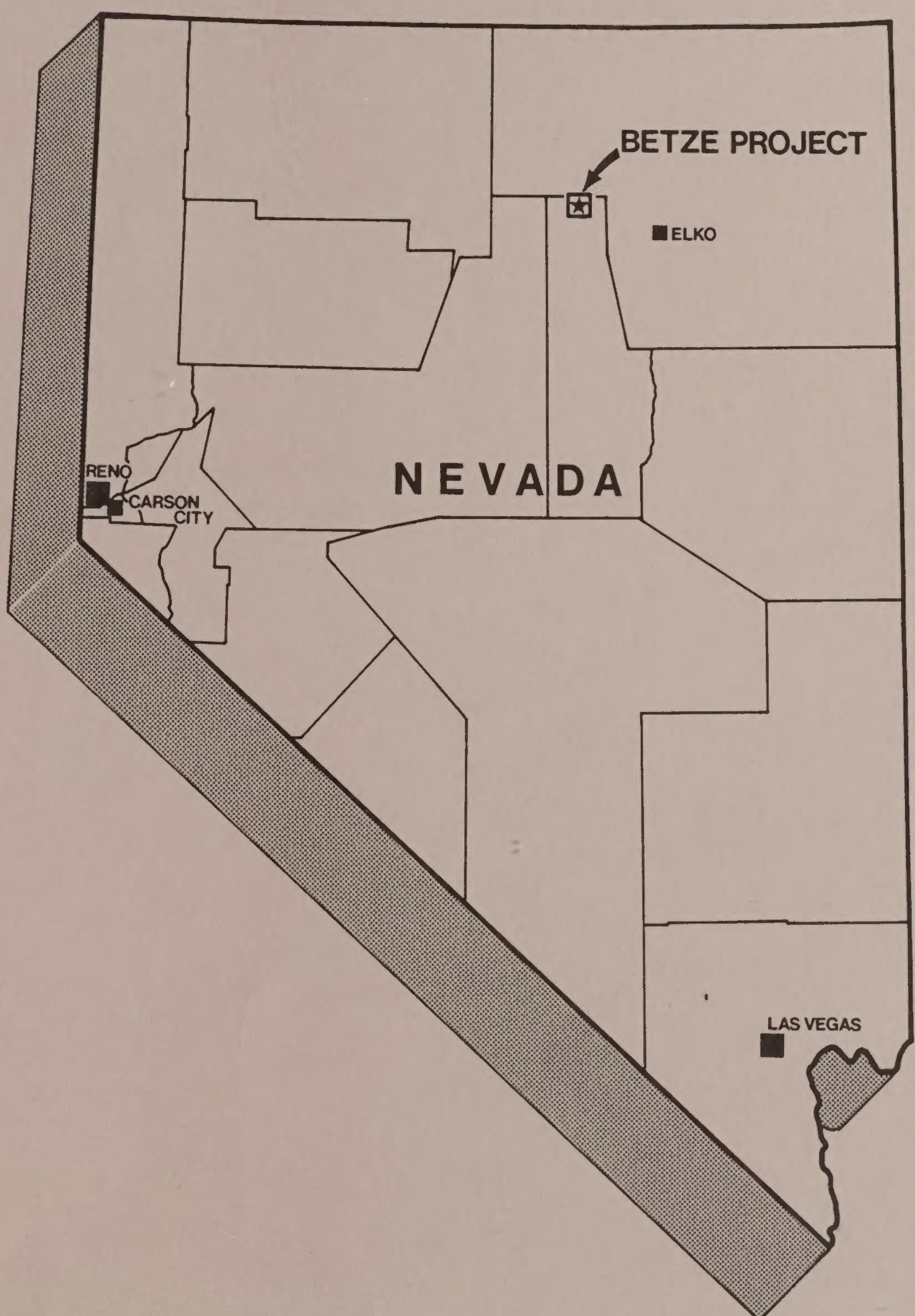
United States Department of the Interior
Bureau of Land Management

Elko District Office — January 1991

# Draft Environmental Impact Statement Betze Project

## Barrick Goldstrike Mines Inc.



BUREAU OF LAND MANAGEMENT
ELKO DISTRICT OFFICE

# DRAFT

# ENVIRONMENTAL IMPACT STATEMENT
# BETZE PROJECT

DRAFT

# ENVIRONMENTAL IMPACT STATEMENT
# BETZE PROJECT

Prepared by

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
ELKO DISTRICT OFFICE
Elko, Nevada

January 1991

Nevada State Director

Jan 10, 1991
Date

DRAFT

ENVIRONMENTAL IMPACT STATEMENT
BETZE PROJECT

| | |
|---|---|
| Lead Agency: | U.S. Department of the Interior<br>Bureau of Land Management<br>Elko District Office<br>Elko, Nevada |
| Project Location: | Elko and Eureka Counties, Nevada |
| Comments on this EIS should be directed to: | Nick Rieger<br>Project Manager<br>Elko District Office<br>Bureau of Land Management<br>P.O. Box 831<br>Elko, NV 89801<br>(702) 738-4071 |
| Date Draft EIS was made available to the Environmental Protection Agency and the public: | January 11, 1991 |
| Date by which comments should be received by the BLM: | March 11, 1991 |

Abstract:

Barrick Goldstrike Mines Inc. (Barrick) proposes to continue and to expand its existing gold mining and processing operations at the Goldstrike Mine in Eureka and Elko Counties, Nevada. The existing and proposed activities are located on lands administered by the Elko Resource Area of the U.S. Bureau of Land Management (BLM) and on privately owned lands. The proposed Betze Project involves the expansion of an existing open-pit mine to permit recovery of ore which contains approximately 15.1 million ounces of gold. The project also includes the expansion of Barrick's existing processing facilities to process the ore mined from that deposit.

This environmental impact statement (EIS) describes the project components, reasonable project alternatives, and the environmental consequences of implementing the proposed Betze Project or the alternatives. The alternatives analysis includes locations for waste rock disposal areas, ore stockpiles, heap leach facilities, and tailings impoundment; water handling and disposal; reclamation; and the No Action alternative.

SUMMARY

Barrick Goldstrike Mines Inc. (Barrick) proposes to continue and to expand its existing gold mining and processing operations at the Goldstrike Mine in Eureka and Elko Counties, Nevada. The existing and proposed activities are located on lands administered by the Elko Resource Area of the U.S. Bureau of Land Management (BLM) and on privately owned lands. In April 1989, Barrick submitted a Plan of Operations amendment to the BLM describing the proposal, known as the Betze Project. The BLM reviewed the proposal and determined that preparation of an environmental impact statement (EIS) was necessary. This EIS describes the components of, reasonable alternatives to, and environmental consequences of implementing the Betze Project.

The Betze Project involves the expansion of an existing open-pit mine to permit recovery of ore which contains approximately 15.1 million ounces of gold. The project also includes the expansion of Barrick's existing processing facilities to process the ore mined from that deposit.

Purpose and Need

Barrick's purpose in proposing the Betze Project is to utilize and expand the existing work force, equipment, and infrastructure of the Goldstrike operation to recover, process, and sell the gold contained within the Betze deposit. The gold would be mined and processed over the estimated 20-year operational life of the Betze Project.

Gold, as a precious metal, is distinguished from other major commodities on domestic and foreign markets because of its investment qualities. During the 1980s, the fabrication of gold to meet commercial and industrial demands increased dramatically. Carat jewelry fabrication alone absorbed more than half of the gold supplied annually to world markets. While gold production increased significantly during the past decade, jewelry demand, record demand of gold for bar hoarding in the Far East, and increased central bank reserves kept the supply and demand relationship buoyant.

During the coming decade, gold production is expected to continue to increase from the western countries, in particular the United States. This production increase is expected to offset anticipated decreases in production in South Africa and the Soviet Union. As a result, gold is becoming an important export commodity for the United States as its increasing production is used to satisfy strong overseas demand for jewelry and gold investment uses.

The BLM is preparing this EIS in response to Barrick's proposed amendment to the existing Plan of Operations. The proposed mining and processing facilities would be located in part on unpatented

mining and millsite claims administered by the BLM; therefore, those operations must comply with procedures and standards described in the BLM regulations for mining of public lands (43 CFR 3809, the "Surface Management Regulations"). The Surface Management Regulations recognize the statutory right, arising under the General Mining Law, of mining claim holders to develop federal mineral resources. However, such development must be consistent with the Mining and Mineral Policy Act of 1970 and the Federal Land Policy and Management Act of 1976. The regulations adopted pursuant to those statutes require the BLM to review proposed operations to ensure that: 1) adequate provisions are included to prevent undue and unnecessary degradation of federal lands; 2) measures are included to provide for reasonable reclamation; and 3) the proposed operations will comply with other applicable federal, state, and local laws and regulations.

Description of Proposed Action

Barrick proposes to expand the existing mining and processing operations at the Goldstrike Mine to recover both oxide and sulfide ore from the Betze deposit. Mine development would involve expansion of the existing Post Pit to form the Betze Pit. The ultimate Betze Pit would be approximately 8,000 feet long, 4,500 feet wide, and 1,800 feet deep.

The expansion of mining operations would require additional waste rock disposal areas, ore stockpiles, and expansion of existing mine dewatering facilities. The expansion of heap leaching operations would require a new heap leach pad, solution collection ponds, and gold recovery facilities to allow leaching of approximately 22.0 million tons of the 45.3 million tons of lower grade oxide ore. The existing carbon stripping, electrowinning, and refining facility, located on the AA Block, would be used to process the gold-loaded carbon from both existing and proposed leach facilities. The expansion of the mill facilities would include an increase in milling capacity from 6,000 tons per day (tpd) to approximately 13,000 tpd, construction of five additional autoclaves, expansion of the oxygen plant, and construction of an additional tailings impoundment. The infrastructure at the Goldstrike Mine, including equipment fleets, ancillary facilities, and personnel, would increase to accommodate the proposed expansion.

The major components of the Proposed Action include the Betze Pit, Extended South waste rock disposal area, extended dewatering facilities, North Block heap leach facility, mill expansion, North Block tailings impoundment, two ore stockpiles, topsoil stockpiles, and haul roads and pipeline corridors. The total disturbance associated with the Proposed Action is approximately 2,189 acres.

The Proposed Action includes reclamation of all project facilities except the Betze Pit. Disturbed areas would be graded to an overall slope of 2.5H:1V, topsoiled, and revegetated.

<u>Project Alternatives</u>

The analysis of alternatives in this EIS discusses alternatives to specific project components rather than alternative scenarios to the entire project. This type of evaluation enables greater flexibility in selection of various components that comprise the project as a whole.

Project alternatives were selected for analysis in the EIS based on various criteria, including:

- public or agency issue or concern;
- technical or economic feasibility;
- potential environmental advantage; and
- relationship to purposes and needs of Barrick for the project.

Alternatives were considered in detail for the following components:

- waste rock disposal locations;
- ore stockpile locations;
- heap leach pad locations;
- tailings impoundment locations;
- water handling; and
- reclamation.

The EIS also addresses the No Action alternative.

The following is a list of the alternatives considered in detail in the EIS. Barrick would construct and reclaim each alternative component for which an alternative location is considered in detail in the same manner as discussed for the Proposed Action.

Waste Rock Disposal Area Locations

North Block Area
Clydesdales Block Area
Far West Area

Ore Stockpile Locations

Existing South Block Waste Rock Disposal Area
AA Block Leach Pads
Rodeo Creek Area

Heap Leach Pad Locations

Western North Block Area

Tailings Impoundment Locations

Expanded North Block Area
Central North Block Area

Water Handling and Disposal

Infiltration
Reinjection
Discharge to Rodeo or Boulder Creeks

Reclamation

Waste Rock Disposal Area

Natural Angle of Repose
Side Slopes Recontoured to 3.0H:1V
Insloping Waste Rock Area Benches

Tailings Impoundment

Cover with Waste Rock

Betze Pit

Partial Pit Backfill

No Action Alternative

Summary of Impacts

Section 2.4 of this EIS presents a comparison of the impacts associated with the Proposed Action and the alternatives. Detailed information on potential impacts and mitigation measures is provided in Chapter 4, Environmental Consequences. The following is a summary of potential impacts associated with the Proposed Action; impacts associated with specific facility location alternatives or reclamation alternatives are discussed only if they differ substantially from the Proposed Action. For most resources, the No Action alternative would not result in additional impacts beyond those associated with previously approved operations.

Topography and Mineral Resources

The Betze Project would change the topography in the project area due to the creation of new landforms comprising the Betze Pit, waste rock disposal areas, heap leach facilities, and tailings impoundment. Subsequent access to mineral deposits other than the

Betze Pit could potentially be affected, either positively or negatively, by the existence of project facilities. Alternative waste rock disposal areas would cause minor differences in the area and height of the landforms created by the disposal areas.

Paleontology, Geology, and Potential Geologic Hazards

No paleontological resources have been identified within the project area; if such resources were identified during construction or operations, the BLM would be contacted and a mitigation plan developed. The slopes of the waste rock disposal areas have the potential to become unstable during project operations, creating a geologic hazard. The North Block heap leach pad and tailings impoundment would be located on potentially expansive soils; however, there is a low potential for structural damage to these facilities because of the size of the structures. The facilities would be designed and constructed based on the results of geotechnical studies.

Air Resources

The Betze Project would emit particulate matter, gaseous materials, and trace metals. Particulate emissions would comprise the principal impacts to air quality and would primarily be associated with the ore mining, transport, and processing operations. Gaseous emissions would result from mining and construction equipment and processing operations. There would be trace metals emissions from the mine and processing facilities. The partial pit backfill alternative would postpone reclamation resulting in the continuation of increased particulate matter emissions for an additional 9 years.

Water Resources

The withdrawal of water from the groundwater system by dewatering of the Betze Pit at a projected rate of 29,300 gpm and the subsequent discharge of water at a projected rate of 22,300 gpm would potentially impact both surface water and groundwater quantity and quality. The construction of the Betze Pit, additional waste rock disposal areas, ore stockpiles, a tailings impoundment, and a heap leach facility would also potentially impact surface and groundwater quantity and quality.

Water Quantity Impacts. The primary impact on surface water and groundwater resources would result from the withdrawal of substantial quantities of water in the area of the Betze Pit and the subsequent discharge of that water west of the Betze Project area into the Boulder Valley drainage. The dewatering operations would create a localized cone of depression in the water table; this cone of depression could potentially reduce or eliminate flow to some of the water supply wells, springs, and seeps in the area. Flow in some of the perennial sections of local creeks, particularly Rodeo and Brush Creeks, could also potentially be reduced or eliminated.

Following the cessation of the dewatering operations, the Betze Pit would fill with water. The cone of depression would continue to expand after dewatering ceases until approximately the year 2030. The water table elevation is anticipated to return to within 45 feet of the original pre-dewatering elevation within 100 years; thereafter, the water table in the pit would eventually reach equilibrium and would be reestablished at the pre-mining water elevation of approximately 5,300 feet. During and following recovery of groundwater elevations, the hydrologic system would return to pre-mining conditions. Impacts to wells, seeps, springs, and creeks would cease, and flow would be restored.

The water from dewatering operations would be treated to remove naturally-occurring arsenic and then would be discharged into an unnamed drainage for storage in the TS Ranch Reservoir. A pipeline from the reservoir to lower Boulder Valley is capable of delivering water for irrigation of approximately 7,500 acres in lower Boulder Valley. These lands are operated by the TS Ranch Joint Venture which also holds water rights authorizing the pumping of groundwater for irrigation use. The dewatering water would be used in satisfaction of these existing water rights.

The discharge would cause a major increase in the flow of the unnamed drainage, increasing the potential for erosion. Increased water storage in the TS Ranch Reservoir would result in greater evaporation and increased seepage to the groundwater system. Groundwater recharge at the irrigation area would result in localized groundwater mounding and a slight increase in evapotranspiration. Groundwater system modeling projects that there would be no significant effect on the overall water balance of the Boulder Valley system during dewatering and recovery; the model projects that the groundwater system would return to pre-mining conditions.

Alternative discharge methods, subject to regulatory approval, involve infiltration, reinjection, or direct discharge to Rodeo or Boulder Creeks. Infiltration or reinjection would reduce evapotranspiration losses, compared to the Proposed Action, and would cause localized increases in groundwater elevations beneath the areas used for infiltration or reinjection. The direct discharge of water to Rodeo or Boulder Creeks could cause streambank and channel erosion and sedimentation impacts. A portion of the discharge flow would be lost due to evaportanspiration; most of the discharged water would infiltrate into the streambed and recharge the groundwater system. The use of dewatering water for irrigation would be reduced or eliminated by any of the discharge alternatives.

Construction of the Betze Pit, waste rock disposal areas, ore stockpiles, heap leach facility, tailings impoundment, and associated ancillary facilities would affect surface water resources by reducing to a small degree the area of the Rodeo Creek drainage basin. After reclamation of these facilities, except for the Betze Pit and tailings impoundment which would be non-discharging, the surface flows would be similar to pre-mining conditions.

Water Quality Impacts. The dewatering water would be treated prior to discharge to meet NPDES requirements; therefore, no adverse surface water or groundwater quality impacts are anticipated. A release or seepage from the heap leach pad, tailings impoundment, or processing facilities could potentially degrade surface water or groundwater water quality. Seepage of acidic water from the ore stockpiles has the potential to affect groundwater. The waste rock disposal areas are projected to have an overall net acid neutralizing potential, and the waste rock would have an overall ability to consume, rather than produce, acid. The Betze Pit water body and pit wall rock are projected to have an overall net acid neutralizing potential; therefore, the pit wall rock and water contained in the Betze Pit would have an overall ability to consume, rather than produce, acid. Since the groundwater in the vicinity of the Betze Pit shows relatively high naturally-occurring arsenic levels, there is a potential for elevated arsenic levels within the Betze Pit water body. Aquatic biota production in the Betze Pit water body is expected to be low.

Alternative locations for the ore stockpiles involve placement above an existing waste rock disposal area or heap leach pads; these alternatives would provide a barrier to potential groundwater contamination. Another alternative ore stockpile location is along Rodeo Creek; seepage of acidic water has the potential to affect groundwater.

The alternative of partially backfilling the Betze Pit would preclude development of a new water body in the pit and would result in elevated groundwater arsenic concentrations compared to the Proposed Action.

Soils

The Proposed Action would result in the temporary disturbance of approximately 2,189 acres of soils. Topsoil would be salvaged, stored in stockpiles, and then reapplied to approximately 1,844 acres during reclamation. The 690-acre Betze Pit (345 acres of additional disturbance) would not be reclaimed. Alternative project facilities would cause minor differences in the acreage of temporary soils disturbance. Reclamation alternatives would affect the potential for slope stability, erosion, and successful reclamation and revegetation.

Vegetation

The Proposed Action would result in the temporary disturbance of an additional 1,844 acres of vegetation and the permanent disturbance of an additional 345 acres of vegetation. Up to 271 acres of riparian vegetation could be temporarily affected by the potential decrease in the flow of water from seeps, springs, and creeks. Conversely, the discharge of dewatering water could increase riparian vegetation in the unnamed drainage and irrigation area. Alternative project facilities would cause minor differences in the acreage of temporary vegetation disturbance.

Wildlife

The Proposed Action would result in the temporary removal of an additional 1,844 acres of moderate to low quality wildlife habitat; 345 additional acres of habitat within the Betze Pit would be permanently removed. The existing displacement of certain wildlife migration routes would continue to exist. There would be indirect impacts to wildlife due to increased traffic, noise, and human presence. Project facilities would disturb approximately 676 acres of sage grouse habitat. There would be impacts to aquatic biota associated with the decrease in flow in local creeks. Wildlife that use the seeps and springs would be affected if the flow of water from the seeps and springs were to be reduced by dewatering operations. Alternative project facilities would cause minor differences in the acreage of temporary disturbance to wildlife habitat.

Recreation and Wilderness

No impacts are anticipated to recreation and wilderness resources due to the Proposed Action or the alternatives.

Noise and Visual Resources

There would be no exceedance of noise standards at sensitive receptors. The Proposed Action and the alternatives would result in the creation of new landforms; these changes would be consistent with the BLM's Visual Resource Management objectives.

Cultural Resources

A total of 64 cultural resource sites have been identified during surveys conducted to-date of areas associated with the Proposed Action; additional surveys of previously unsurveyed areas would be conducted prior to their disturbance to determine the presence of additional sites. Mitigation of significant resources would be required in compliance with Section 106 of the National Historic Preservation Act. Alternative project facilities would result in differences in the number of cultural resource sites potentially affected; however, mitigation of significant resources would be implemented under a cultural resources treatment plan.

Land Use

The use of the project area for livestock grazing had been terminated prior to the submittal of the Plan of Operations amendment for the Betze Project; therefore, no temporary impacts to grazing would occur as a result of additional disturbance caused by the project. If flows in seeps and springs were to be diminished by dewatering operations, livestock use of such seeps and springs would be affected. There would be a permanent loss of an additional 345 acres of grazing lands associated with the Betze Pit. The Proposed Action would be consistent with the BLM Resource Management Plan for the Elko Resource Area and with state and local land use plans.

Socioeconomics

The Betze Project would generate a peak population increase of 723 people during construction, 225 people during operations, and a peak total of 414 people during the overlap of construction and operations in 1992. This population is expected to generate an increased demand for 144 additional housing units during the peak months in 1992, causing an impact to the market for temporary rental housing. The project would also increase the demand for public services and facilities. The demand on the local infrastructure and services would result in a fiscal impact to the economy of Elko County. Positive fiscal effects would result in Eureka County from the Betze Project. The project would also provide additional mining employment opportunities to the local population and some growth in the retail and service sectors.

<u>Agency Preferred Alternative</u>

National Environmental Policy Act regulations direct the BLM to identify a preferred alternative. This identification may occur in the Draft EIS or in the Final EIS. In this instance, the BLM has chosen to have the benefit of the Draft EIS and public comments on the Draft EIS prior to identifying a preferred alternative. The BLM will identify the agency preferred alternative in the Final EIS.

[illegible]

Land Use

[illegible]

would be mitigated. There would be a permanent loss of additional [illegible] acres of [illegible] associated with the Tetra site. The Proposed Action would be consistent with the BLM Resource Management Plan [illegible] land use plans.

[illegible]

[illegible] Eureka County from the Tetra Project. The project would also provide [illegible] employment [illegible]

Agency Preferred Alternative

National Environmental Policy Act regulations [illegible] the Draft EIS [illegible] The BLM will identify the agency preferred alternative in the Final EIS.

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

LIST OF TABLES

LIST OF TABLES (CONTINUED)

LIST OF TABLES (CONTINUED)

LIST OF FIGURES

LIST OF FIGURES (CONTINUED)

LIST OF FIGURES (CONTINUED)

# 1.0 INTRODUCTION AND PURPOSE AND NEED

## 1.1 Introduction

Barrick Goldstrike Mines Inc. (Barrick) proposes to continue and to expand its existing gold mining and processing operations at the Goldstrike Mine in Eureka and Elko Counties, Nevada. The existing and proposed activities are located on lands administered by the Elko Resource Area of the U.S. Bureau of Land Management (BLM) and on privately owned lands. In April 1989, Barrick submitted a Plan of Operations amendment to the BLM describing the proposal, known as the Betze Project. In accordance with 40 CFR 1501.4, the BLM reviewed the proposal and determined that preparation of an environmental impact statement (EIS) was necessary. Therefore, the BLM is serving as the lead agency for preparation of an EIS in compliance with the National Environmental Policy Act of 1969 (NEPA).

This EIS has been prepared in compliance with NEPA, the Council on Environmental Quality (CEQ) regulations for implementing the procedural provisions of NEPA (40 CFR 1500-1508), and the BLM's NEPA Handbook (H-1790-1). The EIS describes the components of, reasonable alternatives to, and environmental consequences of implementing the Betze Project. The purpose of the EIS is to assist the BLM and the public in comparing the environmental impacts of a range of reasonable project alternatives.

The Betze Project involves the expansion of an existing open-pit mine to permit recovery of ore which contains approximately 15.1 million ounces of gold. The project also includes the expansion of Barrick's existing processing facilities to process the ore mined from that deposit. The existing mine and processing facilities are located within the Carlin Trend in north-central Nevada. The Carlin Trend consists of a number of rich mineral deposits, some of which are being mined by parties other than Barrick. Figure 1-1 identifies the general location of the Betze Project. Figure 1-2 depicts the relationship of the Betze Project to nearby mining operations.

## 1.2 Purpose and Need

Barrick's purpose in proposing the Betze Project is to utilize and expand the existing work force, equipment, and infrastructure of the Goldstrike operation to recover, process, and sell gold contained within the Betze deposit. The estimated 15.1 million ounces of gold contained within the ore would be mined and processed over the estimated 20-year operational life of the Betze Project.

Gold, as a precious metal, is distinguished from other major commodities on domestic and foreign markets because of its

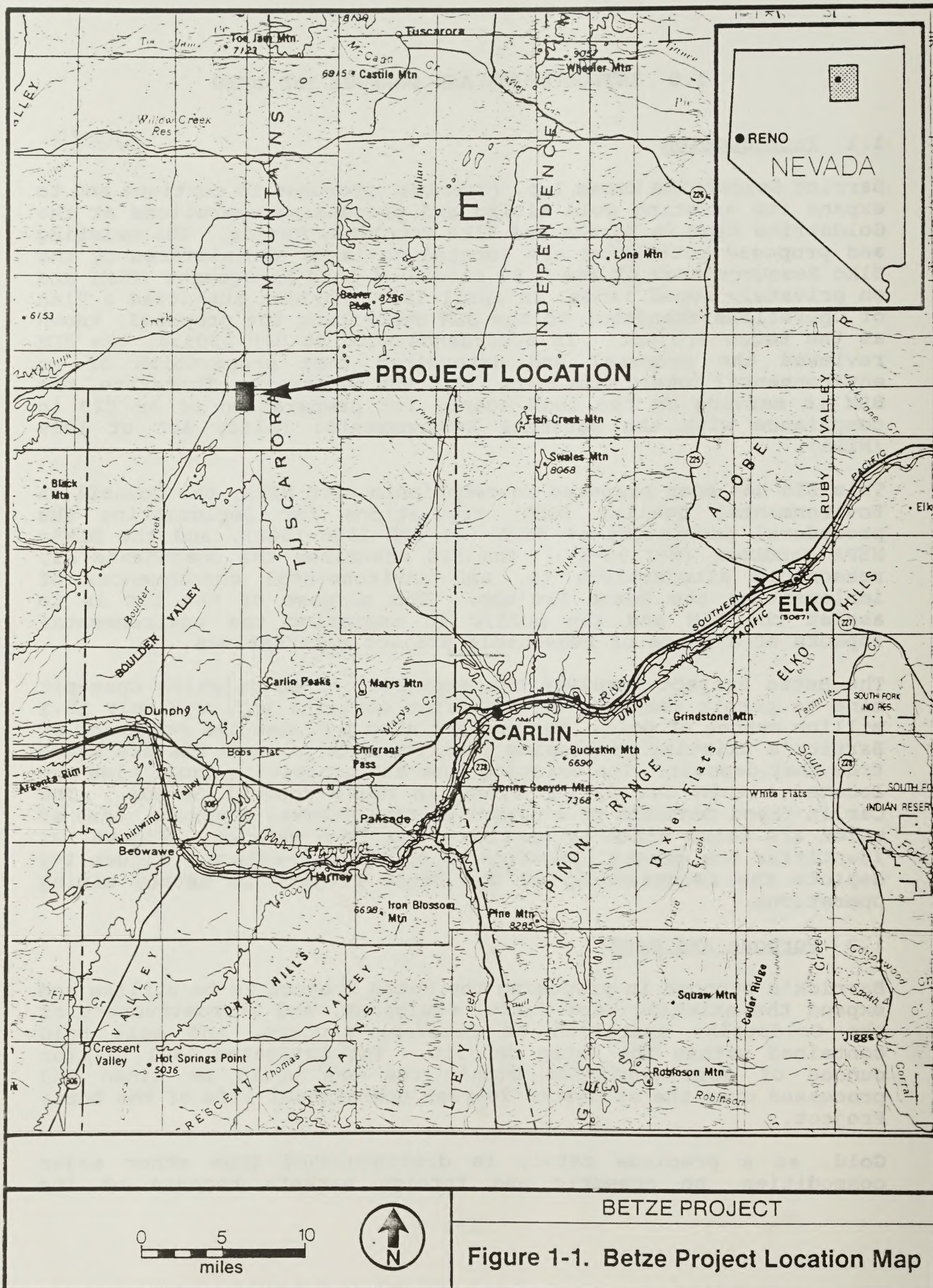
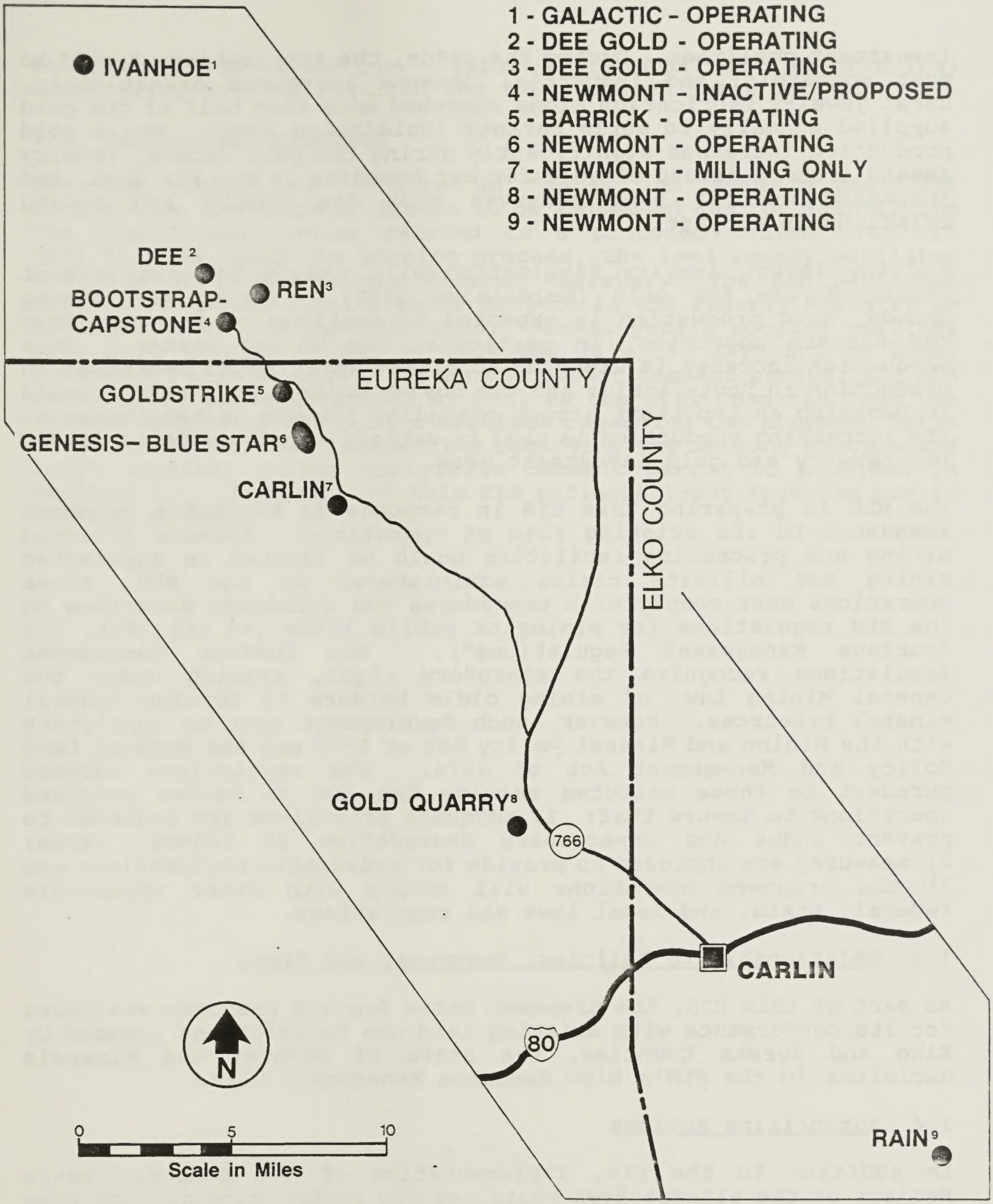



**Figure 1-1. Betze Project Location Map**




BETZE PROJECT

**Figure 1-2. Carlin Trend Mining Operations**

investment qualities. During the 1980s, the fabrication of gold to meet commercial and industrial demands increased dramatically. Carat jewelry fabrication alone absorbed more than half of the gold supplied annually to world markets (Goldfields 1990). While gold production increased significantly during the past decade, jewelry demand, record demand of gold for bar hoarding in the Far East, and increased central bank reserves kept the supply and demand relationship buoyant.

For the 1990s, jewelry fabrication will remain the single most important use for gold (Goldfields 1990). During the coming decade, gold production is expected to continue to increase from the Western countries, in particular the United States. This production increase is expected to offset anticipated decreases in production in South Africa and the Soviet Union. As a result, gold is becoming an important export commodity for the United States as its increasing production is used to satisfy strong overseas demand for jewelry and gold investment uses.

The BLM is preparing this EIS in response to Barrick's proposed amendment to its existing Plan of Operations. Because proposed mining and processing facilities would be located on unpatented mining and millsite claims administered by the BLM, those operations must comply with procedures and standards described in the BLM regulations for mining of public lands (43 CFR 3809, the "Surface Management Regulations"). The Surface Management Regulations recognize the statutory right, arising under the General Mining Law, of mining claim holders to develop federal mineral resources. However, such development must be consistent with the Mining and Mineral Policy Act of 1970 and the Federal Land Policy and Management Act of 1976. The regulations adopted pursuant to those statutes require the BLM to review proposed operations to ensure that: 1) adequate provisions are included to prevent undue and unnecessary degradation of federal lands; 2) measures are included to provide for reasonable reclamation; and 3) the proposed operations will comply with other applicable federal, state, and local laws and regulations.

## 1.3 Relationship to Policies, Programs, and Plans

As part of this EIS, the proposed Betze Project has been evaluated for its conformance with existing land use restrictions imposed by Elko and Eureka Counties, the State of Nevada, and minerals decisions in the BLM's Elko Resource Management Plan.

## 1.4 Authorizing Actions

In addition to the EIS, implementation of the proposed Betze Project or the alternatives would require authorizing actions from the BLM and other federal, state, and local agencies with jurisdiction over the project. Authorizing actions are land use or environmental permits, licenses, or approvals required for project construction or operation. Table 1-1 summarizes the principal authorizing actions required for the proposed Betze Project.

## 1.5 Public Participation

The CEQ regulations require an "early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action" (40 CFR 1501.7). To begin the scoping process, the lead agency publishes a Notice of Intent in the Federal Register. The BLM published Notices of Intent for the Betze Project in the Federal Register on April 19, 1989 and June 29, 1989. Formal public scoping meetings were held in Elko on May 3, 1989 and July 19, 1989 and in Reno, Nevada on July 20, 1989. During the public comment period, the BLM received 12 comment letters as well as the oral comments from the persons attending the public meetings regarding the proposed Betze Project. Additional information regarding the scoping process and input received during the public comment period is provided in Section 5.0. The scope of this EIS reflects input from the public scoping process.

TABLE 1-1

REGULATORY REQUIREMENTS

| Authorizing Action | Lead Regulatory Agency |
|---|---|
| Plan of Operations | BLM |
| National Environmental Policy Act Compliance | BLM |
| National Historic Preservation Act Compliance | BLM and Nevada Division of Historic Preservation and Archaeology |
| American Indian Religious Freedom Act Compliance | BLM |
| Nationwide (Section 404) Permit | U.S. Army Corps of Engineers |
| Microwave Radio Station License | Federal Communications Commission |
| Radio Station License | Federal Communications Commission |
| High Explosives License/Permit | Bureau of Alcohol, Tobacco, and Firearms |
| Industrial Artificial Pond Permit | Nevada Department of Wildlife |
| Water Appropriation Permits | State Engineer |
| National Pollutant Discharge Elimination System (NPDES) Permit | Nevada Division of Environmental Protection (NDEP), Department of Conservation and Natural Resources |
| Air Quality Registration Certificates and Permits to Operate | NDEP |
| Mining Facilities Permit | NDEP |
| Mine Reclamation Permit | BLM/NDEP |
| Solid Waste Disposal Permit | NDEP |
| Potable Water | Nevada Division of Health (NDH), Department of Human Resources |
| Tailings Impoundment - Construction Permit | State Engineer - Dam Safety |
| Sewer System Approvals | NDH, NDEP |
| Radioactive Materials License | NDH |
| Safety Plan | Mine Safety and Health Administration (MSHA) |

# 2.0 PROPOSED ACTION AND ALTERNATIVES

This chapter describes the action proposed by Barrick and a range of reasonable alternatives. The major issues and concerns identified throughout the scoping process, issues identified by affected agencies and pertinent legal authorities, and agency policies were used in the development of alternatives. Barrick's existing operations are described in Section 2.1 to establish the context for the description of the Proposed Action and alternatives. Section 2.2 describes the proposed Betze Project. Section 2.3 describes the alternatives considered in detail by the BLM, the alternatives eliminated from detailed consideration, and the No Action alternative. Section 2.4 is a summary and comparison of the environmental impacts associated with the Proposed Action and the alternatives.

## 2.1 Existing Operations

This section describes the existing Goldstrike Mine operations to establish the context for the description of the proposed expansion of operations contained in Section 2.2. There are other existing or potential gold mining operations in the vicinity of the Goldstrike Mine. These other operations are addressed in the discussion of the affected environment in Chapter 3.0.

### 2.1.1 Location and Land Ownership

Barrick's existing gold mining operations are located in the Tuscarora Range in north-central Nevada. The mining operations are located in Township 36 North, Range 49 East and Township 36 North, Range 50 East, approximately 25 miles northwest of the town of Carlin, Nevada, as shown on Figure 1-1. The Goldstrike Mine is sited in the Little Boulder Basin, a topographic feature which contains the drainage of Brush, Rodeo, and Bell Creeks. Brush and Bell Creeks drain to Rodeo Creek. Rodeo Creek converges with Boulder Creek in northern Boulder Valley west of the project area. Elevations at the project range from 5,100 feet above mean sea level (AMSL)[1] in the foothills of Boulder Valley to 5,926 feet AMSL in the highest portion of the Betze Project area which contains the open-pit mining operations. The Betze Project area is bounded on the east by the 6,000 to 7,500-foot Tuscarora Mountains, a north-trending range typical of the Basin and Range physiographic province, and on the west by Boulder Creek.

---

[1] Unless otherwise indicated, whenever this EIS references an elevation, the elevation base datum is one established by Barrick. There are discrepancies among the three survey systems currently in use in the area (Barrick, Newmont, and U.S. Geological Survey); for consistency, this document is based on Barrick's survey and elevations.

The Goldstrike Mine is owned by Barrick Goldstrike Mines Inc. A map depicting the land owned or controlled by Barrick in the area is shown on Figure 2-1. The Goldstrike Mine and ancillary facilities are located principally on unpatented mining or millsite claims on public lands, although some operations at the mine occur on private lands. The property consists of several non-contiguous blocks which total approximately 6,475 acres. The approximate acreage for each block is shown below:

| | |
|---|---|
| South Block | 2,443 acres |
| North Block | 2,590 acres |
| AA Block | 856 acres |
| Clydesdales Block | 546 acres |
| Buzz Block | 40 acres |

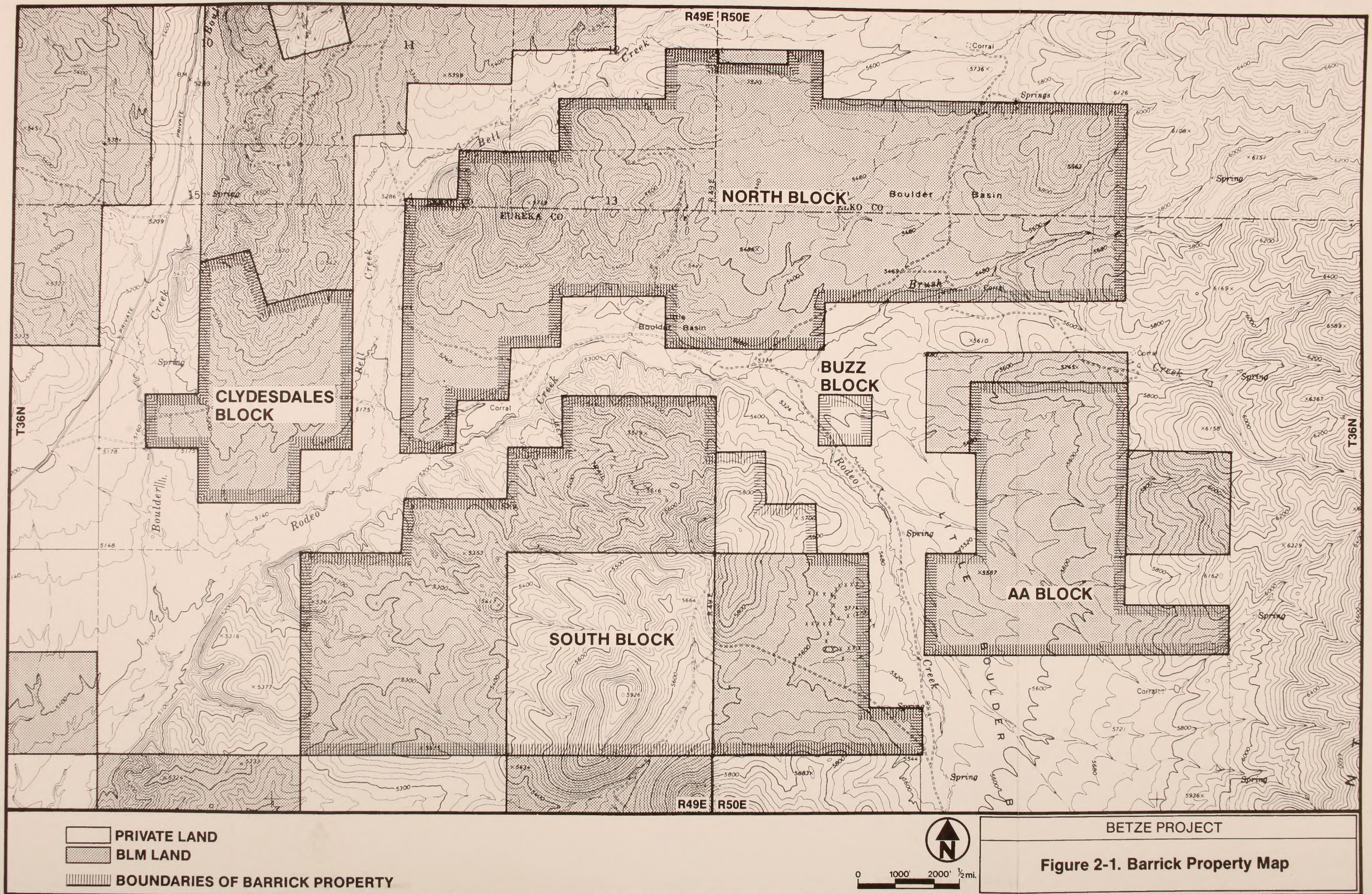
The majority of the lands immediately surrounding Barrick's holdings are private lands owned by subsidiaries of Newmont Mining Corporation, including Newmont Gold Company (Newmont) and the Elko Land and Livestock Company (ELLCO). ELLCO and AgriBeef Company are partners in the TS Ranch Joint Venture, an agricultural operation which grazes cattle on a large area surrounding the Betze Project area.

#### 2.1.2 History of Exploration and Mining Operations at the Goldstrike Mine and Surrounding Area

Gold was first discovered in the Carlin area in 1907. The Big Six Mining Company constructed the first gold processing plant on the Carlin Trend in 1913. Currently, several mining operations, consisting of open pits, crushers, mills, tailings impoundments, heap leach facilities, waste rock disposal areas, and ancillary facilities are located in the vicinity of the Betze Project area.

Figure 1-2 shows the locations of these operations and others along the Carlin Trend. The nearest active mining operation to the Goldstrike Mine is Newmont's Genesis Mine, located approximately 1.0 mile south of the South Block. The nearest mill is Newmont's Mill No. 4, located adjacent to the north side of the AA Block. Newmont's North Area heap leach pads are located adjacent to and south of the AA Block. Combined gold production from Barrick's Goldstrike Mine and Newmont's North Area operations in 1989 totalled approximately 680,000 ounces. The Newmont operations are described more fully in Section 3.12.3.3.

Western States Minerals JV-1 (Western States), Barrick's predecessor at the Goldstrike Mine, began operating the mine in the late 1970s. Western States first filed a Plan of Operations for surface disturbance of federal lands with the BLM in 1981, following the adoption by the BLM of a requirement that such plans be filed. Western States subsequently amended the Plan of Operations as required, to expand its open-pit mining of several deposits at the mine and for its heap leaching activities. The




BETZE PROJECT

**Figure 2-1. Barrick Property Map**

Plan of Operations amendments allowed the mining of various deposits, the most important of which is the Post deposit, and allowed the construction and operation of heap leach pads and related mining and processing facilities for gold recovery.

Barrick acquired Western States' interest in the Goldstrike Mine in December 1986. Barrick submitted a Plan of Operations amendment to the BLM for authorization to construct a mill and tailings impoundment to augment the previously approved heap leach and related facilities operated by Western States. This Plan of Operations amendment was approved by the BLM in December 1987.

During 1987, Barrick made the first of a series of significant gold discoveries at the Goldstrike Mine. A Plan of Operations amendment for expansion of mining and continued exploration drilling on the South Block was approved by the BLM in 1989. This amendment authorized the expansion of the Post Pit, mining of additional ore reserves in satellite pits, expansion of the South Block waste rock disposal area, expansion of mine dewatering operations, construction of a 1,500-ton per day (tpd) autoclave, and additional exploration drilling. Figure 2-2 depicts existing facilities at the Goldstrike Mine. Appendix A contains a list of previous plans of operations and their amendments.

As Barrick continued to mine the Post deposit, it also continued to explore the area around the Post Pit. Barrick drilled approximately 220 holes and ultimately defined approximately 15.1 million ounces of gold in the Betze deposit. The Betze deposit is distinguishable from other deposits presently being mined in the immediate area, including the surface Post deposit, chiefly because of its size, relatively high grade, and "sulfide" ore characteristics. The ore in the Betze deposit contains varying amounts of sulfur. The form in which the sulfur is contained in the ore dictates whether the ore is considered to be "oxide" or "sulfide" ore. In sulfide ore, the majority of the sulfur is present in an un-oxidized state, combined mostly with iron as a sulfide mineral pyrite ($FeS_2$). In oxide ore, the majority of the sulfur occurs in the oxidized state as a sulfate. The form in which the sulfur occurs determines the amenability of the ore to conventional cyanide leaching processes. Of the 15.1 million ounces of gold contained in the Betze deposit, approximately 13.0 million ounces are contained in ore that Barrick characterizes as sulfide ore.

During 1989-1990, Barrick and Newmont discovered or delineated a number of other smaller but significant mineralized areas beneath or near the Betze deposit. These mineralized areas include Barrick's Deep Post, Screamer, Rodeo, and Purple Vein deposits, and Newmont's Deep Star and Deep Post deposits. At the present time, no development of these mineralized areas is being proposed by the companies.

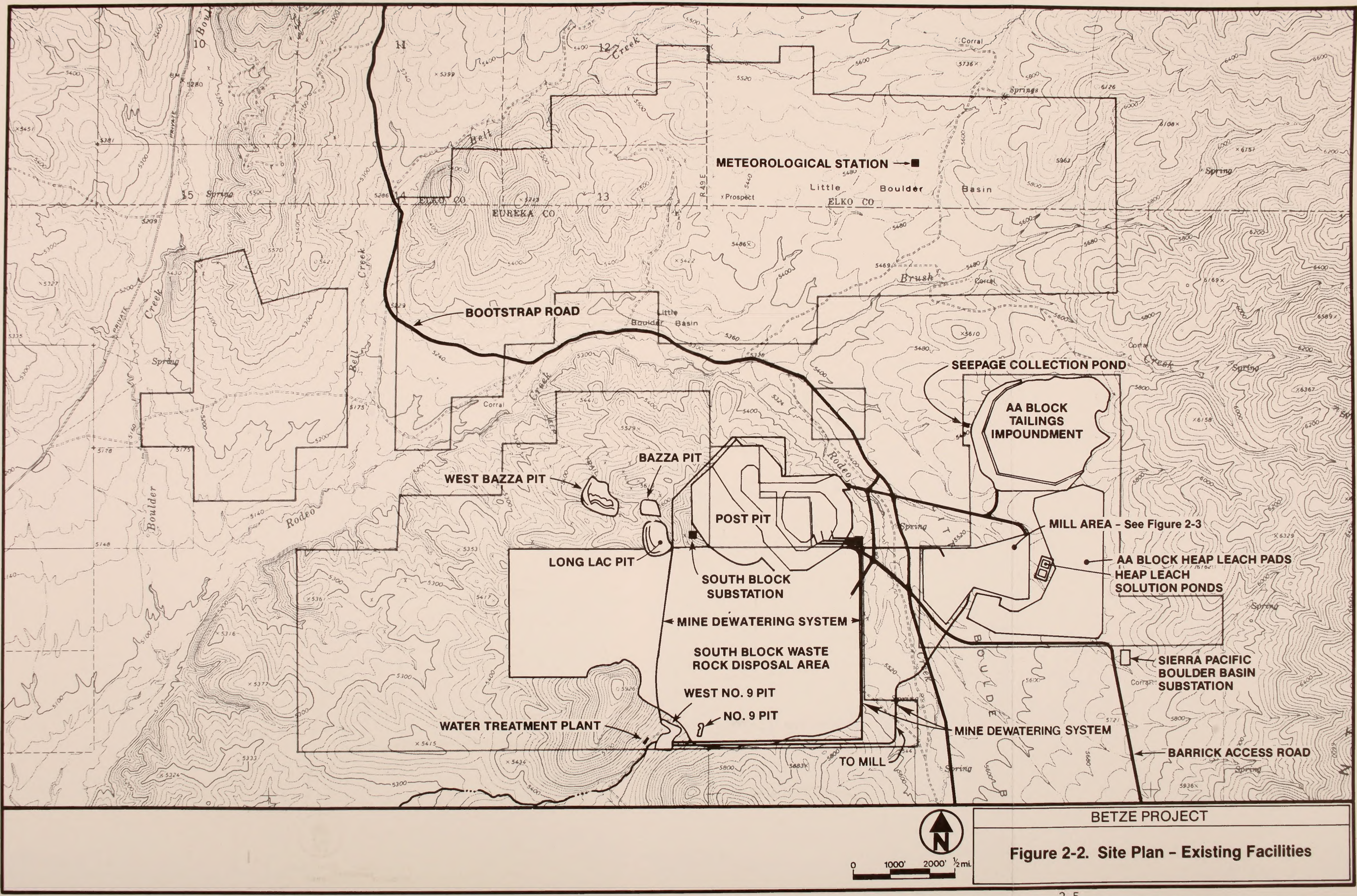
Plan of Operations amendments allowed the mining of various deposits, the most important of which is the Post deposit, and allowed the construction and operation of heap leach pads and related mining and processing facilities for gold recovery.

Barrick acquired Western States' interest in the Goldstrike Mine in December 1986. Barrick submitted a Plan of Operations amendment to the BLM for authorization to construct a mill and tailings impoundment to augment the previously approved heap leach and related facilities operated by Western States. This Plan of Operations amendment was approved by the BLM in December 1987.

During 1987, Barrick made the first of a series of significant gold discoveries at the Goldstrike Mine. A Plan of Operations amendment for expansion of mining and continued exploration drilling on the South Block was approved by the BLM in 1988. This amendment authorized the expansion of the Post Pit, mining of additional ore reserves in satellite pits, expansion of the South Block waste rock disposal area, expansion of mine dewatering operations, construction of a 1,200-ton per day (tpd) autoclave, and additional exploration drilling. Figure 1-2 depicts existing facilities at the Goldstrike Mine. Appendix A contains a list of previous plans of operations and their amendments.

As Barrick continued to mine the Post deposit, it also continued to explore the area around the Post Pit. Barrick drilled approximately 230 holes and ultimately defined approximately 15.1 million ounces of gold in the Betze deposit. The Betze deposit is distinguishable from other deposits presently being mined in the immediate area, including the surface Post deposit, chiefly because of its size, relatively high grade, and "sulfide" ore characteristics. The ore in the Betze deposit contains varying amounts of sulfur. The form in which the sulfur is contained in the ore dictates whether the ore is considered to be "oxide" or "sulfide" ore. In sulfide ore, the majority of the sulfur is present in an unoxidized state, combined mostly with iron as a sulfide mineral pyrite ($FeS_2$). In oxide ore, the majority of the sulfur occurs in the oxidized state as a sulfate. The form in which the sulfur occurs determines the amenability of the ore to conventional cyanide leaching processes. Of the 15.1 million ounces of gold contained in the Betze deposit, approximately 13.0 million ounces are contained in ore that Barrick characterizes as sulfide ore.

During 1989-1990, Barrick and Newmont discovered or delineated a number of other smaller but significant mineralized areas beneath or near the Betze deposit. These mineralized areas include Barrick's Deep Post, Screamer, Brown, and Purple Vein deposits, and Newmont's Deep Star and Deep Post deposits. At the present time, no development of these mineralized areas is being proposed by the companies.




BETZE PROJECT

**Figure 2-2. Site Plan - Existing Facilities**

### 2.1.3 Existing Mining Operations

Barrick currently operates the Post Pit and other much smaller open pits as shown on Figure 2-2. Approximately 300,000 to 325,000 tons of ore and waste per day are moved using conventional drilling, blasting, excavating, and hauling methods. The daily tonnage figures include approximately 50,000 to 100,000 tons of material that Barrick presently is mining from a portion of the Post Pit located on Newmont's property. Barrick continues to operate, from time to time, other smaller open pits (e.g., Bazza, West Bazza, Long Lac) originally developed by Western States. In the mining operation, ore and waste rock are first drilled using large-diameter blasthole drilling rigs. The drilled holes are then charged with ammonium nitrate prills (or slurry) and blasted. The resultant broken rock is excavated on production benches having individual heights of either 20 or 40 feet. Excavation is performed by electric and hydraulic shovels and large front-end loaders. Haulage trucks having carrying capacities of 85, 100, or 190 tons are used to transport the ore and waste rock out of the pits.

Waste rock is trucked to the South Block waste rock disposal area, to Newmont's property, or to mine construction projects. Newmont's ore is hauled to Newmont's processing facilities or to Newmont's ore stockpiles. Barrick's ore is trucked approximately 1.5 miles to ore stockpiles or to the processing facilities on the AA Block. Higher grade ore is sent to the mill circuit. Lower grade ore either is sent to the crushing and agglomeration circuit or is hauled directly to the AA Block leach pads as run-of-mine ore. Topsoil is stripped prior to construction and mining and is stored in topsoil stockpiles for use in reclamation of disturbed areas.

Water trucks are used to suppress dust on the roads and waste rock disposal area. During dry periods, an estimated 100,000 gallons of water per hour are distributed on road surfaces. In addition, dust suppression is accomplished through the application of a dust suppressant (magnesium chloride solution) onto the main haul roads, service roads, parking areas, and the main access road to the Goldstrike Mine. Magnesium chloride is hygroscopic, i.e., it attracts and retains moisture. The road surfaces are treated to retain moisture for a much longer time than if untreated, resulting in lower fugitive dust emissions.

The magnesium chloride solution ranges from 28 to 34 percent magnesium chloride by weight, and pH ranges from 6 to 7. The solution is chemically stable, and is mildly corrosive to metals; it is not considered to be a hazardous material or a hazardous waste. The suggested disposal procedure for released solution is to allow it to absorb directly into soil, or dilute the solution into a water treatment facility.

A specially equipped truck applies a metered amount of the magnesium chloride solution across a road surface. The application usually begins in the spring, to avoid both loss through snowmelt run-off, and creation of dangerous conditions since treated surfaces are initially slick when wet. The solution is reapplied on an as-needed basis, usually one or two times during the summer. Water trucks keep the road surfaces dampened between applications. Magnesium chloride is generally not applied during the winter months because the road surfaces are usually wet or frozen.

The Post Pit has reached depths of 300 to 700 feet below the surrounding surface. The primary objective in Barrick's open-pit slope design is to produce safe highwall slopes which also will achieve maximum economic recovery of the ore reserve. Experience in the Post Pit has shown that the north and south walls may be mined to overall heights of up to 700 feet at an interramp slope angles of 43 to 49 degrees. Portions of the east and west highwalls were previously found to be unstable at these slope angles, and these highwalls are currently being mined at an interramp slope angles as low as 30 degrees.

The existing surface disturbance of the Post Pit is approximately 245 acres. The total surface disturbance of Barrick's existing mining and processing operations is approximately 2,190 acres. Table 2-1 lists the approximate acreages disturbed by the major components of Barrick's existing mining and processing operations. Table 2-2 shows the roster of existing mining equipment.

The Post Pit is being dewatered using in-pit wells, perimeter wells, and in-pit sumps. The quantity of dewatering water has varied from 0 to 15,000 gallons per minute (gpm). Mining of the satellite pits, when conducted, does not require dewatering independent of the Post Pit dewatering operations.

Up to 2,200 gpm of water from dewatering operations is used for mining and milling purposes, including process operations, mine operations, dust control, exploration drilling, and construction. Water not required for mining and milling purposes is pumped from the Post Pit area to the West No. 9 Pit. The water is then pumped to a water treatment facility that is located next to the West No. 9 Pit. Ferric sulfate is used in the treatment process to reduce the concentration of naturally occurring soluble arsenic. Flocculent is added to the treatment stream to aid in the settling of the iron-arsenic precipitate in the lined clarification ponds. Extraction procedure (EP) toxicity testing and toxicity characteristic leaching procedure (TC) testing have determined that the precipitate generated during the water treatment is not a characteristic hazardous waste. The precipitate is removed from the settling ponds on a regular basis and deposited in the tailings impoundment. After treatment, the water is released via an unnamed drainage to the TS Ranch Reservoir, which is located approximately 3.0 miles southwest of the Goldstrike Mine. Erosion control

TABLE 2-1

EXISTING MAJOR FACILITY DISTURBANCE

| Facility | Acreage |
|---|---|
| AA Block Facilities (Mill, Tailings Impoundment, Leaching Facilities, Administration/Maintenance Buildings) | 760 |
| South Block Waste Rock Disposal Area | 720 |
| Post Pit | 245 |
| Other Small Pits | 125 |
| Topsoil Stockpiles (14 sites) | 76 |
| Miscellaneous Disturbance[1] | 264 |
| Total Existing Disturbance | 2,190 |

[1] Miscellaneous disturbance includes disturbance caused by facilities which are ancillary to the major project components, including haul roads; access roads; exploration drill sites; dewatering well sites; water pumping and treatment facilities; electrical substations, corridors, and facilities; communications facilities; and explosives storage areas.

TABLE 2-2

EXISTING MINE EQUIPMENT

| Equipment Type | | Number[1] |
|---|---|---|
| Shovels | Hydraulic - 13.5 cubic yard | 3 |
| | Hydraulic - 23.5 cubic yard | 4 |
| | Electric - 42.5 cubic yard | 2 |
| Haul Trucks | 85 ton capacity | 4 |
| | 100 ton capacity | 18 |
| | 190 ton capacity | 30 |
| Front-End Loaders | 13.5 cubic yard | 4 |
| Blast-Hole Drills | 40,000 lb rating | 5 |
| | 60,000 lb rating | 5 |
| Rubber-Tired Dozer | 824 Series | 2 |
| | 834 Series | 5 |
| Tracked Dozers | D8 | 1 |
| | TD25 | 3 |
| | TD40 | 3 |
| | D10 | 4 |
| Road Graders | 14 G | 1 |
| | 16 G | 5 |
| Water Trucks | 8,000 gallon capacity | 1 |
| | 11,000 gallon capacity | 1 |
| | 18,000 gallon capacity | 3 |
| Scrapers | 30 cubic yard | 2 |
| Backhoes | 6 cubic yard | 1 |
| | 10.5 cubic yard | 1 |
| Crane | 40 ton capacity | 2 |
| | 150 ton capacity | 1 |

[1] Third quarter 1990.

structures have been constructed in the unnamed drainage and portions of the drainage have been lined with riprap to minimize erosion and sedimentation.

The TS Ranch Reservoir stores water developed from the mining operations of Barrick for agricultural use in lower Boulder Valley. A pipeline presently delivers irrigation water from the reservoir to arable land owned by ELLCO in lower Boulder Valley. The pipeline and irrigation area are described in the TS Ranch Reservoir EA (BLM 1990a). The TS Ranch Joint Venture has installed 15 center-pivot irrigation systems to irrigate 2,715 acres of land. The pipeline has the capacity to deliver enough water from the reservoir to the TS Ranch Joint Venture to permit the operation of an additional 32 center-pivot irrigation systems of varying pivot length. If all of the center-pivot irrigation systems are installed, a total of 7,504 acres could be irrigated at the TS Ranch. The TS Ranch holds water rights authorizing the ranch to pump groundwater from lower Boulder Basin to irrigate these 7,504 acres. Under the Proposed Action, dewatering water would satisfy these water rights during the dewatering period, after which the TS Ranch could continue irrigation using groundwater wells.

Monitoring of surface and groundwater is mandated by the BLM and the NDEP. Rodeo, Brush, and Boulder Creeks are sampled on a monthly basis for flow rates and chemical parameters. Some of the groundwater wells are monitored on a monthly basis under the NPDES permit; the remaining wells are monitored on a quarterly basis. Groundwater is sampled prior to the startup of a facility (e.g., heap leach facility, tailings impoundment) to establish a baseline database. Monitoring continues during the operation of the facility and into the post-closure phase. Monitoring would cease only after compliance with closure standards has been demonstrated to the satisfaction of the BLM and the NDEP.

### 2.1.4 Existing Processing Operations

Presently, Barrick uses both heap leaching and milling processes to recover gold from the mined ore.

2.1.4.1 <u>Heap Leaching Operations</u>. In 1989, Barrick recovered 96,950 ounces of gold at the Goldstrike Mine by heap leaching. The existing heap leach operation is a closed-loop, zero discharge circuit. A cyanide leach solution is applied to ore heaps, collected, and pumped to the gold recovery facility. After gold recovery, the leach solution is recycled back to the heaps. The facilities for recovery of gold from heap leaching operations are self-contained and are separate from the milling operations. The specific components of the heap leaching operation include:

- Crushing and Agglomeration. Leach-grade ore is hauled to the gyratory crusher system for size reduction and agglomeration. The gyratory crusher system is composed of a primary crusher, a secondary crusher, and an ore stockpile. The primary gyratory crusher, which can process up to 1,750 tons per hour, reduces the ore to less than a nominal 6-inch size. The leach ore is further reduced to less than a nominal 3-inch size in the secondary impact crusher. Cement and/or lime is added after secondary crushing to buffer the leach solution and to agglomerate the fine material to enhance percolation of solution through the heap. Ore from the crushing circuit is stored in a 30,000-ton ore stockpile prior to truck delivery to the AA Block leach pads. The AA Block leach pads also receive lower-grade oxide ore directly as run-of-mine ore. Existing heap leach pads and those approved by the BLM but not yet constructed are shown on Figure 2-2. Ore is progressively stacked on the pads in 30- to 50-foot lifts.

- Leaching. A dilute cyanide solution (0.012 to 0.040 percent) is applied to the ore on the leach pads and percolates through the heap to a synthetic liner. The cyanide extracts the gold from the ore into solution. The gold-rich solution, known as pregnant solution, is collected in the pregnant solution ponds and pumped to the gold recovery facility.

- Adsorption. The gold recovery facility is composed of vertical tanks, or columns containing activated carbon through which the pregnant solution is pumped. The gold in the solution adsorbs onto the activated carbon leaving a barren solution. The barren solution is then recirculated back to the heaps from the barren solution ponds after cyanide and caustic are added to maintain adequate cyanide concentration and pH control, respectively.

- Desorption (Carbon Stripping). The loaded carbon is transferred from the columns to the acid wash tank; hydrochloric acid is used to remove carbonates and metals. After acid washing, the loaded carbon is sent to the stripping circuit. The gold is stripped from the carbon with a heated strip solution of 0.2 percent sodium cyanide and 2 percent sodium hydroxide.

- Electrowinning and Refining. The gold-bearing strip solution is pumped to the electrowinning circuits, where the gold is electroplated out of solution onto steel wool cathodes. The gold-loaded steel wool cathodes are placed in a mercury retort to remove any mercury. Following processing in the mercury retort, the dry cathodes and appropriate fluxes are charged into an electric furnace for refining. The gold is produced as either 500- or 1,000-ounce gold dore' bars.

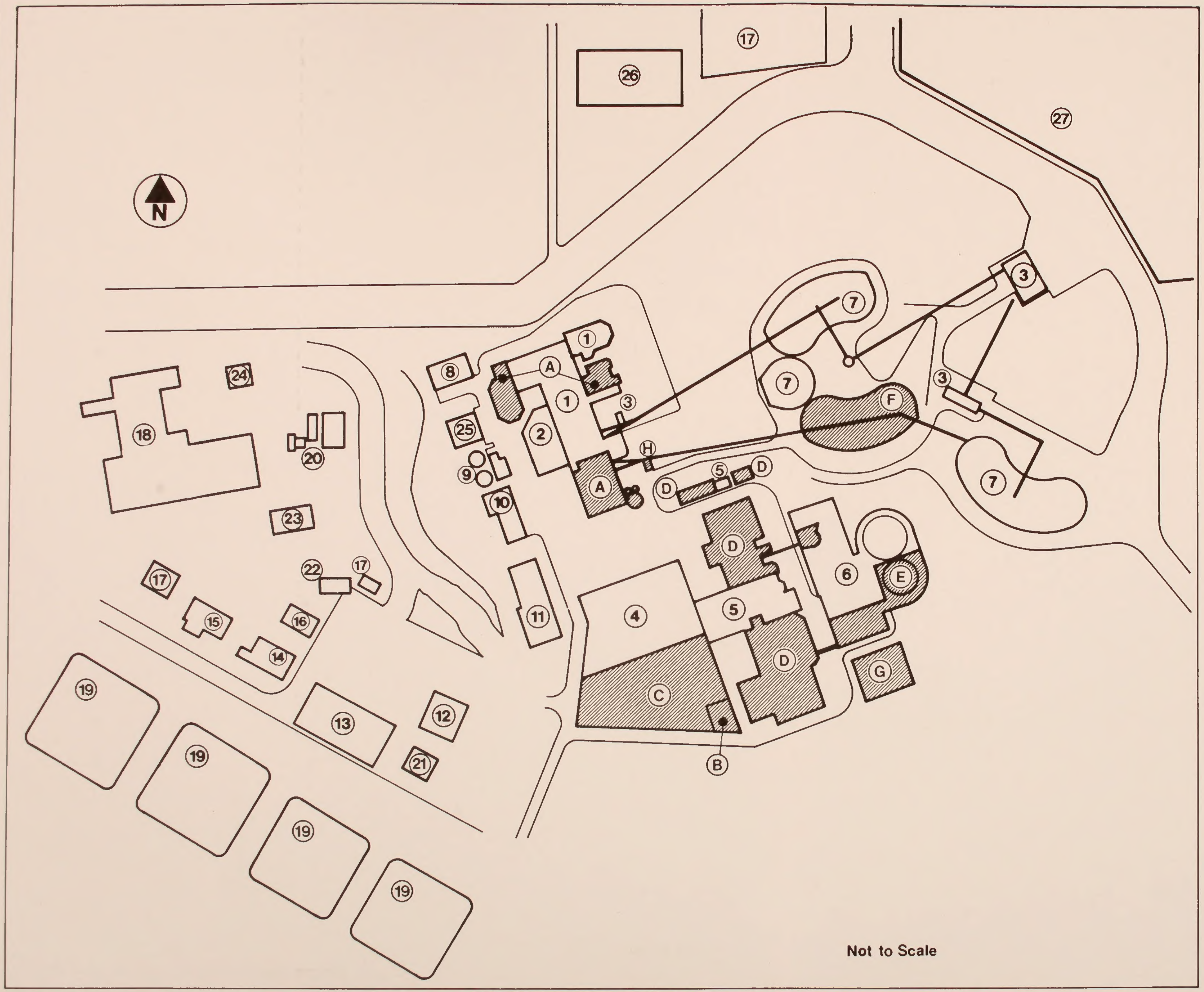
- Carbon Reactivation. After the loaded carbon has been stripped of its gold, the carbon is pumped to a reactivation kiln feed screen, where it is dewatered. Organic contaminants are removed from the screened carbon in a propane-fired reactivation kiln. The reactivated carbon discharges from the kiln into a quench tank, from which it is educted to a reactivated carbon wash screen. The screened reactivated carbon is recycled back to the adsorption columns. Fine carbon from the reactivated carbon wash screen is collected in a wash settling pond, dried, and sent to an off-site smelter to recover any remaining gold.

2.1.4.2 Milling Operations. In 1989, Barrick recovered 110,250 ounces of gold at the Goldstrike Mine by milling. The existing mill, though of a nominal 3,500 tpd design capacity, has demonstrated the capacity to process approximately 6,000 tpd of material. The mill is composed of crushing, grinding, pressure oxidation, leaching, gold recovery, and refining circuits. Approximately 25 percent, or 1,500 tpd, of the present mill ore feed is sulfide ore. Only the sulfide ore is processed through the mill's pressure oxidation circuit. A site plan of the existing milling facilities is shown on Figure 2-3, and photographs of the existing mill are shown on Figure 2-4. The specific components of the milling operation include:

- Crushing. Mill-grade ore is reduced to a nominal 5-inch size in the jaw crusher. The crushed ore is stored in a 7,500-ton capacity stockpile. The ore is reclaimed by underground feeders and fed to the mill.

- Grinding. The grinding circuit in the existing mill consists of a semi-autogenous (SAG) mill and two ball mills operating in closed circuit with classifying cyclones. Water and pebble lime, for pH control, are added to the SAG mill. The resultant slurry is approximately 35 to 40 percent solids, with 80 percent of the solids passing 150 mesh.

