	PYRITIC SULFUR	TOTAL SULFUR	
5 NORTH WASTE												
5 North Antler Peak (1998) (SVL 192045)	0.06	0.06	0	0.12	1.9	3.8	542	540.1	538.2	285.26	142.63	8.24
5 North Battle Fm (1998) (SVL 192046)	0.01	0.02	0	0.03	0.3	0.9	214	213.7	213.1	713.33	237.78	8
5 North Edna Mtn (1998) (SVL 192047)	0.13	0.04	0	0.17	4.1	5.3	96.5	92.4	91.2	23.54	18.21	7.86
5 North Havallah (1998) (SVL 192048)	0.08	0.01	0	0.09	2.5	2.8	20.8	18.3	18	8.32	7.43	7.81
8 NORTH WASTE												
8 North Edna Mtn (1998) (SVL 192049)	0.33	0	0.05	0.38	10.4	12	51.2	40.8	39.2	4.92	4.27	7.98
8 North Havallah (1998) (SVL 192050)	0.13	0	0.08	0.21	4.1	6.6	14	9.9	7.4	3.41	2.12	7.89

Table A-3
Marigold Mine Meteoric Water Mobility Procedure Analyses

TAILINGS SOLIDS										
SAMPLE LOC.	Tailing	Tailing	Tailings	Tailings	Tailings	Tailings	Tailings	Tailings	Tailings	Tailings
SAMPLE TYPE	Solids	Solids	Solids	Solids	Solids (1st)	Solids (2nd)	Solids (3rd)	Solids (4th)	Comp-1	Comp-2
SAMPLE NO.	F246-02	G071-02	G303-04L	H006-04L	E42468A	E42469	E52347	E52348	E76071	E76072
DATE	1992	4/10/92	11/23/92	2/3/93	7/12/93	7/12/93	12/2/93	12/2/93	2/5/94	2/5/94
CROSS REF	ABA-3	ABA-8	ABA-13	ABA-23	ABA-42	ABA-43	ABA-44	ABA-45	ABA-55	ABA-56
CONSTITUENT										
pH	8.96	8.79	8.3	8.2	8.8	8.9	8.6	8.6	8.4	8.5
TDS	428	390	412	374	227	273	115	233	178	191
SULFATE	12.5	20.6	104	41.6	53.8	69.4	29	66.9	38.3	43.1
ALKALINITY	44	44	103	126	61	77	67	88	66	63
CHLORIDE	33.15	20	53.18	43	21.8	22.2	9.1	21.2	13.2	14.2
NITRATE	1	0.24	1.23	1.16	2.32	2.22	0.25	1.09	0.5	0.45
PHOSPHORUS	0.919	0.395	0.35	0.716	0.08	0.11	-0.07	0.08	-0.3	-0.3
WAD CYANIDE	0.4	0.122	-0.02	0.87	0.28	0.12	0.1	0.23	0.167	0.201
ALUMINUM	1.062	1.484	0.172	9.42	0.87	0.2	0.06	0.05	0.07	-0.03
ANTIMONY	-0.025	-0.05	-0.05	-0.05	0.014	0.2	0.014	0.026	0.012	0.017
ARSENIC	0.636	0.068	2.02	0.304	0.44	3.88	0.31	3.73	0.59	1.22
BARIUM	2.051	0.582	0.32	1.465	0.298	0.154	0.12	0.056	0.23	0.189
CADMIUM	-0.005	0.14	-0.005	-0.005	0.002	-0.002	-0.002	-0.002	-0.004	-0.004
CHROMIUM	-0.025	0.078	0.336	0.019	0.011	0.09	-0.004	0.257	0.011	0.019
COBALT	-0.007	0.032	-0.015	0.027	0.042	0.014	0.017	0.033	-0.008	-0.008
COPPER	-0.5	0.116	0.22	0.03	0.01	0.008	-0.005	-0.005	-0.003	0.003
FLUORIDE	0.143	-0.2	5.65	0.34	0.3	4.1	0.3	2.6	0.62	0.64
IRON	1.347	1.47	0.68	6.55	1.36	0.28	0.54	0.47	0.349	0.343
LEAD	-0.025	-0.025	-0.01	-0.025	0.002	0.001	-0.001	-0.001	-0.001	-0.001
MANGANESE	0.176	0.193	0.032	0.134	-0.002	-0.002	0.007	-0.002	-0.002	-0.002
MERCURY	-0.001	0.1775	0.171	0.0499	0.1	0.25	0.0003	0.305	0.113	0.214
MOLYBDENUM	0.045	0.024	0.029	-0.01	0.039	0.04	0.02	0.046	0.01	0.02
NICKEL	-0.015	0.125	-0.025	0.043	0.04	0.02	0.02	0.02	-0.02	-0.02
SELENIUM	-0.005	-0.005	-0.002	-0.002	-0.04	-0.04	0.002	0.013	-0.04	-0.04
SILVER	-0.025	-0.02	-0.05	-0.05	0.005	0.007	-0.003	0.006	-0.004	-0.004
THALLIUM	0.037	0.225	-0.1	-0.1	-0.001	0.001	0.001	0.004	-0.001	-0.001
TIN	0.007	0.022	-0.05	-0.05	-0.06	-0.06	-0.03	-0.03	-0.04	-0.04
VADADIUM	0.047	0.101	-0.01	0.034	0.034	0.081	0.011	0.029	-0.01	-0.01
ZINC	0.088	0.13	-0.05	-0.05	0.008	0.004	-0.002	-0.002	-0.004	-0.004

Table A-3
Marigold Mine Meteoric Water Mobility Procedure Analyses

TAILINGS SOLIDS	Tailings Solids	Tailings Solids	Tailings Solids	Tailings Solids	Tailings Solids	Tailings Solids
SAMPLE LOC.	Monitor Lab					
SAMPLE TYPE	1992	2/7/96	2/5/94	2/5/94	4/7/98	1/10/97
SAMPLE NO.	ABA-18					
DATE						
CROSS REF						
CONSTITUENT						
pH	8.6	8.76	8.4	8.5	8.72	9.1
TDS	279	145	178	191	315	251
SULFATE	53.9	28.4	38.3	43.1	62.8	51.1
ALKALINITY	39.9	57.8	66	63	78.2	74.3
CHLORIDE	43.6	4.88	13.2	14.2		40.4
NITRATE	2.6	2.14	0.5	0.45	2.55	8.33
PHOSPHORUS	0.046	-0.18	-0.03	-0.3	-0.11	-0.11
WAD CYANIDE		0.04	0.167	0.201	0.36	0.24
ALUMINUM		0.03	0.07	-0.03	-0.037	0.711
ANTIMONY		0.043	0.012	0.017	0.055	0.013
ARSENIC	5.02	0.36	0.59	1.22	1.62	0.62
BARIUM		0.236	0.23	0.189	0.188	0.189
CADMIUM		-0.0024	-0.004	-0.004	-0.002	-0.002
CHROMIUM		-0.005	0.011	0.019	0.016	-0.008
COBALT		-0.005	-0.008	-0.008	0.015	0.041
COPPER		-0.003	-0.003	0.003	0.007	0.004
FLUORIDE	4.87	0.82	0.62	0.64	1.2	0.6
IRON		0.134	0.349	0.343	0.509	0.661
LEAD		-0.001	-0.001	-0.001	-0.001	-0.001
MANGANESE		0.004	-0.002	-0.002	0.001	0.005
MERCURY	0.308	-0.0002	0.113	0.214	0.0134	0.0008
MOLYBDENUM		0.018	0.01	0.02	0.032	0.034
NICKEL	-0.04	-0.017	-0.02	-0.02	-0.016	0.017
SELENIUM	0.026	0.06	-0.04	-0.04	-0.048	0.069
SILVER		-0.003	-0.004	-0.004	-0.005	0.005
THALLIUM		-0.001	-0.001	-0.001	-0.001	-0.001
TIN		-0.046	-0.04	-0.04	-0.038	-0.038
VADADIUM		0.009	-0.01	-0.01	0.008	0.008
ZINC		0.002	0.004	0.004	0.005	0.012

Table A-3
Marigold Mine Meteoric Water Mobility Procedure Analyses

LEACH SOLIDS										
SAMPLE LOC.	Top Zone	8-South	8-South	Top Zone	8-South	8-South	8-South	8-South	Top Zone	Top Zone
SAMPLE TYPE	Leach	Leach	Leach	Leach	Leach (1st)	Leach (2nd)	Leach (3rd)	Leach (4th)	Leach (1st)	Leach (2nd)
SAMPLE NO.	G071-02	G071-02	G303-04L	G303-04L	E42464	E42466	E52340	E52341	E42470	E42472
DATE	3/27/92	3/27/92	11/23/92	11/23/92	7/12/93	7/12/93	12/2/93	12/2/93	7/12/93	7/12/93
CROSS REF	ABA-4	ABA-6	ABA-10	ABA-12	ABA-34	ABA-35	ABA-36	ABA-37	ABA-38	ABA-39
CONSTITUENT										
pH	7.59	8.01			6.8	6.9	8.2	8.1	7.5	6.9
TDS	163	121			86	106	119	108	215	227
SULFATE	7	6.2			18.3	19.3	24.1	18.3	44.7	28.9
ALKALINITY	23	42			56	62	76	66	62	63
CHLORIDE	36.24	113.4			1.7	1.8	7.5	3.7	26.7	39.7
NITRATE	0.024	0.49			0.47	0.34	1.15	1.33	0.64	2.61
PHOSPHORUS	0.181	-0.1	-0.25	0.125	0.17	0.15	-0.07	-0.07	0.03	0.07
WAD CYANIDE	-0.005	-0.005			-0.01	-0.01	-0.01	-0.01	-0.01	0.06
ALUMINUM	0.678	0.209	0.024	0.754	-0.01	-0.01	-0.02	-0.02	0.02	-0.01
ANTIMONY	-0.05	-0.05	-0.05	-0.05	0.002	-0.001	0.004	0.002	0.01	0.002
ARSENIC	-0.05	-0.05	-0.005	0.973	0.04	-0.04	0.05	0.04	0.26	0.18
BARIUM	0.089	0.15	0.102	0.141	0.19	0.181	0.171	0.184	0.102	0.181
CADMIUM	-0.005	-0.005	-0.005	-0.005	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002
CHROMIUM	0.056	0.052	-0.01	-0.01	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004
COBALT	0.022	0.022	-0.015	-0.015	-0.002	-0.002	0.004	-0.003	-0.002	-0.002
COPPER	0.052	0.5	-0.01	-0.01	0.003	0.004	-0.005	-0.005	0.003	0.003
FLUORIDE	-0.2	-0.2			0.6	0.4	0.6	0.5	1.2	1.7
IRON	0.227	0.152	-0.05	0.11	-0.02	-0.02	-0.01	-0.01	-0.02	-0.02
LEAD	-0.025	-0.025	-0.01	0.017	-0.001	-0.001	0.001	-0.001	0.002	0.001
MANGANESE	0.095	0.09	-0.005	0.059	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002
MERCURY	0.0018	0.0051	0.0084	0.0406	-0.0002	0.0011	-0.0002	-0.0002	0.01	0.23
MOLYBDENUM	-0.005	-0.008	0.048	-0.015	0.02	0.012	0.016	0.009	0.015	0.018
NICKEL	0.106	0.111	-0.025	-0.025	0.01	-0.01	-0.01	-0.01	-0.01	-0.01
SELENIUM	-0.005	-0.025	-0.002	-0.002	-0.04	-0.04	0.002	0.002	-0.04	-0.04
SILVER	-0.02	-0.02	-0.05	-0.05	0.002	-0.002	-0.003	-0.003	0.002	0.002
THALLIUM	0.194	0.233	-0.1	-0.1	-0.001	-0.001	0.002	-0.001	-0.001	0.001
TIN	0.027	0.063	-0.05	-0.05	-0.06	-0.06	-0.03	-0.03	-0.06	-0.06
VADADIUM	0.016	0.012	-0.01	-0.01	0.004	-0.003	0.007	0.005	-0.003	0.006
ZINC	0.076	0.062	-0.05	-0.05	0.003	0.003	-0.002	-0.002	0.002	-0.002

Table A-3
Marigold Mine Meteoric Water Mobility Procedure Analyses

LEACH SOLIDS				
SAMPLE LOC.	Top Zone	East Hill	Top Zone	8-South
SAMPLE TYPE	Leach (4th)	Leach (4th)	Leach	Leach
SAMPLE NO.	E52346	E52434	Monitor Lab	Monitor Lab
DATE	12/2/93	12/2/93	6/15/92	6/15/92
CROSS REF	ABA-40	ABA-41	ABA-14	ABA-16
CONSTITUENT				
pH	7.9	8.1	7.6	8
TDS	224	1860	82	36
SULFATE	23.4	643	19.9	8.17
ALKALINITY	71	100	57.1	34.4
CHLORIDE	7.6	566	3.04	4.06
NITRATE	15	1.61	0.4	1
PHOSPHORUS	-0.07	-0.07	0.028	1.5
WAD CYANIDE	-0.01	-0.01		
ALUMINUM	0.02	0.02		
ANTIMONY	0.009	0.002		
ARSENIC	0.6	0.8	0.148	0.031
BARIUM	0.167	0.021		
CADMIUM	-0.002	-0.002		
CHROMIUM	-0.004	0.024		
COBALT	0.004	0.004		
COPPER	-0.005	-0.005		
FLUORIDE	1.02	1.8	0.724	0.119
IRON	-0.01	-0.01		
LEAD	-0.001	-0.001		
MANGANESE	-0.002	-0.002		
MERCURY	0.0023	0.0005	-0.0005	0.0137
MOLYBDENUM	0.016	0.227		
NICKEL	-0.01	0.01	-0.04	-0.04
SELENIUM	0.002	0.003	-0.005	-0.005
SILVER	-0.003	-0.003		
THALLIUM	0.001	0.002		
TIN	-0.03	-0.03		
VADADIUM	0.004	-0.003		
ZINC	-0.002	-0.002		

Table A-3
Marigold Mine Meteoric Water Mobility Procedure Analyses

8 SOUTH WASTE										
SAMPLE LOC.	8-South	8-South	8-South	8-South	8-South	8-South	8-South	8-South	8-South	8-South
SAMPLE TYPE	Waste	Waste	Waste	Waste	Waste (1st)	Waste (2nd)	Waste (3rd)	Waste (4th)	Valmy	Antler
SAMPLE NO.	F346-02A	G071-02	G303-04L	H006-04L	E42465	E42467	E52342	E52543	E76062	E76063
DATE	1/7/92	3/27/92	4/23/92	2/3/93	7/12/93	7/12/93	12/2/93	12/2/93	12/5/94	12/5/94
CROSS REF	ABA-1	ABA-7	ABA-9	ABA-20	ABA-24	ABA-25	ABA-26	ABA-27	ABA-46	ABA-47
CONSTITUENT										
pH	8.62	7.95	8.55	8.24	8.2	8.05	7.49	7.9	8	8.6
TDS	34	108	27	209	105	98	100	129	211	233
SULFATE	8	8	6	19.5	18.5	19.7	25.8	20.9	9.59	25.8
ALKALINITY	37	42	37.5	78	56	60	85	71	76	161
CHLORIDE	1.77	4.99	8.86	11	2.6	2	5	3	2.75	11.4
NITRATE	0.5	0.44	4.5	1.64	1.12	0.7	1.83	2.4	0.19	0.28
PHOSPHORUS	0.249	0.103	-0.25	-0.25	0.09	0.07	-0.07	-0.07	-0.3	-0.3
WAD CYANIDE	-0.02	-0.005	-0.02	-0.02	-0.01	-0.01	-0.01	-0.01	-0.005	-0.005
ALUMINUM	0.508	0.145	0.074	-0.065	-0.01	-0.01	-0.02	-0.02	-0.03	-0.03
ANTIMONY	0.018	-0.05	-0.05	-0.05	-0.001	0.002	-0.001	0.003	0.002	0.004
ARSENIC	0.124	-0.05	-0.05	-0.005	-0.04	-0.04	-0.04	0.06	0.23	0.11
BARIUM	0.044	0.127	0.279	0.178	0.189	0.164	0.17	0.203	0.342	0.212
CADMIUM	-0.005	-0.005	-0.005	-0.005	-0.002	-0.002	-0.002	-0.002	-0.004	-0.004
CHROMIUM	-0.025	0.054	0.015	0.013	-0.004	0.007	0.012	-0.004	-0.004	-0.004
COBALT	-0.007	0.023	-0.01	-0.015	-0.002	-0.002	0.003	-0.003	-0.008	-0.008
COPPER	-0.5	0.054	-0.01	-0.01	0.003	0.002	-0.005	-0.05	-0.003	-0.003
FLUORIDE	-0.05	-0.2	0.15	0.29	0.3	1.1	0.7	0.7	0.64	0.78
IRON	0.185	0.105	0.1	-0.1	-0.02	-0.02	-0.01	-0.01	-0.009	-0.009
LEAD	-0.025	-0.025	-0.01	-0.01	0.001	0.001	-0.001	0.001	0.001	-0.001
MANGANESE	-0.025	0.088	-0.005	-0.01	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002
MERCURY	-0.001	0.0251	0.012	0.0045	0.0006	0.0005	0.0012	-0.0002	-0.0002	-0.0002
MOLYBDENUM	0.056	-0.008	-0.01	0.029	0.005	0.02	0.029	0.016	-0.01	0.02
NICKEL	-0.015	0.104	-0.025	-0.025	0.02	-0.01	-0.01	-0.01	-0.02	-0.02
SELENIUM	-0.005	-0.005	-0.002	-0.002	-0.04	-0.04	0.02	0.002	-0.04	-0.04
SILVER	-0.025	-0.02	-0.05	-0.05	0.002	-0.002	-0.003	-0.003	-0.004	-0.004
THALLIUM	-0.04	0.19	0.071	-0.1	0.001	-0.001	-0.001	-0.001	-0.001	-0.001
TIN	-0.08	0.044	-0.05	0.1	-0.06	-0.06	-0.03	-0.03	-0.04	-0.04
VADADIUM	-0.008	0.014	-0.01	-0.01	-0.003	0.008	0.005	0.004	-0.01	-0.01
ZINC	0.016	0.064	-0.05	-0.05	-0.002	-0.002	-0.002	-0.002	-0.004	-0.004

Table A-3
Marigold Mine Meteoric Water Mobility Procedure Analyses

8 SOUTH WASTE		
SAMPLE LOC.	8-South	8-South
SAMPLE TYPE	Battle	Waste
SAMPLE NO.	E76064	Monitor Lab
DATE	12/5/94	6/15/92
CROSS REF	ABA-48	ABA-17
CONSTITUENT		
pH	8.5	7.6
TDS	180	68
SULFATE	18	9.92
ALKALINITY	65	50.2
CHLORIDE	3.08	6.08
NITRATE	0.05	0.9
PHOSPHORUS	-0.3	0.02
WAD CYANIDE	-0.005	
ALUMINUM	0.03	
ANTIMONY	0.026	
ARSENIC	0.18	0.036
BARIUM	0.41	
CADMIUM	-0.004	
CHROMIUM	-0.004	
COBALT	-0.008	
COPPER	0.004	
FLUORIDE	1.08	0.195
IRON	-0.009	
LEAD	0.002	
MANGANESE	0.002	
MERCURY	0.0003	0.00946
MOLYBDENUM	0.04	
NICKEL	-0.02	-0.04
SELENIUM	-0.04	-0.005
SILVER	-0.004	
THALLIUM	-0.001	
TIN	-0.04	
VADADIUM	0.01	
ZINC	-0.004	