- Pressure Oxidation. Oxide and sulfide ore slurries are processed through the cyanide leaching circuit separately. The oxide ore slurry is sent directly to the carbon-in-leach (CIL) circuit after grinding. The sulfide ore slurry is sent to the pressure oxidation circuit. Initially the slurry is thickened and acidulated using sulfuric acid. The sulfide ore slurry is then pumped to a pressure oxidation (autoclave) vessel operating at a temperature of approximately 440°F and a pressure of




**EXISTING FACILITIES**

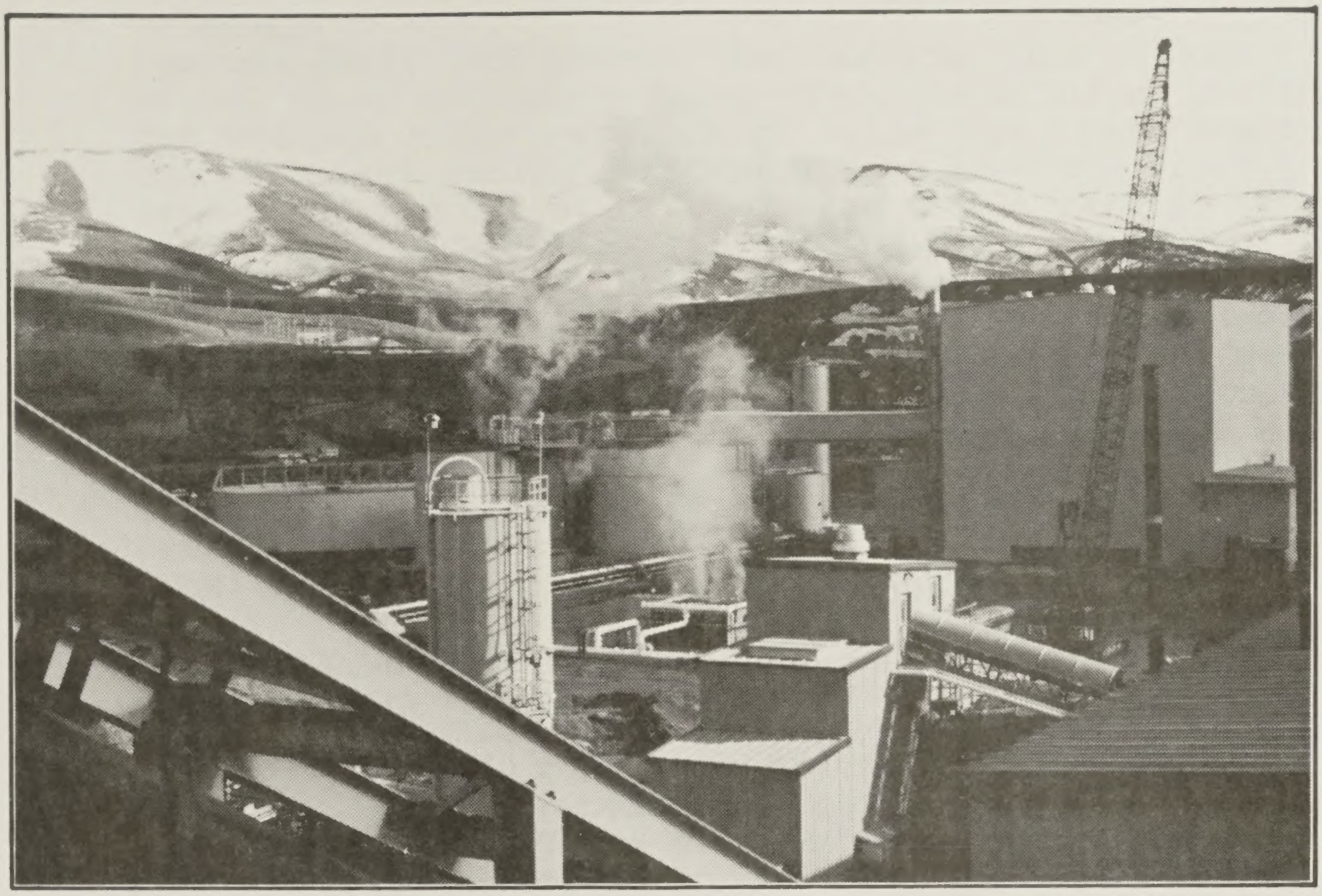
1. Mills, CIL Tanks, and Refinery
2. Mill Substation
3. Crushers
4. Oxygen Plant
5. Autoclave
6. Reaction Tanks and Thickener
7. Ore Stockpiles
8. Propane Tanks
9. Water Supply
10. Mill Maintenance Shops
11. Contractor Office and Warehouse
12. Administration Building
13. Technical Services Building
14. Assay Laboratory
15. ADR Building
16. Sample Storage
17. Fuel Storage Areas
18. Mine Maintenance Building and Warehouse
19. Heap Leach Solution Ponds
20. Vehicle Wash
21. Safety and Training Building
22. Ambulance/Fire Station
23. Tire Shop
24. Sewage Treatment Facility
25. Metallurgical Laboratory
26. Fleet Fueling Facilities
27. Coarse Ore Stockpile

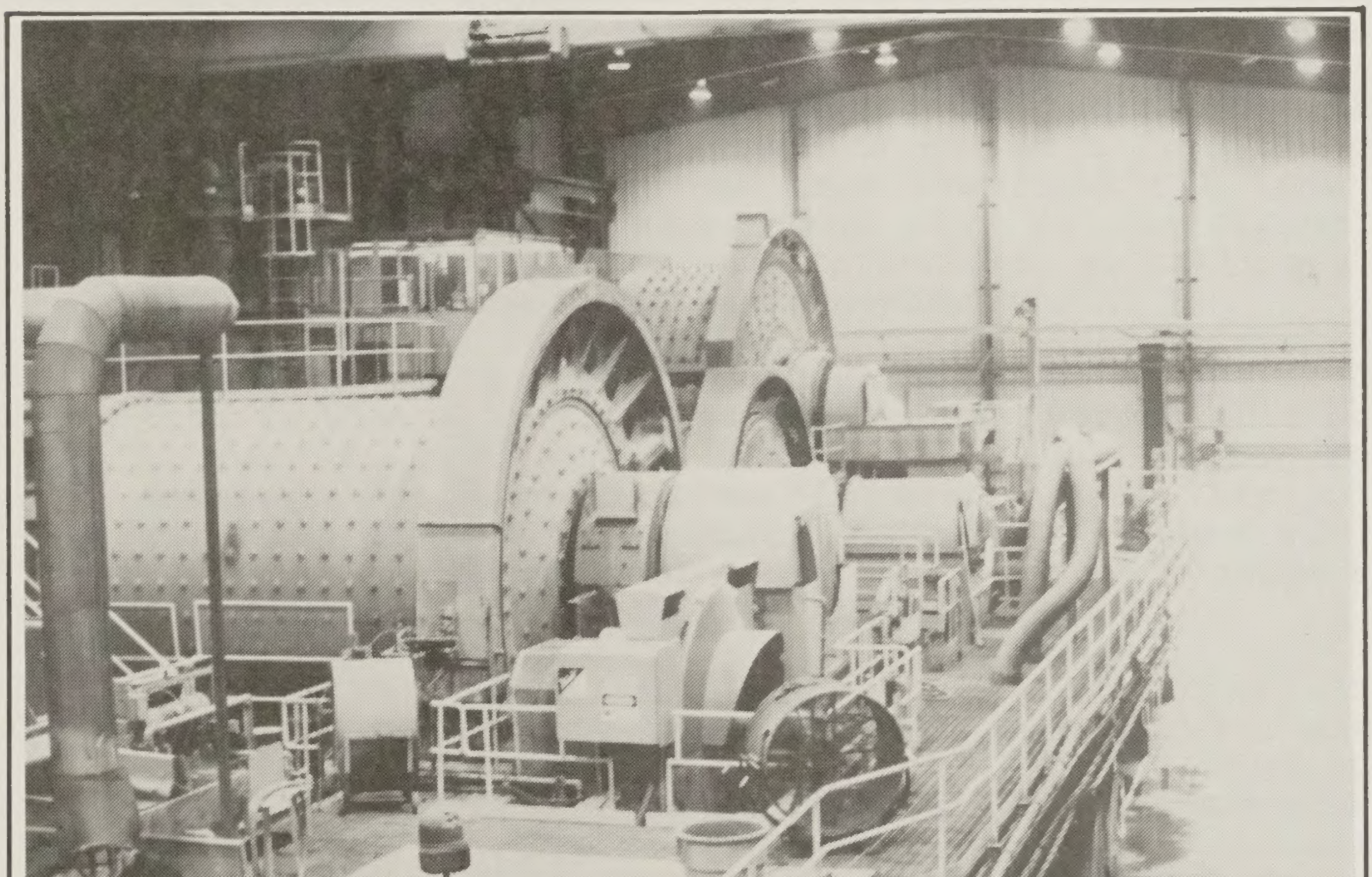
**PROPOSED FACILITIES**

A. Mills, CIL Tanks, And Refinery
B. Oxygen Plant Substation
C. Oxygen Plant
D. Autoclaves
E. Reaction Tanks and Thickener
F. Ore Stockpile
G. Propane Tanks
H. Crusher

BETZE PROJECT

**Figure 2-3. Mill and Ancillary Facilities**





BETZE PROJECT

**Figure 2-4. Photographs of Existing Goldstrike Mill**

approximately 455 pounds per square inch (psi). A 40,000 pound per hour propane-fired steam boiler provides the process steam required to raise the temperature of the autoclave during start-up and to heat the slurry, as needed, during operations. Oxygen from a 175-tpd oxygen plant is sparged into the sulfide ore slurry in the autoclave to oxidize the sulfide minerals. The oxidized ore slurry that is discharged from the autoclave is treated with lime to increase the pH, and is then pumped to the CIL circuit. Lime for neutralization is stored in a 250-ton capacity silo. Dry lime is discharged from the silo to a lime slaker with an output capacity of 9,000 pounds per hour. Additional discussion of the pressure oxidation circuit may be found in Section 2.2.3.2.

- Carbon-in-Leach Processing. The CIL circuit performs two functions: a dilute cyanide solution dissolves the gold that is contained in the finely-ground ore slurry, and the gold that is contained in the cyanide solution is adsorbed onto activated carbon particles which are mixed with the slurry. These actions proceed simultaneously. The gold-rich slurry is pumped into the first CIL tank. The carbon is introduced into the last of the CIL tanks. The process uses a counter-current flow. The ore slurry flows from the first CIL tank through each tank to the last CIL tank. The carbon flows from the last CIL tank to the first CIL tank, adsorbing the gold from the ore slurry. The loaded carbon from the first CIL tank is screened out of the slurry and sent to the stripping circuit. The ore slurry, now referred to as tailings, is discharged to the tailings impoundment.

- Carbon Stripping. The loaded carbon from the first CIL tank is placed in the acid wash tank; hydrochloric acid is used to remove carbonates and metals. After acid washing, the loaded carbon is sent to the stripping circuit. The gold is stripped from the carbon with a heated strip solution of 0.2 percent sodium cyanide and 2 percent sodium hydroxide.

- Electrowinning and Refining. The gold-bearing strip solution is pumped to the electrowinning circuits, where the gold is electroplated out of solution onto steel wool cathodes. The gold-loaded steel wool cathodes are placed in a mercury retort to remove any mercury. Following processing in the mercury retort, the dry cathodes and appropriate fluxes are charged into an electric furnace for refining. The gold is produced as either 500- or 1,000-ounce gold dore' bars.

- Carbon Reactivation. After the loaded carbon has been stripped of its gold, the carbon is pumped to the reactivation kiln feed screen, where it is dewatered. Organic contaminants are removed from the screened carbon in a propane-fired reactivation kiln. The reactivated carbon is discharged from the kiln into a quench tank, from which it is educted to a wash screen. The screened reactivated carbon is then recycled back to the CIL circuit. Fine carbon is collected, dried, and shipped to an off-site smelter to recover any remaining gold.

- Tailings Impoundment. After leaching is completed in the CIL circuit, the slurry, now called tailings, is treated with hydrogen peroxide to neutralize residual cyanide. The tailings then are pumped to the tailings impoundment located north of the mill on the AA Block as shown on Figure 2-2. The existing tailings impoundment has been designed for permanent storage of 26 million tons of mill tailings. Solids settle in the impoundment, while process solution and runoff that accumulate in the impoundment are recycled to the mill by a barge-mounted pumping system.

2.1.4.3 Roads. There are three types of roads at the project area: access roads, haul roads, and exploration roads. The main access road starts at Newmont's Mill No. 1 and continues north for 5.1 miles onto land controlled by Barrick. This road, approved under BLM Right-of-Way Number 4N4 8045, has disturbed approximately 62 acres.

Barrick has constructed haul roads to connect the Post Pit with the existing South Block waste rock disposal area, and with the tailings impoundment, ore stockpiles, crushers, and heap leach pads located on the AA Block. There are approximately 4 miles of major haul roads. Also, approximately 15 miles of roads have been constructed in the project area as a result of the mineral exploration program.

2.1.4.4 Mine Wastes. Barrick's existing mining and processing operations generate a variety of solid and hazardous wastes. Barrick is licensed by the NDEP to operate a Class III landfill at the Goldstrike Mine. Solid wastes generated by mining and processing operations are disposed of in the Class III landfill. The hazardous wastes generated by Barrick consist primarily of solvents used in equipment maintenance operations. Barrick has a contractual relationship with a company that supplies such solvents under which the company maintains the cleaning equipment, replaces the solvent on a regular basis, and regenerates the used solvent at its facilities.

Under the Bevill Amendment to the Resource Conservation and Recovery Act, virtually all of the wastes generated by Barrick's mining and processing operations (e.g., waste rock, tailings) are not subject to regulation as hazardous wastes. EPA is developing regulations for the disposal and management of such mining wastes. In addition, the mining facilities regulations adopted by the NDEP establish minimum design criteria for various mine components, including waste rock disposal areas, tailings impoundments, and heap leach pads.

2.1.5 Existing Ancillary Facilities and Infrastructure

The existing ancillary facilities that support mining and milling operations are shown on Figure 2-3 and include:

- Mine maintenance buildings (containing truck bays, lubrication facilities, offices, training rooms, and conference rooms);
- Mill maintenance buildings (containing electrical, mechanical, and pipe fitting equipment and supplies);
- Administration and technical services buildings (containing offices, training rooms, conference rooms, and storage vaults);
- Safety building (containing supplies and training materials, training rooms, first aid room, and laboratory);
- Ambulance and fire station;
- Warehouse (containing covered storage of 30,000 square feet plus open storage);
- Metallurgical laboratory;
- Assay laboratory and sample storage building;
- Electric utilities including substations and powerlines. Electrical power is provided by Sierra Pacific Power Company from the Boulder Basin substation located southeast of the AA Block. The Boulder Basin substation is fed jointly from the Coyote Creek substation located 9 miles northwest of the Goldstrike Mine and the Maggie Creek substation located 19 miles south of the Goldstrike Mine. Barrick has constructed two main substations: the Mill substation and the South Block substation. Smaller substations are located throughout the property.
- Water supply (composed of several wells, pump house, pumping skids and a piping network);
- Water treatment facility;

- Propane storage;
- Sewage treatment (a rotating biological contactor);
- Fuel storage (gasoline and diesel);
- Communications (microwave system);
- Explosives storage (isolated bermed magazines); and
- Gatehouse (composed of security offices, parking, and truck scale).

The following is a listing of employees, by department, as of the end of the Second Quarter 1990:

Barrick Personnel Summary

| Department | Number of Employees |
|---|---|
| Mine | 719 |
| Process | 254 |
| Administration | 120 |
| Total | 1,093 |

In addition, there are approximately 16 persons employed by a contractor for blasting, 15 to 50 persons employed by construction contractors, and 35 to 50 persons employed by exploration drilling contractors.

Barrick provides bus transportation for its employees to and from the mine. Barrick also contributes to housing by sponsoring the construction of houses and apartments, and by purchasing mobile homes in the Elko area. To date, Barrick has underwritten the construction of approximately 550 housing units in the Elko area.

Other financial assistance to the community is provided by Barrick to help the community meet the increasing demand on services. Barrick made direct contributions of $412,000 in 1988 and more than $500,000 in 1989 to various local governmental agencies, principally for school, water supply, and sewage treatment facilities.

2.1.6 Health and Human Safety

Health and human safety issues are regulated by various agencies, both state and federal. Mining operations are regulated by the federal Mine Safety and Health Administration (MSHA), which enforces regulations regarding occupational hazards of surface and underground mines. Issues addressed by MSHA regulations include safety, noise, lighting, ventilation, heating, radiation, and exposure to hazardous materials. The EPA requires a Spill Prevention, Control, and Countermeasures Plan (SPCC). The Nevada Division of Health, Department of Human Services requires an Emergency Response Plan which, in some cases, can also serve as an SPCC plan. An integral part of an SPCC plan is the identification of hazards from sources (including materials, on-site facilities, vehicles, and operations), and a stated plan for accident prevention and response.

2.1.7 Existing Reclamation Requirements

The reclamation procedures required by the existing authorizations for Barrick's Plans of Operations or the NDEP are summarized in this section.

2.1.7.1 <u>Topsoil Stripping and Stockpiling</u>. In areas that are being disturbed, the topsoil is salvaged using conventional construction equipment. Topsoil depths vary from area to area. Barrick is currently salvaging approximately 6 to 24 inches of topsoil across the mine site. Once the topsoil is stripped, it is placed in stockpiles for use in reclamation.

The topsoil stockpiles are located to minimize impacts from operations. The stockpiles are graded to slopes of 2.5H:1V, and the surfaces of the topsoil stockpiles are seeded during the first fall season to reduce erosion. Diversion channels are constructed around the topsoil stockpiles, as necessary, to protect the stockpiles from surface water flows. The stockpiles are marked with appropriate signs.

In order to reduce rutting and to limit soil erosion during construction, traffic is curtailed on areas where topsoil has not been removed. Soils that are disturbed by construction activities are reclaimed as soon as possible following construction.

2.1.7.2 <u>Waste Rock Disposal Area</u>. The overall slope of the waste rock disposal area will be regraded to a 2.5H:1V slope from the natural angle of repose of approximately 1.3H:1V. The regraded disposal area will be covered with approximately 1 foot of topsoil. The surface and side slopes of the disposal area will be revegetated with a seed mixture approved by the BLM.

2.1.7.3 <u>Heap Leach Facilities</u>. Upon closure, the processing facilities will be dismantled and either buried on-site in conformance with applicable solid waste disposal requirements or removed from the mine site. Following active leaching, the heaps will be rinsed with water or a solution containing a cyanicide until the weak-acid-dissociable (WAD) cyanide levels meet the regulations established by the NDEP. The current WAD cyanide closure standard is 0.2 mg/l. Any remaining solution in the solution collection ponds will be evaporated or removed and treated. The synthetic collection pond liners will be folded with any precipitate contained inside. The folded liners will be buried in place or delivered to an approved disposal facility. The ponds then will be breached or backfilled. The heaps will be regraded to overall slopes of approximately 2.5H:1V, covered with topsoil, contoured to control erosion, and revegetated.

2.1.7.4 Mill and Ancillary Facilities. Upon closure, the mill and ancillary facilities will be dismantled and either buried on-site in conformance with applicable solid waste disposal requirements or removed from the millsite and other areas. Foundations, basements, walls, and sumps will be flattened or otherwise covered with earth. The top surfaces of the disturbed areas will be graded to blend with the natural topography. Any steep cut-and-fill slopes will be regraded to a slope of 2.5H:1V or gentler. The tops of the slopes will be rounded slightly to help conform the slopes to the appearance of the surrounding natural terrain.

Road fills and drainage crossings will be regraded to a gradient that will promote revegetation, and culverts will be removed. Drainage crossings will not be regraded if they are part of roads that have a post-mining use as determined by the BLM. Dikes and ditches that are no longer required for control of surface drainage will be regraded during reclamation to blend with the surrounding terrain. The regraded surfaces will be covered uniformly with topsoil and revegetated.

2.1.7.5 Tailings Impoundment. During closure of the tailings impoundment, solution will be evaporated, and the solids will dry sufficiently to allow reclamation to proceed. Any liquid collected in the seepage collection pond will continue to be collected and pumped back into the impoundment during reclamation. When the tailings surface dries, topsoil will be spread over the surface, and the surface will be revegetated. Subgrade rock will be applied to the surface of the impoundment, if necessary, to provide support for equipment during reclamation. The subgrade material used will be appropriate as a growth medium.

2.1.7.6 Revegetation. All reclaimed areas will be covered with a layer of topsoil obtained from the topsoil stockpiles. The topsoil will be applied and spread with construction equipment in a manner that will reduce compaction. After resurfacing with topsoil, the areas will be ripped to a depth of 2 feet with rippers set approximately 1.5 feet apart. The depth of ripping will be adjusted depending on the amount of rock or cobble material that might be pulled to the surface.

During reclamation, a seed mix approved by the BLM will be applied to all topsoiled areas during the first fall following regrading. If necessary, areas to be reseeded will be scarified with a tooth harrow or disc. The seed will be applied with a rangeland drill or will be sown by broadcast and harrow methods where drilling would not be practicable. The drill will be pulled along the contour wherever possible.

The final seed mixture will be determined based on reclamation success to date and the requirements specified by the BLM to meet the BLM's post-mining land use criteria. Revegetation success will be determined by the BLM authorized officer. Boundary fences will be maintained to allow vegetation to become re-established and will be removed only upon concurrence from the BLM authorized officer.

## 2.2 Proposed Action

### 2.2.1 Summary of Proposed Action

Operations at the Goldstrike Mine have involved the mining of predominantly oxide ore from the Post deposit and other smaller ore deposits. Over the last several years, Barrick has defined a deeper, predominantly sulfide ore deposit, the Betze deposit. The Betze deposit is approximately 4,000 feet long and 1,000 feet wide, with thicknesses as great as 600 feet. The ultimate Betze Pit, as proposed, would be approximately 8,000 feet long, 4,500 feet wide, and 1,800 feet deep. The current ore reserve estimate indicates a combined oxide and sulfide reserve of 15.1 million contained ounces of gold. Barrick proposes an expansion of its existing gold mining operations to allow the development of the Betze deposit. This development would necessitate the expansion of the existing Post Pit and would require an increase in the capacity of the heap leaching and milling facilities. The description of the Proposed Action is based on Barrick's best available data. Some components of the project are sensitive to a number of factors, including gold price, future regulatory constraints, and costs related to production. As a result, some changes in the project are anticipated. Additional regulatory review and approval by the BLM would be required where the BLM determines that significant modifications to the Plan of Operations are proposed or the scope of impacts as presented within this EIS change significantly.

The expansion of mining operations would require additional waste rock disposal areas, ore stockpiles, and a continuation and expansion of existing mine dewatering facilities. The expansion of heap leaching operations would require a new heap leach pad, solution collection ponds, and gold recovery facilities (carbon columns) to allow leaching of approximately 22.0 million tons of the 45.3 million tons of lower grade oxide ore. The existing carbon stripping, electrowinning, and refining facility, located on the AA Block, would be used to process the gold-loaded carbon from both existing and proposed leach facilities. The expansion of the mill facilities would require an increase of milling capacity from 6,000 tpd to approximately 13,000 tpd, construction of five additional autoclaves, expansion of the oxygen plant, and construction of an additional tailings impoundment. The infrastructure at the Goldstrike Mine, including equipment fleets, ancillary facilities, and personnel, would have to be increased to accommodate the proposed expansion.

The gold mineralization in the Betze deposit includes both oxide and sulfide ore zones. The characteristics of the two types of ore are described in Section 2.1.2.

Figure 2-5 shows the general location of the various components of the Proposed Action. Table 2-3 presents the acreages that would be disturbed by the proposed mining and processing activities. These components are discussed in more detail in the following subsections.

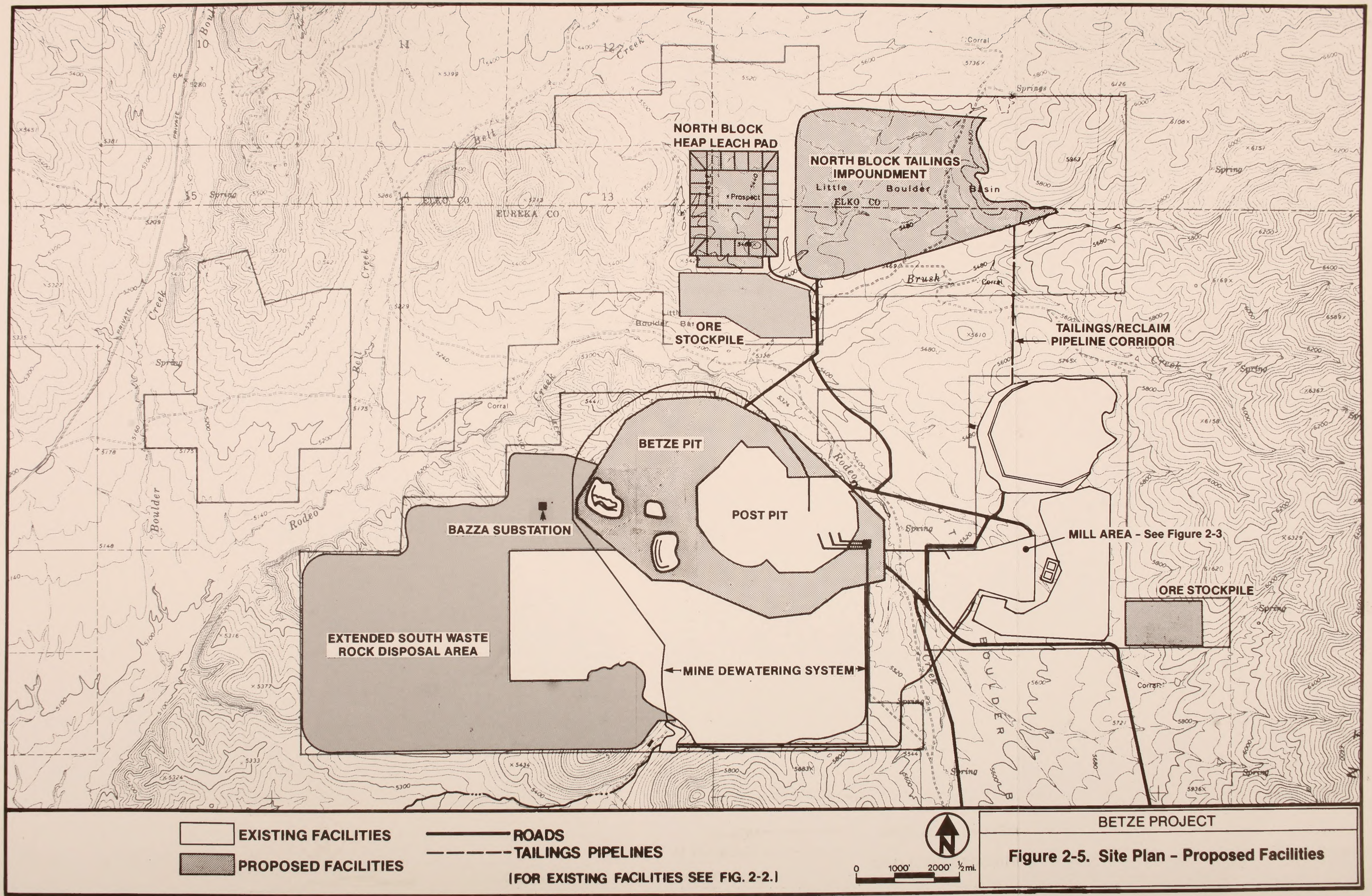
### 2.2.2 Proposed Mining Operations

Development of the Betze Pit would involve the progressive expansion of the Post Pit, both laterally and to depth. This development would proceed in a series of stages, as shown on Figure 2-6.

2.2.2.1 Drilling and Blasting. Ore would be drilled in the Betze Pit on benches 20 feet in height, using standard drilling patterns with 6- to 10-inch diameter holes spaced approximately 15 to 35 feet apart. Waste rock would be drilled on benches 40 feet high, using similar drilling patterns. Both ore and waste rock would be blasted with ammonium nitrate-based explosives with an average powder factor of approximately 0.4 pounds of explosive per ton of rock.

2.2.2.2 Loading and Hauling. The blasted rock would be loaded by hydraulic and electric shovels or front-end loaders into 85-ton, 100-ton, or 190-ton capacity trucks. Waste rock would be hauled to the waste rock disposal areas or to construction projects. Ore would be trucked to the processing facilities on the AA Block, to the new heap leaching facility, or to ore stockpiles. The equipment fleet that Barrick would use to meet the proposed mining schedule is described in Table 2-4. The number of specific pieces of equipment may vary in response to particular short-term mining needs. Estimated annual fuel consumption for the maximum vehicle fleet would be approximately 13 million gallons of diesel fuel and 312,000 gallons of gasoline. If practical, Barrick may install a trolley-assist system to power electrically driven trucks on certain upgrade haulage routes.

Haulage ramps in the proposed Betze Pit have been designed for a width of 120 feet and a gradient of 8 percent; minor sections would have grades as steep as 10 to 12 percent. Haul roads from the Betze Pit to the waste rock disposal areas, ore stockpiles, and the processing facilities would be approximately 180 feet wide including berms, shoulders, and drainage ditches.




BETZE PROJECT

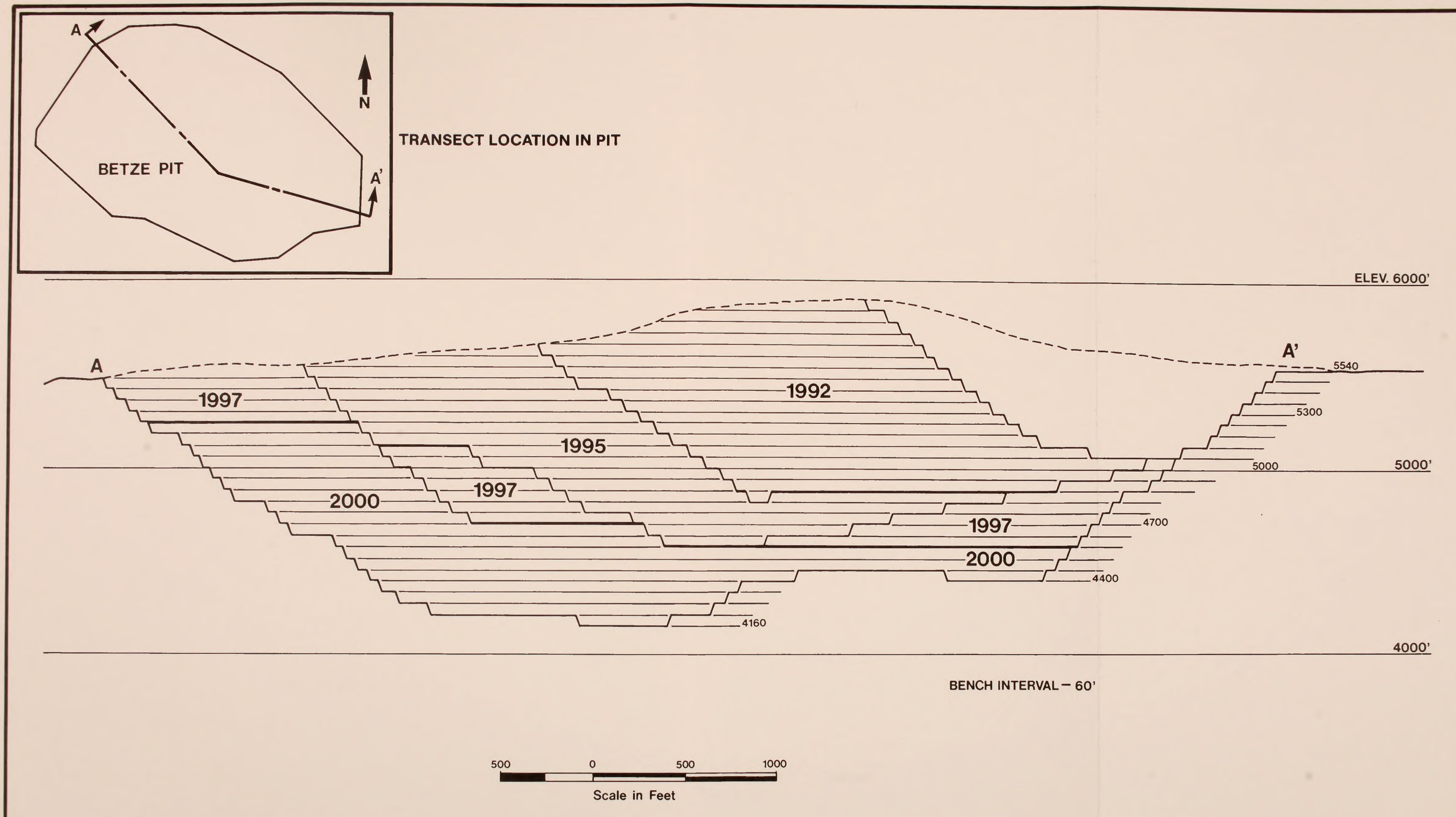
Figure 2-5. Site Plan - Proposed Facilities

TABLE 2-3

ADDITIONAL DISTURBANCE BY PROPOSED FACILITIES

| Facility | Acreage |
|---|---|
| North Block Heap Leach Pad | 142 |
| North Block Tailings Impoundment | 476 |
| Extended South Waste Rock Disposal Area | 912 |
| Betze Pit | 345[1] |
| Haul Roads/Pipeline Corridor/Construction Areas | 92 |
| Ore Stockpiles | 140 |
| Topsoil Stockpiles | 82 |
| Additional Proposed Disturbance | 2,189 |

[1] The total additional area to be disturbed by the Betze Pit would be approximately 445 acres, including approximately 100 acres that have been affected by previous mining.




BETZE PROJECT

**Figure 2-6. Betze Pit Mine Plan**

TABLE 2-4

PROPOSED MINE EQUIPMENT

| Equipment Type | | Number |
|---|---|---|
| Shovels | Hydraulic - 13.5 cubic yard | 3 |
| | Hydraulic - 23.5 cubic yard | 4 |
| | Electric - 42.5 cubic yard | 3 |
| Haul Trucks | 85 ton capacity | 4[1] |
| | 100 ton capacity | 18 |
| | 190 ton capacity | 40 |
| Front End Loaders | 13.5 cubic yard | 4 |
| Blast Hole Drills | 40,000 lb rating | 5 |
| | 60,000 lb rating | 5 |
| | Long-Hole Rig | 1 |
| Rubber-Tired Dozer | 834 Series | 7 |
| Tracked Dozers | D8 | 1 |
| | TD25 | 3 |
| | TD40 | 3 |
| | D10 | 4 |
| Road Graders | 16 G Class | 6 |
| Water Trucks | 8,000 gallon capacity | 1 |
| | 11,000 gallon capacity | 1 |
| | 18,000 gallon capacity | 5 |
| Scrapers | 30 cubic yard | 4 |
| Backhoes | 6 cubic yard | 2 |
| | 10.5 cubic yard | 1 |
| Crane | 40 ton capacity | 2 |
| | 150 ton capacity | 1 |

[1] The 85-ton trucks eventually will be retired.

2.2.2.3 Ore Stockpiles. After 1991, the mining operations would produce sulfide ore at a rate greater than the capacity of the processing facilities. Lower grade sulfide ore would be hauled to ore stockpiles for subsequent processing in the years following the completion of mining operations (after the year 2000). Based upon present estimates of ore reserves, the ore stockpiles would ultimately contain 48 million tons of sulfide ore, an amount sufficient to sustain processing operations for approximately 10 years after completion of mining of the Betze deposit.

In addition, after conversion of the mill facilities to treat 6,000 tpd of sulfide ore by the end of 1991, higher grade oxide ore would be processed through the mill in batches. As mined, higher grade oxide ore would be hauled to ore stockpiles to allow the accumulation of a sufficient quantity for batch processing through the mill.

The Proposed Action would require two ore stockpiles. One ore stockpile, approximately 94 acres, would be located south of the proposed North Block heap leach pad; another ore stockpile, approximately 46 acres, would be located east of the AA Block heap leach pads. The locations of the proposed ore stockpiles are shown on Figure 2-5.

2.2.2.4 Waste Rock Disposal. Waste rock constitutes more than 85 percent of the material contained within the proposed Betze Pit. The greatest portion of waste rock would be hauled directly from the mine to the waste rock disposal areas; a fraction of the waste rock would be used as material for construction projects.

The Proposed Action would require development of the Extended South waste rock disposal area, which entails the extension of the existing South Block waste rock disposal area to the west, to achieve full utilization of the available surface of the South Block while remaining within Barrick's property boundaries. The Proposed Action would also require continued disposal on the existing South Block waste rock disposal area. As of January 1, 1991, the remaining capacity of the existing South Block waste rock disposal area would be approximately 161 million tons of waste rock. The proposed annual schedule of waste rock deliveries is shown in Table 2-5.

The proposed Extended South waste rock disposal area, south and southwest of the Betze Pit, has been designed to contain all the waste that would be generated during the mining of the Betze Pit. The Extended South waste rock disposal area would have a final elevation of 5,900 to 6,000 feet. The height of the Extended South waste rock disposal area would be approximately 700 feet above the original ground elevation on its north and west boundaries and approximately 500 feet above the original ground elevation on its south and east boundaries. The Extended South waste rock disposal area would cover approximately 912 acres.

TABLE 2-5

ANNUAL SCHEDULE OF WASTE ROCK DELIVERIES

(MILLION TONS)

| Year | Total |
|---|---|
| 1991 | 88.77 |
| 1992 | 87.85 |
| 1993 | 100.04 |
| 1994 | 98.41 |
| 1995 | 74.94 |
| 1996 | 73.36 |
| 1997 | 73.24 |
| 1998 | 72.91 |
| 1999 | 70.36 |
| 2000 | 40.71 |
| TOTAL | 780.59 |

Access to the Extended South waste rock disposal area would be from the southeast and northwest margins of the Betze Pit. The maximum one-way haul distance from the perimeter of the Betze Pit would be approximately 2.1 miles.

The waste rock disposal area would be constructed by dumping laterally in vertical lifts approximately 100 feet high. Each succeeding lift would be recessed to create a terraced effect. The terraces would assist in the control of runoff and erosion, provide slope stability, and facilitate reclamation. The slopes of each lift would be modified during reclamation from the natural angle of repose of approximately 1.3H:1V to a more gentle slope angle of approximately 2.3H:1V, which would allow topsoil placement and operation of reclamation equipment. The final overall dump slope would be approximately 2.5H:1V. The proposed reclamation measures are described in more detail in Section 2.2.5.

2.2.2.5 Mining Schedule. The proposed mine production schedule is shown in Table 2-6. Mine development has been designed by Barrick to provide timely access to higher grade sections of the Betze deposit, to provide reasonable consistency in the total tonnages to be mined from year to year, and to utilize efficiently the compliment of proposed mine equipment. Under the Proposed Action, the Betze deposit would be mined to completion in the year 2000. The Proposed Action would allow continuation of the existing daily production rate from open-pit operations of approximately 300,000 to 325,000 tons of ore and waste rock per day. Initially, the bulk of the ore would be produced from oxide ore zones. Approximately 60 percent of the oxide ore reserve would be mined prior to 1993. Thereafter, operations would progress into the underlying sulfide ore zones, and smaller quantities of oxide ore would be produced during the remaining life of the Betze Pit.

As shown in Table 2-6, during the later stages of mining in the Betze Pit, the production rate would diminish because of the increased haulage distances and elevations to the waste rock disposal areas. However, maximum sulfide ore production is expected in the year 2000, the last year of mining. At the conclusion of mining of the Betze deposit, the pit would have reached a depth of approximately 1,300 to 1,800 feet below the surrounding terrain. The pit walls would have final approximate overall slope angles of between 30 and 49 degrees. The pit would remain following completion of mining. As noted in Section 2.2.2.3, processing would continue for another 10 years after the completion of mining of the Betze deposit. The average stripping ratio for the proposed Betze Pit is 5.7 tons of waste per ton of ore. The overall stripping ratio is influenced by the large tonnages of lower-grade oxide ore within the pit.

2.2.2.6 Mine Dewatering. Mining of the Betze Pit would require the continuation and expansion of the dewatering operations in the Post Pit. Inflow estimates have been based on modeling

TABLE 2-6

MINE PRODUCTION SCHEDULE

1991 - 2000

| Year | Oxide Ore | Sulfide Ore | Waste Rock | Total |
|---|---|---|---|---|
| | Million Tons | | | |
| 1991 | 18.90 | 0.99 | 88.77 | 108.66 |
| 1992 | 12.42 | 8.32 | 87.85 | 108.59 |
| 1993 | 2.56 | 5.89 | 100.04 | 108.49 |
| 1994 | 0.97 | 6.50 | 98.41 | 105.88 |
| 1995 | 1.48 | 4.09 | 74.94 | 80.52 |
| 1996 | 2.69 | 4.01 | 73.36 | 80.06 |
| 1997 | 1.04 | 7.40 | 73.24 | 81.68 |
| 1998 | 2.74 | 5.60 | 72.91 | 81.25 |
| 1999 | 3.95 | 4.60 | 70.36 | 78.91 |
| 2000 | 3.15 | 38.80 | 40.71 | 82.66 |
| TOTAL | 49.91 | 86.20 | 780.59 | 916.70 |

criteria that reflect the existence of hydrologic boundaries. Pumping would be required to keep water levels below the elevation of the working pit floor to allow continuation of mining. Generally, the pumping rates would increase as the Betze Pit becomes progressively deeper. The pumping rates would vary from year to year depending on whether the mine plan for a particular year would involve increasing the depth or the lateral extent of the Betze Pit. After mining would cease in the year 2000, approximately 4,500 gpm would continue to be pumped to supply water for the continued milling operations. The following is an estimate of groundwater pumping rates by year (Leggette, Brashears & Graham, Inc. 1990):

| Year | Average Pumping Rate (gpm) |
|---|---|
| 1991 | 18,300 |
| 1992 | 12,100 |
| 1993 | 10,300 |
| 1994 | 12,200 |
| 1995 | 18,900 |
| 1996 | 14,300 |
| 1997 | 12,800 |
| 1998 | 17,700 |
| 1999 | 17,400 |
| 2000 | 29,300 |
| 2001 | 4,500 |
| 2002 | 4,500 |
| 2003 | 4,500 |
| 2004 | 4,500 |
| 2005 | 4,500 |
| 2006 | 4,500 |
| 2007 | 4,500 |
| 2008 | 4,500 |
| 2009 | 4,500 |
| 2010 | 4,500 |

An expanded analysis of the factors that may influence the pumping rates is included in Section 4.4.2 and the Leggette, Brashears & Graham Report (1990). The Betze Pit would be dewatered by using existing and planned perimeter wells, in-pit wells, and in-pit sumps to intercept the projected inflow. In-pit wells and sumps would be necessary because a component of the inflow would be contributed by upward vertical flow into the pit bottom. It is estimated that a total of 30 to 40 additional wells, both in-pit and perimeter, would need to be drilled and placed into use by the year 2000.

Horizontal drain holes, as needed, would be drilled into the pit walls. The drain holes would be used to supplement the dewatering wells and to improve pit wall stability. A piezometer network would be constructed in the Betze Pit to monitor the drainage of the various in-pit hydrogeologic sectors and to determine where additional horizontal drain holes would be necessary.

Water produced from the wells would be piped either to booster pump stations located outside of the active mine area or directly to the West No. 9 Pit. The booster pump stations would pump the water to either the mill and leach operations or to the existing holding area, the West No. 9 Pit, which is shown on Figure 2-7. Water collected in the in-pit sumps would be pumped from floating barges. The sumps would be located as needed on pit benches and in the pit bottom. The water from the sumps would also be pumped to the West No. 9 Pit. Water would be pumped from West No. 9 Pit to Barrick's water treatment facility, which is described in Section 2.1.3.

Approximately 5,000 gpm of dewatering water would be used for Barrick's mining and milling purposes, including process operations, mine operations, dust control, exploration drilling, construction, and, with approved treatment, potable consumption. Water also would be provided to Newmont for mining and milling uses.

Water from dewatering operations not used to satisfy mining and milling needs would be discharged via an unnamed drainage to the TS Ranch Reservoir, as described in Section 2.1.3. The water stored in the TS Ranch Reservoir would be used for irrigation purposes in satisfaction of existing water rights. If the quantity of dewatering water were to exceed mining and irrigation demands, the excess water would be discharged to Rodeo Creek or Boulder Creek. In this situation, water would be discharged to Rodeo Creek from the dewatering operations, after treatment, if necessary, or would be discharged to Boulder Creek from the TS Ranch Reservoir. Regulatory review and approval by the NDEP and the Nevada State Engineer would be necessary prior to any such discharge. If discharge to Rodeo Creek or Boulder Creek were not approved, the excess water would be disposed of by infiltration or reinjection. Regulatory review and approval by the NDEP and the Nevada State Engineer would be necessary prior to implementation of alternative infiltration or reinjection programs. These alternative disposal methods are studied in this EIS as alternatives.

The unnamed drainage would continue to be monitored for any indications of erosion, and the existing sediment control dams would be appropriately maintained. Additional sediment control structures would be built to control channel erosion, as necessary.

The Proposed Action would require the construction of additional haul and access roads to the North Block from the South and AA Blocks, as shown in Figure 2-5. Barrick would construct about 1.7 miles of haul roads, 180 feet in width, from the Betze Pit to the North Block. These roads would disturb approximately 38 acres. A corridor containing the tailings slurry and reclaim solution pipelines, as well as an access road for light vehicles, would be constructed between the AA and North Blocks. This corridor would be about 0.75 mile long and would disturb about 6 acres.

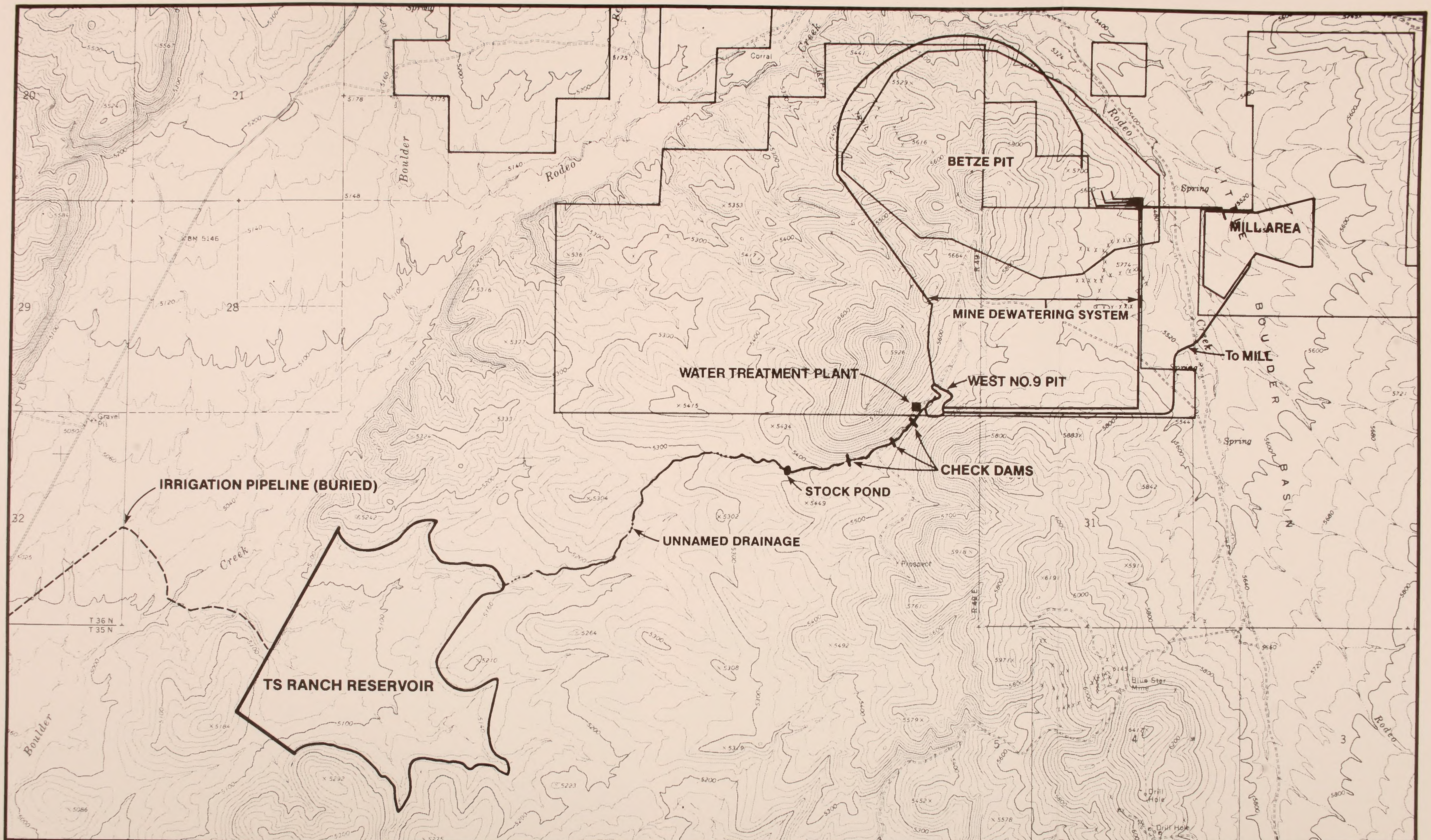
Water pumped from the wells would be piped to [illegible] stations located [illegible] of the [illegible] West No. 3 Pit. The [illegible] would [illegible] the water [illegible] the pit [illegible] area [illegible] No. [illegible] Fill which [illegible] collected in [illegible] The pumps would be located [illegible] bottom [illegible] No. 3 Pit. Water would be [illegible] water treatment facility, which [illegible]

Approximately 5,000 gpm of dewatering water would be used for Barrick's mining and milling purposes, including process operations, mine operations, dust control, exploration drilling construction, and, with approved treatment, potable consumption. Water [illegible] would be provided to Newmont for [illegible] uses.

Water from dewatering operations not used to satisfy mining and milling needs would be discharged via an unnamed drainage to the TS Ranch Reservoir, as described in Section 2.1.1. The water stored in the TS Ranch Reservoir would be used for irrigation purposes in satisfaction of existing water rights. If the quantity of dewatering water were to exceed mining and irrigation demands, the excess water would be discharged to Rodeo Creek or Boulder Creek. In this situation, water would be discharged to Rodeo Creek from the dewatering operations, after treatment, if necessary, or would be discharged to Boulder Creek from the TS Ranch Reservoir. Regulatory review and approval by the NDEP and the Nevada State Engineer would be necessary prior to any such discharge. If discharge to Rodeo Creek or Boulder Creek were not approved, the excess water would be disposed of by infiltration or reinjection. Regulatory review and approval by the NDEP and the Nevada State Engineer would be necessary prior to implementation of alternative infiltration or reinjection programs. [illegible] methods are [illegible]

The [illegible] would continue to [illegible] in [illegible] existing [illegible] would be [illegible]. Additional [illegible] structures would be built to [illegible]

The proposed action would require the construction of [illegible] haul and access roads to the [illegible] from the [illegible] AA Blocks, as shown in Figure 2-5. Barrick would construct [illegible] 1.7 miles of haul roads [illegible] feet in width, [illegible] Block. [illegible] A corridor containing the [illegible] pipelines, as well as an access road [illegible] constructed between [illegible] be about 0.3 mile long and would [illegible]




BETZE PROJECT

**Figure 2-7. Proposed Mine Dewatering Arrangement Map**

Barrick anticipates the construction of additional exploration roads in the project area. These roads would be constructed as authorized in the North Block and the South Block Environmental Assessments, or, if appropriate, under a Notice of Intent.

The Proposed Action would generate solid and hazardous wastes at the Goldstrike Mine. Barrick would comply with applicable solid and hazardous waste regulations and mining facilities regulations that govern the storage, handling, and disposal of such wastes.

### 2.2.3 Proposed Processing Facilities

The proposed expansion of mining operations to allow the recovery of the gold contained in the Betze deposit would require the expansion of heap leaching operations, the expansion of milling facilities, the construction of five additional autoclaves, a corresponding increase in oxygen plant capacity, and the construction of an additional tailings impoundment.

BLM policy requires that cyanide use at mining operations conform with BLM Instruction Memorandum 90-566 (August 6, 1990) and NV-90-411 (August 22, 1990), which contain the BLM's "Policy for Surface Management of Mining Operations utilizing Cyanide or other Leaching Techniques" (the "Cyanide Policy"). The Cyanide Policy provides for the fencing of facilities that contain certain levels of cyanide, reporting of wildlife mortalities, leak detection systems, and other measures. Additional operating or reclamation requirements that are determined to be necessary based upon the Cyanide Policy would be reflected in the Final EIS or Record of Decision and shall be conditions of any approval of Barrick's Plan of Operations amendment.

2.2.3.1 Heap Leaching Expansion. Beginning in 1991, mining of the Post Pit and the proposed Betze Pit would generate approximately 45.3 million tons of oxide leach ore. The existing and future leaching facilities already permitted in the AA Block are capable of processing approximately 23.3 million tons of leach ore. Additional heap leaching operations would be required to allow processing of approximately 22.0 million tons of leach ore.

The Proposed Action would expand heap leaching operations by the construction of a heap leach pad, solution collection ponds, a gold recovery facility (carbon columns), and associated infrastructure in the central portion of the North Block (see Figure 2-5). The facilities would be located west of the proposed North Block tailings impoundment and would disturb approximately 142 acres.

Leach-grade ore would be hauled to the new leach pad from either the existing crushing and agglomeration circuit located on the AA Block or from the Betze Pit as run-of-mine ore.

The leach pad would be designed and constructed to meet, or exceed, the requirements of Nevada Administrative Code § 445.24362, which establishes minimum design requirements for the construction of heap leach pads. The leach pad would consist of a synthetic liner that would be placed on a prepared subbase of at least 12 inches of native or amended soil. A leak detection/collection system would be incorporated into the leach pad design.

The solution ponds would be designed and constructed to meet, or exceed, the requirements of Nevada Administrative Code § 445.24364, which establishes minimum design requirements for the construction of solution ponds. Each pond would have a primary synthetic liner and a secondary liner of clay or synthetic material. If a secondary clay liner were to be used, the liner would be a minimum of 12 inches thick. A leak detection/collection system would be installed between the primary and secondary liner. The leak detection/collection system would be capable of recovering any process solutions that might leak through the primary synthetic liner.

The ore would be loaded onto the proposed heap leach pad in four to five lifts of about 40 to 50 feet each to a maximum total height of 200 feet. A dilute cyanide solution would be applied to the leach ore on the pad and would percolate through the heap to the synthetic liner, extracting the gold into solution. The pregnant solution would be collected in the pregnant solution collection pond and would be pumped to the carbon columns in the gold adsorption facility. The gold in solution would be adsorbed onto the activated carbon in the carbon columns, leaving a barren solution. The barren solution would be stored in a barren solution pond. The barren solution would be recirculated to the heap after the addition of cyanide and caustic makeup to maintain adequate cyanide concentration and pH control. The gold-loaded carbon from the carbon columns would be trucked to the existing facility on the AA Block for carbon stripping, electrowinning, and refining.

The solution ponds would be designed to contain all process fluids, and precipitation from the 100-year, 24-hour storm event. In addition, the ponds would be fenced and netted to prevent access by wildlife.

2.2.3.2 Mill Facilities Expansion. The existing mill treats 6,000 tpd of ore, approximately 1,500 tpd of which are sulfide ore. Under the Proposed Action, the pressure oxidation circuit would be expanded to treat 6,000 tons of sulfide ore per day and the milling capacity would be expanded to 13,000 tpd by the end of 1991. The pressure oxidation circuit would be further expanded to treat approximately 13,000 tons of sulfide ore per day by the end of 1992.

To treat 6,000 tons of sulfide ore per day by the end of 1991, Barrick would need to add the following additional equipment:

- two autoclaves
- one acidulation tank
- one lime storage silo
- one lime slaker
- one steam boiler
- 600 tpd of additional oxygen plant capacity
- additional propane storage capacity

After the conversion of the mill to a 6,000 tpd sulfide ore circuit, oxide ore would still be processed through the mill, as needed.

The expansion from 6,000 to approximately 13,000 tpd of mill grinding, leaching, and gold recovery capacity would require the following additional equipment:

- one SAG mill
- one short head cone crusher
- one ball mill
- a bank of cyclones
- two CIL tanks
- two pressure stripping vessels
- four sets of electrowinning cells
- one induction furnace
- carbon reactivation system

The expansion from 6,000 tpd to 13,000 tpd of pressure oxidation capacity would require the following additional equipment:

- three autoclaves
- one thickener and three acidulation tanks
- neutralization tanks
- one lime storage silo
- two lime slakers
- one slaked lime storage tank
- 600 tpd of additional oxygen plant capacity
- two steam boilers
- additional propane storage capacity

The new mill facilities would be located adjacent to the existing facilities to take advantage of existing power and water supplies and to reduce the need for extended infrastructure such as pipelines, powerlines, and roads. A new 120-kV powerline and substation serving the proposed oxygen plant would be needed. In some instances, expansion would consist of direct additions to existing structures. Figure 2-3 shows the location and arrangement of the existing and proposed milling facilities. A more detailed description of each major component is set forth below.

<u>Crushing</u>. The crushing circuit would not be expanded. The existing jaw crusher is undersized for crushing 13,000 tons of ore per day. However, additional crushing capacity would be gained by

the integration of the existing gyratory crusher into the milling circuit. This would allow one crusher to supplement the other or to replace it during periods of maintenance or repair. A second coarse ore stockpile, with a live capacity of approximately 7,500 tons, also would be needed.

Milling. An additional milling circuit would be required to grind the incremental 7,000 tpd of ore. This circuit would consist of a SAG mill, a short head cone crusher to crush oversize material from the SAG mill discharge, a ball mill, and a bank of cyclones.

Pressure Oxidation. To process 13,000 tpd of sulfide ore, a total of six pressure oxidation circuits would be required. One circuit, rated at 1,500 tons of ore per day, is part of the existing mill; two additional circuits, each rated at 2,250 tpd, would be installed in 1991 to raise the total capacity to 6,000 tpd of sulfide ore. Three similar circuits would be added in 1992 to reach the design capacity of 13,000 tpd. The mill would continue to process oxide ore until the end of 1992, by which time the mill would be fully converted to treat sulfide ore. After completion of the mill conversion, oxide ore would continue to be processed through the mill in batches. Sulfide ore would be fed directly from the mine to the mill until mining operations cease in the year 2000. Thereafter, feed for the mill would be drawn from the sulfide ore stockpiles until 2010.

The sulfide ore from the milling circuit would be thickened and then acidulated with sulfuric acid. A system of additional thickening and acidulation tanks would be built to treat the ore milled at the design rate of 13,000 tpd.

The acidulation process would convert the carbonates in the sulfide ore slurry to carbon dioxide, thereby reducing the venting requirements in the autoclave. Sulfuric acid for acidulation of the slurry would be received by truck and unloaded into either the existing or the proposed storage tanks. Table 2-7 shows the estimated reagent usage for the proposed facility expansion. Following acidulation, the sulfide ore slurry would be pumped into the pressure oxidation circuits.

Each pressure oxidation circuit would consist of a series of two splash steam condensers, where incoming slurry would be pre-heated; a horizontal autoclave vessel in which the oxidation would take place; and two slurry flash tanks and slurry heat exchangers where the temperature and pressure of the exiting slurry would be lowered back to atmospheric conditions. The oxidized ore slurry that would be discharged from the pressure oxidation circuit would be treated with lime to increase the pH in the neutralization tanks.

Oxygen required for the pressure oxidation process would be produced in a cryogenic air separation plant located near the

TABLE 2-7

ESTIMATED ANNUAL REAGENT USAGE

| | 1991 | 1992 | 1993-2010 |
|---|---|---|---|
| Estimated High Level Consumption (tons)[1] | | | |
| Lime | 20,220 | 74,208 | 149,172 |
| Sulfuric Acid | 15,468 | 61,884 | 131,508 |
| Oxygen | 53,460 | --[2] | --[2] |
| Propane | 5,808 | 23,220 | 49,344 |
| Cyanide | 1,296 | 2,952 | 3,444 |
| Estimated Low Level Consumption (tons)[1] | | | |
| Lime | 7,968 | 28,824 | 57,372 |
| Sulfuric Acid | 5,400 | 21,600 | 45,900 |
| Oxygen | 53,460 | --[2] | --[2] |
| Propane | 3,240 | 12,960 | 27,540 |
| Cyanide | 1,296 | 2,952 | 3,444 |

[1] Maximum and minimum levels of estimated annual reagent usage are shown as reagent consumption is dependent on the percentage of sulfur in the ore. Actual reagent consumption would vary as the sulfur content in the ore feed varies.

[2] After 1991, Barrick's oxygen needs would be supplied by the on-site oxygen plant as discussed in the text.

autoclave installation. The existing oxygen plant, which produces 175 tpd of oxygen, would be expanded in two increments of 600 tpd each, to provide an ultimate oxygen capacity of 1,375 tpd. Liquid-oxygen storage tanks and vaporizers would be provided in order to supply the autoclaves with oxygen when the oxygen plant would not be operating.

Lime for neutralization would be pneumatically conveyed into two lime storage tanks, each with a capacity of 500 tons. Lime slurry would be produced in three additional continuous lime slakers, each with a capacity of 12,500 pounds per hour. The slaked lime would be stored in additional storage tanks.

Process steam would be required to raise the temperature of the autoclaves during start-up or to provide slurry heating during operations. The largest process steam requirement would occur during periods when the sulfur content of the ore drops below 1.5 percent. Three propane-fired steam boilers, each rated at 100,000 pounds of steam per hour, would be added. Propane for these boilers would be stored in propane storage tanks located immediately east of the autoclaves.

<u>CIL Circuit</u>. Two 40-foot diameter CIL tanks would be added to the existing CIL circuit to treat 13,000 tpd of ore. Slurry would be pumped from the pressure oxidation circuit to both the existing and proposed CIL circuits, which would be operated in parallel. The proposed circuit would be operated in a manner identical to the existing circuit. Tailings from both CIL circuits would be recombined in an enlarged tailings pumpbox. The tailings would be treated with hydrogen peroxide to neutralize any residual cyanide prior to being pumped to the tailings impoundments.

<u>Carbon Stripping</u>. Additional acid wash tanks would be installed as needed. The loaded carbon would be placed in the acid wash tanks, where the carbon would be treated with hydrochloric acid to remove carbonates and metals, prior to being pumped to the carbon stripping vessels. Two 12-ton capacity carbon stripping vessels would be added to the existing circuit. These vessels would be operated in an identical manner to the existing strip circuit. Additional carbon stripping capacity would be required due to the increased mill throughput and anticipated higher grade of the sulfide ore.

<u>Electrowinning</u>. The higher grade of the sulfide ore and the increased mill throughput also would require the addition of four sets of electrowinning cells and an additional induction furnace.

2.2.3.3 <u>Tailings Impoundment</u>. Construction of a second tailings impoundment would be necessary to contain the additional tailings generated by processing the ore from the Betze deposit. The site proposed for the second impoundment is on the North Block, east of the proposed North Block heap leach pad area as shown on

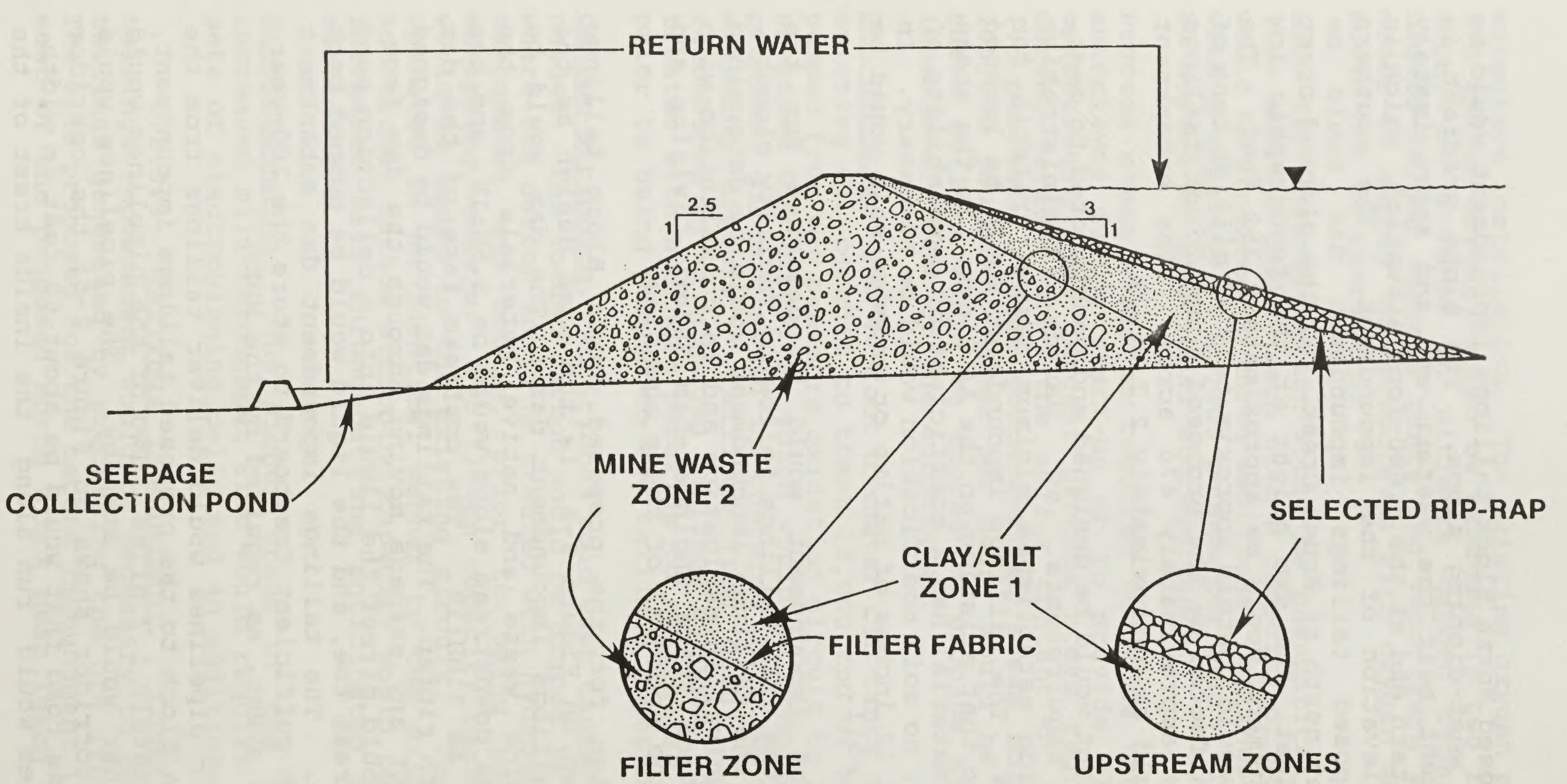
Figure 2-5. The proposed North Block tailings impoundment would be located on a gentle west-dipping slope. The slope gradient is approximately 3 percent near the western end and approximately 16 percent at the eastern end at the 5,680-foot elevation, which is the planned crest elevation of the impoundment. The southern extent of the proposed tailings impoundment dam would be approximately 350 feet north of Brush Creek. At the planned crest elevation of 5,680 feet, the dam height at the topographic low point under the embankment would be approximately 252 feet. The tailings impoundment would contain approximately 67 million tons of tailings. The area affected by the proposed North Block tailings impoundment would be approximately 476 acres. The embankment centerline length would be approximately 2.7 miles.

The tailings impoundment would be designed and constructed to meet, or exceed, the requirements of Nevada Administrative Code § 445.24368, which establishes minimum design criteria for tailings impoundments. The tailings impoundment would be located on material similar to that existing on the AA Block. In the areas where the underlying material has a coefficient of permeability of $1x10^{-6}$ cm/sec or less, no soil modification would be necessary. In other areas, at least 12 inches of native or amended soil would be placed on the native soil.

The proposed tailings impoundment would be designed for the permanent storage of the mill tailings following facility closure. The final design for the tailings impoundment would be determined after further geotechnical investigation and in consultation with the NDEP and the Nevada State Engineer-Dam Safety Division and would be subject to the approval of these agencies.

The preliminary design for the proposed North Block tailings impoundment dam, shown on Figure 2-8, is the same design as the existing AA Block tailings impoundment dam. The dam would be constructed using mine waste and native materials from the impoundment area. The downstream slope would be 2.5H:1V, and the upstream slope would be 3.0H:1V. The upstream face of the dam would be protected with riprap. The tailings dam would be designed to control and collect any seepage moving through the dam face. The drainage system would direct the liquid into a collection pond located at the downstream toe, and the liquid would be pumped back into the impoundment. The tailings impoundment dam embankment would be designed with sufficient freeboard to store the 100-year, 24-hour precipitation event, as required by the NDEP.

Three 20-inch diameter pipelines would deliver tailings from the mill located on the AA Block to the proposed tailings impoundment, a distance of approximately 1.7 miles. Two of the pipelines would operate while the other would be standby. The pipelines would follow the pipeline corridor shown on Figure 2-5; the corridor would include an access road that would be about 60 feet in width. The tailings pipelines would run along the inside crest of the




BETZE PROJECT

Figure 2-8. Tailings Dam Section

embankment and discharge slurry into the impoundment. Solid tails would settle out against the upstream side of the embankment and progressively build a beach within the impoundment. The tailings decant reclaim water would form a pool in the upstream reaches of the impoundment area and be recycled back to the mill on the AA Block using a barge-mounted pumping system.

The tailings and return solution pipeline systems would be designed for zero discharge conditions. The reclaim system would consist of two 16-inch pipelines; one would operate and one would be standby. All pipelines would be placed in a ditch lined with either impervious clay or a synthetic liner for the length of the pipeline route. Unplanned releases from a pipeline would flow along the lined ditch into a containment pond having a storage capacity of 270,000 cubic feet. This pond would be constructed north of Brush Creek at the topographic low point along the pipeline route. The pond would be lined with either impervious clay or a synthetic liner and would be large enough to contain flow for an 8-hour release event plus the entire volume in either the tailings or reclaim pipelines.

An earthen embankment or bridge structure would be constructed across Brush Creek to provide a viaduct on which the tailings and return solution pipelines would be placed. A culvert would be placed through the embankment to allow water in Brush Creek to flow through the embankment. This culvert would be sized to handle the maximum flow volume expected from the 100-year, 24-hour precipitation event.

### 2.2.4 Proposed Work Force and Ancillary Facilities

2.2.4.1 Work Force. At the end of the Second Quarter 1990, the work force at the Goldstrike Mine was 1,093 employees. To meet the Betze Project expansion labor requirements, the number of operations employees would increase to a maximum of 1,170 in 1992. Table 2-8 shows projected changes in the work force for the Betze Project to the year 2010. The work force necessary for the Betze Project would remain fairly constant until mining ends in 2000. At that time, the number of employees would decline to about 410. This work force would continue to process ore from the stockpiles until 2010. After 2010, a reclamation crew would continue to work on site for several years.

As of the end of the Second Quarter 1990, approximately 65 to 115 contractor employees were on site to handle blasting operations, drilling operations, and minor construction projects. The number of contractor employees would range from 75 to a peak of 750 in the summer months of 1991 during the mill expansion and construction of the additional autoclaves. In 1992, the construction work force would range from 115 to 250. The number of construction personnel on site would decrease to less than 50 after the completion of the major construction projects at the end of 1992.

TABLE 2-8

BARRICK GOLDSTRIKE MINES INC.

MANPOWER ESTIMATES

| Year | Mine | Process | Admin | Total |
|---|---|---|---|---|
| July 1990 | 719 | 254 | 120 | 1,093 |
| 1991 | 719 | 254 | 120 | 1,093 |
| 1992 | 739 | 311 | 120 | 1,170 |
| 1993 | 739 | 311 | 120 | 1,170 |
| 1994 | 739 | 311 | 110 | 1,160 |
| 1995 | 739 | 311 | 100 | 1,150 |
| 1996 | 739 | 311 | 100 | 1,150 |
| 1997 | 739 | 291 | 100 | 1,130 |
| 1998 | 739 | 291 | 100 | 1,130 |
| 1999 | 739 | 291 | 100 | 1,130 |
| 2000 | 739 | 291 | 100 | 1,130 |
| 2001 | 40 | 291 | 76 | 407 |
| 2002 | 40 | 291 | 76 | 407 |
| 2003 | 40 | 291 | 76 | 407 |
| 2004 | 40 | 291 | 76 | 407 |
| 2005 | 40 | 291 | 76 | 407 |
| 2006 | 40 | 291 | 76 | 407 |
| 2007 | 40 | 291 | 76 | 407 |
| 2008 | 40 | 291 | 76 | 407 |
| 2009 | 40 | 291 | 76 | 407 |
| 2010 | 40 | 291 | 44 | 374 |

Note: Approximately 40 to 60 local college students would be employed annually from May until September under Barrick's student hire program. These temporary employees have not been included in the yearly total.

2.2.4.2 Ancillary Facilities. Existing ancillary facilities were described in Section 2.1.5. Additional expansions would be necessary for the proposed Betze Project operations, as described below.

Safety Building. A new safety building would be constructed at the location of the existing safety facility. It would contain offices, areas for emergency equipment, a first aid room, a training room, and an industrial hygiene laboratory.

Electrical Facilities. A new substation to handle increased power demands on the South Block (the Bazza substation) would be constructed in Section 24, Township 36 North, Range 49 East (see Figure 2-5); this substation would be supplied at 120 kV from the Boulder Basin substation. An additional 120 kV line would be constructed from the Boulder Basin substation to the existing South Block substation. Construction of the line would follow the guidelines set forth in Olendorff et al. (1981) to prevent accidental electrocution of raptors.

Power for mining operations would be distributed from the South Block substation and the proposed Bazza substation to the equipment by powerlines around the pit perimeter and by moveable electrical cables to the mobile equipment. Powerlines from the Bazza substation would also bring power to the pit area for the pit dewatering system. Power would be transformed down to suitable voltage for use at the wells, sumps, and booster pump stations.

The expansion of the oxygen plant would increase power demands and would require the construction of an additional substation. The new substation would be located near the existing oxygen plant substation and would be supplied from the Boulder Basin substation.

A distribution line would be installed to supply power to the North Block tailings impoundment and leach facilities. This distribution line would originate at the Mill substation, would run through the AA Block, and then follow the tailings and reclaim pipelines route to the North Block tailings impoundment. The line would then run west to the leach facilities. Table 2-9 presents the incremental and total peak power demand for the proposed facilities.

Power would be distributed to the proposed ancillary facilities at the plant site by cables in buried ducts. Tie cables would be installed to allow operations to continue in the event that one of the main transformers failed. Emergency power requirements would be provided by the installation of additional diesel generators to augment the existing battery of diesel generators. Should normal power fail, essential loads and services would be powered by the generators.

Water Supply. Existing underground pipelines would be extended to service new areas, as necessary. Process water pumps would be

TABLE 2-9

ELECTRICAL POWER FORECAST - PEAK DEMAND

| Year | Anticipated Equipment Addition | Incremental Peak Demand (MW) | Total Peak Demand (MW) |
|---|---|---|---|
| 1990 | | | 23.5 |
| 1991 | #2 Autoclave | 1.1 | |
| | #3 Autoclave | 1.1 | |
| | Betze Pit | 6.0 | |
| | #2 Oxygen Plant | 12.5 | |
| | Mill Expansion | 10.0 | |
| | | 30.7 | 54.2 |
| 1992 | #4 Autoclave | 3.3 | |
| | #5 Autoclave | 1.1 | |
| | #6 Autoclave | 1.1 | |
| | #3 Oxygen Plant | 12.5 | |
| | | 18.0 | 72.2 |

refitted to handle the larger flows. Additional water lines and hydrants would be added to the existing fire suppression system. The existing reverse-osmosis water treatment unit would be used to supply potable water needs.

<u>Propane Supply</u>. New propane storage tanks and pipelines would be installed as necessary to feed the propane to the new boiler house, autoclaves, and additional ancillary facilities.

<u>Sewage Treatment</u>. Additional gravity sewers would be constructed to collect sanitary wastes. These additional lines would be connected to the existing sewer system. Effluent from the sewage treatment plant would continue to be pumped to the mill for disposal in the tailings impoundment.

<u>Fuel Storage</u>. Existing fuel storage would be expanded by adding new tanks, as necessary. Any new fuel storage areas would be bermed and lined with a synthetic liner to contain any spills. Fire suppression systems would be incorporated into any new storage areas to minimize the danger to personnel and damage to structures in the event of a spill or an accident.

<u>Roads</u>. Yard areas would be excavated or filled to a uniform grade. Service roads would be designed and constructed for the anticipated loads. Drainage crossings at road fills would be constructed with culverts sized and sloped to pass the flow from the 25-year, 24-hour precipitation event. Ditches would be constructed along the uphill margins of road cuts. The ditches would be sized as appropriate to divert the runoff from the uphill areas along the margin of the road to the nearest drainage channel. The outer margins of road fills would be fitted with drainage control berms to collect and route runoff along the road surface and away from the outer slopes of the road fill.

<u>Communications</u>. The existing microwave telephone system may be expanded. It is expected that the mine expansion would require the relocation of the existing microwave repeater station. The on-site telephone system would also be expanded.

<u>Explosives Storage</u>. The existing powder magazine is contained within a 12-foot high earthen barricade which is approximately 330 feet long by 400 feet wide. An expansion of the powder magazine within the existing earthen barricade is proposed.

### 2.2.5 Proposed Reclamation

The long-term goals for reclamation of the Betze Project and Barrick's operations as a whole are to leave areas disturbed by mining in a stable configuration that would withstand erosion and prevent slump failure, and to establish diverse self-renewing plant communities that at least equal or exceed the plant communities which existed before Barrick's development.

BLM policy requires that Barrick have an approved reclamation surety, that conforms with the requirements of 43 CFR 3809 and BLM Instruction Memoranda 90-582 (August 14, 1990) and NV-90-412 (August 22, 1990). In addition, the Nevada Mine Reclamation Act requires Barrick to obtain a reclamation permit for the Proposed Action prior to implementation. The amount of the surety and the reclamation plan on which the reclamation permit would be based would be reviewed and approved jointly by the BLM and the NDEP, with the BLM as the lead agency. The surety would be for 100 percent of the projected reclamation costs, including neutralization, for that portion of the Proposed Action on which cyanide is used, stored, or transported, although it may be less than 100 percent for certain other areas. Barrick would be required to comply with this policy. The bonding policy provides that the bond shall be addressed in a NEPA document, if possible. Because the policy is new, and depends in part upon implementation of Nevada's new reclamation requirements, the proposed amount and terms of the bond cannot be determined at this time. However, the amount and terms of the surety would be established prior to a final decision on the Proposed Action and discussed in the Final EIS or Record of Decision. The final bonding requirements would be imposed as conditions of any approval of Barrick's Plan of Operations amendment.

The Betze Pit would remain in place following the completion of mining. All buildings, structures, and equipment would be removed from the surface and disposed of properly, and to the extent feasible and reasonable, mining disturbances would be sloped to blend and match the natural surrounding topography. The reclamation goals would emphasize species diversity and plant mixes to create a mosaic pattern of plant community types within the project area. Plant selection would emphasize species (preferably native) which would maximize opportunities for wildlife habitat and livestock forage.

To achieve the above goals, a program of test plots would be implemented to evaluate and select a successful and specific reclamation program. The emphasis of this program would be on developing three to four plant species mixes which would be adaptable to the different geomorphic settings expected within the reclaimed project area. Various surface preparation practices would also be evaluated for their success in promoting plant establishment and resistance to soil erosion. A reclamation study plan would be developed in cooperation with the BLM, the Nevada Department of Wildlife, and the Soil Conservation Service to implement the test plot program during 1991. Based on the results generated by the reclamation study, the BLM would select the plant mixes and cultural practices to be used in reclaiming project disturbances.

Specific reclamation procedures that would be conducted are discussed on the following pages. The final selection of specific reclamation measures and the schedule for implementation of such measures upon final reclamation would be determined by the NDEP and the BLM on a case-by-case basis.

2.2.5.1 Topsoil Stripping and Stockpiling. In areas slated for disturbance, the topsoil would be salvaged using conventional construction equipment such as bulldozers, front-end loaders and trucks, and scrapers. Topsoil depths would vary from area to area. An average of 16 inches of topsoil would be stripped across the mine project area. Topsoil would then be stockpiled in designated storage areas for future use in reclamation.

Topsoil stockpiles would be located to minimize impacts from the operations and would be graded to slopes of 2.5H:1V to reduce erosion. The surfaces of the topsoil stockpiles would be reseeded during the first fall season following construction to minimize the spread of noxious weeds and soil loss due to wind and water erosion. Diversion channels would be constructed upgradient of the topsoil stockpiles where appropriate to protect the stockpiles from surface water flows. All stockpiles would be marked with appropriate signs.

2.2.5.2 Topsoiling and Surface Preparation. During final reclamation, all areas to be reclaimed would be covered with a layer of approximately 1 foot of topsoil obtained from the topsoil stockpiles. The topsoil would be applied and spread with construction equipment in a manner that would reduce compaction. After resurfacing with topsoil, the areas, in general, would be ripped along the contour to a depth of 2 feet with rippers set approximately 1.5 feet apart. The depth of ripping would be adjusted depending on the amount of rock or cobble material that might be pulled to the surface. Contour furrowing, discing, pitting, or dozer basins would be used, singly or in combination, where appropriate, to minimize soil erosion and increase moisture retention.

2.2.5.3 Revegetation. Seed mixtures approved by the BLM would be applied to all topsoiled areas during the first fall following regrading. Areas to be reseeded would be scarified with a tooth harrow or disc. The seed would be applied with a rangeland drill or broadcast and then harrowed where drilling may not be suitable. Drill seeding would be conducted along the contour wherever possible.

The final seed mixtures and pattern or location of seeding would be determined by the BLM based on reclamation success to date and the BLM's post-mining land use criteria. Boundary fences (3 to 4 strand barbed-wire) would be erected around reclaimed areas and maintained until vegetation re-establishment has occurred to sustain livestock use on a seasonal basis. Fence removal would be done only upon concurrence from the BLM authorized officer.

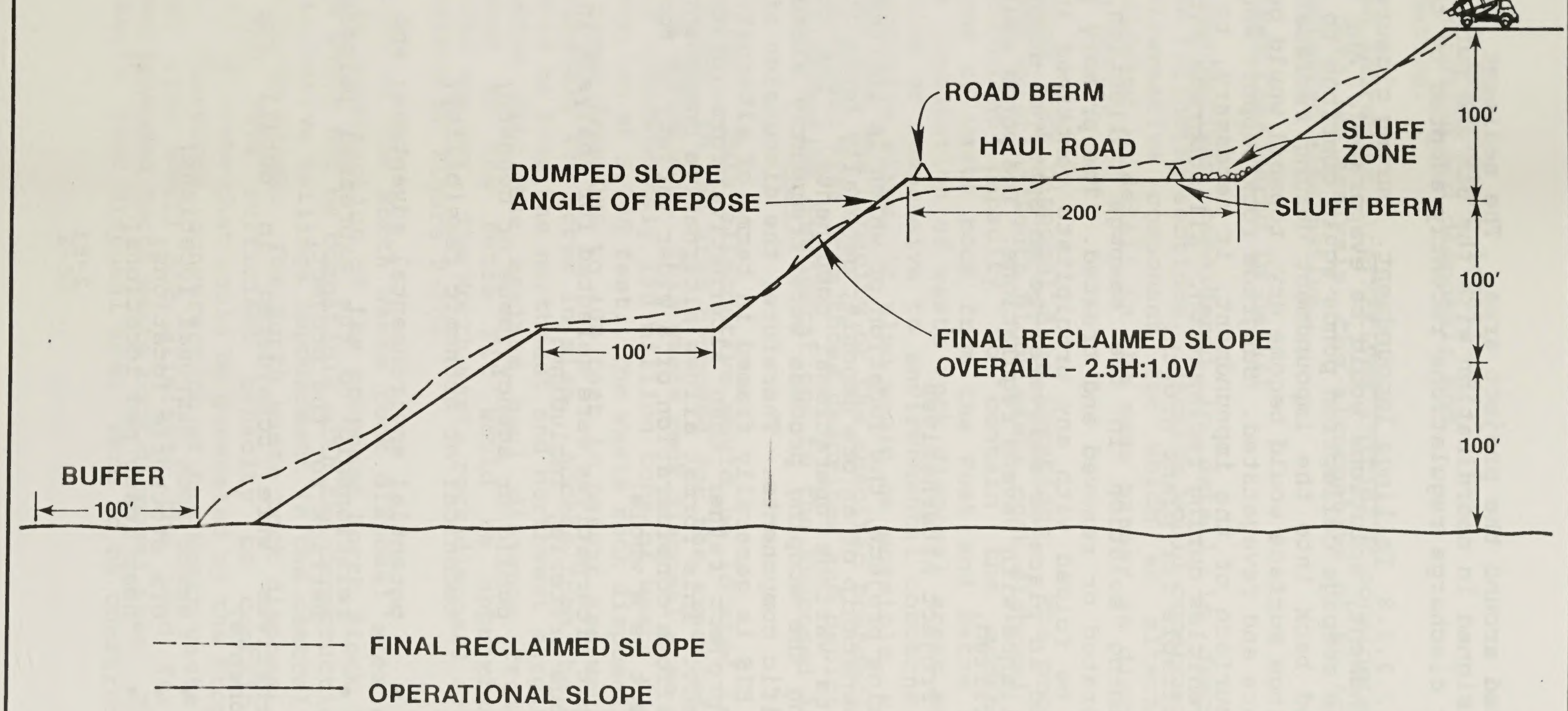
2.2.5.4 Waste Rock Disposal Areas. The waste rock disposal areas would be constructed by dumping laterally in 100-foot vertical lifts. Each succeeding lift would be set back sufficiently from the previous lift to leave a terrace at its base to control runoff and erosion. During reclamation, the slope of each lift would be modified from the natural angle of repose to allow topsoil placement and operation of reclamation equipment. The final overall slope would be approximately 2.5H:1V (Figure 2-9). Topsoil would be spread uniformly over the surface and revegetated with approved seed mixtures.

2.2.5.5 Heap Leach Facilities. Following active leaching, the heaps would be rinsed with water or a solution containing a cyanicide. The heaps would be closed when the WAD cyanide levels met the requirements established by the NDEP. The current WAD cyanide closure standard is 0.2 mg/l. Remaining solutions in the solution collection ponds would be evaporated or removed and treated. The primary pond liners would then be folded with any precipitate contained inside and either buried in place or delivered to an approved disposal facility in compliance with Nevada regulations. The ponds would be breached or backfilled. The heaps would be regraded to slopes of approximately 2.5H:1V, covered with topsoil, contour furrowed to control erosion, and revegetated.

2.2.5.6 Mill and Ancillary Facilities. Upon closure, the mill and ancillary facilities would be dismantled and buried on-site in conformance with applicable solid waste disposal requirements or removed from the project area in compliance with NDEP regulations. Foundations, basements, walls, and sumps would be flattened or otherwise covered with earth. The top surfaces of the disturbed areas would be graded to blend with the natural topography. Any steep cut-and-fill slopes would be regraded to a slope of 2.5H:1V or gentler. The tops of the slopes would be rounded slightly to help give the slopes an appearance similar to that of the surrounding natural terrain.

Road fills and drainage crossings would be regraded to a natural shape and gradient and any culverts would be removed. Drainage crossings would not be regraded if they are part of roads that would have a post-mining use as determined by the BLM. Dikes and ditches that would no longer be required for control of surface drainage would be regraded during reclamation to blend with the surrounding terrain. The regraded surfaces would be covered uniformly with topsoil and revegetated.

2.2.5.7 Sediment Control. A sediment control plan would be developed to minimize the amount of sediment transported from the project area to the drainages of Rodeo, Boulder, Bell, and Brush Creeks. Sediment control would likely be accomplished through armoring (riprap), run-on diversions, and a series of sediment catchments of an appropriate type and capacity which would be




BETZE PROJECT

Figure 2-9. Waste Rock Disposal Area

located around the project area. The sediment control plan would be designed in coordination with the BLM and pursuant to the storm water discharge regulations recently adopted by the EPA.

2.2.5.8 Tailings Impoundment. During closure of the tailings impoundment, solutions would be evaporated. Any liquid collected in the seepage collection ponds would continue to be collected and pumped back into the impoundment during reclamation. After the tailings surface would become dry, topsoil would be spread over the surface and revegetated. Subgrade rock support would be applied to the surface of the impoundment, if necessary, to provide support for vehicles during reclamation. All subgrade material used would be suitable for plant growth.

Remaining solution in the seepage collection pond would be evaporated or removed and treated. The primary pond liner would then be folded with any precipitate contained inside and either buried in place or delivered to an approved disposal facility in compliance with Nevada regulations. The ponds would be breached or backfilled.

## 2.3 Project Alternatives

A mining project, the location of which is limited by the location and ownership of an ore deposit, generally lends itself to analysis by its various operational components. The comments received during the scoping process were frequently aimed at one or more specific components. Therefore, the discussion of alternatives in this EIS is generally framed in terms of alternative components of the project rather than alternative formulation of the entire project. This format allows alternative components to be combined and allows consideration of a wider variety of formulations of the project as a whole.

Project alternatives were selected for analysis in the EIS based on various criteria, including:

- public or agency issue or concern;
- technical or economic feasibility;
- potential environmental advantage; and
- relationship to the expressed purposes and needs of Barrick for the project.

Alternatives were considered in detail for the following components:

- waste rock disposal locations;
- ore stockpile locations;
- heap leach pad locations;

- tailings impoundment locations;
- water handling and disposal; and
- reclamation.

This section also addresses alternatives initially considered but eliminated from detailed analysis, the alternative of No Action, and the BLM's preferred alternative.

### 2.3.1 Alternatives Considered in Detail

Each of the alternatives considered in detail is described separately in the following sections. Barrick would construct and reclaim each alternative component for which an alternative location is considered in detail in the same manner as discussed for the Proposed Action.

2.3.1.1 Waste Rock Disposal Area Locations. The proposed Extended South and existing South Block waste rock disposal areas would have sufficient capacity to contain the additional 780.6 million tons of waste rock from the Post and Betze Pits. Alternatively, a combination of waste rock disposal areas may be more cost-effective or responsive to environmental concerns. In addition to alternative sites, it also would be possible, within certain limits, to vary the capacity or the specific boundaries of each waste rock disposal area from those described and depicted in this analysis. Alternative configurations to the Proposed Action include:

- North Area. This alternative would be located in the North Block, in the area proposed for the expanded heap leaching operations. This waste rock disposal area could contain approximately 190 million tons of waste rock to an elevation of 5,700 feet. The waste rock disposal area would range from 250 to 400 feet in height and would be approximately 430 acres in size. Access from the Betze Pit would be from the northeast and northwest margins of the Betze Pit; the maximum haul distance from the perimeter of the Betze Pit would be approximately 2.2 miles one way. The North waste rock disposal area is illustrated on Figure 2-10a.

  Selection of the North waste rock disposal area would preclude construction of the proposed North Block leach pad and would not be compatible with the construction of the alternative tailings impoundment in the central area of the North Block. The North waste rock disposal area would not have sufficient capacity to contain the quantity of waste that would be generated by the Proposed Action. Therefore, construction of the North waste rock disposal area would not eliminate the need for the proposed Extended South waste rock disposal area. If the North waste rock disposal area were to be constructed,

* waste-handling and disposal;
* reclamation.

This section also addresses alternatives considered but eliminated from detailed analysis and the Agency's preferred alternative.

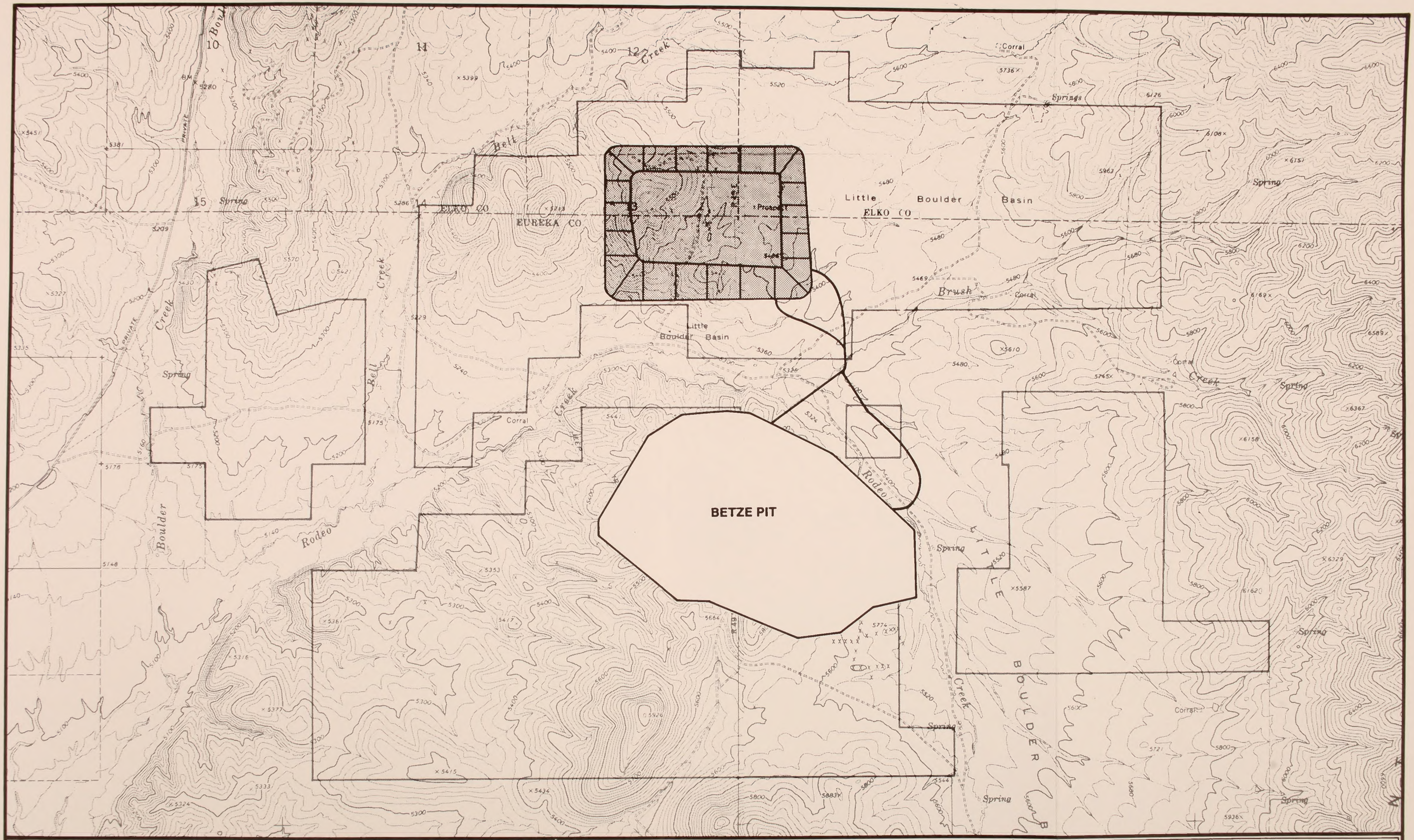
2.7.1 Alternative Project Components

Each of the alternative project components is described separately in the following sections. Further, only a summary analysis of each alternative component for which an alternative location is considered is discussed [illegible] for the proposed Amendment.

2.7.1.1 Waste Rock Disposal Areas. Under the proposed action, the proposed expanded north and existing south waste rock disposal areas would have sufficient capacity to contain the additional 301.1 million tons of waste rock from the East and Beta Pits. Alternatively, a combination of waste rock disposal areas may be more attractive in responding to environmental concerns. In addition, an alternative waste rock site would be possible, although certain limits on [illegible] capacity [illegible] waste rock disposal sites were considered and evaluated in this analysis. [illegible] the proposed [illegible].

* North Site. This alternative would be located between the [illegible] and the proposed [illegible] and would contain approximately 100 million tons of waste rock to an elevation of 5,700 feet. The waste rock disposal area would be approximately 280 acres in size [illegible]. It would be from the northeast and northwest margins of the Beta Pit [illegible] the perimeter of the pits. It would be approximately 1.1 miles [illegible]. The [illegible] waste rock disposal area is illustrated on Figure 2-10.

Selection of the North waste rock disposal area would preclude expansion of the proposed Beta pit and would not be compatible with the construction of the alternative tailings impoundment in the central area of the North site. The North waste rock disposal area would not have sufficient capacity to contain the quantity of waste that would be generated by the proposed action. Therefore, construction of the North waste rock disposal area would not eliminate the need for the proposed Extended waste rock disposal area. If the North waste rock disposal area were to be constructed,




BETZE PROJECT

**Figure 2-10a. North Waste Rock Disposal Area Alternative**

the Extended South waste rock disposal area also would need to be built as proposed, except the ultimate height of the disposal area would be approximately 5,700 feet rather than 5,900 feet.

- Clydesdales Area. This alternative would be located primarily on land controlled by Barrick, but would extend beyond the property boundaries in certain areas in order to maximize the storage volume. Barrick would have to either make arrangements with other landowners to implement this alternative or reduce the capacity of the waste rock disposal area. The Clydesdales waste rock disposal area could contain up to 310 million tons of waste rock, would disturb approximately 642 acres, and would have a maximum elevation of 5,500 feet. The maximum height of the facility would be about 360 feet; while the average height would be about 200 feet. The nearest access from the Betze Pit would be from the northwest end of the pit, a distance of approximately 1.2 miles. The longest haul distance would be about 2.3 miles one way. Figure 2-10b illustrates the Clydesdales waste rock disposal area.

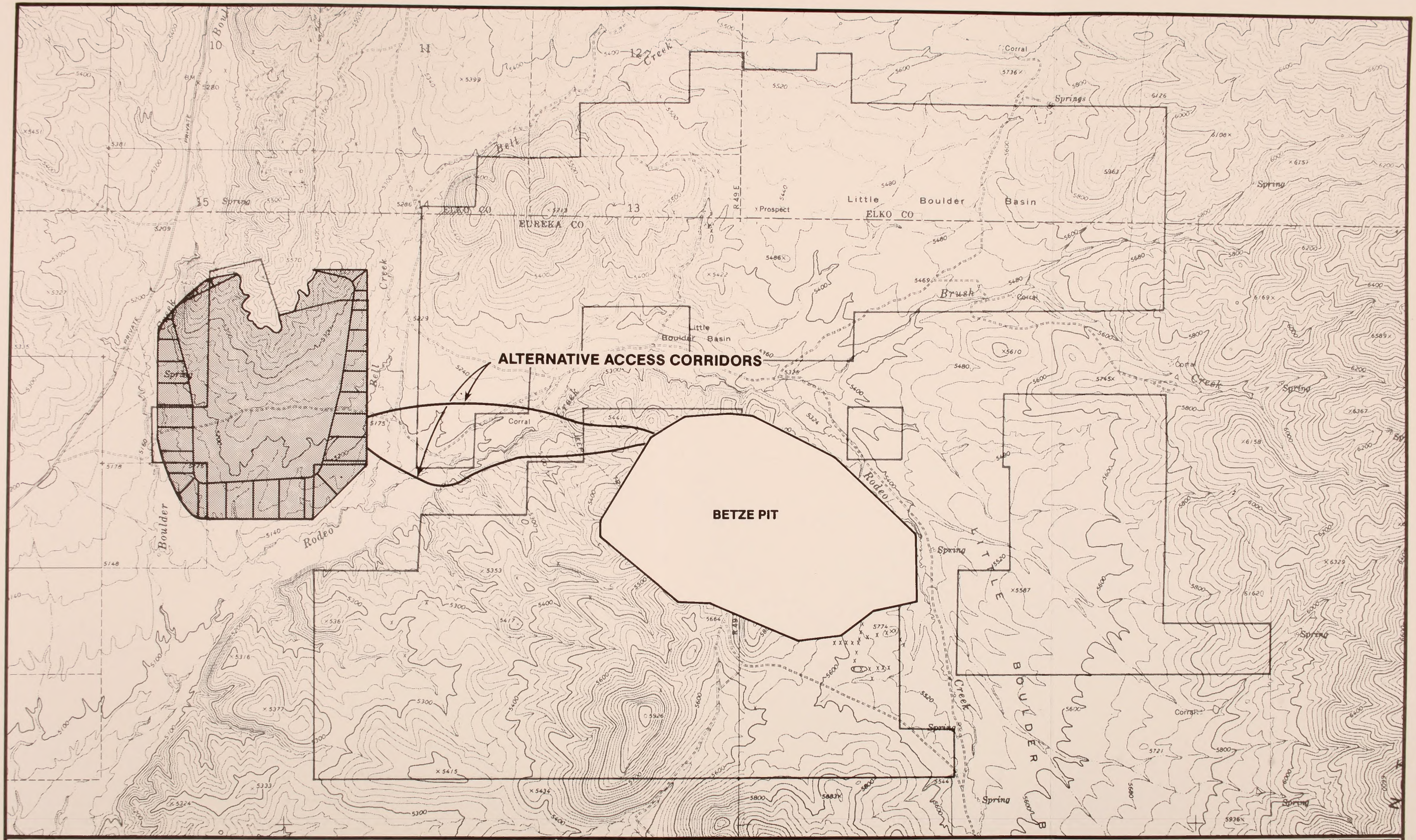
  Selection of the Clydesdales waste rock disposal area would be compatible with other components of the Proposed Action or the alternatives. The Clydesdales waste rock disposal area would not ~~have~~ sufficient capacity to contain the quantity of waste rock that would be generated by the Proposed Action. Construction of the Clydesdales waste rock disposal area would not eliminate the need for the proposed Extended South waste rock disposal area. If the Clydesdales waste rock disposal area were to be constructed, the Extended South waste rock disposal area also would need to be built as proposed, except that the ultimate height of the disposal area would be approximately 5,600 feet rather than 5,900 feet.

  The North and the Clydesdales waste rock disposal areas together would not have sufficient capacity to contain the quantity of waste rock that would be generated by the Proposed Action. Construction of both the North and the Clydesdales waste rock disposal areas would not eliminate the need for the proposed Extended South waste rock disposal area. If both the North and the Clydesdales waste rock disposal areas were to be constructed, the Extended South waste rock disposal area would need to be constructed as proposed, except that the total surface area of the disposal area would be 550 acres, rather than 912 acres, and the ultimate height of the Extended South waste rock disposal area would be 5,600 feet, rather than 5,900 feet. Under this the Extended South waste rock disposal area also would need to be built as proposed, except the ultimate height of the disposal area would be approximately 5,700 feet rather than 5,900 feet.

Clydesdales Area. This alternative would be located entirely on land controlled by Barrick, but would extend beyond the property boundaries in certain areas in order to maximize the storage volume. Barrick would have to either make arrangements with other landowners to implement this alternative or reduce the capacity of the waste rock disposal area. The Clydesdales waste rock disposal area could contain up to 1.3 million tons of waste rock, would disturb approximately 410 acres, and would have a maximum elevation of 5,300 feet; the maximum height of the facility would be about 400 feet, while the average height would be about 200 feet. The nearest access from the Betze Pit would be from the southwest end of the pit, a distance of approximately 1.5 miles. The longest haul distance would be about 2.3 miles one way. Figure 2-15b illustrates the Clydesdales waste rock disposal area.

Selection of the Clydesdales waste rock disposal area would be compatible with other components of the Proposed Action or the alternatives. The Clydesdales waste rock disposal area would not have sufficient capacity to contain the quantity of waste rock that would be generated by the Proposed Action. Construction of the Clydesdales waste rock disposal area would not eliminate the need for the proposed Extended South waste rock disposal area. If the Clydesdales waste rock disposal area were to be constructed, the Extended South waste rock disposal area also would need to be built as proposed, except that the ultimate height of the disposal area would be approximately 5,800 feet rather than 5,900 feet.

The North and the Clydesdales waste rock disposal areas together would not have sufficient capacity to contain the quantity of waste rock that would be generated by the Proposed Action. Construction of both the North and the Clydesdales waste rock disposal areas would not eliminate the need for the proposed Extended South waste rock disposal area. If both the North and the Clydesdales waste rock disposal areas were to be constructed, the Extended South waste rock disposal area would need to be constructed as proposed, except that the total surface area of the disposal area would be 680 acres, rather than 910 acres, and the ultimate height of the Extended South waste rock disposal area would be 5,800 feet, rather than 5,900 feet. Under this




BETZE PROJECT

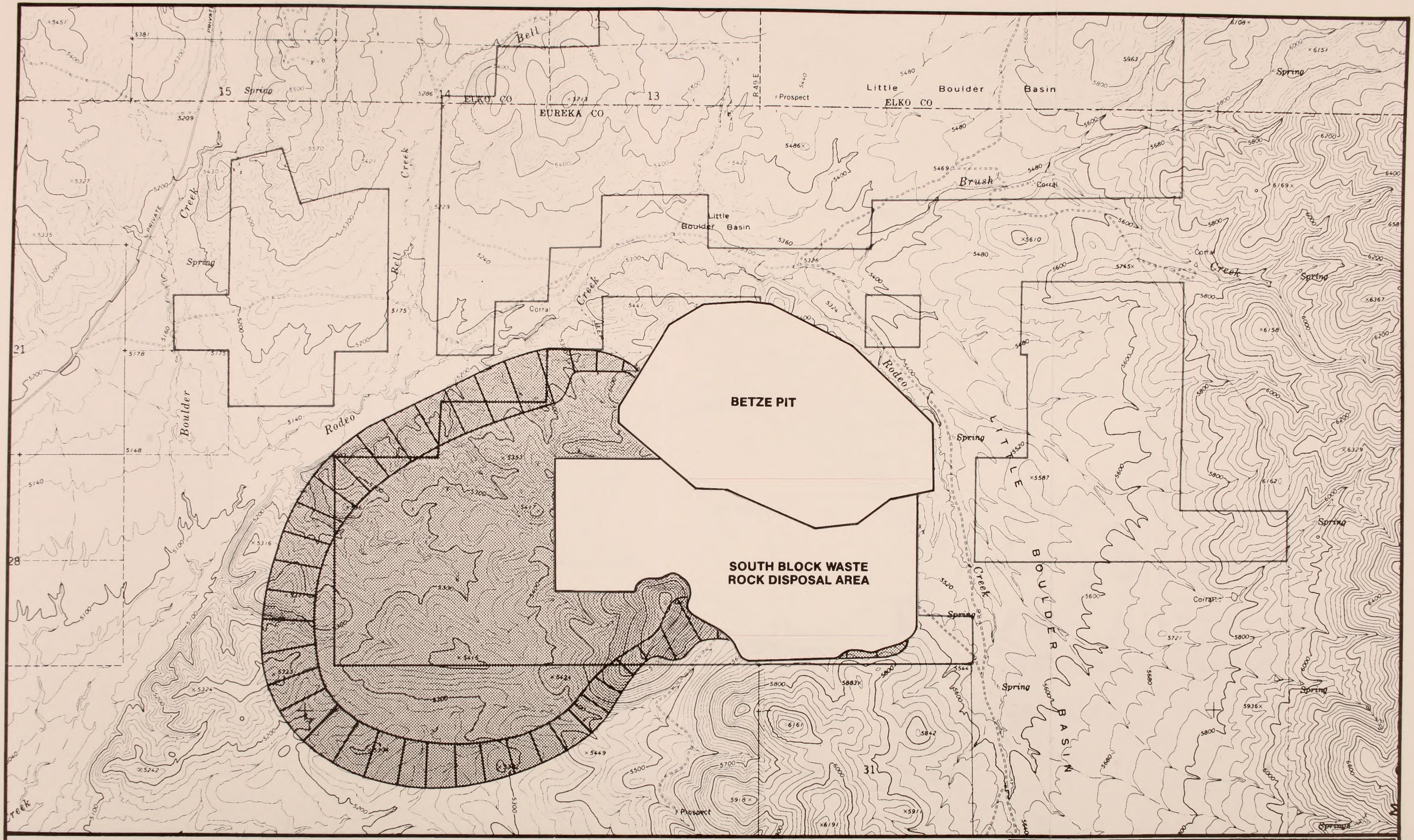
**Figure 2-10b. Clydesdales Waste Rock Disposal Area Alternative**

alternative, the Extended South waste rock disposal area likely would not affect the far western portion of the South Block.

- Far West Area. This alternative is a variation of the proposed Extended South waste rock disposal area. This alternative represents a waste rock disposal area for the South Block that would not be constrained by Barrick's property boundaries. While utilizing all of the South Block, this alternative would extend beyond Barrick's property boundaries to the south and west to increase the available capacity. Developing this alternative would require Barrick to make arrangements with third parties which either own or manage the adjacent lands. The Far West waste rock disposal area could contain up to 2.23 billion tons of waste rock, would disturb approximately 1,713 acres, and would, if fully utilized, have a maximum elevation of 5,900 to 6,000 feet. Access from the Betze Pit would be from the southeast and northwest margins of the Betze Pit; the maximum haul distance from the perimeter of the pit would be approximately 2.2 miles one way. A waste rock disposal area of this size would have the capacity, subject to regulatory approval, to accept waste rock from other operations of Barrick, Newmont, or others in the immediate vicinity. The Far West waste rock disposal area is illustrated on Figure 2-10c.

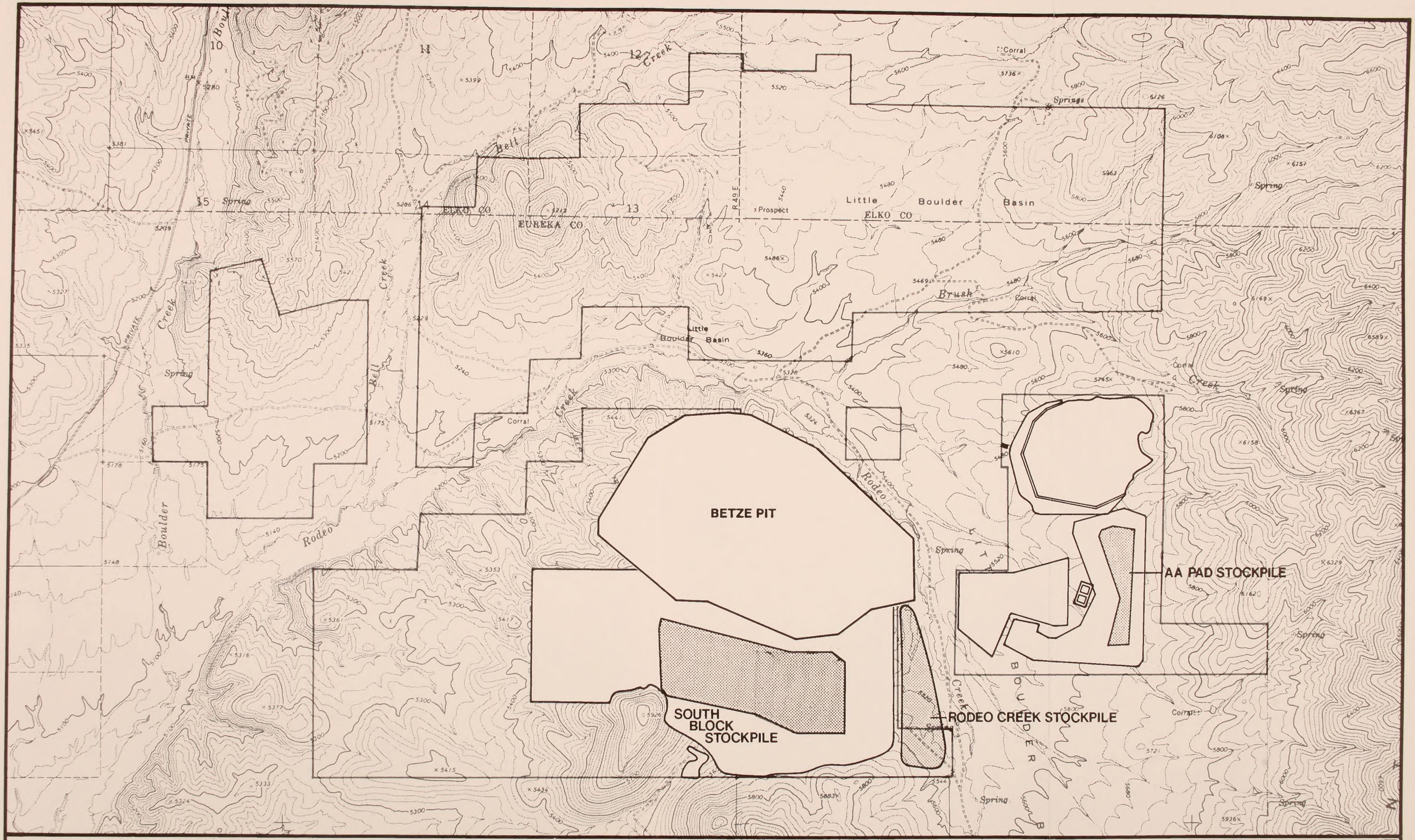
2.3.1.2 Ore Stockpile Locations. Ore stockpiles would be necessary because mining would proceed at a rate greater than the rate of processing by the mill and because oxide ore would be accumulated for batch processing through the mill after completion of the mill conversion to process sulfide ore. Therefore, ore that would not be processed immediately would accumulate until the end of mining in the year 2000, or until a sufficient quantity of ore had accumulated to warrant processing a batch of oxide ore. After the conclusion of mining, the stockpiled ore would be processed through the mill over a 10-year period. The Proposed Action anticipates two ore stockpiles (North Block and AA Block Panhandle). Three alternative stockpile locations are also evaluated in this EIS, as described below and shown on Figure 2-11.

- Existing South Block Waste Rock Disposal Area. In this alternative, an ore stockpile would be located over "topped out" sections of the existing South Block waste rock disposal area. This stockpile would have a capacity of 40 million tons of ore. The ore stockpile would affect approximately 211 acres of previously disturbed land, and would be located about 2,000 feet from the Betze Pit. This location of the ore stockpile would require a maximum haul route from the perimeter of the




BETZE PROJECT

**Figure 2-10c. Far West Waste Rock Disposal Area Alternative**




NOTES: AA Pad Stockpile is on top of leached AA Block Leach Pads.
South Block Stockpile is on top of South Block Waste Rock Disposal Area.

BETZE PROJECT

**Figure 2-11. Ore Stockpiles – Alternative Locations**

pit of approximately 1.5 miles to climb to the top of the waste rock disposal area.

- AA Block Leach Pads. This alternative would locate an ore stockpile on top of the leach pads after leaching had ceased and the leach pads had been closed under applicable BLM and NDEP regulations. This stockpile would contain 0.3 million tons of ore. No new areas would be disturbed, and the ore stockpile would cover nearly 37 acres. Haul roads already exist from the Betze Pit, a distance of approximately 1.3 miles.

- South Block - Rodeo Creek. Under this alternative, the ore stockpile would be located on both Barrick and Newmont lands just east of Barrick's South Block but west of Rodeo Creek. This stockpile would have a capacity of 9.5 million tons of ore. The ore stockpile would cover approximately 74 acres and would have a maximum haul distance of 1 mile from the Betze Pit. Approximately 24 acres would be on Barrick claims composed of undisturbed land, and 50 acres would be on previously disturbed lands owned by others with whom Barrick would have to make arrangements.

2.3.1.3 Heap Leaching Locations. The mining of the Betze Pit would require additional heap leaching operations to process the approximately 45.3 million tons of leach ore that would be produced from the Post and Betze Pits. The approved heap leaching facilities do not have sufficient capacity to handle all of this volume. New heap leaching facilities to process approximately 22.0 million tons of leach ore would be required. The proposed facilities would be located in the central portion of the North Block, west of the proposed tailings impoundment, and would disturb approximately 142 acres. An alternative site evaluated in this EIS is discussed below.

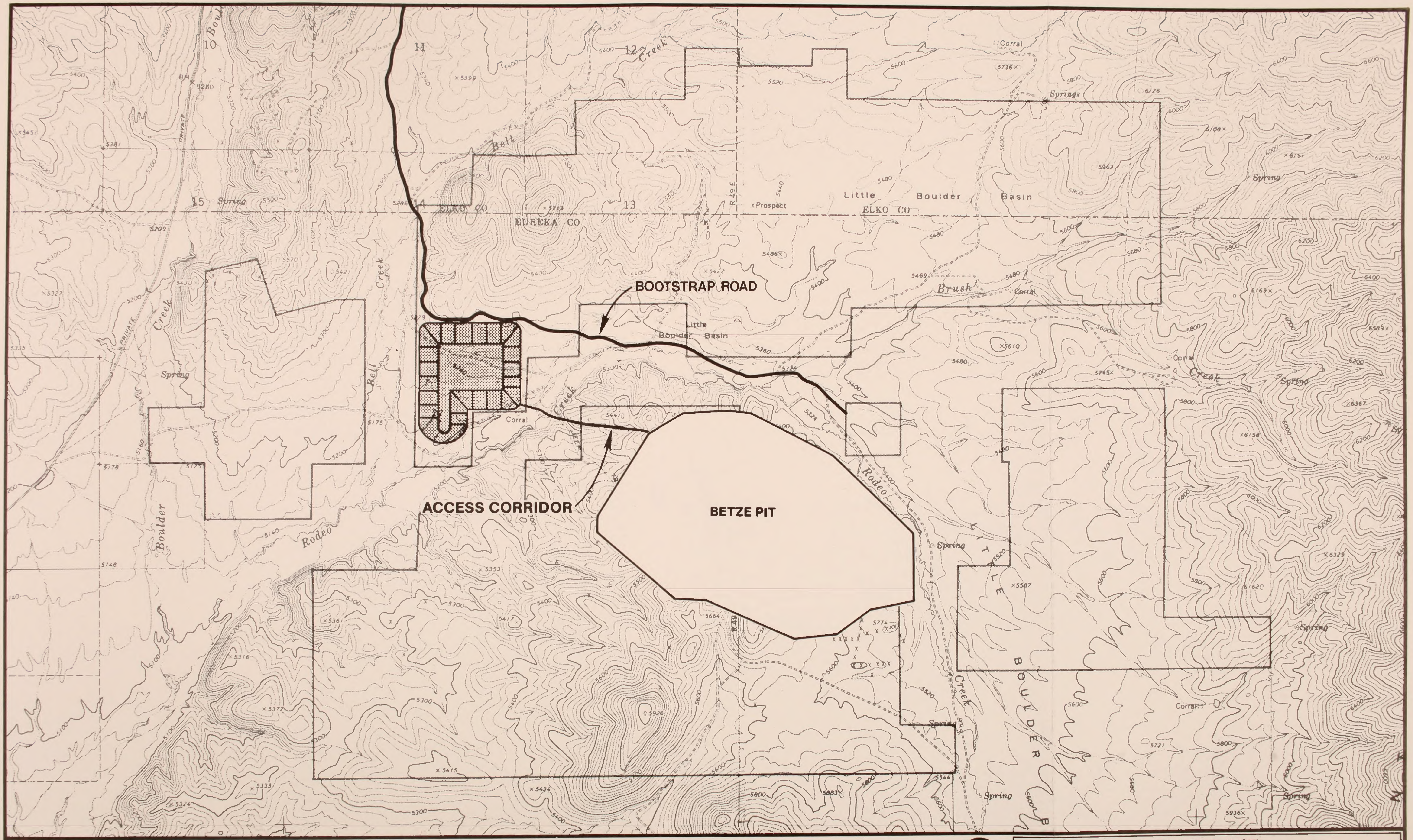
- Western North Block. This alternative would locate the heap leaching operations in the southwest corner of the North Block. The heap leaching operations would disturb approximately 145 acres and would require the realignment of the existing Bootstrap road. Figure 2-12 shows the alternative leach pad location and the Bootstrap road. The heap leach facility would be approximately 500 feet from Rodeo Creek at its nearest point. The facility would not fall within the Rodeo Creek floodplain. Similar to the proposed heap leaching facilities located in the central portion of the North Block, the alternative would require the construction of a heap leach pad in multiple lifts to an ultimate height of 200 feet. In addition, solution collection ponds, a gold adsorption facility (carbon columns), and associated infrastructure would be constructed. The gold-loaded pit of approximately 1.5 miles to climb to the top of the waste rock disposal areas.

* SE Block Leach Pads. This alternative would locate an ore stockpile on top of the leach pads after leaching had ceased and the leach pads had been closed under applicable BLM and NDEP regulations. This stockpile would contain 9.5 million tons of ore. No new areas would be disturbed, and the ore stockpile would cover nearly 70 acres. Haul roads already exist from the Betze Pit, a distance of approximately 1.1 miles.

* South Block - Rodeo Creek. Under this alternative, the ore stockpile would be located on both Barrick and Newmont lands just east of Barrick's South Block and west of Rodeo Creek. This stockpile would have a capacity of 9.5 million tons of ore. The ore stockpile would cover approximately 74 acres and would have a maximum haul distance of 1 mile from the Betze Pit. Approximately 24 acres would be on Barrick claims composed of undisturbed land, and 50 acres would be on previously disturbed lands owned by others with whom Barrick would have to make arrangements.

2.4.3 Heap Leaching Locations. The mining of the Betze Pit would require additional heap leaching operations to process the approximately 45.1 million tons of leach ore that would be produced from the Post and Betze Pits. The approved heap leaching facilities do not have sufficient capacity to handle all of this volume. New heap leaching facilities to process approximately 22.9 million tons of leach ore would be required. The proposed facilities would be located in the central portion of the North Block, west of the proposed tailings impoundment, and would disturb approximately 155 acres. An alternative site evaluated in this EIS is discussed below.

* Eastern North Block. This alternative would locate the heap leaching operations in the southeast corner of the North Block. The heap leaching operations would disturb approximately 155 acres and would require the realignment of the existing Bootstrap road. Figure 2-11 shows the alternative leach pad location and the Bootstrap road. The heap leach facility would be approximately 250 feet from Rodeo Creek at its nearest point. The facility would not fall within the Rodeo Creek floodplain. Similar to the proposed heap leaching facilities located in the central portion of the North Block, this alternative would require the construction of a heap leach pad in multiple lifts to an ultimate height of 250 feet. In addition, solution collection ponds, a gold adsorption facility (carbon columns), and associated infrastructure would be constructed. The gold-laden




BETZE PROJECT

**Figure 2-12. Alternative Leach Pad Location and Bootstrap Road**

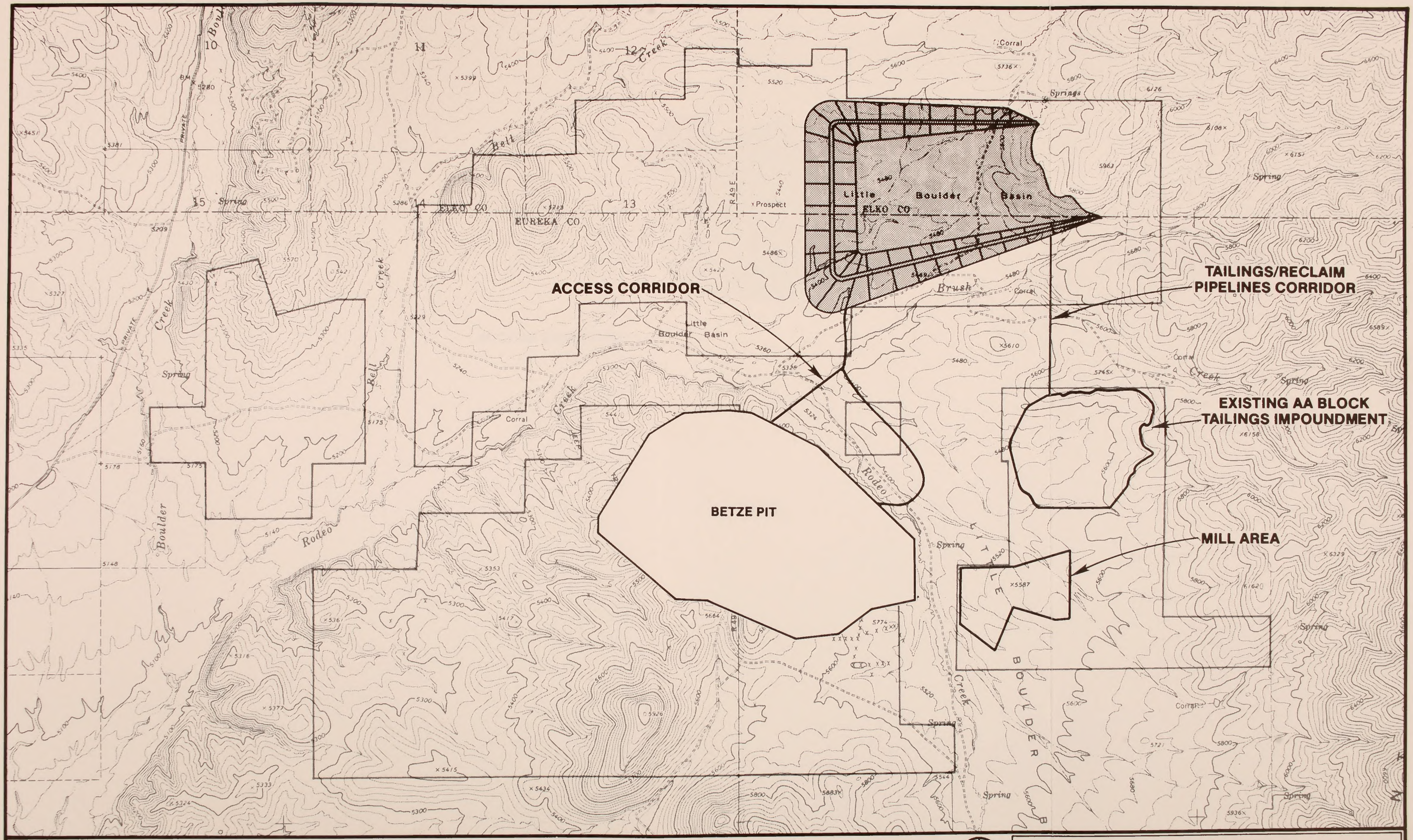
carbon would be trucked to the existing facility on the AA Block for acid washing, carbon stripping, electrowinning, and refining.

2.3.1.4 Tailings Impoundment Locations. The milling of the ore from the Betze Pit would require the construction of additional tailings disposal capacity of at least 67 million tons. The alternative sites and configurations evaluated in this EIS are discussed below.

- Expanded North Block. This alternative would be similar to the Proposed Action in that the location would be the same, but the impoundment would be larger in all dimensions. The centerline length of the embankment would be approximately 3.2 miles, and the total disturbed area would be approximately 703 acres. The impoundment would have capacity for approximately 108 million tons of tailings. The height of the impoundment would be 325 feet at its highest point. Subject to regulatory approval, a tailings impoundment of this size would have the capacity to accept tailings from other operations of Barrick, Newmont, or others within the immediate vicinity. Selection of the Expanded North Block tailings impoundment alternative would incorporate the proposed North Block tailings impoundment. This alternative is shown on Figure 2-13a.

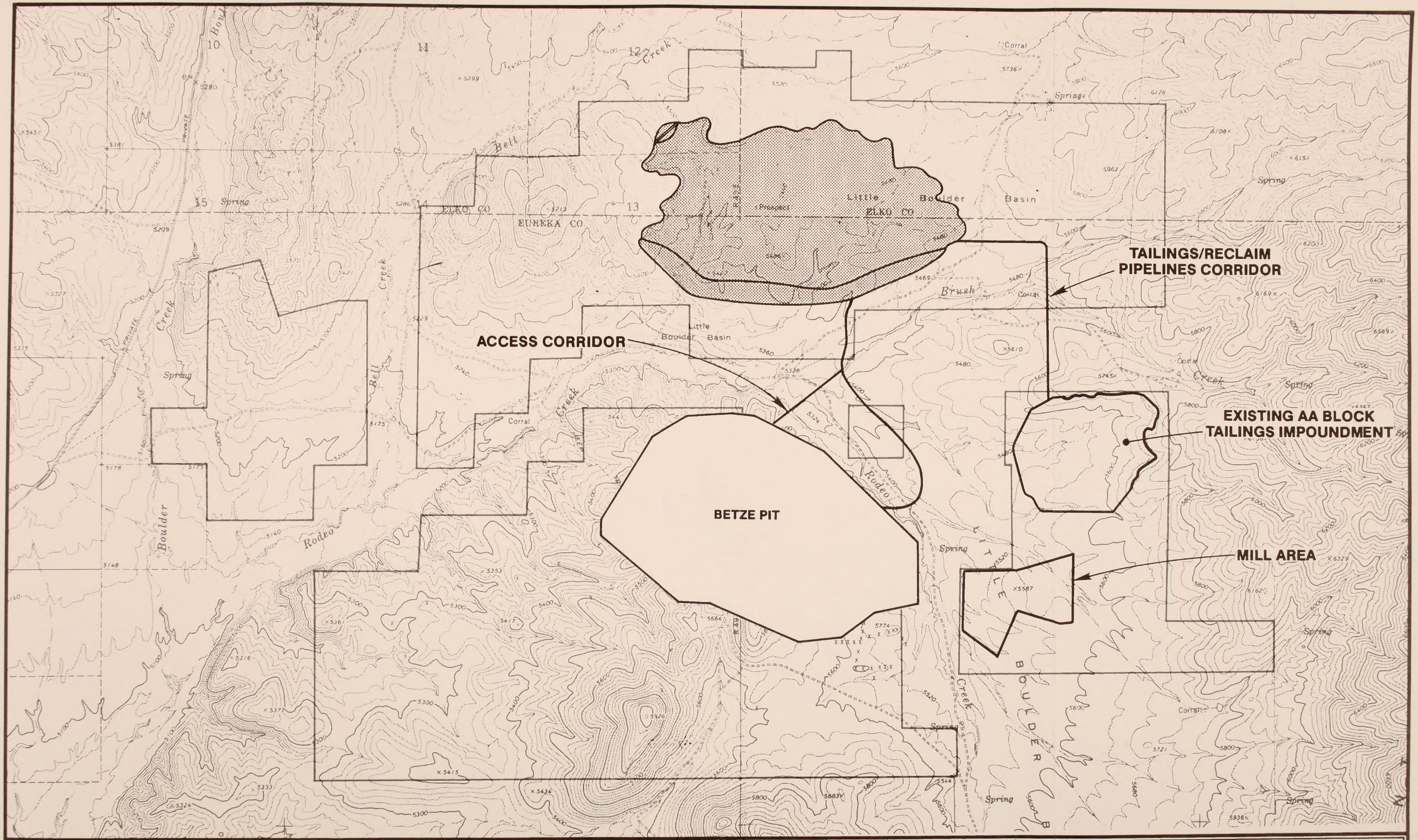
- Central North Block. The embankment in this location would have a centerline length of 1.6 miles, and the total disturbed area would be approximately 650 acres. The maximum embankment height would be 190 feet. The impoundment could contain approximately 67 million tons of tailings. Selection of the Central North Block tailings impoundment alternative would preclude the construction of the proposed North Block heap leach pad and the alternative North waste rock disposal area. The location is shown on Figure 2-13b.

2.3.1.5 Water Handling and Disposal. The Proposed Action involves discharge of water not used for mining and milling down an unnamed drainage to the TS Ranch Reservoir for eventual use for irrigation in Boulder Valley. If more water were produced by dewatering than could be used in mining, milling, and irrigation uses, subject to regulatory approval, the excess water would be discharged into Rodeo or Boulder Creeks; or if that is not possible, the water would be infiltrated or reinjected. These alternative disposal methods are treated as alternatives in this EIS. Specific sites for the infiltration or reinjection alternatives have not been identified because Barrick has been unable to obtain access to land in Boulder Valley that is owned or controlled by others. Access is necessary to evaluate the suitability of specific sites for infiltration or reinjection.




BETZE PROJECT

**Figure 2-13a. Expanded North Block Tailings Alternative**




BETZE PROJECT

**Figure 2-13b. Central North Block Tailings Alternative**

- Infiltration. Infiltration fields would be constructed in Boulder Valley. The excess dewatering water would then be piped from either the TS Ranch Reservoir or directly from the dewatering operations to the fields for infiltration. This alternative could only be implemented after conducting geotechnical surveys in the area to confirm the existence of suitable infiltration capacity and to determine the depth to and existing quality of ground water in the area. Disposal of water by infiltration would also require regulatory review and approval by the NDEP and the Nevada State Engineer prior to construction. In addition, if the infiltration operation were to be implemented on land managed by the BLM, Barrick would comply with the applicable BLM land management regulations.

- Reinjection. A series of injection holes would be drilled in Boulder Valley, cased with perforated casings, and fitted with pumps mounted on the surface. The excess water would then be piped either from the TS Ranch Reservoir or directly from the dewatering operations to the injection holes. The pumps would inject the water under pressure into subsurface strata. This alternative would require that test holes be drilled and pressure tested and that existing water quality be documented. Injection feasibility would have to be demonstrated before the NDEP and the Nevada State Engineer would approve permits for the project. In addition, if the reinjection operation were to be implemented on land managed by the BLM, Barrick would comply with the applicable BLM land management regulations.

- Discharge to Rodeo or Boulder Creek. Under this alternative, water would be discharged to Rodeo Creek from the dewatering operations, after treatment if necessary, or would be discharged directly to Boulder Creek without entering the TS Ranch Reservoir. In either case, water would flow down Boulder Creek. Regulatory review and approval by the NDEP and the Nevada State Engineer would be necessary prior to discharge.

2.3.1.6 Reclamation Alternatives. Various landforms created by the proposed mining project would remain following the completion of mining and processing operations. The following section discusses different techniques that could be used to reclaim project components.

Waste Rock Disposal Area. The side slopes of the proposed or alternative waste rock disposal areas could be left in various configurations which could affect the visual, topographic, and revegetation impacts of the project.

- Natural Angle of Repose. In this alternative, the waste rock disposal area side slopes would be left at the natural dump angle of repose of approximately 1.3H:1V, and the slopes would not be flattened. The benches and top of the disposal areas would be reclaimed with topsoil and revegetated; the side slopes would not be reclaimed.

- Side Slopes Flattened to 3.0H:1V. Waste rock disposal area side slopes would be flattened from the natural angle of repose to an overall slope of approximately 3.0H:1V. The tops, benches, and sideslopes of the disposal areas would be reclaimed with topsoil and revegetated.

- Insloping Waste Rock Area Benches. The Proposed Action would retain benches across the faces of the waste rock which are slightly out-sloped to eliminate the surface ponding and infiltration of water into the waste rock mass. This alternative would retain benches with a slight slope inward toward the face of the slope, thereby increasing moisture retention to facilitate revegetation and improving the capture of sediment generated by erosion of the slopes above the bench.

Tailings Impoundment

- Cover with Waste Rock. Under this alternative, waste rock would be dumped on top of the tailings impoundment in a selective manner to create an uneven surface of small hills and swales. The impoundment would then be covered with topsoil and revegetated. The tailings impoundment would need to drain for approximately 10 to 20 years before it would be capable of supporting the large volume of waste rock that would be placed on the surface of the tailings impoundment under this alternative.

Betze Pit

- Partial Pit Backfill. Under this alternative, the Betze Pit would be partially backfilled with waste rock to the projected post-mining water elevation of 5,300 feet. This would involve maintaining an equipment fleet to load and carry approximately 452 million tons of waste rock back into the pit. It is estimated that partial backfilling would require more than 9 years to accomplish following the end of mining and would cost approximately $423.2 million.

2.3.2 Alternatives Eliminated from Detailed Consideration

This section describes additional alternatives which were initially considered for analysis in the EIS but which were subsequently eliminated due to technical or economic infeasibility, due to the lack of environmental advantage over the Proposed Action, or because the alternatives were not reasonably responsive to the purpose and needs of the project proponent. The range of reasonable project (as opposed to component) alternatives is more limited in the context of a mining operation than many other types of proposed actions because the location and ownership of the project proponent's ore deposit is fixed. For these reasons, alternatives such as mining a different deposit, mining in a different location, or obtaining gold from different sources are not considered in detail.

In the case of an expansion of an existing mine and processing facility, the range of reasonable component alternatives also is limited to some extent by the location and character of the existing development and facilities. For example, alternatives to the existing mill site, access, and utility corridors are not considered in detail for this reason.

Certain other alternatives are not considered in detail because the alternatives were not considered responsive to the project proponent's needs and because the environmental impacts of such alternatives would be indistinguishable from either the Proposed Action or the No Action alternative. For example, patenting is a discretionary option open to a claimant possessing valid mining or millsite claims. The possible alternative of the BLM issuing patents under the mining laws (and possibly eliminating the need for review under the BLM's regulations) is not considered in detail because Barrick has advised the BLM that it would expand the mine as proposed regardless of whether the mine were located on private or public land.

One alternative that was considered by the BLM and eliminated from detailed treatment is the processing of part of Barrick's ore at existing Newmont facilities. This alternative was considered unreasonable because Newmont does not have the excess capacity necessary to process Barrick's ore.

An additional alternative that was considered by the BLM and eliminated from detailed consideration is the expansion of the existing tailings impoundment on the AA Block to contain a portion of the tailings generated by processing of the ore from the Betze Project. Expansion of the existing tailings impoundment would be limited because of the location of Newmont milling facilities north of the impoundment, the Barrick leach pads south of the impoundment, and the property line and associated Newmont access road to Mill No. 4 east of the impoundment. Given the constraints imposed by the presence of these facilities, the maximum expansion of the existing AA Block tailings impoundment could contain only an additional 1 to 2 million tons of tailings. Expansion of the existing AA Block tailings impoundment to achieve this marginal increase in tailings capacity is not considered to be feasible.

Another alternative that was considered by the BLM but eliminated from detailed consideration is complete back-filling of the Betze Pit. This alternative would involve returning waste rock to the open pit to fill it to the approximate original surface. The BLM considered the alternative unreasonable for several reasons. It is estimated that the equipment fleet of shovels, loaders, and trucks that was used for mining, and associated personnel, would have to work for approximately 12 years to load, haul, and dump an estimated 603.4 million tons of waste rock back into the pit. The cost of complete backfill would be approximately $532.3 million compared to a partial backfill cost of $423.2 million.

During the time required to completely backfill the pit, reclamation of significant portions of the waste rock disposal areas would not proceed, and air quality, water quality, and other environmental impacts associated with loading, hauling, and dumping would continue. Finally, complete backfilling would seriously impair access to the Deep Post deposit controlled by Barrick and Newmont. As noted below, development of the Deep Post deposit is not presently proposed. Nevertheless, the BLM believes it would be unreasonable to foreclose the possibility of mining the deposit by requiring complete backfilling of the Betze Pit.

A variant of backfilling considered by the BLM but not addressed in detail in this EIS is backfilling with waste from another mining operation. Although such an alternative would likely be more cost-effective than returning waste to the pit from which it came, it would require the active mining of a pit in the near vicinity of the Betze Pit after the completion of operations at the latter. Whether such a pit would be in operation is speculative. In addition, this alternative would not address the concern of impairing access to the Deep Post deposit previously described.

The alternative of underground mining by block caving methods was extensively considered. This alternative was considered to be infeasible by Barrick for several reasons. First, the Betze deposit largely lies beneath waste rock that is intermingled with oxide ore. Conceptually, the deeper ore could be mined by either underground or open-pit mining. Block caving is a method applicable to the bulk mining of ore deposits in weak rock. However, the Betze deposit is highly fractured and may not permit underground mining, particularly in view of expected water inflows and high temperatures. Block caving is highly productive, but grade control is difficult and dilution of the ore grade from the introduction of waste rock can be excessive. Control of the ore grade is considered by Barrick to be essential to a profitable operation at the Goldstrike Mine because dilution increases the milling expense and significantly increases the quantity of tailings that must be impounded. The dilution of the ore deposit ore grade would be about 50 percent under a block caving operation. In contrast, open-pit mining permits a high degree of grade control and reduces the volume of tailings produced. Second, underground mining would be inconsistent with the simultaneous open-pit mining of the near-surface oxide reserves of the Upper Post and Betze deposits, and would require Barrick to either forego mining of the surface deposits or delay the development work on an underground mine until surface mining was completed. This would effectively delay the recovery of commercial quantities of ore for several years beyond the completion of surface mining. Finally, underground mining presents safety and subsidence concerns not presented by surface mining. For these reasons, the BLM eliminated the alternative of underground mining from detailed consideration.

The alternative of expanding the Betze Project proposal to embrace concurrent mining of the Deep Post deposit also was considered. Barrick considered this alternative to be presently infeasible, remote, and speculative because of several considerations. First, the Deep Post deposit occurs at significant depth and crosses Barrick's property boundary with Newmont. It presents technical problems with respect to access, hydrology, temperature, rock stability, and mining methods. Extensive drilling, modeling, and engineering will be required to determine how and when the Deep Post deposit could be most economically developed. Only the most preliminary work in that regard has been initiated by Barrick. Second, a substantial portion of the deposit is owned by Newmont, with whom Barrick has no agreement for such development. Newmont has indicated to Barrick and the public that it intends to concentrate its short-term development on oxide rather than sulfide ore. In the absence of an agreement with Newmont or a defined proposal to mine the Deep Post deposit, Barrick has advised the BLM that the company cannot satisfy the enormous capital and other requirements for such development. Barrick also has advised the BLM that it will be not less than 3 to 5 years before any proposal for which a meaningful environmental analysis could be prepared is likely to be forthcoming, and it could be many years thereafter before such a proposal would be implemented.

Although development of the Deep Post deposit is not presently proposed and will require additional environmental analysis if and when it is proposed, it is considered to be reasonably foreseeable by the BLM. For this reason, the development of the Deep Post deposit is discussed briefly in this EIS as an action which may result in cumulative impacts with the Proposed Action.

### 2.3.3 No Action Alternative

For purposes of this EIS, the No Action alternative is characterized as the BLM's disapproval of the proposed amendment to the Plan of Operations. Under the No Action alternative, Barrick would continue to mine and process ore from the Post Pit and other satellite pits as authorized by existing approvals.

The intent of the No Action alternative is to illustrate the environmental consequences if the proposed or alternative expansion of Barrick's project does not occur. While the No Action alternative is characterized as disapproval of the proposed amendment, there may be other circumstances that effectively cause the same result. For example, if the application of some existing or future law or a precipitous drop in gold prices prevented Barrick from proceeding with all or part of its proposal, the environmental consequences may be substantially the same as if the amendment, or parts of it, were disapproved. Alternative circumstances under which the expansion may not proceed are not discussed in detail because of their similarity to the No Action alternative of disapproval.

The BLM may be subject to certain limitations on its authority to select or implement the No Action alternative as it is described in this EIS. While the BLM can condition its approval of the Proposed Action on Barrick's acceptance of mitigation and reclamation measures that, in the discretion of the BLM, are necessary to prevent unnecessary and undue degradation of public lands, the BLM does not have the authority to categorically deny an amendment to a plan of operations that complies with the provisions of 40 CFR 3809. The BLM recognizes that such limitations may not affect other variations on the No Action alternative. Consequently, the No Action alternative is fully evaluated in this EIS.

The Proposed Action includes some mining by Barrick on lands owned by Newmont. If Barrick does not mine on Newmont's land, it is possible that Newmont may do so. In order to better illustrate the environmental consequences of Barrick's proposal, the No Action alternative assumes that such mining by Newmont would not occur on the adjacent Newmont land if it is not conducted as part of Barrick's proposal.

### 2.3.4 Agency Preferred Alternative

NEPA regulations direct the BLM to identify a preferred alternative. This may be done in the Draft EIS or in the Final EIS. In this instance, the BLM has chosen to have the benefit of a Draft EIS and public comments on the Draft EIS prior to identifying a preferred alternative. A preferred alternative will be identified in the Final EIS.

## 2.4 Summary Comparison of Impacts

A summary of the impacts associated with implementation of the Proposed Action or the alternatives is provided in Tables 2-10 through 2-16.

The tables include potential impacts for which additional evaluation is required before the impacts can be quantified. They include:

- Additional geotechnical studies of the tailings impoundment and heap leach sites prior to final design.
- Geotechnical studies of sites for disposal of pit water by infiltration or reinjection.
- Continued cultural resource inventory and evaluation.