Table A-3
Marigold Mine Meteoric Water Mobility Procedure Analyses

TOP ZONE N WASTE										
SAMPLE LOC.	Top Zone	Top Zone	Top Zone	Top Zone	Top Zone	Top Zone	Top Zone	Top Zone	Top Zone	Top Zone
SAMPLE TYPE	Waste	Waste	Waste	Waste	Waste (1st)	Waste (2nd)	Waste (3rd)	Waste (4th)	Valmy	Valmy
SAMPLE NO.	F246-02	G071-02	G303-04L	H006-041L	E42471	E42473	E52344	E52345	E76065	TAZ95-1
DATE	1/14/92	3/27/92	11/23/92	2/3/93	7/12/93	7/12/93	12/2/93	12/2/93	12/2/93	6/4/97
CROSS REF	ABA-2	ABA-5	ABA-11	ABA-22	ABA-28	ABA-29	ABA-30	ABA-31	ABA-49	ABA-62
CONSTITUENT										
pH		7.85		7.72	7.1	7.3	8.1	7.8	8.2	8.25
TDS		518		267	183	293	329	132	179	102
SULFATE		44		7.2	36.7	52.9	92.4	15.9	21.1	15.6
ALKALINITY		40		74	93	72	124	71	88	45
CHLORIDE		9.99		14	3.3	71.7	24.9	4.1	8.84	8.1
NITRATE		0.5		0.76	0.37	2.61	0.65	-0.01	0.33	1.55
PHOSPHORUS	0.068	0.252	0.288	-0.25	0.15	0.07	0.13	-0.07	-0.3	-0.18
WAD CYANIDE		-0.005		-0.02	-0.01	-0.01	-0.01	-0.01	-0.005	-0.01
ALUMINUM	0.113	0.49	1.665	4.692	0.43	0.03	0.09	0.06	-0.03	0.142
ANTIMONY	-0.025	-0.05	-0.05	-0.05	0.007	0.002	0.004	0.008	0.01	-0.003
ARSENIC	0.094	0.061	1.067	0.247	1.28	0.15	0.96	0.77	0.36	0.78
BARIUM	-0.025	0.118	0.292	0.112	0.104	0.452	0.18	0.211	0.208	0.258
CADMIUM	-0.025	-0.005	-0.005	-0.005	-0.002	-0.002	-0.002	-0.002	-0.004	-0.0024
CHROMIUM	-0.005	0.051	0.016	0.016	0.007	0.005	-0.004	-0.004	-0.004	-0.005
COBALT	-0.007	0.023	-0.015	-0.015	-0.002	-0.002	-0.03	-0.003	-0.008	-0.005
COPPER	-0.5	0.152	0.062	-0.01	0.005	0.007	-0.005	-0.005	-0.003	0.005
FLUORIDE		0.3		0.48	2.3	1.8	2.4	1	1.62	1.6
IRON	-0.15	0.259	0.29	0.26	0.1	-0.02	-0.01	-0.01	-0.009	0.031
LEAD	-0.025	-0.025	-0.01	0.026	0.001	0.001	-0.001	-0.001	0.001	-0.001
MANGANESE	-0.025	0.115	0.045	0.013	-0.002	-0.002	0.003	-0.002	-0.002	0.034
MERCURY	-0.001	0.0031	0.008	0.0021	0.0008	0.0049	0.0006	0.0004	-0.0002	-0.0002
MOLYBDENUM	-0.008	-0.008	-0.01	-0.01	0.063	0.021	0.027	0.007	0.01	0.064
NICKEL	-0.015	0.121	-0.025	-0.025	-0.01	-0.01	-0.01	-0.01	-0.02	-0.017
SELENIUM	-0.005	-0.005	-0.002	-0.002	-0.04	-0.04	0.004	0.003	-0.04	-0.04
SILVER	-0.025	-0.02	-0.05	-0.05	0.003	0.003	-0.003	-0.003	-0.004	0.007
THALLIUM	-0.04	0.101	-0.1	-0.1	0.001	0.001	-0.001	-0.001	-0.001	-0.001
TIN	-0.08	0.097	-0.05	0.089	0.07	-0.06	-0.03	-0.03	-0.04	-0.046
VADADIUM	-0.008	0.081	0.015	-0.01	0.009	0.009	0.021	-0.003	0.01	-0.004
ZINC	0.005	0.739	-0.05	-0.05	0.003	0.002	-0.002	-0.002	-0.004	-0.002

Table A-3
Marigold Mine Meteoric Water Mobility Procedure Analyses

TOP ZONE N WASTE			TOP ZONE S WASTE			
SAMPLE LOC.	Top Zone		Top Zone S	Top Zone S	Top Zone S	Top Zone S
SAMPLE TYPE	Waste		Antler	Valmy	Antler	Valmy
SAMPLE NO.	Monitor Lab		TZ96-1	TZ96-2	TZ97-A	TZ97-V
DATE	6/15/92		6/4/97	6/4/97	11/19/97	11/19/97
CROSS REF	ABA-15		ABA-63	ABA-64	ABA-70	ABA-71
CONSTITUENT						
pH	8.2		8.42	8.33	6.67	7.03
TDS	1480		72	88	79	121
SULFATE	19.1		17.4	30.2	15	13
ALKALINITY	67.8		52.8	44.7	50	61.7
CHLORIDE	20.3		2.2	18	3.7	5.7
NITRATE	2.6		4.06	1.86	0.44	0.55
PHOSPHORUS	-0.01		-0.18	-0.18	-0.11	-0.11
WAD CYANIDE			-0.01	-0.01	-0.01	-0.01
ALUMINUM			0.061	0.059	0.05	0.119
ANTIMONY			-0.003	-0.003	0.004	-0.003
ARSENIC	0.787		0.09	0.3	0.08	0.25
BARIUM			0.186	0.112	0.149	0.255
CADMIUM			-0.0024	-0.0024	-0.002	-0.002
CHROMIUM			-0.005	-0.005	-0.008	0.008
COBALT			-0.005	-0.005	0.006	-0.003
COPPER			0.007	0.005	-0.004	-0.004
FLUORIDE	1.75		0.4	0.8	0.2	0.8
IRON			-0.024	-0.024	-0.019	0.031
LEAD			-0.001	-0.001	-0.001	0.016
MANGANESE			0.003	-0.002	0.005	0.004
MERCURY	0.0035		-0.0002	-0.0002	0.0003	0.0005
MOLYBDENUM			0.059	0.032	0.021	0.021
NICKEL	0.07		-0.017	-0.017	-0.016	-0.016
SELENIUM	-0.005		-0.04	-0.04	-0.048	-0.048
SILVER			0.006	0.004	-0.005	-0.005
THALLIUM			-0.001	-0.001	-0.001	-0.001
TIN			-0.046	-0.046	0.039	0.056
VADADIUM			-0.004	0.012	-0.007	-0.007
ZINC			-0.002	-0.002	-0.004	0.007

Table A-3
Marigold Mine Meteoric Water Mobility Procedure Analyses

EAST HILL N WASTE										
SAMPLE LOC.	East Hill	East Hill	East Hill	East Hill	East Hill	East Hill	East Hill	East Hill	East Hill	East Hill
SAMPLE TYPE	Waste (3rd)	Waste (4th)	Leach (4th)	Havallah	Valmy	Antler	Havallah	Antler	Valmy	Antler
SAMPLE NO.	E52349	E52350	E52434	E76066	E76067	E76068	EH95-1	EH95-2	EH95-3	EH96-1
DATE	12/2/93	12/2/93	12/2/93	12/5/94	12/5/94	12/5/94	6/4/97	6/4/97	6/4/97	6/4/97
CROSS REF	ABA-32	ABA-33	ABA-41	ABA-50	ABA-51	ABA-52	ABA-57	ABA-58	ABA-59	ABA-60
CONSTITUENT										
pH	8.1	8.1	8.1	8.3	8.1	8.2	8.45	9.12	8.8	8.3
TDS	561	166	1860	309	150	173	1170	280	137	26
SULFATE	206	30.5	643	61.1	13.6	22.8	273	62.9	27.9	9.4
ALKALINITY	83	97	100	66	69	114	72.6	63.5	60	34.6
CHLORIDE	87.9	65.4	566	20.8	3.32	10.5	331	83.7	5.6	2.8
NITRATE	1.09	0.6	1.61	0.69	0.04	0.31	43.8	1.07	1.27	0.42
PHOSPHORUS	-0.07	-0.07	-0.07	-0.3	-0.3	-0.3	0.33	0.19	-0.18	-0.18
WAD CYANIDE	-0.01	-0.01	-0.01	-0.005	-0.005	-0.005	-0.01	-0.01	-0.01	-0.01
ALUMINUM	0.04	-0.02	0.02	0.05	-0.03	0.03	0.093	0.401	0.251	0.012
ANTIMONY	-0.001	-0.001	0.002	0.006	0.002	0.003	-0.003	-0.003	-0.003	-0.003
ARSENIC	0.4	0.23	0.8	0.69	0.22	0.07	0.57	0.17	0.89	-0.04
BARIUM	0.046	0.062	0.021	0.278	0.387	0.125	0.087	0.188	0.234	0.173
CADMIUM	-0.002	-0.002	-0.002	-0.004	-0.004	-0.004	-0.002	-0.0024	-0.0024	-0.0024
CHROMIUM	-0.004	-0.004	0.024	-0.004	-0.004	-0.004	-0.005	-0.005	0.005	-0.005
COBALT	-0.003	-0.003	0.004	-0.008	-0.008	-0.008	-0.005	-0.005	-0.005	-0.005
COPPER	0.006	0.007	-0.005	-0.003	-0.003	-0.003	0.008	0.009	0.009	0.007
FLUORIDE	1.3	1.4	1.8	3.01	0.55	0.67	1.4	0.6	1.6	0.2
IRON	-0.01	-0.01	-0.01	-0.009	-0.009	-0.009	0.027	0.017	0.056	-0.024
LEAD	-0.001	-0.001	-0.001	-0.001	0.001	-0.001	-0.001	-0.001	-0.001	-0.001
MANGANESE	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	0.006	0.022	0.017	0.002
MERCURY	0.0004	0.0003	0.0005	0.0003	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002
MOLYBDENUM	0.034	0.023	0.227	0.03	0.01	0.04	0.08	-0.014	0.045	0.026
NICKEL	-0.01	-0.01	0.01	-0.02	-0.02	-0.02	-0.017	-0.017	-0.017	0.019
SELENIUM	0.001	0.002	0.003	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04
SILVER	-0.003	-0.003	-0.003	-0.004	-0.004	-0.004	0.011	0.009	0.011	-0.008
THALLIUM	0.001	0.002	0.002	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
TIN	-0.03	-0.03	-0.03	-0.04	-0.04	-0.04	-0.046	-0.046	-0.046	-0.046
VADADIUM	0.093	0.146	-0.003	0.05	-0.01	-0.01	0.035	0.005	0.006	-0.004
ZINC	-0.002	-0.002	-0.002	-0.004	-0.004	-0.004	-0.002	-0.002	-0.002	-0.002

Table A-3
Marigold Mine Meteoric Water Mobility Procedure Analyses

EAST HILL N WASTE					EAST HILL S WASTE
SAMPLE LOC.	East Hill	East Hill N			East Hill S
SAMPLE TYPE	Valmy	Valmy			Valmy
SAMPLE NO.	EH96-2	EHN97-V			EHS97-V
DATE	6/4/97	11/19/97			11/19/97
CROSS REF	ABA-61	ABA-68			ABA-69
CONSTITUENT					
pH	8.2	6.64			7.69
TDS	122	98			329
SULFATE	12	8.6			70.9
ALKALINITY	43.1	52.1			87.6
CHLORIDE	2.2	2			52.6
NITRATE	0.59	0.65			2.25
PHOSPHORUS	0.24	-0.11			-0.11
WAD CYANIDE	-0.01	-0.01			-0.01
ALUMINUM	0.242	0.049			0.126
ANTIMONY	-0.003	-0.003			0.008
ARSENIC	0.13	0.19			0.43
BARIUM	0.299	0.103			0.145
CADMIUM	-0.0024	-0.002			-0.002
CHROMIUM	-0.005	-0.008			-0.008
COBALT	-0.005	-0.004			-0.003
COPPER	0.013	-0.004			-0.004
FLUORIDE	0.7	0.4			1.5
IRON	0.028	-0.019			0.031
LEAD	-0.001	-0.001			-0.001
MANGANESE	0.011	0.002			0.007
MERCURY	-0.0002	0.0017			0.0004
MOLYBDENUM	0.059	0.023			0.083
NICKEL	-0.017	-0.016			-0.016
SELENIUM	-0.04	-0.048			-0.048
SILVER	0.015	-0.005			-0.005
THALLIUM	-0.001	-0.001			-0.001
TIN	-0.046	-0.038			0.096
VADADIUM	-0.004	-0.007			0.02
ZINC	-0.002	-0.004			-0.004

Table A-3
Marigold Mine Meteoric Water Mobility Procedure Analyses

RED ROCKS N WASTE										
SAMPLE LOC.	Red Rock	Red Rock	Red Rock	Red Rock						
SAMPLE TYPE	Battle	Antler	Antler	Valmy						
SAMPLE NO.	E76069	E76070	RR95-1	RR95-2						
DATE	12/5/94	12/5/94	6/4/97	6/4/97						
CROSS REF	ABA-53	ABA-54	ABA-65	ABA-66						
CONSTITUENT										
pH	8.3	8.3	8.31	8.02						
TDS	217	268	116	35						
SULFATE	27.3	36.1	58.5	16.1						
ALKALINITY	121	131	47.4	42.2						
CHLORIDE	18.4	24.5	10.5	3.5						
NITRATE	1.29	1.89	2.04	1.44						
PHOSPHORUS	-0.3	-0.3	-0.18	0.23						
WAD CYANIDE	-0.005	-0.005	-0.01	-0.01						
ALUMINUM	-0.03	0.04	0.074	0.075						
ANTIMONY	0.008	0.002	-0.003	-0.003						
ARSENIC	0.1	0.08	-0.04	0.38						
BARIUM	0.127	0.124	0.077	0.071						
CADMIUM	-0.004	-0.004	-0.0024	-0.0024						
CHROMIUM	-0.004	-0.004	-0.005	-0.005						
COBALT	-0.008	-0.008	-0.005	-0.005						
COPPER	-0.003	-0.003	0.007	0.007						
FLUORIDE	0.66	1.15	0.4	0.8						
IRON	-0.009	-0.009	-0.024	-0.024						
LEAD	-0.001	0.001	-0.001	-0.001						
MANGANESE	-0.002	-0.002	-0.002	-0.002						
MERCURY	-0.0002	-0.0002	-0.0002	0.0004						
MOLYBDENUM	0.03	0.03	0.034	0.044						
NICKEL	-0.02	-0.02	-0.017	-0.017						
SELENIUM	-0.04	-0.04	0.06	-0.04						
SILVER	-0.004	-0.004	0.009	0.008						
THALLIUM	-0.001	-0.001	-0.001	-0.001						
TIN	-0.04	-0.04	0.061	-0.046						
VADADIUM	-0.01	-0.01	0.004	-0.004						
ZINC	-0.004	-0.004	-0.002	-0.002						

Table A-3
Marigold Mine Meteoric Water Mobility Procedure Analyses

8 NORTH WASTE		
SAMPLE LOC.	8 North	8 North
SAMPLE TYPE	Antler Peak	Havallah
SAMPLE NO.	192049	192050
DATE	Dec-98	Dec-98
CROSS REF	ABA-85	ABA-86
CONSTITUENT		
pH	7.86	7.68
TDS	281	288
SULFATE	28.2	24
ALKALINITY	86.4	81.5
CHLORIDE	28.4	27
NITRATE	0.5	0.36
PHOSPHORUS	0.11	0.11
WAD CYANIDE	0.01	0.01
ALUMINUM	-0.037	-0.037
ANTIMONY	-0.002	-0.002
ARSENIC	-0.04	-0.04
BARIUM	0.349	0.213
CADMIUM	-0.002	-0.002
CHROMIUM	-0.008	-0.008
COBALT	0.006	0.004
COPPER	0.004	0.006
FLUORIDE	4.1	3.2
IRON	0.02	0.019
LEAD	-0.001	-0.001
MANGANESE	0.094	0.037
MERCURY	0.0002	0.0002
MOLYBDENUM	0.023	0.011
NICKEL	-0.016	-0.016
SELENIUM	-0.048	-0.048
SILVER	-0.005	-0.005
THALLIUM	-0.001	-0.001
TIN	-0.038	-0.038
VADADIUM	-0.007	-0.007
ZINC	0.007	0.004

Table A-3
Marigold Mine Meteoric Water Mobility Procedure Analyses

5 NORTH WASTE				
SAMPLE LOC.	5 North	5 North	5 North	5 North
SAMPLE TYPE	Antler Peak	Battle Fm	Edna Mtn	Havallah
SAMPLE NO.	192045	192046	192047	192048
DATE	Dec-98	Dec-98	Dec-98	Dec-98
CROSS REF	ABA-81	ABA-82	ABA-83	ABA-84
CONSTITUENT				
pH	7.22	7.49	7.76	7.56
TDS	489		408	351
SULFATE	91.5	29.5	21	17.9
ALKALINITY	94.1	230	113	103
CHLORIDE	30	54.2	31.2	38.8
NITRATE	0.35	0.89	0.48	0.65
PHOSPHORUS	0.18	-0.11	0.21	0.18
WAD CYANIDE	-0.01		-0.01	-0.01
ALUMINUM	-0.037	0.045	-0.037	-0.037
ANTIMONY	-0.002	-0.002	-0.002	-0.002
ARSENIC	-0.04	-0.04	-0.04	-0.04
BARIUM	0.22	0.254	0.587	0.481
CADMIUM	0.007	-0.002	0.004	0.003
CHROMIUM	-0.008	0.008	-0.008	-0.008
COBALT	0.011	0.005	0.008	0.006
COPPER	0.011	0.006	0.006	0.006
FLUORIDE	-0.5	1.6	-0.5	-0.5
IRON	0.072	0.026	-0.019	-0.019
LEAD	-0.001	-0.001	-0.001	-0.001
MANGANESE	0.013	0.017	0.053	0.02
MERCURY	-0.0004	0.0049	0.0067	0.0074
MOLYBDENUM	0.067	0.105	0.011	0.013
NICKEL	-0.016	-0.016	-0.016	-0.016
SELENIUM	0.132	-0.048	-0.048	-0.048
SILVER	0.005	-0.005	-0.005	-0.005
THALLIUM	-0.001	0.012	-0.001	-0.001
TIN	-0.038	-0.038	-0.038	-0.038
VADADIUM	0.009	-0.007	-0.007	-0.007
ZINC	0.017	0.034	0.02	0.019

Table A-3
Marigold Mine Meteoric Water Mobility Procedure Analyses

SAMPLE LOC.										
SAMPLE TYPE										
SAMPLE NO.										
DATE										
CROSS REF										
CONSTITUENT										
pH										
TDS										
SULFATE										
ALKALINITY										
CHLORIDE										
NITRATE										
PHOSPHORUS										
WAD CYANIDE										
ALUMINUM										
ANTIMONY										
ARSENIC										
BARIUM										
CADMIUM										
CHROMIUM										
COBALT										
COPPER										
FLUORIDE										
IRON										
LEAD										
MANGANESE										
MERCURY										
MOLYBDENUM										
NICKEL										
SELENIUM										
SILVER										
THALLIUM										
TIN										
VADADIUM										
ZINC										

Table A-4
Groundwater Quality
Marigold Mine Area

WELL NAME AND WATER DEPTH	Sample Date	LOCATION Northing	LOCATION Easting	pH	TDS	SO4	Cl	Nitrate	Na	K	Ca	Mg	HCO3	F	Water Level Date	Water Level Level
VALMY POWER																
PLANT WELLS																
		(T-R-S-qtr/qtr)														
Test Hole #2	10/3/75	(35-44-17ad)		9.44	433	35.5	24.5	2.57	132.5	3.24	0.5	0.08	109			
(265-286 feet)																
Test Hole #2	9/19/75	(35-44-17ad)		9.21	1318	134	154	0.13	502	6.69	0.63	0.41	572			
(481-491 feet)																
Test Hole #2	10/1/75	(35-44-17ad)		8.8	1416	146	216	0.04	538	5.02	0.32	0.14	626			
(601-622 feet)																
Test Hole #3	10/30/75	(34-45-25cc)		7.8	238	57	31.6	1.13	53	2.15	21.2	7.2	125.4			
(144-196 feet)																
Test Hole #3	10/29/75	(34-45-25cc)		8.72	240	17.7	41.2	1.24	90	0.78	1.6	0.35	127.1			
(410-430 feet)																
Test Hole #3	10/24/75	(34-45-25cc)		7.6	1745	413	188	0.09	630	7.5	22.7	13	1122			
(560-600 feet)																
Test Hole #4	11/15/75	(33-44-9cc)		8.95	282	45	12.7	4.7	72	5	6	0.27	102.6			
(410-450 feet)																
Test Hole #7	12/17/75	(34-43-17aa)		7.14	1433	222	80.8	0.04	490	40	37	10.1	1136			
(248-311 feet)																
Test Hole #8	1/6/76	(33-44-27dc)		8	119	45.8	15.4	0.04	40.5	4.8	21.3	5.77	125.9			
(442-483 feet)																
Test Hole #9	1/28/76	(33-43-1cc)		8.2	420	90	52.9	1.5	107.5	4.9	20	7.5	208			
(352-392 feet)																
MARIGOLD																
BEDROCK																
WATER WELLS																
WW-1	12/18/96	35934	25963			53.2	25.5	0.22	21.1	2.41	48.2	15.5	140	0.2	Nov-96	4395
	12/18/91			7.84	243	31	23.04	0.43	24.03	2.52	46.7	13.1	161	1.76		
WW-2	12/18/96	30669	24836			50.4	26.8	0.27	22.8	2.31	46.6	14.4	142	0.2	Nov-96	4392
	12/27/91			7.34	255	33.5	19.5	0.37	21.2	1.19	45.3	14.14	144	0.07		
WW-3	12/18/96	25645	23880			50.1	27.9	0.33	22.5	2.04	47.9	14	145	0.2	Jul-94	4410.4
	12/27/91			7.3	244	33.5	15.95	0.25	22.27	1.2	46.24	14.86	141	0.06		
NM-028	5/27/86	23601	19799			12	21		18	2.1	31	9	120	<.1		
NM-030	5/30/86	24386	19200			29	17		24	1.8	36	8	140	<.1		