TABLE 2-10

SUMMARY OF PROPOSED ACTION

| Resource/ Potential Impact | Potential Mitigation | Overall Proposed Action | Major Proposed Components | | | | | | | | No Action |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Betze Pit | Extended South Waste Rock Disposal | Ore Stockpiles | North Block Heap Leach Pad | North Block Tailings Impoundment | Pit Dewatering and Discharge to Unnamed Drainage | Processing Facilities Expansion | Reclamation | |
| <u>Topography and Mineral Resources</u> | | | | | | | | | | | |
| Change in topography. | Contour edges of landform along existing topography or with hill construction. | Creation of new landforms; construct check dams and armor channel. | Extension of existing pit 8,000 feet long, 4,500 feet wide, and 1,800 feet deep. | Extension of existing landform. | Creation of temporary landform. | Creation of new landform. | Creation of new landform. | Potential increased erosion of creek channel. | Expansion of existing facilities. | Reduce effects of Proposed Action over the long term. | No additional impact. |
| Effect on access to mineral resources. | None presented. | Affect access to minerals. | Enhance access to potential deep deposits beneath pit. | Potentially impair access to minerals. | No impact. | Potentially impair access to minerals. | Potentially impair access to minerals. | Potentially enhance access to minerals | Temporary impairment of access. | Potentially impair access to or development of minerals. | Enhance access to potential reserves beneath proposed facilities other than Betze Pit. |
| <u>Paleontology, Geology, and Potential Geologic Hazards</u> | | | | | | | | | | | |
| Structural damage due to geologic hazards. | None presented. | Potential structural impacts without proper design. | Low potential. | Low potential. | No impact. | Low potential. | Low potential. | No impact. | Low potential. | Reduce effects of Proposed Action over the long term. | No additional impact. |
| Geologic hazard(s) created by project facilities. | None presented (Proposed Action includes control measures). | Potential creation of geologic hazard(s). | Low potential. | Steep slopes may present unstable conditions during operations. | No impact. | No impact. | Low potential of failure during project life. | No impact. | Low potential. | Reduce effects of Proposed Action over the long term. | No additional impact. |
| Impact to paleontological resources. | Notify BLM of resource and develop mitigation plan. | No resources identified. | No resources identified. | No resources identified. | No resources identified. | No resources identified. | No resources identified. | No resources identified. | No resources identified. | No resources identified. | No resources identified. |
| <u>Air Resources</u> | | | | | | | | | | | |
| Fugitive particulate matter (PM-10) emissions. | None presented (controls included in Proposed Action). | Increased PM-10 emissions. | Continued PM-10 emissions. | Increased PM-10 emissions. | Increased PM-10 emissions. | Increased PM-10 emissions. | Increased PM-10 emissions during construction. | No impact. | Increased PM-10 emissions. | Increased PM-10 emissions during reclamation. Reduce long-term effects of Proposed Action. | Continued mining for 1 to 2 years. No additional impact. |
| Gaseous emissions. | None presented. | Increased gaseous emissions. | Impact due to hauling. | Impact due to hauling. | Impact due to hauling. | Impact due to hauling. | Impact during construction. | Not applicable. | Increased gaseous emissions. | Impact from operation of equipment. | Continued mining and processing for 1 to 2 years. No additional impact. |
| Trace metal emissions. | None presented. | Increased metal emissions. | Minor increase in emissions. | Impact due to hauling. | Impact due to hauling. | Impact due to hauling. | Impact during construction. | Not applicable. | Increased trace metal emissions. | Impact from operation of equipment. | Continued mining and processing for 1 to 2 years. No additional impact. |
| <u>Water Resources</u> | | | | | | | | | | | |
| Drawdown of groundwater levels of 10 feet up to 6 miles from pit. | None presented (Proposed Action includes monitor level of groundwater and flow from selected seeps and springs). | Pit dewatering at projected rate of 29,300 gpm. | Dewatering of pit to elevation 4,140 feet by year 2000; full recovery in about 100 years. | Not applicable. | Not applicable. | Not applicable. | Not applicable. | Potential reduction in flow of seeps and springs, groundwater recovery in about 100 years. | Not applicable. | Not applicable. | No additional impact. |

## TABLE 2-10 (CONTINUED)

| Resource/ Potential Impact | Potential Mitigation | Overall Proposed Action | Major Proposed Components | | | | | | | | No Action |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Betze Pit | Extended South Waste Rock Disposal | Ore Stockpiles | North Block Heap Leach Pad | North Block Tailings Impoundment | Pit Dewatering and Discharge to Unnamed Drainage | Processing Facilities Expansion | Reclamation | |
| Water Resources (Continued) | | | | | | | | | | | |
| Reduction in surface water flow. | None presented (Proposed Action includes monitoring creek flows). | Pit dewatering at projected rate of 29,300 gpm. | Dewatering of pit to elevation 4,140 feet by year 2000; full recovery in about 100 years. | Not applicable. | Not applicable. | Not applicable. | Not applicable. | Potential reduction in flow in sections of creeks, recovery in about 100 years. | Not applicable. | Not applicable. | No additional impact. |
| Water level reduction in water supply wells during dewatering and recovery. | None presented (Proposed Action includes monitoring groundwater levels). | Reduction in water supply in wells near pit. | Dewatering of pit to elevation 4,140 feet by year 2000; full recovery in about 100 years. | Not applicable. | Not applicable. | Not applicable. | Not applicable. | Minor increase in pumping costs in water supply wells due to reduction in water levels, recovery in about 100 years. | Not applicable. | Not applicable. | No additional impact. |
| Accelerated erosion from dewatering discharge at projected rate of 22,300 gpm in unnamed drainage. | None presented (Proposed Action includes construction of check dams and armoring of channel). | Dewatering discharge at projected rate of 22,300 gpm to unnamed drainage. | Not applicable. | Not applicable. | Not applicable. | Not applicable. | Not applicable. | Increased flows and potential erosion in unnamed drainage. | Not applicable. | Not applicable. | No additional impact. |
| Increased water storage in TS Ranch Reservoir during dewatering and discharge of excess water to Rodeo or Boulder Creeks. | None presented. | Irrigate up to 7,500 acres and discharge excess to Rodeo or Boulder Creeks. | Not applicable. | Not applicable. | Not applicable. | Not applicable. | Not applicable. | Evaporation from reservoir, seepage flow to groundwater system, reduce groundwater withdrawal in irrigated area, and potential erosion of Rodeo or Boulder Creeks from discharge of excess water. | Not applicable. | Not applicable. | No additional impact. |
| Increased evapotranspiration due to irrigation | None presented. | Groundwater mounding and increased surface water flow. | Not applicable. | Not applicable. | Not applicable. | Not applicable. | Not applicable. | Evapotranspiration and seepage flow to groundwater system due to irrigation in lower Boulder Valley. | Not applicable. | Not applicable. | No additional impact. |
| Boulder Flat Hydrologic System. | None presented. | Long-term maintenance of water balance in hydrographic system. | Evaporation from Betze Pit water body of 710 ac-ft/year. | Not applicable. | Not applicable. | Not applicable. | Not applicable. | Evapotranspiration from irrigated area, mining and milling water uses; both beneficial uses. | Not applicable. | Not applicable. | No additional impact. |
| Reduction in surface water drainage basin areas from placement of project facilities. | None presented. | Changes in surface drainage due to project facilities and associated diversions. | 690-acre reduction in drainage area. | Reduced surface drainage area (912 acres). | Temporarily reduced surface drainage area (140 acres). | Temporarily reduced surface drainage area (142 acres). | Reduced surface drainage (476 acres). | Increased flows to unnamed drainage and TS Ranch Reservoir. | Temporarily reduced surface drainage. | Restore drainage over reclaimed areas, except for tailings impoundment. | No additional impact. |
| Change in surface water quality. | None presented (controls included in Proposed Action). | Treat discharge waters to meet NPDES requirements; tailings and heap leach designed for zero discharge. | Water body formed after dewatering ceases. | Minimal runoff volumes expected. | Acidic runoff could degrade surface water quality; runoff contained by berms. | Potential release could degrade water quality. | Potential tailings spill could degrade water quality. | Treat discharge waters to meet NPDES requirements. | Potential release could degrade water quality. | Reduce effects of Proposed Action. | No additional impact. |

## TABLE 2-10 (CONTINUED)

| Resource/ Potential Impact | Potential Mitigation | Overall Proposed Action | Major Proposed Components | | | | | | | | No Action |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Betze Pit | Extended South Waste Rock Disposal | Ore Stockpiles | North Block Heap Leach Pad | North Block Tailings Impoundment | Pit Dewatering and Discharge to Unnamed Drainage | Processing Facilities Expansion | Reclamation | |
| **Water Resources (Continued)** | | | | | | | | | | | |
| Change in groundwater quality. | Proposed Action includes monitoring pit water quality and groundwater; ferric sulfate treatment, if necessary, of pit water. | Potential adverse water quality impacts. | Potential elevated arsenic level in pit water. | Potential seepage of water containing sulfate, TDS, manganese, and arsenic prior to reclamation. | Potential acidic seepage. | Potential release from pad could degrade groundwater. | Potential release from tailings impoundment could degrade groundwater. | Seepage from unnamed drainage, reservoir, and irrigated area may slightly reduce groundwater quality. | Potential release could degrade water quality. | Reduce effects of Proposed Action. | Potential for higher levels of arsenic in pit water than for Proposed Action; otherwise no additional impact. |
| Cyanide impacts to groundwater. | None presented (monitoring and remediation included in Proposed Action). | Tailings treated with cyanicide to neutralize cyanide; tailings and heap leach designed for zero discharge. | Not applicable. | Not applicable. | Not applicable. | Potential release could degrade groundwater quality. | Potential release could degrade groundwater quality. | Not applicable. | Potential release could degrade groundwater quality. | Reduce effects of Proposed Action. | No additional impact. |
| **Soils** | | | | | | | | | | | |
| Soil disturbance and loss. | None presented (topsoil salvage included in Proposed Action). | Additional 2,189 acres | 345 additional acres. | 912 acres | 140 acres | 142 acres | 476 acres | Not applicable. | No new impact. | Topsoil would be reapplied to 1,844 acres. | No additional impact. |
| Areas to be reclaimed. | None presented (reclamation included in Proposed Action). | 1,844 acres (includes disturbance other than major components). | Would not be reclaimed. | 912 acres | 140 acres | 142 acres | 476 acres | Not applicable. | Reclaimed as part of approved operations. | 1,844 acres would be topsoiled and revegetated. | Areas disturbed by approved operations, except Post Pit, would be reclaimed. |
| **Vegetation** | | | | | | | | | | | |
| Vegetation disturbance. | None presented (reclamation included in Proposed Action). | 1,844 acres additional temporary disturbance; 345 acres additional permanent disturbance. | 345 acres additional permanent disturbance; mostly Loamy (25-19). | 912 acres temporary disturbance; mostly Loamy (25-19) and Seeding I. | 140 acres temporary disturbance; mostly Seeding II. | 142 acres temporary disturbance; Seeding II and Loamy (25-19). | 476 acres temporary disturbance; mostly Seeding II. | Not applicable. | No new impact. | Reduce effects of Proposed Action through revegetation. | Areas disturbed by approved operations, except Post Pit, would be reclaimed. |
| Temporary change in riparian vegetation. | Monitor groundwater elevations, seeps, and springs; implement on-site and off-site mitigation, if necessary. | Potentially up to 271 acres. | Not applicable. | Not applicable. | Not applicable. | Not applicable. | Not applicable. | Riparian vegetation may decrease due to dewatering (seeps and springs) and increase due to discharge (unnamed drainage and irrigation area). | Not applicable. | Not applicable. | No additional impact. |
| **Wildlife** | | | | | | | | | | | |
| Temporary removal of moderate to low quality wildlife habitat. | Off-site mitigation, if feasible. | 1,844 acres | Not applicable. | 912 acres; 130 acres of chukar habitat. | 140 acres; North Block - sage grouse and Hungarian partridge habitat. | 142 acres; sage grouse habitat, close to lek. | 476 acres; poor sage grouse habitat, close to lek. | Potential change in riparian habitat associated with seeps and springs and along the unnamed drainage during dewatering period. | No new impact. | 1,844 acres of potential improvement of wildlife habitat through revegetation. | No additional impact. |
| Permanent removal of wildlife habitat. | Off-site mitigation, if feasible. | 345 additional acres. | 345 additional acres; 45 acres of chukar habitat. | Not applicable. | Not applicable. | Not applicable. | Not applicable. | Not applicable. | Not applicable. | Not applicable. | No additional impact. |
| Creation of barriers to migration routes. | None presented. | 20-year extension of existing displacement during operations. | 20-year extension of existing displacement during operations. | 20-year extension of existing displacement during operations. | 20-year extension of existing displacement during operations. | 20-year extension of existing displacement during operations. | 20-year extension of existing displacement during operations. | Not applicable. | 20-year extension of existing displacement during operations. | Reduce effects of Proposed Action through reclamation. | No additional impact. |

## TABLE 2-10 (CONTINUED)

| Resource/ Potential Impact | Potential Mitigation | Overall Proposed Action | Major Proposed Components | | | | | | | | No Action |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Betze Pit | Extended South Waste Rock Disposal | Ore Stockpiles | North Block Heap Leach Pad | North Block Tailings Impoundment | Pit Dewatering and Discharge to Unnamed Drainage | Processing Facilities Expansion | Reclamation | |
| **Wildlife (Continued)** | | | | | | | | | | | |
| Impacts due to increased traffic, noise, and human presence. | None presented (policy measures included in Proposed Action). | Slight increase in road kills, legal and illegal hunting, harassment, and other disturbance. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Potential to encourage wildlife use through revegetation. | No additional impact. |
| Impacts to aquatic biota due to decrease or loss of flow in local creeks. | Off-site mitigation, if feasible. | Loss of aquatic resources in local creeks during dewatering and recovery. | Potential development of aquatic biota in Betze Pit water body. | No impact. | No impact. | No impact. | No impact. | Loss of aquatic biota in creeks experiencing decreased flows during dewatering and recovery. | No impact. | Not applicable. | No additional impact. |
| **Recreation and Wilderness** | | | | | | | | | | | |
| No impacts are anticipated. | None presented. | No impacts are anticipated. | No impact. | No impact. | No impact. | No impact. | No impact. | No impact. | No impact. | Potential improve- in recreation due to revegetation. | No additional impact. |
| **Noise** | | | | | | | | | | | |
| Increase in noise level at sensitive receptors. | None presented. | No exceedance of noise standard off-site. | No impact. | No impact. | No impact. | No impact. | No impact. | No impact. | No impact. | No impact. | No additional impact. |
| **Visual Resources** | | | | | | | | | | | |
| Project would be consistent with VRM objectives. | Contour edges of landforms along existing topography or with hill construction. | Consistent with VRM objectives. | Creation of pit 8,000 feet long, 4,500 feet wide, and 1,800 feet deep. | Creation of new landform. | Creation of temporary landform. | Creation of new landform. | Creation of new landform. | Consistent flow in unnamed drainage during dewatering. | Expansion of existing facilities. | Reduction in visual impact. | No additional impact. |
| **Cultural Resources** | | | | | | | | | | | |
| Potential impacts to cultural resources. | None presented (mitigation of significant resources in compliance with Section 106 of NHPA included in Proposed Action). | 64 sites identified to date. | No sites identified to date. | 23 sites identified. | 4 sites identified. | 6 sites identified. | 22 sites identified. | No impact. | No impact. | Not applicable. | No additional impact. |
| **Land Use** | | | | | | | | | | | |
| Temporary loss of grazing lands. | None presented (reclamation included in Proposed Action). | No impact; grazing use previously terminated. | No impact; grazing use previously terminated. | No impact; grazing use previously terminated | No impact; grazing use previously terminated. | No impact; grazing use previously terminated. | No impact, grazing use previously terminated. | Use of dewatering discharge for irrigated agriculture, potential impact on seeps and springs. | No impact; grazing use previously terminated. | Potential for improved grazing conditions due to reclamation. | No additional impact. |
| Permanent loss of grazing (pit). | None presented. | 345 additional acres. | 345 additional acres. | Not applicable. | Not applicable. | Not applicable. | Not applicable. | No impact. | Not applicable. | Potential for improved grazing conditions due to reclamation. | No additional impact. |

## TABLE 2-10 (CONTINUED)

| Resource/ Potential Impact | Potential Mitigation | Overall Proposed Action | Major Proposed Components | | | | | | | | No Action |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Betze Pit | Extended South Waste Rock Disposal | Ore Stockpiles | North Block Heap Leach Pad | North Block Tailings Impoundment | Pit Dewatering and Discharge to Unnamed Drainage | Processing Facilities Expansion | Reclamation | |
| <u>Socioeconomics</u> | | | | | | | | | | | |
| Population increase in local communities. | None presented. | Peak population increase of 723 people during construction; 225 during operations; 414 total peak during overlap in 1992. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Decline in current workforce, potential loss of population in local communities. |
| Increased demand for housing. | 1. Lease RV lots or small park in Elko or Carlin. 2. Prelease apartment units as they become available. 3. Provide a mancamp operated by Barrick. | Need for 144 additional housing units during peak in 1992. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Indirect impacts. | No additional impact for 1 to 2 years as mining continues. Potential decline in workforce, local populations, and resulting depression in housing market. |
| Increased demand on schools and other public services and facilities. | None presented. | Increase in demand for public services and facilities. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Indirect impacts. | No additional impact for 1 to 2 years as mining continues. Potential decline in workforce, local populations, and demand for schools and public services. |
| Increased traffic on existing roads | None presented (Proposed Action would continue Barrick's use of buses for personnel). | Up to 54 additional vehicle trips per day on road north of Carlin. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Indirect impacts. | No additional impact for 1 to 2 years as mining continues. Then potential decline in workforce, construction, and traffic. |
| Fiscal impact to Elko County. | None presented. | Infrastructure and service demand exceeding incremental county revenues. Sustained economic development. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Indirect impacts. | Indirect impacts. | No additional impact for 1 to 2 years. Then potential decline in work-force, local populations, infrastructure demand, and economic development. |

TABLE 2-11

COMPARISON OF ALTERNATIVE HEAP LEACH PADS WITH PROPOSED ACTION

| Resource/Potential Impact | Potential Mitigation | Heap Leach: Proposed Action (Central North Block) | Heap Leach: Western North Block |
|---|---|---|---|
| **Topography and Mineral Resources** | | | |
| Change in topography. | Contour edges of landform. | Creation of new landform. | Same as Proposed Action. |
| Effect on access to mineral resources. | None presented. | Potentially impair access to minerals. | Same as Proposed Action. |
| **Paleontology, Geology, and Potential Geologic Hazards** | | | |
| Structural damage due to geologic hazards. | None presented. | Low potential. | Same as Proposed Action. |
| Geologic hazard(s) created by project facility(s). | None presented. | No impact. | No impact. |
| Impact to paleontological resources. | Notify BLM of resource and develop mitigation plan. | No resources identified. | Same as Proposed Action. |
| **Air Resources** | | | |
| Fugitive particulate matter (PM-10) emissions. | None presented (controls included in Proposed Action). | Increased PM-10 emissions. | Same as Proposed Action. |
| **Water Resources** | | | |
| Changes in surface water hydrology. | None presented. | Minor reduction in drainage area. | Same as Proposed Action. |
| Changes in surface water quality. | None presented. | Potential release of contained fluids; NDEP requires zero discharge design. | Similar to Proposed Action, but closer to Rodeo and Bell Creeks. |
| Changes in groundwater quality. | None presented. | Potential impact from release. | Same as Proposed Action. |
| **Soils** | | | |
| Topsoil disturbance. | None presented (topsoil salvage included in Proposed Action). | 142 acres | 145 acres |
| Area to be reclaimed. | None presented (reclamation included in Proposed Action). | 142 acres | 145 acres |

TABLE 2-11 (CONTINUED)

| Resource/Potential Impact | Potential Mitigation | Heap Leach: Proposed Action (Central North Block) | Heap Leach: Western North Block |
|---|---|---|---|
| **Vegetation** | | | |
| Temporary vegetation disturbance. | None presented (reclamation included in proposed action). | 142 acres; Seeding II and Loamy (25-19). | 145 acres; mostly Seeding II. |
| **Wildlife** | | | |
| Temporary removal of wildlife habitat. | None presented (reclamation included in proposed action). | 142 acres; sage grouse habitat, close to lek. | 145 acres; 2 acres Hungarian partridge habitat. |
| Creation of barriers to migration routes. | None presented. | 20-year extension of existing displacement. | Same as Proposed Action. |
| Impacts due to increased traffic, noise, and human presence. | None presented (policy measures included in Proposed Action). | Slight increase in road kills, legal and illegal hunting, harassment, other disturbance. | Same as Proposed Action. |
| **Recreation and Wilderness** | | | |
| No impacts are anticipated. | None presented. | No impact. | No impact. |
| **Noise** | | | |
| Increase in noise level at sensitive receptors. | None presented. | No exceedance of noise standard. | Same as Proposed Action. |
| **Visual Resources** | | | |
| Project would be consistent with VRM objectives. | Contour edges of landforms. | Creation of new landform. | Same as Proposed Action. |
| **Cultural Resources** | | | |
| Potential significant impacts to cultural resources. | None presented (Proposed Action includes mitigation of significant resources in compliance with Section 106 of NHPA). | 6 sites identified. | 6 sites identified. |

TABLE 2-11 (CONTINUED)

| Resource/Potential Impact | Potential Mitigation | Heap Leach: Proposed Action (Central North Block) | Heap Leach: Western North Block |
|---|---|---|---|
| <u>Land Use</u> | | | |
| Temporary loss of grazing lands. | None presented (reclamation included in Proposed Action). | The alternative heap leach location would be within the fence that has been constructed to exclude livestock from active mining operations. The impact on grazing from the alternative heap leach location would not vary from the Proposed Action. | |
| Compatibility with other proposed or alternative components. | Not applicable. | Would preclude use of the alternative North Block waste rock disposal area and Central Area North Block tailings impoundment. | Would be consistent with other proposed or alternative project components. |

TABLE 2-12

COMPARISON OF ALTERNATIVE WASTE ROCK DISPOSAL AREAS WITH PROPOSED ACTION

| Resource/Potential Impact | Potential Mitigation | Proposed Action (Extended South Waste Rock Disposal) | Waste Rock Disposal: North Block | Waste Rock Disposal: Clydesdales Area | Waste Rock Disposal: Far West Area |
|---|---|---|---|---|---|
| Topography and Mineral Resources | | | | | |
| Change in topography | Contour edges of landform. | Creation of new landform. | Creates an additional new landform; 200-foot reduction in height of Extended South waste rock area. | Creates an additional new landform; 300-foot reduction in height of Extended South waste rock area. | Creates a more extensive landform, but one that is not constrained by property boundaries. |
| Effect on access to mineral resources. | None presented. | Potentially impair access to minerals. | Potentially impair access to additional minerals. | Potentially impair access to additional minerals. | Potentially impair access to additional minerals. |
| Geology, Minerals, and Seismicity | | | | | |
| Structural damage due to geologic hazards. | None presented. | Low potential. | Low potential. | Lack of potentially expansive soils. | Same as Proposed Action. |
| Geologic hazard(s) created by project facility(s) | Monitor for waste rock areas for slope failure. | Potential creation of geologic hazard(s) from unsuitable ground conditions. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. |
| Impact to paleontological resources. | Notify BLM and develop mitigation plan. | No resources identified. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. |
| Air Resources | | | | | |
| Fugitive particulate matter (PM-10) emissions. | None presented (controls included in Proposed Action). | Increased PM-10 emissions. | Same as Proposed Action. | Similar to Proposed Action, may be greater due to longer haul distance. | Similar to Proposed Action, may be greater due to longer haul distance. |
| Water Resources | | | | | |
| Changes in surface water hydrology. | Implement erosion control plan, construct diversion berms and dikes. | Alteration of Rodeo, Brush, and Boulder Creek drainage areas. | Same as Proposed Action. | Covers a spring. | Relocation of unnamed drainage channel. |
| Changes in surface water quality. | None presented. | Minimal runoff volumes expected. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. |

TABLE 2-12 (CONTINUED)

| Resource/Potential Impact | Potential Mitigation | Proposed Action (Extended South Waste Rock Disposal) | Waste Rock Disposal: North Block | Waste Rock Disposal: Clydesdales Area | Waste Rock Disposal: Far West Area |
|---|---|---|---|---|---|
| **Water Resources (Continued)** | | | | | |
| Changes in groundwater quality. | None presented. | Potential seepage of minor volumes of water containing sulfate, TDS, manganese, and arsenic prior to reclamation. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. |
| Potential acid generation from waste rock. | None presented. | Potential for acidic water containing sulfate, TDS, manganese, and arsenic prior to reclamation. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. |
| **Soils** | | | | | |
| Topsoil disturbance. | None presented (topsoil salvage included in Proposed Action). | 912 acres | 430 acres in addition to Proposed Action. | 642 acres in addition to Proposed Action. | 1,713 acres |
| Areas to be reclaimed. | None presented (reclamation included in Proposed Action). | 912 acres | 430 acres in addition to Proposed Action. | 642 acres in addition to Proposed Action. | 1,713 acres |
| **Vegetation** | | | | | |
| Temporary vegetation disturbance. | None presented (reclamation included in Proposed Action). | 912 acres; mostly Loamy (25-19) and Seeding I. | 430 acres in addition to Proposed Action; mostly Loamy (25-19) and Seeding II. | 642 acres in addition to Proposed Action; mostly Seeding II and Loamy (25-19). | 1,713 acres; mostly Loamy (25-19) and Seeding I. |
| **Wildlife** | | | | | |
| Temporary removal of moderate to low quality wildlife habitat. | None presented (reclamation included in Proposed Action). | 912 acres; 130 acres of chukar habitat. | 430 acres in addition to Proposed Action; sage grouse habitat, close to lek. | 642 acres in addition to Proposed Action; 10 acres of chukar habitat. | 1,713 acres; chukar habitat. |
| Creation of barriers to migration routes. | None presented. | 20-year extension of existing displacement during operations. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. |
| Impacts due to increased traffic, noise, and human presence. | None presented (policy measures included in Proposed Action). | Slight increase in road kills, legal and illegal hunting, harassment, and other disturbance. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. |

TABLE 2-12 (CONTINUED)

| Resource/Potential Impact | Potential Mitigation | Proposed Action (Extended South Waste Rock Disposal) | Waste Rock Disposal: North Block | Waste Rock Disposal: Clydesdales Area | Waste Rock Disposal: Far West Area |
|---|---|---|---|---|---|
| **Recreation and Wilderness** | | | | | |
| No impacts are anticipated. | None presented. | No impact. | No impact. | No impact. | No impact. |
| **Noise** | | | | | |
| Increase in noise level at sensitive receptors. | None presented. | No exceedance of noise standard. | Same as Proposed Action. | Possible exceedance of noise standard at line shack. | Same as Proposed Action. |
| **Visual Resources** | | | | | |
| Project would be consistent with VRM objectives. | Contour edges of landform. | Consistent with VRM objectives. | Similar to Proposed Action. | Similar to Proposed Action. | Similar to Proposed Action. |
| **Cultural Resources** | | | | | |
| Potential significant impacts to cultural resources. | None presented (Proposed Action includes mitigation of significant resources in compliance with Section 106 of NHPA). | 23 sites identified. | 11 sites identified. | 11 sites identified. | 23 sites identified to date. |
| **Land Use** | | | | | |
| Temporary loss of grazing lands. | None presented (reclamation included in Proposed Action). | The impact on grazing would not materially differ if the alternative waste rock disposal areas were selected because grazing has previously been eliminated as an existing use on all of the land that would be affected by the proposed or alternative waste rock disposal areas. | | | |
| Compatibility with other proposed or alternative components. | Not applicable. | Would not preclude use of any other proposed or alternative component. | Does not have sufficient capacity to contain all waste rock generated by Proposed Action. Would preclude proposed North Block leach facilities and alternative. Central North Block tailings impoundment. | Does not have sufficient capacity to contain all waste rock generated by Proposed Action. Would not preclude use of any other proposed or alternative component. | Would not preclude use of any other proposed or alternative component. |

TABLE 2-13

COMPARISON OF ORE STOCKPILE ALTERNATIVES WITH PROPOSED ACTION

| Resource/Potential Impact | Potential Mitigation | Proposed Action (North Block and AA Block) | Ore Stockpiles: South Block Waste Rock Area | Ore Stockpiles: AA Block Leach Pads | Ore Stockpiles: South Block Rodeo Creek |
|---|---|---|---|---|---|
| **Topography and Mineral Resources** | | | | | |
| Change in topography. | Contour edges of landform. | Creation of temporary landform. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. |
| Effect on access to mineral resources. | None presented. | Potentially impair access to minerals temporarily. | No impact. | No impact. | Same as Proposed Action. |
| **Paleontology, Geology, and Potential Geologic Hazards** | | | | | |
| Structural damage due to geologic hazards. | None presented. | No impact. | No impact. | No impact. | No impact. |
| Geologic hazard(s) created by project facilities. | None presented. | No impact. | No impact. | No impact. | No impact. |
| Impact to paleontological resources. | Notify BLM and develop mitigation plan. | No resources identified. | No impact. | No impact. | Same as Proposed Action. |
| **Air Resources** | | | | | |
| Fugitive particulate matter (PM-10) emissions. | None presented (controls included in Proposed Action). | Increased PM-10 emissions. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. |
| **Water Resources** | | | | | |
| Changes in surface water hydrology. | None presented. | Temporary, minor reduction in drainage area. | No impact. | No impact. | Similar to Proposed Action, but closer to Rodeo Creek. |
| Changes in groundwater quality. | Install liner beneath ore stockpiles. | Potential acidic seepage. | Acid consuming material can be placed beneath ore. | Liner already in place beneath heap leach pad. | Same as Proposed Action. |
| **Soils** | | | | | |
| Topsoil disturbance. | None presented (topsoil salvage included in Proposed Action). | 140 acres | No impact. | No impact. | 24 acres |

TABLE 2-13 (CONTINUED)

| Resource/Potential Impact | Potential Mitigation | Proposed Action (North Block and AA Block) | Ore Stockpiles: South Block Waste Rock Area | Ore Stockpiles: AA Block Leach Pads | Ore Stockpiles: South Block Rodeo Creek |
|---|---|---|---|---|---|
| **Soils (Continued)** | | | | | |
| Areas to be reclaimed. | None presented (reclamation included in Proposed Action). | 140 acres | Reclaimed as part of disposal area under Proposed Action. | Reclaimed as part of leach pad under Proposed Action. | 24 acres |
| **Vegetation** | | | | | |
| Temporary vegetation disturbance. | None presented (reclamation included in Proposed Action). | 140 acres; mostly Seeding II. | No impact. | No impact. | 24 acres; mostly Loamy (25-19). |
| **Wildlife** | | | | | |
| Temporary removal of wildlife habitat. | None presented (reclamation included in Proposed Action). | 140 acres; North Block - sage grouse and Hungarian partridge habitat. | No impact. | No impact. | 24 acres of chukar habitat. |
| Creation of barriers to migration routes. | None presented. | 20-year extension of existing displacement during operations. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. |
| Impacts due to increased traffic, noise, and human presence. | None presented (policy measures included in Proposed Action). | Slight increase in road kills, legal and illegal hunting, harassment, and other disturbance. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. |
| **Recreation and Wilderness** | | | | | |
| No impacts are anticipated. | None presented. | No impact. | No impact. | No impact. | No impact. |
| **Noise** | | | | | |
| Increase in noise level at sensitive receptors. | None presented. | No exceedance of noise standard. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. |
| **Visual Resources** | | | | | |
| Project would be consistent with VRM objectives. | Contour edges of landforms. | Consistent with VRM objectives. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. |

TABLE 2-13 (CONTINUED)

| Resource/Potential Impact | Potential Mitigation | Proposed Action (North Block and AA Block) | Ore Stockpiles: South Block Waste Rock Area | Ore Stockpiles: AA Block Leach Pads | Ore Stockpiles: South Block Rodeo Creek |
|---|---|---|---|---|---|
| <u>Cultural Resources</u> | | | | | |
| Potential significant impacts to cultural resources. | None presented (Proposed Action includes mitigation of significant resources in compliance with Section 106 of NHPA). | 4 sites identified. | No impact. | No impact. | No sites identified to date. |
| <u>Land Use</u> | | | | | |
| Temporary loss of grazing lands. | None presented (reclamation included in Proposed Action). | The proposed and alternative ore stockpile areas would be located within the fence that has been constructed to exclude livestock from active mining operations. The impact on grazing from the alternative ore stockpile areas would not vary from the Proposed Action. | | | |
| Compatibility with other proposed and alternative components. | Not applicable. | The proposed and alternative ore stockpile areas would not preclude use of any other proposed or alternative components. | | | |

TABLE 2-14

COMPARISON OF ALTERNATIVE TAILINGS IMPOUNDMENTS WITH PROPOSED ACTION

| Resource/Potential Impact | Potential Mitigation | Proposed Action (North Block) | Tailings Disposal | |
|---|---|---|---|---|
| | | | Expanded North Block | Central Area North Block |
| Topography and Mineral Resources | | | | |
| Change in topography. | Contour edges of landform. | Creation of new landform. | Same as Proposed Action. | Same as Proposed Action. |
| Effect on access to mineral resources. | None presented. | Potentially impair access to minerals. | Same as Proposed Action. | Same as Proposed Action. |
| Paleontology, Geology, and Potential Geologic Hazards | | | | |
| Structural damage due to geologic hazards. | None presented. | Low potential. | Same as Proposed Action. | Same as Proposed Action. |
| Geologic hazard(s) created by project facility(s). | None presented. | Low potential of failure during project life. | Same as Proposed Action. | Same as Proposed Action. |
| Impact to paleontological resources. | Notify BLM and develop mitigation plan. | No resources identified. | Same as Proposed Action. | Same as Proposed Action. |
| Air Resources | | | | |
| Fugitive particulate matter (PM-10) emissions. | None presented (controls included in Proposed Action). | Increased PM-10 emissions during construction. | Same as Proposed Action. | Same as Proposed Action. |
| Water Resources | | | | |
| Changes in surface water hydrology. | None presented (Proposed Action includes sediment control plan and construction of diversion berms). | Rodeo and Bell Creek drainages would be altered. | Same as Proposed Action. | Same as Proposed Action. |
| Changes in surface water quality. | None presented. | Potential tailings spill or embankment failure could degrade water quality. | Same as Proposed Action. | Same as Proposed Action. |
| Cyanide impacts to groundwater. | None presented. | Potential seepage from tailings could degrade water quality. | Same as Proposed Action. | Same as Proposed Action. |

TABLE 2-14 (CONTINUED)

| Resource/Potential Impact | Potential Mitigation | Proposed Action (North Block) | Tailings Disposal: Expanded North Block | Tailings Disposal: Central Area North Block |
|---|---|---|---|---|
| **Soils** | | | | |
| Topsoil disturbance. | None presented (topsoil salvage included in Proposed Action). | 476 acres | 703 acres | 650 acres |
| Areas to be reclaimed. | None presented (reclamation included in Proposed Action). | 476 acres | 703 acres | 650 acres |
| **Vegetation** | | | | |
| Temporary vegetation disturbance. | None presented (reclamation included in Proposed Action). | 476 acres; mostly Seeding II. | 703 acres; mostly Seeding II. | 650 acres; mostly Seeding II. |
| **Wildlife** | | | | |
| Temporary removal of wildlife habitat. | None presented (reclamation included in Proposed Action). | 476 acres; poor sage grouse habitat, close to lek. | 703 acres; poor sage grouse habitat, close to lek. | 650 acres; sage grouse winter habitat, close to lek. |
| Creation of barriers to migration routes. | None presented. | 20-year extension of existing displacement during operations. | Same as Proposed Action. | Same as Proposed Action. |
| Impacts due to increased traffic, noise, and human presence. | None presented (policy measures included in Proposed Action). | Slightly increase in road kills, legal and illegal hunting, harassment, and other disturbance. | Same as Proposed Action. | Same as Proposed Action. |
| **Recreation and Wilderness** | | | | |
| No impacts are anticipated. | None presented. | No impact. | No impact. | No impact. |
| **Noise** | | | | |
| Increase in noise level at sensitive receptors. | None presented. | No exceedance of noise standard. | Same as Proposed Action. | Same as Proposed Action. |

TABLE 2-14 (CONTINUED)

| Resource/Potential Impact | Potential Mitigation | Proposed Action (North Block) | Tailings Disposal: Expanded North Block | Tailings Disposal: Central Area North Block |
|---|---|---|---|---|
| Visual Resources | | | | |
| Project would be consistent with VRM objectives. | Contour edges of landform. | Consistent with VRM objectives. | Same as Proposed Action. | Less visual impact than Proposed Action. |
| Cultural Resources | | | | |
| Potential significant impacts to cultural objectives. | None presented (Proposed Action includes mitigation of significant resources in compliance with Section 106 of NHPA). | 22 sites identified. | 21 sites identified. | 10 sites identified. |
| Land Use | | | | |
| Temporary loss of grazing lands. | None presented (reclamation included in Proposed Action). | Since grazing is no longer an existing use in the area that would be affected by the alternative tailings impoundment locations, the impact on grazing in the short term from any of the alternative tailings impoundment locations would not vary. Similarly, once reclamation is completed, the impact on grazing would be the same as the Proposed Action. | | |
| Compatibility with other proposed or alternative components. | Not applicable. | Would preclude use of Central Area North Block tailings impoundment. | Would preclude use of Central Area North Block tailings impoundment. | Would preclude use of North Block and Expanded North Block tailings impoundments, North Block heap leach facilities, and North waste rock disposal area. |

TABLE 2-15

COMPARISON OF RECLAMATION ALTERNATIVES WITH PROPOSED ACTION

| Resource/ Potential Impact | Potential Mitigation | Proposed Action (2.5H:1V Slopes, Waste Rock) | Waste Rock 1.3H:1V Slopes | Waste Rock 3.0H:1V Slopes | Waste Rock Insloping Benches | Tailings - Waste Rock Cover | Betze Pit - Partial Backfill |
|---|---|---|---|---|---|---|---|
| Topography and Mineral Resources | | | | | | | |
| Change in topography. | Contour edges of landform. | Creation of new landform. | Steeper landform of smaller area. | More moderately sloping but higher landform. | Same as Proposed Action. | More uneven topography. | Fill most of pit and reduction in size of waste rock disposal area(s). |
| Effect on access to mineral resources. | None presented. | Enhance or impair access to minerals. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. | Impair access to potential deep deposits beneath pit. |
| Paleontology, Geology, and Potential Geologic Hazards | | | | | | | |
| Structural damage due to geologic hazards. | None presented. | Low potential. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. |
| Geologic hazard(s) created by project facility(s) | Inhibit pit access; monitor waste rock areas for slope failure. | Potential creation of geologic hazard(s) from unsuitable ground conditions. | Higher potential for waste rock slope failures. | Lower potential for waste rock slope failure. | Reduces erosion from but increase infiltration into waste rock. | Potential creation of hazard without proper design. | Decreased potential for waste rock area slope failures and pit wall instability. |
| Impact to paleontological resources. | Notify BLM and develop mitigation plan. | No resources identified. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. |
| Air Resources | | | | | | | |
| Fugitive particulate matter (PM-10) emissions. | None presented (controls included in Proposed Action). | Increased PM-10 emissions. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. | Postponement of reclamation and continuation of PM-10 emissions for 9 years during pit backfill. |
| Water Resources | | | | | | | |
| Changes in surface water hydrology. | None presented. | Temporary reduction in surface drainage. | Greater infiltration than Proposed Action. | Same as Proposed Action. | Slight decrease in runoff from waste rock. | Potential for runoff from impoundment. | Same as Proposed Action. |

TABLE 2-15 (CONTINUED)

| Resource/ Potential Impact | Potential Mitigation | Proposed Action (2.5H:1V Slopes, Waste Rock) | Waste Rock 1.3H:1V Slopes | Waste Rock 3.0H:1V Slopes | Waste Rock Insloping Benches | Tailings - Waste Rock Cover | Betze Pit - Partial Backfill |
|---|---|---|---|---|---|---|---|
| Water Resources (Continued) | | | | | | | |
| Water loss from basin during and after groundwater recovery. | None presented. | Maintenance of water balance in hydrographic system. | Not applicable. | Not applicable. | Not applicable. | Not applicable. | Less evaporation from Betze Pit during and after recovery. |
| Changes in surface water quality. | None presented. | None | Potentially greater erosion and sedimentation. | Same as Proposed Action. | Reduces erosion from but increases infiltration into waste rock. | Potential for runoff from impoundment. | Same as Proposed Action. |
| Degradation of groundwater due to pit water quality. | Monitor pit water quality; treat pit water, if necessary. | Not applicable. | Not applicable. | Not applicable. | Not applicable. | Not applicable. | Elevated arsenic concentrations compared to Proposed Action; no open water body. |
| Changes in groundwater quality. | None presented. | Seepage of acidic water containing sulfates, TDS, manganese, and arsenic prior to reclamation. | Same as Proposed Action. | Same as Proposed Action. | Increased infiltration into waste rock. | Not applicable. | Lower quality groundwater than Proposed Action. |
| Potential cyanide impacts from tailings. | None presented. | Not applicable. | Not applicable. | Not applicable. | Not applicable. | Potential for runoff from impoundment. | Not applicable. |
| Soils | | | | | | | |
| Topsoil disturbance. | None presented (topsoil salvage included in Proposed Action. | 912 acres | Same as Proposed Action, but lower. | Same as Proposed Action, but higher. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. |
| Areas to be reclaimed. | None presented (reclamation included in Proposed Action). | Adequate slope stability and revegetation. | Increased potential for slope instability and erosion, less potential for reclamation. | Increased potential for successful revegetation. | Slightly increased potential for successful revegetation. | Lower potential for revegetation and revegetation, delayed until tailings dry sufficiently to permit waste rock placement. | 350 additional acres to be revegetated. |

TABLE 2-15 (CONTINUED)

| Resource/ Potential Impact | Potential Mitigation | Proposed Action (2.5H:1V Slopes, Waste Rock) | Waste Rock 1.3H:1V Slopes | Waste Rock 3.0H:1V Slopes | Waste Rock Insloping Benches | Tailings – Waste Rock Cover | Betze Pit – Partial Backfill |
|---|---|---|---|---|---|---|---|
| Vegetation | | | | | | | |
| Temporary vegetation disturbance. | None presented (reclamation included in Proposed Action). | 912 acres | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action; increased moisture retention. | Same as Proposed Action. | Postponement of revegetation on waste rock areas 9 additional years. |
| Wildlife | | | | | | | |
| Temporary removal of wildlife habitat. | None presented (reclamation included in Proposed Action). | 912 acres | Same as Proposed Action. | Same as Proposed Action. | Slightly increased potential for successful reclamation. | Revegetation would be delayed until tailings dry sufficiently to permit placement of waste rock. | Continuation of habitat disturbance on waste rock areas for 9 additional years. |
| Impacts due to increased traffic, noise, and human presence. | None presented (policy measures included in Proposed Action). | Slight increase in road kills, legal and illegal hunting, harassment, and other disturbance. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. | Continuation of increased activity for 9 additional years. |
| Recreation and Wilderness | | | | | | | |
| No impacts are anticipated. | None presented. | No impact. | No impact. | No impact. | No impact. | No impact. | No impact. |
| Noise | | | | | | | |
| Increase in noise level at sensitive receptors. | None presented. | No exceedance of noise standard. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. | Noise would be generated by placement of waste rock 15 to 20 years after deposition of tailings ceases. | Noise generation would continue for 9 additional years. |
| Visual Resources | | | | | | | |
| Project would be consistent with VRM objectives. | Contour edges of landforms. | Consistent with VRM objectives. | Greater visual impact of waste rock areas. | Slightly less visual impact than Proposed Action. | Same as proposed Action. | Less visual impact than Proposed Action. | Reduction in long-term visual impact of waste rock areas and pit. |

TABLE 2-15 (CONTINUED)

| Resource/ Potential Impact | Potential Mitigation | Proposed Action (2.5H:1V Slopes, Waste Rock) | Waste Rock 1.3H:1V Slopes | Waste Rock 3.0H:1V Slopes | Waste Rock Insloping Benches | Tailings - Waste Rock Cover | Betze Pit - Partial Backfill |
|---|---|---|---|---|---|---|---|
| Cultural Resources | | | | | | | |
| Potential significant impacts to cultural resources. | None presented (Proposed Action includes miti-gation of signifi-cant resources in compliance with Section 106 of NHPA). | 23 sites identified to date. Action. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. |
| Land Use | | | | | | | |
| Temporary loss of grazing lands. | None presented (reclamation included in Proposed Action). | Reclamation; potentially improved grazing. | Reclamation; no grazing on slopes. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. | Reclamation of additional 350 acres. |
| Creation of new 350-acre water body in abandoned pit. | None presented. | Not applicable. | Not applicable. | Not applicable. | Not applicable. | Not applicable. | No open water in pit following closure. |

TABLE 2-16

COMPARISON OF ALTERNATIVE WATER DISPOSAL METHODS WITH PROPOSED ACTION

| Resource/ Potential Impact | Potential Mitigation | Proposed Action (Discharge to TS Ranch Reservoir) | Water Disposal Methods | | |
|---|---|---|---|---|---|
| | | | Infiltration | Reinjection | Discharge to Rodeo or Boulder Creek |
| Topography and Mineral Resources | | | | | |
| Change in topography. | None presented (Proposed Action includes construct check dams and armor channel). | Increased erosion of unnamed drainage channel. | No impact. | No impact. | Greater incising of creek channel(s). |
| Paleontology, Geology, and Potential Geologic Hazards | | | | | |
| Impact to paleontological resources. | Notify BLM of resource and develop mitigation plan. | No resources identified. | Location not yet determined. | Location not yet determined. | Same as Proposed Action. |
| Air Resources | | | | | |
| No impacts are anticipated. | | | | | |
| Water Resources | | | | | |
| Accelerated erosion from dewatering discharge. | None presented (Proposed Action includes construct check dams and armor channel). | Increased flow and erosion in unnamed drainage. | No impact. | No impact. | Greater streambed and channel erosion in Rodeo or Boulder Creek. |
| Increased water storage in TS Ranch Reservoir during dewatering. | None presented. | Increase in agriculture irrigated with dewatering water, rather than groundwater. | Reduction in water for irrigation and reduction in discharge to Boulder Creek. | Reduction in water for irrigation and reduction in discharge to Boulder Creek. | Reduction in water for irrigation. |
| Increased evapotranspiration due to irrigation. | None presented (Proposed Action includes monitor groundwater levels). | Seepage to groundwater system and increased surface water evaporation. | Lower evapotranspiration rates. | Lower evapotranspiration rates. | Higher evapotranspiration rates. |
| Water loss from basin during groundwater recovery. | None presented. | Maintenance of water balance in hydrographic basin. | Same as Proposed Action. | Same as Proposed Action. | Same as Proposed Action. |
| Changes in ground-water quality. | None presented (Proposed Action includes treatment plant for arsenic). | Potential slight degradation of groundwater quality due to seepage of treated water from unnamed drainage, reservoir, and irrigated area. | Potential slight degradation of groundwater due to infiltration of dewatering water. | Potential slight degradation of groundwater due to reinjection of dewatering water. | Potential slight degradation of groundwater due to seepage of dewatering water from creek channels. |

TABLE 2-16 (CONTINUED)

| Resource/ Potential Impact | Potential Mitigation | Proposed Action (Discharge to TS Ranch Reservoir) | Water Disposal Methods: Infiltration | Water Disposal Methods: Reinjection | Water Disposal Methods: Discharge to Rodeo or Boulder Creek |
|---|---|---|---|---|---|
| Soils | | | | | |
| Topsoil disturbance. | None presented (topsoil salvage included in Proposed Action). | No impact. | Acreage not yet determined. | Acreage not yet determined. | No impact. |
| Vegetation | | | | | |
| Temporary vegetation disturbance. | None presented (reclamation included in Proposed Action). | Riparian vegetation may develop along unnamed drainage. | Location and acreage not yet determined. | Location and acreage not yet determined. | Riparian vegetation may increase along creek channels. |
| Wildlife | | | | | |
| Temporary effect on wildlife habitat. | None presented (reclamation included in Proposed Action). | Riparian vegetation that may develop and presence of water may benefit wildlife. | Location and acreage not yet determined. | Location and acreage not yet determined. | Riparian vegetation may increase and additional water may benefit wildlife. |
| Impacts to aquatic biota due to altered conditions. | None presented (sediment control plan part of Proposed Action). | Increased flows in unnamed drainage may encourage development of riparian vegetation. | No impact. | No impact. | Increased, consistent flow conditions during dewatering may alter composition of aquatic biota. |
| Recreation and Wilderness | | | | | |
| No impacts are anticipated. | None presented. | No impact. | No impact. | No impact. | No impact. |
| Noise | | | | | |
| Increase in noise level at sensitive receptors. | None presented. | No exceedance of noise standard. | No impact. | Pump station may have noise effects. | No impact. |
| Visual Resources | | | | | |
| Project would be consistent with VRM objectives. | Contour edges of landforms. | Consistent with VRM objectives. | Location not yet determined. | Location not yet determined. | Same as Proposed Action. |

TABLE 2-16 (CONTINUED)

| Resource/ Potential Impact | Potential Mitigation | Proposed Action (Discharge to TS Ranch Reservoir) | Water Disposal Methods: Infiltration | Water Disposal Methods: Reinjection | Water Disposal Methods: Discharge to Rodeo or Boulder Creek |
|---|---|---|---|---|---|
| Cultural Resources | | | | | |
| Potential significant impacts to cultural resources. | None presented (Proposed Action includes mitigation of significant resources in compliance with Section 106 of NHPA. | No impact. | Location not yet determined. | Location not yet determined. | Surveys not completed. |
| Land Use | | | | | |
| Temporary loss of grazing lands. | None presented (reclamation included in Proposed Action). | The likely locations for reinjection or infiltration are not within the fence that has been constructed to exclude livestock from active mining operations. To the extent that such alternatives would disturb additional land presently used for grazing, AUMs would be lost, at least during the period of active dewatering. | | | |

# 3.0 AFFECTED ENVIRONMENT

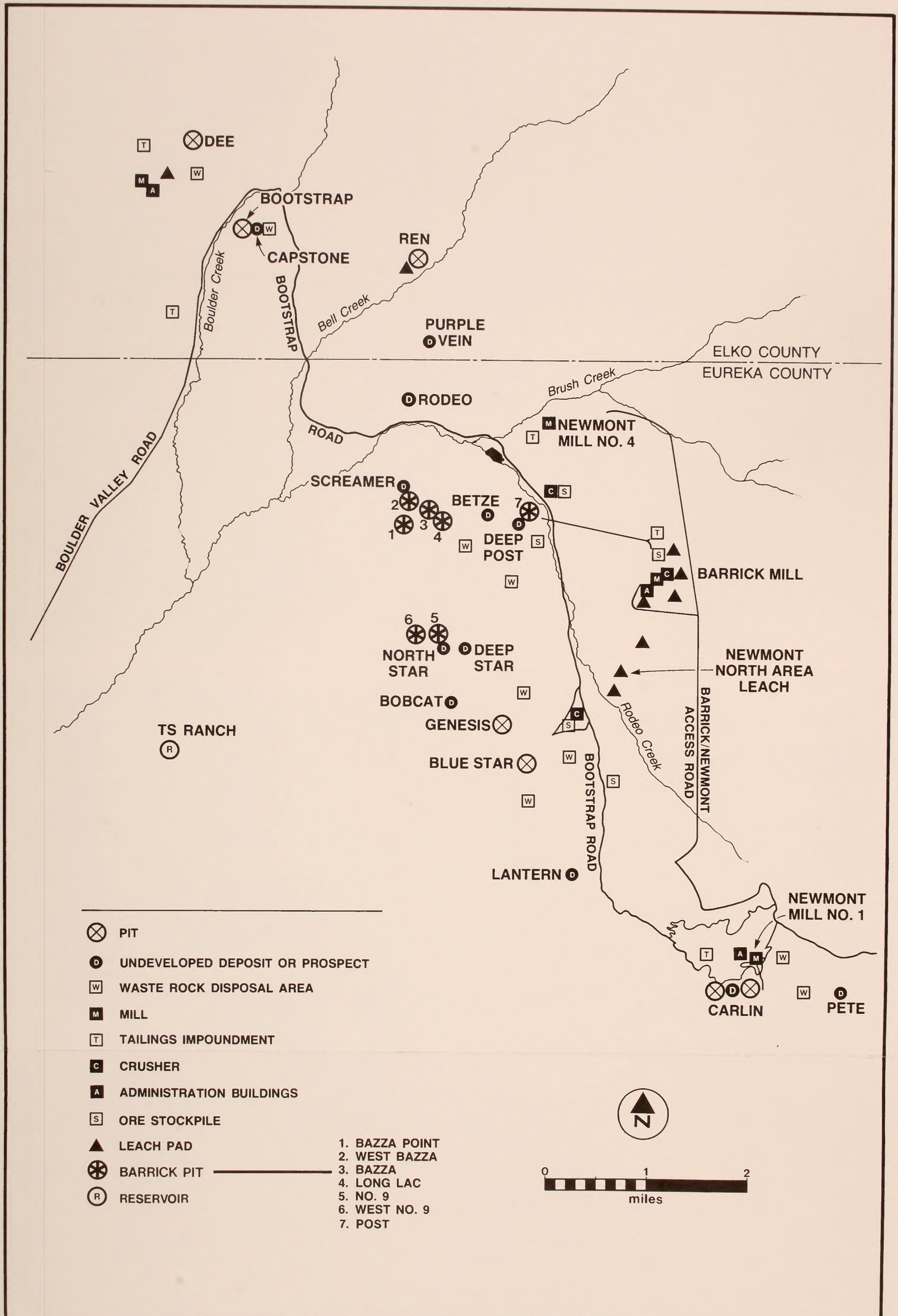
Chapter 3.0 describes the environment that would be affected by development of the Betze Project. The information summarized in this chapter was obtained from published sources; unpublished materials; interviews with local, state, and federal agencies; and reconnaissance surveys of the project site. The affected environment varied with different resources. For some resources, such as vegetation and soils, the affected area was determined to be the physical location and immediate vicinity of the mine site and the ancillary facilities. For other resources, such as air resources, water resources, and socioeconomics, the affected environment was larger. For each resource, the affected environment described was determined by the extent of the environmental impacts of the Proposed Action.

## 3.1 Topography and Mineral Resources

### 3.1.1 Topography

The terrain in the vicinity of the proposed Betze Project is typical of the Basin and Range physiographic province; it is dominated by north-trending fault-block mountain ranges which expose sedimentary rocks of the Paleozoic Age. The Betze Project is sited in the Little Boulder Basin, which contains the drainages of Brush, Rodeo, and Bell Creeks. These drainages converge with Boulder Creek in northern Boulder Valley west of the project area. Elevations in the project area range from 5,100 feet above mean sea level (AMSL) in the foothills of Boulder Valley to 5,926 feet AMSL in the highest portion of the South Block. Little Boulder Basin is bounded to the east by the 6,000- to 7,500-feet topography of the Tuscarora Mountains, a small north-trending range.

As described in more detail in Section 3.12.3.3, the existing environment in the vicinity of the Betze Project area has been affected by extensive mineral exploration and mining activity. Mining operations have been and are being conducted by Newmont, Dee and Barrick in the vicinity of the project area. These mining operations include open pits, associated waste rock disposal areas, heap leach facilities, milling facilities, tailings impoundments, administration buildings, and related ancillary facilities. The location of these facilities are depicted on Figure 3-1. The TS Ranch Joint Venture has constructed an irrigation reservoir, approximately 3.0 miles southwest of the project area, which utilizes water produced from Barrick's existing dewatering program. The historic and existing exploration and mining activities in the vicinity of the proposed Betze Project have largely altered the natural topography of Little Boulder Basin and the ridge that separates Little Boulder Basin from Boulder Valley.




BETZE PROJECT

**Figure 3-1. Existing Mining And Processing Facilities in the Project Vicinity**

### 3.1.2 Mineral Resources

During the early twentieth century, the development of placer deposits along Lynn, Sheep, and Rodeo Creeks produced gold from the vicinity of the Betze Project area. Historic mining activities in the project area consist of exploration pits and shallow workings. There are numerous exploration pits in the area of the Goldstrike Stock southeast of the project area. During the 1950s, turquoise was mined from workings southeast of the project area. In 1962, discovery of a large, low grade, disseminated gold ore body at the Carlin Mine stimulated prospecting for this type of deposit throughout Nevada.

Locally, gold mineralization is hosted by the Popovich Formation (e.g., Betze deposit, Deep Post deposit, and Screamer deposit), Rodeo Creek Formation, and the Goldstrike Stock. The largest ore deposits, the Betze and Deep Post, occur in the silty limestones of the Popovich Formation. The smaller deposits in the Rodeo Creek Formation occur in calcareous siltstone to fine grained sandstone interbedded in siliceous rocks. These deposits are oxidized and generally low in sulfide content.

Ore deposits occur in isolated tabular to lenticular ore bodies which appear to be structurally controlled. Alteration associated with mineralization appears to be decalcification, argillization, and silicification. Argillic alteration has produced kaolinitic clay predominantly along structures. Supergene weathering has produced oxides and sulfates to depths of up to 1,000 feet.

Gold mineralization in the Betze deposit consists of oxide and sulfide ore zones. Oxide ore zones consist of micron-sized gold disseminated in iron oxides which have been produced by the oxidation of the sulfide ore. Oxide ore zones extend to depths ranging from the surface to 900 feet below the surface. Sulfide ore deposits consist of disseminated, gold-bearing, arsenian pyrite and marscasite which characteristically contain a higher grade of gold than the iron oxide. Sulfide ore zones have been delineated to a depth of 1,800 feet below ground surface. The distinction between oxide and sulfide ores is discussed in Section 2.1.2.

Barrick projects that the minable reserves contained within the proposed Betze Pit are: 49.9 million tons of oxide ore; 86.2 million tons of sulfide ore; and 780.6 million tons of waste rock. Based on data from drilling on 200-foot centers, mine feasibility studies have estimated the Betze deposit to be approximately 4,000 feet long and 1,000 feet wide with vertical thicknesses as great as 600 feet. Current ore reserve estimates of combined oxide and sulfide mineralization are 15.1 million contained ounces of gold.

In addition to Barrick's proposed Betze Project, Barrick, Newmont and Dee are currently engaged in mineral exploration and mining in the vicinity of the Betze Project area. The existing operations include Barrick's surface Post Pit and other smaller pits, Newmont's Blue Star and Genesis Mines, and Dee's Dee and Ren Mines. These existing open-pit operations, as well as several inactive mines (e.g., Newmont's Carlin and Bootstrap Mines) are depicted in Figure 3-1 and are described in greater detail in Section 3.12.3.3. These operations include open pits, heap leach pads, mills, waste rock disposal areas, tailings impoundments, administration buildings and related ancillary facilities.

Exploration has identified a number of undeveloped mineralized areas or deposits including the Bobcat, Lantern, Pete, Rodeo, Deep Post, Deep Star, Screamer, Purple Vein, Capstone, and North Star. Exploration for additional reserves by Barrick, Newmont, Dee, and other mining companies is ongoing, and future reserves could include extensions of the identified ore bodies, low-grade ore classified as waste rock, and other as yet undiscovered ore bodies in the area. Because Barrick and Newmont have discovered additional deposits and mineralized areas in the vicinity of the Betze Project, it is likely that mineral exploration and mining will continue in the area for several decades.

## 3.2 Paleontology, Geology and Geologic Hazards

### 3.2.1 Paleontology

The Elko BLM District Paleontological Inventory was reviewed, and no known significant paleontological locations occur in the vicinity of the Proposed Action (Firby and Schorn 1983). Megascopic fossils observed in the mine area are known to occur throughout the Paleozoic Age rock assemblages in the region. No significant fossils are known to be indigenous or site specific to the proposed mine area.

### 3.2.2 Geology

The project site is located at the northern end of Boulder Valley, on the west side of the Tuscarora Mountains. The site is bounded by north-trending, fault blocks, the vertical displacements along which have exposed sedimentary rocks typical of the Basin and Range physiographic province. The geologic setting is composed of Lower Paleozoic marine sediments, a Jurassic intrusive, and Late Tertiary tufaceous sediments which are overlain by Quaternary fluvial and colluvial sediments.

The Lower Paleozoic Age sedimentary sequence consists of the Silurian-Devonian Roberts Mountains Formation, the Devonian Popovich Formation, and the Ordovician-Silurian Vinini Formation, which was thrust over the Popovich Formation along the Roberts Mountain Thrust. Lower Paleozoic Age sedimentary rock is composed of a sequence of carbonate shelf, slope, and basin facies that have gradational contacts.

The Roberts Mountain Formation consists of carbonaceous calcareous siltstones to fine-grained sandstones. Strata of the Roberts Mountain Formation have been observed at depths beginning at 1,400 to 1,500 feet below ground surface in the northern part of the project area. The Popovich Formation consists of medium- to thick-bedded carbonaceous silty to muddy limestones interbedded with calcareous siltstones and mudstones. Units of the Popovich Formation have been observed at depths beginning at 600 to 800 feet below ground surface. Sedimentary rocks of the Ordovician-Silurian Vinini Formation are lithologically diverse and consist of thin- to medium-bedded siltstone, mudstone, argillite, limestone, chert, and fine-grained sandstone. Surface exposures of the Ordovician-Silurian Vinini Formation are found throughout the northern part of the proposed Betze Pit (Figure 3-2).

The granodioritic Jurassic Goldstrike Stock intrudes the Lower Paleozoic Age sedimentary formations in the project area. Contact metamorphism, as a result of the intrusion, has developed minor skarn (lime-bearing silicates) along the contacts of the intrusive with the calcareous sedimentary rock. Numerous dikes and sills have intruded the sediments along structural zones. Surface exposures of the Goldstrike Stock are found in the southern part of the proposed Betze Pit (Figure 3-2).

Late Tertiary tuffaceous, fluvial, and lacustrine sediments of the Carlin Formation mantle the Paleozoic rocks in the northern part of the project area. The Carlin Formation, in turn, is overlain by varying thicknesses of unconsolidated Quaternary alluvium in the project area. Deep drilling in Little Boulder Basin indicates that the Paleozoic sequence underlies the Carlin Formation at an average depth of approximately 600 feet.

Valley-fill alluvial sediments in Little Boulder Basin consist of Quaternary to Holocene gravel, sand, and silt deposited by streams, slope wash, and wind.

Structurally, the project area is bisected by numerous northwest and northeast trending faults. The northeast trending faults or fault zones appear to have offset the northwest trending fault zones. High-angle faults have produced extensive fracturing and jointing with localized zones of intense shearing and brecciation. Jointing appears more extensively in the sedimentary rocks than in the more competent Goldstrike Stock. The stratigraphic units have gentle dips to the southwest except in the vicinity of high-angle faults, where bedding attitudes may be steep to vertical due to folding.

### 3.2.3 Geologic Hazards

Potential geologic hazards at the project site were evaluated based upon available literature, aerial photograph interpretation, preliminary geotechnical investigations, and detailed geologic

The Roberts Mountains [illegible] allochthonous [illegible] Formation [illegible] project area. [illegible] thick-bedded [illegible] Carlin Formation [illegible] have been [illegible] below ground surface. [illegible] rocks of the [illegible] Vinini Formation [illegible] and some of it [illegible] siltstone, limestone, chert, and [illegible] sequence [illegible] the proposed [illegible].

The [illegible] the lower Paleozoic [illegible] project area [illegible] metamorphism [illegible] the [illegible] and the contacts of the [illegible] with the [illegible] have intruded the [illegible] structural zones. Surface exposures of the [illegible] are found in the southern part of the proposed [illegible] (Figure [illegible]).

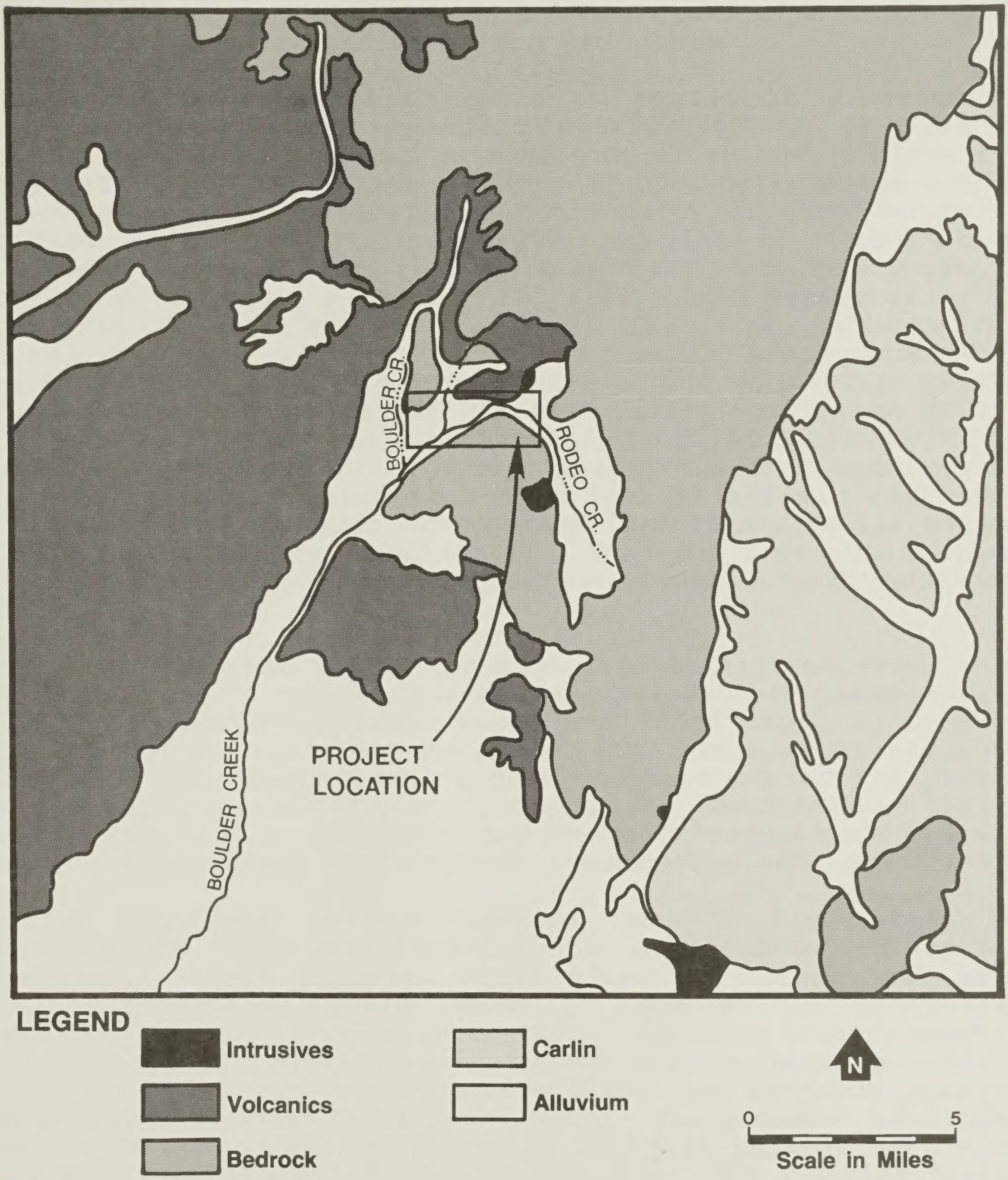
Late Tertiary [illegible] and lacustrine sediments of the Carlin Formation [illegible] the Paleozoic rocks in the southern part of the project area. The Carlin Formation [illegible] varying thicknesses of [illegible] in the project area. [illegible] the pit [illegible] the Carlin Formation at a [illegible] depth of [illegible] feet.

Valley-fill alluvial sediments in Little Boulder Basin consist of Quaternary [illegible] gravels, sand, and silt deposited by streams, slope wash, and [illegible].

Structural [illegible] affected by [illegible] and [illegible] northeast [illegible] fault zones [illegible] the northwest [illegible] zones [illegible] the strata [illegible] gentle dips to the south [illegible] in the vicinity of high-angle faults. [illegible] may be [illegible] folding.

1.2.3 [illegible]

Potential [illegible] were evaluated based upon [illegible] photographic interpretation, preliminary [illegible] investigations, and detailed geologic




Note: Site-specific geotechnical studies, i.e., Welch Engineering, Inc. 1988, have characterized the alluvium along Rodeo Creek as part of the Carlin Formation.

BETZE PROJECT

**Figure 3-2. Surface Geology Map**

mapping. Evidence of seismic activity in the project area is demonstrated by numerous northwest and northeast trending fault structures. However, no fault scarps suggestive of recent seismic activity have been identified in the project area.

A summary of major seismic events in Nevada is presented in Table 3-1. To identify historic earthquakes in the project vicinity, two radial searches extending 30 miles and 90 miles from the site (latitude 41 degrees 00 minutes and longitude 116 degrees 25 minutes) were conducted by the University of Reno Seismology Laboratory. Historic earthquakes within 30 miles of the site range from barely detectable up to magnitude 5.1. The magnitude 5.1 earthquake occurred on September 18, 1945, south-southwest of the site. The 90-mile radial search of the area indicated the strongest historic earthquake in the search area occurred on October 3, 1915, with a magnitude 7.8. The epicenter of this earthquake correlates with the Pleasant Valley earthquake of 1915 (Table 3-1) and was located approximately 80 miles southwest of the project site (von Hake 1974). Originally, the area encompassing the project site was classified as a Zone II seismic risk (NOAA 1973), but in 1985 the area was reclassified to a Zone III seismic risk (Uniform Building Code 1985). Such an area could expect moderate to major damage from the maximum credible earthquake (NOAA 1973).

Numerous faults exist within the mine area itself; however, there is no indication of recent (historical) movement on these faults. Regionally, a north-northeast Basin and Range fault is apparent within Boulder Valley along Boulder Creek. This fault separates the rocks of the Sheep Creek Range from the rocks of the project area within the western Tuscarora Mountains. Faulting and tilting of the blocks within the Basin and Range Province took place in post-early Pleistocene time (Roberts, Montgomery and Lehner 1967).

Potential secondary seismic effects due to liquefaction of saturated sandy soils are limited by the dry climate and depth to groundwater. Where alluvial soils occur in the project area, seismic liquefaction could occur if susceptible soils (and impounded tailings) become saturated. Isolated occurrences of expansive clay in residual soils may be present beneath alluvial soils. Kaolinite and non-expansive clays are commonly observed along argillic altered fault zones within the proposed mine area. No active or potential landslides or rockfall hazards were noted during surficial mapping at the project site. The limiting factors of seismic sensitivity are the dry climate, thin upland soils, and general lack of clay soils.

Evidence of expansive materials was found in the Carlin Formation during geotechnical site investigations (Welsh Engineering 1988). Geotechnical data from boreholes and test pits in the AA Block and the North Block indicated a potential for expansive materials. Measurements of the plasticity index (PI) on subsurface soil

TABLE 3-1

MAJOR SEISMIC EVENTS IN NEVADA

| Date | Epicenter Location | Intensity[1] Magnitude | Area[2] ($mi^2$) | Remarks |
|---|---|---|---|---|
| 1845 poss. 1852 | Stillwater area (?) poss. Pyramid Lake | greater than 7 | unknown | Report based on boyhood recollection of local inhabitant. Shock knocked down people, shook river bank, may have diverted river. |
| Mar. 26, 1872 | Owens Valley, CA | X-XI approx. 8 | 640,000 | 23 persons killed, 60 injured in Lone Pine; 52 houses (mostly adobe) destroyed. Faulting along east side of Owens Valley extended for more than 41 mi; scarps up to 23 ft high. |
| Oct. 2, 1915 | Pleasant Valley | X approx. 7.8 | 500,000 | Faulting for 20-25 mi along west face of Sonoma Range, scarps up to 13 ft high. All buildings destroyed in Kennedy; chimneys toppled, walls cracked in Winnemucca. Mine tunnels caved in; water tanks fell, roads cracked. |
| Dec. 20, 1932 | Cedar Mountains | X 7.3 | 500,000 | Created fissures; zone of rupture 37 mi long, 4-9 mi wide. Chimneys toppled in Mina and Luning. Boulders dislodged from hillsides. Groundwater flow changed. |
| Dec. 16, 1954 | Fairview Peak and Dixie Valley (2 events 4 min. apart. Fairview Peak approx. 34 mi south of Dixie) | X 7.1; 6.8 | 200,000 | These two earthquakes produced two zones of surface rupture; southern (Fairview zone 30 mi long, 6 mi wide; northern zone (Dixie) 25 mi long, 3 mi wide. Highways cracked, groundwater flow changed. |

Sources: National Oceanic and Atmospheric Administration. 1973. Earthquake history of the United States. NOAA Environmental Data Service Publication 41-1.

Ryall, A. 1977. Earthquake hazard in the Nevada region.

Bulletin of the Seismological Society of America. Volume 67, no. 2, April.

[1]Roman numeral represents intensity as measured on the Modified Mercalli Intensity Scale. Arabic number represents magnitude as measured on the Richter Scale.

[2]Area represents the area over which the effects of the earthquake were felt. Figures given are estimates; in many cases (particularly in the 1800s), information on the extent of earthquake effects is very sketchy, relying on the recollections of a few individuals in sparsely populated areas. The low population density also accounts for the limited damage to property.

samples ranged from 18 to 39. A PI greater than 35 indicates a probable volume expansion (dry to saturated) of greater than 30 percent (Holtz and Kovacs 1981).

Swelling of soils is dependent on the constituent clay mineralogy, fabric, and cementation. Volcanic rocks are a major source of expansive soils (Johnson and DeGraff 1988). Water must also be present to cause the swelling to occur. Annual fluctuations of the water table or the introduction of groundwater discharges could increase the potential for swelling.

## 3.3 Air Resources

Baseline meteorology, air quality, and dispersion conditions representative of the Betze Project area were estimated using data from the Betze Project and other nearby monitoring stations in north-central Nevada.

Meteorological and air quality data are being collected on the North Block at the location depicted on Figure 2-2. This monitoring site (the "Goldstrike meteorological station") includes a 30-foot meteorological tower which measures wind speed, wind direction, and standard deviation of the wind direction. Temperature and relative humidity are monitored at 6 feet above ground level. Precipitation and evaporation are measured near ground level. Particulate matter sized 10 microns or less (PM-10) is measured every third day at approximately 11 feet above ground level.

### 3.3.1 Temperature and Precipitation

Table 3-2 presents summaries of temperature and precipitation data from the Goldstrike meteorological station and at the following other stations: Elko (56 miles east, southeast), and Beowawe (27 miles south). These other stations are similar in elevation to the project site.

Temperature data indicate relatively wide diurnal and seasonal variability which is typical of much of the Great Basin climates. The high elevation and proximity of mountains also contribute to the wide range of temperatures. The warmest temperatures occur in late July and early August, with coldest temperatures occurring in January and February. For the period from October 11, 1989 to October 10, 1990 (the "1989-1990 monitoring period"), the temperature extremes in the Betze Project area ranged from a high of 97°F (August 5, 1990) to a low of 2°F (February 15, 1990) with an annual average of 53°F. Measured extremes during the 29-year period that constitutes the data base at Elko and Beowawe range from 104°F in the summer to -38°F in the winter.

Precipitation in the region is relatively sparse and averages between 8 to 10 inches annually. The long-term average annual

TABLE 3-2

REGIONAL TEMPERATURE AND PRECIPITATION DATA

| Station | Elevation in Feet | Years of Record | Period of Record | | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Maximum, Minimum, and Mean Temperatures (°F) | | | | | | | | |
| Elko | 5,050 | 29 | 1941-1970 | Max | 58.0 | 67.0 | 77.0 | 83.0 | 92.0 | 101.0 | 102.0 | 102.0 | 99.0 | 86.0 | 74.0 | 59.0 | 102.0 |
| | | | | Min | -38.0 | -28.0 | -9.0 | 4.0 | 10.0 | 23.0 | 32.0 | 25.0 | 12.0 | 8.0 | -11.0 | -22.0 | -38.0 |
| | | | | Mean | 23.3 | 29.4 | 35.0 | 43.5 | 51.8 | 59.6 | 69.6 | 67.0 | 57.5 | 46.9 | 34.8 | 25.8 | 45.4 |
| Beowawe | 4,684 | 29 | 1941-1970 | Max | 65.0 | 70.0 | 79.0 | 84.0 | 94.0 | 102.0 | 104.0 | 104.0 | 101.0 | 91.0 | 75.0 | 64.0 | 104.0 |
| | | | | Min | -29.0 | -10.0 | -4.0 | 10.0 | 12.0 | 17.0 | 31.0 | 24.0 | 8.0 | 2.0 | 9.0 | -23.0 | -29.0 |
| | | | | Mean | 27.2 | 33.7 | 38.5 | 46.5 | 54.7 | 61.6 | 70.5 | 67.6 | 58.2 | 48.6 | 37.0 | 29.2 | 47.8 |
| Betze Project | 5,500 | 1 | 1989-1990 | Max | 57.2 | 52.9 | 64.2 | 77.2 | 77.2 | 93.9 | 95.2 | 96.6 | 91.8 | 75.7 | 65.3 | 51.8 | 96.6 |
| | | | | Min | 5.5 | 1.9 | 15.8 | 25.9 | 28.0 | 34.5 | 44.8 | 44.2 | 43.7 | 19.6 | 12.0 | 14.7 | 1.9 |
| | | | | Mean | 30.2 | 27.9 | 41.0 | 50.4 | 50.9 | 64.2 | 74.5 | 71.1 | 68.4 | 47.8 | 37.6 | 31.5 | 53.0 |
| | | | | | | | | | Mean Monthly Precipitation (Total Inches) | | | | | | | | |
| Elko | 5,050 | 29 | 1941-1970 | | 1.16 | 0.77 | 0.82 | 0.82 | 1.02 | 1.01 | 0.40 | 0.61 | 0.33 | 0.66 | 1.01 | 1.12 | 9.73 |
| Beowawe | 4,684 | 29 | 1941-1970 | | 0.68 | 0.59 | 0.55 | 0.85 | 1.00 | 1.07 | 0.27 | 0.35 | 0.34 | 0.57 | 0.80 | 0.87 | 7.94 |
| Betze Project[1] | 5,500 | 9 months | 1990 | | 1.22 | 0.40 | 0.69 | 2.17 | 2.62 | 1.03 | 0.23 | 0.77 | 0.37 | NA | NA | NA | NA |

Data Source: National Climatic Data Center, Asheville, North Carolina.

NA - Not available.

[1]First full month of data was January 1990.

precipitation is approximately 9.7 inches. The 29-year record of precipitation data for Elko and Beowawe shows the heaviest amounts falling during the winter as snow and in May and June as rain. Summer precipitation occurs mostly as scattered showers and thunderstorms and makes only a minor contribution to overall precipitation totals. The precipitation gauge at the Goldstrike meteorological station was activated on December 7, 1989. From that date until October 11, 1990, the total precipitation on-site measured 9.5 inches, which is within the range of the average precipitation figures for Elko.