Sources: Marigold 1997 Annual Report
JBR Baseline Report, 1998
Guyton 1977a

Table A-4
Groundwater Quality
Marigold Mine Area

WELL NAME	Sample Date	LOCATION		pH	TDS	SO4	Cl	Nitrate	Na	K	Ca	Mg	HCO3	F	Water Level	
		Northing	Easting												Date	Level
MARIGOLD																
ALLUVIAL																
MONITOR WELLS																
TDOH-6	3/8/95	24123	26072	7	257	49.3	23.7		24.2	6.1	46.5	15.6	123	0.1	Dec-95	4421.9
TDOH-12L	11/4/97	24522	25935	6.79	313	13.2	99.4	3.35	22	1.9	52.8	15.3	80.8	0.2	6/10/98	4391.5
TDOH-12U	11/19/96	24502	25901	6.59	478	15.2	196	8.33	28.4	3.95	69.6	20.9	56.8	0.2	Nov-96	4404.7
TDOH-15	3/9/95	24479	26130	7.12	231	10.6	50.8		18	2.91	35.5	10.8	98.4	0.18	Jun-98	4404.7
TDOH-16	11/19/96	24319	26368	7.73	291	67.4	24.6	0.17	34.4	3.44	56.2	14.9	157	0.2	Jun-98	4398.2
TDOH-17	10/9/96	23912	26511	8.04	276	70.3	23.5	0.31	27.1	3.73	55.8	15.8	149	0.3	Jun-98	4394.4
TDOH-18L	11/4/97	24098	26443	7.31	291	60	33.1	0.84	30	3.4	54.3	18.3	162	0.4	Jun-98	4385.6
TDOH-18U	11/4/97	24098	26443	7.83	326	70.6	23.5	0.29	71.4	13.1	27.8	15.2	240	0.6	6/10/98	4386.01
TDOH-19L	11/4/97	24484	26104	7.48	291	70.7	22.8	0.13	26.4	1.5	52.7	13.9	179	0.3	6/10/98	4384.7
TDOH-19U	11/4/97	24484	26104	7.82	265	28.5	44.1	0.55	66.5	9.6	28.4	12.7	215	0.4	6/10/98	4389.5
TDOH-20L	11/4/97	24383	25083	7.39	196	24.5	21.8	0.24	19.9	2.7	39.7	10.5	129	0.3	6/10/98	4387.4
TDOH-20U	11/4/97	24383	25083	8.1	410	59.9	28.5	0.14	130	11.1	13.1	7.11	239	1	6/10/98	4392.5
MARIGOLD																
PERCHED AQUIFER																
MONITOR WELLS																
TDMP-1	11/4/97	24221	25945	6.4	715	23.2	333	4.85	39.3	3.1	126	32.6	28.2	0.1	6/10/98	4542.2
TDMP-2	11/4/97	23956	26280	6.24	1030	15.9	433	27.9	51.3	4	165	43.5	8.6	0.1	6/10/98	45644.7
TDOH-1	11/4/97	24282	25866	6.42	719	36.5	311	8.67	34.1	2.7	130	33.8	22.8	0.1	6/10/98	4543.6
TDOH-2	11/4/97	24159	26024	6.3	783	15.7	383	8.64	47.5	3.4	127	32.5	12	0.1	6/10/98	4541.4
TDOH-3	11/4/97	24310	26022	6.64	519	8.2	267	3.65	34.2	3.3	99.1	25.8	24.2	0.1	6/10/98	4530.8
TDOH-4	11/4/97	24407	25711	6.39	762	23.9	329	11.9	38.8	2.8	133	34.7	21.4	0.1	6/10/98	4531.8
TDOH-5	11/4/97	24246	26099	6.92	309	10.7	112		26.6	2.3	42.2	11.4	16.1	0.2	6/10/98	4522.9
TDOH-7	5/6/93	24141	25590	7.55	2060	385	758		178	8.6	430	87		0.22	6/10/98	
TDOH-8	8/7/97	23303	27087	7.07	466	9.4	158	2.54	25.4	3.3	66.3	13	28	0.2	6/10/98	4476.2
TAILINGS DAM																
PZ-1	3/6/97	24167	25551	7.46	1520	406	258	44	342	4.63	395	32.5	191	2.9	6/10/98	4684.3
PZ-2	12/17/91	24152	25526	7.46	1774	470	261	3.82	364	10.9	102	21.4		1.87	6/10/98	4699.5
PZ-5	11/4/97	23491	26528	7.46	3250	1460	878	9.44	715	7	333	76.4	149	0.5	6/10/98	4727.7

Sources: Marigold 1997 Annual Report
JBR Baseline Report, 1998
Guyton 1977a

Table A-4
Groundwater Quality
Marigold Mine Area

WELL NAME	Sample Date	LOCATION		Fe	Pb	Mn	Alk	As	Ba	Cd	Cr	Cu	Hg	Se	Ag	Zn
		Northing	Easting													
VALMY POWER																
PLANT WELLS																
		(T-R-S-qtr/qtr)														
Test Hole #2	10/3/75	(35-44-17ad)		0.56			185.7									
(265-286 feet)																
Test Hole #2	9/19/75	(35-44-17ad)		0.75			741									
(481-491 feet)																
Test Hole #2	10/1/75	(35-44-17ad)		0.14			741									
(601-622 feet)																
Test Hole #3	10/30/75	(34-45-25cc)		0.25			125.4									
(144-196 feet)																
Test Hole #3	10/29/75	(34-45-25cc)		0.14			141.9									
(410-430 feet)																
Test Hole #3	10/24/75	(34-45-25cc)		0.93			1122									
(560-600 feet)																
Test Hole #4	11/15/75	(33-44-9cc)		0.51			116.6									
(410-450 feet)																
Test Hole #7	12/17/75	(34-43-17aa)		0.31			1136									
(248-311 feet)																
Test Hole #8	1/6/76	(33-44-27dc)		0.05			125.9									
(442-483 feet)																
Test Hole #9	1/28/76	(33-43-1cc)		<3			208									
(352-392 feet)																
MARIGOLD																
BEDROCK																
WATER WELLS																
WW-1	12/18/96	35934	25963	0.33	<.001	<.002	140	0.007	0.054	<.002	<.005	<.003	<.0002	<.003	<.003	0.008
	12/18/91			0.007	<.025	<.025	148	0.68	0.053	<.005	<.025	0.002	<.001	<.005	<.025	0.004
WW-2	12/18/96	30669	24836	0.37	0.002	0.007	142	0.006	0.053	<.002	<.005	0.007	<.0002	<.003	<.003	0.007
	12/27/91			0.352	0.057	<.025	144	0.035	0.59	<.005	<.025	<.005	<.001	<.005	<.025	<.25
WW-3	12/18/96	25645	23880	1.28	0.007	0.006	145	0.003	0.101	<.002	<.005	0.004	<.0002	<.003	<.003	0.003
	12/27/91			0.357	<.025	0.002	141	0.07	0.059	<.005	<.025	<.005	<.001	<.005	<.025	0.002
NM-028	5/27/86	23601	19799	0.01	<.2	0.01	120	15	100	<.4	0.7	4.3		<3	<.1	5
NM-030	5/30/86	24386	19200	<.01	<.2	0.01	140	6	43	<.4	0.8	0.8		<3	<.1	2

Sources: Marigold 1997 Annual Report
JBR Baseline Report, 1998
Guyton 1977a

Table A-4
Groundwater Quality
Marigold Mine Area

WELL NAME	Sample Date	LOCATION		Fe	Pb	Mn	Alk	As	Ba	Cd	Cr	Cu	Hg	Se	Ag	Zn
		Northing	Easting													
MARIGOLD																
ALLUVIAL																
MONITOR WELLS																
TDOH-6	3/8/95	24123	26072	20.5	0.029	0.496	73	0.012	0.371	0.002	0.036	0.039	0.002	0.001	0.004	0.077
TDOH-12L	11/4/97	24522	25935	0.022	0.001	0.01	73.7	0.002	0.32	0.002	0.008	0.016	0.0002	0.002	0.005	0.061
TDOH-12U	11/19/96	24502	25901	0.024	0.001	0.006	22.7	0.001	0.52	0.002	0.005	0.003	0.0002	0.003	0.003	0.003
TDOH-15	3/9/95	24479	26130	5.88	0.006	0.117	71.4	0.005	0.29	0.002	0.026	0.014	0.0002	0.001	0.002	0.027
TDOH-16	11/19/96	24319	26368	0.024	0.001	0.05	157	0.002	0.05	0.002	0.005	0.003	0.0002	0.003	0.003	0.002
TDOH-17	10/9/96	23912	26511	0.064	0.001	0.019	157	0.002	0.057	0.002	0.005	0.02	0.0002	0.005	0.004	0.043
TDOH-18L	11/4/97	24098	26443	0.02	0.001	0.008	155	0.002	0.058	0.002	0.008	0.031	0.0002	0.002	0.005	0.026
TDOH-18U	11/4/97	24098	26443	0.019	0.001	0.005	192	0.018	0.043	0.002	0.008	0.004	0.0002	0.002	0.005	0.004
TDOH-19L	11/4/97	24484	26104	0.019	0.001	0.006	166	0.003	0.038	0.002	0.008	0.005	0.0002	0.002	0.005	0.007
TDOH-19U	11/4/97	24484	26104	0.021	0.001	0.105	160	0.023	0.06	0.002	0.008	0.004	0.0002	0.002	0.005	0.004
TDOH-20L	11/4/97	24383	25083	0.019	0.001	0.013	124	0.006	0.058	0.002	0.008	0.006	0.0002	0.002	0.005	0.004
TDOH-20U	11/4/97	24383	25083	0.05	0.001	0.053	253	0.04	0.041	0.002	0.008	0.006	0.0002	0.002	0.005	0.004
MARIGOLD																
PERCHED AQUIFER																
MONITOR WELLS																
TDMP-1	11/4/97	24221	25945	0.037	0.001	0.006	22	0.001	0.311	0.002	0.008	0.004	0.002	0.002	0.005	0.004
TDMP-2	11/4/97	23956	26280	0.091	0.001	0.015	11.3	0.001	1.07	0.002	0.008	0.004	0.0003	0.002	0.005	0.009
TDOH-1	11/4/97	24282	25866	0.286	0.001	0.026	28.9	0.001	0.394	0.002	0.008	0.004	0.003	0.004	0.005	0.004
TDOH-2	11/4/97	24159	26024	0.039	0.001	0.006	14.1	0.001	0.734	0.002	0.008	0.004	0.0004	0.002	0.005	0.005
TDOH-3	11/4/97	24310	26022	0.019	0.001	0.001	30.3	0.002	0.611	0.002	0.008	0.004	0.0002	0.002	0.005	0.007
TDOH-4	11/4/97	24407	25711	0.114	0.001	0.008	21.4	0.001	0.783	0.002	0.008	0.007	0.0006	0.002	0.005	0.009
TDOH-5	11/4/97	24246	26099	0.019	0.001	0.004	16.4	0.001	0.298	0.002	0.008	0.004	0.0002	0.002	0.005	0.006
TDOH-7	5/6/93	24141	25590	6.5	0.085	4.76	211	0.007	0.15	0.05	0.05	0.1	0.001	0.004	0.01	1.54
TDOH-8	8/7/97	23303	27087	0.023	0.001	0.053	39.9	0.001	0.306	0.002	0.008	0.006	0.0002	0.003	0.005	0.024
TAILINGS DAM																
PZ-1	3/6/97	24167	25551	0.267	0.001	0.114	191	0.006	0.071	0.002	0.005	0.02	0.0002	0.003	0.003	
PZ-2	12/17/91	24152	25526	1.38	0.06	0.406	228	0.482	0.04	0.005	0.025	0.5	0.001	0.089	0.025	
PZ-5	11/4/97	23491	26528	0.787	0.001	0.066	139	0.003	0.021	0.002	0.008	0.02	0.004	0.002	0.005	

Sources: Marigold 1997 Annual Report
JBR Baseline Report, 1998
Guyton 1977a

APPENDIX B

REPRESENTATIVE WILDLIFE SPECIES IN THE VICINITY OF THE MARIGOLD MINE

Appendix B

Representative Wildlife Species in the Vicinity of the Marigold Mine (Including Battle Mountain Range and Humboldt River)

MAMMALS

Merriam's shrew	*Sorex merriami*
California myotis	*Myotis californicus*
small-footed myotis	*Myotis ciliolabrum*
long-eared myotis	*Myotis evotis*
little brown myotis	*Myotis lucifugus*
fringed myotis	*Myotis thysanodes*
cave myotis	*Myotis velifer*
long-legged myotis	*Myotis volans*
Yuma myotis	*Myotis yumanensis*
silver-haired bat	*Lasionycteris noctivagans*
western pipistrelle	*Pipistrellus hesperus*
big brown bat	*Eptesicus fuscus*
Pacific Townsend's big-eared bat	*Corynorhinus townsendii townsendii*
pale Townsend's big-eared bat	*Corynorhinus towsendii pallescens*
spotted bat	*Euderma maculatum*
pallid bat	*Antrozous pallidus*
Mexican free-tailed bat	*Tadarida brasiliensis*
pygmy rabbit	*Brachylagus idahoensis*
mountain cottontail	*Sylvilagus nuttallii*
black-tailed jackrabbit	*Lepus californicus*
yellow-bellied marmot	*Marmota flaviventris*
white-tailed antelope squirrel	*Ammospermophilus leucurus*
Townsend's ground squirrel	*Spermophilus townsendii*
Townsend's pocket gopher	*Thomomys townsendii*
northern pocket gopher	*Thomomys talpoides*
little pocket mouse	*Perognathus longimembris*
Great Basin pocket mouse	*Perognathus parvus*

Appendix B (Continued)

dark kangaroo mouse	*Microdipodops megacephalus*
Ord's kangaroo rat	*Dipodomys ordii*
Great Basin kangaroo rat	*Dipodomys microps*
Merriam's kangaroo rat	*Dipodomys merriami*
western harvest mouse	*Reithrodontomys megalotis*
deer mouse	*Peromyscus maniculatus*
canyon mouse	*Peromyscus crinitus*
northern grasshopper mouse	*Onychomys leucogaster*
desert woodrat	*Neotoma lepida*
montane vole	*Microtus montanus*
long-tailed vole	*Microtus longicaudus*
sagebrush vole	*Lagurus curtatus*
coyote	*Canis latrans*
kit fox	*Vulpes macrotis*
badger	*Taxidea taxus*
long-tailed weasel	*Mustela frenata*
striped skunk	*Mephitis mephitis*
raccoon	*Procyon lotor*
mountain lion	*Felis concolor*
bobcat	*Lynx rufus*
western spotted skunk	*Spilogale gracilis*
mule deer	*Odocoileus hemionus*

REPTILES

zebra-tailed lizard	*Callisaurus draconoides*
common collared lizard	*Crotapahytus collaris*
black-collared lizard	*Crotaphytus insularis*
long-nosed leopard lizard	*Gambelia wislizenii*
desert spiny lizard	*Sceloporus magister*
western fence lizard	*Sceloporus occidentalis*

sagebrush lizard	*Sceloporus graciosus*
side-blotched lizard	*Uta stansburiana*
short-horned lizard	*Phrynosoma douglassi*
desert horned lizard	*Phrynosoma platyrhinos*
western whiptail lizard	*Cnemidophorus tigris*
western skink	*Eumeces skiltonianus*
striped whipsnake	*Masticophis taeniatus*
coachwhip	*Masticophis flagellum*
western patch-nosed snake	*Salvadora hexalepis*
gopher snake	*Pituophis melanoleucus*
common kingsnake	*Lampropeltis getulus*
long-nosed snake	*Rhinocheilus lecontei*
garter snake	*Thamnophis elegans*
night snake	*Hypsiglena torquata*
western rattlesnake	*Crotalus viridis*
BIRDS	
least bittern	*Ixobrychus exilis hesperis*
white-faced ibis	*Pleqadis chihi*
black tern	*Chlidonias niger*
Swainson's hawk	*Buteo swainsoni*
red-tailed hawk	*Buteo jamaicensis*
ferruginous hawk	*Buteo regalis*
rough-legged hawk	*Buteo lagopus*
golden eagle	*Aquila chrysaetos*
bald eagle	*Haliaeetus leucocephalus*
turkey vulture	*Cathartes aura*
American kestrel	*Falco sparverius*
peregrine falcon	*Falco peregrinus anatum*
prairie falcon	*Falco mexicanus*

Appendix B (Continued)

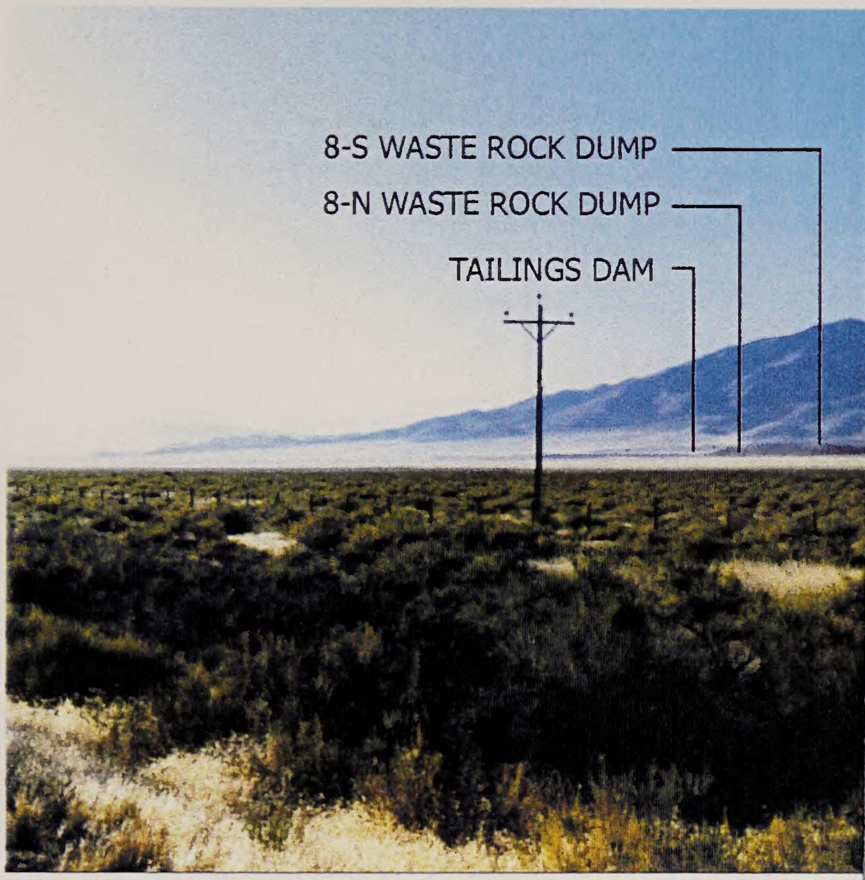
northern goshawk	*Accipiter gentilis*
Cooper's hawk	*Accipiter cooperii*
sharp-shinned hawk	*Accipiter striatus*
northern harrier	*Circus cyaneus*
sage grouse	*Centrocercus urophasianus*
California quail	*Callipepla californica*
mountain quail	*Oreortyx pictus*
chukar	*Alectoris chukar*
killdeer	*Charadrius vociferus*
mourning dove	*Zenaida macroura*
great horned owl	*Bubo virginianus*
burrowing owl	*Athene cunicularia*
short-eared owl	*Asio flammeus*
common nighthawk	*Chordeiles minor*
common poorwill	*Phalaenoptilus nuttallii*
black-chinned hummingbird	*Archilochus alexandri*
gray flycatcher	*Empidonax wrightii*
Say's phoebe	*Sayornis saya*
western kingbird	*Tyrannus verticalis*
ash-throated flycatcher	*Myiarchus cinerascens*
horned lark	*Eremophila alpestris*
violet-green swallow	*Tachycineta thalassina*
cliff swallow	*Hirundo pyrrhonota*
barn swallow	*Hirundo rustica*
white-throated swift	*Aeronautes saxatalis*
black-billed magpie	*Pica pica*
common raven	*Corvus corax*
rock wren	*Salpinctes obsoletus*
mountain bluebird	*Sialia currucoides*
western bluebird	*Sialia mexicana*

Appendix B (Continued)

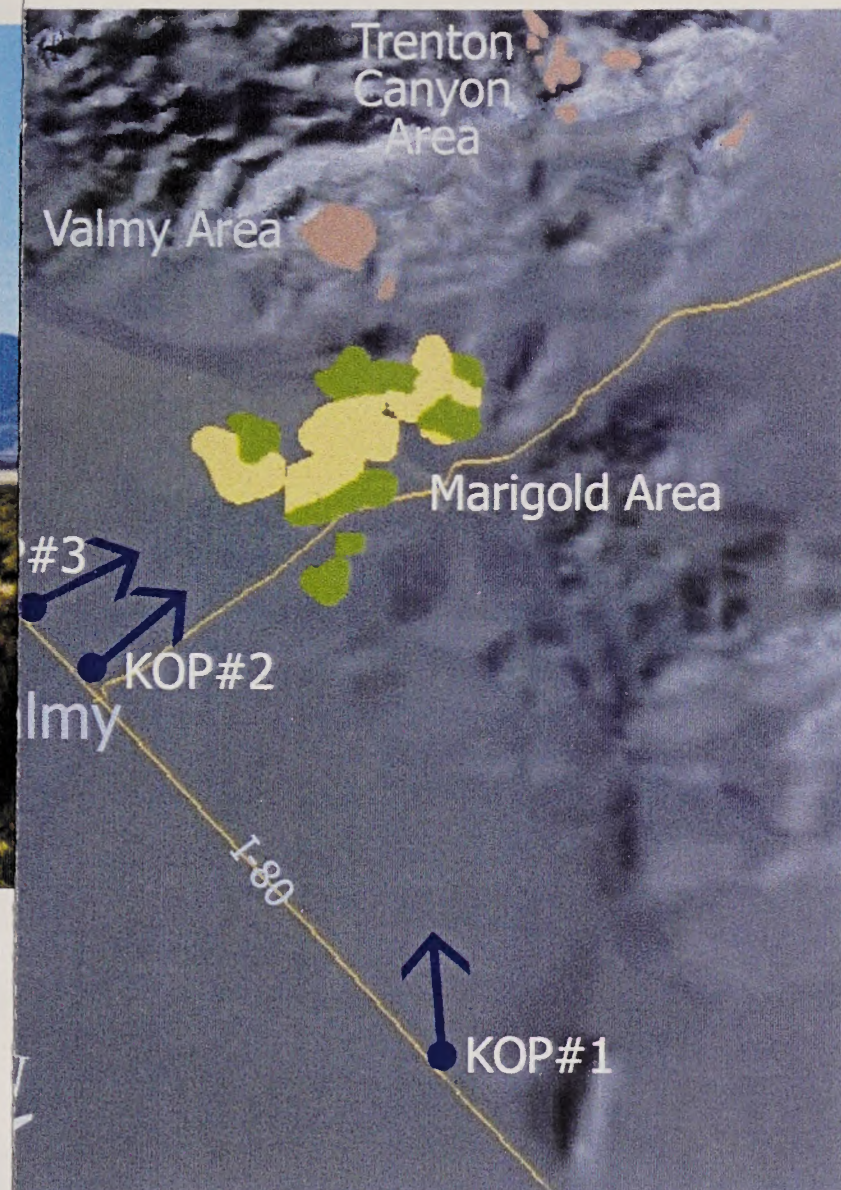
Townsend's solitaire	*Myadestes townsendi*
American robin	*Turdus migratorius*
cedar waxwing	*Bombycilla cedrorum*
loggerhead shrike	*Lanius ludovicianus*
sage thrasher	*Oreoscoptes montanus*
European starling	*Sturnus vulgaris*
black-throated gray warbler	*Dendroica nigrescens*
warbling vireo	*Vireo gilvus*
lazuli bunting	*Passerina amoena*
northern oriole	*Icterus galbula*
green-tailed towhee	*Pipilo chlorurus*
spotted towhee	*Pipilo erythrophthalmus*
Brewer's sparrow	*Spizella breweri*
American tree sparrow	*Spizella arborea*
vesper sparrow	*Pooecetes gramineus*
lark sparrow	*Chondestes grammacus*
chipping sparrow	*Spizella passerina*
savannah sparrow	*Passerculus sandwichensis*
grasshopper sparrow	*Ammodramus savannarum*
black-throated sparrow	*Amphispiza bilineata*
sage sparrow	*Amphispiza belli*
Lapland longspur	*Calcarius lapponicus*
western meadowlark	*Sturnella neglecta*
Brewer's blackbird	*Euphagus cyanocephalus*
blue-gray gnatcatcher	*Polioptila caerulea*
bushtit	*Psaltriparus minimus*
northern flicker	*Colaptes auratus*
western tanager	*Piranga ludoviciana*
house sparrow	*Passer domesticus*
American goldfinch	*Carduelis tristis*
house finch	*Carpodacus mexicanus*

APPENDIX C

VISUAL SIMULATIONS AND BLM VISUAL CONTRAST RATING WORKSHEETS



Simulation of Height of

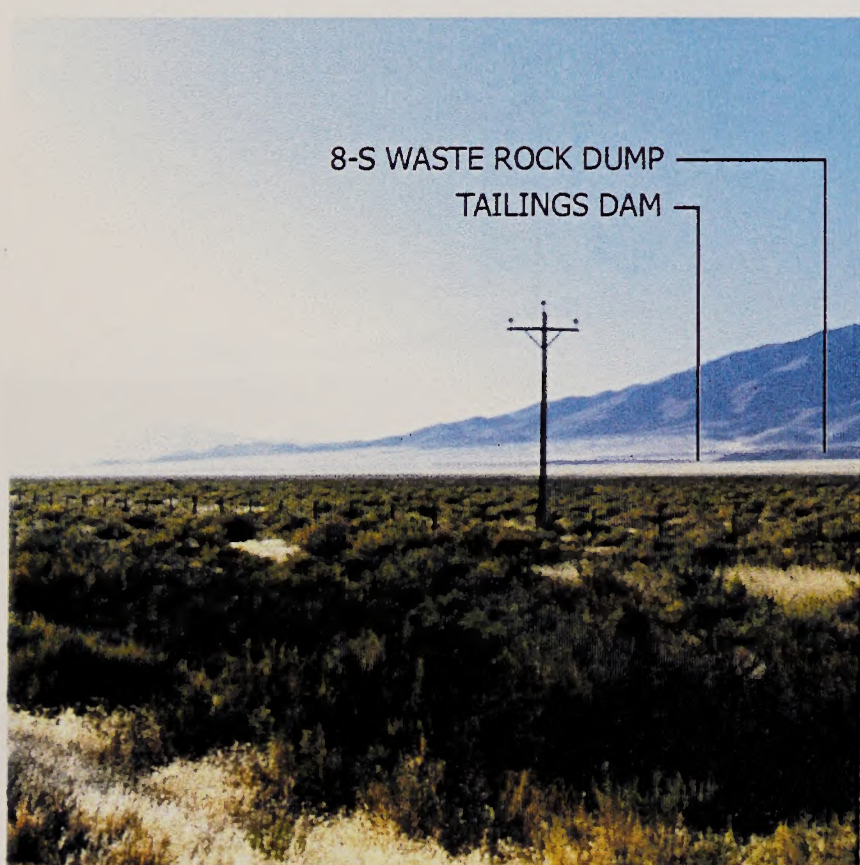


tion Map

Existing Marigold Mine Features

Proposed Marigold Mine Features

Proposed Trenton Canyon Project Features



Existing Conditions Pho

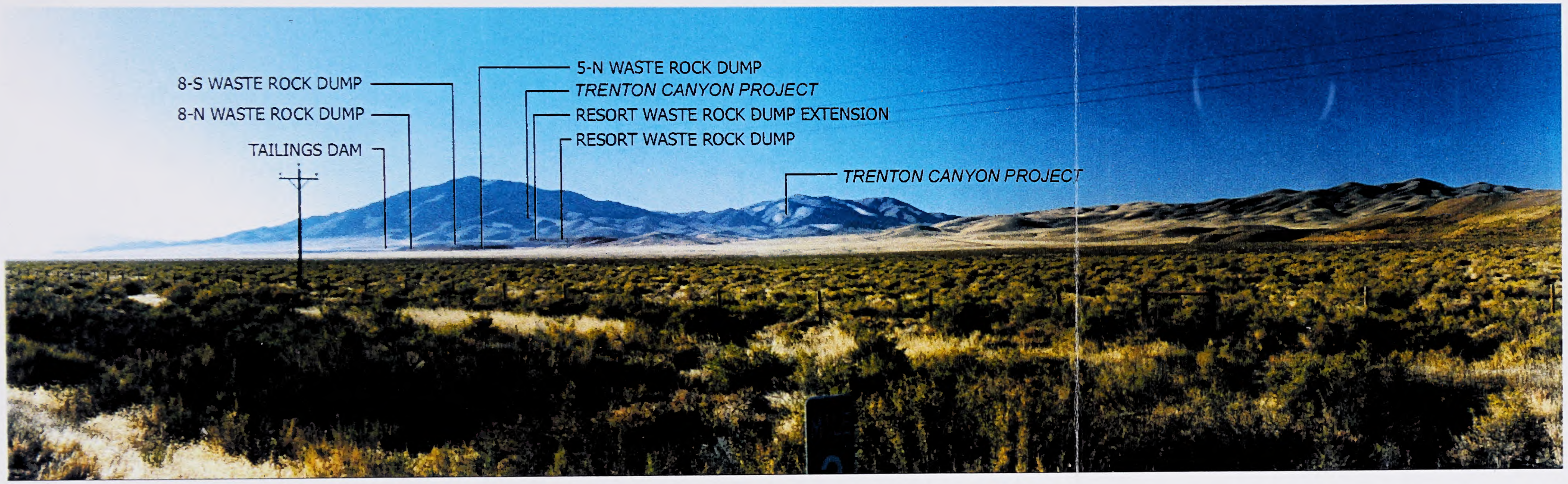
Note: For proper scale size, view images at 16

SIMULATION OF HEIGHT OF
MINING CONDITIONS
STONEHOUSE, KOP#1

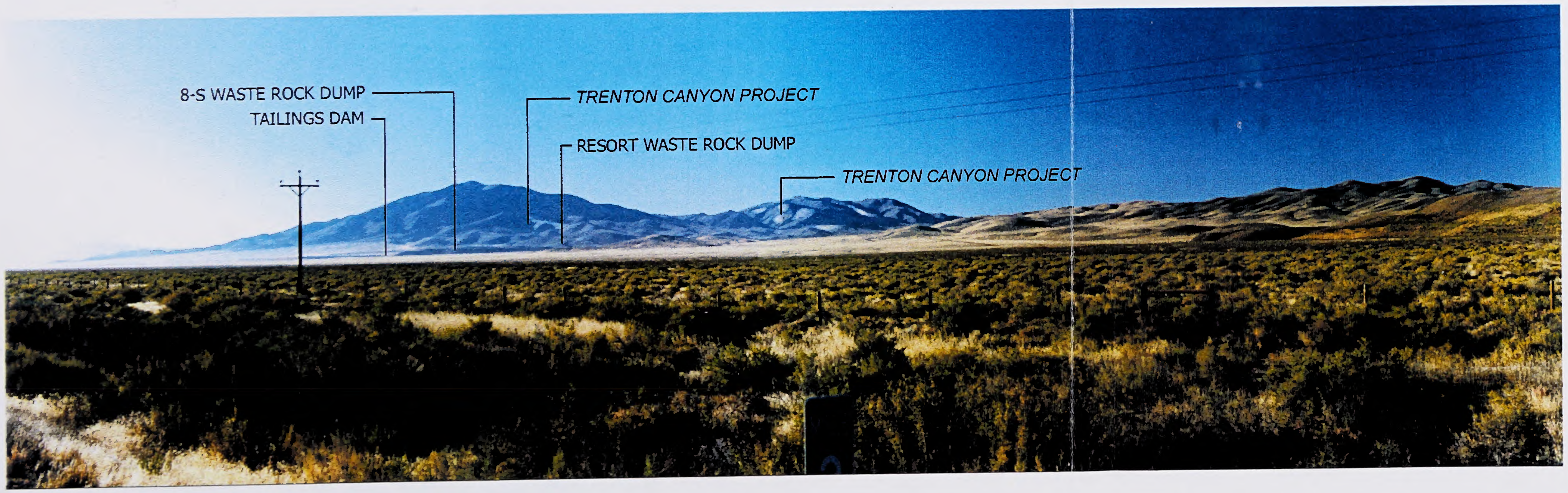
MARIGOLD MINE PROJECT
HUMBOLDT COUNTY, NV

EDAW
November 1999

C-1

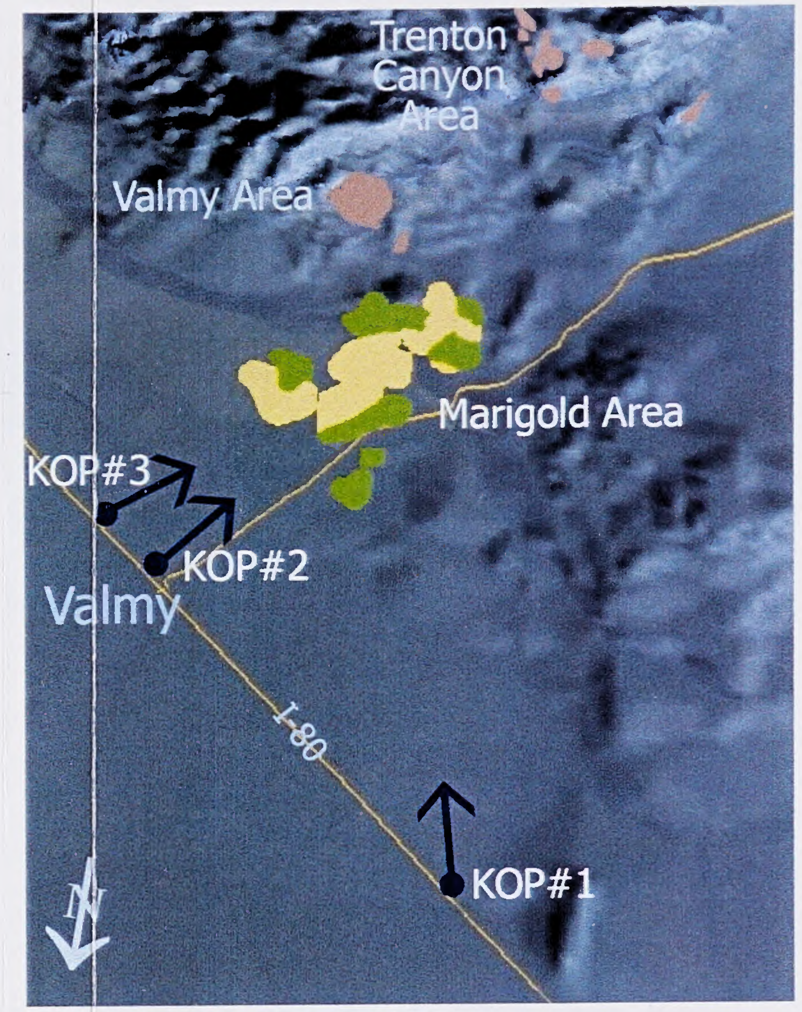


Simulation of Height of Mining Conditions



Existing Conditions Photograph

Note: For proper scale size, view images at 16" from eye.



Location Map

- Existing Marigold Mine Features
- Proposed Marigold Mine Features
- Proposed Trenton Canyon Project Features