### 3.3.2 Winds

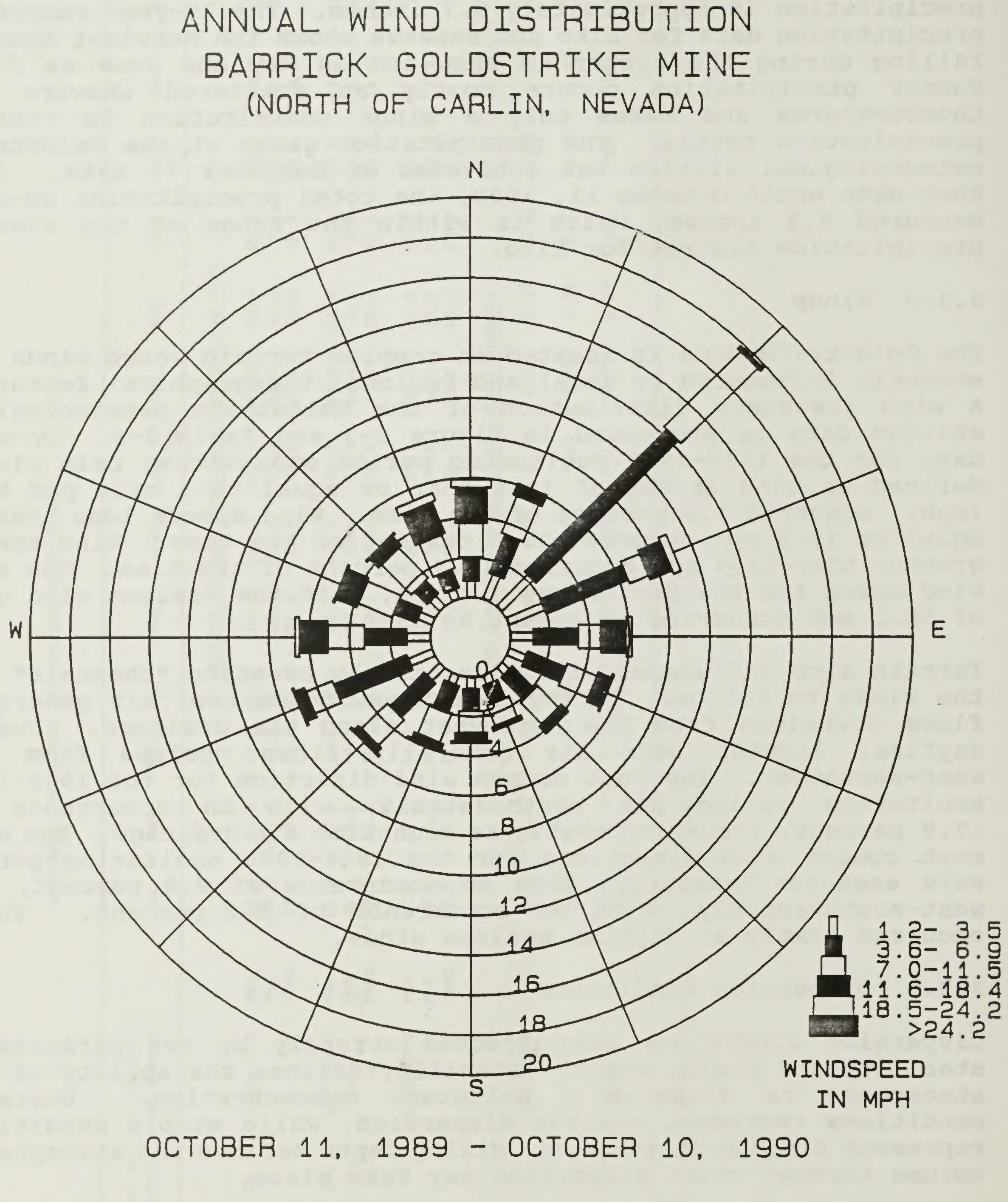
The Goldstrike Mine is located in complex terrain where winds are strongly influenced by local and regional topographical features. A wind frequency distribution of the Goldstrike meteorological station data is presented in Figure 3-3 and Table 3-3. On-site data for the 1989-1990 monitoring period showed that calm winds, defined as wind speeds of less than or equal to 1 mile per hour (mph), occurred 1.2 percent of the time. Wind speeds less than or equal to 11.5 mph occurred 83.5 percent of the time. Wind speeds greater than 11.5 mph occurred 15.3 percent of the time. The mean wind speed for the period was 7.4 mph, with the maximum wind gust of 55.2 mph occurring on August 9, 1990.

Terrain also influences wind direction by creating "channels" for the winds to follow. During nighttime, dense cool air generally flows downslope from the northeast along the drainage. During daytime, lighter warm air generally flows upslope from the west-southwest. The most common wind direction for the 1989-1990 monitoring period was northeasterly, with an occurrence of 17.9 percent, occurring mostly as nighttime air drainage. The next most common wind directions for the 1989-1990 monitoring period were east-northeasterly, with an occurrence of 9.0 percent, and west-southwesterly, with an occurrence of 7.2 percent. These occurred mostly as daytime upslope winds.

### 3.3.3 Dispersion Conditions

Dispersion conditions are affected strongly by two parameters: stability and mixing depth. Stability defines the ability of the atmosphere to disperse a pollutant concentration. Unstable conditions represent maximum dispersion, while stable conditions represent minimum dispersion. Mixing depth defines the atmospheric volume through which dispersion may take place.

Dispersion data listed in Table 3-3 from the project site for the 1989-1990 monitoring period showed that unstable conditions occurred 32.2 percent of the time, neutral conditions (which occur when there is little or no vertical temperature gradient) occurred 30.9 percent of the time, and stable conditions occurred 35.7 percent of the time. In general, westerly winds are




BETZE PROJECT

**Figure 3-3. Annual Wind Distribution - Barrick Goldstrike Mine**

TABLE 3-3

WIND SPEED, WIND DIRECTION, AND STABILITY FREQUENCY DISTRIBUTION (PERCENT)

FOR BETZE PROJECT

OCTOBER 11, 1989 - OCTOBER 10, 1990

| | Wind Speed Class[1] | | | | | | All | Mean Wind | Stability Class[2] | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direction | 1 | 2 | 3 | 4 | 5 | 6 | Speeds | Speed (mph) | A | B | C | D | E | F | All |
| N | 0.8 | 1.2 | 1.7 | 1.8 | 0.4 | 0.0 | 6.0 | 9.8 | 0.2 | 0.1 | 0.5 | 3.5 | 0.5 | 1.1 | 6.0 |
| NNE | 1.3 | 2.1 | 2.0 | 0.6 | 0.0 | 0.0 | 6.0 | 6.7 | 0.1 | 0.1 | 0.2 | 1.9 | 1.3 | 2.3 | 6.0 |
| NE | 2.2 | 10.1 | 5.3 | 0.2 | 0.0 | 0.0 | 17.9 | 6.0 | 0.1 | 0.1 | 0.1 | 5.2 | 6.7 | 5.4 | 17.7 |
| ENE | 1.9 | 4.5 | 1.0 | 1.2 | 0.4 | 0.0 | 9.0 | 7.0 | 0.1 | 0.1 | 0.2 | 2.6 | 1.0 | 5.0 | 8.9 |
| E | 1.1 | 2.3 | 1.1 | 1.3 | 0.3 | 0.0 | 6.1 | 8.2 | 0.2 | 0.1 | 0.3 | 2.5 | 0.5 | 2.5 | 6.1 |
| ESE | 0.9 | 2.1 | 1.6 | 0.7 | 0.1 | 0.0 | 5.5 | 7.4 | 0.2 | 0.1 | 0.6 | 2.3 | 0.5 | 1.7 | 5.5 |
| SE | 0.5 | 1.6 | 1.5 | 0.5 | 0.0 | 0.0 | 4.1 | 7.3 | 0.4 | 0.4 | 0.6 | 1.3 | 0.4 | 1.0 | 4.1 |
| SSE | 0.5 | 1.0 | 1.1 | 0.2 | 0.0 | 0.0 | 2.7 | 6.8 | 0.4 | 0.4 | 0.5 | 0.6 | 0.1 | 0.7 | 2.7 |
| S | 0.6 | 1.1 | 1.1 | 0.4 | 0.1 | 0.0 | 3.2 | 7.3 | 0.7 | 0.5 | 0.7 | 0.7 | 0.1 | 0.5 | 3.3 |
| SSW | 0.5 | 1.4 | 1.6 | 0.3 | 0.1 | 0.0 | 4.0 | 7.5 | 1.3 | 1.1 | 0.8 | 0.5 | 0.1 | 0.3 | 4.0 |
| SW | 0.9 | 2.4 | 1.8 | 0.3 | 0.1 | 0.0 | 5.5 | 6.6 | 2.2 | 1.4 | 0.9 | 0.6 | 0.0 | 0.3 | 5.5 |
| WSW | 1.3 | 3.9 | 1.4 | 0.5 | 0.1 | 0.0 | 7.2 | 6.2 | 2.5 | 1.6 | 1.6 | 1.1 | 0.1 | 0.4 | 7.2 |
| W | 1.2 | 2.1 | 1.8 | 1.4 | 0.2 | 0.0 | 6.9 | 7.9 | 1.6 | 1.1 | 1.8 | 1.9 | 0.1 | 0.4 | 6.9 |
| WNW | 0.8 | 1.2 | 1.8 | 1.1 | 0.1 | 0.0 | 5.0 | 8.5 | 0.8 | 0.6 | 1.3 | 1.8 | 0.1 | 0.5 | 5.1 |
| NW | 0.7 | 0.9 | 2.1 | 0.6 | 0.1 | 0.0 | 4.4 | 8.1 | 0.4 | 0.5 | 1.1 | 1.5 | 0.2 | 0.6 | 4.4 |
| NNW | 0.5 | 1.0 | 1.8 | 1.7 | 0.4 | 0.0 | 5.5 | 10.4 | 0.3 | 0.2 | 0.7 | 3.2 | 0.3 | 0.8 | 5.5 |
| All Directions | 15.9 | 38.9 | 28.7 | 12.7 | 2.4 | 0.2 | 98.8 | | 11.7 | 8.7 | 11.8 | 30.9 | 12.2 | 23.5 | 98.8 |

[1] Definition of Wind Speed Classes:

| Wind Speed Class | Wind Speed (u) (mph) |
|---|---|
| 1 | $1.2 < u \leq 3.5$ |
| 2 | $3.5 < u \leq 6.9$ |
| 3 | $6.9 < u \leq 11.5$ |
| 4 | $11.5 < u \leq 18.4$ |
| 5 | $18.4 < u \leq 24.2$ |
| 6 | $24.2 < u$ |

[2] Definition of Stability Classes:

| Stability Class | Stability |
|---|---|
| A | Extremely unstable |
| B | Unstable |
| C | Slightly unstable |
| D | Neutral |
| E | Slightly stable |
| F | Very stable |

associated with unstable conditions, while northeasterly winds are associated with stable conditions. Neutral dispersion conditions at the project site are most common when winds are out of the north.

Mixing depth is a regional phenomena and the nearest recording station is located in Winnemucca, Nevada. Mixing depths vary diurnally and seasonally and are at a maximum during summer afternoons when solar insolation is strongest.

Stagnation episodes are defined as periods when there is very little horizontal and vertical air movement. Stagnation episodes are not expected to occur to a significant degree. While nighttime temperature inversions may occur, the Goldstrike meteorological station data shows regular diurnal wind fluctuations which would promote lateral dispersion of pollutants throughout the valley.

### 3.3.4 Air Quality

State of Nevada and federal air quality standards for the regulated pollutants that would be emitted at the Betze Project are listed in Table 3-4. Baseline values for particulate matter and gaseous pollutants are described in the following subsections. No federal ambient air quality standards exist for air toxics such as hydrogen cyanide (HCN) and metals. However, the State of Nevada has incorporated the American Conference of Government Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs), which define acceptable limits of pollution exposure in the workplace, into their air toxics regulations. A safety factor of 42 is used to convert this exposure limit to an ambient air quality standard. The TLV/42 as an 8-hour average exposure is used as the ambient limit for all air toxics in Nevada. This ambient limit for HCN is also listed in Table 3-4.

3.3.4.1 <u>Particulate Matter</u>. Total suspended particulate (TSP) monitoring stations are located at Elko, Battle Mountain, and the Lander County Airport, 5 miles south of Battle Mountain. Table 3-5 summarizes TSP data collected at these sites during the years 1983 through 1986 and at monitoring sites operated during 1984 at the First Miss Gold Getchell Mine (prior to the mine going into operation), 15 miles north of Golconda and 52 miles from the site. The Goldstrike meteorological station measured PM-10 concentrations which are representative of baseline air quality in the vicinity of the Betze Project area. The PM-10 data collected during the 1989-1990 monitoring period also are presented in Table 3-5.

The EPA has recently adopted a PM-10 standard to replace the TSP air quality standard. PM-10 is believed to affect human health because particles of this size can be inhaled into the lungs, while larger particles comprising the balance of TSP are not inhalable. EPA has promulgated a PM-10 standard of 150 micrograms per cubic meter ($\mu g/m^3$) on a 24-hour basis and 50 $\mu g/m^3$ on an annual basis.

TABLE 3-4

STATE OF NEVADA AND FEDERAL AIR QUALITY STANDARDS

| Pollutant | Averaging Period | Concentration ($\mu g/m^3$) |
|---|---|---|
| TSP | Annual[1] | 75 |
| | 24-Hour[2] | 150 |
| PM-10 | Annual[1] | 50 |
| | 24-Hour[2] | 150 |
| $NO_2$ | Annual[1] | 100 |
| CO | 8-Hour[2] | 10,000 |
| | 1-Hour[2] | 40,000 |
| $SO_2$ | Annual[1] | 80 |
| | 24-Hour[2] | 365 |
| | 3-Hour[2] | 1,300 |
| HCN[3] | 8-Hour | 262 |

Note: TSP and HCN are State of Nevada standards.

[1] Not to be exceeded.

[2] Not to be exceeded more than once per year.

[3] Air toxic standard using TLV/42 (ACGIH 1990).

TABLE 3-5

SUMMARY OF REGIONAL PARTICULATE DATA ($\mu g/m^3$)

| Type | Year/Site | Annual Mean | 24-Hour Maximum Concentration | Number of Samples Exceeding Standards: Nevada >150 $\mu g/m^3$ | Federal >260 $\mu g/m^3$ |
|---|---|---|---|---|---|
| TSP | 1983 | | | | |
| | Elko | 41.9 | 104 | 0 | 0 |
| | Battle Mountain | 76.8 | 149 | 0 | 0 |
| | Lander County Airport | 14.1 | 43 | 0 | 0 |
| | 1984 | | | | |
| | Elko | 70.3 | 213 | 4 | 0 |
| | Battle Mountain | 116.3 | 498 | 10 | 2 |
| | Lander County Airport | 19.6 | 391 | 1 | 1 |
| | Getchell Mine (Met Site) | 9.2 | 73 | 0 | 0 |
| | Getchell Mine (Airstrip Site) | 9.3 | 64 | 0 | 0 |
| | Getchell Mine (Mill Site) | 9.9 | 77 | 0 | 0 |
| | 1985 | | | | |
| | Elko | 55.8 | 248 | 1 | 0 |
| | Battle Mountain | 102.0 | 220 | 4 | 0 |
| | Lander County Airport | 25.8 | 253 | 1 | 0 |
| | 1986 | | | | |
| | Elko | 51.1 | 109 | 0 | 0 |
| | Battle Mountain | 74.8 | 175 | 1 | 0 |
| | Lander County Airport | 18.4 | 80 | 0 | 0 |
| PM-10 | 1989/1990 | | | | |
| | Barrick Goldstrike | 16.4 | 142[1] | 0 | 0 |

[1] This occurred on a day with wind gusts greater than 50 mph. The second highest PM-10 concentration was 61 $\mu g/m^3$.

Although EPA dropped the TSP standard from the National Ambient Air Quality Standards (NAAQS), the State of Nevada continues to have a TSP standard of 150 $\mu g/m^3$ on a 24-hour basis and 75 $\mu g/m^3$ on an annual basis.

Particulate data from the Goldstrike meteorological station for the 1989-1990 monitoring period showed no exceedances of the EPA standard for PM-10. The highest 24-hour PM-10 concentration was 142 $\mu g/m^3$, collected on August 9, 1990. This occurred on a day with wind gusts greater than 50 mph. The second highest 24-hour PM-10 concentration was 61 $\mu g/m^3$ on August 21, 1990. The arithmetic average for the period was 16.4 $\mu g/m^3$.

Data from the Elko, Battle Mountain, and Lander County Airport sites show occasional exceedances of the Nevada state standard for TSP. However, the Elko and Battle Mountain TSP samplers are located in areas where TSP concentrations are greatly influenced by the effects of urban activity (e.g., automobile traffic on dirt roads, construction work, street repair). The TSP samplers at the Getchell Mine were located in a more rural environment prior to the start of mining operations. Thus, data at this site may be more representative of ambient background TSP concentrations in the Betze Project area. These data show no exceedances of the Nevada state nor federal 24-hour and annual standards.

3.3.4.2 Other Pollutants. In addition to particulate emissions, the existing mining and processing operations in the vicinity of the proposed Betze Project also emit other gases and "non-criteria" pollutants. Carbon monoxide (CO) and nitrogen dioxide ($NO_2$) are emitted from propane-fired kilns and boilers used in processing operations and from heavy mining equipment and other vehicles that burn diesel fuel and gasoline. Sulfur dioxide ($SO_2$), hydrogen sulfide ($H_2S$), sulfuric acid mist, and particulate sulfur are emitted during ore processing in the autoclave. $SO_2$ also is emitted by heavy mining equipment and other vehicles that burn diesel fuel and gasoline. Since large sources of CO, $NO_2$, and $SO_2$ are generally associated with urban areas and major point sources, no monitors for these pollutants exist near the project site.

Non-criteria pollutants are air contaminants that are not regulated by the NAAQS, including trace metals such as arsenic, barium, and selenium. Safe ambient levels for non-criteria pollutants are the subject of considerable scientific debate. The significance levels for non-criteria pollutants have been set by the NDEP at the TLV published by the ACGIH (1990) divided by a safety factor of 42 for an 8-hour average. To determine the existing concentration of non-criteria pollutants in the vicinity of the proposed Betze Project, sections of selected filters from the Goldstrike meteorological station were analyzed for metals content.

Portions of four PM-10 filter samples from the lot collected at the Goldstrike meteorological station depicted on Figure 2-2 were analyzed for elements of potential concern.

The PM-10 filters were analyzed for total arsenic (As), total barium (Ba), total cyanide (CN), weak acid dissociable cyanide (WAD CN), and selenium (Se). These five parameters were chosen based on considerations such as being unique to the mining/processing operations, potential toxicity, and metals content in whole rock analyses of core samples taken from the area of the proposed Betze Pit. The PM-10 filters analyzed were chosen based on measured PM-10 concentrations and wind conditions on the day the sample was collected. Samples were selected for 3 days which represent meteorological conditions indicating potential impacts from Barrick and/or Newmont, and one sample was chosen to reflect background conditions. The samples chosen from February 16, May 14, May 23, and June 10, 1990, were selected for the following reasons:

February 16: The sample collected on this date was the highest PM-10 value measured during the first 9 months of monitoring. Winds were moderate to strong from the south; thus, the Goldstrike meteorological station was downwind of the existing Barrick and Newmont operations.

May 14: The sample collected on this date represents impacts from background sources. The PM-10 value measured is one of the higher background values. Winds were from the northwest through northeast most of the day making the Goldstrike meteorological station upwind of the existing Barrick and Newmont operations.

May 23: The sample collected on this date was one of the higher PM-10 values measured. Winds were from the south and southwest through the middle of the day. The Goldstrike meteorological station was downwind of the existing Barrick and Newmont operations during this period.

June 10: The sample collected on this date had a moderately heavy PM-10 load, and there were moderate to strong winds from the south and southwest. The Goldstrike meteorological station was downwind of the existing Barrick and Newmont operations.

In addition to analyzing the four filters described above, one blank filter was analyzed to determine representative existing concentrations of the elements associated with the filters themselves. Each analysis was then corrected based on the analysis of the "blank" filter.

The filters were analyzed using EPA-approved methodologies listed below:

| Compound | EPA Methodology | Type |
|---|---|---|
| As | #7060 | GFAA |
| Ba | #6010 | ICAP |
| CN | #9010 | Colorometric |
| Se | #7740 | GFAA |

The results of the PM-10 filter analyses are presented in Table 3-6. Barium concentrations were highest on 2 of the 3 days when winds were from the south and southwest, the direction of the existing Barrick and Newmont operations. Arsenic was detected only on these 2 days, and total cyanide was detected on one of these days. The presence of these elements suggests that some transport and impact from the existing Barrick and Newmont operations occurred on these 2 days. The measured concentrations of As, Ba, CN, and Se during these selected highest particulate impact days at the Goldstrike meteorological station were minimal and would not present a threat to human health. The values reported are orders of magnitude below applicable Nevada air quality standards, which are equal to the corresponding Threshold Limit Values (TLV) divided by 42 (TLV/42).

## 3.4 Water Resources

The description of existing water resources in the Betze Project area is divided into a discussion of water quantity and water quality. The surface water hydrology and groundwater hydrology are presented in the following sections, including a discussion of the regional hydrologic setting, flow characteristics at various sampling stations within the surface drainage system, and water levels within groundwater wells. An analysis of the water quality of the surface water and the aquifers within the project area is included, as is a discussion of the interaction between surface water and groundwater.

### 3.4.1 Surface Water and Groundwater Hydrology

3.4.1.1 Regional Hydrology. Surface runoff from the project area flows west and southwest via Rodeo Creek, Boulder Creek, and Rock Creek, occasionally flowing into the Humboldt River near Battle Mountain, Nevada, a distance of approximately 40 miles from the proposed Betze Project. Several springs in the upstream portions of the Boulder Creek, Bell Creek, Brush Creek, and Rodeo Creek drainages, shown on the U.S. Geological Survey (USGS) 7.5-minute quadrangle topographic map (Figure 3-4), contribute to perennial flow in the upper reaches of these stream systems.

TABLE 3-6

PM-10 FILTER MEASURED COMPOUND/METALS CONCENTRATIONS

GOLDSTRIKE METEOROLOGICAL STATION

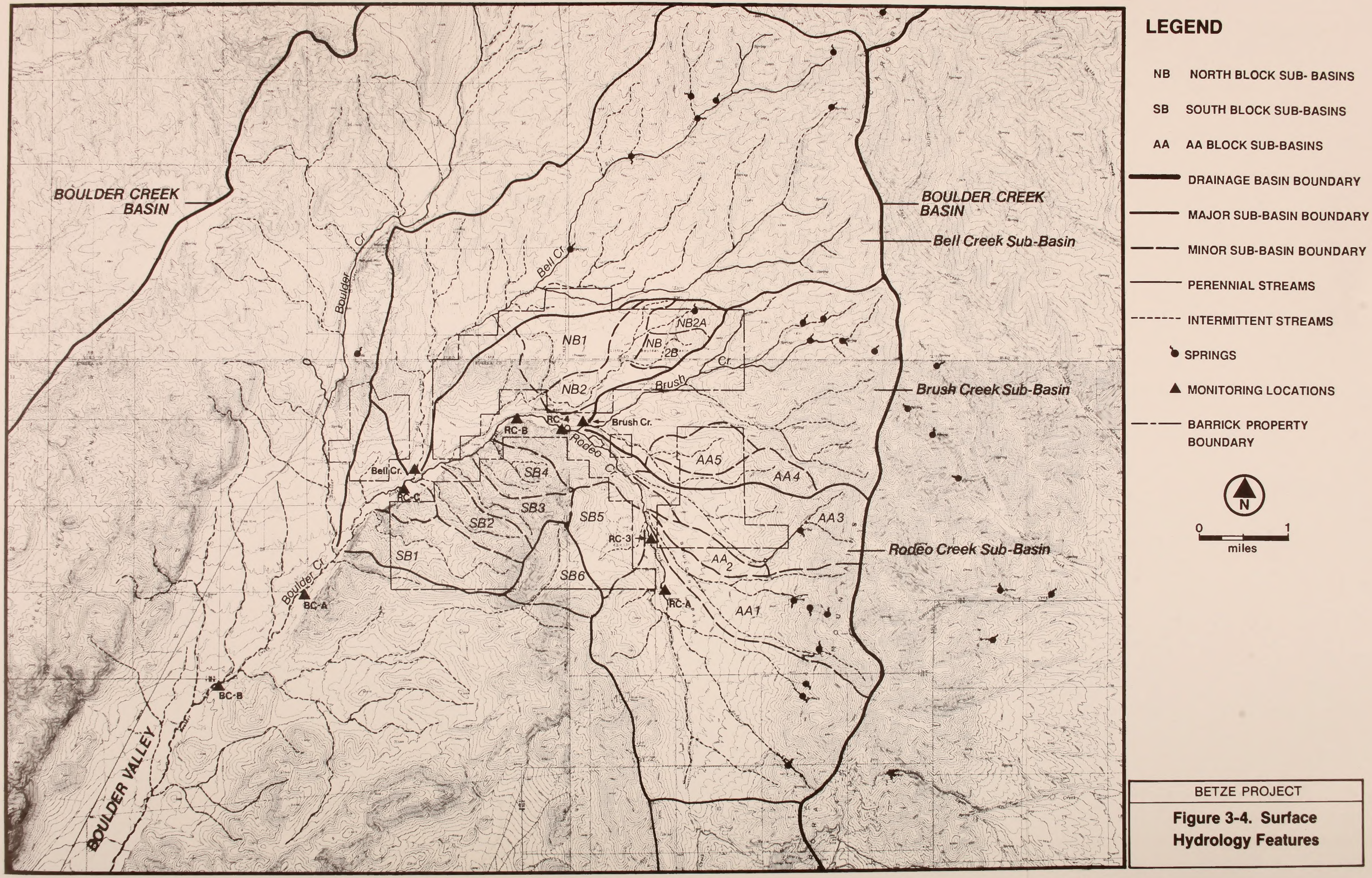
| Date | Compound/Metal | 24-Hour Average Concentration ($\mu g/m^3$) | Significance Level[1] ($\mu g/m^3$) | Percent of Significance Level |
|---|---|---|---|---|
| 2/16/90 | Total CN | <0.007[2] | 119.0 | <0.006 |
| | WAD CN[3] | <0.007 | 119.0 | <0.006 |
| | Total As | 0.03 | 4.8 | 0.6 |
| | Total Ba | 0.04 | 11.9 | 0.3 |
| | Total Se | <0.01 | 4.8 | <0.2 |
| 5/14/90[4] | Total CN | <0.007 | 119.0 | <0.006 |
| | WAD CN | <0.007 | 119.0 | <0.006 |
| | Total As | <0.007 | 4.8 | <0.1 |
| | Total Ba | 0.006 | 11.9 | 0.05 |
| | Total Se | <0.01 | 4.8 | <0.2 |
| 5/23/90 | Total CN | 0.01 | 119.0 | 0.008 |
| | WAD CN | <0.007 | 119.0 | <0.006 |
| | Total As | 0.03 | 4.8 | 0.6 |
| | Total Ba | 0.01 | 11.9 | 0.08 |
| | Total Se | <0.01 | 4.8 | <0.2 |
| 6/10/90 | Total CN | <0.007 | 119.0 | <0.006 |
| | WAD CN | <0.007 | 119.0 | <0.006 |
| | Total As | <0.007 | 4.8 | <0.1 |
| | Total Ba | 0.006 | 11.9 | 0.05 |
| | Total Se | <0.01 | 4.8 | <0.2 |

[1] Nevada air toxics standard based on TLV/42.

[2] "<" denotes less than detection limit.

[3] Weak Acid Dissociable cyanide represents cyanide which can be dissociated in the laboratory using a weak acid at a pH of 4.5, meaning the cyanide is more susceptible to dissociation and the formation of HCN. Total cyanide is detected in the laboratory by using a stronger acid solution at pH less than 2.0 and, therefore, represents cyanide in a relatively stable condition.

[4] Represents local background levels.




BETZE PROJECT

**Figure 3-4. Surface Hydrology Features**

Overall, however, surface flow in these drainages infiltrates into the alluvial aquifer adjacent to the stream, and all creeks downstream of the project area are ephemeral to the Humboldt River. Surface flow reaches the Humboldt River only during rare or extreme precipitation events.

There are no permanent stream gaging stations within the project area or along Boulder Creek. The closest USGS gaging station is located on Rock Creek upstream of its confluence with Boulder Creek, approximately 25 miles southwest of the project area. Several gaging stations are located on the Humboldt River which flows from east to west approximately 25 to 30 miles south of the project area. The three closest stations, from upstream to downstream on the river, are located at Palisade, Nevada, near Argenta, Nevada and at Battle Mountain, Nevada. The drainage area for each of the three stations on the Humboldt River ranges from about 5,000 square miles ($mi^2$) to 8,900 $mi^2$; mean annual discharge ranges from about 340 cfs to 400 cfs; and runoff ranges from about 240,000 acre-feet to 270,000 acre-feet (Earth Info 1989). The discharge is influenced by numerous irrigation diversions.

Data from mineral exploration drilling provide the majority of the information used to define the groundwater levels within the project area. Figure 3-2 shows a compilation of geologic maps for the project area. Groundwater elevations from several previous environmental assessments and reports (BLM 1988b, 1988c, 1989a, 1989b; Barrick Goldstrike 1989; Leggette, Brashears & Graham, Inc. 1990) are compiled on a single map (Figure 3-5) to show the direction and gradient of groundwater flow within the project area. Generally, groundwater follows topography in flowing from the northeast side of the project area to the southwest into Boulder Valley. South of the proposed Betze Pit, a groundwater mound is associated with the granodiorite Goldstrike Stock, which is less permeable than other formations within the project area.

Recharge generally occurs in the central and eastern portions of the project area. Groundwater discharges at several springs within the Rodeo Creek, Brush Creek, and Bell Creek drainages. These creeks maintain perennial flow immediately downstream of the springs. Further downstream, the drainages become ephemeral as the result of infiltration and recharge to the alluvial aquifers adjacent to the creeks.

Elevated water temperatures are observed in deep wells in the vicinity of the Betze Pit. Elevated water temperatures may be indicative of upward migration of groundwater (Papadopulos & Associates 1988). The recharge volume from deep sources is not considered to be significant.

Average annual precipitation for the area is approximately 9.7 inches, based upon long-term records from a recording rain gauge in Elko, Nevada. Rainfall amounts for the 10-, 25-, 50-, and

Overall, however, surface flow in these drainages infiltrates into the alluvial aquifer adjacent to the stream, and all creeks downstream of the project area are ephemeral to the Humboldt River. Surface flow reaches the Humboldt River only during rare or extreme precipitation events.

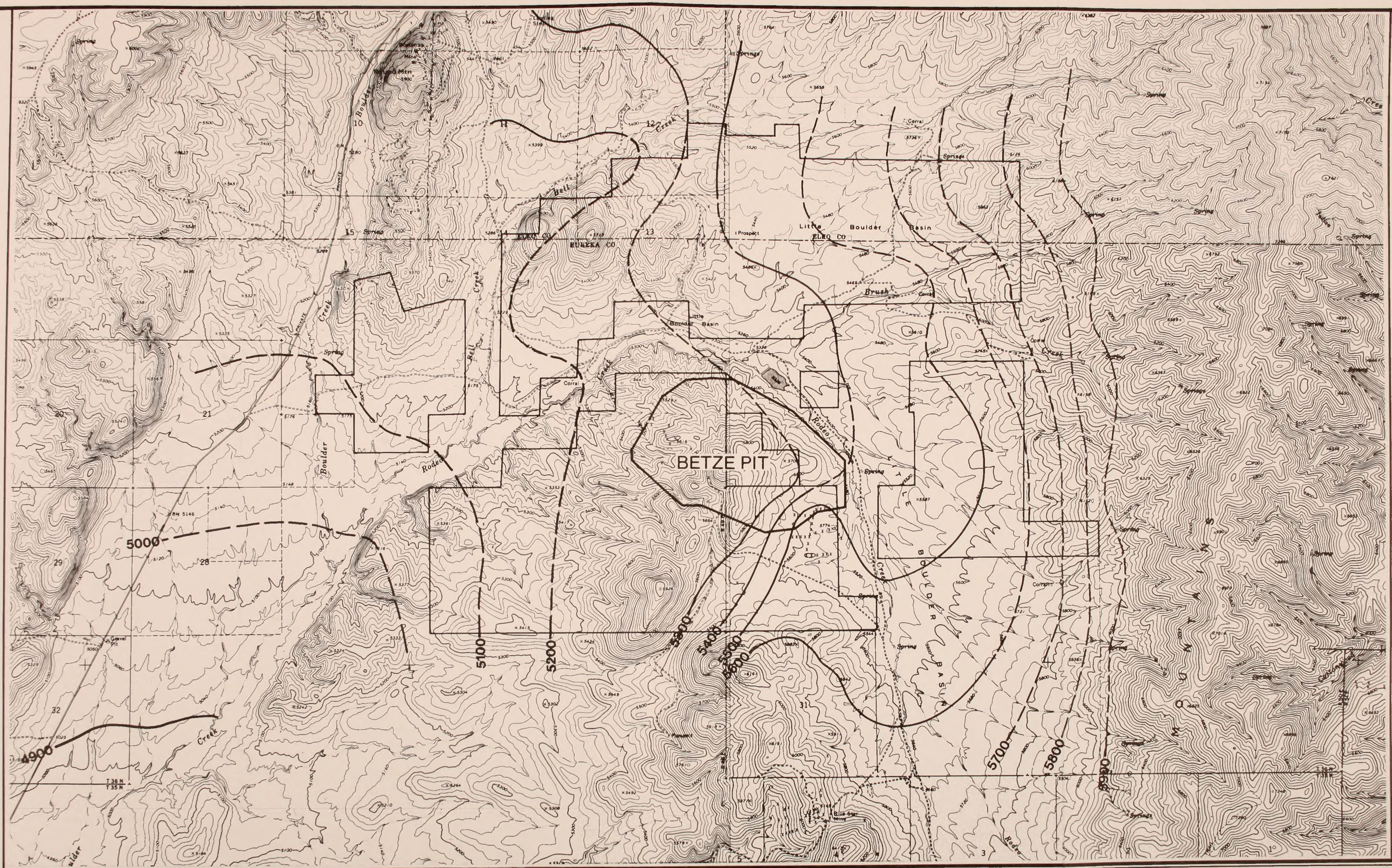
There are no permanent stream gaging stations within the project area or along Boulder Creek. The closest USGS gaging station is located on Maggie Creek upstream of its confluence with Boulder Creek, approximately 10 miles southwest of the present area. Several gaging stations are located on the Humboldt River which flows from east to west approximately 25 to 30 miles south of the project area. The three closest stations, from upstream to downstream on the river, are located at Palisade, Nevada, near Argenta, Nevada and at Battle Mountain, Nevada. The drainage area for each of the three stations on the Humboldt River ranges from about 5,000 square miles ($mi^2$) to 8,900 $mi^2$; mean annual discharge ranges from about 300 cfs to 450 cfs; and runoff ranges from about 240,000 acre-feet to 370,000 acre-feet (Earth Info 1993). The discharge is influenced by numerous irrigation diversions.

Data from mineral exploration drilling provide the majority of the information used to define the groundwater levels within the project area. Figure 3-3 shows a compilation of geologic maps for the project area. Groundwater elevations from several previous environmental assessments and reports (BLM 1993b, 1995a, 1995b, 1996b; Baker Consultants 1989; Leggette, Brashears & Graham, Inc. 1990) are compiled on a single map (Figure 3-5) to show the direction and gradient of groundwater flow within the project area. Generally, groundwater follows topography in flowing from the northeast side of the project area to the southwest into Boulder Valley. South of the proposed Betze Pit, a groundwater mound is associated with the granodiorite Goldstrike Stock, which is less permeable than other formations within the project area.

Because of [illegible] occurs in the central and eastern portions of the project area, groundwater discharges at several springs within the Rodeo Creek, Brush Creek, and Bell Creek drainages. These springs sustain perennial flow immediately downstream of the springs. Further downstream, the drainages become ephemeral as the result of infiltration and recharge to the alluvial aquifers adjacent to the creeks.

Elevated water temperatures are observed in deep wells in the vicinity of the Betze Pit. Elevated water temperatures may be indicative of upward migration of groundwater (Schumacher & Associates 1989). The recharge volume from deep sources is not considered to be significant.

Average annual precipitation for the area is approximately 9.7 inches, based upon long-term records from a recording rain gauge in Elko, Nevada. Rainfall amounts for the 10-, 25-, 50-, and




5300———— - - - - GROUNDWATER ELEVATION CONTOUR (Dashed where inferred.)

0 — 1 miles

N

BETZE PROJECT

**Figure 3-5. Pre-Dewatering Groundwater Elevation Map**

100-year, 6-hour precipitation events are 1.2, 1.4, 1.6, and 1.8 inches, respectively (Miller et al. 1973).

3.4.1.2 Surface Drainage System. The Rodeo Creek drainage basin has its headwaters in Little Boulder Basin at a low divide with Sheep Creek 2.5 miles southeast of the project area. Perennial flow in Rodeo Creek starts at a series of springs in Little Boulder Basin just east of the southeast corner of the South Block (Figure 3-4) slightly upstream of station Rodeo Creek-A (RC-A). The stream is deeply entrenched in a narrow channel with many undercut banks (JBR Consultants Group 1989). Flow records (Table 3-7) indicate that surface flow, although variable, is continuous throughout the year. The springs that feed Rodeo Creek are probably the result of groundwater discharge from the relatively impermeable granodiorite, which contains high groundwater elevations (see Figure 3-5). Creek flow upstream of RC-A occurs in response to intense thunderstorms or snow melt. The drainage area at RC-A of approximately 3,200 acres is impacted by mining activity at Newmont's Blue Star-Genesis operation. The open pit drains internally, leach pads are non-discharging, and waste rock disposal areas contain coarse material that promotes infiltration of precipitation. Therefore, it is likely that Newmont's operation causes a moderate reduction in surface storm runoff. Perennial flow quantity in Rodeo Creek is probably currently unaffected by Newmont's operation.

Rodeo Creek above the station referred to as Rodeo Creek-B (RC-B) has a drainage area of 11,200 acres which includes Brush Creek. Data from this station indicate that flow occurs through winter and spring and tends to diminish or dry up during late summer and fall (Table 3-7). RC-B is located about 0.75 mile downstream of an earthen dam constructed by the BLM in the 1960s to capture sediment transported by the creek. Water stored behind the dam discharges over a spillway during high flow events and through a discharge pipe during low flows. Downstream of the dam at station RC-4, which is approximately 0.5 mile upstream of RC-B, a series of springs appears along a bedrock outcrop. These springs provide some recharge to this section of Rodeo Creek, which is ephemeral in this area. The channel of Rodeo Creek from this point to the confluence with Boulder Creek is a meandering channel that gradually becomes less incised.

Station Rodeo Creek-C (RC-C) is located immediately downstream of the confluence of Bell Creek with Rodeo Creek (Figure 3-4). Above RC-C, Rodeo Creek has a drainage area of 23,600 acres. At this point, Rodeo Creek is about 1 mile upstream and northwest of its confluence with Boulder Creek. The channel at RC-C shows evidence of sedimentation. This is consistent with water quality data (discussed in Section 3.4.2) which shows increasing levels of total suspended solids (TSS) in a downstream direction. Flow at RC-C occurs in the spring over relatively short durations (Table 3-7). Lengthy dry periods are common during the remainder of the year.

TABLE 3-7

SURFACE WATER FLOW MEASUREMENTS[1]

| Station | Date | Flow CFS | Flow GPM |
|---|---|---|---|
| Rodeo Creek A (RC-A) | 12/08/88 | 0.025 | 11 |
| | 01/03/89 | frozen | frozen |
| | 03/21/89 | 0.033 | 21 |
| | 04/11/89 | 0.033 | 12 |
| | 05/17/89 | 0.016 | 7 |
| | 06/27/89 | 0.187 | 84 |
| | 07/17/89 | 0.014 | 7 |
| | 08/17/89 | 0.020 | 9 |
| | 09/13/89 | --- | 5 |
| | 10/18/89 | 0.014 | 6 |
| | 11/03/89 | --- | 130 |
| | 12/06/89 | 0.134 | 60 |
| | 01/03/90 | 0.067 | 30 |
| | 01/18/90 | --- | 3 |
| | 01/21/90 | --- | 1 |
| | 02/07/90 | 0.002 | 1 |
| | 03/15/90 | 0.018 | 8 |
| | 04/04/90 | 0.009 | 4 |
| | 05/03/90 | 0.007 | 3 |
| | 06/06/90 | 0.011 | 5 |
| | 07/17/90 | 0.011 | 5 |
| | 08/03/90 | 0.016 | 7 |
| Rodeo Creek B (RC-B) | 12/08/88 | 0.335 | 150 |
| | 01/04/89 | 0.018 | 8 |
| | 02/17/89 | 0.000 | 0.02 |
| | 03/12/89 | 6.512 | 2,920 |
| | 03/21/89 | 1.784 | 800 |
| | 04/11/89 | 0.027 | 12 |
| | 05/17/89 | 0.580 | 260 |
| | 06/27/89 | 0.060 | 27 |
| | 07/17/89 | 0.020 | 9 |
| | 08/17/89 | 0.007 | 3 |
| | 09/13/89 | 0.000 | 0 |
| | 10/06/89 | 0.000 | 0 |
| | 11/02/89 | 0.000 | 0 |
| | 12/06/89 | 0.000 | 0 |
| | 01/03/90 | | frozen |
| | 01/18/90 | 0.000 | 0 |
| | 02/07/90 | 0.000 | 0 |
| | 03/15/90 | 0.223 | 100 |
| | 04/04/90 | 0.011 | 5 |
| | 05/03/90 | 0.004 | 2 |
| | 06/06/90 | 0.002 | 1 |
| | 07/20/90 | 0.000 | 0 |
| | 08/03/90 | 0.000 | 0 |

TABLE 3-7 (CONTINUED)

| Station | Date | Flow CFS | Flow GPM |
|---|---|---|---|
| Rodeo Creek C (RC-C) | 12/08/88 | 0.335 | 150 |
| | 01/04/89 | 0.000 | 10" standing |
| | 02/17/89 | 0.000 | 0 |
| | 03/12/89 | 5.508 | 2,470 |
| | 03/21/89 | 2.453 | 1,100 |
| | 04/11/89 | | not recorded |
| | 05/17/89 | 0.029 | 13 |
| | 06/27/89 | 0.031 | 14 |
| | 07/17/89 | 0.007 | 3 |
| | 08/17/89 | 0.000 | 0 |
| | 09/13/89 | 0.000 | 0 |
| | 10/06/89 | 0.000 | 0 |
| | 11/02/89 | 0.000 | 0 |
| | 12/06/89 | 0.000 | 0 |
| | 01/03/90 | 0.000 | 0 |
| | 02/07/90 | 0.000 | 0 |
| | 03/15/90 | 1.115 | 500 |
| | 04/04/90 | 0.011 | 5 |
| | 05/03/90 | 0.000 | 0 |
| | 06/06/90 | 0.000 | 0 |
| | 07/20/90 | 0.000 | 0 |
| | 08/03/90 | 0.000 | 0 |
| Boulder Creek A (BC-A) | 12/08/88 | 0.000 | 0 |
| | 03/12/89 | 74.014 | 33,190 |
| | 04/11/89 | | not recorded |
| | 05/19/89 | | not recorded |
| | 08/17/89 | 0.000 | 0 |
| | 12/06/89 | 0.223 | 100 (est) |
| | 01/03/90 | 0.000 | 0 |
| | 02/15/90 | 0.000 | 0 |
| | 03/15/90 | 4.237 | 1,900 |
| | 04/04/90 | 16.266 | 7,294 |
| | 05/03/90 | 1.191 | 534 |
| | 06/06/90 | 1.059 | 475 |
| | 07/20/90 | 0.000 | 0 |
| | 08/03/90 | 0.000 | 0 |
| Boulder Creek B (BC-B) | 03/12/89 | 71.003 | 31,840 |
| | 03/13/89 | 63.020 | 28,260 |
| | 04/11/89 | | not recorded |
| | 05/19/89 | 0.580 | 260 |
| | 10/06/89 | 0.000 | 0 |
| | 12/06/89 | 0.000 | 0 |
| | 01/03/90 | 0.000 | 0 |
| | 03/15/90 | 4.237 | 1,900 |
| | 04/04/90 | 13.262 | 5,947 |
| | 05/03/90 | 0.678 | 304 |

TABLE 3-7 (CONTINUED)

| Station | Date | Flow CFS | Flow GPM |
|---|---|---|---|
| | 06/06/90 | 1.059 | 475 |
| | 07/20/90 | 0.000 | 0 |
| | 08/03/90 | 0.000 | 0 |
| Bell Creek | 10/06/88 | 0.000 | 0 |
| | 03/12/89 | 17.193 | 7,710 |
| | 10/06/89 | 0.000 | 0 |
| Brush Creek | 10/20/88 | 0.045 | 20 |
| | 11/11/88 | 0.033 | 15 |
| | 12/08/88 | 0.049 | 22 |
| | 01/04/89 | 0.080 | 36 |
| | 02/17/89 | 0.027 | 12 |
| | 03/13/89 | 4.505 | 2,020 |
| | 03/21/89 | 2.453 | 1,100 |
| | 04/11/89 | 2.453 | 1,100 |
| | 05/17/89 | 0.169 | 76 |
| | 06/27/89 | 0.279 | 125 |
| | 07/17/89 | 0.051 | 23 |
| | 08/17/89 | 0.025 | 11 |
| | 09/13/89 | 0.025 | 11 |
| | 10/06/89 | 0.045 | 20 |
| | 11/02/89 | 0.049 | 22 |
| | 12/06/89 | 0.056 | 25 |
| | 01/03/90 | 0.011 | 5 |
| | 02/07/90 | 0.056 | 25 |
| | 03/15/90 | 0.274 | 123 |
| | 04/04/90 | 0.062 | 28 |
| | 05/03/90 | 0.116 | 52 |
| | 06/06/90 | 0.089 | 40 |
| | 07/20/90 | 0.033 | 15 |
| | 08/03/90 | 0.049 | 22 |
| Boulder Creek Above Rodeo Creek Confluence | 03/13/89 | 47.499 | 21,300 |
| Boulder Creek Approx. 2 Miles Below BC-B | 03/13/89 | 62.016 | 27,810 |

Source: JBR Consultants Group and Barrick Goldstrike Mines Inc.

[1] Flow data are not available for RC-3 and RC-4.

In summary, Rodeo Creek is perennial in its middle reaches and intermittent in its upper and lower reaches. The source of the creek in the vicinity of RC-A is most likely spring discharge of groundwater from the granodiorite stock. There may be some groundwater discharge from the Carlin Formation via springs on the east side of Rodeo Creek within the lower portions of the reach between RC-A and RC-B. The stream is generally incised between RC-A and RC-C, to depths of 4 to 24 feet (BLM 1988a). Incision may have been caused by excessive grazing along the banks of the creek or by range fires within the watershed. The downstream variation of flow during a single storm or runoff event is high with the Rodeo Creek-Boulder Creek system (see Table 3-7, flow events on 12/6/89 or 3/15/90). Flow variations may be related to the occurrence of localized precipitation, or antecedent moisture conditions.

Brush Creek enters Rodeo Creek from the northeast about 3.5 miles above the confluence of Rodeo Creek with Boulder Creek (Figure 3-4). Brush Creek is perennial in its upper and lower reaches, but it is ephemeral in its mid-section. The stream channel is incised in its lower portions to depths of about 10 feet. The channel bed consists almost entirely of gravel; silt contents are 10 percent or less (BLM 1988a). Flow records for the Brush Creek station near the mouth of the stream show that discharge is perennial, with the highest flows occurring in late winter and spring. It is interesting to note the discontinuity in flow between the Brush Creek station and RC-B, which is located downstream of the confluence of Rodeo Creek and Brush Creek. During numerous flow events (i.e., 12/6/89, 5/3/90, 8/3/90, Table 3-7) there is flow in Brush Creek but no flow in Rodeo Creek, indicating that the flows from Brush Creek have infiltrated into the alluvial aquifer.

Bell Creek enters Rodeo Creek from the north about 1.5 miles upstream of the confluence of Rodeo Creek with Boulder Creek (Figure 3-4). The stream flows perennially in its upper reaches north of the project area, but becomes intermittent about 2 miles above its confluence with Rodeo Creek. The lower portion of the channel contains a short reach of perennial pools that are maintained by subsurface flow (BLM 1988a).

Boulder Creek flows to the south from its headwaters north and east of the project area in the Tuscarora Mountains. The creek turns to the south-southwest at the confluence with Rodeo Creek and continues in a similar direction toward the Humboldt River. Most of the upper reaches of Boulder Creek are perennial due to recharge from springs in the headwater areas. The creek becomes ephemeral about 1 mile above its confluence with Rodeo Creek and remains ephemeral until its confluence with Rock Creek. Streamflow records (Table 3-7) show that flow decreases in a downstream direction (flow events recorded on 4/4/90 and 5/3/90) indicating infiltration into the alluvium of Boulder Valley. The channel of Boulder Creek is about 3 feet deep and 50 feet wide just downstream of the confluence with Rodeo Creek (JBR Consultants Group 1989). The stream bed consists of boulders, cobbles, and gravel with minor amounts of silt.

3.4.1.3 Peak Flows and Runoff. Peak flows and runoff for drainages within the proposed Betze Project area were estimated utilizing the Soil Conservation Service (SCS) Graphical Curve Number Method (SCS 1972). Drainage sub-basins for which hydrologic computations have been made are shown in Figure 3-4, and the results of the computations are tabulated in Table 3-8. Sub-basins were delineated on USGS 7.5-minute quadrangle maps (Figure 3-4). The selection of sub-basins for inclusion in the analysis was based upon the extent of disturbance that would occur within the sub-basin. Therefore, there are some small sub-basins for which hydrologic computations were not necessary. Peak flows typically occur during the months of April, May, and June in response to snowmelt or during the summer months in response to thunderstorm precipitation. The SCS Curve Number Method models runoff in response to a single precipitation event and, therefore, does not model streamflow response to snowmelt.

Average annual runoff for Rodeo Creek Basin was estimated utilizing a method developed by Riggs and Moore (1965). Regional runoff estimates for each 1,000-foot elevation zone within the Rodeo Creek basin were combined to obtain an estimate of mean annual runoff for the entire basin. The region containing the proposed Betze Project is expected to produce runoff only from those portions of the basin that are above 7,000 feet (Riggs and Moore 1965). Since only about 3 percent of the Rodeo Creek basin is above 7,000 feet, the estimated mean annual runoff is 0.5 cubic feet per second (cfs) (or approximately 360 acre-feet). Field data and observations suggest that the surface flow of Rodeo Creek usually infiltrates or evaporates before reaching Boulder Creek. It is probable that the average annual runoff from the higher elevations of the basin never reaches the basin outlet and that the actual runoff may be highly variable from year to year. Runoff is likely to occur in Little Boulder Basin occasionally in response to extreme precipitation events or during unusually high spring runoff.

3.4.1.4 Rodeo and Boulder Creek Floodplains. Floodplain mapping has been performed by the Federal Emergency Management Agency (FEMA). A flood hazard boundary map of the project area including both Boulder Creek and Rodeo Creek depicts the 100-year floodplain (Zone A) for both creeks (FEMA 1982). The mapped floodplain of Rodeo Creek extends approximately 1,000 feet above the confluence of Rodeo Creek and Bell Creek. Utilizing a method described by Thomas and Lindskov (1983), a physiographic floodplain was identified for the remainder of Rodeo Creek. The method, known as the Reconnaissance Method, is an interpretative means of identifying flood-prone areas based upon examination of the stream of interest. Flood-prone areas are then delineated on a topographic map based upon a general knowledge of geomorphic and

TABLE 3-8

MODELED SUB-BASIN FLOW SUMMARY

| Basin[1] | Area (acres) | SCS Curve No. | Storm Event Peak Discharge (cfs) | | | | Storm Event Runoff Volume (Acre Feet) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 10-Year | 25-Year | 50-Year | 100-Year | 10-Year | 25-Year | 50-Year | 100-Year |
| South Block | | | | | | | | | | |
| SB-1 | 687 | 74 | 12 | 23 | 36 | 52 | 3.53 | 6.61 | 10.45 | 14.95 |
| SB-2 | 341 | 74 | 9 | 18 | 28 | 40 | 1.75 | 3.28 | 5.19 | 7.42 |
| SB-3 | 329 | 74 | 7 | 13 | 21 | 30 | 1.69 | 3.17 | 5 | 7.16 |
| SB-4 | 291 | 74 | 10 | 18 | 29 | 42 | 1.5 | 2.8 | 4.43 | 6.33 |
| SB-5 | 448 | 74 | 14 | 26 | 40 | 58 | 2.3 | 4.31 | 6.81 | 9.75 |
| SB-6 | 440 | 74 | 12 | 23 | 36 | 52 | 2.26 | 4.23 | 6.69 | 9.58 |
| AA Block | | | | | | | | | | |
| AA-1 | 1,290 | 68 | 4 | 13 | 25 | 41 | 1.45 | 4.38 | 8.7 | 14.25 |
| AA-2 | 224 | 74 | 5 | 9 | 14 | 20 | 1.15 | 2.16 | 3.41 | 4.87 |
| AA-3 | 1,046 | 68 | 4 | 11 | 23 | 37 | 1.18 | 3.55 | 7.05 | 11.55 |
| AA-4 | 322 | 67 | 1 | 3 | 7 | 11 | 0.24 | 0.87 | 1.83 | 3.1 |
| AA-5 | 304 | 73 | 7 | 13 | 21 | 30 | 1.29 | 2.53 | 4.11 | 5.98 |
| Brush Creek | 3,787 | | | | | 2,830 | | | | |
| North Block | | | | | | | | | | |
| NB-1 | 472 | 74 | 14 | 26 | 41 | 59 | 2.43 | 4.54 | 7.18 | 10.27 |
| NB-2 | 820 | 74 | 14 | 27 | 43 | 61 | 4.21 | 7.89 | 12.47 | 17.84 |
| NB-2A | 233 | 74 | 8 | 14 | 22 | 32 | 1.2 | 2.24 | 3.54 | 5.07 |
| NB-2B | 170 | 74 | 6 | 10 | 17 | 24 | 0.87 | 1.64 | 2.59 | 3.7 |
| Bell Creek | 9,343 | | 2,011 | | | 4,062 | | | | |

[1]See Figure 3-4 for location of the sub-basins.

hydraulic principles. A narrow floodplain was thus extended upstream to the vicinity of RC-A (Figure 3-6). This floodplain is located based upon aerial photographs and USGS topographic maps and may not precisely delineate the 100-year floodplain. However, it represents the extent of flat area adjacent to Rodeo Creek that may be inundated during extreme flow events.

3.4.1.5 Hydrogeologic Conditions. Groundwater in the project area occurs within shallow alluvium, the Carlin Formation, Paleozoic sedimentary rocks and the granodiorite stock. The Paleozoic sedimentary rocks are split into two major groups, called the upper plate and lower plate, based upon the relationship of each group to the Roberts Mountain Thrust Fault (BLM 1988a). Seeps and springs occur in the area, primarily on the western flank of the Tuscarora Mountains. Sufficient data do not presently exist to determine which of the seeps and springs are hydraulically connected to the regional groundwater system, or which of the seeps and springs are perched groundwater discharge zones, isolated from the regional groundwater system by local geologic faults or low permeability zones.

Shallow alluvial deposits are found adjacent to creeks in the project area. Subsurface drainage within these deposits follows the course of Rodeo Creek. The creek flows north on the east side of the South Block, and westerly around the north end of the South Block to Boulder Creek. Alluvium generally consists of interbedded clay, silt, sand, and gravel deposited by channel and overbank flows of the creek. The permeability of the alluvium in the Little Boulder Basin ranges from 1 x $10^{-4}$ cm/sec to 8 x $10^{-2}$ cm/sec (BLM 1988c). There is usually a direct hydraulic connection between groundwater in the alluvium and any surface flow in streams. There is also a hydraulic connection between groundwater in the alluvium and in the underlying bedrock formations.

The Tertiary Carlin Formation is found east and north of Rodeo Creek (BLM 1988a and 1988b) in Little Boulder Basin. The formation is up to 600 feet thick and consists of a complex of sandy tufaceous silts, shales, and conglomerates (BLM 1988b). The variable nature of the formation produces zones of more coarsely grained layers of permeable material interbedded with more finely grained relatively impermeable material. The impermeable beds retard the flow of water and locally confine the underlying permeable zones (BLM 1988b). Flow in the Carlin Formation in the project area is generally from east to west along the permeable layers and the bedding planes within the formation. Very little vertical flow occurs and, in fact, it appears that the Carlin Formation acts as an aquitard, producing locally confined conditions within the underlying sedimentary rock (BLM 1988a). This is demonstrated by the fact that a well drilled by Newmont through the Carlin Formation into the underlying sedimentary rocks produced artesian flow conditions (BLM 1988c). The permeability of the Carlin Formation ranges from 6.0 x $10^{-7}$ cm/sec to 2.4 x


FLOODPLAIN

0 1
miles

BETZE PROJECT

**Figure 3-6. Rodeo and Boulder Creek Floodplains**

$10^{-4}$ cm/sec (BLM 1988c). Most of the recharge of the Carlin Formation probably is derived from direct infiltration of precipitation and snowmelt from the mountains. Lesser amounts are derived from the underlying sedimentary rocks.

The topographic high south and west of Rodeo Creek and east of Boulder Creek is underlain by the Paleozoic sedimentary rocks (upper and lower plate) and the Cretaceous granodiorite. The proposed Betze Pit would be located predominantly within the sedimentary rock and, to a lesser extent, within the granodiorite. The upper plate rocks which are host to the oxide mineral deposits of the Post Pit consist primarily of siltstone, limestone, argillite, and quartzite (BLM 1988a). The lower plate rocks are composed of carbonaceous meta-limestones and dolomites that host the sulfide deposits of the Betze Pit. Both the upper and lower plate rocks have been extensively fractured and altered; resulting in a highly variable secondary porosity and permeability (BLM 1988a). Prior to dewatering activities, the groundwater table within the sedimentary rock in the vicinity of the Post Pit was at an elevation of about 5,300 feet (BLM 1988a). At present, the groundwater elevations in the Post Pit have been depressed approximately 300 feet by the existing dewatering program.

The major fault systems within the sedimentary rock trend northwest and dip to the north. Minor fault systems trend north and northeast. The Post Fault, located on the east side of the proposed Betze Pit, is thought to act as a no-flow boundary (flow barrier) (Papadopulos & Associates 1988). In fact, exploratory drilling revealed a 100-foot drop in groundwater elevations across, from east to west, the Post Fault prior to active dewatering. The existing mining operation has mined through the fault, and has exposed the fault trace in the eastern walls of the Post Pit. Thermal (110° to 130°F) waters observed in drill holes at depths of 800 to 1,200 feet probably migrate upward along fractures associated with the major fault system, which is also associated with higher than normal well yields. Recharge of the sedimentary rock probably occurs from infiltration of direct precipitation and snowmelt. Deeper portions of the sedimentary rock may also be recharged by east to west groundwater flow in the project area (BLM 1988a).

The Cretaceous Goldstrike Stock is intruded into the sedimentary rock at the southeast corner of the proposed Betze Pit. Preliminary hydrologic analysis indicates that the contact between the stock and the sedimentary rock is highly altered and acts as a no-flow boundary (BLM 1988a). The mound in the groundwater elevation associated with the stock suggests that the granodiorite has a lower permeability than the surrounding metasediments. The gradient of the groundwater surface to the east and northeast from the granodiorite indicates that groundwater in the granodiorite stock flows toward Little Boulder Basin and discharges into Rodeo

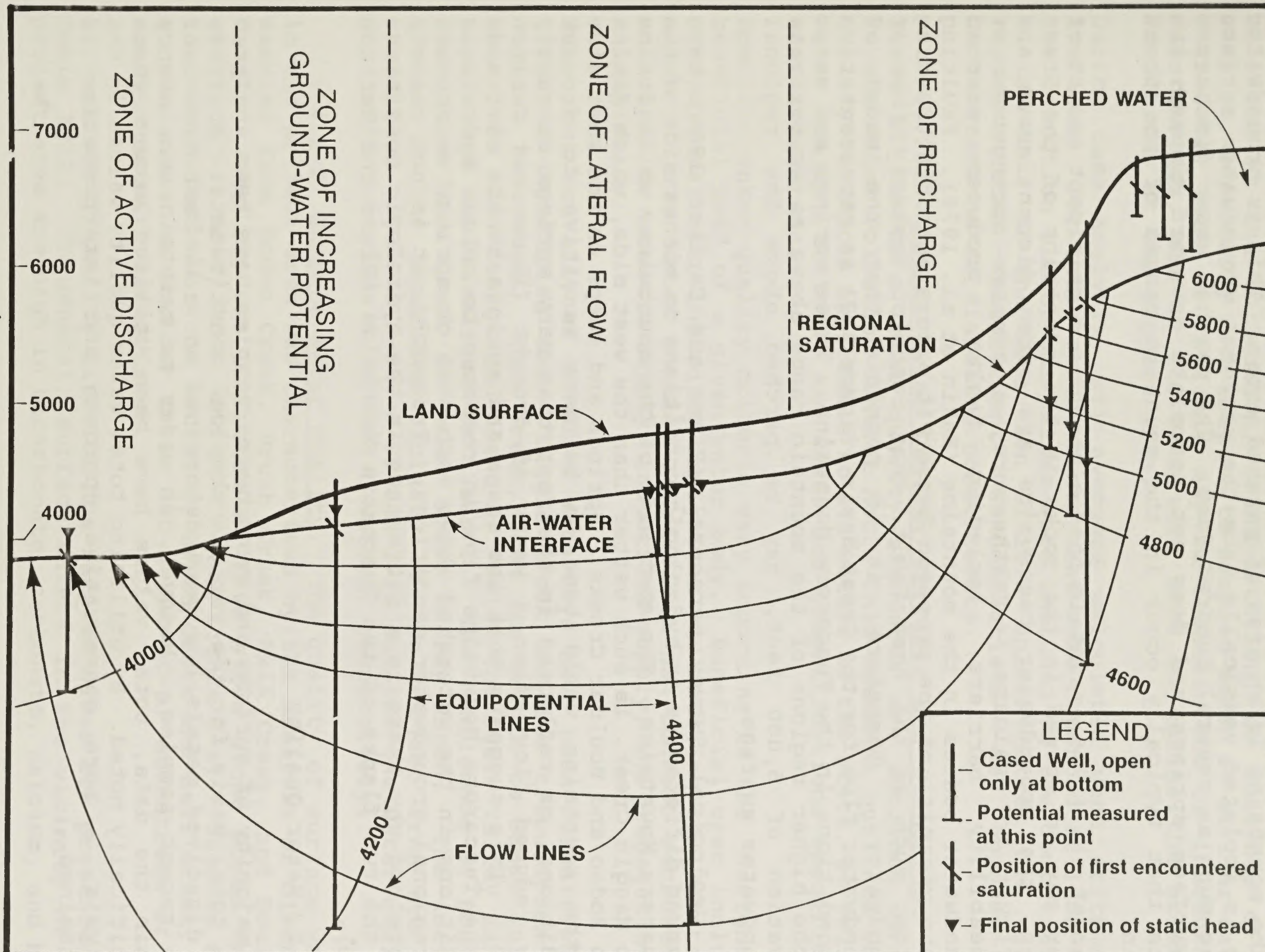
Creek. The groundwater elevation in the granodiorite averages 5,500 to 5,600 feet (BLM 1988a).

Groundwater conditions in Boulder Valley are characterized from data gathered from monitoring wells recently drilled in the vicinity of the reservoir, in the unnamed drainage, and at the irrigation areas. Drill logs suggest that a thin veneer of alluvium overlies the Carlin Formation in the valley. Groundwater conditions in Boulder Valley are somewhat similar to those in Little Boulder Basin east of Rodeo Creek, except that no springs are present and Boulder Creek is ephemeral along its channel in the valley. Groundwater flow within the alluvium follows the surface slope of Boulder Valley and is tributary to the Humboldt River hydrologic system (Harrill et al. 1988). The groundwater table is over 100 feet below the surface in two wells located about 1.5 miles downstream from the confluence of Boulder Creek and Rodeo Creek (Kiracofe 1990). Groundwater levels in the reservoir area are about 300 to 400 feet below ground surface while those in the Boulder Valley west of the reservoir are 30 to 70 feet below ground surface. Water levels in the alluvium along Boulder Creek rise to within 10 to 25 feet of the surface in the lower reaches of Boulder Valley (Thomas et al. 1986).

An inventory of springs and seeps in the vicinity of the project was undertaken during October and November 1989 to establish background flow rates and water chemistry within an area that could potentially be impacted by dewatering activities (JBR Consultants Group 1990). The inventory identified 131 springs or seeps within a study area that encompasses the watersheds of Boulder, Bell, Brush, and Rodeo Creeks as well as tributaries to Maggie Creek on the eastern flank of the Tuscarora Mountains. With the exception of a small spring adjacent to Rodeo Creek about 1 mile upstream from the confluence with Bell Creek, all springs and seeps are upgradient from the proposed Betze Pit and related facilities.

The majority of the springs and seeps are located east and north of the project area on the western flank of the Tuscarora Mountains in the headwaters of Boulder, Bell, and Brush Creeks (JBR Consultants Group 1990). Observed flow rates vary from a high of 22 gallons per minute (gpm) at a spring in upper Bell Creek to less than 1 gpm at numerous sites throughout the study area. Generally, the springs with flow rates greater than 1 gpm are located in the higher elevations of the Tuscarora Mountains within about 2 miles of the topographic divide between the Boulder Creek drainage to the west and the Maggie Creek drainage to the east.

At this time, there is insufficient site-specific information to determine the hydraulic connectivity between springs and seeps in the Tuscarora Mountains and the regional groundwater system. However, regional studies of groundwater in the Great Basin (Mifflin 1988; Eakin et al. 1976) suggest that these springs and seeps could be perched above the groundwater table. Figure 3-7




BETZE PROJECT

Figure 3-7. Idealized Sketch of Fluid Potentials in Great Basin Flow Systems (After Mifflin 1968).

depicts an idealized cross-sectional sketch of groundwater flow in the Great Basin. Upstream of the "zone of recharge" at the crest of the mountains is an area of perched water. This is groundwater that is isolated vertically from the regional groundwater surface by as much as several hundred feet. The perched water discharges to surface springs and does not percolate downward through the rocks that typically occur in the mountain ranges of the Great Basin.

Eakin et al. (1976) maintain that although a significant amount of water may be stored in the rocks in the mountains of the Great Basin, the groundwater reservoirs are often discontinuous and difficult to evaluate. Furthermore, a complex arrangement of permeability barriers, including faults, produces perched groundwater bodies in the mountains (Eakin et al. 1976). Faulting in the vicinity of the proposed Betze Pit occurs as north trending faults, such as the Post Fault, that restrict westerly flow of groundwater. Therefore, it is possible that the model of groundwater flow for the Great Basin (Figure 3-7) is representative of conditions in the Tuscarora Mountains. Those springs and seeps in the higher regions of the mountain range above an approximate elevation of 6,000 feet, may be perched above the regional groundwater surface.

U.S. Geological Survey personnel (Plume and Carlton 1990) have observed differences in hydrologic conditions on either side of the Tuscarora Mountains. The east side of the mountains, which drains into Maggie Creek, is much wetter than the west side, which drains into Rodeo and Boulder Creeks. Springs and seeps on the west side of the mountains would tend to be more sensitive to drought conditions, as reflected in the fact that many springs currently show reduced flow after 4 years of drought (Plume and Carlton 1990). This suggests that the seeps and springs on the west side of the Tuscarora Mountains flow in response to unique hydrologic conditions in the watershed above each seep or spring, as opposed to regional groundwater conditions. Presently, it is not clearly understood why there is a difference in the hydrologic conditions for the two flanks of the Tuscarora Mountains (Plume and Carlton 1990).

### 3.4.2 Water Quality

The majority of surface and groundwater samples have been analyzed on a total basis for the various chemical constituents. Analysis for dissolved metals has been determined on a limited number of more recent samples. However, in order to maintain consistency within the data, total values have been utilized except where specifically noted. By utilizing total water quality values in the analysis, a more conservative approach and interpretation is maintained.

Water samples were collected by Barrick and JBR Associates. Quality assurance/quality control procedures were not always utilized in the collection, transportation, or analysis of the samples, especially with respect to samples taken at earlier dates. Therefore, some of the data may be inconsistent or inaccurate. Nevertheless, all of the data were used to define the existing conditions at the project area.

During data analysis, all averages calculated were arithmetic averages. For those constituents that were reported at less than the detection limit, the values were included in the computations at one-half of the detection limit. Unless noted, the values report total constituent concentrations as opposed to concentrations of dissolved constituents.

3.4.2.1 Nevada Water Quality Criteria and Standards. The State of Nevada's water quality standards are outlined in the Nevada Water Pollution Control Act. This document outlines water quality standards applicable to all waters of the state, as well as water quality criteria and water use classifications specific to selected waters.

Specific water quality criteria vary according to the "designated beneficial use" of a given water body. Beneficial uses include: agricultural use, including irrigation and watering of livestock; aquatic life; water contact recreation; non-contact recreation; municipal or domestic supply; industrial supply; and propagation of wildlife.

Many, but not all, of Nevada's waterways have been classified in terms of beneficial use. Maggie Creek and its tributaries are class A waterways. Rock Creek, from its origin to Squaw Valley Ranch, is also designated class A. Below the Squaw Valley Ranch, Rock Creek is classified as class C. The confluence of Boulder Creek and Rock Creek is below Squaw Valley Ranch. The smaller creeks in the immediate vicinity of the project area are not classified. Tables 3-9A, 3-9B and 3-9C outline the water quality standards for class A, B, and C waters, respectively.

3.4.2.2 Surface Water Quality. The quality of surface water in the project area was characterized by the analysis of discrete samples from Rodeo Creek, Brush Creek, Bell Creek, and Boulder Creek. Sampling was conducted at five sites along Rodeo Creek (RC-A, RC-3, RC-4, RC-B, and RC-C) (see Figure 3-4). Samples were also collected near the mouths of Brush Creek and Bell Creek, and at two sites on Boulder Creek (BC-A and BC-B) downstream of the confluence with Rodeo Creek.