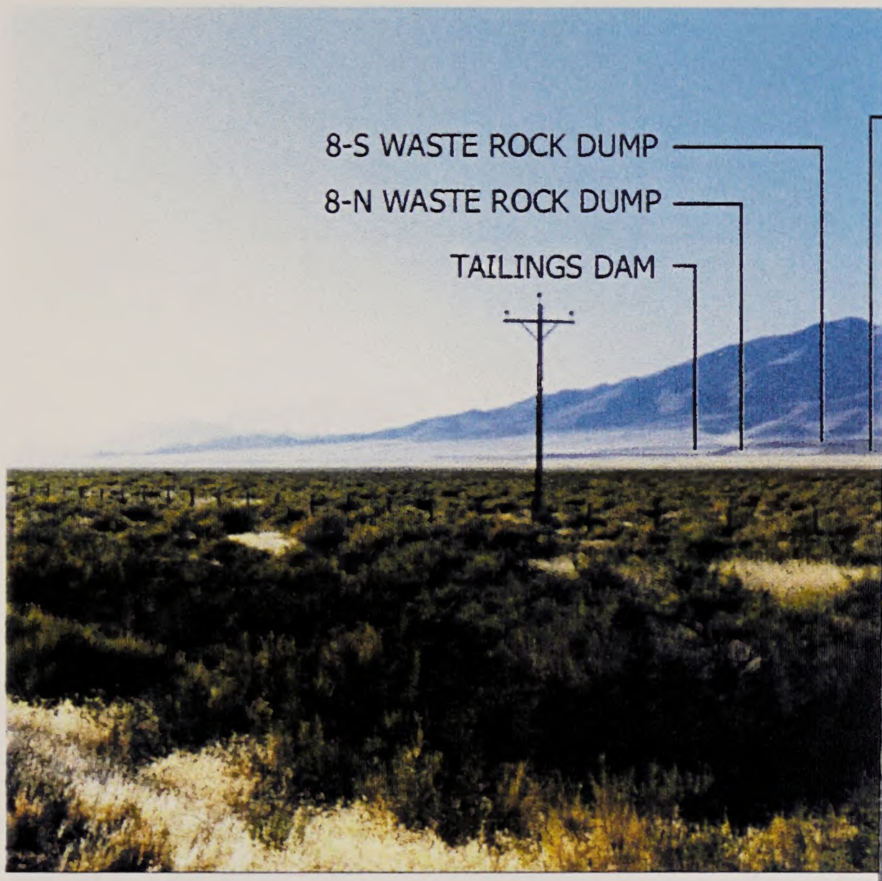
SIMULATION OF HEIGHT OF MINING CONDITIONS
STONEHOUSE, KOP#1

MARIGOLD MINE PROJECT
HUMBOLDT COUNTY, NV

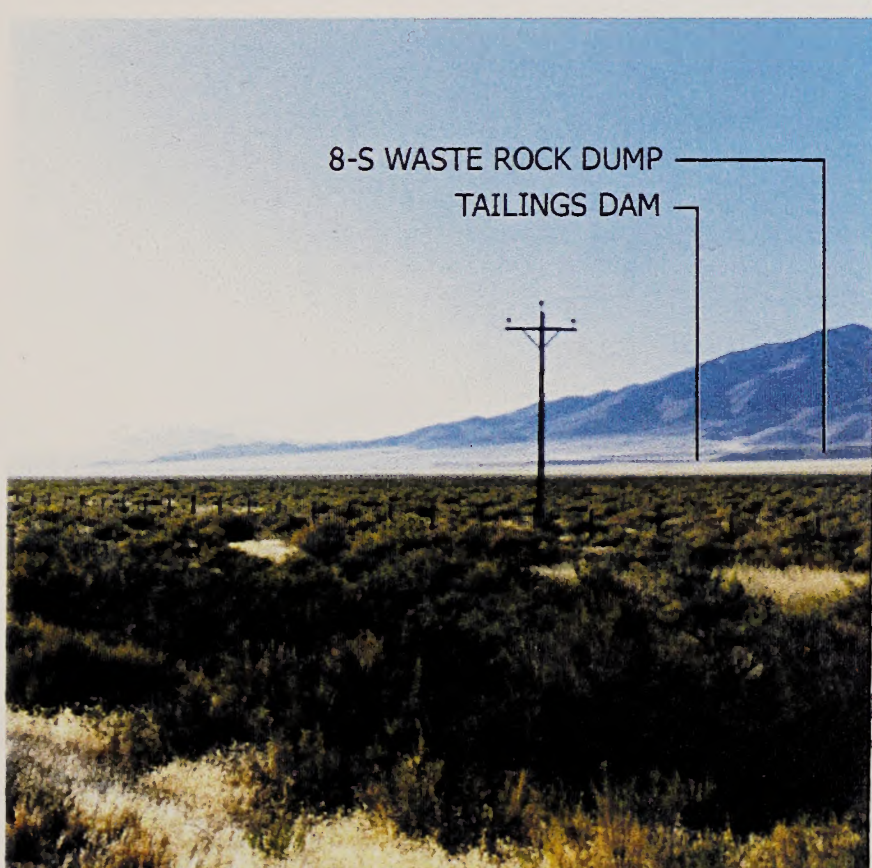
EDAW

November 1999

C-1

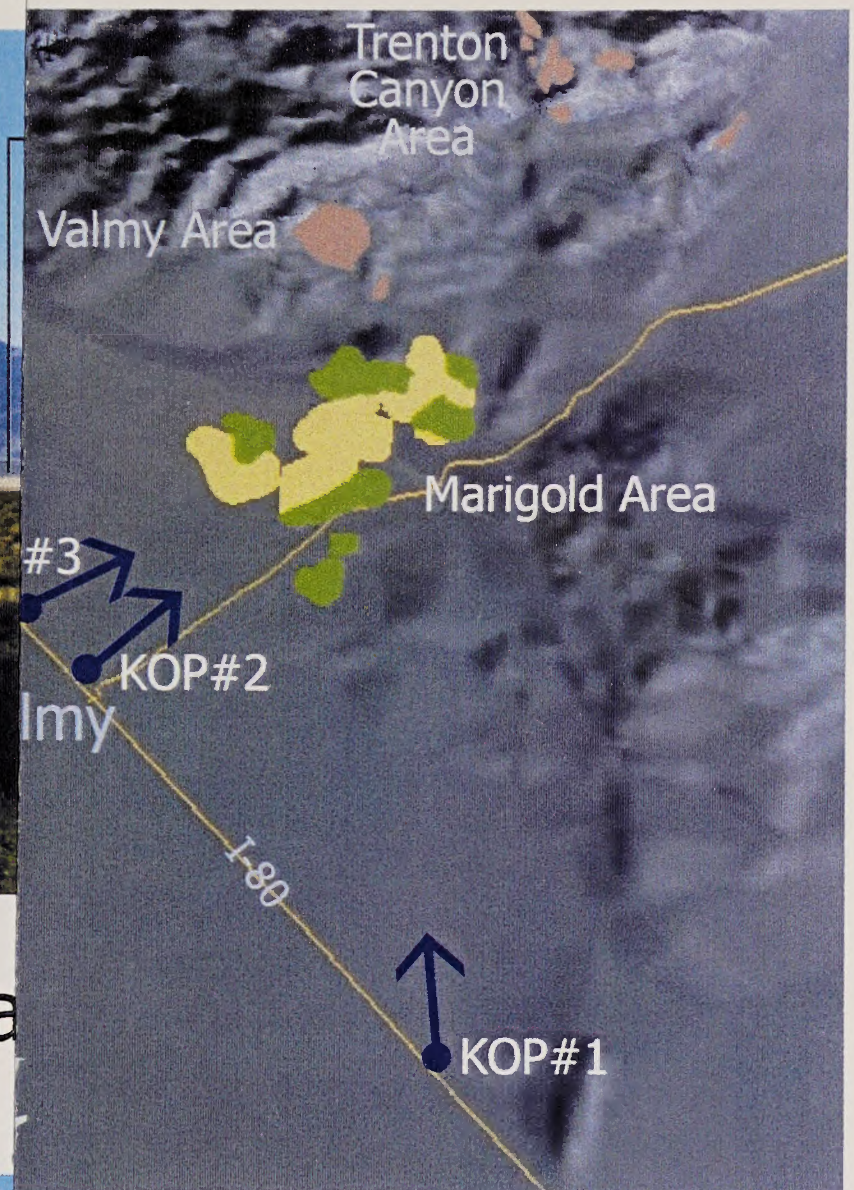


Simulation of Post-Recla



Existing Conditions Pho

Note: For proper scale size, view images at 16



tion Map

Existing Marigold Mine Features

Proposed Marigold Mine Features

Proposed Trenton Canyon Project Features

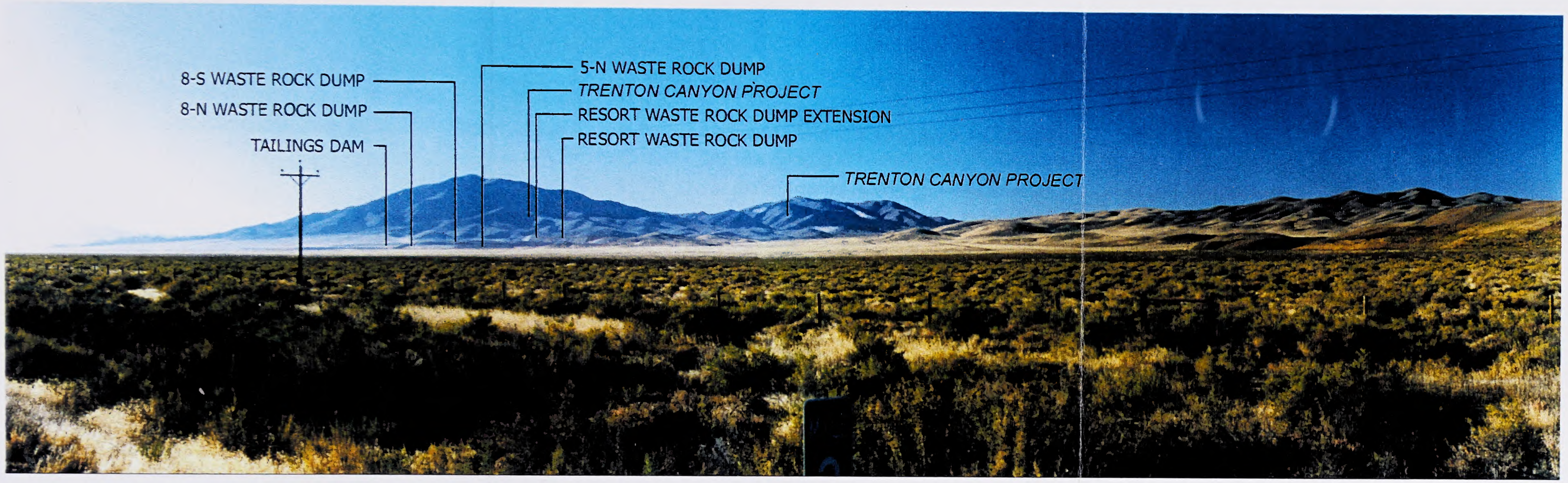
SIMULATION OF POST-RECLAMATION CONDITIONS STONEHOUSE, KOP#1

MARIGOLD MINE PROJECT
HUMBOLDT COUNTY, NV

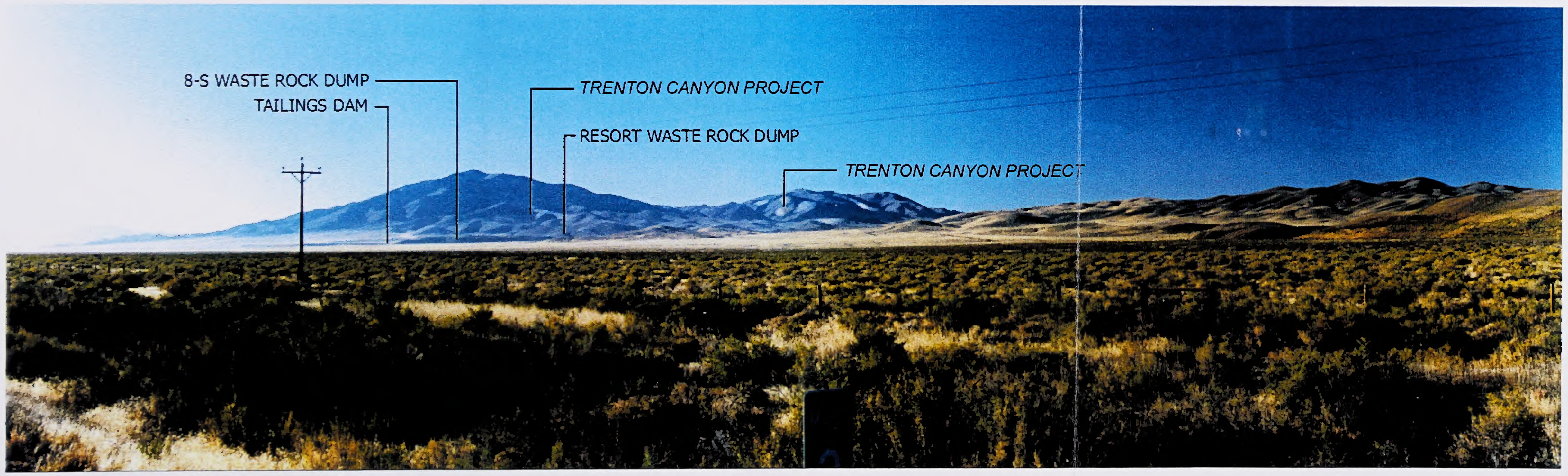
EDAW

November 1999

C-2

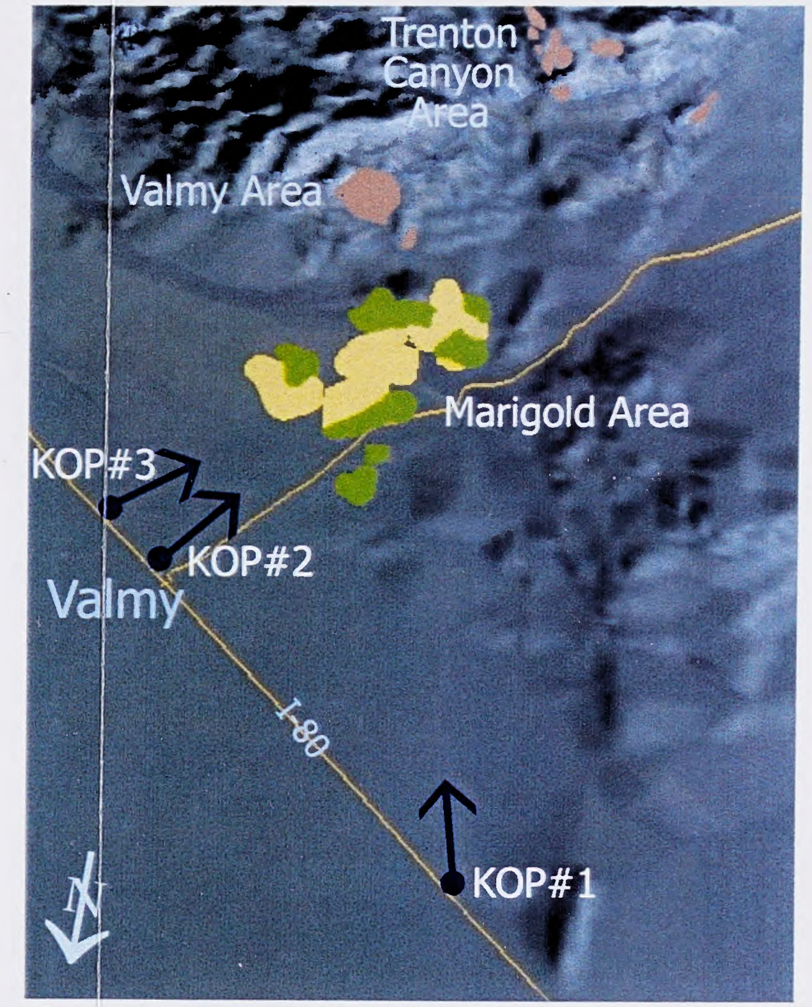


Simulation of Post-Reclamation Conditions



Existing Conditions Photograph

Note: For proper scale size, view images at 16" from eye.



Location Map

Existing Marigold Mine Features

Proposed Marigold Mine Features

Proposed Trenton Canyon Project Features

SIMULATION OF POST-RECLAMATION CONDITIONS

STONEHOUSE, KOP#1

MARIGOLD MINE PROJECT

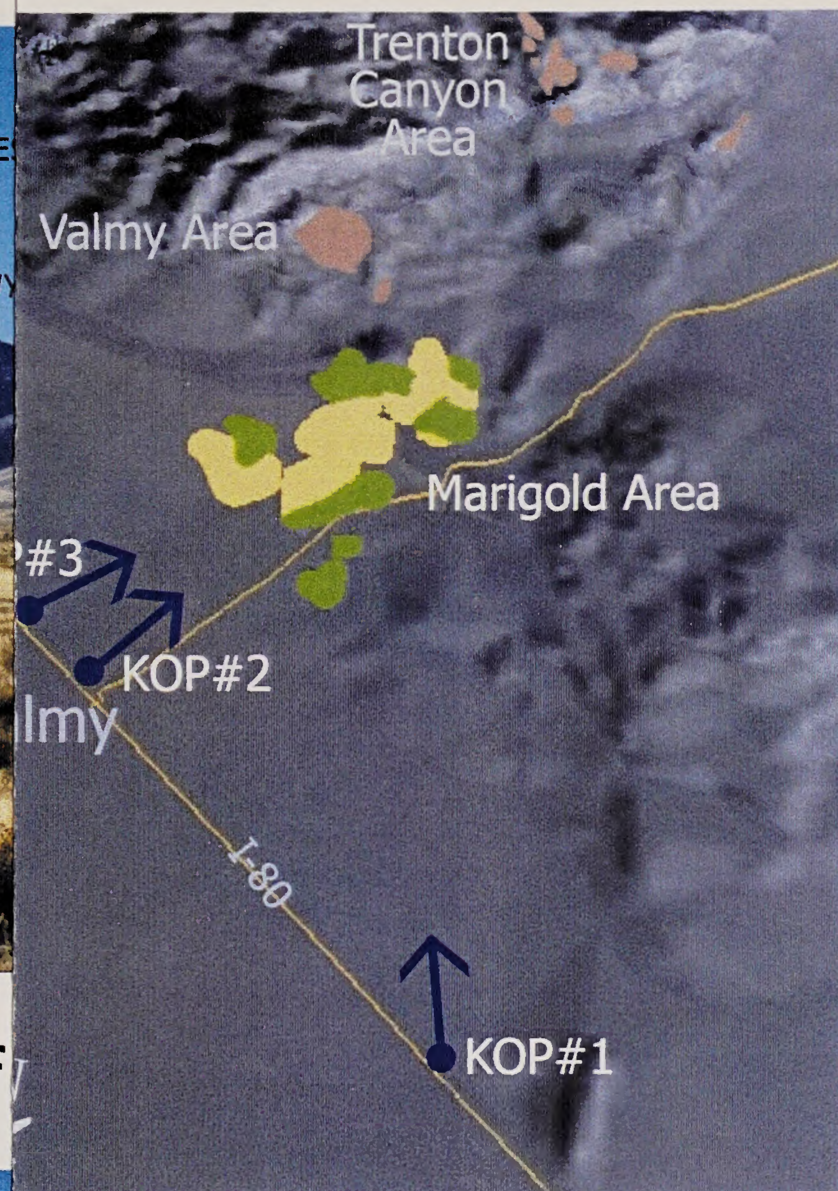
HUMBOLDT COUNTY, NV

EDAW

November 1999

C-2

Simulation of Height of



tion Map

- Existing Marigold Mine Features
- Proposed Marigold Mine Features
- Proposed Trenton Canyon Project Features

Existing Conditions Pho

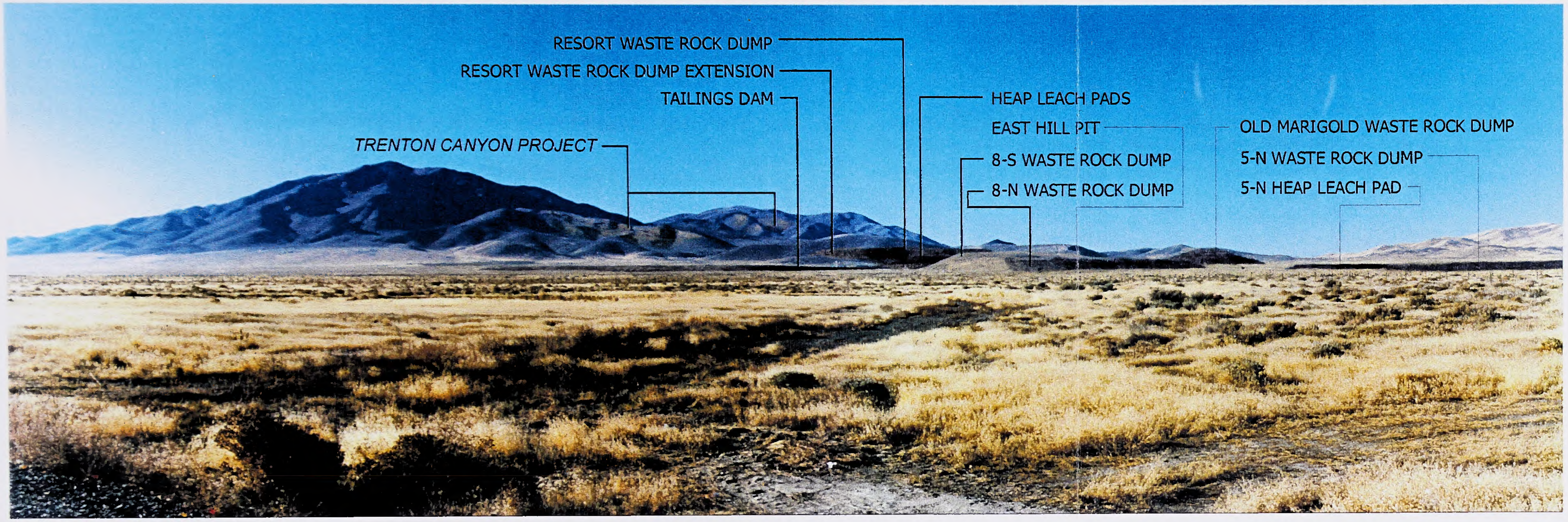
SIMULATION OF HEIGHT OF MINING CONDITIONS
VALMY, KOP#2

MARIGOLD MINE PROJECT
HUMBOLDT COUNTY, NV

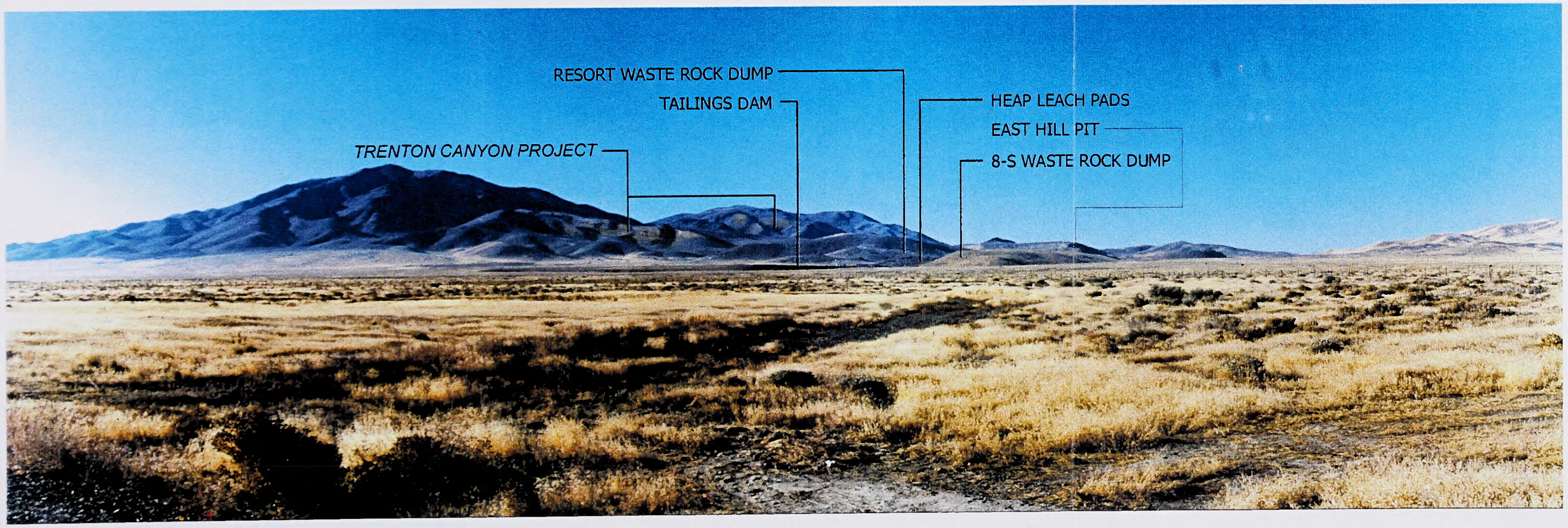
EDAW
November 1999

C-3

Note: For proper scale size, view images at 16

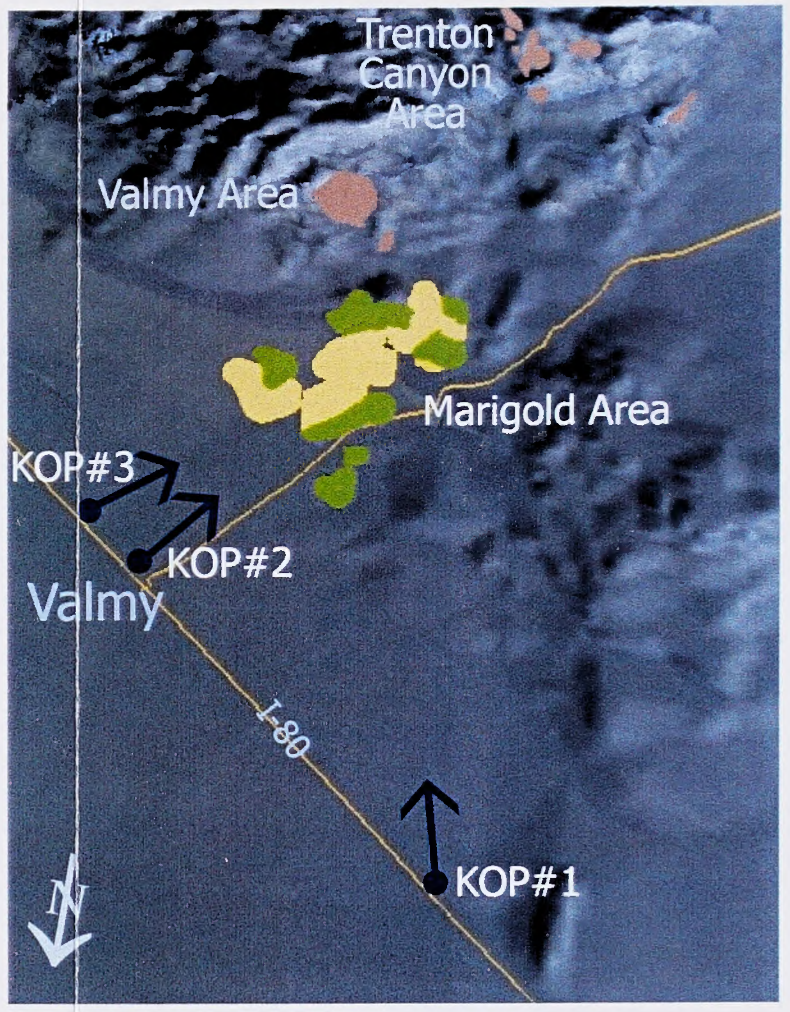


Simulation of Height of Mining Conditions



Existing Conditions Photograph

Note: For proper scale size, view images at 16" from eye.



Location Map

- Existing Marigold Mine Features
- Proposed Marigold Mine Features
- Proposed Trenton Canyon Project Features

SIMULATION OF HEIGHT OF MINING CONDITIONS

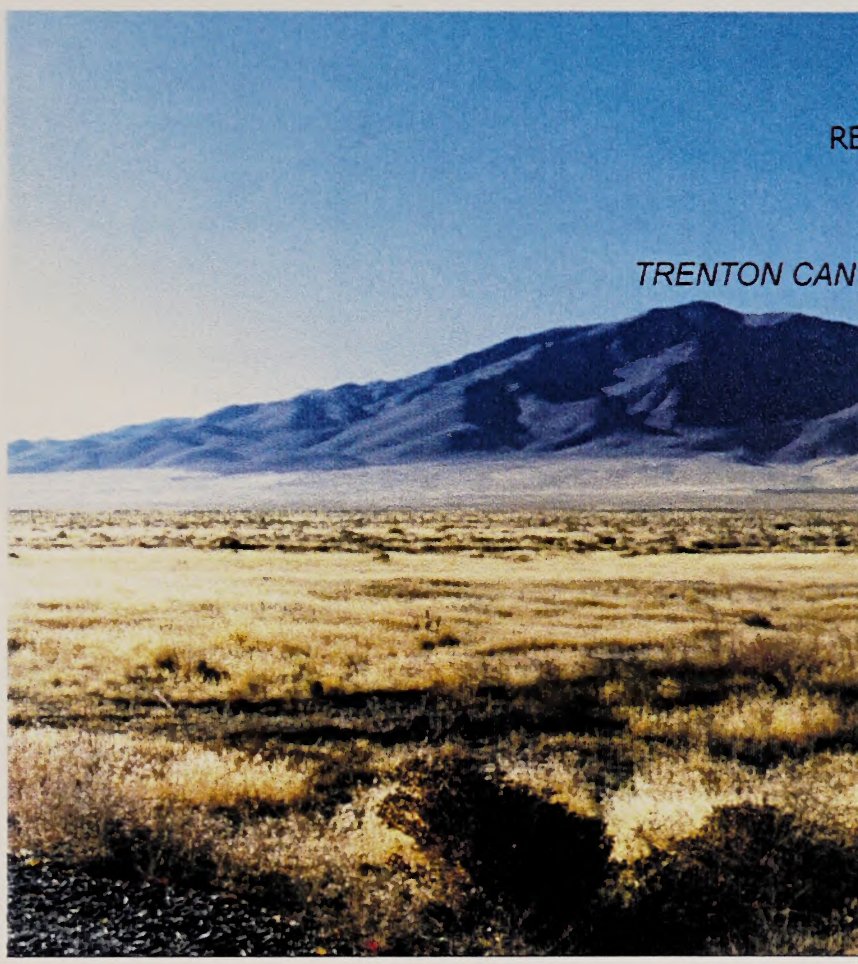
VALMY, KOP#2

MARIGOLD MINE PROJECT
HUMBOLDT COUNTY, NV

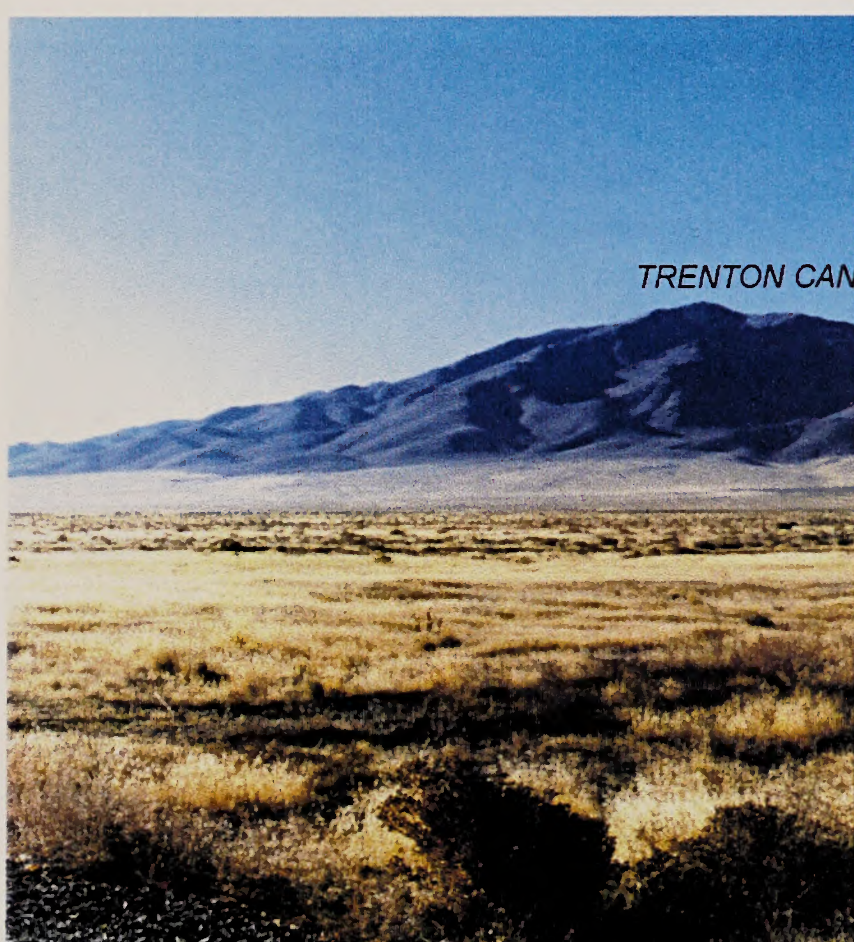
EDAW

November 1999

C-3

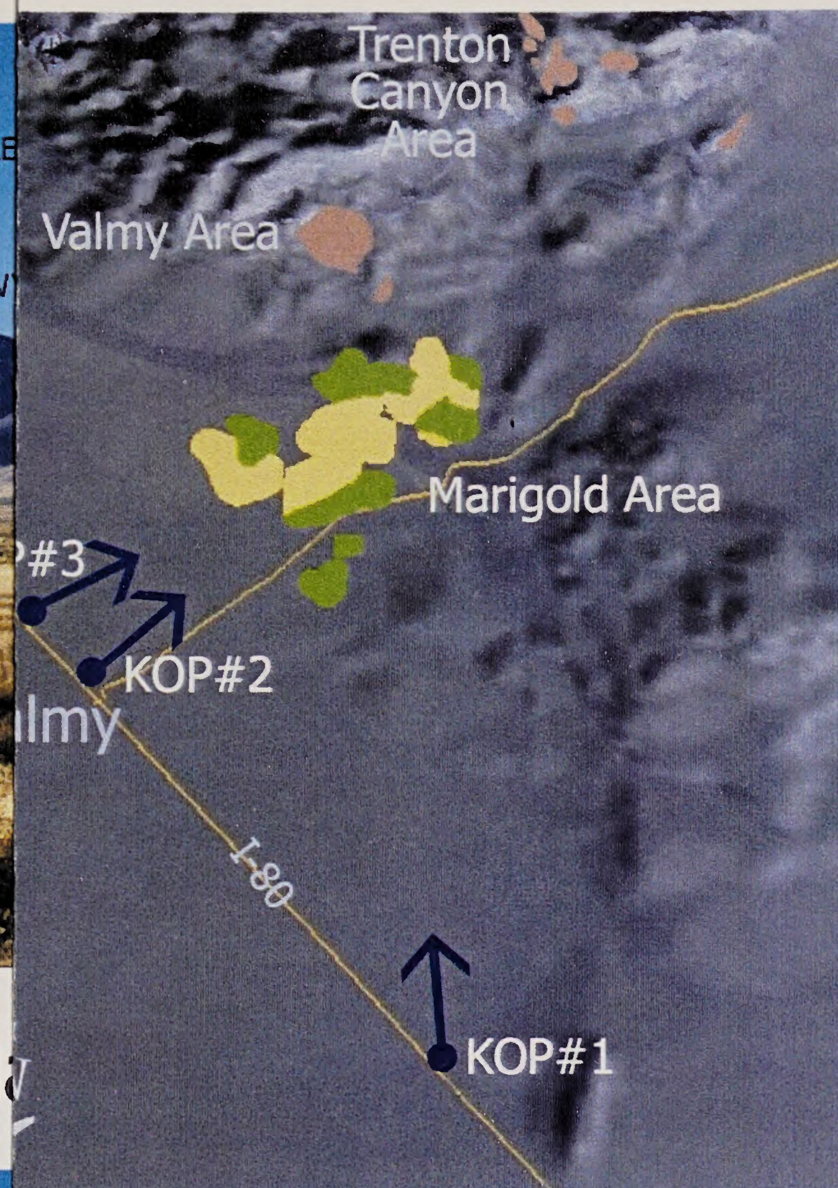


Simulation of Post-Recl



Existing Conditions Pho

Note: For proper scale size, view images at 16



tion Map

- Existing Marigold Mine Features
- Proposed Marigold Mine Features
- Proposed Trenton Canyon Project Features

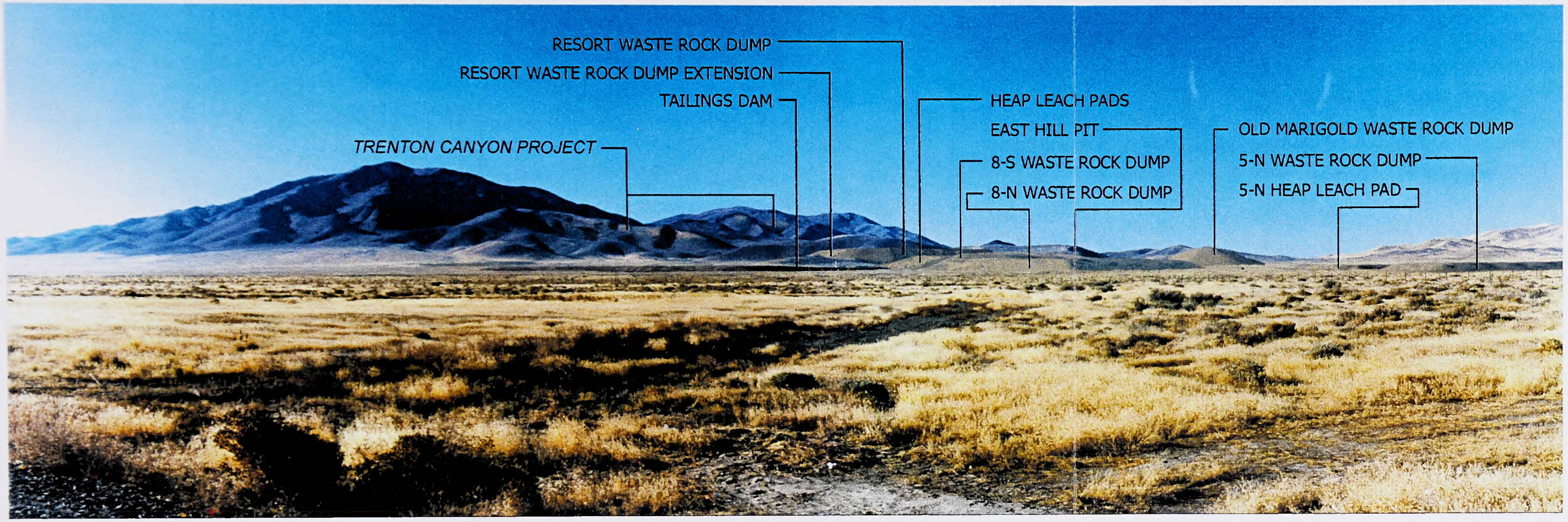
SIMULATION OF POST-RECLAMATION CONDITIONS
VALMY, KOP#2

MARIGOLD MINE PROJECT
HUMBOLDT COUNTY, NV

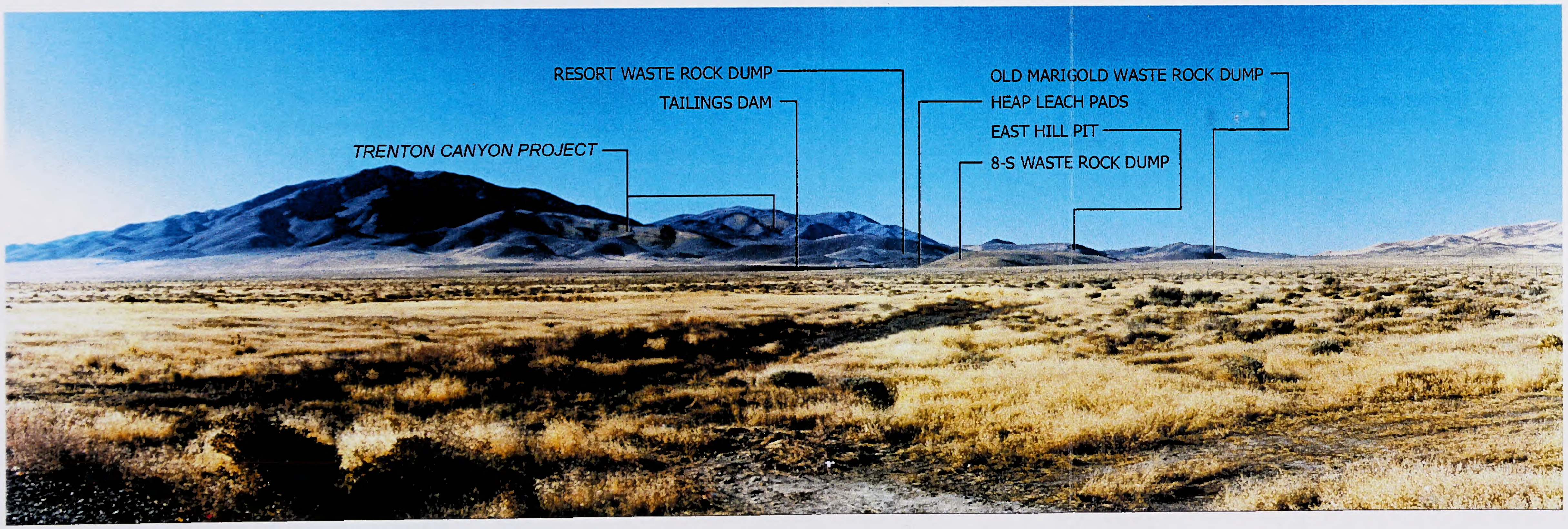
EDAW

November 1999

C-4

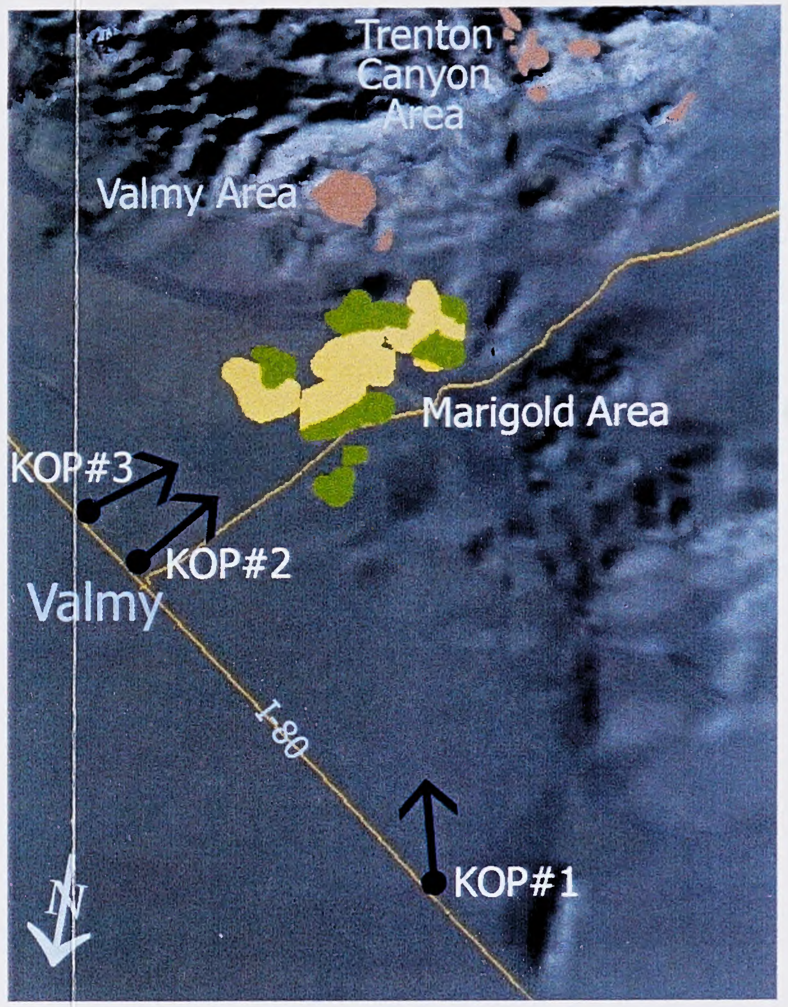


Simulation of Post-Reclamation Conditions



Existing Conditions Photograph

Note: For proper scale size, view images at 16" from eye.



Location Map

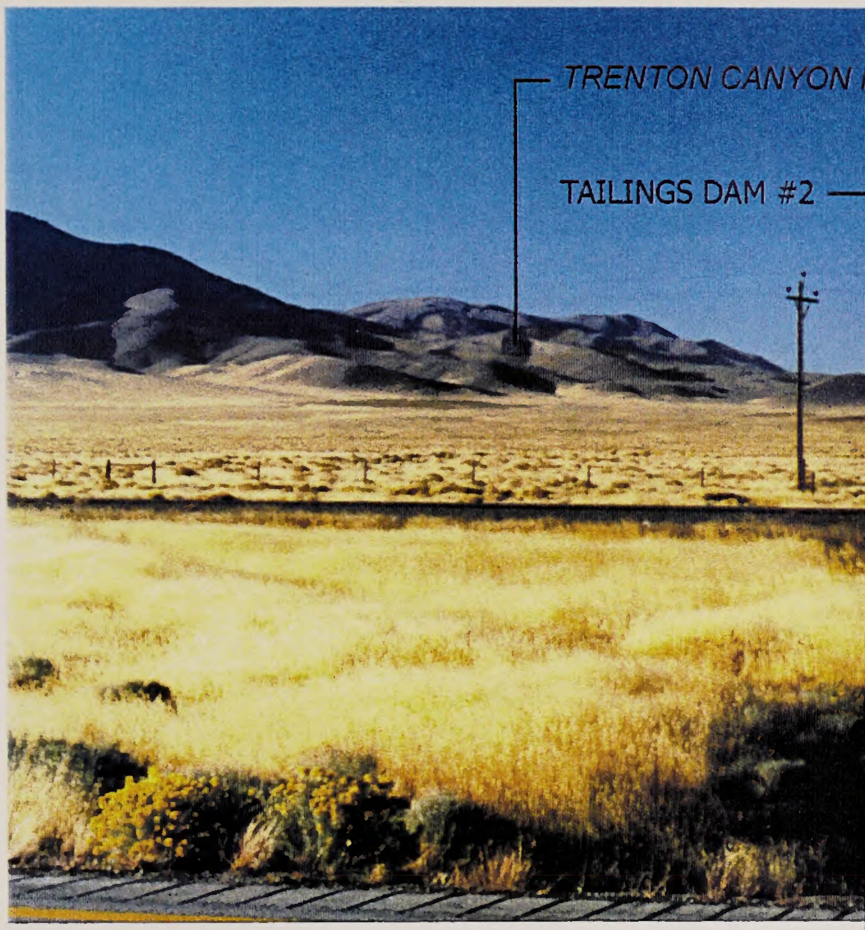
- Existing Marigold Mine Features
- Proposed Marigold Mine Features
- Proposed Trenton Canyon Project Features