Surface water quality data for the sampled sites are presented in Table 3-10. In general, surface waters in the vicinity of the project area are high in bicarbonate, carbonate, calcium, and have

## TABLE 3-9A

## CLASS A WATER QUALITY STANDARDS

| Item | Specifications |
|---|---|
| Floating solids, sludge deposits, taste or odor-producing substances | None attributable to human activities. |
| Sewage, industrial wastes or other wastes | None |
| Toxic materials, oils, deleterious substances, colored or other wastes | None |
| Settleable solids | Only amounts attributable to human activities which will not make the waters unsafe or unsuitable as a drinking water source or which will not be detrimental to aquatic life or for any other beneficial use established for this class. |
| pH | Range between 6.5 to 8.5. |
| Dissolved oxygen | Must not be less than 6.0 mg/l. |
| Temperature | Must not exceed 20° C. Allowable temperature increase above natural receiving water temperature: None. |
| Fecal coliform | The fecal coliform concentration, based on a minimum of 5 samples during any 30-day period, must not exceed a geometric mean of 200 per 100 ml, nor may more than 10 percent of total samples during any 30-day period exceed 400 per 100 ml. |
| Total phosphate | Must not exceed 0.15 mg/l in any stream at the point where it enters any reservoir or lake, nor 0.30 mg/l in streams and other flowing waters. |
| Total dissolved solids | Must not exceed 500 mg/l or one-third above that characteristic of natural conditions (whichever is less). |

TABLE 3-9B

CLASS B WATER QUALITY STANDARDS

| Item | Specifications |
|---|---|
| Floating solids, settleable solids or sludge deposits | Only such amounts attributable to human activities which will not make the waters unsafe or unsuitable as a drinking water source, injurious to fish or wildlife or impair the waters for any other beneficial use established for this class. |
| Sewage, industrial wastes or other wastes | None which are not effectively treated to the satisfaction of the department. |
| Odor-producing substances | Only such amounts which will not impair the palatablility of drinking water or fish or have a deleterious effect upon fish, wildlife or any beneficial uses established for waters of this class. |
| Toxic materials, oil, deleterious substances, colored or other wastes, or heated or cooled liquids | Only such amounts as will not render the receiving waters injurious to fish or wildlife or impair the receiving waters for any beneficial uses established for this class. |
| pH | Range between 6.5 to 8.5 |
| Dissolved oxygen | For trout waters, not less than 6.0 mg/l; for nontrout waters, not less than 5.0 mg/l. |
| Temperature | Must not exceed 20°C for trout waters or 24°C for nontrout waters. Allowable temperature increase above natural receiving water temperatures: None. |
| Fecal coliform | The fecal coliform concentration, based on a minimum of 5 samples during any 30-day period, must not exceed a geometric mean of 200 per 100 ml, nor may more than 10 percent of total samples during any 30-day period exceed 400 per 100 ml. |
| Total phosphates | Must not exceed 0.3 mg/l. |
| Total dissolved solids | Must not exceed 500 mg/l or one-third above that characteristic of natural conditions (whichever is less). |

TABLE 3-9C

CLASS C WATER QUALITY STANDARDS

| Item | Specifications |
|---|---|
| Floating solids, solids that will settle or sludge deposits | Only those amounts attributable to human activities which will not make the receiving waters injurious to fish or wildlife or impair the waters for any other beneficial use established for this class. |
| Sewage, industrial wastes or other wastes | None which are not effectively treated to the satisfaction of the department. |
| Toxic materials, oil, deleterious substances, colored or other wastes, or heated or cooled liquids | Only such amounts as will not render the receiving waters injurious to fish or wildlife or impair the waters for any beneficial use established for this class. |
| pH | Range between 6.5 to 8.5 |
| Dissolved oxygen | For waters with trout, not less than 6.0 mg/l; for waters without trout, not less than 5.0 mg/l. |
| Temperature | Must not exceed 20°C for waters with trout or 34°C for waters without trout. Allowable temperature increase above natural receiving water temperatures: 3°C. |
| Fecal coliform | The more stringent of the following apply: 1) The fecal coliform concentration must not exceed a geometric mean of 1,000 per 100 ml nor may more than 20 percent of total samples exceed 2,400 per 100 ml; 2) The annual geometric mean of fecal coliform concentration must not exceed that characteristic of natural conditions by more than 200 per 100 ml nor may the number of fecal coliform in a single sample exceed that characteristic of natural conditions by more than 400 per 100 ml; and 3) The fecal coliform concentration, based on a minimum of 5 samples during any 30-day period, must not exceed a geometric mean of 200 per 100 ml, nor may more than 10 percent of total samples during any 30-day period exceed 400 per 100 ml. This is applicable only to those waters used for primary contact recreation. |
| Total phosphates | Must not exceed 1.0 mg/l. |
| Total dissolved solids | Must not exceed 500 mg/l or one-third above that characteristic of natural conditions (whichever is less). |

TABLE 3-10

MEAN WATER QUALITY DATA FOR SURFACE WATER STATIONS

| PARAMETER | RC-A | RC-3 | RC-4 | RC-B | RC-C | BRUSH | BELL | BC-A | BC-B |
|---|---|---|---|---|---|---|---|---|---|
| Alkalinity as CaCO3, mg/l | 188.250 | 162.800 | 134.567 | 198.500 | 216.750 | 170.778 | 135.000 | 49.000 | 54.000 |
| Aluminum (T) as Al, mg/l | <0.100 | <0.100 | <0.100 | 0.432 | 0.314 | 0.128 | 0.330 | 1.800 | 1.700 |
| Ammonia as NH3-N, mg/l | 0.127 | 0.384 | 0.130 | 0.241 | 1.056 | 0.132 | <0.100 | <0.200 | <0.200 |
| Arsenic (T) as As, mg/l | 0.199 | 0.071 | 0.067 | 0.048 | 0.076 | 0.010 | 0.089 | 0.005 | 0.006 |
| Barium (T) as Ba, mg/l | 0.186 | 0.112 | 0.097 | 0.059 | 0.119 | 0.087 | 0.218 | 0.120 | 0.110 |
| Bicarbonate as HCO3, mg/l | 224.250 | 194.600 | 145.000 | 222.444 | 238.625 | 204.333 | 164.000 | 59.000 | 65.000 |
| Boron (T) as B, mg/l | 0.175 | 0.142 | 0.138 | 0.196 | 0.435 | 0.082 | <0.140 | <0.100 | <0.100 |
| Cadmium (T) as Cd, mg/l | | <0.010 | <0.010 | 0.005 | <0.010 | 0.005 | 0.010 | | |
| Calcium as Ca, mg/l | 52.800 | 26.263 | 43.040 | 35.613 | 55.371 | 38.267 | 39.200 | 12.000 | 13.000 |
| Carbonate as CO3, mg/l | <5.000 | 0.840 | 9.300 | 8.067 | 12.313 | 1.411 | 0.000 | <5.000 | <5.000 |
| Chloride as Cl, mg/l | 69.725 | 30.720 | 46.767 | 26.333 | 46.113 | 16.922 | 9.210 | <0.005 | 3.600 |
| Chromium (Hex) as Cr, mg/l | <0.010 | <0.010 | 0.008 | <0.005 | <0.010 | <0.010 | <0.010 | | |
| Chromium (T) as Cr, mg/l | <0.001 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | 0.020 | <0.005 | <0.005 |
| Conductivity, uhmos/cm | 683.167 | 489.500 | 492.571 | 618.345 | 812.694 | 480.950 | 380.000 | 196.667 | 195.000 |
| Copper (T) as Cu, mg/l | <0.005 | 0.014 | 0.014 | <0.010 | 0.004 | <0.010 | <0.010 | <0.005 | <0.005 |
| Cyanide (T) as CN, mg/l | <0.010 | 0.007 | <0.005 | <0.005 | 0.005 | <0.010 | <0.002 | <0.005 | <0.005 |
| Cyanide (Free) as CN, mg/l | <0.100 | <0.100 | 0.013 | <0.100 | 0.030 | 0.028 | <0.002 | <0.100 | <0.100 |
| Cyanide (WAD) as CN, mg/l | <0.010 | <0.005 | 0.003 | <0.005 | 0.004 | 0.003 | | <0.005 | <0.005 |
| Fluoride as F, mg/l | <0.600 | 0.442 | 0.230 | 0.663 | 0.905 | 0.491 | <0.430 | <0.500 | <0.500 |
| Gold as Au, mg/l | <0.010 | 0.006 | <0.010 | <0.010 | <0.010 | 0.006 | 0.010 | <0.005 | <0.005 |
| Hardness as CaCO3, mg/l | 201.250 | 153.200 | 182.333 | 267.444 | 372.625 | 193.444 | 178.000 | 51.000 | 51.000 |
| Hardness (Non-Carb) as CaCO3 | 0.000 | 0.000 | 9.000 | 69.600 | 63.250 | 3.000 | 9.000 | | |
| Hardness (T) as CaCO3, mg/l | 158.000 | 134.200 | 188.667 | 269.400 | 365.250 | 187.600 | 188.000 | | |
| Hydroxide as OH, mg/l | <5.000 | 0.000 | 0.000 | <5.000 | 1.250 | <5.000 | 0.000 | <5.000 | <0.500 |
| BODs, mg/l | 0.500 | 1.133 | 0.500 | 0.500 | 1.400 | 1.100 | | | |
| COD, mg/l | 2.500 | 8.000 | <5.000 | 5.333 | 8.750 | 2.667 | | | |
| TOC, mg/l | 11.900 | 18.500 | 13.000 | 22.533 | 35.000 | 95.300 | | | |
| Iron (D) as Fe, mg/l | 0.005 | 0.024 | <0.010 | 0.014 | 0.051 | 0.013 | 0.220 | | |
| Iron (T) as Fe, mg/l | 0.116 | 1.725 | 2.186 | 1.486 | 2.171 | 0.147 | <5.300 | 1.600 | 1.800 |
| Lead (T) as Pb, mg/l | 0.005 | 0.010 | 0.016 | <0.010 | 0.012 | 0.004 | 0.010 | <0.005 | <0.005 |
| Magnesium as Mg, mg/l | 19.025 | 15.388 | 21.700 | 27.038 | 31.523 | 23.289 | 21.700 | 4.500 | 5.000 |
| Manganese (T) as Mn, mg/l | 0.089 | 0.086 | 0.078 | 0.035 | 0.043 | 0.030 | <0.140 | 0.045 | 0.043 |
| Mercury as Hg, mg/l | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | <0.001 | <0.001 |
| Nickel (T) as Ni, mg/l | <0.010 | <0.010 | 0.015 | <0.010 | 0.014 | 0.007 | 0.033 | <0.010 | <0.010 |
| Nitrate as NO3-N, mg/l | 0.962 | 0.155 | 0.122 | 0.080 | 1.599 | 0.037 | 0.048 | 0.147 | <0.050 |
| Nitrite as NO2-N, mg/l | 0.003 | 0.017 | 0.030 | 0.009 | 0.019 | 0.012 | 0.013 | | |
| Phosphate (Ortho) as PO4-P, | 0.137 | 0.212 | 0.377 | 0.224 | 0.153 | 0.184 | 0.190 | 0.110 | 0.110 |
| Potassium as K, mg/l | 7.575 | 7.420 | 8.200 | 10.256 | 11.725 | 5.922 | 3.100 | 2.400 | 2.600 |
| Selenium (T) as Se, mg/l | <0.005 | 0.002 | 0.002 | 0.004 | 0.006 | 0.002 | 0.003 | <0.005 | <0.005 |
| Silica (D) as SiO2, mg/l | 42.200 | 42.980 | 29.800 | 40.720 | 40.025 | 40.680 | <20.600 | | |
| Silica (T) as SiO2, mg/l | 15.667 | | | 13.813 | 13.475 | 16.700 | | 11.000 | 11.000 |
| Silver (T) as Ag, mg/l | 0.004 | 0.015 | 0.010 | <0.010 | <0.010 | 0.004 | 0.010 | <0.005 | <0.005 |
| Sodium as Na, mg/l | 62.175 | 42.800 | 39.080 | 41.288 | 75.765 | 23.244 | 31.100 | 7.300 | 8.100 |
| Sulfate as SO4, mg/l | 68.675 | 36.880 | 78.133 | 132.956 | 265.375 | 65.811 | 103.000 | 19.000 | 21.000 |
| Suspended Solids, mg/l | 9.755 | 25.300 | 29.760 | 123.361 | 370.289 | 6.812 | <171.000 | 8.000 | 8.000 |
| Settleable Solids, ml/l/hr | 0.100 | | | 0.126 | 0.089 | 0.125 | | 0.200 | <0.100 |
| Thallium as Tl, mg/l | <0.005 | <0.010 | <0.010 | 0.004 | <0.010 | <0.010 | 0.010 | <0.005 | <0.005 |
| Total Dissolved Solids, mg/ | 456.750 | 320.200 | 342.000 | 468.556 | 696.000 | 309.000 | 107.000 | 120.000 | 120.000 |
| TPH, mg/l | <1.000 | | | | 0.500 | | | 0.500 | |
| Turbidity, NTU | 22.327 | 24.338 | 39.900 | 45.919 | 76.013 | 2.683 | 24.000 | 9.433 | 15.000 |
| Zinc (T) as Zn, mg/l | 0.058 | 0.103 | 0.048 | 0.010 | 0.023 | 0.031 | 0.298 | 0.022 | 0.021 |
| pH Units | 8.325 | 8.245 | 8.493 | 8.352 | 8.345 | 8.105 | 8.180 | 8.467 | 8.400 |
| Cations, meq/l | 5.940 | 4.770 | 5.653 | 6.648 | 10.960 | 5.104 | 5.180 | | |
| Anions, meq/l | 5.700 | 4.876 | 5.657 | 8.000 | 10.963 | 5.128 | 5.120 | | |

high alkalinity. All water quality data for each sampling site are provided in Appendix B.

RC-A and RC-3 are located on Rodeo Creek upstream of the proposed Betze Pit, RC-4 and RC-B are adjacent to the proposed pit, and RC-C is located on Rodeo Creek downstream of the proposed project just below the confluence with Bell Creek. Brush Creek is tributary to Rodeo Creek from the northeast, and it is relatively unimpacted by mining with the possible exception of runoff from surface disturbance at Newmont's Mill No. 4. Water quality stations on Boulder Creek (BC-A and BC-B) measure flow from Rodeo Creek and Boulder Creek downstream of the project area. A comparison of water quality data from these stations provides insight into the present impacts of mining activities on Rodeo Creek.

Arsenic levels in Rodeo Creek are above the drinking water standard of 0.05 mg/l. The mean arsenic concentration for RC-B is at the drinking water standard, while the mean arsenic concentrations at the other four stations are above the standard. Maximum values range from 0.12 at RC-3 to 1.4 mg/l at RC-C. These naturally occurring arsenic levels are probably caused by the discharge of groundwater that has been in contact with rocks containing high levels of arsenic. Brush Creek contains levels of arsenic below the drinking water standard. The one sample from Bell Creek contains arsenic in excess of the standard. When Boulder Creek is flowing, the parameters meet drinking water standards.

Cyanide occasionally has been found in Rodeo Creek and Brush Creek at levels below the drinking water standard of 0.2 mg/l. The occurrence of cyanide in surface waters is relatively short-lived because of the tendency for cyanide to degrade rapidly in the environment. In surface waters cyanide may be oxidized, volatilized, degraded by sunlight and biological activity, or complexed with heavy metals within the environment due to its high reactivity.

Detection of cyanide at sampling sites within the project area has been sporadic. These data may result from sample collection, preservation or analytic error, especially since the reported concentrations commonly approach the level of detection.

3.4.2.3 Dewatering and Discharge Water Quality. Currently, water from dewatering wells is pumped to the West No. 9 Pit, treated to remove arsenic, and subsequently discharged down the unnamed drainage to the TS Ranch Reservoir. A comparison of water quality analyses for the West No. 9 Pit and the existing NPDES discharge point (WNPD-1) shows the reduction in arsenic levels resulting from treatment (Table 3-11). The mean value of arsenic in the inflow stream (West No. 9 Pit) is 0.14 mg/l and the mean for the outflow is 0.03 mg/l, indicating a removal efficiency of about 80 percent. Levels of other constituents remain essentially

TABLE 3-11

WATER QUALITY PARAMETERS FOR DEWATERING AND DISCHARGE

| PARAMETER | WEST #9 PIT | | | DISCHARGE POINT (WNPD-1) | | | FLUME ABOVE DAM | | |
|---|---|---|---|---|---|---|---|---|---|
| | MINIMUM | MEAN | MAXIMUM | MINIMUM | MEAN | MAXIMUM | MINIMUM | MEAN | MAXIMUM |
| Alkalinity as CaCO3, mg/l | 216.000 | 311.100 | 370.000 | 260.000 | 340.667 | 400.000 | 240.000 | 275.625 | 330.000 |
| Aluminum (T) as Al, mg/l | 0.050 | 0.166 | 0.420 | | | | | | |
| Ammonia as NH3-N, mg/l | 0.050 | 0.588 | 2.090 | 0.100 | 0.827 | 2.200 | 0.100 | 0.506 | 1.200 |
| Arsenic (T) as As, mg/l | 0.005 | 0.138 | 0.590 | 0.003 | 0.032 | 0.060 | 0.007 | 0.028 | 0.042 |
| Barium (T) as Ba, mg/l | 0.005 | 0.107 | 0.220 | 0.080 | 0.131 | 0.230 | 0.080 | 0.123 | 0.160 |
| Bicarbonate as HCO3, mg/l | 248.000 | 371.200 | 440.000 | 320.000 | 415.333 | 480.000 | 260.000 | 326.875 | 400.000 |
| Boron (T) as B, mg/l | 0.547 | 0.830 | 1.100 | 0.700 | 0.760 | 0.900 | 0.700 | 0.769 | 0.900 |
| Cadmium (T) as Cd, mg/l | <0.010 | <0.010 | <0.010 | 0.003 | 0.003 | 0.003 | <0.005 | <0.005 | <0.005 |
| Calcium as Ca, mg/l | 28.700 | 52.930 | 93.300 | 16.000 | 76.133 | 95.000 | 26.000 | 57.438 | 85.000 |
| Carbonate as CO3, mg/l | 0.000 | 2.960 | 7.800 | <5.000 | <5.000 | <5.000 | 2.500 | 2.719 | 6.000 |
| Chloride as Cl, mg/l | 11.900 | 18.930 | 29.800 | 15.000 | 18.467 | 24.000 | 15.000 | 19.063 | 25.000 |
| Chromium (Hex) as Cr, mg/l | 0.005 | 0.005 | 0.005 | | | | | | |
| Chromium (T) as Cr, mg/l | 0.003 | 0.004 | 0.005 | <0.005 | <0.005 | 0.006 | <0.005 | <0.005 | <0.005 |
| Conductivity, uhmos/cm | 537.000 | 778.400 | 1000.000 | 670.000 | 881.333 | 1100.000 | 570.000 | 812.500 | 1000.000 |
| Copper (T) as Cu, mg/l | 0.003 | 0.007 | 0.025 | 0.003 | 0.005 | 0.010 | <0.005 | <0.005 | 0.007 |
| Cyanide (T) as CN, mg/l | 0.003 | 0.016 | 0.058 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.005 |
| Cyanide (Free) as CN, mg/l | 0.001 | 0.021 | 0.050 | | | | | | |
| Cyanide (WAD) as CN, mg/l | 0.003 | 0.003 | 0.003 | | | | | | |
| Fluoride as F, mg/l | 0.550 | 1.249 | 1.600 | 0.700 | 1.140 | 1.400 | 0.600 | 1.094 | 1.400 |
| Gold as Au, mg/l | 0.003 | 0.004 | 0.005 | | | | | | |
| Hardness as CaCO3, mg/l | 139.000 | 238.500 | 370.000 | | | | | | |
| Hardness (Non-Carb) as CaCO3, mg/l | 0.000 | 0.000 | 0.000 | | | | | | |
| Hardness (T) as CaCO3, mg/l | 129.000 | 212.167 | 343.000 | | | | | | |
| Hydroxide as OH, mg/l | 0.000 | 1.000 | 2.500 | <5.000 | <5.000 | <5.000 | <5.000 | <5.000 | <5.000 |
| Iron (D) as Fe, mg/l | 0.005 | 0.072 | 0.360 | | | | 0.005 | 0.008 | 0.010 |
| Iron (T) as Fe, mg/l | 0.055 | 0.358 | 0.835 | 0.020 | 1.095 | 5.100 | 0.070 | 0.927 | 2.700 |
| Lead (T) as Pb, mg/l | 0.003 | 0.022 | 0.073 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| Magnesium as Mg, mg/l | 13.900 | 24.700 | 34.300 | 22.000 | 24.267 | 27.000 | 22.000 | 24.000 | 26.000 |
| Manganese (T) as Mn, mg/l | 0.005 | 0.020 | 0.047 | 0.007 | 0.055 | 0.220 | 0.005 | 0.033 | 0.074 |
| Mercury as Hg, mg/l | 0.000 | 0.000 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Nickel (T) as Ni, mg/l | 0.005 | 0.007 | 0.023 | | | | | | |
| Nitrate as NO3-N, mg/l | 0.160 | 0.726 | 1.540 | 0.320 | 1.159 | 2.500 | 0.080 | 1.194 | 3.100 |
| Nitrite as NO2-N, mg/l | 0.003 | 0.063 | 0.155 | | | | | | |
| Phosphate (Ortho) as PO4-P, mg/l | 0.005 | 0.029 | 0.080 | | | | | | |
| Potassium as K, mg/l | 10.300 | 23.030 | 29.500 | 17.000 | 21.733 | 25.000 | 19.000 | 22.813 | 27.000 |
| Selenium (T) as Se, mg/l | 0.001 | 0.002 | 0.003 | <0.005 | <0.005 | 0.007 | <0.005 | <0.005 | 0.006 |
| Silica (D) as SiO2, mg/l | 17.700 | 24.750 | 30.500 | | | | | | |
| Silica (T-ICP) as SiO2, mg/l | 15.000 | 15.500 | 16.000 | | | | | | |
| Silver (T) as Ag, mg/l | 0.003 | 0.013 | 0.093 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| Sodium as Na, mg/l | 57.200 | 76.440 | 87.000 | 64.000 | 74.867 | 83.000 | 59.000 | 77.813 | 88.000 |
| Sulfate as SO4, mg/l | 12.800 | 81.960 | 165.000 | 53.000 | 75.800 | 110.000 | 56.000 | 79.813 | 110.000 |
| Settleable Solids , mLs/L/hr | 0.050 | 0.050 | 0.050 | | | | | | |
| Suspended Solids, mg/l | 0.500 | 16.800 | 66.000 | 2.500 | 27.033 | 250.000 | 2.500 | 46.469 | 100.000 |
| Thallium as Tl, mg/l | 0.003 | 0.004 | 0.005 | | | | | | |
| Total Dissolved Solids, mg/l | 326.000 | 481.600 | 584.000 | | | | | | |
| Turbidity, NTU | 0.800 | 5.307 | 20.000 | 1.000 | 5.567 | 40.000 | 0.500 | 4.644 | 14.000 |
| Zinc (T) as Zn, mg/l | 0.003 | 0.048 | 0.285 | 0.003 | 0.019 | 0.041 | 0.003 | 0.012 | 0.028 |
| pH Units | 7.520 | 8.018 | 8.400 | 7.400 | 7.747 | 8.000 | 7.700 | 7.981 | 8.500 |
| Cations, meq/l | 5.340 | 8.183 | 11.230 | | | | | | |
| Anions, meq/l | 5.480 | 8.010 | 10.940 | | | | | | |

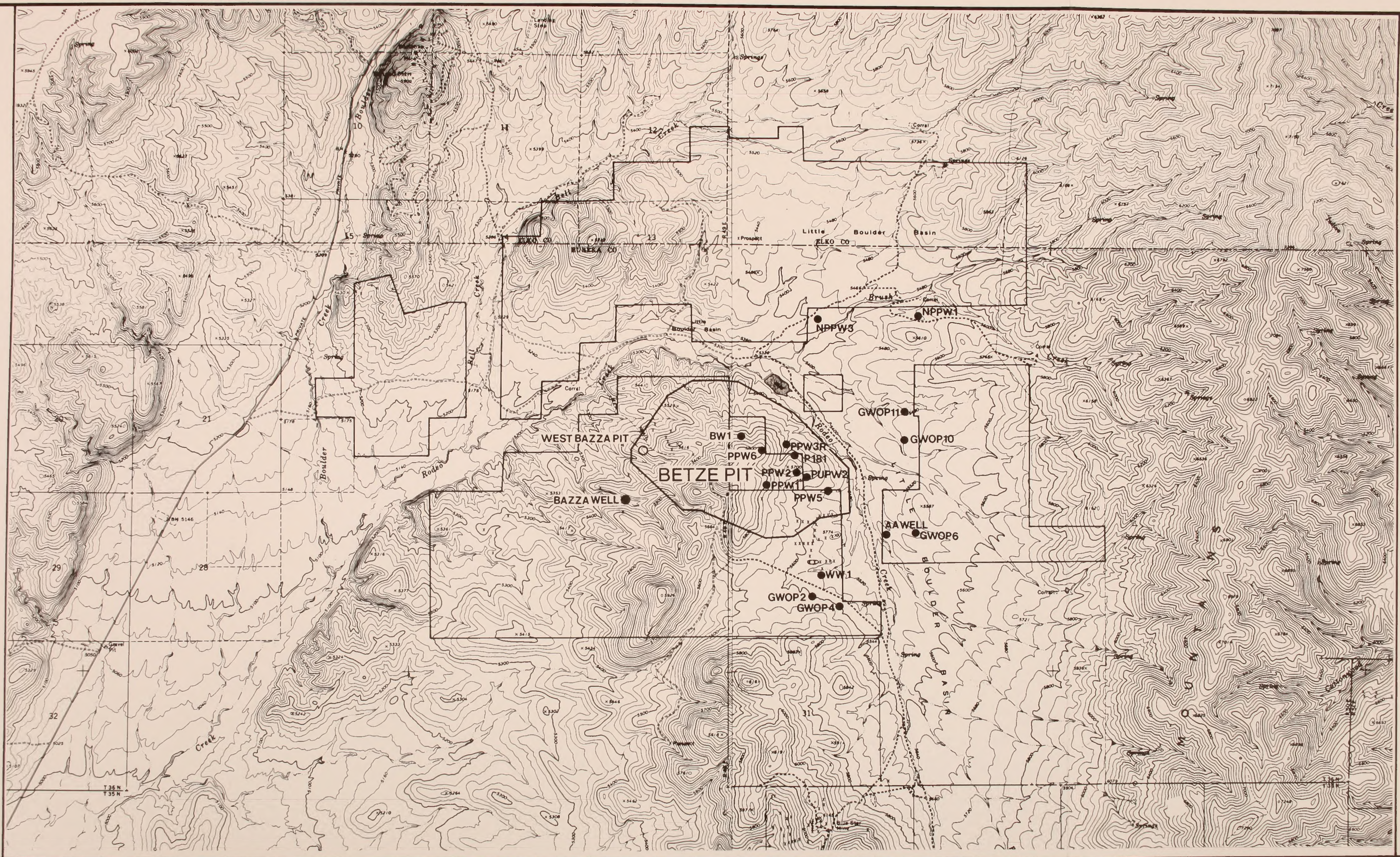
unchanged. Discharge from the treatment plant is regulated by NPDES Permit No. NEV 89068.

Discharge from the treatment plant flows down the unnamed drainage into the TS Ranch Reservoir. A sampling station is located on the unnamed drainage at the point where the water enters the reservoir. Water quality data from this sampling site indicate that the water entering the reservoir is essentially the same as water discharged from the treatment plant (Table 3-11). Water is presently accumulating within the reservoir for eventual irrigation use in Boulder Valley.

3.4.2.4 <u>Tailings Discharge</u>. Cyanide content of the tailings slurry prior to treatment ranges from about 100 to 150 parts per million (ppm). Prior to pumping to the tailings impoundment, the slurry is treated with hydrogen peroxide to reduce the levels of cyanide. Hydrogen peroxide destroys cyanide through oxidation to form cyanate which is further degraded into carbonate and ammonium. Cyanide levels in the tailings slurry are less than 50 ppm at the discharge point into the tailings impoundment. Levels are further reduced as the hydrogen peroxide reaction and natural cyanide degradation processes, such as volatilization, sunlight (UV) degradation and biological activity, continue. Water collected in the tailings impoundment is recycled back to the mill for reuse as process fluid. The tailings dam is designed to seep. This seepage is collected and pumped back into the tailings pond for recycling.

3.4.2.5 <u>Groundwater Quality</u>. The quality of subsurface water was determined by analysis of water samples from exploration drill holes. The locations of the drill holes from which samples were taken are shown on Figure 3-8, and information for each well is presented in Table 3-12. The analytical results for each of the Barrick wells are presented in the Water Resources Technical Report. Deep drilling in the vicinity of the proposed Betze Pit encountered thermal waters with temperatures as high as 130°F (Papadopulos & Associates 1988).

Groundwater quality reflects the chemistry of the rocks through which the water flows. Three distinct geologic units were identified within the project area: the Carlin Formation, the granodiorite, and the Paleozoic sedimentary rock. The water quality within each unit is characterized by reviewing data for wells which are typical of each formation (Table 3-13). In general, water within the Paleozoic sedimentary rocks, which includes limestones and dolomites, has a higher alkalinity relative to the water in the Carlin Formation and the granodiorite. The TDS for all formations averages about 470 mg/l and ranges from about 230 mg/l to 1,000 mg/l. The pH of all groundwaters ranges from 6.5 to 9.8, with an average of about 7.7. The water is classified as a calcium-bicarbonate type (BLM 1988a, 1988b).




● P181 WELL LOCATION AND NUMBER/NAME

0 1 miles

BETZE PROJECT

**Figure 3-8. Groundwater Well Locations**

TABLE 3-12

WATER WELL INFORMATION

| Well ID | Total Depth (feet) | Number of Samples | Rock Type/Formation |
|---|---|---|---|
| AA Well | 803 | 17 | Carlin/Paleozoic limestones and siltstones |
| GWOP-6 | 80-100 | 6 | Carlin |
| GWOP-10 | 80-100 | 11 | Carlin |
| GWOP-11 | 80-100 | 11 | Carlin |
| WW-1 | 300 | 7 | Granodiorite |
| GWOP-2 | 80 | 8 | Granodiorite |
| GWOP-4 | 80 | 16 | Granodiorite |
| Bazza Well | 400 | 10 | Paleozoic limestones and siltstones |
| PPW-1 | 802 | 1 | Paleozoic limestones and siltstones |
| PPW-2 | 750 | 1 | Paleozoic limestones and siltstones |
| PPW-5 | 900 | 1 | Paleozoic limestones and siltstones |
| W. Bazza Pit | | 5 | Paleozoic limestones and siltstones |
| PPW-6 | 1,325 | 1 | Paleozoic limestones and siltstones |
| PPW-6A[1] | 1,440 | 1 | Paleozoic limestones and siltstones |
| BW-1 | 1,712 | 3 | Granodiorite/Paleozoic limestones and siltstones |
| P-181 | 800 | 8 | Paleozoic limestones and siltstones |
| PUPW-2 | 900 | 7 | Paleozoic limestones and siltstones |

TABLE 3-12 (CONTINUED)

| Well ID | Total Depth (feet) | Number of Samples | Rock Type/Formation |
|---|---|---|---|
| PPW-3R | 385 | 1 | Paleozoic limestones and siltstones |
| NPPW-3[2] | 1,213 | 4 | Carlin/Paleozoic limestones and siltstones |
| NPPW-1[2] | 1,225 | 4 | Paleozoic limestones and siltstones |

[1]The location of this well is not shown on Figure 3-8 due to its proximity to Well PPW-6.

[2]Newmont wells.

TABLE 3-13

Summary of Mean Water Quality Data By Geologic Formation

| PARAMETER | CARLIN: AA WELL | CARLIN: GWOP-6 | CARLIN: GWOP-11 | GRANODIORITE: WW-1 | GRANODIORITE: GWOP-4 | SEDIMENTARY ROCK: BAZZA WELL | SEDIMENTARY ROCK: BW-1 | SEDIMENTARY ROCK: P-181 |
|---|---|---|---|---|---|---|---|---|
| Alkalinity as CaCO3, mg/l | 153.462 | 151.333 | 176.000 | 143.600 | 199.167 | 421.909 | 414.000 | 153.250 |
| Aluminum (T) as Al, mg/l | 0.289 | 9.800 | 3.820 | 0.064 | 10.647 | 0.089 | 0.100 | 0.050 |
| Ammonia as NH3-N, mg/l | 0.332 | 1.470 | 0.100 | 0.166 | 0.213 | 1.688 | 1.160 | 0.173 |
| Arsenic (T) as As, mg/l | 0.065 | 0.048 | 0.026 | 0.032 | 0.798 | 0.028 | 0.796 | 0.024 |
| Barium (T) as Ba, mg/l | 0.049 | 0.580 | 0.286 | 0.041 | 0.466 | 0.198 | 0.146 | 0.079 |
| Bicarbonate as HCO3, mg/l | 186.846 | 185.667 | 180.600 | 174.400 | 242.667 | 512.636 | 504.000 | 186.750 |
| Boron (T) as B, mg/l | 0.125 | 0.214 | 0.254 | 0.158 | 0.165 | 0.738 | 0.840 | 0.134 |
| Cadmium (T) as Cd, mg/l | 0.006 | 0.010 | | 0.005 | 0.010 | 0.005 | | 0.005 |
| Calcium as Ca, mg/l | 28.192 | 33.967 | 33.600 | 58.400 | 52.083 | 95.009 | 90.600 | 41.438 |
| Carbonate as CO3, mg/l | 0.769 | 1.667 | 14.700 | 0.500 | 3.333 | 1.364 | 5.000 | 0.000 |
| Chloride as Cl, mg/l | 17.677 | 58.433 | 32.200 | 59.760 | 24.400 | 15.982 | 14.600 | 31.425 |
| Chromium (Hex) as Cr, mg/l | 0.005 | 0.010 | | 0.005 | 0.014 | 0.005 | | 0.005 |
| Chromium (T) as Cr, mg/l | 0.004 | 0.032 | 0.004 | 0.005 | 0.018 | 0.004 | 0.005 | 0.021 |
| Conductivity, uhmos/cm | 451.231 | 818.167 | 561.818 | 767.857 | 504.867 | 945.091 | 1748.000 | 495.875 |
| Copper (T) as Cu, mg/l | 0.017 | 0.186 | 0.010 | 0.008 | 0.092 | 0.032 | 0.005 | 0.014 |
| Cyanide (T) as CN, mg/l | < 0.005 | 0.904 | < 0.005 | 0.035 | 0.007 | 0.002 | 0.005 | 0.003 |
| Cyanide (Free) as CN, mg/l | < 0.100 | 0.546 | < 0.100 | 0.009 | 0.050 | 0.026 | 0.100 | 0.001 |
| Cyanide (WAD) as CN, mg/l | < 0.005 | 1.038 | 0.005 | 0.007 | 0.005 | 0.003 | 0.005 | |
| Fluoride as F, mg/l | 0.477 | 1.187 | 1.180 | 0.344 | 0.620 | 1.448 | 1.540 | 0.622 |
| Gold as Au, mg/l | 0.005 | 0.011 | 0.003 | 0.010 | 0.009 | 0.006 | 0.005 | 0.008 |
| Hardness as CaCO3, mg/l | 155.538 | 186.667 | 134.200 | 295.200 | 209.333 | 337.364 | 336.000 | 212.750 |
| Hardness (Non-Carb) as CaCO3, mg/l | 0.000 | 34.000 | | 129.250 | 0.000 | 15.800 | | 26.250 |
| Hardness (T) as CaCO3, mg/l | 130.000 | 169.500 | | 304.750 | 151.500 | 339.200 | | 186.000 |
| Hydroxide as OH, mg/l | 0.769 | 1.667 | 2.500 | 0.500 | 3.333 | 1.364 | 5.000 | 0.000 |
| Iron (D) as Fe, mg/l | 0.073 | 0.205 | | 0.227 | 0.174 | 0.193 | | 0.043 |
| Iron (T) as Fe, mg/l | 0.657 | 6.680 | 3.436 | 0.828 | 11.950 | 1.669 | 1.582 | 0.572 |
| Lead (T) as Pb, mg/l | 0.009 | 0.056 | 0.011 | 0.010 | 0.041 | 0.019 | 0.005 | 0.035 |
| Magnesium as Mg, mg/l | 16.192 | 17.700 | 10.420 | 37.140 | 15.267 | 24.500 | 22.200 | 20.075 |
| Manganese (T) as Mn, mg/l | 0.055 | 1.101 | 0.092 | 0.014 | 0.583 | 0.060 | 0.035 | 0.008 |
| Mercury as Hg, mg/l | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Nickel (T) as Ni, mg/l | 0.008 | 0.051 | 0.006 | 0.030 | 0.021 | 0.009 | 0.010 | 0.016 |
| Nitrate as NO3-N, mg/l | 0.479 | 3.917 | 0.595 | 1.018 | 0.704 | 0.044 | 0.050 | 0.451 |
| Nitrite as NO2-N, mg/l | 0.015 | 0.579 | | 0.055 | 0.006 | 0.006 | | 0.017 |
| Phosphate (Ortho) as PO4-P, mg/l | 0.108 | 0.136 | 0.122 | 0.021 | 0.120 | 0.051 | 0.104 | 0.240 |
| Potassium as K, mg/l | 6.346 | 5.867 | 14.400 | 7.540 | 7.883 | 20.555 | 23.000 | 2.688 |
| Selenium (T) as Se, mg/l | 0.002 | 0.004 | 0.003 | 0.003 | 0.004 | 0.002 | 0.005 | 0.001 |
| Silica (D) as SiO2, mg/l | 44.133 | 46.150 | | 25.625 | 42.100 | 33.560 | | 29.663 |
| Silica (T-ICP) as SiO2, mg/l | 28.250 | 35.000 | 29.400 | 8.300 | 25.250 | 21.000 | 18.200 | |
| Silver (T) as Ag, mg/l | 0.007 | 0.008 | 0.003 | 0.005 | 0.007 | 0.004 | 0.005 | 0.022 |
| Sodium as Na, mg/l | 28.938 | 87.533 | 72.400 | 35.980 | 42.167 | 72.155 | 75.400 | 27.950 |
| Sulfate as SO4, mg/l | 49.508 | 111.267 | 73.600 | 152.000 | 44.900 | 101.764 | 88.200 | 58.188 |
| Settleable Solids , mLs/L/hr | 0.088 | 0.200 | 0.840 | 0.050 | 1.150 | 0.050 | 0.100 | |
| Suspended Solids, mg/l | 12.938 | 1050.333 | 417.400 | 3.760 | 1666.833 | 10.136 | 47.800 | 1.688 |
| Thallium as Tl, mg/l | 0.004 | 0.008 | 0.003 | 0.005 | 0.007 | 0.004 | 0.005 | 0.005 |
| Total Dissolved Solids, mg/l | 316.000 | 500.333 | 362.000 | 536.400 | 359.333 | 583.364 | 692.000 | 364.875 |
| Turbidity, NTU | 4.421 | 260.000 | 62.284 | 4.128 | 172.800 | 15.182 | 3.300 | 2.071 |
| Zinc (T) as Zn, mg/l | 0.099 | 0.460 | 0.017 | 0.101 | 0.188 | 0.065 | 0.010 | 0.143 |
| pH Units | 7.479 | 7.557 | 8.191 | 7.874 | 7.559 | 7.245 | 7.000 | 7.721 |
| Cations, meq/l | 4.220 | 6.725 | | 7.843 | 4.840 | 10.118 | | 5.019 |
| Anions, meq/l | 4.214 | 6.645 | | 7.605 | 5.110 | 10.318 | | 5.201 |

Groundwater within the Carlin Formation was characterized by examining water quality data from the AA Well and wells GWOP-6 and GWOP-11. The AA Well penetrates through the Carlin Formation and into the Paleozoic sedimentary rock; the well has screened intervals in both formations. GWOP-6 and GWOP-11 are shallow wells that are screened in the upper 100 feet of the Carlin Formation. Arsenic in the AA Well ranges from less than 0.01 to 0.3 mg/l. Water within the Carlin Formation is generally of good quality except for arsenic, which is sometimes found to exceed the drinking water standard. Arsenic levels in the two GWOP wells range from 0.015 mg/l to 0.077 mg/l. The higher value is marginally above the drinking water standard of 0.05 mg/l. Total cyanide levels greater than 0.2 mg/l were found in two samples from GWOP-6, which is located down-gradient of the heap leach facility.

The groundwater in the granodiorite was characterized by water quality samples from WW-1 and GWOP-4. The highest levels of arsenic (7.26 and 2.45 mg/l) were found in samples from GWOP-4. The well is often dry or contains only 1 or 2 feet of water (Giraudo 1990). The high total arsenic values are correlated with high levels of TSS, suggesting that the arsenic could be contained in suspended sediment. Some samples from GWOP-4 also report low levels of cyanide. This well is located to the east of a heap leach pad operated by the previous owner of the property. With the exception of one sample, only total cyanide was detected in GWOP-4 whereas no free or weak acid dissociable (WAD) cyanide was detected. The detection of total cyanide in the absence of free or WAD cyanide would indicate that the cyanide is most likely complexed with sediment or other compounds within the water and is relatively non-toxic.

The groundwater in the Paleozoic sedimentary strata is characterized by the Bazza Well, and wells BW-1 and P-181. The Bazza Well typifies groundwater in the Paleozoic sedimentary rock that has been relatively unaffected by sulfide mineralization. Arsenic levels from this well generally range from 0.01 mg/l to 0.05 mg/l, with one value being above the drinking water standard. Alkalinity, bicarbonate, and calcium are relatively high. Low levels of total cyanide have been observed in the well. BW-1 is typical of dewatering wells around the present Post Pit and within the area to be mined during the Betze Pit expansion. This well has high levels of arsenic ranging from 0.6 mg/l to 1.1 mg/l. Other deep wells have elevated levels of arsenic.

Well P-181 is unusual in that it has low levels of arsenic (0.01 mg/l to 0.046 mg/l) although it is located within the area to be mined where high concentrations of arsenic in the rock are present. The well was located either within or near the Post Fault (Listerud 1990) prior to mining through the fault by the Post Pit operations. It may be that the low permeability of the fault isolated the well from arsenic waters associated with the ore body, or that higher groundwater flow rates along the fault diluted the arsenic that entered into solution from the rock. This well was constructed as a dewatering test well and was pumped for about 6 months. At the end of the pumping phase, low levels of total cyanide were detected. The well was abandoned and removed by mining operations as the Post Pit expanded. Presently, the water from the dewatering wells, which is representative of water quality within the ore body, averages approximately 0.2 to 0.25 mg/l of arsenic.

Water samples from 26 springs and seeps were collected and submitted for chemical analysis as part of the spring and seep inventory (JBR Consultants Group 1990). Fourteen samples were analyzed for arsenic. The average arsenic concentration was 0.044 mg/l, with a maximum concentration of 0.063 mg/l. High levels of sulfate (1,200 mg/l) and TDS (2,470 mg/l) were detected in a spring on the west edge of the Clydesdales Block. These levels suggest that the water from the spring had been in contact with sulfide minerals. The water was subsequently neutralized, resulting in the present pH of 8.18. The remainder of the samples from the springs and seeps have an average sulfate level of 87 mg/l and an average TDS of 321 mg/l.

### 3.4.3 Water Uses

Information on water uses within the project area was obtained by a computer search of water rights filings at the Nevada State Engineer's Office (see Appendix B). Within the Boulder Flat Hydrographic Area 61, there are filings for 58 irrigation water rights, 45 mining and milling rights, 35 stock watering rights, and 4 domestic wells. The mining and milling wells are located along the upper reaches of Boulder Creek and Rodeo Creek where most of the active mining is taking place. The irrigation and stock watering wells are scattered throughout Boulder Valley. Within a 4-mile radius of the proposed Betze Pit, there are 24 mining and milling wells, 2 stock watering wells, and 1 surface irrigation diversion. By expanding to a 10-mile radius, an additional 7 mining and milling wells, 8 stock watering wells, and 12 irrigation wells are included. The domestic water rights are held by various mining companies to provide potable water for mining personnel.

## 3.5 Soils

Detailed soil mapping and sampling of an extensive area in the vicinity of the Betze Project area was conducted in 1988 (JBR Consultants Group 1989). This Order II soil survey covered approximately 8,169 acres and included field sampling for laboratory analysis of 14 of the 20 soils mapped in the study area. Eight of the 20 mapped soils were established U.S. Soil Conservation Service (SCS) soil series; the remainder were new soils identified during the study. Two small areas, the southeast corner of AA Block and the northern extension of North Block, were not included in the survey. The SCS Order III Tuscarora Mountain soil survey information was used for these areas (Soil Conservation Service and BLM 1980). The soils map of the study area is presented as Figure 3-9.

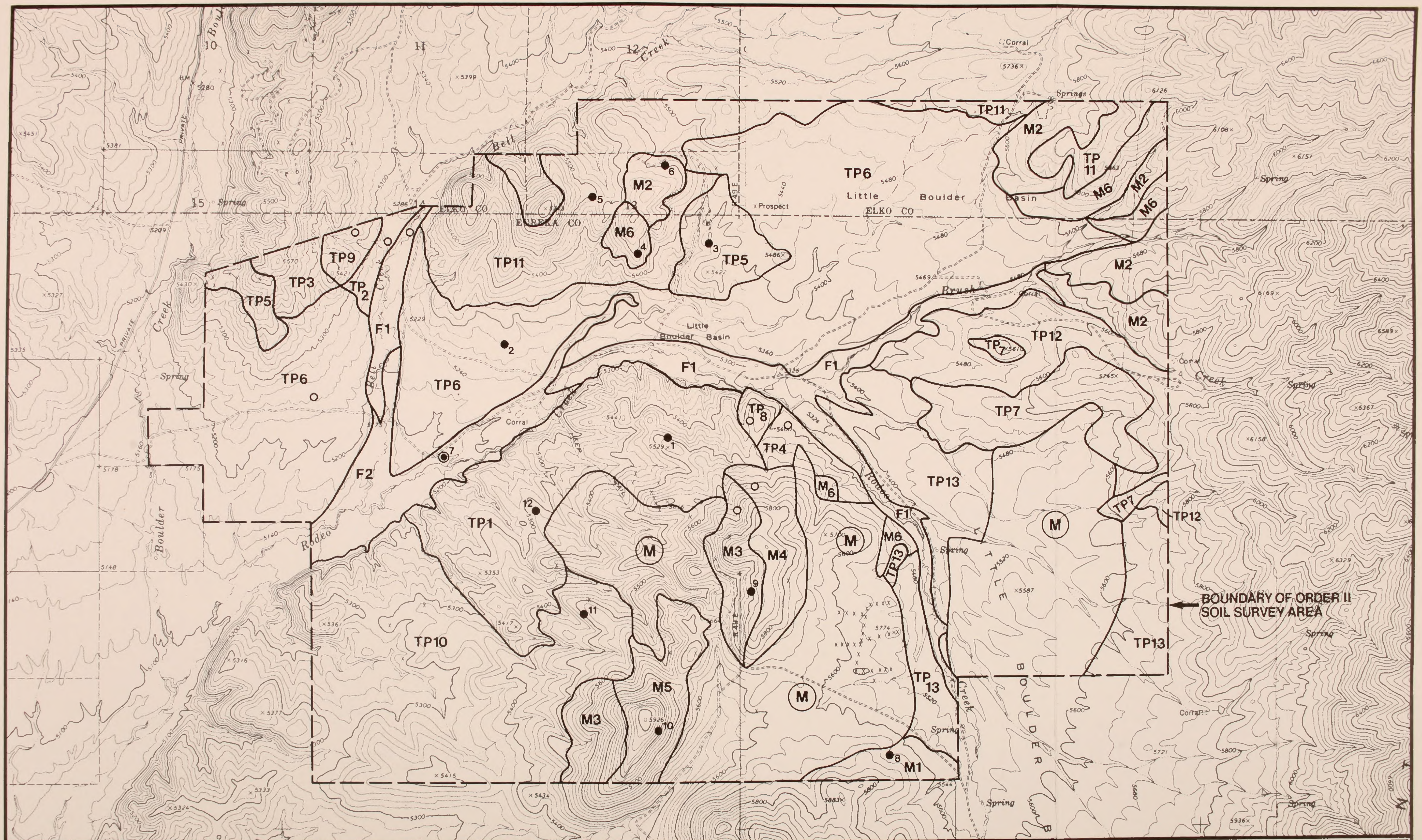
Of the 20 soils, 19 were mapped as individual map units (one soil type per map unit); as such, soil descriptions but not map unit descriptions were described in the JBR report. Table 3-14 provides project site information and interpretation for these soils.

The terrain of Little Boulder Basin is typical of the Basin and Range physiographic province. As discussed in Section 3.1.1, the north trending fault-block mountain ranges expose Paleozoic sedimentary rocks, which have been locally intruded by igneous stocks, dikes, and veins. At lower elevations adjacent to the rock outcrops, the Paleozoic rocks are mantled by Tertiary sandy tuffaceous siltstones and conglomerates of the Carlin Formation. Unconsolidated Quaternary alluvium, of various thickness, is found in valleys. The interbedded nature of the bedrock, combined with the greatly varying intensity of rock deformation and alteration, has produced a great variety of weathering effects and therefore a wide variety of soil types.

Soils have been grouped as: 1) mountain slope soils, 2) terrace and piedmont slope soils, and 3) floodplain soils. The mountain slope soils include Blue Star, Brushcreek, Long Lac, Post, Post-rocky variant, and Shortcreek. These soils consist of deep, well drained, moderately permeable soils on ridges and upper slopes of the mountains. Parent materials are residuum and colluvium derived from a variety of rock types including limestones, siltstones, and argillites. Soil depth varies greatly depending on rock type and degree of weathering and alteration. Soil can be salvaged until the underlying C horizon substratum is encountered. This depth generally ranges from 17 to 30 inches across the project area.

Terrace and piedmont slope soils include Bazza, Bell, Bootstrap, Boulflat, Clydesdales, Cortez, Donna, Havingdon, Rabbit, Ramires, Sagehill, and Stampede. These soils are derived from colluvium and alluvium, and in some cases residuum. Soil depth varies greatly, but is usually less deep than that of the mountain slope soils. Many of these soils have indurated hardpans that limit topsoil salvage. Soil salvage depth ranges from 8 to 24 inches depending on soil type.

Floodplain soils include Welch and Welch-drained. These soils are derived from mixed alluvial materials. Both soils often have depths greater than 60 inches, and have stratified layers of variable texture. The entrenchment of stream channels has lowered the water table, changing the floodplain vegetation from meadows to large shrub communities. These soils can provide large quantities of good topsoil material, with salvage depths ranging from 5 to




● ENSR [BG] SAMPLE SITE [with JBR]
○ JBR SAMPLE ONLY
◉ ENSR [BG] SAMPLE ONLY

TP1-SOIL UNIT SYMBOL
(M) MINED LANDS

FOR EXPLANATION OF SYMBOLS, SEE TABLE 3-14.

BETZE PROJECT

**Figure 3-9. Soils Map**

TABLE 3-14

SOIL CHARACTERISTICS AND INTERPRETATIONS

| Map Unit Symbol | Soil Name | Landform | Slopes (%) | Parent Material | Soil Depth (in.) | Soil Texture | Erosion Hazard | Range Site | Salvageable Topsoil Depth (inches) | Topsoil Quality |
|---|---|---|---|---|---|---|---|---|---|---|
| M1 | Blue Star | mountain slopes | 10–30 | siltstones, argillites | 46 | gravelly sandy clay loams | moderate | 25–12 | 30 | Good |
| M2 | Brushcreek | mountain slopes | 15–30 | igneous rocks | 35 | clay loams | moderate | 25–12 | 20 | Fair |
| M3 | Long Lac | mountain slopes | 15–30 | carbonate rocks, quartzites, argillites, siltstones | 29 | gravelly clay loams | moderate | 24–5<br>25–19 | 18 | Good |
| M4 | Post | mountain slopes | 10–30 | carbonate rocks, quartzites, argillites, siltstones | 29 | sandy loams to clay loams | moderate | 24–5<br>25–19 | 29 | Good |
| M5 | Post, rocky variant | mountain slopes | 10–30 | carbonate rocks, quartzites, argillites, siltstones | 32 | sandy clay loams | moderate | 24–5<br>25–19 | 30 lower slopes, 17 ridges (24 avg.) | Good |
| M6 | Shortcreek[1] | terraces | 15–50 | quartzites | 60 | very gravelly clay loams | moderate to severe | 25–14 | 20 | Fair |
| TP1 | Bazza | piedmont | 5–15 | residuum and colluvium of limestone and chert | 40 | clay loams | moderate to slight | 25–19 | 24 | Fair |
| TP2 | Bell | alluvial fan | 4–8 | limestone alluvium | 26 | loam and clay loams | slight | 25–21 | 12 | Poor |
| TP3 | Bootstrap | slopes | 8–30 | shales | 12 | gravelly loams | slight to moderate | 25–21 | 12 | Poor |
| TP4 | Boulflat[1] | hill slopes | 10–30 | residum and colluvium of chert, quartzite and silt | 34 | gravelly loams | moderate | 25–19 | 13 | Poor |
| TP5 | Clydesdales | terraces | 4–15 | mixed colluvium and alluvium | 14 | gravelly clay loams | slight | 25–19 | 7 | Poor |
| TP6 | Cortez[1] | alluvial fan | 4–15 | mixed alluvium | 31 | loam to clay loams | slight | 25–19 | 12 | Poor |
| TP7 | Donna[1] | piedmont | 4–15 | tuffaceous sediments | 26 | clay loams | slight | 25–18 | 10 | Fair |

TABLE 3-14 (CONTINUED)

| Map Unit Symbol | Soil Name | Landform | Slopes (%) | Parent Material | Soil Depth (in.) | Soil Texture | Erosion Hazard | Range Site | Salvageable Topsoil Depth (inches) | Topsoil Quality |
|---|---|---|---|---|---|---|---|---|---|---|
| TP8 | Havingdon[1] | foothills | 15–30 | residuum of chert, shale, and silt | 21 | silt loams | moderate | 25–19 | 10 | Fair |
| TP9 | Rabbit | hill slopes | 8–30 | residuum from limestone | 10 | clay loams | slight | 25–21 | 10 | Poor |
| TP10 | Ramires[1] | piedmont | 4–15 | tuffaceous sediments | 34 | clay loams | slight | 25–19 | 14 | Poor |
| TP11 | Sagehill | mountain slopes | 0–8 | quartzite | 18 | gravelly loam to clays | slight | 25–19 | 8 | Poor |
| TP12 | Stampede[1] | hill slopes | 4–15 | tuffaceous sediments | 38 | clay loams | slight | 25–14 | 8 | Fair |
| TP13 | Stampede–Donna | See Stampede (TP12) and Donna (TP7) descriptions. | | | | | | | 9 | |
| F1 | Welch[1] | floodplains | 2–8 | mixed alluvium | 60+ | loams to clay loams | slight | 25–3 | 60+ | Good |
| F2 | Welch, drained | floodplains | 0–4 | mixed alluvium | 60+ | silt loams | slight | 25–3E | 60+ | Good |

[1]Soil Conservation Service and BLM 1980. The other soils were identified specifically by JBR Consultants Group, Inc. 1989 for the Betze Project.

15 feet. However, mine plan objectives include nondisturbance of stream channels, where possible.

The Mined Land unit contains areas previously disturbed by mining and associated activities. No topsoil material is available from these areas.

In summary, soil suitability evaluations indicate that all soils have suitable topsoil in the upper portions of the soil profiles. The underlying C horizon substratum is not recommended for salvage in all but floodplain soils due to high clay or rock fragment content or the presence of an indurated hardpan which restricts soil salvage operations. Soil material on terraces and piedmont slopes cannot be salvaged once the indurated hardpans are encountered.

Since 1987, when Barrick began operating the Goldstrike Mine, all areas to be disturbed have been stripped of topsoil prior to initiating mining or construction. The stripped topsoil has been placed in topsoil stockpiles for use in reclamation. The previous operators of the Goldstrike Mine, however, did not conduct a comprehensive topsoil removal and stockpiling program. As a result, not all of the topsoil from previously disturbed areas was recovered for use in reclamation. At present, Barrick estimates that available topsoil resources would be sufficient to provide between 8 to 12 inches of topsoil cover for the presently disturbed areas.

## 3.6 Vegetation

The combination of topography and a mid-latitude steppe climate, common to the Great Basin, has produced the grass and shrub dominated vegetation characteristic of the Little Boulder Basin. Disturbances to the vegetation, including overgrazing, large-scale range fires of the 1960s, past and present mining operations, and mineral exploration, have converted much of the remaining native vegetation within the project area to early seral stage non-native annuals, sagebrush, and rabbitbrush. The BLM introduced seedings of crested wheatgrass to much of the area as part of rehabilitation efforts subsequent to extensive range fires in the mid-1960s. Riparian vegetation exists in association with perennial stream flow in Bell, Brush and Rodeo Creeks, as well as near springs and seeps located throughout the Little Boulder Basin.

Baseline vegetation studies were performed on the project area in 1988 (JBR Consultants Group 1989). Data from these studies are used to describe the major vegetative types within the project area: upland vegetation, riparian/loamy bottom, floodplains, seedings and mined lands. Each ecological site is based on the differences in production, proportion, and kind of plant species that are potentially dominant for a specific site. Table 3-15 identifies the ecological site types and the number of acres for

TABLE 3-15

ECOLOGICAL SITE DESCRIPTIONS AND ACREAGE

| Ecological Site | Major Vegetation Components | Ecological Status | Acres | Property Block |
|---|---|---|---|---|
| 25-3 Loamy Bottom 8-14"[1] | Big Sagebrush/Cheatgrass | Mid-seral | 91 | North Block |
| | | | 5 | Buzz Block |
| 25-12 Loamy Slope 10-16"[1] | Big Sagebrush/Cheatgrass with Rye | Mid-seral | 228 | North Block |
| 25-14 Loamy 10-12"[1] | Cheatgrass/Big Sagebrush | Early seral | 102 | North Block |
| 25-19 Loamy 8-10"[1] | Cheatgrass/Big Sagebrush | Early seral | 142 | Clydesdales Block |
| | | | 622 | North Block |
| | | | 55 | AA Block |
| | | | 1,202 | South Block |
| 25-21 Shallow Gravelly Loam 8-10"[1] | Cheatgrass/Big Sagebrush | Early seral | 73 | North Block |
| | | | 5 | Clydesdales Block |
| Seeding I (S-I) | Crested Wheatgrass/ Big Sagebrush | Excellent Condition | 292 | South Block |
| Seeding II (S-II) | Crested Wheatgrass/ Big Sagebrush | Good Condition | 399 | Clydesdales Block |
| | | | 1,474 | North Block |
| | | | 128 | AA Block |
| | | | 35 | Buzz Block |
| Mined Lands (m) | | Disturbed | 673 | AA Block |
| | | | 949 | South Block |

[1] Zone of precipitation.

each vegetative type associated with the individual property blocks. Table 3-16 lists typical species by common and scientific name. A vegetation map of the project area is also provided and presented as Figure 3-10.

The vegetation communities within the project area have been grouped into five ecological sites: Loamy Bottom (25-3), Loamy Slope (25-12), Loamy (25-14), Loamy (25-19), and Shallow Gravelly Loam (25-21); and are displayed on Figure 3-10. Site forms for these ecological sites are provided in Appendix C.

### 3.6.1 Upland Vegetation Communities

The principal vegetative components of the existing upland sites consist of sagebrush and annual grasses. Disturbance caused by fires and grazing have resulted in the conversion of most of these vegetative sites to early- and mid-seral ecological stages. The effect of this has been to decrease the composition of native perennial vegetation, such as bluebunch wheatgrass and Idaho fescue, to predominantly big sagebrush and cheatgrass. As a result of past disturbance from fires and overgrazing, little plant diversity occurs in these early seral communities.

### 3.6.2 Riparian/Loamy Bottom and Floodplains

Important vegetative components associated with the Proposed Action are the riparian areas and the loamy bottom floodplains. These sites, found adjacent to surface water, are valuable in arid environments, not only for providing water and wildlife habitat but also for allowing greater diversity and productivity than other vegetative habitats. The riparian and loamy bottom vegetation components are critical in stabilizing streambanks, enhancing water quality, and moderating stream flows by maintaining high water tables. A small portion of the approximately 575 acres associated with Brush, Bell, and Rodeo Creek floodplains, as well as numerous springs and seeps throughout the area, sustain riparian vegetation. Since the fall of 1989, livestock have been excluded from the project area, initiating riparian recovery.

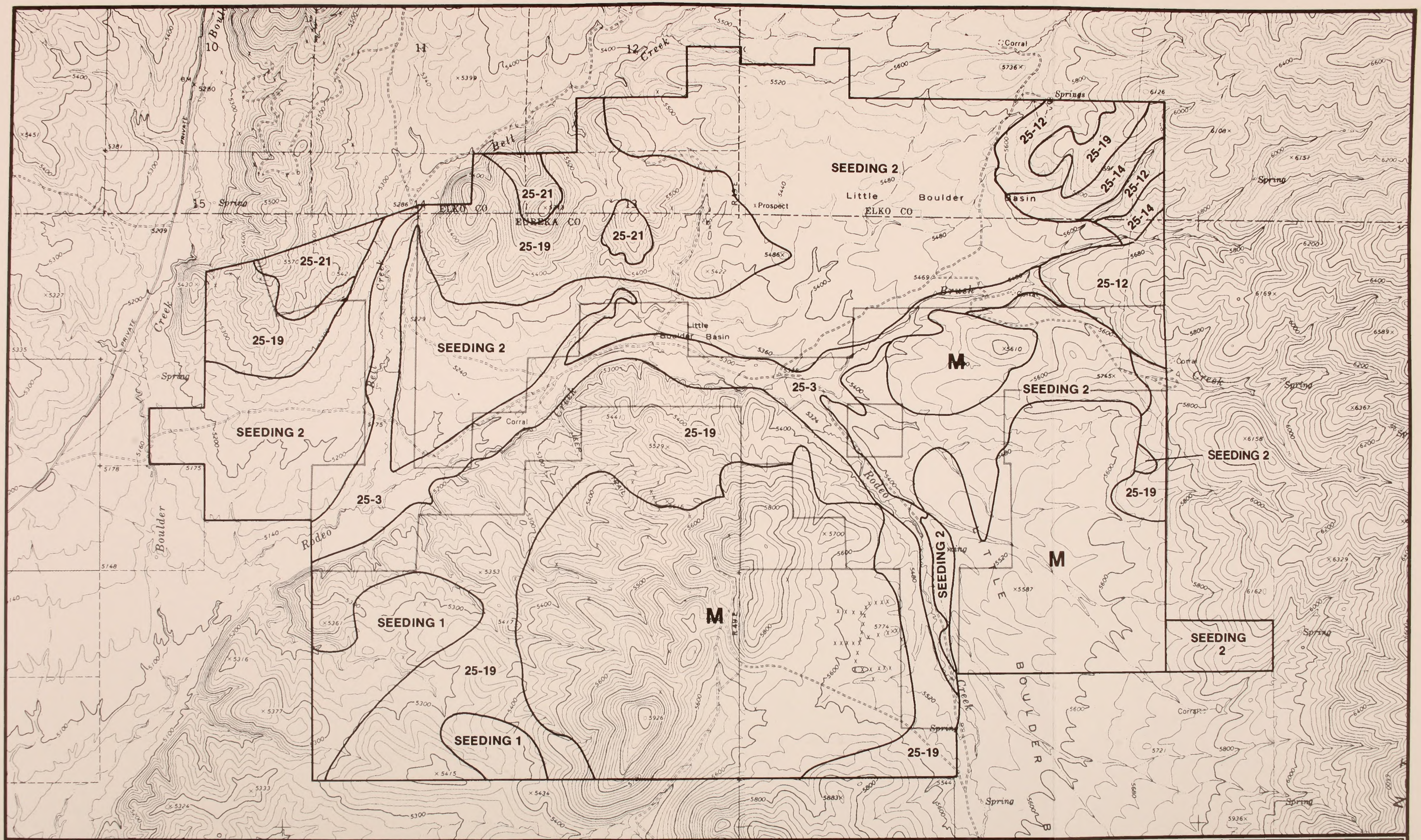
Based on data collected during the seep and spring inventory, an estimate of the total acreage of riparian/aquatic areas associated with the 131 springs and seeps identified by the inventory was compiled. (JBR Consultants Group 1990b). The total acreage of riparian/aquatic areas within the inventory area was estimated to be 330 acres. The estimate is not an assessment of "wetland" acreage as defined by the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act, although some portion of the riparian/aquatic area may constitute wetlands.

Of the total acreage included in the estimate, 270 acres are associated directly with identified spring and seeps; 22 acres are associated with perennial stream reaches of upper Boulder, Rodeo,

TABLE 3-16

PLANT SPECIES LIST

| Scientific Name | Common Name |
|---|---|
| Agropyron cristatum | Crested wheatgrass |
| Agropyron dasystachyum | Thickspike wheatgrass |
| Agropyron spicatum | Bluebunch wheatgrass |
| Amelanchier alnifolia | Saskatoon serviceberry |
| Artemisia arbuscula | Low sagebrush |
| Artemisia tridentata tridentata | Basin big sagebrush |
| Artemisia tridentata vaseyana | Mountain big sagebrush |
| Artemisia tridentata wyomingensis | Wyoming big sagebrush |
| Aster sp. | Aster |
| Astragalus spp. | Milkvetch |
| Balsamorhiza hookeri | Hooker balsamroot |
| Brassica spp. | Mustard |
| Bromus tectorum | Cheathgrass |
| Calachortus spp. | Sego lily |
| Castelleja spp. | Paintbrush |
| Chrysothamnus nauseosus | Rubber rabbitbrush |
| Chrysothamnus viscidiflorus | Douglas rabbitbrush |
| Crepis acuminata | Tapertip hawksbeard |
| Descurainia sophia | Flaxweed tansy mustard |
| Elymus cinereus | Basin wildrye |
| Erodium cicutarium | Filaree |
| Erigeron spp. | Daisy |
| Eriogonum spp. | Buckwheat |
| Lomatium spp. | Biscuitroot |
| Lupinus caudatus | Tailcup lupine |
| Oryzopsis hymenoides | Indian ricegrass |
| Phlox spp. | Phlox |
| Poa nevadensis | Nevada bluegrass |
| Poa scabrella | Pine bluegrass |
| Poa secunda | Sandberg bluegrass |
| Purshia tridentata | Antelope bitterbrush |
| Sitanion hystrix | Bottlebush squirreltail |
| Stipa thurberiana | Thurber needlegrass |
| Zygodenus paniculatus | Foothill deathcamas |




| | | |
|---|---|---|
| **VEGETATION TYPES** | **25-12 - LOAMY SLOPE 10-16"p.z.** | **25-21 - SHALLOW GRAVELLY LOAM 8-12"p.z.** |
| **M - MINED AREA** | **25-14 - LOAMY 10-12"p.z.** | **p. z. - zone of annual precipitation** |
| **25-3 - LOAMY BOTTOM 8-14"p.z.** | **25-19 - LOAMY 8-10"p.z.** | |

BETZE PROJECT

**Figure 3-10. Vegetation Map**

Bell, and Brush Creeks; and 36 acres are associated with riparian areas with no spring or seep discharge at the time of the survey. The riparian/aquatic areas associated with each of the springs and seeps identified in the inventory ranged in extent from less than 50 square feet to 35 acres.

The estimate does not attempt to characterize the quality of the riparian/aquatic area associated with the individual springs and seeps, which is highly variable. Many of the springs and seeps have been severely degraded by livestock use and are of poor quality with riparian vegetation consisting of sparse, overgrazed grasses and forbs. Other areas, however, are comprised of dense willows, wild rose and other shrubs, in addition to hydrophytic and aquatic forbs.

3.6.3 Seeded Grass

Crested wheatgrass seedings were established in the Little Boulder Basin by the BLM during the mid-1960s after extensive range fires destroyed native vegetation. Designations of these vegetative sites are based upon forage conditions which are characterized by the estimated relative percent composition of the seeded species. Seeding 1 refers to an excellent forage condition class, with crested wheatgrass consisting of more than 75 percent of the community. Seeding 2, which is a good forage condition, consists of 50 percent to 75 percent crested wheatgrass in the community.

3.6.4 Mined Lands

This category comprises 5,500 acres in the area extending from the Carlin Mine to the Dee Mine and includes all lands which have been disturbed by mining or related activities. For the most part, plant communities have been completely removed, leaving only small remnants of previously existing vegetation scattered within the altered terrain. Invader species, such as Russian thistle, cheatgrass, rubber rabbitbrush, and big sagebrush, can be found on the less active sites. At present, topsoil stockpiles and one small waste disposal area have been revegetated. Results of this program have been favorable; good stands of pubescent wheatgrass, crested wheatgrass, and yellow sweet clover have been established.

3.7 <u>Wildlife Resources</u>

Wildlife studies have been conducted in the vicinity of the project area since November 1987 as part of the baseline data collection program (see e.g., JBR Consultants Group 1989). This section discusses both terrestial and aquatic wildlife.

3.7.1 Terrestrial Wildlife

Three vegetation communities comprise the wildlife habitats of the Little Boulder Basin: the riparian/loamy bottom community (SCS ecological site description 25-3); the upland/sagebrush community (SCS ecological site descriptions 25-12, 14, 19, 21); and the seeded grass community (S-I, S-II) (BLM 1990b). Most of the native vegetation in the vicinity of the project area has been replaced by annuals and exotic grasses following range fires, overgrazing, and reseeding (JBR Consultants Group 1989). Table 3-17 presents the species list for the wildlife resources that may be present in the vicinity of the project area.

3.7.1.1 Game Species. Typical game species which inhabit Little Boulder Basin include sage grouse, chukar, Hungarian partridge, mourning dove, mule deer, and pronghorn antelope.

Although sage grouse historically inhabited much of the upland/sagebrush community in the Little Boulder Basin, wildfires and reseeding of the range have resulted in an increased coverage of grasses and seral species unsuitable for sage grouse habitat. Currently, sage grouse are rarely observed south of Brush Creek and are not expected to occur along Rodeo Creek. Present grouse populations appear to be concentrated in the Bell Creek drainage (JBR Consultants Group 1989).

A large sage grouse lek is located on the terrace south of Bell Creek in Barrick's North Block. The area of the lek extends over the length of the open southwest-facing slope. Several small satellite leks have been noted in the area: one on the ridge west of the large lek and two across Bell Creek to the north. Field searches did not reveal any hen use close to the main lek. This may be due to the lack of stands of large sagebrush. Sage grouse broods were discovered along the foothills of the Tuscarora Range, 1 to 2 miles east of the lek (JBR Consultants Group 1989).

Chukar inhabit the hills flanking Little Boulder Basin, especially on the open rocky ridges and on hillsides of cheatgrass (BLM 1988c). Chukar also use some areas of sagebrush cover, especially those areas previously disturbed which have developed a cheatgrass understory. While chukar primarily use the hills, they occasionally come to the valley streams, but return to the high ridges for cover and food (JBR Consultants Group 1989).

A small population of Hungarian partridge inhabit the project area throughout the year. Partridges are known to utilize lower Rodeo and Brush Creeks. Hungarian partridge habitat is centered around the riparian vegetation community and adjacent terraces (JBR Consultants Group 1989).

Mourning doves nest in Little Boulder Basin during the summer from May through August or early September. Doves use all habitats and nest on the ground or in low shrubs. Previously burned, non-seeded areas of sagebrush community appear to be preferred feeding sites

TABLE 3-17

WILDLIFE RESOURCES SPECIES LIST

| Common Name | | Scientific Name |
|---|---|---|
| Game Species | | |
| | Sage grouse | Centrocercus urophasianus |
| | Chukar | Alectoris chukar |
| | Hungarian partridge | Perdix perdix |
| | Mourning dove | Zenaida macroum |
| | Mule deer | Odocoileus hemionus |
| | Pronghorn antelope | Antilocapra americana |
| Bird Species | | |
| Waterfowl | Mallards | Anas platyrhynchos |
| | Gadwalls | Anas strepera |
| | Cinnamon teal | Anas cyanoptera |
| | Coot | Fulica americana |
| | Great blue heron | Ardea herodias |
| | Black-crowned night heron | Nycticorax nycticorax |
| Shorebirds | Killdeer | Chradrius vociferus |
| | Sandpipers | Calidris spp. |
| | Avocets | Recurvirostra americana |
| Raptors | American kestrel | Falco sparverius |
| | Prairie falcon | Falco mexicanus |
| | Red-tailed hawk | Buteo jamaicensis |
| | Golden eagle | Aguila chrysaetos |
| | Northern harrier | Circus cyaneus |
| Other | Great-horned owl | Bubovirgini anus |
| | Horned lark | Eremophila alpestris |
| | Western meadowlark | Sturnella neglecta |
| | Raven | Corvus corax |
| Amphibians and Reptiles | | |
| | Desert horned lizard | Phrynosoma platyrhinos |
| | Sagebrush lizard | Sceloporus graciosus |
| | Western yellow-bellied racer | Coluber constrictor mormon |
| | Great Basin gopher snake | Pituophis melanoleucus deserticola |
| Other Mammals | | |
| | Black-tailed jackrabbit | Lepus californicus |
| | Mountain cottontail | Sylvilagus nuttallii |
| | Coyote | Canis latrans |
| | Badger | Taxidea taxus |
| | Gray fox | Urocyon cinereoargenteus |
| | Kit fox | Vulpes macrotis |
| | Raccoon | Procyon lotor |
| | Bobcat | Lynx rufus |

for doves. Mourning dove use of the area outside of Little Boulder Basin is transitory and scattered in the spring and summer (JBR Consultants Group 1989).

Mule deer use the area primarily for fall and spring range. The deer move south to Boulder Flats and the lower Boulder Valley for the winter. The open terrain and lack of escape and thermal cover in the Tuscarora Mountains and adjacent basins severely restricts winter use by deer when snow cover is present. The BLM rates the range as being in fair condition and does not collect any AUM data for deer use in the area (BLM 1988a). The Nevada Department of Wildlife (NDOW) does not rate this range as critical or crucial deer winter range (BLM 1988a). During the summer, deer move to the higher elevations of the main Tuscarora Mountains. Few deer are found in Little Boulder Basin during the summer, due to the open terrain and lack of cover (JBR Consultants Group 1989). NDOW has indicated that mule deer historically used migration routes on the western side of the Tuscarora Mountains (Erickson 1990). Existing mining activity has caused the mule deer migration route to be shifted east of the Tuscarora Mountains between winter forage in the Dunphy Hills and summer forage in the Independence Mountains.

Pronghorn antelope have recently expanded their range into the north Boulder Valley area because of favorable water distribution and grazing opportunities (BLM 1988b). Antelope are known to winter in the Sheep Creek Range and to disperse east and north in the spring. Antelope have been observed near the Bootstrap Mine and on the terrace south of Bell Creek during the spring and summer (JBR Consultants Group 1989).

3.7.1.2 Waterfowl. Ducks and shorebirds are commonly found along Boulder, Bell, and Rodeo Creeks and in the stock ponds associated with these streams. While many waterfowl and birds utilize the creeks and ponds during migration, some species such as mallards, gadwalls, and cinnamon teal nest in the uplands adjacent to the stock ponds. Some shorebirds such as killdeer also nest adjacent to ponds and wet meadows. Coots are known to nest in the emergent vegetation around the sedimentation control pond on Rodeo Creek. Great blue herons and black-crowned night herons have been observed regularly using streams and stock ponds for feeding, primarily along the Humboldt River, which is approximately 25 miles from the project area (JBR Consultants Group 1989).

3.7.1.3 Birds. Several species of raptors have been observed in the project area. The American kestrel is common in Little Boulder Basin. This small falcon nests in holes in the banks of the entrenched Brush and Rodeo Creeks. Two eyries were located during field surveys, and a third may exist along these same streams. Kestrels prefer open country where they prey on insects and small mammals (JBR Consultants Group 1989).

Prairie falcons appear to be most numerous in Boulder Valley, although individuals may be seen elsewhere. One known eyrie is located on lower Boulder Creek (JBR Consultants Group 1989).

According to JBR Consultants Group (1989), red-tailed hawks have been observed in Little Boulder Basin. In 1988, a pair of red-tailed hawks nested in the West No. 9 Pit near the south boundary of the South Block. This pair's territory extended south into the hills toward the Blue Star and Genesis Mines.

Golden eagles are occasionally seen in Little Boulder Basin. During surveys conducted in 1988, most observations were of flights from one side of the basin to the other. One pair of golden eagles was repeatedly seen in the Brush Creek drainage, but no nest was observed (JBR Consultants Group 1989). Golden eagles have been observed perched on powerline poles in the western portion of the South Block (BLM 1988a).

Northern harriers occasionally have been observed coursing back and forth over the open terraces searching for small mammals or birds. Harriers frequent open shrub country and usually nest on the ground within the shrub cover. No paired or territorial birds were recorded during the raptor surveys (JBR Consultants Group 1989).

The only species of owl known to occur in Little Boulder Basin is the great horned owl. One individual was flushed from a roost along lower Rodeo Creek (JBR Consultants Group 1989). Burrowing owls have been observed outside of Little Boulder Basin, north of Dee Gold (Barss 1990).