SIMULATION OF POST-RECLAMATION CONDITIONS
VALMY, KOP#2

MARIGOLD MINE PROJECT
HUMBOLDT COUNTY, NV

EDAW
November 1999

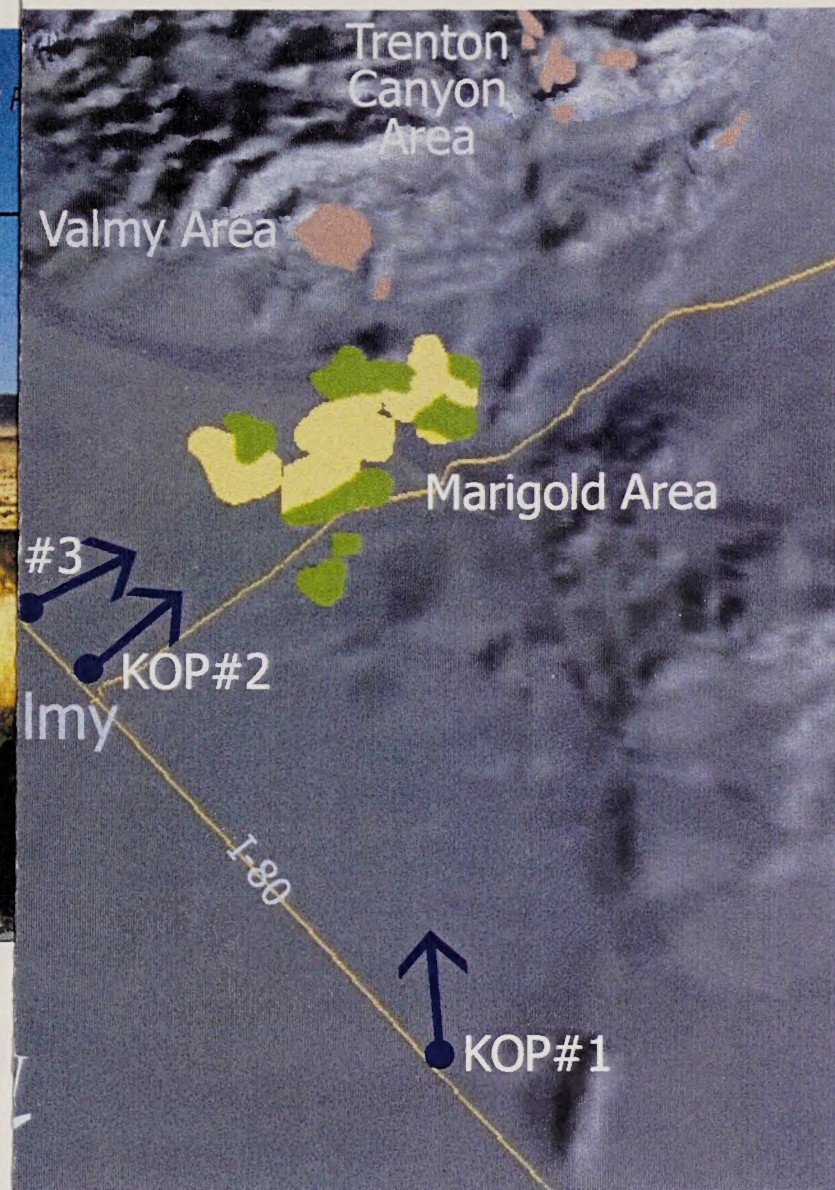
C-4



Simulation of Height of

Existing Conditions Pho

Note: For proper scale size, view images at 16



tion Map

Existing Marigold Mine Features

Proposed Marigold Mine Features

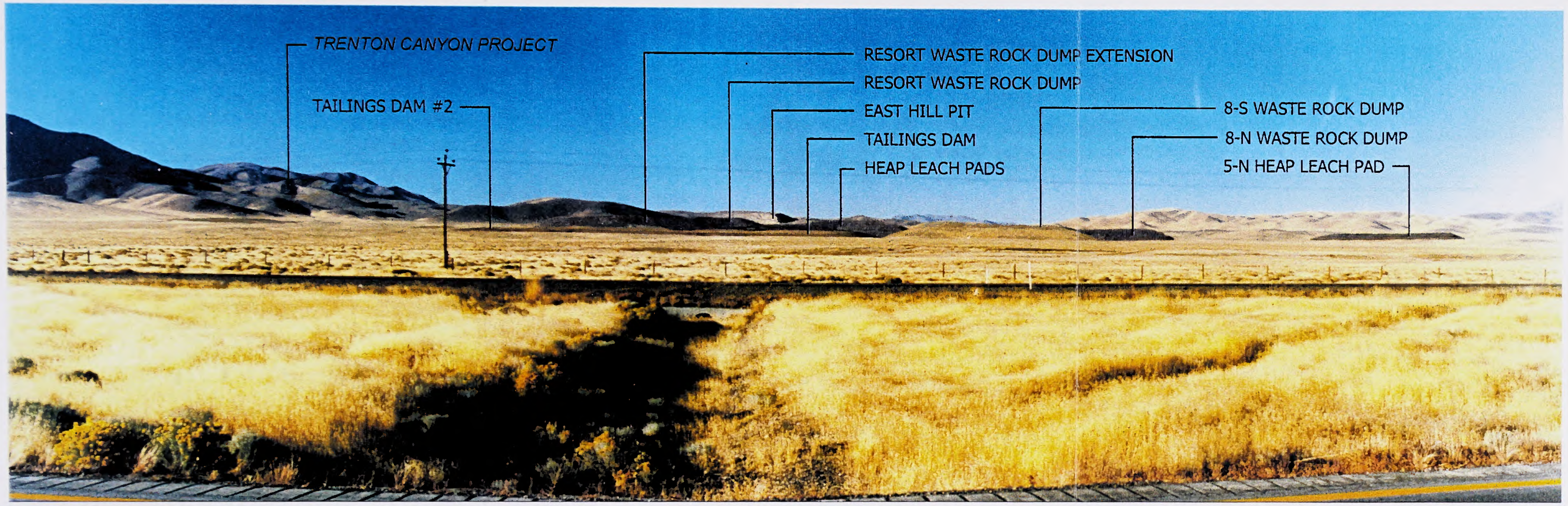
Proposed Trenton Canyon Project Features

SIMULATION OF HEIGHT OF
MINING CONDITIONS
UTH OF VALMY, KOP#3

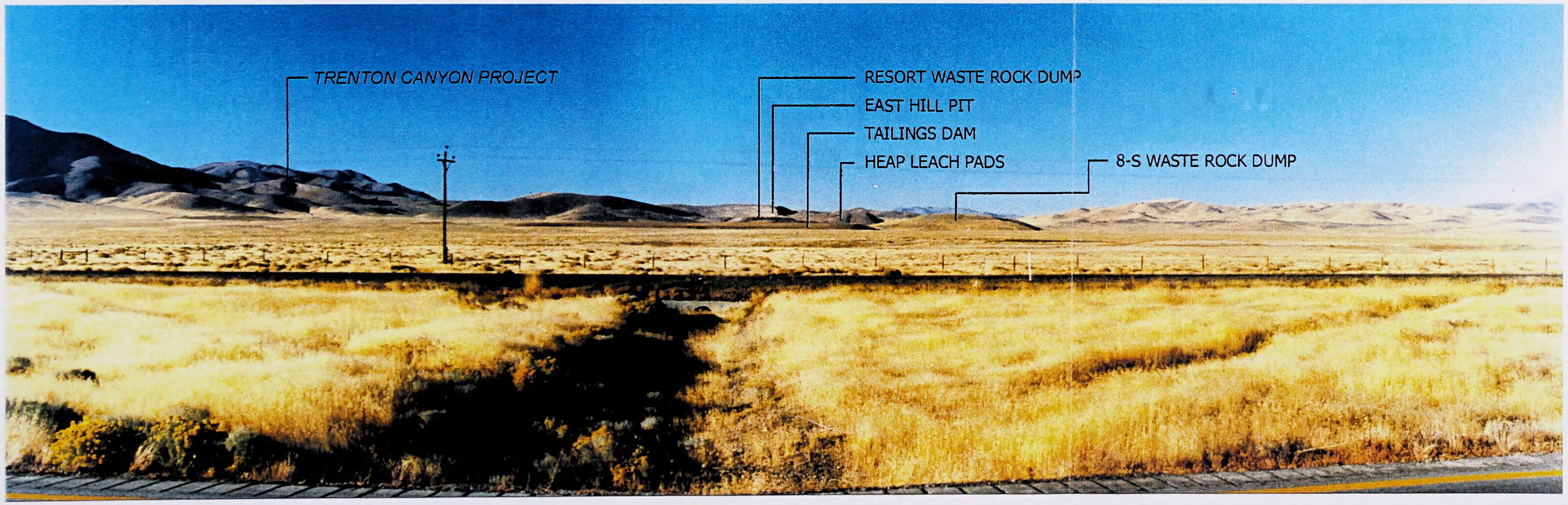
MARIGOLD MINE PROJECT
HUMBOLDT COUNTY, NV

EDAW
November 1999

C-5

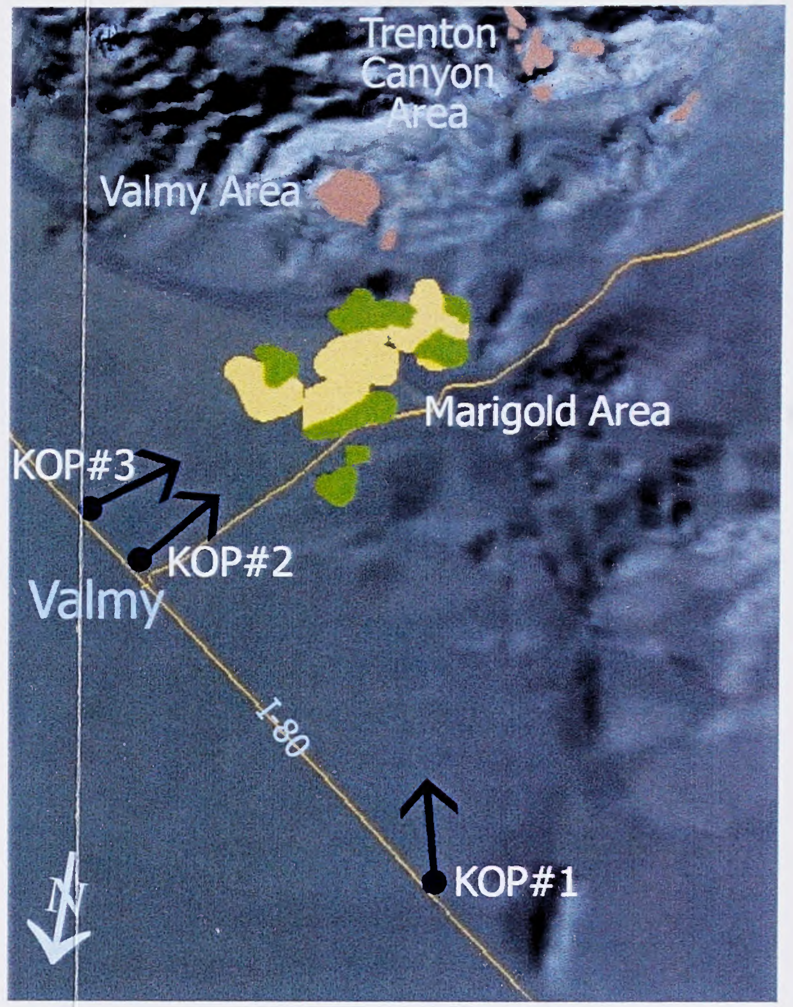


Simulation of Height of Mining Conditions



Existing Conditions Photograph

Note: For proper scale size, view images at 16" from eye.



Location Map

- Existing Marigold Mine Features
- Proposed Marigold Mine Features
- Proposed Trenton Canyon Project Features

SIMULATION OF HEIGHT OF MINING CONDITIONS

SOUTH OF VALMY, KOP#3

MARIGOLD MINE PROJECT
HUMBOLDT COUNTY, NV

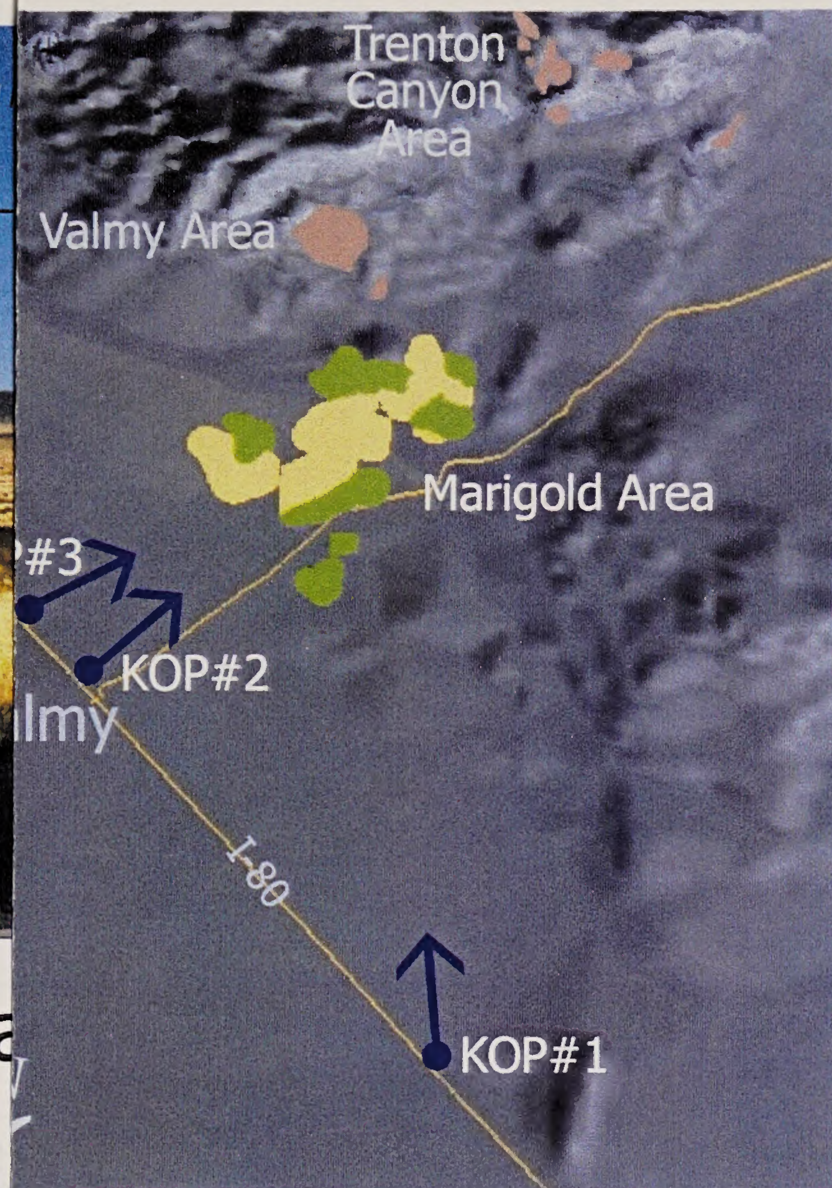
EDAW
November 1999

C-5

Simulation of Post-Recla

Existing Conditions Pho

Note: For proper scale size, view images at 16



tion Map

Existing Marigold Mine Features

Proposed Marigold Mine Features

Proposed Trenton Canyon Project Features

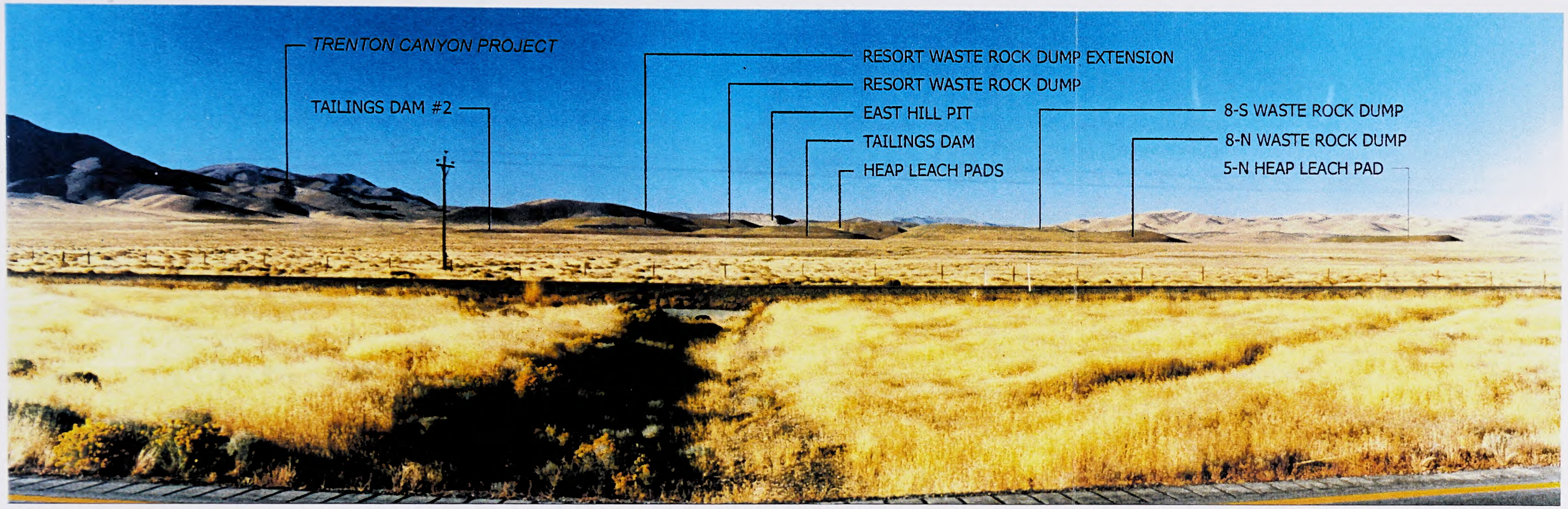
SIMULATION OF POST-
RECLAMATION CONDITIONS
UTH OF VALMY, KOP#3

MARIGOLD MINE PROJECT
HUMBOLDT COUNTY, NV

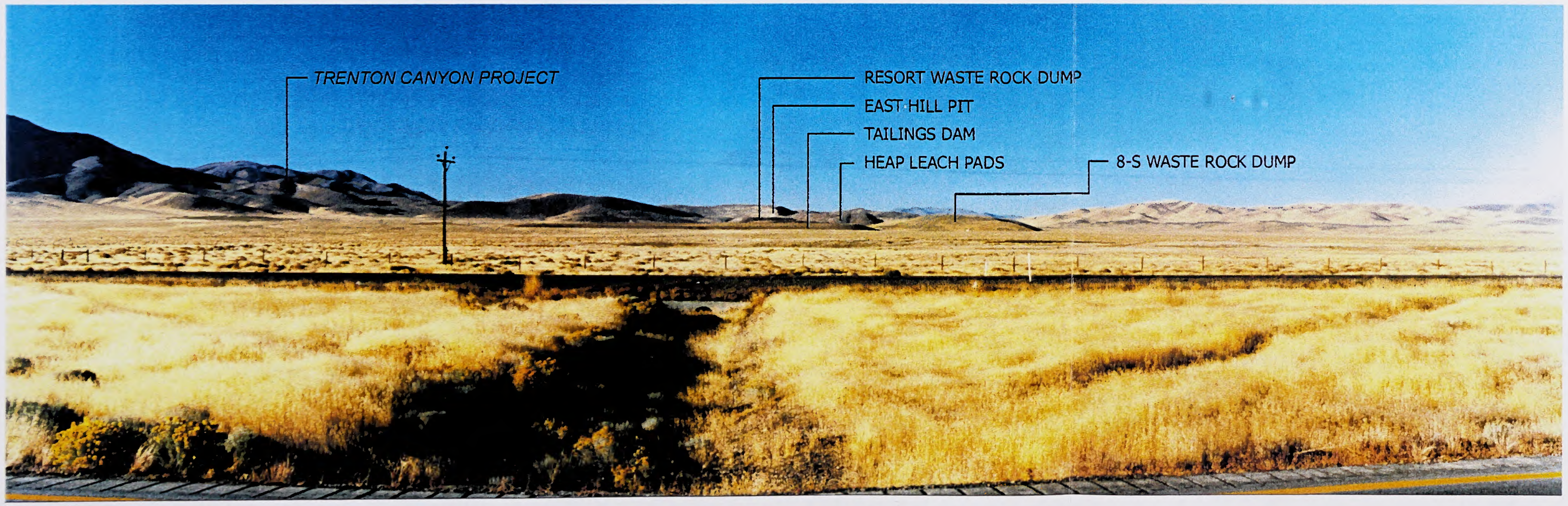
EDAW

November 1999

C-6

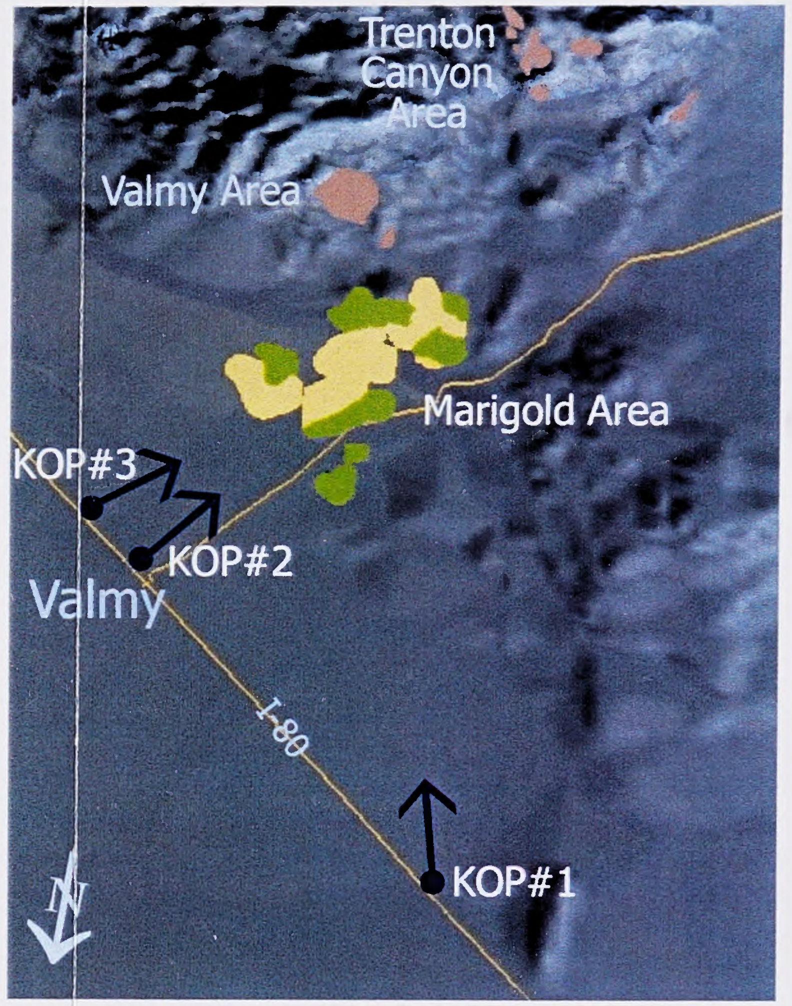


Simulation of Post-Reclamation Conditions



Existing Conditions Photograph

Note: For proper scale size, view images at 16" from eye.