Ravens, which readily adapt to human activities, are common in the project area throughout the year. A nest with six young birds was found in the hills north of Rodeo Creek (JBR Consultants Group 1989).

Many species of passerines inhabit the ecosystems found in Little Boulder Basin. Since the previously burned terraces and other open terrain contain virtually no vegetative cover, only ground nesting species, such as the horned lark and western meadowlarks, are able to exist there. The highest density and diversity of birds are found in the loamy bottoms due to the presence of riparian vegetation and dense shrub cover. Although riparian vegetation generally supports a greater variety and density of birds than any other vegetative type, stream entrenchment has greatly diminished the riparian vegetation in Little Boulder Basin. The presence of vertical soil banks in the stream channel, however, has enabled cavity-nesting species to occupy the loamy bottoms (JBR Consultants Group 1989).

3.7.1.4 <u>Other Mammals</u>. The open, arid terrain of Little Boulder Basin supports large and varied populations of small mammals and birds which compose the prey base for the area's mammalian predators and raptors. Numerous lagomorphs and rodents are able to find cover in the short, sparse vegetation (i.e., black-tailed jack rabbit and mountain cottontail). These animals successfully exploit the limited vegetation food sources and, in turn, provide food for the coyotes, badgers, gray fox, and kit fox. Raccoons live along Boulder and Rodeo Creeks and feed upon a number of prey including insects, bird eggs, and fish (JBR Consultants Group 1989; Burt and Grossenheider 1976). Bobcats dwell in the main Tuscarora Mountains and may occasionally enter the project area (JBR Consultants Group 1989).

Although amphibians and reptiles are not a prominent part of the area's ecosystem due to the cool climate, several species have been observed in the project area. The desert horned lizard, the most abundant reptile in Little Boulder Basin, is common on the foothills and terraces. The sagebrush lizard has been recorded in unburned patches of sagebrush at lower elevations. Although neither species is very common in the project area, the western yellow-bellied racer has been recorded only in the floodplain habitat, and the Great Basin gopher snake has been found in the foothills and on the terraces. Reptiles in Little Boulder Basin are active from May to early September and, because of their limited numbers, are only a small part of the prey base of the area (JBR Consultants Group 1989).

3.7.2 Aquatic Wildlife

According to studies conducted in November 1987 and April 1988 (JBR Consultants Group 1989), the habitat quality of Rodeo, Brush, and Boulder Creeks in the project area is moderate to poor. In 1987, invertebrates were sampled at six stations established along the entire 5.6 miles of Rodeo Creek. As typically occurs in headwater habitats with low flows, macroinvertebrate diversity was slightly reduced in the two stations closest to the headwaters. The middle three stations not only exhibited greater diversity and biomass of macroinvertebrates, but they also contained pollution-sensitive invertebrates such as mayflies (Cinygmula), stoneflies (Zapada and Capnidae), beetles (Deronectes), and Tipula flies. The station closest to the confluence with Boulder Creek exhibited the lowest biological populations and diversity due to increased sedimentation. Field investigations conducted in 1988 showed that hardy, pollution-resistant species had replaced many of the pollution-sensitive invertebrates throughout the creek. According to data gathered in 1988, this appeared to be due to increased sedimentation and low stream flow (JBR Consultants Group 1989).

Brush Creek can be divided into three segments: the upper section, the intermittent mid-section, and the lower perennial section. The upper section, with small perennial flows, is located in the foothills of the Tuscarora Mountains. Flow in the lower perennial section is maintained by springs. The upper section of Brush Creek contains a relatively high number of organisms including caddisflies (Hesperophylax) and Helicopsyche (Trichoptera) which typically occur in clean-water habitats, as well as pollution-resistant flies (Diptera). Brush Creek has a much higher diversity of aquatic macroinvertebrates in the lower section than in the upper section. Several species typically found in lentic habitats, such as water boatmen (Corixidae) and predaceous diving beetles (Dytiscidae), as well as species associated with clean-water habitats, such as stoneflies (Isoperla) and caddisflies, occur in the lower section of Brush Creek. Although the water quality in the lower section of Brush Creek is relatively high and there exists a wide variety of habitats, the gradient and substrate are not ideal for certain macroinvertebrate fauna (JBR Consultants Group 1989).

Boulder Creek below the confluence with Rodeo Creek has been affected by grazing and mining activities in the Rodeo Creek drainage, and contains a very low diversity of macroinvertebrates. Only very hardy macroinvertebrates occur in this section of Boulder Creek due to extensive deposits of fine-grained sediments in the streambed (JBR Consultants Group 1989).

## 3.8 Threatened and Endangered Species

### 3.8.1 Plants

According to the Nevada Natural Heritage Program (Kolar 1990), there are no threatened or endangered plants known to occur in the project area.

### 3.8.2 Animals

According to the Nevada Natural Heritage Program (Kolar 1990), there are no threatened or endangered animal species known to occur in the project area. Peregrine falcons and an occasional bald eagle may migrate through the area; however, the habitat is not suitable for year-round use (BLM 1988a).

The Lahontan speckled dace (Rhinichthys osculus robustus) is listed as a state-sensitive species because there is little known about it. This fish was found throughout most of Rodeo Creek, in the upper and lower sections of Brush Creek, and in Boulder Creek (JBR Consultants Group 1989). The species occurs throughout much of Nevada and often replaces trout as stream conditions deteriorate (Evans 1990).

## 3.9 Recreation/Wilderness

### 3.9.1 Recreation

The public lands within the BLM's Elko Resource Area (RA) provide diverse recreation opportunities ranging from snow skiing to whitewater rafting. The greatest demand results from reservoir fishing, sight-seeing, upland game bird hunting, and mule deer hunting (BLM 1985).

The project area is located in terrain lacking unusual features or water-based recreational sites to attract people. Primary recreational opportunities consist of hunting, off-road vehicle (ORV) use, and rockhounding. These opportunities are relatively limited because many of the lands are now intensively utilized for mining activities; there is heavy mining-related truck use on the roads, and access to many areas is restricted by mining company safety closures and security gates on roads.

Recreational ORV use is dispersed throughout the Elko RA. Apart from the areas closed to public access for safety and security reasons by the mine operators, the project area is open to ORV use under the BLM's management decision to open the entire resource area except for special designated areas (BLM 1987a). The specific management prescription regarding ORV use designates 98 percent of the Elko RA open to ORVs. In the remaining 2 percent, consisting of Special Recreation Management Areas (SRMAs) and portions of Wilderness Study Areas (WSAs), ORV use is limited to designated roads and trails (BLM 1987a).

There are no SRMAs within or in close proximity to the project area (BLM 1987a). The closest BLM SRMA is the 3,360-acre South Fork Canyon, located approximately 30 miles southeast of the project area (BLM 1987a). The South Fork Canyon SRMA has no developed facilities. The BLM will be preparing a management master plan in the future which will emphasize recreation, e.g., water-based and day-use recreation. The BLM is considering minimal development (Treiman 1990). The Wilson Reservoir is located approximately 45 miles north of the project area. This recreation area has been operating at over capacity for several years (Treiman 1990). The BLM has noticed an increase in day-use over the past few years. The developed facilities at Wilson Reservoir are limited to a boat ramp, restrooms, a trailer dump, and a hand-pump for water (Treiman 1990). The BLM has requested funding in the fiscal year 1991 budget to make some improvements, i.e., improve the boat ramp, and add parking and campsites (Treiman 1990). At Wildhorse Reservoir, located approximately 60 miles north of Elko, the BLM has a campground and the State of Nevada operates a boat ramp and a campground.

There are no existing or proposed Wild and Scenic Rivers within the vicinity of the project area. The South Fork of the Owyhee River, approximately 25 miles north/northeast of the project area, is under consideration for Wild and Scenic River designation (Treiman 1990). The remainder of the Elko RA, outside the WSAs and SRMAs, is managed for dispersed recreation activities.

The South Fork Reservoir State Recreation Area (SRA) is located adjacent to the BLM's South Fork Canyon SRMA. The South Fork

Reservoir SRA is mostly used for fishing and motorboating. There are no developed facilities (Gill 1990).

There are three U.S. Forest Service Ranger Districts within Elko County, including the Mountain City Ranger District, the Jarbidge Ranger District, and the Ruby Mountains Ranger District. There are three campgrounds in the Mountain City Ranger District and two campgrounds in the Jarbidge Ranger District. The Jarbidge Wilderness Area is also located in the Jarbidge Ranger District. These areas experience most of their impact on weekends; the overall use is fairly light (Schaffran 1990).

The Ruby Mountains Ranger District experiences the heaviest recreation use. There are 4 campgrounds (totalling approximately 121 campsites), 2 picnic areas, and 2 wilderness areas in the Ruby Mountains Ranger District. The developed facilities are currently at capacity (Schaffran 1990).

The communities of Elko and Carlin, and Spring Creek private facilities, provide more urbanized recreational facilities, including swimming pools, tennis courts, basketball courts, parks, playgrounds, softball fields, and little league fields. A discussion of urban facilities and services is presented in Section 3.13.

### 3.9.2 Wilderness

The project area is located in terrain containing hills and relatively small mountain ranges that have extensive road systems. This, plus the disturbance caused by past and present mining activities, eliminated the general area around the project area from consideration as a WSA early in the review process.

The closest WSA is the Little Humboldt River WSA located approximately 27 miles northwest of the project area (BLM 1987a). This 42,213-acre unit is arranged along a 14-mile long diagonal axis running northwest to southeast and is about 9 miles wide. The WSA includes the upper drainage basin of the South Fork of the Little Humboldt River, situated between the middle slopes of the Snowstorm Mountains on the west, Castle Ridge on the east, Owyhee Bluffs on the south, and the Owyhee Desert on the north.

This WSA provides an excellent variety of primitive recreation opportunities including hiking, camping, stream fishing, hunting, nature study, photographic areas, rock climbing, and wildlife observation plus the potential for a system of horse trails. One of the significant opportunities within the WSA is the viewing and photographing of wild horses; portions of the Little Humboldt and Bullhead Wild Horse Herd Areas are located within the Little Humboldt River WSA (BLM 1987a).

The preliminary decision by the BLM is to recommend a portion (29,775 acres) of the Little Humboldt River WSA as being suitable for wilderness designation and 12,438 acres as being non-suitable for wilderness designation (BLM 1987a). A final decision will be made by the U.S. Congress after 1991. All WSAs will continue to be managed under the BLM's Interim Management Policy and Guidelines for Lands Under Wilderness Review until completion of the wilderness review process (BLM 1987a).

## 3.10 Aesthetic Resources

### 3.10.1 Visual Resources

The visual resource investigation for the Proposed Action was conducted using procedures established in the BLM Manual, Section 8400, Visual Resource Management (VRM). Under the VRM system, the affected environment for visual resources is characterized using an inventory and evaluation process that addresses scenic quality, viewer sensitivity, and distance between viewers and a proposed modification to the landscape, the Betze Project in this case. The results of the three-step inventory process are used to determine visual resource management classes for lands in the project area. Each VRM class has specific objectives defining how the visual environment is to be managed on lands so designated. Table 3-18 describes the range of VRM classes and their associated management objectives.

The visual resource area that would be affected by the proposed Betze Project is defined as the viewshed of the project, or the area from which the project would be seen. This includes Little Boulder Basin and part of the Boulder Creek Valley between the Sheep Creek Range and the Tuscarora Mountains.

The project area is located in the Basin and Range physiographic province as defined by Fenneman (1931). The province is characterized by a series of relatively low and generally undistinguished, north trending mountain ranges separated by broad alluvial valleys or basins.

The topography of the project area consists of low rolling hills at the foot of the Tuscarora Mountains which are cut by flat, gently sloping valleys 0.5 to 1.5 miles wide along Rodeo, Brush, and Boulder Creeks. The Tuscarora Mountains stand above the project site by over 3,000 feet at a nearby 8,600-foot peak, but the moderate slopes and rounded forms of the higher ridges are generally similar to the lower foothills.

Vegetation in the project area is very homogeneous, consisting of low shrubs and grasses. Shrub species are limited to rabbitbrush and sagebrush, which exhibit generally uniform growth habit and coloration. Grasses include both native and introduced species of perennial and annual grasses. Disturbed areas are barren except

TABLE 3-18

VISUAL RESOURCE MANAGEMENT CLASSES

| | |
|---|---|
| Class I Objective: | 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. |
| Class II Objective: | 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. |
| Class III Objective: | 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. |
| Class IV Objective: | 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. |
| Rehabilitation Areas: | Areas in need of rehabilitation from a visual standpoint should be flagged during the inventory process. The level of rehabilitation will be determined through the resource management planning (RMP) process by assigning the VRM class approved for that particular area. |

Source: BLM Manual Handbook 8410-1.

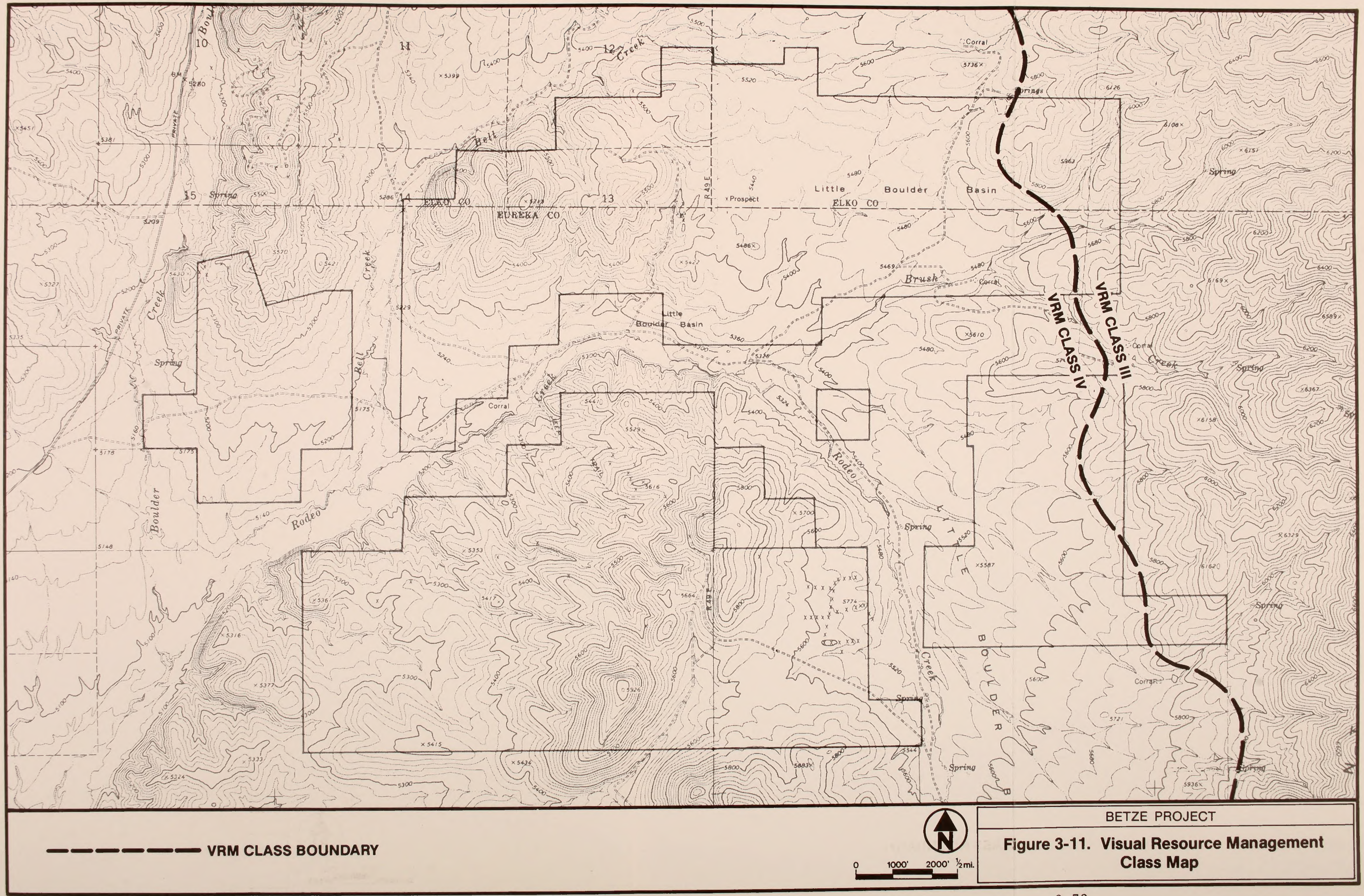
for small topsoil stockpiles which have been reseeded with grasses. Vegetation colors range from grey-green to medium olive, with a muted buff yellow for a brief period when the rabbitbrush is in flower.

Major creeks in the project area are considered perennial in certain segments, but they are barely noticeable from most of the project area. Natural colors in the project area are muted with very little variety. Soils are brown, with subtle tints ranging from greyish brown to buff.

The dominating visual feature of the project area is the extensive network of mining activity that occupies much of a 11-mile segment of the Carlin Trend from the Dee Gold Mine to Newmont's Carlin Mine. The native topography has been transformed into a series of flat-topped, steep-sided, geometric benches woven together by a maze of haul roads and access roads. Several square miles extending southward from Newmont's Mill No. 4 are, for practical purposes, almost totally disturbed by existing mining activity. The disturbed area includes most of the AA Block, the existing South Block waste rock disposal area, and the existing and proposed pit area. Vegetation has been removed from much of the area; rock and soil colors range from light grey to black, with many hues of brown from buff and golden to near maroon.

Virtually all of the visitors to the project area are mine employees, contractors, or service personnel. The public has limited access to the area via Boulder Valley Road or from Maggie Creek Road across the Tuscarora Mountains. Gatehouses established by Barrick, Dee, and Newmont on the access roads to the companies' respective mining operations limit traffic in the immediate project area to mining-related visits for safety and security reasons. Thus, traffic not related to local mines is very light. The project area is not visible from major travel routes or recreation use areas in the region. The project area is in foreground/ middleground viewing distance for viewers on local roads. Based on the predominance of mine workers among potential viewers and the limited recreational opportunities in the area to attract other users, viewer sensitivity to visual resources is currently considered to be low.

The BLM's generalized VRM classification map designates most of the project area as Class IV, with a strip of Class III along the eastern side at the foot of the Tuscarora Mountains (Figure 3-11). Site-specific application of the VRM system inventory procedures suggests a Class III designation for the lower foothills of the Tuscarora Mountains is marginal, and the demarcation line between Class III and Class IV areas should be farther east (Figure 3-11). Management objectives for VRM Class III and Class IV areas are specified in Table 3-18.




BETZE PROJECT

**Figure 3-11. Visual Resource Management Class Map**

3.10.2 Noise

A description of the environment potentially affected by noise emissions from the proposed project includes identification of noise-sensitive receptors and existing noise sources in the vicinity, characterization of terrain features that may affect noise transmission, and determination of existing noise levels.

The proposed Betze Project is located in an unpopulated, remote valley. There are no occupied, year-round residences or other sensitive receptors within many miles of the proposed project area. There is an old line shack, currently hosting two travel trailers, on Boulder Creek just off the southwest corner of the Clydesdales Block. This site is occupied seasonally by TS Ranch workers.

The principal sources of noise in the area are existing mining and milling operations by Barrick at the Goldstrike Mine and by Newmont on adjacent properties. Wind and, to a lesser degree, insects and birds also contribute to existing ambient noise in the vicinity.

The terrain in the project area is complex. As a result, there are probably locations near existing mining activity that are effectively shielded from mining noise. There may also be locations where noise is focused and intensified by terrain. No attempt was made to analyze terrain effects in detail because of the lack of noise-sensitive receptors in the area. The TS Ranch line shack site is shielded by terrain from current activity in the pit area and from Barrick's milling and leaching areas.

Monitoring of existing noise levels was not deemed necessary because of the remote location of the project, the presence of existing mining operations, and the fact that there are no sensitive receptors in the area. It is estimated, based on EPA literature, site visits, and previous experience with mining projects in remote areas, that existing noise levels range from 40 to 65 decibels, A-weighted (dBA), in most of the project area, except in close proximity to high activity areas. Decibels are units for expressing the relative intensity of sounds; dBA are weighted to achieve close approximation to the human hearing spectrum. The lower end of the range (40 dBA) represents noise levels one would experience in a small rural community. Quieter parts of the project area would be at or below this level much of the time. The upper end of the range (65 dBA) represents areas where the background mechanical "hum" of mining and milling activity would be commonly perceived but not at close enough range to interfere with conversation.

3.11 <u>Cultural Resources</u>

3.11.1 Cultural Resources Overview

Information concerning cultural resources in the project area is found in cultural resource inventories and other studies conducted on lands under management of the BLM Elko District Office. Most of these inventories apply directly to the project area, although information from inventories in adjacent areas and data from excavations and inventories in the region are also relevant. Most inventories pertaining to the project area were conducted according to BLM standards in effect prior to 1989 (i.e., USDI 1985a), although that by Schroedl (1990) was conducted under newer standards (USDI 1989). Overviews of the paleoenvironment, prehistory, ethnohistory, and history are found in regional documents (James 1981; Rusco 1982); and more project-specific summaries are found in the cultural resource inventories and other reports discussed below.

Six reports of cultural investigations pertaining to the project area have been filed with the BLM Elko District Office. Three of these were limited to surface examination (Hicks 1989; Coulam 1988; Schroedl 1986); however, Schroedl's results were incorporated entirely in a subsequent report by Russell et al. (1986) discussing additional surface inventories as well as limited testing. Tipps and Coulam (1988) describe results of an excavation at one site and testing at another. Most recently, Schroedl (1990) completed a surface inventory as well as limited subsurface probing.

The earliest inventory reports are not specific in identifying the criteria under which the archaeological sites were recommended as eligible for listing on the National Register of Historic Places (NRHP). However, from the site descriptions, cultural resources overviews, and the nature of recommendations, it is apparent that the only eligibility criterion considered in these reports was the potential to yield important information about the past. Schroedl (1990) is specific in identifying this criterion as the basis for NRHP eligibility and further justifies that conclusion with regard to specific and appropriate research domains. In their evaluation of CRNV-12-5682, Tipps and Coulam (1988) specify the site's NRHP eligibility using this criterion. The site descriptions and overviews indicate that other NRHP eligibility criteria may not be applicable to any of the sites in the project area (Burke 1988).

3.11.2 Cultural Resources Identified in the Project Area

In the proposed project area, there are numerous cultural resources in the form of prehistoric archeological sites, although one historic site is also noted. All are open sites with lithic debitage and many contain ground stone implements as well. The sites range in age from the Archaic to the historic period (ca 5000 B.C. to A.D. 1850), although those from the Late Prehistoric and

Numic periods (A.D. 500-1850) are most common. Subsurface deposits have been demonstrated on some sites and may exist on others. A cultural resources overview for the area is presented in the Cultural Resources report for the Betze Project Environmental Impact Statement, which is available for public review at the Elko BLM office.

Surveys covering 6,475 acres have been conducted on the AA, South, Clydesdales, Buzz, and North Blocks to determine the occurrence of cultural resources on both private and public land. A total of 262 large sites, small sites, and isolates have been recorded to date. The cultural resource occurrences found on each block are shown on Table 3-19. A large site contains over 20 artifacts, while a small site has between 1 and 20 artifacts present, and an isolate has only 1 artifact at the site. A pre-mining inventory exists only on a portion of the South Block, so the totals reflect only those resources that have been inventoried.

The 40 cultural resource sites that have been recorded on the AA Block no longer exist; therefore, a total of 222 sites remain within the project area. Three sites on the AA Block, CRNV-12-5585, CRNV-12-5588, and CRNV-12-5589, were evaluated for NRHP eligibility and were determined not to be eligible. The remaining sites on the AA Block were treated in accordance with the Final Environmental Assessment - Barrick Goldstrike Mine Mill and Tailings Pond (BLM 1988b), and the Final Environmental Assessment - Barrick Goldstrike Mine South Block Operations (BLM 1988a), which were approved by the BLM.

Data recovery was also completed at site CRNV-12-5682 which is located on the North Block; this site was determined to be eligible for the NRHP. Of the remaining 124 large and small sites, no sites are known to be eligible for NRHP: 16 have been determined not to be eligible for the NRHP, and 108 sites have not been evaluated for NRHP eligibility. The BLM and the Nevada State Historic Preservation Officer (SHPO) have agreed that isolates are not NRHP eligible and have not been included in the above analysis.

### 3.11.3 Cultural Resource Inventories and Evaluations in the Vicinity of the Project Area

In addition to the cultural resource inventories performed on lands owned or controlled by Barrick, numerous inventories and evaluations covering over 4,948 acres in the vicinity of the Goldstrike Mine have been conducted, most being done in accordance with the BLM cultural resource inventory standards in effect prior to 1989. General results are similar to those described for the Betze Project. All sites are archeological in nature, and historic period sites are very scarce. Most prehistoric sites are open lithic scatters, although ground stone implements are common.

TABLE 3-19

OCCURRENCES OF CULTURAL RESOURCE SITES

| Block | Large Sites | Small Sites | Isolates | Total |
|---|---|---|---|---|
| AA | 10 | 16 | 14 | 40 |
| South | 10 | 13 | 21 | 44 |
| North | 53 | 35 | 73 | 161 |
| Clydesdales | 9 | 3 | 4 | 16 |
| Buzz | 1 | 0 | 0 | 1 |
| TOTAL | 83 | 67 | 112 | 262 |

These reports have identified 254 sites: 88 large sites, 100 small sites, and 66 isolates. These totals are slightly skewed because the earliest reports combined small sites and isolates and characterized them as large sites. The earliest inventories recorded no isolates at all. Of the 254 sites, 7 sites have been determined to be eligible for the NRHP, 137 sites have been determined not to be NRHP eligible, and 44 sites have not been evaluated.

### 3.11.4 Native American Concerns

Intangible cultural values have emerged as a form of significance criterion (USDI n.d.b). For example, Indian tribes may have interests in cultural properties, including those which are not located on Indian lands, and those interests may constitute the basis for concluding that a cultural resource is NRHP eligible. In the case of the Betze Project area, the BLM has provided the Western Shoshone Tribe with information about the project but has received no response. Although there appear to be no pertinent Native American concerns (Jaynes 1990), the BLM will continue to keep Native Americans apprised of the project.

The Western Shoshone occupied the territory surrounding the project area at the time of contact with Euro-Americans. The ethnographic record is documented in Steward (1938), who conducted interviews with Native Americans early in the twentieth century and obtained recollections of camp locations, foodways, festivals, marriage patterns, and other information. A mobile hunting and gathering lifestyle characterized the Western Shoshone existence, although the fertile Humboldt River Valley apparently allowed for much smaller exploitation zones than elsewhere in the Great Basin. Population centered on the river basin with larger, more permanently occupied settlements near present day sites such as Palisade, Carlin, and Elko. The village site closest to the project area is to the east in Independence Valley near Maggie Creek; according to Steward (1938), this group was somewhat autonomous from others in the Humboldt River Valley and held its own festivals. Roots, seeds, pine nuts, rabbits, fish, antelope, and other foods characterized the diet of Western Shoshone people in the area, particularly along the Humboldt River.

### 3.11.5 Status of Cultural Resources Investigations

All previous cultural resources reports have been found to be satisfactory and have been accepted by the BLM. Recommendations within one report (Hicks 1989) concerning NRHP eligibility for large and small sites are in abeyance pending accumulation of additional information requested by the BLM. Further, the recommendations by Schroedl (1990) are pending consultation between the BLM and the Nevada SHPO.

Certain areas within the claim blocks have not yet been inventoried; these include approximately 56 acres in three strips along the western edge of the Clydesdales Block (an alternative), approximately 9 acres on the northern edge of the North Block, and an area of approximately 13 acres in the AA Block, north of the proposed ore stockpile area. A total area of approximately 894 acres outside Barrick's property but within alternatives has not been inventoried for cultural resources primarily because the land involved is privately owned and Barrick has been unable to obtain permission to enter the property to inventory cultural resources on such property.

## 3.12 Land Use

### 3.12.1 Land Status/Ownership

The Elko RA contains approximately 5,967,854 acres, of which approximately 3,134,019 acres are under administration by the BLM (BLM 1985). The Elko RA encompasses portions of three counties; Elko (approximately 23 percent of the county), Eureka (approximately 19 percent of the county), and Lander (approximately 4 percent of the county) (BLM 1985). The public land pattern is generally consolidated, with the exception of a 40-mile wide band of checkerboard land consisting of alternating federal and private sections. This pattern was created when the Act of July 1, 1862 granted alternating sections of land to the Union Pacific Railroad and Central Pacific Railway as incentive for construction of the transcontinental railroad. About two-thirds of the ownership of this area remains in a checkerboard pattern (BLM 1985).

The land pattern in the vicinity of the Betze Project area is generally consolidated into blocks of public and private lands. The project area is located just north of the large checkerboard area of public and private land ownership.

The Goldstrike property is controlled by Barrick Goldstrike Mines Inc. The property, located in Eureka and Elko counties, is divided into several non-contiguous groups of claims on public lands administered by the BLM and on some fee lands owned by Barrick.

### 3.12.2 Land Use Plans

Given the large percentage of federal land in Eureka and Elko counties, federal management programs, particularly those administered by the BLM, will continue to significantly influence land use in the area. In addition, since the Betze Project area consists of unpatented mining claims on lands administered by the BLM, the BLM's land use plans, policies, and regulations have primary jurisdiction over land use activities on these parcels. The BLM has developed the current Elko Resource Management Plan (RMP) to guide long-term management of the lands that it manages. The development of the Elko RMP was the result of a long planning process which included preparation of three separate public documents: the Elko Resource Area Draft Resource Management Plan and Environmental Impact Statement (BLM 1985); the Elko Resource Area Final Proposed Resource Management Plan and Environmental Impact Statement (BLM 1986a); and the Elko Resource Management Plan Record of Decision (BLM 1987a).

The following is a summary of the planning issues and management decisions contained in the RMP Record of Decision as they relate to the proposed project.

Land Tenure Adjustments and Corridors. The Betze Project area is located in an area designated for retention by the BLM. It is located just northeast of a large area identified for "transfer primarily by exchange." There are no designated corridors or planning corridors traversing the project area.

Access. There are no roads traversing the project area that have been identified for acquisition by the BLM due to access considerations. Access to the general area is available by public roads under the jurisdiction of Eureka County and the State of Nevada.

Recreation. A discussion of recreation resources is presented in Section 3.9.1.

Wilderness. A discussion of wilderness issues is presented in Section 3.9.2.

Wildlife. The project area is located in an area designated for "other deer winter range." A discussion of wildlife resources is presented in Section 3.7.

Woodland Products. There are no designated woodland product harvest areas in the vicinity of the project area. The closest fuel and post harvest area is approximately 19 miles southeast of the project area. The closest Christmas tree harvest area is approximately 30 miles southeast of the project area.

Minerals. The objective of minerals management in the Elko RA is to maintain the public lands for exploration, development, and production of mineral resources while mitigating conflicts with wildlife, wild horses, recreation, and wilderness resources. The short- and long-term management actions include designating the Elko RA open to mineral entry for locatable minerals, except for an administrative site. The project area is located in an area designated as open to oil and gas and geothermal leasing, subject to standard leasing stipulations.

### 3.12.3 Land Use

Land use in the vicinity of the project area reflects typical land use patterns throughout the Elko RA and primarily consists of ranching, agriculture, mining, and dispersed recreation. Recreation resources are discussed in Section 3.9.1.

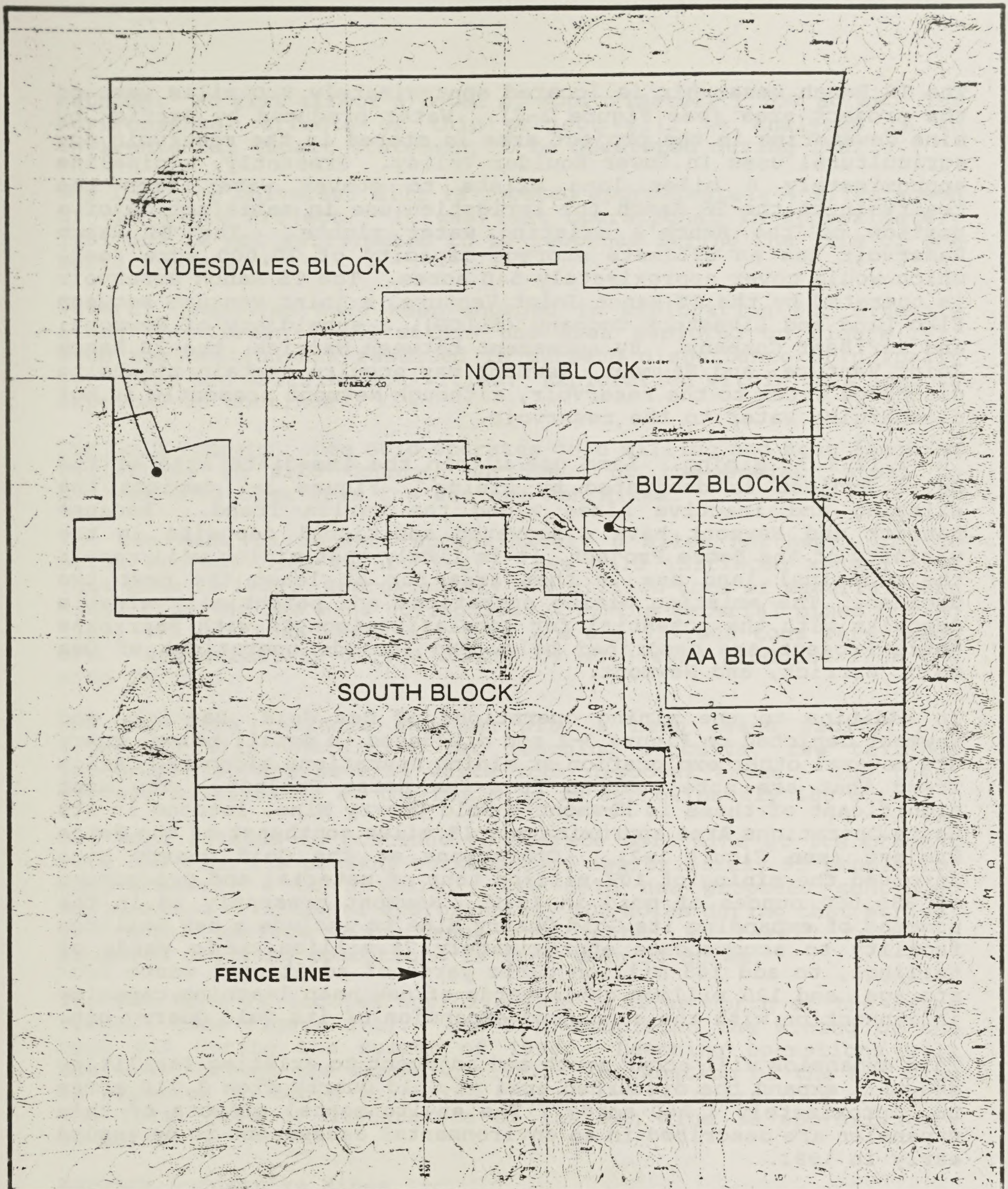
3.12.3.1 Ranching. A Rangeland Program Summary (BLM 1987b) was issued after completion of the Elko RMP to inform livestock permittees and the interested public about implementation of the rangeland management program throughout the Elko District. It identifies allotment-specific objectives for livestock, wildlife, and wild horses. It outlines allotment-specific monitoring studies needed to evaluate the attainment of objectives and the range improvements proposed to implement the RMP.

The project area is located within an area historically used for ranching and is within the extreme northern edge of the T Lazy S Grazing Allotment (BLM 1987a). There are 72,928 acres of public land within this allotment (BLM 1985). Currently one licensed operator, the TS Ranch Joint Venture, is utilizing the allotment (BLM 1987b). Total grazing preference within the allotment is 18,486 animal-unit-months (AUMs) for livestock (3.9 acres per AUM). Current active grazing preference and average licensed use is 15,250 AUMs for livestock and 396 AUMs for deer with an apparent downward trend (BLM 1985). The allotment is grazed from mid-March to the end of December (BLM 1985).

The T Lazy S allotment is categorized as an "Improve" allotment under the BLM's selective range management policy (BLM 1987b). This identifies the allotment as a high priority for improvement of rangeland production and condition based on consultation between the livestock operator and the BLM, with input from the Nevada Department of Wildlife (NDOW) and the interested public. The long-term management objective for the T Lazy S allotment is to provide forage to sustain 13,081 AUMs for livestock grazing and 793 AUMs for mule deer (BLM 1987b).

By agreement between Barrick, the TS Ranch Joint Venture, and Newmont, a fence has been constructed that encloses the active mining area, which encompasses most of the proposed Betze Project area. Livestock grazing has been eliminated from the lands within the active mining area and the livestock grazing preference rights for that area have been removed from active status. The location of the fence is shown in Figure 3-12. Until mining ceases, livestock grazing has been eliminated as a land use within the active mining area.

3.12.3.2 Agriculture. Presently the closest agricultural production is approximately 8 miles southwest of the project area. The nearest production occurs on several ranches in the lower Boulder Valley and further south along the Humboldt River.




BETZE PROJECT

**Figure 3-12. Existing Fence Line**

The TS Ranch Reservoir is located approximately 3.0 miles west of the project area (see Figure 2-7). Water produced by Barrick by mine dewatering in the project area is stored in the reservoir for agricultural uses in lower Boulder Valley. Presently, a pipeline approximately 6 miles long exists to convey water from the reservoir to the TS Ranch for irrigation use in satisfaction of a portion of the Ranch's existing water rights. The TS Ranch Reservoir has an ultimate storage capacity of 20,000 acre feet, which would cover approximately 540 acres. The TS Ranch Reservoir is operated by the TS Ranch Joint Venture, a joint venture between Elko Land and Livestock Company (ELLCO), a subsidiary of Newmont, and AgriBeef Company. By agreement between Barrick, the TS Ranch Joint Venture, and Newmont, Newmont may acquire certain rights to discharge water to the reservoir, although Newmont presently is not discharging water to the reservoir.

3.12.3.3 Mining. Land use within the immediate area of the Betze Project is dominated by mining. Figure 1-2 depicts the existing and inactive mines along the Carlin Trend. Because Barrick and Newmont have discovered additional deposits in the vicinity of the Betze Project, it is likely that mining will remain the principal land use in that area for at least the next two decades. The existing mining operations and potentially minable deposits with the potential for cumulative impacts with Barrick's Betze Project are described below and include operations of Dee Gold, Barrick, and Newmont.

In addition to the mining operations of Dee Gold, Barrick, and Newmont depicted on Figure 3-1 and discussed in detail below, there are several other exploration or mining operations along the Carlin Trend that are more removed from the Betze Project. The most significant of these is Newmont's Gold Quarry Mine, located in its South Operations Area approximately 18 miles southeast of the Betze Project (see Figure 1-2). Operations at the Gold Quarry Mine involved the mining of 107 million tons of material and production of 880,000 ounces of gold in 1989. Newmont presently is in the process of expanding its Gold Quarry Mine to include a new tailings facility to accommodate approximately 78 million cubic yards of tailings, to add 165 million cubic yards of additional waste rock storage, and 120 million cubic yards of new heap leaching capacity in connection with the continued expansion of its Gold Quarry pit.

This expansion will occur south and adjacent to existing facilities and will expand the disturbed area at Gold Quarry from 3,210 acres to approximately 4,200 acres. The environmental effects of this expansion are described in an environmental assessment to be issued early in 1991.

Approximately 13 miles northwest of the Betze Project, Galactic Resources is developing the Ivanhoe Mine. Subject to BLM's approval, this mine is expected to produce 60,000 to 70,000 ounces of gold per year for approximately 10 years by heap leaching methods. It will affect a total of approximately 1,200 acres. The environmental effects of this project will be analyzed in an environmental impact statement to be developed during 1991.

The inactive Universal Mill is located approximately 4 miles south of the Betze Project. It was last operational in approximately 1981 and is not anticipated to be reopened during the life of the Betze Project.

Several companies have been engaged in exploration for minerals along the Carlin Trend within the area depicted on Figure 1-2. Such exploration has resulted in surface disturbance principally for roads and drilling activities. Exploration within this area is expected to continue.

Dee Gold Company. Dee Gold operates gold milling and heap leaching facilities in Elko County, northwest of the project area, to process gold ores from the Dee and Ren Mines.

The Dee Mine is located approximately 6 miles northwest of the Betze Project (see Figure 3-1). Dee Gold initiated mining from this mine in 1983. Approximately 4.8 million tons of material were mined from the Dee Mine during 1989. Of the material mined during 1989, 478,000 tons were mill feed ore and 557,000 tons were leach ore. Approximately 45,000 ounces of gold were produced from the mine in 1989.

The Dee Mine includes an open pit, a heap leach facility, a 1,500 tpd mill containing vat leaching circuits, two tailings impoundments, and several waste rock disposal areas. The total surface disturbance at the Dee Mine is approximately 460 acres.

Dee Gold intends to continue to operate this mine at its present rate and with its present workforce of approximately 95 people for approximately 4 to 5 years. Dee Gold has proposed continued exploration drilling of approximately 100 holes during that period. The total surface disturbance anticipated to result from the proposed drilling operations is less than 50 acres.

The Ren Mine is located approximately 3 miles north of the Betze Project (see Figure 3-1). Dee Gold completed the mining of the open pit during the summer of 1990. Leaching operations will continue through the summer of 1991. Reclamation of the Ren Mine is expected to begin following completion of operations in 1991. The total area of disturbance at the Ren Mine is approximately 60 acres.

Barrick Goldstrike Mines Inc.

Existing Barrick Operations. Barrick operates both milling and heap leaching facilities to process gold ores from several existing pits in the Betze Project area. These pits and facilities are described in Section 2.1.

Potentially Minable Deposits or Prospects of Barrick. Barrick's Deep Post deposit occurs at the 4,420 to 3,900 foot elevation, approximately 200 feet beneath the projected bottom of the existing surface Post deposit. The deposit extends across the Newmont boundary line. Barrick is currently evaluating the feasibility of mining this deposit by either surface or underground mining methods. The Deep Post reserves are presently projected to be approximately 16.6 million tons of ore averaging 0.192 ounces of gold per ton of ore. Barrick has no current plans to mine this deposit; however, it is reasonably foreseeable that this deposit could be developed.

The Purple Vein prospect occurs at depths of 800 to 1,800 feet below the surface, approximately 1 mile north of the projected ultimate boundary of the proposed Betze Pit. Barrick is conducting an exploration program to further define the extent and quality of the mineral resource. The results of drilling completed during the first half of 1990 indicate the presence of an inferred mineral resource containing approximately 13.0 million tons of ore having an average grade of 0.40 ounces of gold per ton of ore, or approximately 5.0 million ounces of contained gold. Based on these drilling results, Barrick does not expect the inferred tonnage of ore to be increased significantly as the result of additional drilling. Barrick has no current plans to mine this deposit; however, it is reasonably foreseeable that it could be developed.

The Screamer prospect occurs at depths of 900 to 1,300 feet below the surface, approximately 0.25 mile west of the projected ultimate boundary of the proposed Betze Pit. Barrick's exploration has identified a mineralized zone. At present, the prospect is not well enough defined to project the inferred reserves. Barrick intends to further explore to define the extent and quality of the mineral resource. Barrick believes that while it is unlikely that this mineralization would support a separate mine, it may potentially be minable by underground methods via access from the proposed Betze Pit at the conclusion of mining operations in the Betze deposit. However, Barrick has no current plans to mine this prospect.

The Rodeo prospect occurs at depths of 900 to 1,200 feet below the surface, approximately 0.5 mile northwest of the projected ultimate boundary of the proposed Betze Pit. Barrick's exploration has identified a mineralized zone which Barrick is further exploring to define the extent and quality of the mineral resource. Barrick has no current plans to mine this prospect.

Newmont Gold Company

Newmont operates both milling and heap leaching facilities in Eureka and Elko Counties to process both oxide and refractory gold ores from its mines along the Carlin Trend. These mines and facilities are subdivided into three geographically distinct operational areas: the Rain Area, the South Area, and the North Area (See Figure 1-2). Within these three operating areas, Newmont has identified 15 gold deposits and orebodies (Newmont 1990). At this time, active mining is taking place in five of these orebodies: the Rain Mine, the Gold Quarry Mine, the Genesis Mine, the Blue Star Mine and the Post Mine.

Newmont's North Area facilities and mines have the greatest potential for cumulative environmental impacts with the operations of the proposed Betze Project. (See Figure 3-1). Approximately 473,000 ounces of gold were produced from the North Area during 1989. Of that total, 211,200 ounces were recovered by leaching and 261,800 ounces were produced from Mill No. 1 and Mill No. 4. Reserves contained in Newmont's North Area deposits are described on Table 3-20.

Newmont's principal active North Area operations are the Genesis, Blue Star, and Post mines; the North Area Leach facility; Mill No. 1, and Mill No. 4. Ore from the Genesis and Blue Star Mines is currently either processed through Mill No. 4 or leached at the North Area Leach facility. Ore from the Post deposit is presently mined by Barrick and delivered to Mill No. 4 and the North Area Leach facility. Newmont's forecast of gold production from its North Area Operations through 1992 is shown on Table 3-21.

To maintain current production levels and to provide feed for the North Area mills and leach facility, Newmont proposes to phase in production from other near-surface North Area oxide deposits as production from existing mines declines. Newmont is considering initial development of the Bootstrap/Capstone, North Star, and Carlin orebodies in the years 1994 to 1997. The Carlin Mine may be reopened as early as 1991. Newmont does not anticipate that any of these developments would change appreciably the current Newmont work force because existing operations would be phased out as new operations are developed.

Existing Newmont North Area Operations. The Genesis Mine is located approximately 4 miles northwest of Mill No. 1 and approximately 0.5 mile northeast of the Blue Star Mine (see Figure 3-1).

Newmont initiated mining from the Genesis deposit in 1986. Approximately 17.5 million tons of material were mined from the Genesis Mine during 1989, down from the 21.5 million tons mined in 1988. Of the material mined during 1989, nearly 1.0 million tons were mill ore and 4 million tons were leach ore. Approximately

TABLE 3-20

NEWMONT'S NORTH AREA GEOLOGIC GOLD RESOURCES[1] AND RESERVES[2]

| Deposit | Tons (Thousands) | Ounces/Ton | Resource[2] Ounces (Thousands) | Reserve Ounces[2] (Thousands) |
|---|---|---|---|---|
| Blue Star | 21,902 | 0.030 | 655 | 601 |
| Genesis | 33,373 | 0.045 | 1,516 | 846 |
| Deep Post | 170,100 | 0.067 | 11,331 | 4,971 |
| Surface Post | 24,300 | 0.046 | 1,115 | 1,094 |
| North Star | 6,941 | 0.052 | 359 | 204 |
| Capstone/ Bootstrap | 25,112 | 0.039 | 974 | 758 |
| Carlin | 20,787 | 0.029 | 610 | 134 |
| Pete | 15,747 | 0.030 | 470 | 153 |
| Bobcat | 17,679 | 0.029 | 516 | --- |
| Lantern | 15,451 | 0.028 | 433 | --- |
| Total | 351,392 | Not Applicable | 17,979 | 8,761 |

Source: Newmont 1990.

[1] Resources include material on stockpile and include measured, indicated, and inferred resources estimated as of December 27, 1989.

[2] Reserves include material on stockpile and are the estimated proven and probable reserves as of December 27, 1989.

TABLE 3-21

NEWMONT'S NORTH AREA FORESEEABLE

MINING PRODUCTION LEVELS

| Year | Genesis | Waste and Ore Combined<br>Million Tons of Material Moved<br>Blue Star | Post | Total |
|---|---|---|---|---|
| 1989 | 17.5 | 8.9 | 20.4 | 46.8 |
| 1990 | 23.5 | 9.3 | 24.3 | 57.1 |
| 1991 | 11.2 | 12.8 | 28.0 | 52.0 |
| 1992 | 6.8 | 12.3 | 11.0 | 30.1 |

Source: Newmont 1990.

300,000 ounces of gold were produced from the Genesis Mine during 1989. Newmont currently projects the production rate from the Genesis Mine to be approximately 23.5 million tons of ore and waste in 1990, 11.2 million tons of ore and waste in 1991, and 6.8 million tons of ore and waste in 1992. Mining in the Genesis Pit is forecasted to be substantially complete by 1995; however, ongoing exploration programs may extend the reserves. The Genesis Pit is currently planned to ultimately reach the 4,190-foot elevation (Newmont mine datum).

Beginning in early 1990, mining operations at the Genesis Mine have required dewatering at a rate of 450 gpm. The water produced by dewatering has been used by Newmont for its processing needs. It is projected that the dewatering may increase to a maximum of 2,800 gpm as mining operations continue through 1995. Newmont anticipates that it will use all of this water in its mining, milling, and leach processes. Exploration drilling at depth has not been attempted to date, although such activity is contemplated by Newmont within the near term.

The Blue Star Mine is located 0.5 mile southwest of the Genesis Mine (See Figure 3-1). Newmont initiated mining from the Blue Star deposit during 1974. Approximately 8.9 million tons of material were mined from the Blue Star Mine during 1989, an increase from the 4.1 million tons mined in 1988. Of the material mined during 1989, approximately 100,000 tons were mill ore and 1.6 million tons were leach ore. For 1989, Blue Star Mine production was nearly 35,000 ounces of gold. Newmont currently projects that the mine production rate from the Blue Star pit will be approximately 9.3 million tons of ore and waste during 1990, 12.8 million tons of ore and waste during 1991, and 12.3 million tons of ore and waste during 1992. Mining of the Blue Star Pit is expected to be completed in 1993. The Blue Star Pit will ultimately be encompassed by the Genesis Pit.

Mining operations at the Blue Star Mine to date have not required dewatering. It is expected that future dewatering will not be necessary at Blue Star. Exploration drilling at depth has not yet been attempted although such activity is planned in conjunction with the development of the Genesis deposit.

The surface Post Mine is located approximately 1 mile southwest of Mill No. 4 (See Figure 3-1). Until July 1990, the Newmont oxide material from this orebody was mined by Barrick under a mining agreement with Newmont. Newmont terminated the mining agreement in July, 1990. Barrick is continuing to mine Newmont's portion of the surface Post Mine under a separate agreement with Newmont that allows Barrick to mine on Newmont property as necessary to obtain access to Barrick's ore. The ore mined from Newmont's portion of the surface Post Mine is presently sent to Mill No. 4 and the North Area Leach facility.

Mining on Newmont's portion of the Post Pit began in 1987. Approximately 20.4 million tons of material were mined from Newmont's portion of the Post Pit during 1989. An estimated 1.2 million tons of mill ore and 3.0 million tons of leach ore were delivered to Newmont's facilities. Gold production from Newmont's portion of the Post Pit in 1989 was approximately 170,000 ounces. Newmont currently plans that the production rate from Newmont's portion of the Post Pit will be approximately 24 million tons of ore and waste during 1990, 28 million tons of ore and waste during 1991, and 11 million tons of ore and waste during 1992. Oxide mining is forecast to be completed in 1992, with the pit reaching the 5,020-foot elevation (Barrick datum).

Waste rock from the Post Pit is hauled approximately 1.5 miles to the South Block waste rock disposal area located southwest of the pit. Dewatering is presently accomplished in association with Barrick's dewatering program. Newmont has no plans to conduct a separate dewatering operation in the Post Pit at this time.

Mill No. 1, located just beyond the south end of the Little Boulder Basin, (see Figure 3-1) is a conventional cyanide operation composed of crushing, milling, and carbon-in-leach (CIL) circuits. Mill No. 1 also contains a chlorine circuit to treat carbonaceous refractory ore. Mill tailings from the milling circuit are discharged into the tailings impoundment, which is located immediately to the northwest of the mill. Until recently, Mill No. 1 had processed approximately 1.5 million tons per year of oxide ore received from the Genesis and Blue Star pits. The refractory circuit had treated 220,000 short tons per year of stockpiled carbonaceous refractory ore previously mined from the Carlin pit.

Newmont has modified Mill No. 1 to process 1,000 tons per day of carbonaceous ore that was mined from the presently inactive Carlin Mine and stockpiled. There is sufficient refractory ore in stockpiles to feed the mill for several years. All of the oxide ore from the Genesis and Blue Star Mines is now being processed at Mill No. 4.

Mill No. 4 is Newmont's northernmost active processing facility (See Figure 3-1). The mill is located approximately 1 mile north of the Post Mine and approximately 4 miles southeast of the inactive Bootstrap Mine. The primary crushing circuit currently crushes both mill feed and a portion of leach oxide ores mined from the Post Pit. Crushed leach ore is stockpiled and subsequently transported to the North Area Leach facility at a rate of 3.5 million short tons per year. Mill tailings are discharged into the Mill No. 4 tailings impoundment located immediately west of the mill. The capacity of the existing tailings impoundment is approximately 9 million tons; the impoundment is projected to reach capacity in 1992. Newmont intends to expand the capacity of this impoundment to 31 million tons; engineering design and the evaluation of alternative impoundment sites by Newmont are ongoing.

The North Area Leach facility is a conventional cyanide heap leach operation for lower grade gold ores. Ores from Newmont's Genesis, Blue Star, and Post Mines are crushed by primary and secondary crushers and hauled by truck to the pad. Phase I of the leach pad is lined with 60 mil high density polyethylene (HDPE)(a synthetic liner); ore will be stacked to a height of approximately 120 feet. The contiguous Phase II leach pad is lined with 80 mil HDPE and will have an ultimate heap height of 200 feet. A weak cyanide solution is applied to the heap; the solution percolates through the ore and is ultimately collected in the pregnant (gold-bearing) solution pond. The pregnant solution is then pumped to carbon columns, located north of the pad, where the gold is adsorbed onto carbon. The gold-impregnated carbon is trucked to the South Area for further refining. The North Area Leach facility will continue to be expanded in a phased approach, to the ultimate capacity of 48 million tons.

Inactive Mines and Potentially Minable Deposits or Prospects of Newmont. The Bootstrap/Capstone Mine is located 4 miles northwest of Newmont's Mill No. 4 (see Figure 3-1). The Bootstrap Mine began production in 1973; active mining operations were suspended in 1984. Ore from the Bootstrap Mine was processed at Mill No. 1 or at an adjacent leach facility, which has since been decommissioned.

The Capstone deposit is immediately adjacent to the Bootstrap Mine. As of January 1, 1990, the remaining Bootstrap/Capstone deposits include 25.1 million tons of ore having an average grade of 0.039 ounces of gold per ton of ore, containing 758,000 ounces of gold reserves. Newmont currently projects that production from the Bootstrap/Capstone Mine may resume as early as 1995. Production rates will be dictated by total North Area requirements. Mining of the Bootstrap/Capstone deposits is expected to be substantially complete within three to four years following resumption of mining. The current plans indicate the pit would reach maximum depth at the 5,080-foot elevation (Newmont datum). Exploration drilling continues peripheral to the identified reserves. This drilling continues to indicate the presence of ore at depth and along strike.

Waste rock that would be excavated from the Bootstrap/Capstone pit may be hauled approximately 1 mile to a disposal area located east of the open pit. Previous mining operations at the Bootstrap Mine did not require dewatering. Projections indicate that dewatering would be necessary beginning during the second year of mining (Newmont 1990). Also, portions of Boulder Creek would need to be diverted to allow mining in the proposed pit. Projections of dewatering volumes or rates are not available at this time.

The Carlin deposit is located at the southern end of Newmont's North Area approximately 20 miles north of the town of Carlin. Mining of the Carlin deposit began in 1965 and continued uninterrupted until 1986. Intermittent mining of remnant oxide reserves was carried out in 1987. Evaluation and exploration is in progress to define additional reserves adjacent to this pit. The Carlin deposit consists of 20.7 million tons of ore, including stockpiles of 1.9 million tons of ore, containing 134,000 ounces of gold reserves at a grade of 0.029 ounces per ton.

The North Star deposit was discovered in 1978 and is located 5 miles northwest of Mill No. 1. Definition drilling continued through 1983. The deposit is bisected by the property line with Barrick. Mining was carried out on the Barrick portion of the deposit by Western States Minerals during 1986. This mining incorporated some minor development on Newmont property which yielded both mill and leach ore. Mill ore was treated through Mill No. 1 in 1986. Leach material was stockpiled and sent to the North Area Leach facility during early 1988. Ore from the North Star deposit would be used to feed Mill No. 4 and the North Area Leach facility. Waste rock would be deposited at a site southwest of the ultimate pit limit. The North Star deposit consists of 6.9 million tons of ore at a grade of 0.052 ounces of gold per ton of ore.

The Deep Post deposit occurs at the 4,420 to 3,900-foot elevation near the current Post Pit. Newmont is currently evaluating the feasibility of mining this deposit by either underground or surface mining methods. The Deep Post deposit presently is projected to contain approximately 170.1 million tons of ore averaging 0.067 ounces of gold per ton of ore. Newmont has no current plans to mine this deposit; however, it is considered reasonably foreseeable that the Deep Post deposit could be mined.

The Pete deposit is located approximately 1 mile southeast of the Carlin Mine (See Figure 3-1). The Pete deposit consists of 15.7 million tons of ore at a grade of 0.030 ounces of gold per ton of ore.

In addition to the previously discussed minable reserves, three additional mineralized zones are being evaluated by Newmont; Lantern, Bobcat, and Deep Star. At this time, all of these three deposits are classified by Newmont as "advanced geologic prospects" (Newmont 1990).

The Lantern prospect is located 2 miles west-northwest of the Carlin Mine. (See Figure 3-1). The deposit was discovered in 1986. In 1987 two discrete zones, Lantern North and Lantern South, were defined. Geologic drilling presently is being conducted to further define the mineralized zones.

The Bobcat prospect is located approximately 4.5 miles north of the Mill No. 1. (see Figure 3-1). The Bobcat prospect is currently being evaluated as an extension of the Genesis orebody.

Of the oxide orebodies for which Newmont has begun to develop plans, the Lantern and Bobcat prospects are the most advanced. As exploration and development drilling in the North Area continues, Newmont believes that it is reasonable to expect production from these resources. However, until detailed engineering is performed, no estimate of pit size, ore production, waste volumes, or mining schedule can be given.

The Deep Star prospect is located immediately south of the southeast corner of the Betze Project area (see Figure 3-1). Thirty shallow holes were drilled in the area during 1987 and 1988. Many of these holes encountered sporadic low-grade mineralization. Deep exploration drilling during 1989 led to the discovery of high-grade gold mineralization at depths of 900 to 1,300 feet below the surface. The extent of the resources at the Deep Star prospect has not been confirmed although several drill holes intersected mineralization averaging more than 0.5 ounces of gold per ton of ore over intercepts of 50 to 350 feet.

Presently, it appears that the most economic manner to mine this mineralized area is by underground mining techniques. Newmont has no present plan to mine this area; however, definition geologic drilling and engineering feasibility studies focused on developing the Deep Star deposit via underground mining methods are continuing.

Newmont's production has historically been produced from near-surface oxide gold ores that are readily amenable to treatment via weak cyanide solutions, using carbon adsorption for gold recovery. While Newmont's reasonably foreseeable plans concentrate on the continued mining and development of near-surface oxide gold reserves, Newmont has been successful in discovering several deep, sulfide-bearing, gold deposits, including the Deep Post deposit and the Deep Star prospect.

The sulfide elements in the Deep Post and Deep Star orebodies will necessitate additional pretreatment steps to allow extraction of the gold by conventional cyanide processes. While Newmont's earlier planning had forecasted significant capital expenditures in 1991 and 1992 for construction of sulfide ore pretreatment facilities, upon further review, Newmont has determined that continued production from oxide gold ores will defer the requirement for such pretreatment facilities for at least another 3 to 5 years (Newmont 1990). During this time, Newmont intends to continue an intensive evaluation of various technologies that may be used at some point in the future to process these sulfide gold ores.

## 3.13 Social and Economic Values

This section describes existing and projected socioeconomic conditions in the project area, including: population, employment, economy, income, housing, public services, facilities, and fiscal conditions. The tables referenced in this section are located in Appendix E of this Draft EIS. A more detailed socioeconomic technical report was prepared and submitted to the BLM under separate cover and is available for review by the public in the BLM's Elko District Office.

Numerous studies in Elko and Eureka Counties have been completed in the past several years due to the gold-mining boom along the Carlin Trend. The project area is defined as Elko and Eureka Counties in north-central Nevada, including the towns of Elko and Carlin. It is anticipated that most of the workers for the proposed project would reside in the communities of Elko and Carlin based on their proximity to the project site. The Betze Project is located 25 miles northwest of Carlin and is accessible via a state highway. Elko is located 22 miles to the east of Carlin on I-80. It is not expected that Eureka County would experience impacts due to population associated with project construction or operations workforce. The primary impacts in Eureka County would relate to increase in the county property tax and net proceeds revenues.

### 3.13.1 Population and Demography

In the past decade, the State of Nevada has experienced significant population growth. There was a net gain of 376,270 people from 1980 to 1990, which represented a growth rate of 47 percent (Nevada Department of Taxation 1990a). Most of this growth has been due to a net migration of new residents into the state to fill employment opportunities provided by expanded gaming, mining, and construction activities.

The population of Elko County has grown at a faster rate than the remainder of the state. Between 1980 and 1990, the county experienced a 108 percent increase in population due primarily to renewed exploration and mining activities along the Carlin Trend. The population grew from 17,573 in 1980 to an estimated 35,560 in 1990 (Nevada State Governor's Office/UNR-Bureau of Business Research 1990).

Population growth has occurred mainly in the incorporated areas of Elko and Carlin. The population of Carlin grew from an estimated 1,300 in 1988 to 2,750 in 1989 (Nevada Department of Taxation 1990a). The City of Elko's population increased from 8,758 in 1980 to an estimated 16,700 in 1989 (Nevada Department of Taxation 1990a). Table E-1 (Appendix E) presents population data for the state, Elko County, the City of Elko, Eureka County, and the Town of Carlin from 1985 through 1990. Projected population estimates are based on the Nevada Employment Security Department (1990) employment projections and historical population-to-employment ratios.

### 3.13.2 Economy and Employment

The economy in Elko County has historically depended largely upon the service industry, mining, and agriculture. The service industry in Elko County has experienced rapid growth due to increased gaming, particularly in Wendover and Jackpot.

Strong growth in employment has occurred since 1985 in most sectors of the economy due to an increase in gold exploration and production throughout the region. The estimated total number of jobs increased more than 22 percent between 1986 and 1989. Tables E-2 and E-3 show comparative monthly employment figures by sector for Elko and Eureka Counties for June 1987 through June 1989. Employment by sector is reported by place of work; therefore, employment in Elko County does not reflect the number of miners living in Elko County and working in Eureka County.

As shown in Table E-2, growth occurred in all sectors, particularly in construction, trade, and mining. Table E-3 shows that the largest employment growth was in the mining and construction sectors.

Unemployment throughout the State of Nevada has been decreasing steadily. The unadjusted unemployment rate for February 1989 was 5.8 percent, which was comparable to the previous year. This is due primarily to the continued economic growth in the gaming, construction, and mining sectors. Many new jobs are being filled by immigrants.

Elko County shows an even lower unemployment rate than the state. Table E-4 shows annual labor force and unemployment rates for March from 1988 to 1990. This table reflects employment by place of residence; therefore, the figures represent mine employees working in Eureka County but living in Elko County. The unemployment rate for Elko County has decreased from 5.3 percent in March 1988 to 4.6 percent in March 1990.

### 3.13.3 Housing

The existing housing situation is difficult to characterize quantitatively with any degree of accuracy because conditions change almost daily. Table E-5 shows the 1989-90 Northeastern Nevada Development Agency (NENDA) estimates of housing units for Elko, Carlin, and unincorporated Elko County. Since 1988, the permanent housing stock has increased by 1,603 units (Lipparelli and Associates 1990) including 590 apartment or multi-family units and 782 mobile home units.

Developments currently under construction in Elko include Sundance Estates, Brentwood Estates, Rolling Hills, Suncrest, Juniper Hills, Adobe Heights, and Lipparelli Estates. In June 1990, 35 units were available for sale in these developments, and 43 single-family lots and 225 mobile-home lots were available for development (Barss 1990). In addition to these developments, Newmont is developing two areas: Clover Hills and Monte Carlo. Barrick is developing Mountain View, North Hollow, and North Fifth. Currently, Barrick has 37 homes under construction, with 94 additional lots available for development if the need arises (Ingersoll 1990). Barrick also anticipates that 50 apartment units will be available for construction and temporary workers during the construction phase of the project expansion (Ingersoll 1990).

The Spring Creek area outside of Elko is platted for a total of 5,409 lots. Of this total, 3,940 are single-family lots and 1,469 are mobile-home lots. Currently 1,183 (81 percent) of the mobile-home lots are occupied and 785 (19.9 percent) of the single-family lots are occupied. Occupancy of available units at Spring Creek is high (Spring Creek Real Estate 1990).

According to Western Property Management Company, which manages 592 apartment units in the county, there are 485 apartments and single-family units in Elko; the current vacancy rate for rentals is estimated to be 3 percent. The unoccupied units are generally being remodeled or upgraded. The Multiple Listing Service (MLS) of the Board of Realtors showed 23 lots, 7 mobile homes, and 64 houses for sale in Elko; 57 lots and 20 mobile homes for sale in Spring Creek; and 45 homes for sale in unincorporated Elko County as of June 1990. These listings do not represent the entire Elko market. Listings in the Elko Daily Free Press (May 1990) showed 28 residential units, 19 mobile homes, and 2 mobile home lots for sale and 2 mobile homes for rent. The Northern Nevada Home and Business Buyer's Guide listed 75 homes for sale (May 1990).

Elko realtors suggest that homes are typically on the market for less than 60 days (Century 21 1990; Lipparelli and Associates 1990; Algerio Real Estate 1990). As of June 1990, the tight sales market had shown signs of easing as housing supply started to catch up with demand. However, rental housing was extremely tight and demanded premium rents.

Carlin represents a tighter rental housing market than does Elko. There appear to be no vacant units available for rent other than RV spaces. The housing market in Carlin, however, also appears to be easing. The MLS has listed seven homes for sale in Carlin since January 1990. In June 1990, there were an estimated 12 homes for sale (Wanda's Real Estate 1990). Single-family home prices start at $35,000; the average home price in Carlin is $65,000.

Area realtors indicate the real estate market in Elko, Carlin, and Spring Creek is considerably softer than it was a year ago.

However, the supply of housing for sale is adequate to meet the demand. Rental housing continues to be extremely tight with few vacancies.

### 3.13.4 Public Facilities and Services

3.13.4.1 Eureka County. Public facilities and services such as police, fire, medical, sewer, water, solid waste, schools, recreation, and library in Eureka County would not be impacted by the proposed expansion. It is not anticipated that any of the construction or operations workforce would temporarily or permanently locate in Eureka County due to the proximity of Elko and Carlin to the project, relative to the towns in Eureka County.

3.13.4.2 Elko County

Police and Fire Services

Sheriff's Department. As of May 1990, the Elko County Sheriff's Department had a staff of 40 deputies, including 29 in Elko, 5 in Wendover, 4 in Jackpot, 1 in Wells, and 1 in Mountain City; and 5 administration/office personnel (Watson 1990b). As of May 1990, the Elko County Sheriff's Department had 26 marked patrol vehicles. According to the department's Lieutenant Watson, the Sheriff's Department needs four more vehicles to adequately serve the existing population.

County Jail. The Elko County Jail is located in the City of Elko. The building is 2 years old and is in excellent condition (Miller 1990). There are no plans for expansion of the facility in the next 2 years (Watson 1990a). The County Jail has a staff of 14 and a prisoner capacity of approximately 115. The number of staff members is not adequate for the existing average daily prisoner population of 79; five new staff members are needed according to Lieutenant Watson (1990a). Table E-6 provides statistical data on the operations of the Sheriff's Department.

Fire Services. Fire services for incorporated cities in Elko County are provided by municipal fire departments. Unincorporated areas are served by the Nevada Division of Forestry and the Northeastern Fire Protection Department. The current staff of the Northeastern Fire Protection Department, which includes 7 paid staff members and 27 volunteers, is not large enough to handle its existing workload according to department spokesman Murphy (1990).

Emergency Response and Medical Services

Emergency Response. The State Emergency Medical Services office in Elko provides ambulance service for Elko County. The 20 volunteers are trained as Emergency Medical Technicians (EMTs) or Registered Nurses (RNs). Sheriff and fire services also respond to emergency calls. The ambulance service has two ambulances for Elko County.

The Barrick Goldstrike Mine has its own ambulance, which has been permitted by the State Emergency Medical Services office.

Medical Services. The 50-bed Elko General Hospital in Elko is the only full-service hospital between Reno (280 miles west) and Salt Lake City (230 miles east). The hospital is operated by Elko County and has a staff of 215.

Public Utilities

Water. Elko County supplies water to unincorporated areas of the county; incorporated areas are served by private water agencies (Murphy 1990).

Sewage Treatment. Elko County provides sewage treatment for unincorporated areas of the county; incorporated areas are served by municipal sewage treatment services (Murphy 1990).

Electricity. Sierra Pacific Power Company is the major supplier of electricity in Elko County. Wells Rural, Mount Wheeler Rural, Raft River Rural, and Idaho Pacific supply power to outlying rural areas of Elko County (Murphy 1990).

Natural Gas. Southwest Gas supplies natural gas to the cities of Elko and Carlin (Murphy 1990).

Telephone. CP National is the major supplier of telephone service in Elko County, although three small telephone companies are suppliers in outlying rural areas (Murphy 1990).

Solid Waste. There are seven landfills in Elko County under the jurisdiction of the Public Works and Road Departments. The facilities are funded by the 10 percent of the gasoline tax that is collected by the County Road Department (Community Inventory 1989).

Schools

Enrollment. The Elko County School District includes 19 schools with a total enrollment in April 1990 of 7,223 students in grades kindergarten through 12 (Harris 1990). Table E-7 lists the schools in the district which serve the Elko area population, their enrollments for 1987, 1988, and 1989, and their gain or loss of student population from 1988 to 1989. Table E-8 lists the schools in Elko and Carlin and provides the capacity and current enrollment of each. These would be the schools most likely to be affected by population growth associated with the proposed project.

School District Revenues and Expenditures. Table E-9 provides estimated year-end revenues and expenditures for the school years 1984-85 to 1988-89. A pay-as-you-go school construction tax was approved by voters in Elko County in March 1989. The tax increase will cost taxpayers approximately 17 cents in additional property taxes (bringing the total school tax assessment to 70 cents) per $100 of assessed valuation for the next 2 years.

The projected 1990-91 general operating budget for the Elko County School District is $33,851,591, an increase of 46 percent over the 1988-89 revenues. Local tax sources (ad valorem taxes) will provide 42 percent of the projected budget; 50 percent of the budget will be provided by the State of Nevada; and 8 percent will be provided by federal funds for federal-land impacts to state and local governments (Harris 1990).

In 1989, the Nevada Legislature approved Assembly Bill 752, which levies a 50-cent per $100 assessed valuation on Eureka County mines to be paid to Elko County. AB 752 took effect on July 1, 1990 for a period of 3 months. Elko County expects to receive as much as $500,000 during the July to September 1990 period (Harris 1990).

Recreation and Library Services

Recreation. Recreation services in Elko County are under the jurisdiction of either municipal recreation departments, private groups, or the Elko Area Recreation Commission (EARCO). Until recently, EARCO had been primarily involved with maintaining parks. Private groups, such as softball leagues and homeowners' associations, have organized recreational activities (Hoffman 1990).

Recently, EARCO hired a recreation superintendent for a combined Recreation District in the City of Elko and unincorporated Spring Creek. The new Recreation District will coordinate recreation among the city and county schools.

Library Services. The Elko County Library serves 32,311 people in Elko, Eureka, White Pine, and Lander Counties (Community Inventory 1989). The main library is in the City of Elko, and there are seven branch libraries throughout the area.

3.13.4.3 City of Elko

Police and Fire Services

Police. The Elko City Police Department has a staff of 26 patrol and investigative officers, 1 animal control officer, 5 administrative/clerical staff, and 9 communications personnel. The Police Department planned to hire an additional officer in July 1990; the staff would then be adequate to serve the current population (Kirby 1990a). The Police Department serves the incorporated limits of the City of Elko.

Fire Services. The Elko Fire Department has 12 paid firefighters and 18 volunteers housed in two fire stations in the city.

According to representatives of the Department, three paid firefighters and two volunteers are needed to adequately serve the current population (Elko City Fire Department 1990). The Fire Department maintains seven pumper/firetrucks.

Emergency Response and Medical Services. Several agencies provide emergency response services in the Elko area, including the Elko Fire Department, the Elko Police Department, the Elko County Sheriff, the Nevada Highway Patrol, the Nevada Division of Forestry, the State Ambulance Service, and the Bureau of Land Management. Mutual aid between agencies is practiced in the Elko area. Medical services in the City of Elko are provided by Elko General Hospital which is operated by Elko County.

Public Utilities

Water. Water is supplied by municipal wells operated by the City of Elko (City of Elko Engineering Department 1990).

Sewer Service. Sewer service is provided by the City of Elko to all residential, commercial, and industrial users within the incorporated city limits. The sewage treatment plant was recently expanded to meet the needs of the current population (City of Elko Engineering Department 1990).

Solid Waste. Disposal service for the City of Elko is provided by Elko Sanitation Company. The City of Elko operates a 130-acre municipal sanitary landfill. The landfill is funded from the General Fund, and users are charged a fee. Currently, over half of the capacity of the site remains to be used; closure is anticipated in 7 years.

Schools. The Elko County School District operates schools in the City of Elko. The Elko County School District is described in Section 3.13.4.2, Elko County.

Municipal Airport. The Elko Municipal Airport serves the northern Nevada area between Reno and Salt Lake City.