Location Map

- Existing Marigold Mine Features
- Proposed Marigold Mine Features
- Proposed Trenton Canyon Project Features

SIMULATION OF POST-RECLAMATION CONDITIONS SOUTH OF VALMY, KOP#3

MARIGOLD MINE PROJECT
HUMBOLDT COUNTY, NV

EDAW
November 1999

Form 8400-4
(September 1985)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

VISUAL CONTRAST RATING WORKSHEET

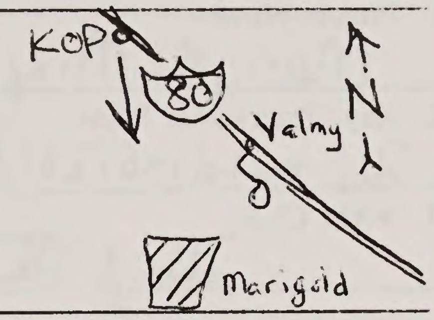
Date November 9, 1999
District Winnemucca
Resource Area
Activity (program) Minerals

SECTION A. PROJECT INFORMATION

1. Project Name
Marigold Mine EIS
2. Key Observation Point
1, mile marker 213, I-80
3. VRM Class
III & IV

4. Location
Township 33N
Range 43E
Section 8,9,18

5. Location Sketch



SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

	1. LAND/WATER	2. VEGETATION	3. STRUCTURES
FORM	B- pyramidal M- flat to rolling F- flat	B- uniform M- " F- "	B- none M- " F- regular, narrow & cylindrical
LINE	B- convex & slightly jagged M- straight & horizontal F- none	B- discontinuous M- none F- discontinuous	B- none M- " F- parallel & vertical
COLOR	B- not visible M- " F- "	B- grey- to olive-green M- straw F- yellow green	B- none M- " F- dark brown
TEXTURE	B- coarse M- medium F- fine	B- fine M- fine F- coarse	B- none M- " F- coarse

SECTION C. PROPOSED ACTIVITY DESCRIPTION (middleground) = M

	1. LAND/WATER	2. VEGETATION	3. STRUCTURES
FORM	M- squat rhomboids	M- none	M- none
LINE	M- straight, horizontal & converging	M- none	M- none
COLOR	M- dark brown	M- none	M- none
TEXTURE	M- fine	M- none	M- none

SECTION D. CONTRAST RATING ☒ SHORT TERM ☐ LONG TERM

1.

DEGREE OF CONTRAST	LAND/WATER BODY (1)				VEGETATION (2)				STRUCTURES (3)			
ELEMENTS	Strong	Moderate	Weak	None	Strong	Moderate	Weak	None	Strong	Moderate	Weak	None
Form			✓					✓				✓
Line			✓					✓				✓
Color			✓					✓				✓
Texture				✓				✓				✓

2. Does project design meet visual resource management objectives? ☒ Yes ☐ No
(Explain on reverse side)

3. Additional mitigating measures recommended
☐ Yes ☒ No (Explain on reverse side)

Evaluator's Names	Date
Randall Rasmussen	11/9/99

Form 8400-4
(September 1985)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

VISUAL CONTRAST RATING WORKSHEET

Date November 9, 1999

District Winnemucca

Resource Area

Activity (program) Minerals

SECTION A. PROJECT INFORMATION

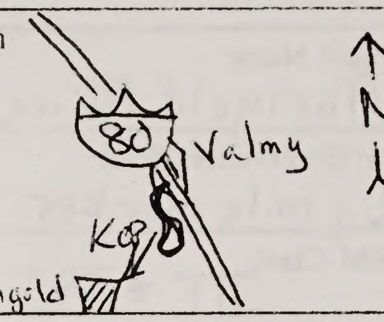
1. Project Name
Marigold Mine EIS

2. Key Observation Point
2, mile marker 216, I-80

3. VRM Class
III & IV

4. Location
Township 33N
Range 43E
Section 8,9,18

5. Location Sketch



SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

	1. LAND/WATER	2. VEGETATION	3. STRUCTURES
FORM	B - pyramidal M - flat to rolling F - flat	B - uniform M - " F - " to patchy	B - none M - Small & cylindrical F - none
LINE	B - convex & slightly jagged M - rolling F - none	B - discontinuous M - " F - horizontal, feint	B - none M - vertical F - none
COLOR	B - not visible M - " F - "	B - grey- to olive-green M - tan to grey-green F - straw to brown	B - none M - white F - none
TEXTURE	B - coarse M - fine to medium F - fine	B - fine M - fine F - fine to coarse	B - none M - medium F - none

SECTION C. PROPOSED ACTIVITY DESCRIPTION (middleground = m)

	1. LAND/WATER	2. VEGETATION	3. STRUCTURES
FORM	m - squat rhomboids	m - absent	m - none
LINE	m - straight, horizontal & converging	m - none	m - none
COLOR	m - brown	m - none	m - none
TEXTURE	m - fine	m - none	m - none

SECTION D. CONTRAST RATING ☒ SHORT TERM ☐ LONG TERM

1.

DEGREE OF CONTRAST	LAND/WATER BODY (1) Strong	Moderate	Weak	None	VEGETATION (2) Strong	Moderate	Weak	None	STRUCTURES (3) Strong	Moderate	Weak	None
ELEMENTS: Form		✓						✓				✓
Line		✓						✓				✓
Color		✓						✓				✓
Texture			✓					✓				✓

2. Does project design meet visual resource management objectives? ☒ Yes ☐ No (Explain on reverse side)

3. Additional mitigating measures recommended ☐ Yes ☒ No (Explain on reverse side)

Evaluator's Names: Randall Rasmussen   Date: 11/9/99

Form 8400-4
(September 1985)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

VISUAL CONTRAST RATING WORKSHEET

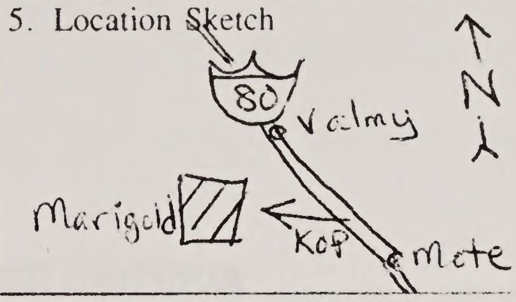
Date November 9, 1999
District Winnemucca
Resource Area
Activity (program) Minerals

SECTION A. PROJECT INFORMATION

1. Project Name: Marigold Mine EIS
2. Key Observation Point: 3, mile marker 218.4, I-80
3. VRM Class: III & IV

4. Location
Township 33N
Range 43E
Section 2

5. Location Sketch



SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

	1. LAND/WATER	2. VEGETATION	3. STRUCTURES
FORM	B - rolling M - flat to rolling F - flat	B - uniform M - " F - "	B - none M - small & square F - regular, narrow & cylindrical strip
LINE	B - convex & rolling M - rolling to straight & horizontal F - none	B - discontinuous M - none F - discontinuous	B - none M - parallel & vertical F - parallel & vertical, flat & horizontal
COLOR	B - not visible M - beige F - not visible	B - grey to olive-green M - olive-green & straw F - straw, grey-green	B - none M - white F - dark brown, grey / black
TEXTURE	B - coarse M - medium to coarse F - fine	B - fine M - fine F - fine to coarse	B - none M - medium F - coarse, fine

SECTION C. PROPOSED ACTIVITY DESCRIPTION (middleground = M)

	1. LAND/WATER	2. VEGETATION	3. STRUCTURES
FORM	M - rhomboids w/ stair-step edges	M - absent	M - none
LINE	M - parallel, horizontal & numerous	M - none	M - none
COLOR	M - beige / light brown	M - none	M - none
TEXTURE	M - fine to medium	M - none	M - none

SECTION D. CONTRAST RATING ☒ SHORT TERM ☐ LONG TERM

1. DEGREE OF CONTRAST

ELEMENTS	Land/Water Body (1) Strong	Land/Water Body (1) Moderate	Land/Water Body (1) Weak	Land/Water Body (1) None	Vegetation (2) Strong	Vegetation (2) Moderate	Vegetation (2) Weak	Vegetation (2) None	Structures (3) Strong	Structures (3) Moderate	Structures (3) Weak	Structures (3) None
Form		✓						✓				✓
Line			✓					✓				✓
Color		✓						✓				✓
Texture				✓				✓				✓

2. Does project design meet visual resource management objectives? ☒ Yes ☐ No (Explain on reverse side)

3. Additional mitigating measures recommended ☐ Yes ☒ No (Explain on reverse side)

Evaluator's Names: Randall Rasmussen
Date: 11/9/99

APPENDIX D

CULTURAL RESOURCES SIGNIFICANCE CRITERIA

APPENDIX D
CULTURAL RESOURCES SIGNIFICANCE CRITERIA

The significance of a cultural heritage resource is an assessment of its importance to the citizens of the United States and indicates whether a site has attributes that qualify it for inclusion on the NRHP. In order to be considered eligible for the NRHP, a cultural resource must be a district, site, building, structure, or object that retains its integrity of location, design, setting, materials, workmanship, feeling, and association, and satisfies at least one of the four significance criteria defined in 36 CFR part 60.4. These criteria include:

- Part 60.4a - sites that are associated with events that have made a significant contribution to the broad patterns of history;

- Part 60.4b - sites that are associated with the lives of persons significant in our past;

- Part 60.4c - sites that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction;

- Part 60.4d - sites that have yielded, or may be likely to yield, important information on prehistory or history (Parker and King no date).

Cultural heritage sites also are considered significant if they are protected under other state or Federal statutes, such as the Native American Graves Protection and Repatriation Act or the Nevada Indian Burial Protection Act (Nevada Regulations Statutes 383.150), which outlines procedures regarding treatment of human burials on state or privately-owned land in Nevada.

An undertaking has an effect on a cultural property if it alters any of the characteristics or criteria that may qualify the property for inclusion on the NRHP or otherwise affects a property's legally protected status. Impacts to cultural heritage resources are considered adverse if the effect diminishes the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Adverse effects can include, but are not limited to:

- Direct physical disturbance, damage, or alteration of all or part of a site or property that is listed on or is eligible for the NRHP, or is protected under state and/or other Federal statutes;

- Isolation of the property from or alteration of the character of the property's setting;

- Introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting;

- Neglect of a property resulting in its deterioration or destruction; and

- Transfer, lease, or sale of the property (36 CFR, 800.9, revised as of July 1, 1994).

Discussions of project impacts are limited to sites within the proposed mine area deemed to be significant or eligible for inclusion on the NRHP or sites that have Federal and/or state protection under other statutes.

Effects of an undertaking that have been found to be adverse as described above may be considered not adverse when:

- The property is of value only for its potential contribution to archeological, historical, or architectural research, and when that value can be preserved through appropriate research conducted in accordance with applicable professional standards and guidelines. This applies only to those sites identified as eligible to the Register under Criterion "D" and mitigated under treatment plans approved by the applicable agencies.

- The undertaking is limited to rehabilitation of structures that preserves the historical and architectural value to the property, and when transfer, sale, or lease includes restrictions or conditions that ensure the preservation of the property's significant features (36 CFR 800.9 (c)(1-3).

Sites eligible to the Register under Criteria A, B, and C that may experience adverse effects from the undertaking can sometimes be mitigated through such methods as development of educational centers or kiosks that provide information on the affected properties. Mitigation for sites nominated under Criteria A, B, and/or C that would experience adverse effects must be developed and defined in a treatment plan approved by the appropriate agencies.

APPENDIX E

CULTURAL RESOURCES SITES TABLES

Table E-1
Marigold Mine Project Area Cultural Resource Sites Located In the Area of Potential Effect (APE)

Site Number	Site Description	National Register of Historic Places Status[1]	State Historic Preservation Officer Concurrence	Eligibility[2] Criteria	Land Ownership	BLM Report Number/ Reference
Cr-NV-22-4244	Lithic scatter	NEL	Becker May 9,1988	–	Public	CR2-2236(P) (Harmon et al. 1988a)
Cr-NV-22-4245	Lithic scatter	NEL	Becker May 9,1988	–	Public	CR2-2236(P) (Harmon et al. 1988a)
Cr-NV-22-4246	Lithic scatter, projectile point, bifaces	NEL	Becker May 9,1988	–	Public	CR2-2236(P) (Harmon et al. 1988a)
Cr-NV-22-4247	Original central area of the Marigold Mine (historic)	NEL	Becker May 9,1988	–	Public	CR2-2236(P) (Harmon et al. 1988a)
Cr-NV-22-4362	Lithic scatter	NEL	Becker May 9,1988	–	Private	CR2-2236(Addendum) (Harmon et al. 1988b)
Cr-NV-22-6085	Lithic scatter	E	Baldrica March 19, 1996	d	Public and Private	CR2-2612 (Newsome 1994) CR2-2632 (Obermayr & Dugas 1995) CR2-2681 (Dugas 1995)

Table E-1 (Continued)

Site Number	Site Description	National Register of Historic Places Status[1]	State Historic Preservation Officer Concurrence	Eligibility[2] Criteria	Land Ownership	BLM Report Number/ Reference
Cr-NV-22-6086	Lithic scatter, lithic source area	NEL	Baldrica March 28, 1996 Baldrica September 14, 1994	–	Private	CR2-2612 (Newsome 1994) CR2-2632 (Obermayr & Dugas 1995)
Cr-NV-22-6087	Historic trash scatter	NEL	Baldrica September 14, 1994	–	UNR	CR2-2612 (Newsome 1994)
Cr-NV-22-6088	Historic trash scatter	NEL	Baldrica March 28, 1996 Baldrica September 14, 1994	–	Public	CR2-2612 (Newsome 1994) CR2-2632 (Obermayr & Dugas 1995)
Cr-NV-22-6089	Historic trash scatter	NEL	Baldrica March 28, 1996 Baldrica September 14, 1994	–	Public	CR2-2612 (Newsome 1994) CR2-2632 (Obermayr & Dugas 1995)
Cr-NV-22-6090	Lithic scatter; historic trash scatter	NEV/UE (recommended as not eligible)	Baldrica September 14, 1994-in this letter the SHPO does not concur; recommends further testing	–	Public	CR2-2612 (Newsome 1994) CR2-2686 (Dugas 1996)
Cr-NV-22-6091	Lithic scatter	NEL	Baldrica September 14, 1994	–	Public	CR2-2612 (Newsome 1994)

Table E-1 (Continued)

Site Number	Site Description	National Register of Historic Places Status[1]	State Historic Preservation Officer Concurrence	Eligibility[2] Criteria	Land Ownership	BLM Report Number/ Reference
Cr-NV-22-6092	Historic trash scatter	NEL	Baldrica September 14, 1994	–	Public	CR2-2612 (Newsome 1994)
Cr-NV-22-6093	Historic trash scatter	NEL	Baldrica September 14, 1994	–	Public	CR2-2612 (Newsome 1994)
Cr-NV-22-6094	Lithic scatter; historic trash scatter with livestock watering facilities	E (Prehistoric component) NEL (Historic component)	Baldrica September 14, 1994	The SHPO letter states "SHPO concurs that HISTORIC property is eligible under criterion d", but the BLM recommendation is that the PREHISTORIC component is eligible.	Public	CR2-2612 (Newsome 1994)
Cr-NV-22-6199	Lithic scatter	E	Baldrica March 19, 1996	d	Private & Public	CR2-2632 (Obermayr & Dugas 1995)
Cr-NV-22-6204	Fire-cracked rock cluster, lithic scatter	E	Baldrica March 19, 1996	d	Public	CR2-2632 (Obermayr & Dugas 1995)
Cr-NV-22-6205	Fire-cracked rock clusters, lithic scatter	E	Baldrica March 19, 1996	d	Public	CR2-2632 (Obermayr & Dugas 1995)

Table E-1 (Continued)

Site Number	Site Description	National Register of Historic Places Status[1]	State Historic Preservation Officer Concurrence	Eligibility[2] Criteria	Land Ownership	BLM Report Number/ Reference
Cr-NV-22-6235	Lithic scatter	NEL	Baldrica March 28, 1996 Baldrica September 14, 1994	–	Private	CR2-2632 (Obermayr & Dugas 1995)
Cr-NV-22-6239	Lithic scatter	NEL	Baldrica March 28, 1996 Baldrica September 14, 1994	–	Private	CR2-2632 (Obermayr & Dugas 1995)
Cr-NV-22-6240	Lithic scatter	NEL	Baldrica March 28, 1996 Baldrica September 14, 1994	–	Private	CR2-2632 (Obermayr & Dugas 1995)
Cr-NV-22-6251	Historic trash scatter	NEL	Baldrica March 28, 1996 Baldrica September 14, 1994	–	Private	CR2-2632 (Obermayr & Dugas 1995)
Cr-NV-22-6252	Trash dump	NEL	Baldrica March 28, 1996 Baldrica September 14, 1994	–	Private	CR2-2632 (Obermayr & Dugas 1995)
Cr-NV-22-6263	Historic trash scatter	NEL	Baldrica March 19, 1996	–	Public	CR2-2681 (Dugas 1995)
Total number of cultural sites within APE = 24 Total number of NRHP-eligible or unevaluated sites within APE = 6						

Table E-1 (Continued)

FOOTNOTES:

[1]NR/UE - No recommendation; unevaluated.
RI/UE - Unevaluated; recommended ineligible.
RE/UE - Unevaluated; recommended eligible.
NEV/UE - Additional information required per agency recommendation; unevaluated.
E - Eligible to the NRHP with SHPO concurrence.
NEL - Not eligible to the NRHP with SHPO concurrence.
APE - Area of potential effect.

[2]National Register of Historic Places Eligibility Criteria:

a: Sites that are associated with events that have made a significant contribution to the broad patterns of history.

b: Sites that are associated with the lives of persons significant in our past.

c: Sites that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction.

d: Sites that have yielded, or may be likely to yield, important information on prehistory or history.

Table E-2
Marigold Mine Project Area Cultural Resource Sites Located Within 500 Feet of the Area of Potential Effect (APE)

Site Number	Site Description	National Register of Historic Places Status[1]	State Historic Preservation Officer Concurrence	Eligibility[2] Criteria	Land Ownership	BLM Report Number/ Reference
Cr-NV-22-4698	Small lithic scatter	NEL	James July 24, 1989	–	Public	CR2-2294 (Clay 1989)
Cr-NV- 22-4699	Small lithic scatter	NEL	James July 24, 1989	–	Public	CR2-2294 (Clay 1989)
Cr-NV-22-6195	Small lithic scatter	E	Baldrica March 28, 1996	d	Public	CR2-2632 (Obermayr & Dugas 1995)
Cr-NV- 22-6196	Lithic scatter; historic trash scatter	NEL	Baldrica March 28, 1996 Baldrica September 14, 1994	–	Private and Public	CR2-2632 (Obermayr & Dugas 1995)
Cr-NV-22-6242	Small trash scatter	NEL	Baldrica March 28, 1996	–	Private	CR2-2632 (Obermayr & Dugas 1995)
Cr-NV-22-6246	Fire-cracked rock cluster	E	Baldrica March 28, 1996	d	Private	CR2-2632 (Obermayr & Dugas 1995)
Cr-NV-22-6247	Fire-cracked rock cluster	E	Baldrica March 28, 1996	d	Private	CR2-2632 (Obermayr & Dugas 1995)
Cr-NV-22-6248	Fire-cracked rock clusters; lithic scatter	E	Baldrica March 19, 1996	d	Private	CR2-2632 (Obermayr & Dugas 1995)
Cr-NV-22-6264	Debitage and tool scatter; base camp	E	Baldrica March 19, 1996	d	Public and Private	CR2-1681(P) (Dugas 1995)
Cr-NV-22-6375	Intermediate Prehistoric camp	NEL	Baldrica October 18, 1996	–	Private	CR2-2686(P) (Dugas 1996)

Table E-2 (Continued)

Site Number	Site Description	National Register of Historic Places Status[1]	State Historic Preservation Officer Concurrence	Eligibility[2] Criteria	Land Ownership	BLM Report Number/ Reference
Cr-NV-22-6376	Lithic scatter, base camp; historic stone alignments and trash scatter	E (prehistoric component) NEL (historic component)	Baldrica October 18, 1996	d	Public and Private	CR2-2686(P) (Dugas 1996)
Cr-NV-22-6377	Lithic scatter	NEL	Baldrica October 18, 1996	–	Private	CR2-2686(P) (Dugas 1996)
Total Number of Sites Within 500 feet of APE = 12 Total Number of NRHP-eligible or unevaluated sites within 500 feet of APE = 6						

FOOTNOTES:

[1]NR/UE - No recommendation; unevaluated.
RI/UE - Unevaluated; recommended ineligible.
RE/UE - Unevaluated; recommended eligible.
NEV/UE - Additional information required per agency recommendation; unevaluated.
E - Eligible to the NRHP with SHPO concurrence.
NEL - Not eligible to the NRHP with SHPO concurrence.
APE - Area of potential effect.

[2]National Register of Historic Places Eligibility Criteria:

a: Sites that are associated with events that have made a significant contribution to the broad patterns of history.

b: Sites that are associated with the lives of persons significant in our past.

c: Sites that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction.

d: Sites that have yielded, or may be likely to yield, important information on prehistory or history.