Recreation and Library Services

Recreation. The City of Elko maintains a budget for recreation and golf. The city does not have a recreation department, but maintains its parks with a portion of the room tax revenues collected. The municipal golf course is supported by user fees (Murphy 1990). The Ruby View Golf Course is an 18-hole golf course with clubhouse and restaurant, driving range, and putting green. There are four existing parks, including Main City Park, Riverview Park, Fifth Street Park, and Hillside Park. Main City Park includes four tennis courts, one soccer field, two outdoor basketball courts, one handball court, a paved midway, a children's play area, horseshoe pits, two ballfields, softball practice areas, skating rink berms, and restrooms. Riverview Park includes two softball fields. Fifth Street Park has one soccer field. Hillside Park includes two tennis courts and a children's play area. Picnic facilities are available at all parks. Elko also operates a softball complex and an indoor/outdoor heated pool.

Library. The Elko County Library serves the City of Elko.

3.13.4.4 Community of Carlin

Police and Fire Services

Police. The Carlin Police Department has six sworn officers, four nonsworn staff members, and three reserves. The police patrol the 2-mile by 2-mile town limits and respond to calls within a 5-mile radius of town. Present staff levels are adequate to serve the current population (Kranovich 1990).

Fire Services. The Carlin Fire Department is a volunteer fire department with 26 volunteers; 19 are trained as EMTs, 1 is an RN, 1 is a Licensed Practical Nurse, and 2 are First Responders (Togurelli 1990). The primary service area for the Carlin Fire Department is the Town of Carlin, although the department also provides service for a distance of 12 miles to the east, 25 miles west to Dunphy, 60 to 70 miles to the south, and 50 or more miles to the north to serve area mines. A mutual aid agreement is in effect with the Nevada Division of Forestry, the State Fire Agency, and all of the other fire departments in Elko and Eureka Counties.

Emergency Response and Medical Services. Emergency response activities in the City of Carlin are under the jurisdiction of the Carlin Fire Department and the Carlin Police Department. Medical services for Carlin are provided by the Elko General Hospital in Elko, 23 miles to the east.

Public Utilities

Electricity. Wells Rural Electric Company provides electricity for Carlin from the Bonneville power plant, a hydroelectric plant near Wells. Wells Rural Electric has not experienced any strain on its capacity and does not anticipate any (Johnston 1990).

Water. Carlin gets its water from a municipal well which supplies an average of 1,200 gallons per minute and Arthur Springs which supplies an average of 800 gallons per minute. It is estimated that the existing water supply could serve a population of 5,000. The present population of Carlin is 2,750 (Ariazzi 1990b).

The water treatment system currently treats an average of 800,000 gallons per day and has an average total treatment capacity of 2,900,000 gallons per day. The treatment system is in good condition, with no plans for renovation or expansion (Community Inventory 1989).

Sewer Service. Carlin maintains a sewage treatment system that serves 95 percent of the residences and 100 percent of the commercial and industrial facilities within the central community. The system is designed for a maximum population of 3,500.

Carlin is in the process of completing a $1.2 million sewer expansion project. Approximately 71 percent of the funding for the project came from the EPA (Community Inventory 1989). Other funding was provided by Community Development Block Grants and donations from local mines.

Solid Waste. Carlin operates an 80-acre municipal sanitary landfill north of the city limits. Because less than half an acre is filled each year, it is anticipated that the service life of the landfill is quite long (Community Inventory 1989).

Schools. The Elko County School District operates schools in Carlin. The Elko County School District is described in Section 3.13.4.2, Elko County.

Recreation and Library Services

Recreation. Carlin maintains a 32-acre city park, which has a playground, tennis courts, basketball courts, a baseball field, a concession stand, and bleachers. There is an additional 1.6-acre baseball field, concession stand, and bleachers in the city. Proposed long-range plans include a municipal swimming pool, golf course or putting green, an additional baseball field, and an additional playground. Land has been donated for the proposed swimming pool, but funding for the other proposed improvements has not been secured.

There are no user fees for recreation services and parks, although organized sports teams share in the cost of electricity. Local room tax revenues are earmarked for park acquisition.

Library Services. The Elko County Library serves Carlin, although there is no branch library in Carlin.

3.13.5 Government and Public Finance

The principal governing bodies in Elko County include the county administration (Commissioners and Planning Commissions), the school district, the City of Elko, and the Town of Carlin. The three Elko County Commissioners oversee county operations which include roads, sheriff, judicial, assessor, clerk, recorder, and library services. The school district is governed by an elected board which administers schools and support services for the county.

The Eureka County Commissioners oversee the operations of all governmental services in Eureka County including roads, justice, and public safety.

The City of Elko and Town of Carlin are each administrated by a mayor and council. The cities provide public services and facilities in the areas of streets and roads, sanitation, water, police, fire, cemetery, and parks and recreation.

The governmental revenue sources and expenditures in Elko County and Eureka County are useful in helping to determine the financial impacts of industrial development on the counties and local communities. From 1985 to 1989, assessed value increased dramatically. The average annual increase in assessed value was 10.4 percent for Elko County, 6.1 percent for the City of Elko, 14.1 percent for the Town of Carlin, and 59.1 percent for Eureka County during this 4-year period. This can be attributed to the overall growth in mining development and associated development of residential and commercial properties. Assessed value is expected to continue to grow at a steady pace until 1991 or 1992, when mining activity is expected to level off (Naroll 1990). Table E-10 shows assessed valuation for the years 1985 to 1990 for Elko County, Eureka County, and the cities of Elko and Carlin.

3.13.5.1 Elko County. Revenues and expenditures for Elko County were examined for the fiscal period 1985 to 1990. The budget figures presented in the text and Table E-11 have not been adjusted to constant dollars. Based on Table E-11, it appears that, overall, Elko County revenues and expenditures increased at a rate considerably higher than the national rate. These increases were a result of the dramatic growth that occurred in Elko County from mining exploration and production over this period.

Revenues. Intergovernmental resources include federal, state, and local sources of funds including the motor vehicle tax, gas tax, and basic city/county relief sales tax. These sources have consistently provided a substantial majority of the revenues to Elko County. In fiscal year 1989-1990, these revenues are projected to represent approximately 43 percent of total revenue. The next most important sources of revenues generated in the county are projected to be from property tax (26.6 percent), other taxes (10.9 percent), and charges for services (6.3 percent).

Expenditures. General fund expenditures are grouped into four major categories: 1) general government, 2) public works, 3) public safety, and 4) judicial. General government includes executive functions, finance, assessor, and buildings and grounds. General government expenditures accounted for a projected 30.4 percent of expenditures in fiscal year 1989-90. Expenditures in this area increased an average of 23.9 percent annually.

Public works represented 30.9 percent of total expenditures in 1989-90 and grew at an average annual rate of 48.8 percent. Much of this growth occurred in improvements to highways and streets. Public works showed the greatest increase in expenditures.

Public safety represents 15.5 percent of total expenditures, but has only grown at an average annual rate of 4.9 percent from 1985 to 1989.

Judicial represents 6.3 percent of total expenditures, and has increased at an average annual rate of 21.5 percent from 1985 to 1989.

Overall, Elko County budget constraints appear severe, particularly in public safety. Other areas of growth include increases in welfare expenditures averaging 31.8 percent growth annually. Welfare represents 6.1 percent of the general fund budget.

If distribution of sales tax revenues is not changed in fiscal year 1990-91, Elko County will likely experience budget cuts and layoffs. The fiscal condition of the county is weak due to inadequate revenues necessary to meet budgetary demands (Ritter 1990).

The assessed valuation for Elko County for 1989-90 is $534,814,009. Nevada state statutes limit indebtedness to 10 percent of assessed valuation. To date, Elko County has approximately $4,030,000 in outstanding general obligation bonds and $161,400 in other general obligation debt. The debt margin is therefore $49,290,001.

#### 3.13.5.2 City of Elko

Revenues. The City of Elko receives operating revenues through five major sources: 1) taxes (property, room, and supplemental city/county relief tax), 2) licenses, fees, and permits, 3) intergovernmental transfers (base city/county relief tax, gas tax, motor vehicle tax), 4) fines and forfeits, and 5) charges for current services. In 1989-90, revenues from intergovernmental transfers are projected to represent the largest component (53.2 percent) of revenues. The other revenues shown in Table E-12 represent a much smaller portion of overall revenues.

Over the period of 1985-86 to 1989-90, the total operating revenues for the city have grown at an average annual rate of 11.7 percent. The largest average growth rates are in charges for services - 22.2 percent; other taxes - 21.1 percent; and property taxes - 16.8 percent.

Expenditures. The total operating expenditures for the city increased from $4.7 million in 1985-86 to $12.8 million in 1989-90. This was a 174 percent increase, compared to a growth in revenues of 56 percent and a growth in population of 80 percent.

The 1989-90 assessed valuation for Elko was $134,833,152; bonded indebtedness is limited to 30 percent of the total assessed valuation. Elko has $159,000 outstanding for a general obligation bond, with a debt margin of $40,290,946. Unsold authorized general obligation bonds total $2.5 million. Other outstanding debts, such as short-term borrowing or warrants, are restricted to 20 percent of assessed value. Other outstanding general obligation debt is $530,597 leaving a debt margin of $26,436,033.

3.13.5.3 Town of Carlin

Revenues. The Town of Carlin receives operating revenues through five major sources: 1) taxes (property and supplemental city/county relief tax), 2) licenses, fees, and permits, 3) intergovernmental transfers (base city/county relief tax, gas tax, motor vehicle tax), 4) fines and forfeits, and 5) charges for current services. Revenues from intergovernmental transfers represent the largest portion of revenues. In 1989-90, these revenues represented over 72 percent of the total revenues received by Carlin. The other revenues shown in Table E-13 represent a much smaller portion of overall revenues.

Expenditures. Total operating expenditures in Carlin increased from $367,282 in 1985-86 to $922,207 in 1989-90, for a 151 percent increase, compared to growth in revenues of 83.6 percent.

The 1989-90 assessed valuation for Carlin was $11,040,106; bonded indebtedness is limited to 30 percent of the total assessed valuation. Carlin has no outstanding general obligation bonds, therefore the city's debt margin is $3,312,032. Carlin's other outstanding general obligation debt is $238,654, which leaves a debt margin of $1,969,367.

3.13.5.4 Eureka County. Eureka County is benefiting most from the growth in mining exploration and production. Much of the actual mine production with associated property tax and net proceeds revenues is occurring in Eureka County; however, only a fraction of the associated socioeconomic impacts have affected Eureka County.

Revenues. The two primary sources of revenue in Eureka County include property taxes (including net proceeds) and revenues from intergovernmental transfers. These two sources comprise over 93 percent of all revenues in Eureka County. Property tax receipts have grown by 392 percent since 1985-86; the average annual growth rate is 49 percent for this period. Intergovernmental revenues have not grown quite as fast, averaging an annual growth rate of 29 percent for a total increase of 181 percent during the same period. The average annual growth rate of total revenues for this period is 34.9 percent.

Expenditures. Governmental expenditures in Eureka County have had a hard time keeping up with revenue increases. Over the period 1985-86 to 1989-90, expenditures have increased by 173 percent, with an average annual growth rate of 28.6 percent. Table E-14 shows revenues and expenditures for Eureka County from 1985-86 to 1989-90.

Eureka County has a 1989-90 assessed valuation of $421,992,094. The county has no outstanding debt, which leaves a debt margin of $42,199,209.

3.13.6 Transportation

Access to the Betze Project site is from the south via the road from Carlin. A two-lane asphalt road maintained by the state extends north from the I-80, central Carlin interchange. From there, a two-lane asphalt road maintained by Newmont extends for approximately 12 miles to the Barrick-Newmont access road, which is a gravel road (see Figure 3-1). The paved section of road is in good condition; the gravel segment of road is very well maintained. Traffic measured just north of I-80 has reflected mainly the level of mining activity, as dispersed recreation and non-mining activity generate only light traffic in the area north of Carlin. Average daily traffic counts varied over the past decade with a general upward trend, ranging from 235 vehicles per day (vpd) in 1978 to 680 vpd in 1987 for an average annual increase of 11 percent (NDOT 1988). There was a dramatic increase in 1988 as traffic tripled to 2,110 vpd; in 1989, traffic increased only slightly to 2,215 vpd (Manning 1990).

The City of Elko experienced substantial increases in traffic on city streets as the population grew through the 1980s. Although traffic generally declined from 1978 to 1981, it has steadily increased since 1982. Traffic on Idaho Street, which is Elko's main thoroughfare, near 12th Street averaged 23,670 vpd in 1989, 68 percent higher than the 1978 level. Traffic at other locations on Idaho Street has not increased as much but overall levels are notably higher than they were in the late 1970s (NDOT 1988; Manning 1990).

In response, the city is implementing an extensive series of planning and street improvement projects. A master plan for traffic management and improvements was prepared in 1987; however, traffic levels projected for the year 2000 were generally exceeded by 1990 (Williams 1990). Consequently, a new master plan is proposed for the 1991-1992 fiscal year. In order to accommodate traffic increases, the city is conducting a major improvement program designed to relieve Idaho Street congestion and improve traffic flow across the Humbolt River.

Local funding for street improvements is provided by revenue bonds supported by the regional transportation (gasoline) tax and by general obligation bonds).

# 4.0 ENVIRONMENTAL CONSEQUENCES

Chapter 4 presents a discussion of the environmental consequences that would result from construction, operation, and reclamation of the proposed Betze Project and the alternatives. This chapter describes the environmental consequences by resource topic, including cumulative impacts. Potential mitigation measures, including monitoring programs, that are not included in the Proposed Action or alternatives are described following each impact assessment, where appropriate.

Technical reports containing additional information relative to impact assessments of the following resources are available for review at the BLM Elko District Office:

- Air Resources
- Water Resources
- Socioeconomics

The Betze Project is located within an area in which there exist several operating mines and minable gold deposits. A full evaluation of cumulative impacts of the Betze Project is presented in this chapter. Existing and foreseeable mining projects and other activities in the vicinity of the Betze Project are discussed in Chapter 3.0. The principal existing active mining operations with the potential to generate cumulative impacts with the Betze Project are Newmont's Blue Star, Genesis, and Carlin Mines; Newmont's Mill No. 1 and Mill No. 4; Newmont's North Area Leaching Facility; and Dee Gold Company's Dee and Ren Mines. Development of other deposits or facilities by Barrick and Newmont is also foreseeable; the cumulative impacts of such activities are considered to the extent that planning for such projects has evolved to a stage where meaningful analysis of future cumulative impacts is possible. Potential cumulative socioeconomic impacts of the proposed Thousand Springs Power Plant are also considered.

## 4.1 Topography and Mineral Resources

### 4.1.1 Proposed Action

The proposed Betze Project would permanently alter the topography and mineralization within the project area. The Proposed Action would result in the permanent removal of 136.1 million tons of ore (which contain approximately 15.1 million ounces of gold) and 780.6 million tons of waste, leaving an open pit approximately 8,000 feet long, 4,500 feet wide, and 1,800 feet deep, which over time would fill with water to a depth of approximately 1,150 feet. Although certain reclamation would occur (see Section 2.2.5), waste rock would be permanently removed from the pit area and placed in the waste rock disposal areas; tailings from the proposed milling operations would be placed in tailings impoundments; and leach grade ore would be permanently placed on the heap leach pads (see Figure 2-5). Reclamation of the waste rock disposal areas, tailings impoundment, and the heap leach pad would create permanent landforms reaching to heights of up to 700 feet above the natural topography. These landforms would have overall side slopes of 2.5H:1V.

The excavation of the pit and the placement of waste rock, tailings, or processing facilities potentially may affect the development of other mineral resources within the immediate area. For example, open-pit mining of the Betze deposit may make it more attractive for Barrick or Newmont to gain access to certain deep deposits from that pit (see discussion in Section 2.3.2). Expansion of mill facilities may make it more economic for Barrick or Newmont to develop other nearby deposits. However, placement on the surface of large volumes of waste rock, tailings, or heap leach material may also foreclose or inhibit the discovery or extraction by surface mining methods of other mineral resources lying below or adjacent to such material. The processed material itself would be accessible for reprocessing at a later time. Much of the area has been explored and, consequently, most mineral resources in the immediate area have been identified. Nearby undeveloped mineralized areas or deposits include: Deep Post, Deep Star, Capstone, Bootstrap, Bobcat, Screamer, Rodeo, Purple Vein, North Star, Lantern, and Pete (see Figure 3-1).

Other minerals besides gold occurring in the Betze mineralized area include arsenic, barium, boron, cadmium, copper, iron, lead, magnesium, manganese, nickel, selenium, silver, and thallium. There was also a turquoise deposit located approximately 2.5 miles south of the Betze Pit location (Roberts et al. 1967). However, it does not appear that any of these minerals occur in economic quantities, as estimated by concentrations of these minerals observed in whole rock samples taken from the Betze Pit area (see Appendix B). It is possible that other mineral resources exist within the project area that have not been identified. Depending upon the location of such mineral resources, the discovery or development of other mineral resources may be inhibited or effectively prevented by the Proposed Action.

### 4.1.2 Alternatives

4.1.2.1 <u>Waste Rock Disposal Areas</u>. The Clydesdales site would involve changes to the topography that extend farther west than the topographic changes associated with other alternative sites. Selection of the North or Clydesdales alternative would not eliminate the need for the proposed Extended South waste rock disposal area. If the North alternative were constructed, the Extended South waste rock disposal area would disturb 912 acres and reach an elevation of approximately 5,700 feet. If the Clydesdales alternative were constructed, the proposed Extended South waste rock disposal area would disturb 912 acres and reach an elevation of 5,600 feet. If both the North and Clydesdales alternatives were constructed, the Extended South waste rock disposal area would be 550 acres in size and 5,600 feet in elevation. Therefore, the selection of the North or Clydesdales alternatives would reduce the size of the landform created by the Extended South waste rock disposal area (see Section 2.3.1.1). The Far West waste rock disposal alternative would have similar impacts on topography and mineral resources as the Proposed Action.

The post-mining topography would vary depending upon the reclamation alternative selected. The Proposed Action would reclaim waste rock disposal area side slopes to an overall slope of 2.5H:1V. The alternative of leaving slopes at the natural dump angle of repose of 1.3H:1V would result in steeper landforms which encompass a smaller surface area than other alternatives. The alternative of reclaiming side slopes to 3.0H:1V would result in more moderately sloping, but higher, landforms than the Proposed Action.

Condemnation drilling conducted to date has indicated that there are no substantial near-surface reserves in the Clydesdales or North alternative waste rock disposal sites. If additional condemnation drilling discloses the presence of economic near-surface deposits, location of waste rock disposal areas may foreclose or inhibit development of such deposits by surface mining methods.

4.1.2.2 <u>Ore Stockpiles</u>. Because of the projected temporary nature of these stockpiles (1991 to 2010), significant impacts to topography or mineral resources are not expected due to the use of alternative stockpile locations.

4.1.2.3 <u>Tailings Impoundment</u>. Barrick proposes to conduct additional condemnation drilling at the alternative sites to determine whether the alternative tailings impoundments would be placed over near-surface economic mineral deposits. If a near-surface economic mineral deposit were to be found, location of the alternative tailings impoundments may foreclose or inhibit development of such deposits by surface mining methods.

An alternative reclamation measure for the proposed tailings impoundment entails dumping waste rock on the impoundment in a selective manner to create uneven hills and swales prior to revegetation. This alternative would result in moderately different topographic impacts and may help avoid surface ponding but otherwise would be similar to the Proposed Action.

4.1.2.4 <u>Water Disposal Methods</u>. Reinjection or infiltration of the dewatering volumes would not significantly affect the topography or mineral resources of the area. Discharging water to the channels of Rodeo and Boulder Creeks may, if not mitigated, cause increased erosion, bank cutting, and deposition to occur.

Greater incising of creek channels, especially Rodeo Creek, would also be expected if water were discharged directly to surface drainages.

4.1.2.5 Partial Pit Backfill. The landforms resulting from the waste rock disposal areas would ultimately be reduced in size in an amount equal to that portion of the fill material removed from such areas for pit backfill. Approximately 452 million tons of material would be removed from one or more of the waste rock disposal areas. The partial filling of the pit would eliminate the Betze Pit water body as a permanent topographic feature and impair access to potential deep deposits beneath the Betze Pit.

4.1.3 Cumulative Impacts

As indicated above, the Betze Project is located within an area in which there exist several operating mines and developable gold deposits (see Figure 3-1). To date, the operating mines and related processing facilities of Barrick, Dee, and Newmont have permanently changed the natural topography of an area approximately 0.5 to 3 miles wide, extending, with minor interruptions, from the Carlin Mine approximately 11 miles to the Dee Mine. Within this area are six open pits ranging in size from 32 acres to approximately 245 acres, with associated waste rock disposal areas, and five tailings impoundments ranging in size from approximately 66 acres to approximately 152 acres. The TS Ranch has constructed an irrigation reservoir which utilizes water developed by Barrick approximately 3.0 miles southwest of the Betze Project (see Section 3.12.3.2). The pits, waste rock disposal areas and other disturbance, together with the TS Ranch Reservoir, have affected approximately 5,500 acres and have largely altered the natural topography of the ridge that exists between Little Boulder Basin and Boulder Valley.

It is foreseeable that Newmont would continue to mine and expand the Genesis, Blue Star, and Post Pits, and begin to develop, by surface mining methods, the Bootstrap/Capstone, North Star, Carlin, Lantern, Pete, and Bobcat orebodies (see Section 3.12.3.3). The Genesis Pit would be expanded into the Blue Star Pit and the Bootstrap Pit into the Capstone deposit. Newmont also proposes to expand the tailings facility at Mill No. 4 to a maximum size of 275 acres. Mining of these deposits would create pits and generate associated waste rock and tailings and other disturbance affecting approximately 666 additional acres. Together with the Betze Project, this projected Newmont development would collectively result in a disturbed area that would be approximately 53 percent larger than the existing area of disturbance. The impacts of the Betze Project described in Section 4.1.1 would contribute incrementally to these changes to the natural landscape.

It is also foreseeable that Newmont could develop the Deep Star and Deep Post deposits, and that Barrick could develop the Deep Post and Purple Vein deposits, although the timing and nature of such potential developments cannot be forecast at this time. It is not presently known whether any of the Deep Post, Deep Star, or Purple Vein deposits would be mined by surface or underground mining methods. If the Deep Post deposit were mined by surface mining methods, it would result in an expansion of the Betze Pit laterally and to depth. In the case of the Deep Star or Purple Vein deposits, development by surface mining methods would result in large new pits south and north of the Betze Pit. If such deposits were mined by underground mining methods, they would generate significantly less waste rock than if mined by surface mining and would not result in the expansion of an existing pit or the creation of another large open pit.

The development of all of the deposits identified in this section, exclusive of the Betze deposit, would result in the permanent removal of approximately 26 million additional ounces of gold.

Reclamation of the waste rock disposal areas and heap leach pads for most of the Newmont, Dee, and Barrick projects is required by law. However, the reclamation would not eliminate the open pits or restore the original topography for the Betze Project or nearby mining disturbance.

### 4.1.4 No Action Alternative

Under the No Action alternative, Barrick would continue to mine the Post Pit and operate the existing mill, South Block waste rock disposal area, AA Block heap leach pads, and tailings impoundment to the extent authorized by existing approvals. The ore in the Betze deposit would remain unmined. Impairment of access to mineral resources underlying proposed facilities other than the Betze Pit would be eliminated, potentially enhancing the likelihood that such minerals would be discovered or recovered. Access to the Deep Post deposits of Barrick or Newmont, which underlie or are adjacent to the Betze Pit itself, would be impaired by the No Action alternative. The topography and mineral resources of the site have been permanently altered by the Post Pit, the South Block waste rock disposal area, the AA Block heap leach pads, and the tailings impoundment. Reclamation of these features would be conducted in accordance with the terms of existing approvals. The Post Pit over time would fill with water to approximately the 5,300-foot level. Side slopes on the South Block waste rock disposal area would be terraced and regraded to an overall 2.5H:1V slope.

### 4.1.5 Mitigation

Incision of creek channels attributable to direct discharges could be mitigated by construction of check dams and channel armoring (riprap). Seeding or revegetating of the channel could also be considered as potential mitigation.

The impact of the Proposed Action on topography could be mitigated by creating uneven or irregular edges and a more rolling to undulating surface. Specific measures to achieve this are as follows: 1) waste rock could be dumped and surfaces graded to create a series of hills and rolling surfaces on the leach pads, tailings impoundments, and waste rock disposal areas; 2) the perimeters of waste rock disposal areas could be varied to follow more natural and uneven lines to blend with the natural landscape; 3) the edges of waste rock disposal areas could be tapered into surrounding hills or topographic highs; and 4) the side slopes of waste rock disposal areas and leach pads could be contoured to create swales and ridges rather than one uniform and benched slope.

## 4.2 Paleontology, Geology, and Potential Geologic Hazards

### 4.2.1 Proposed Action

4.2.1.1 Paleontology. No paleontological sites are known to occur in areas that would be disturbed by the Proposed Action or any alternative (Firby and Schorn 1983).

4.2.1.2 Geologic Hazards to Project Facilities. The Proposed Action would create conditions or facilities that potentially may be affected by geologic hazards. Geologic hazards evaluated at the site include subsidence, expansive soils, slope stability, and seismic events.

Subsidence as a result of mine dewatering is not considered to be probable given the geologic and hydrogeologic conditions at the Betze Project area (see Sections 3.2 and 3.4). In areas to be dewatered, there is relatively little space for consolidation of materials; therefore, subsidence is not considered likely.

Evidence of expansive soils was found in the Carlin Formation during geotechnical site investigations (Welsh Engineering 1988). Outcrops of the Carlin Formation occur along the east side of the mine area, along Rodeo Creek, and in the AA Block and the North Block (see Figure 3-2).

Swelling or shrinkage of expansive soils can result in damage to structures or pavements (Holtz and Kovacs 1981). The problems of swelling and shrinkage are generally confined to the upper layers of soils. Light structures (e.g., small buildings, roads) are generally affected more than heavier structures. Large structures generate static pressures that exceed the swelling pressures of expansive soils. Betze Project facilities would be subject to geotechnical studies to determine the presence of expansive soils. Facility design would address the presence of these soils, where appropriate.

Potential slope failure in the mine is not considered a significant hazard because Barrick has used conservative design parameters and designed pit wall slopes on a sector-by-sector basis to closely address geologic conditions. However, the potential for pit wall instability would temporarily increase following the completion of mining and cessation of dewatering as the pore pressure on the pit walls increases. In time, as the water level in the pit rises, pit wall stability would increase. Pit wall stability would be greater when the water body reaches the pre-mining elevation of 5,300 feet.

Geotechnical monitoring of mine and processing facilities would be conducted by Barrick during the period of active operations. Any major slump failure detected would be mitigated.

Possible seismic hazards would include ground movement and soil liquefaction. Barrick has conducted geotechnical site investigations to evaluate potential hazards. In addition, a probabilistic assessment of historic seismic events within a 150-mile radius of the project site was conducted. (Welsh and Vector 1988a). The project lies within an area of relatively low seismicity. Historic activity within the area included an event of magnitude 7.8 on the Richter scale with an epicenter approximately 67 miles from the project area.

Based on historical information, the existing tailings impoundment on the AA Block was designed to withstand an earthquake acceleration of 0.1g with a dynamic factor of safety of 1.3. At a dynamic factor of safety of 1.0, the existing tailings impoundment could withstand an earthquake acceleration of 0.2g. Assuming that the epicenter were located 67 miles from the project site, at the location of the most severe recorded seismic event, an earthquake of magnitude 8.5 on the Richter scale would be required to generate an acceleration of 0.2g at the project site. Such an earthquake has an annual and 20-year risk of occurrence of 0.002 and 0.033, respectively. Even if such an earthquake were to occur, the tailings dam would not necessarily fail. Moreover, there are no towns, cities, or private dwellings in the vicinity of the Betze Project or downstream in Boulder Valley. Tailings embankment failure could potentially harm mine personnel and the downstream environment in Rodeo Creek or damage mine facilities immediately downstream of the embankment.

Barrick proposes to construct a tailings impoundment within the North Block utilizing the same general design that was used for construction of the existing AA Block tailings impoundment. The suitability of the AA site for a tailings impoundment was considered in a site characterization report (Welsh and Vector 1988a) and a design and construction report (Welsh and Vector 1988b). The design of the existing AA Block tailings impoundment was evaluated for suitability as the basis for design of the new tailings impoundment (ESA 1990). Factors considered included foundation strength, soil permeability, seismic risks, and landslide hazard. This review indicated that the location of the proposed tailings impoundment appears suitable.

4.2.1.3 Geologic Hazards from Project Facilities. The faulted and altered rock within the mine area has potential for slope instability and failure. However, mine feasibility studies, with detailed rock mechanic analyses, developed specific pit designs which address potential stability problems related to these phenomena (Barrick 1990a). Specifically, mine slopes and width of safety benches were designed based upon lithology, structure, and alteration. The design would contribute to slope stability and reduce the rockfall hazard in the pit during operation and during the years to follow mine abandonment.

4.2.2 Alternatives

4.2.2.1 Waste Rock Disposal Areas. The North Block and Clydesdales sites may be partially located on expansive soils of the Carlin Formation. As discussed in Section 4.2.1.2, site-specific geotechnical studies would be conducted to ensure the project design addresses these conditions, if applicable.

The Proposed Action would reclaim waste rock disposal area side slopes to an overall slope of 2.5H:1V. The alternative of leaving slopes at the natural dump angle of repose of 1.3H:1V would result in steeper, and potentially less stable landforms. The alternative of reclaiming side slopes to 3.0H:1V would result in more moderately sloping landforms than the Proposed Action. These would be more stable than slopes left at the angle of repose (1.3H:1V) or the Proposed Action (2.5H:1V).

4.2.2.2 Ore Stockpiles. Due to the temporary nature of these stockpiles, it is not expected that there would be any significant impacts to paleontology, geology, or geologic hazards due to the use of alternative locations.

4.2.2.3 Tailings Impoundment. Preliminary geologic investigations of the project area indicate the alternative sites are underlain by the same geologic formation (Carlin Formation) as the proposed site. Therefore, if similar site characterization and design considerations were employed, impacts similar to those of the Proposed Action would be expected as a result of construction of the alternative tailings impoundments.

4.2.2.4 Water Disposal Methods. Reinjection, infiltration, or direct discharge to Rodeo or Boulder Creeks of the dewatering volumes would not have a significant impact upon the paleontology, geology, or geologic hazards of the area.

4.2.2.5 Partial Pit Backfill. If the pit were partially backfilled, the potential geologic hazard of post-mining pit slope instability would largely be eliminated, although slopes of 100 to 200 feet would still exist around portions of the pit perimeter. The areal extent of side slopes on waste rock disposal areas would also be greatly reduced compared to the Proposed Action.

### 4.2.3 Cumulative Impacts

Mining and processing operations of Barrick, Dee, and Newmont extend from the Carlin Mine to the Dee Mine (see Figure 3-1). No significant paleontological resources have been impacted by these operations (Jaynes 1990). No recent seismic activity (e.g., ground movement or liquefaction) has occurred in the area. Conversely, no significant geologic hazards have resulted to the environment from the operation of these facilities. Localized slumping of pit walls has occurred in area mines.

It is foreseeable that Newmont would expand existing mines and associated facilities and develop additional surface orebodies during the life of the Betze Project. Because no paleontological resources have been identified at or near the project area, no impacts to paleontological resources are anticipated from such additional disturbance. Geotechnical site investigations would be conducted prior to final design of project facilities to minimize potential for facility damage from seismic hazards. Some local slope failure is likely to occur during open-pit mining operations.

Development of Newmont's Deep Star and Deep Post deposits and Barrick's Deep Post and Purple Vein deposits is also foreseeable, although the timing and nature of these potential developments are uncertain. It appears likely that these deposits would be developed following completion of the Betze Project. Development of these deep deposits by underground mining methods would result in small areas of disturbance. Because no paleontological resources have been identified at or near the project area, no impacts to paleontological resources are anticipated from such additional disturbance. Mine designs would address ground stability to ensure structural integrity and worker safety.

### 4.2.4 No Action Alternative

Under the No Action alternative, Barrick would continue to mine the Post Pit and operate the existing mill, South Block waste rock disposal area, AA Block heap leach pads, and tailings impoundment to the extent authorized by existing approvals until ore in the Post Pit is exhausted. The ore in the Betze deposit would remain unmined. The geology of the site would be permanently altered by the creation of the Post Pit, South Block waste rock disposal area, AA Block heap leach pads, and tailings impoundment. Reclamation of these features would be conducted in accordance with the terms of existing approvals. The Post Pit over time would fill with water to approximately the 5,300-foot level. Side slopes on the South Block waste rock disposal area would be terraced and regraded to an overall 2.5H:1V slope.

4.2.5 Mitigation

Hazards associated with steep slopes created by pit walls and waste rock disposal areas could be mitigated as follows:

1. Access to the Betze Pit could be blocked by berming access roads and fencing the perimeter of the pit. Signs could also be placed at strategic locations to warn visitors of unstable conditions and potential hazards.

2. Potential slump failures in waste rock disposal areas and leach pads will normally exhibit themselves as stress fractures in the surface of the material within the first several years following dumping. A potential mitigating measure is to monitor the waste rock disposal areas and leach pads during project operations for advance signs of slump failure and remove and regrade the facilities as appropriate to alleviate the potential problem.

Potential mitigation for paleontological resources could include a requirement that the BLM authorized officer be notified if such resources are uncovered and be given 48 hours to determine significance and develop a plan for the mitigation and possible salvage of the uncovered resources.

4.3 Air Resources

4.3.1 Proposed Action

Impacts to air quality from the proposed Betze Project would result primarily from particulate emissions from the mining and ore processing operations. Gaseous air pollutants would be emitted from mining equipment, ore processing, and construction equipment. Some trace metal emissions would be associated with the particulate emissions.

Mining and hauling would constitute the primary particulate emission sources. Emissions from such activities would remain at or near present (1990) levels during 1991-1994 because the tonnages projected to be mined and haul distances (see Section 2.2.2) are comparable to existing levels. After 1994, the tonnage to be mined is projected to decrease until 2000, when mining would cease. Ore handling and processing operations would constitute a smaller fraction of particulate emissions. Particulate emissions from ore handling and processing would increase from existing levels with the addition in 1991-1992 of new ore processing facilities (see Section 2.2.3). These processing facilities would be fully operational by 1992. As these facilities come on line, particulate emissions from processing would increase and remain relatively constant from 1992 until the conclusion of processing in 2010.

Gaseous emissions of carbon monoxide (CO), nitrogen dioxide ($NO_2$), and sulfur dioxide ($SO_2$) would result primarily from mining equipment engine exhaust, and secondarily from the ore processing. In particular, the oxidation of the sulfide minerals in the autoclaves would generate $SO_2$, hydrogen sulfide ($H_2S$), sulfuric acid mist, and trace quantities of particulate sulfur.

The mining and processing operations would generate small quantities of trace metals. These trace metals are non-criteria pollutants, but are reviewed because some metals are considered carcinogenic. The trace metals emissions were calculated based on their fractional content of the particulate emissions.

4.3.1.1 <u>Particulates</u>. Barrick is presently mining at the rate of approximately 300,000 to 325,000 tons per day (110 to 120 million tons per year). Particulate emissions from the mining and ore processing operations are presently controlled using standard emission control techniques. During processing, all ore conveyor transfers and batch material drop points are controlled either by enclosure, water spray, or both. Pollutant emissions from the crushers are controlled with a fog dust suppression system. Fugitive emissions from mining activities (blasting, rock removal and loading, ore and waste rock hauling, ore and waste rock dumping, and wind erosion) are controlled by the following methods:

- blast hole optimization and stemming,
- minimization of drop height during ore and waste rock removal and transfer,
- watering and chemical dust suppression on haul roads and other areas, and
- restricted vehicle speeds on haul and access roads. Water trucks are used to suppress dust on the roads and waste rock disposal area. During dry periods, an estimated 100,000 gallons of water per hour are distributed on road surfaces. In addition, dust suppression is accomplished through the application of a dust suppressant (magnesium chloride solution) onto the main haul roads, service roads, parking areas, and the main access road to the Goldstrike Mine.

The Proposed Action would essentially maintain the existing level of mining activity and control through 1994, when the quantity of material mined would be reduced approximately 20 percent until mining ceases in 2000 (see Section 2.2.2).

Concentrations of particulates 10 microns or less in aerodynamic diameter (PM-10) have been monitored by Barrick during 1989-1990 at the meteorological station located at the site of the proposed tailings impoundment ("Goldstrike meteorological station"). The

PM-10 monitoring results are reported in Table 3-5. A summary of projected particulate emissions related to the proposed mining and ore processing operations, categorized by individual components of mining and processing, is presented in Table 4-1. These emissions are based on the projected 1991 mine production of 19.89 million tons per year (tpy) of ore (both oxide and sulfide) and 88.77 million tpy of waste rock.

The projected particulate emissions for the worst-case year in Table 4-1 are given for PM-10 and for total suspended particulates (TSP). Of the total projected particulate emissions shown in Table 4-1, the fugitive mining emissions projected for Barrick were 356 pounds per hour for PM-10 and 779 pounds per hour for TSP. PM-10 is believed to affect human health because particles in this size category can be inhaled into the lungs while larger particles, the remainder of the TSP, are not respirable. The U.S. Environmental Protection Agency (EPA) has promulgated PM-10 standards of 150 micrograms per cubic meter ($\mu g/m^3$) on a 24-hour basis, and 50 $\mu g/m^3$ on an annual basis. EPA has eliminated the TSP standard from the National Ambient Air Quality Standards (NAAQS). However, the State of Nevada has, to date, retained the TSP standard of 150 $\mu g/m^3$ on a 24-hour basis, and 75 $\mu g/m^3$ on an annual basis. Consequently, the analyses in this report reflect both PM-10 and TSP emissions. The point source emissions from ore processing are considered to consist entirely of PM-10 particulates.

The Betze Project is located within an area in which there are several operating mines and processing facilities (see Section 3.12.3.3). These mines and processing facilities generate both fugitive and point source emissions similar to the emissions that would be produced by the Betze Project. Fugitive emissions caused by mining activities (blasting, rock excavation and loading, ore and waste rock hauling, ore and waste rock dumping, and wind erosion) are the largest source of particulate emissions, but generally are deposited within a short distance due to gravitational settling. Impacts from such emissions are highly localized in the vicinity of their source, i.e., pits, dumps, and haul roads. However, emissions from process facilities are not deposited as quickly as fugitive emissions from mining. Except for mining activity on adjacent lands, the combined impacts from nearby projects and the Betze Project are expected to result principally from emissions from processing facilities, rather than as a result of fugitive emissions. A summary of PM-10 and TSP emissions from processing facilities at the Barrick, Dee, and Newmont operations is shown in Table 4-2.

In addition to the impact from mining operations, there is a natural ambient particulate background from wind and off-site vehicular traffic. The natural ambient particulate background plus the impact of existing emissions of Barrick, Newmont, and Dee on the Betze Project area is generally reflected in Table 3-5, which shows the PM-10 particulate concentrations in the Betze Project

TABLE 4-1

SUMMARY OF PROJECTED PARTICULATE EMISSIONS

AT BARRICK GOLDSTRIKE MINE[1]

| Operation | TSP (lb/hr) | PM-10 (lb/hr) |
|---|---|---|
| Drilling | 8 | 3 |
| Blasting | 21 | 8 |
| Truck Loading | 124 | 74 |
| Truck Hauling | 312 | 129 |
| Truck Unloading | 124 | 74 |
| Wind Erosion | 190 | 68 |
| Ore Crushing | 18 | 18 |
| Ore Handling | 0.1 | 0.1 |
| Ore Processing | 23 | 23 |
| TOTAL | 820 | 397 |

[1] These emissions are based on the projected 1991 mine production rate of 19.89 million tons per year of ore and 88.77 million tons per year of waste rock.

TABLE 4-2

PARTICULATE MATTER EMISSIONS FOR

CUMULATIVE IMPACT ASSESSMENT

| Source | Pollutant | Process Emission (lb/hr) |
|---|---|---|
| Barrick[1] | PM-10 | 41 |
| | TSP | 41 |
| Newmont Mill 4[2] | PM-10 | 67 |
| | TSP | 67 |
| Newmont North Heap Leach[2] | PM-10 | 92 |
| | TSP | 92 |
| Newmont Mill 1[2] | PM-10 | 83 |
| | TSP | 83 |
| Dee[2] | PM-10 | 81 |
| | TSP | 81 |

[1] Projected emissions from Betze Project based on 1991 mining operations.

[2] Emissions authorized by existing air permits.

area during 1989-1990. The air quality impacts for the Betze Project were predicted by summing the modeled particulate concentrations for the Proposed Action, the incremental emissions attributable to those sources identified in Table 4-2, and the natural ambient particulate background.

The modeling was run using EPA's Industrial Source Complex (ISC) Short Term (ISCST) and Long Term (ISCLT) dispersion models, with on-site meteorological data as input. Meteorological input to the ISCST model consisted of 10 worst-case meteorological condition days from the Goldstrike meteorological data, and a stability windrose developed from data collected at the Goldstrike meteorological station. Actual source and receptor elevations were also input into the model to approximate the terrain around the Betze Project. Although NDEP regulations require only that process sources such as crushers and ore handling be modeled, this particulate modeling analysis also included fugitive emissions from Barrick's mining operations.

Figures 4-1 through 4-4 show modeled PM-10 and TSP particulate concentrations in the Betze Project area. The results of the modeling study including background (both natural and that attributable to existing sources) are shown in Table 4-3. The maximum 24-hour impacts, as predicted for receptors located at the fenced boundary of the active mining area (see Figure 3-12), are 111 micrograms per cubic meter ($\mu g/m^3$) for PM-10 and 128 $\mu g/m^3$ for TSP. The predicted annual maximum concentrations are 49 $\mu g/m^3$ for PM-10 (arithmetic mean) and 48 $\mu g/m^3$ for TSP (geometric mean). The predicted air quality impacts at these receptors are below the federal PM-10 standards and Nevada TSP standards.

4.3.1.2 <u>Gaseous Emissions</u>. The Proposed Action would also result in CO, $NO_2$, and sulfur emissions, including $SO_2$, $H_2S$, sulfuric acid mist, and particulate sulfur.

Carbon monoxide and nitrogen dioxide would be emitted during ore processing by propane-fired carbon reactivation kilns and propane-fired steam boilers, and by combustion of diesel fuel and gasoline in heavy mining equipment and vehicles. Sulfur dioxide would be emitted during ore processing in the autoclaves, and by combustion of diesel fuel and gasoline in heavy mining equipment and vehicles. Hydrogen sulfide, sulfuric acid, and particulate sulfur would be emitted during ore processing in the autoclaves. The emissions from principal sources of CO, $NO_2$, $SO_2$, $H_2S$, sulfuric acid mist, and particulate sulfur are listed in Table 4-4.

<u>Carbon Monoxide</u>. Carbon monoxide emissions are summarized in Table 4-4. There should be minimal emissions from employee vehicle traffic as employees would be bussed to the mine.

The air quality impacts from CO emissions from the Betze Project were predicted by modeling the emissions using the EPA's ISCST

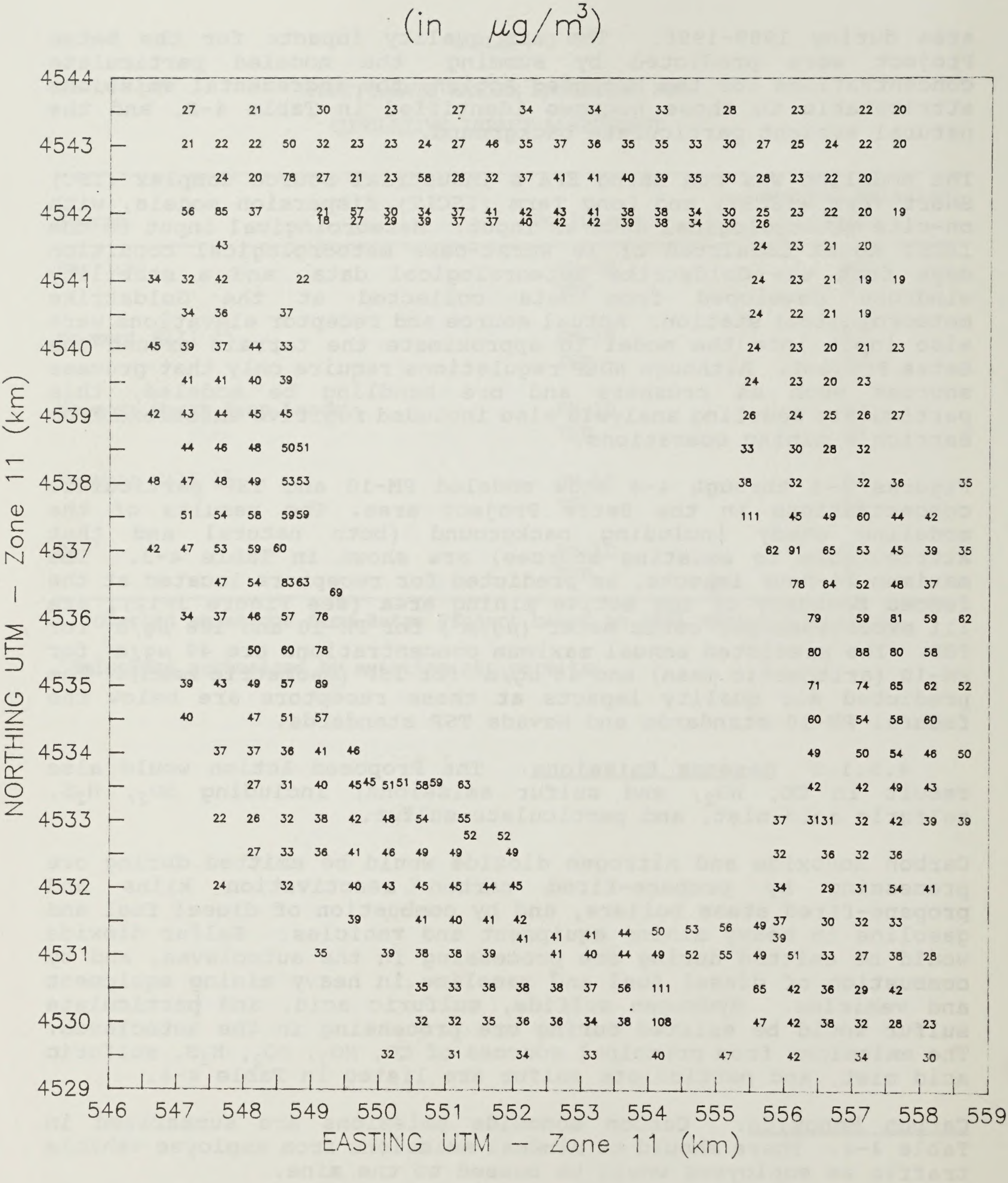



Figure 4-1. Barrick Goldstrike Cumulative PM10 Impacts: 24-Hour

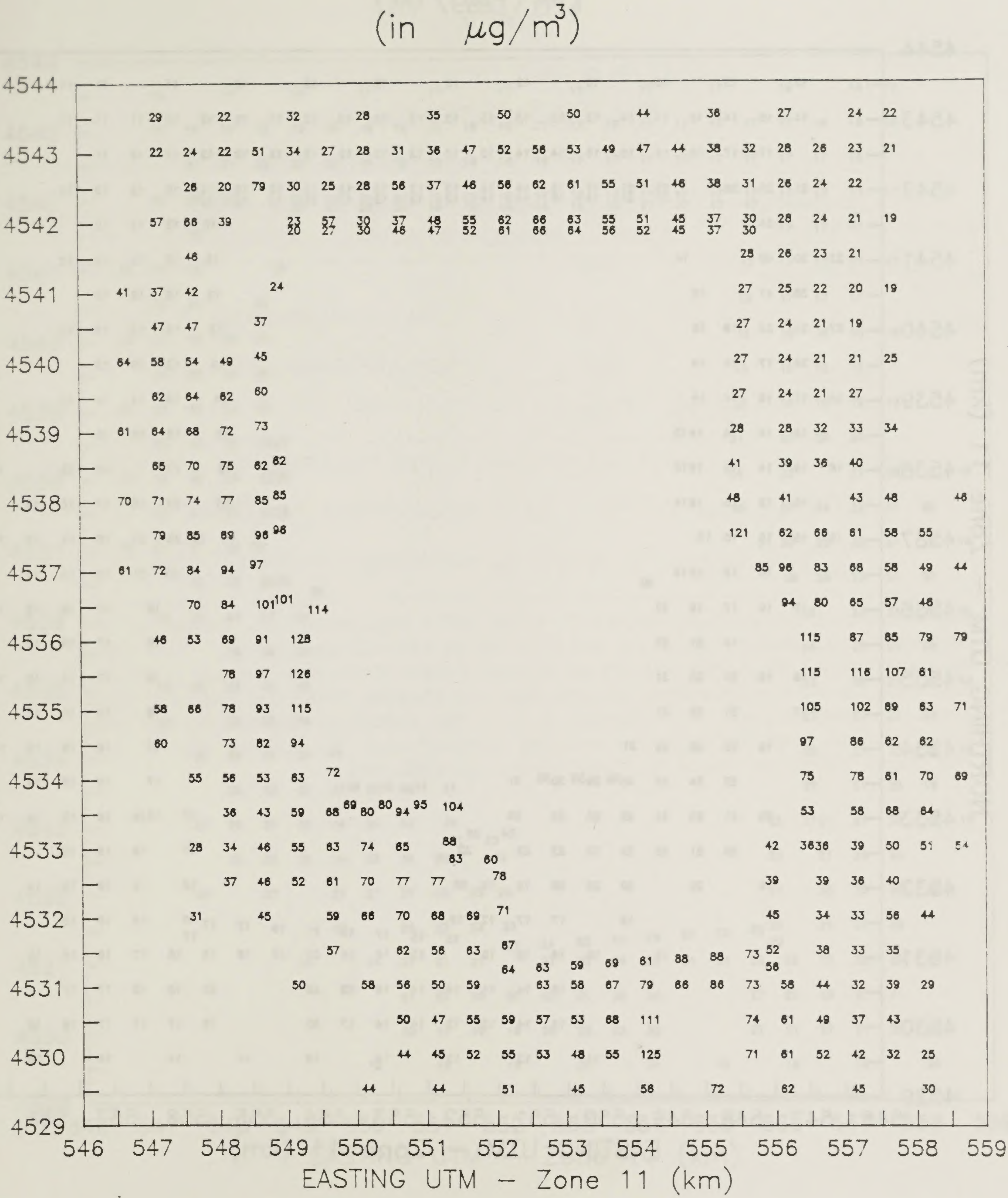



Figure 4-2. Barrick Goldstrike Cumulative TSP Impacts: 24-Hour

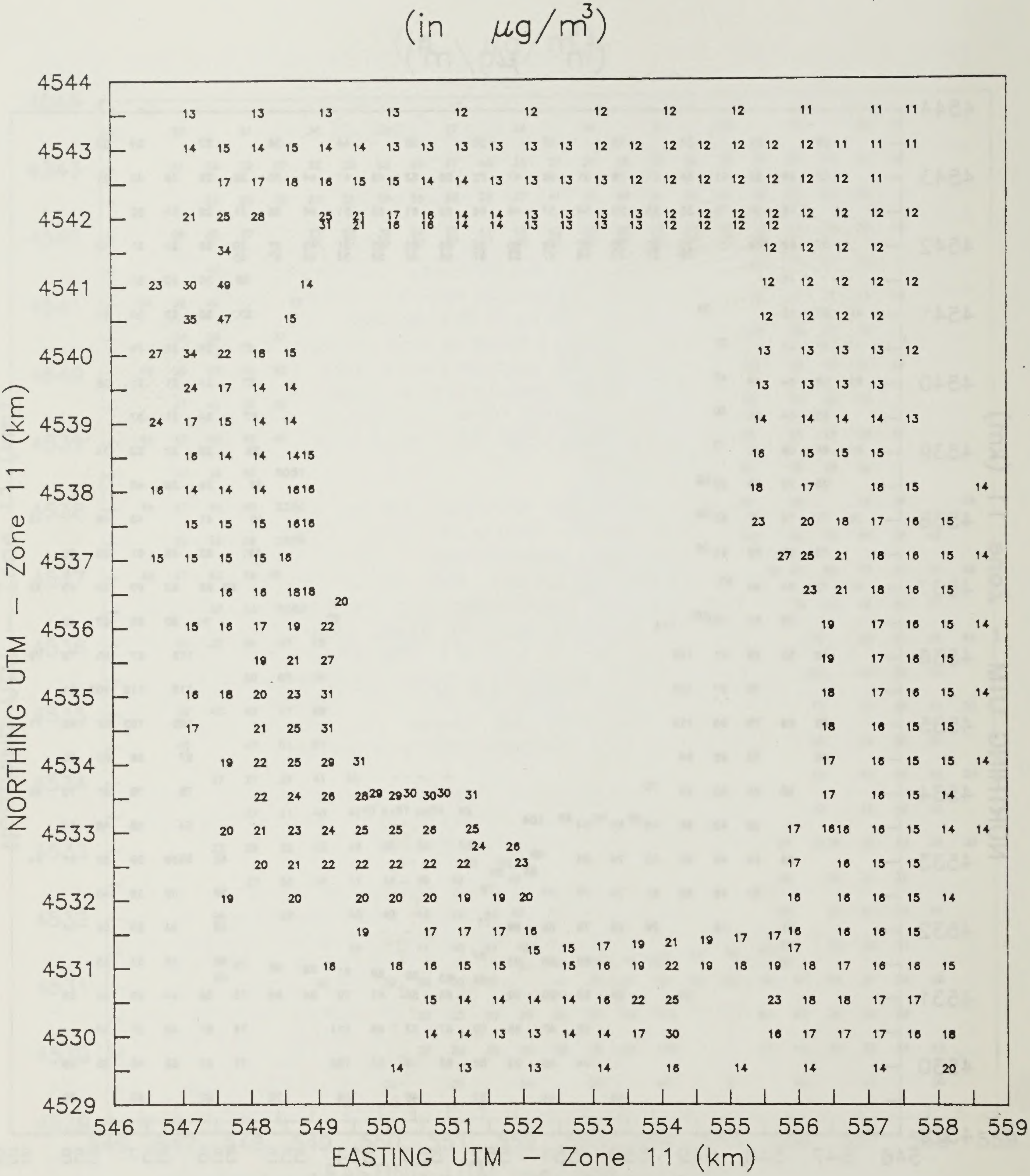



Figure 4-3. Barrick Goldstrike Cumulative PM10 Impact: Annual

(in $\mu g/m^3$)

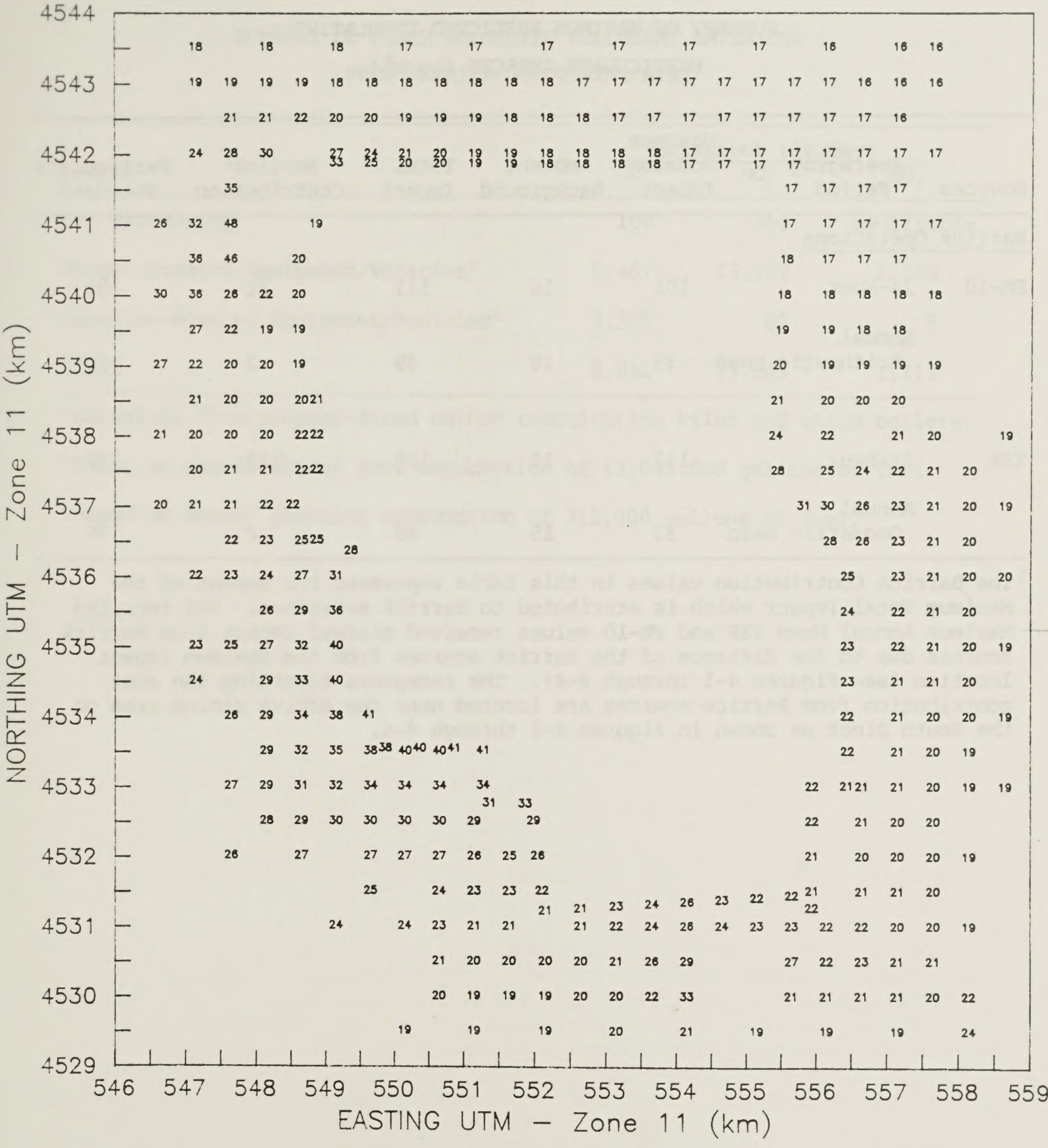



Figure 4-4. Barrick Goldstrike Cumulative TSP Impacts: Annual

TABLE 4-3

SUMMARY OF MAXIMUM PREDICTED CUMULATIVE PARTICULATE IMPACTS ($\mu g/m^3$)

| Sources | Averaging Period | Maximum Modeled Impact | Ambient Background | Total Impact | Barrick[1] Contribution | Particulate Standard |
|---|---|---|---|---|---|---|
| Barrick Operations | | | | | | |
| PM-10 | 24-Hour | 101 | 10 | 111 | 21 | 150 |
| | Annual Arithmetic Mean | 39 | 10 | 49 | 2 | 50 |
| TSP | 24-Hour | 113 | 15 | 128 | 113 | 150 |
| | Annual Geometric Mean | 33 | 15 | 48 | 2 | 75 |

[1] The Barrick Contribution values in this table represent the amount of the Maximum Total Impact which is attributed to Barrick emissions. The reported Maximum Annual Mean TSP and PM-10 values received minimal impact from Barrick sources due to the distance of the Barrick sources from the maximum impact location (see Figures 4-1 through 4-4). The receptors reporting the most contribution from Barrick sources are located near the active mining area on the South Block as shown in Figures 4-1 through 4-4.

TABLE 4-4

SUMMARY OF OTHER PROJECTED POLLUTANT EMISSIONS

FROM BARRICK GOLDSTRIKE MINE

| Source | Emissions (lb/day) CO | $NO_2$ | $SO_2$ |
|---|---|---|---|
| Ore Processing[1] | 100 | 400 | negligible |
| Diesel-Powered Equipment/Vehicles[2] | 5,467 | 13,107 | 1,108 |
| Gasoline-Powered Equipment/Vehicles[3] | 3,385 | 82 | 5 |
| TOTAL | 8,952 | 13,589 | 1,113 |

[1] Emissions from propane-fired carbon reactivation kilns and steam boilers.

[2] Based on annual diesel fuel consumption of 13,000,000 gallons of fuel.

[3] Based on annual gasoline consumption of 312,000 gallons of fuel.

dispersion model, with on-site meteorological data as input. The results of the modeling study are shown in Table 4-5. The modeled maximum 1-hour impact from Barrick sources was 429 $\mu g/m^3$. The modeled maximum 8-hour impact from Barrick sources was 164 $\mu g/m^3$. The modeled impacts are well below the federal and Nevada air quality 1-hour standard of 40,000 $\mu g/m^3$, and the 8-hour standard of 10,000 $\mu g/m^3$. The impacts from existing Dee and Newmont CO emissions were not modeled. Given the general mining activity from both Dee and Newmont, and the distance from Barrick operations, it is conservatively estimated that the impact from all CO sources would be at most 50 percent higher than Barrick CO impacts alone. The combined CO emissions would be well below the applicable standards.

Nitrogen Dioxide. Nitrogen dioxide emissions are summarized in Table 4-4. There should be minimal emissions from employee vehicle traffic as employees would be bussed to the mine.

The air quality impact from $NO_2$ emissions from the Betze Project were predicted by modeling the emissions using the EPA's ISCST dispersion model, with on-site meteorological data as input. The results of the modeling study are shown in Table 4-5. The modeled annual impact from Barrick sources was 17 $\mu g/m^3$. The modeled impact is well below the federal and Nevada air quality annual standard of 100 $\mu g/m^3$. The impacts from existing Dee and Newmont $NO_2$ emissions were not modeled. As with the CO impacts, given the general mining activity from both Dee and Newmont and the distance from Barrick operations, it is conservatively estimated that the impact from all $NO_2$ sources would be at most 50 percent higher than the Barrick impact alone. Combined $NO_2$ emissions would be below the applicable standards.

Sulfur Emissions. The heavy mining equipment and project vehicles would generate $SO_2$. The processing equipment, except for the autoclaves, would not generate $SO_2$. The autoclaves would also generate $H_2S$, sulfuric acid mist, and trace quantities of particulate sulfur. Similar to CO and $NO_2$, there would be minimal emissions from employee vehicular traffic, as employees would be bussed to the mine.

Sulfur emitted from the autoclaves can occur as $SO_2$, $H_2S$, sulfuric acid mist, and particulate sulfur. The autoclave stack source test to determine emissions from the existing autoclave showed hydrogen sulfide to be the major component of sulfur emissions from the autoclave (Horizon Air Measurement Services 1990). The actual $SO_2$, $H_2S$, sulfuric acid mist, and particulate sulfur emissions from the existing autoclave, and the projected emission rates for the existing and five additional autoclaves are shown in Table 4-6. The new autoclaves would begin operation by the end of 1992.

The Nevada Administrative Code (NAC § 445.746) provides an equation for determining the allowable hourly total sulfur emission rate for

TABLE 4-5

SUMMARY OF OTHER PROJECTED POLLUTANT IMPACTS
FROM BARRICK GOLDSTRIKE MINE

| Pollutant | Averaging Period | Predicated Concentration ($\mu g/m^3$) | NAAQS ($\mu g/m^3$) |
|---|---|---|---|
| CO | 1-Hour | 429 | 40,000 |
| | 8-Hour | 164 | 10,000 |
| $NO_2$ | Annual | 17 | 100 |

TABLE 4-6

PROJECTED AUTOCLAVE SULFUR COMPOUND EMISSIONS

| Sulfur Compound | Existing Autoclave[1] (lb/hr) | Five Additional Autoclaves[2] (lb/hr) | Total (lb/hr) |
|---|---|---|---|
| Sulfur Dioxide ($SO_2$) | 0.054 | 0.436 | 0.490 |
| Hydrogen Sulfide ($H_2S$) | 0.46 | 3.71 | 4.17 |
| Sulfuric Acid Mist | 0.117 | 0.939 | 1.056 |
| Particulate Sulfur | <0.05 | <0.40 | <0.45 |
| Total Sulfur | 0.548 | 4.416 | 4.964 |

[1] The existing autoclave has a nominal capacity of 1,500 tpd.

[2] The additional five autoclaves each would have a nominal capacity of 2,250 tpd. Two autoclaves would begin operating by the end of 1991, and the additional three autoclaves would begin operating by the end of 1992.

process components, such as the autoclaves, based on the total sulfur content of the feed. Sulfur emissions contributed by fuels used in the process must be included; however, in this case no sulfur contributions have been added from fuel firing of the steam boilers, since propane has a negligible sulfur content.

Based on an average sulfur content in the ore feed of 2.4 percent, the existing autoclave would be authorized to emit 787 pounds of total sulfur per hour; the six autoclaves would have an allowable emission rate of 5,267 pounds of total sulfur per hour.

The existing autoclave has an emission rate of 0.548 pounds of total sulfur per hour, compared to the allowable rate of 787 pounds per hour. The six autoclaves have a projected emission rate of 4.964 pounds per hour, compared to the allowable emission of 5,267 pounds of total sulfur per hour.

There are no specified emission restrictions for $SO_2$, $H_2S$, sulfuric acid mist, or particulate sulfur, other than for the total sulfur restriction discussed above. The actual and projected sulfur emissions were not modeled for ambient air quality impacts because the emission rate from the existing autoclave was so low in comparison to the allowable total sulfur emission rate.

4.3.1.3 Other Emissions. The ore from the Betze Pit would contain some trace amounts of various metals. To assess the emission levels of such metals from the mining and milling operations, a study of the metals content of the ore and waste rock was conducted. Rock samples were collected from coreholes within the proposed Betze Pit, and the metals content of each sample was determined. The most conservative estimate of the metals content from any of the samples was used in the analysis. The resulting metals concentrations are presented in Table 4-7. The data show that, at most, the metals are present in concentrations that are less than half of the significance levels established by the NDEP. Thus, the concentration of airborne metals is expected to be minimal, and no adverse impacts to human health are anticipated.

In addition to particulate emissions, some of the mercury in the ore would be concentrated along with the gold during the cyanidation process. After the electrowinning step, the gold/steel wool cathodes would be sent to a mercury retort prior to being melted in the furnace (see Section 2.1.4.1). The mercury would be retorted and captured in a closed loop system and subsequently sold. There would be no direct mercury emissions from the retorts. There would be trace amounts of mercury emitted from the autoclave stacks. The autoclave stack source test showed mercury emissions averaging 0.0062 lb/hour, this would be 0.05 lb per 8-hour time period. The de minimis emission rate, the rate below which no further review is required by the NDEP, is 0.25 lb per 8-hour time period.

TABLE 4-7

PROJECTED METALS IMPACT ANALYSIS

| Metal | Metals Content[1] (ppm) | 8-Hour Average Concentration[2] ($\mu g/m^3$) | Significance Level[3] ($\mu g/m^3$) | Percent of Significance Level |
|---|---|---|---|---|
| Arsenic | 5,290 | 1.12 | 4.8 | 24 |
| Barium | 1,490 | 0.32 | 11.9 | 2.7 |
| Boron | 10 | 0.002 | 119 | 0.002 |
| Cadmium | 38 | 0.008 | 1.2 | 0.7 |
| Chromium | 84 | 0.018 | 1.2 | 1.5 |
| Copper | 192 | 0.041 | 23.8 | 0.2 |
| Iron | 47,500 | 10.1 | 23.8 | 42 |
| Lead | 85 | 0.018 | 3.6 | 0.5 |
| Mercury | 52 | 0.011 | 0.2 | 4.7 |
| Magnesium | 19,500 | 4.1 | 238 | 1.7 |
| Manganese | 1,050 | 0.22 | 119 | 0.2 |
| Nickel | 250 | 0.053 | 2.4 | 2.2 |
| Selenium | 20 | 0.004 | 4.8 | 0.1 |
| Silver | 4 | 0.0008 | 0.2 | 0.4 |
| Thallium | 40 | 0.008 | 2.4 | 0.4 |

[1] Based on whole rock analysis. Maximum value in any single sample used.

[2] Calculated based on 8-hour average TSP concentration of 212.4 $\mu g/m^3$.

[3] Nevada air toxics standard based on Threshold Limit Value/42.

Based on the stack-tests for the existing 1,500-tpd autoclave, the projected mercury emission rate for each of the 5 additional 2,250-tpd autoclaves is 0.01 lb/hr, or 0.08 lb per 8-hour time period. Using these figures, the total projected mercury emission rate for the existing and 5 additional autoclaves is 0.45 lb per 8-hour time-period. Barrick anticipates that the air permit applications to be filed with the NDEP for each of the additional autoclaves would have a maximum mercury emission rate of 0.096 lb/hr or 0.768 lbs per 8-hour period. The emissions for the existing autoclave were not modeled for ambient air quality impacts because the emission rate was well below the allowable mercury emission rates.

The cyanidation process would use sodium cyanide in solution at the heap leach pads and in the carbon-in-leach (CIL) circuit at the mill. The solutions are maintained at a high pH in excess of 10 using lime and caustic to maintain the cyanide in solution and to minimize the formation of hydrogen cyanide (HCN). With the continued pH control of the process solutions, HCN formation and the off-gas of HCN would be minimized. The minimal impact from the cyanidation process is reflected in the filter analysis data from existing operations reported in Section 3.3.4.2. Three potential cyanide deposition samples were analyzed with minute quantities of total cyanide found on one of the three samples and none on the other two. There is no NAAQS for HCN.

The nearest Class I area, Jarbidge Wilderness, is more than 70 miles away; no effects from the project are expected on Class I air quality or visibility.

4.3.2 Alternatives

4.3.2.1 Waste Rock Disposal Areas, Ore Stockpiles, and Processing Facilities. The mining operations, waste rock disposal area, and the majority of the processing operation facilities would be located in the southern and eastern portions of Barrick's claim blocks. The alternatives discussed in this EIS would serve to locate various facilities farther to the west or to the north, locations which would disperse fugitive dust emissions by further separating the dust generating activities. Increased hauling distances would generate additional particulate emissions from the levels due to hauling in the Proposed Action.

4.3.2.2 Water Disposal Methods. Emissions of air pollutants would not be significantly different from the Proposed Action if any of the water disposal alternatives were implemented.

4.3.2.3 Partial Pit Backfill. Partially backfilling the Betze Pit would mean that backfilling operations would continue from the year 2000 until 2009. The emissions of particulates from mining would continue for 9 more years compared with the Proposed Action, although at a somewhat reduced rate.

### 4.3.3 Cumulative Impacts

The Betze Project would be located in an area in which there are operating mines and processing facilities of Barrick, Dee, and Newmont. Dee likely will continue to mine and process ore at the Dee Mine. It is not anticipated that any future mining will occur at the Ren Mine.

Newmont likely will continue to mine and expand the Genesis, Blue Star, and Post Pits, and begin to develop by surface mining methods certain other near-surface deposits (see Section 3.12.3.3) during the life of the Betze Project. Newmont has indicated that it does not intend to increase throughput in its processing facilities as a result of these additional projects. Thus, it is reasonable to assume that its point source particulate emissions would remain relatively constant. Fugitive emissions from proposed new mining projects of Newmont may contribute incrementally to particulate concentrations in the Betze Project area, particularly if the North Star deposit is developed while the Betze Project remains in operation. However, in the absence of more definitive plans concerning the specific nature and timing of the development of such projects by Newmont, it is not possible to reasonably forecast whether there would be an incremental contribution of fugitive emissions from such projects to Betze Project emissions or to project whether the contribution would be greater than that of existing Newmont activities.

It is also foreseeable that Newmont could develop certain deep deposits (see Section 3.12.3.3), although the timing and nature of such potential development cannot be predicted at this time. If any of these deposits were developed during the period that the Betze Project was operational, they would potentially contribute incrementally to particulate concentrations in the area. It is unlikely that such development would result in significant new point sources of particulates as existing processing facilities (or those of the Betze Project) would probably be utilized to process ore from such deposits. However, in view of the proximity of these deposits to the Betze Project, there could be synergistic impacts among fugitive emissions from mining if the Betze Project and one or more of the deep deposits were to be mined simultaneously. In view of the uncertainty in the status, timing, and nature of such projects, it is not reasonable to try to quantify any incremental contribution of such projects at this time.

### 4.3.4 No Action Alternative

Under the No Action alternative, Barrick would continue mining the Post Pit at present rates for 1 to 2 years and operate the existing mill, South Block waste rock disposal area, AA Block heap leach pads, and tailings impoundment as authorized by existing approvals. Present levels of particulate, CO, $NO_2$, and various sulfur emissions from mining and processing would continue for that period and then be significantly reduced as reclamation proceeds. Unless Barrick utilized its ore processing facilities to process ore from other mines, emissions associated with ore processing would cease upon termination of Barrick's operations. The air quality in the Betze Project area would continue to be affected by other mining operations in the area. To the extent that there is no net increase in emissions of Barrick or others, the air quality in the area may improve.

#### 4.3.5 Mitigation

Other than the mitigation measures incorporated in the Proposed Action, there are no mitigation measures recommended for air resources.

### 4.4 Water Resources

The withdrawal of large quantities of water from the groundwater system by dewatering of the Betze Pit and the subsequent discharge of water to the TS Ranch Reservoir and to the irrigation areas, or subject to regulatory approval, to Rodeo or Boulder Creeks, have the potential to impact both surface water and groundwater quantity and quality. The construction of additional waste rock disposal areas, ore stockpiles, an additional tailings impoundment, and the additional heap leach facility would also potentially impact surface and groundwater quality. The following sections present a discussion of water resources impacts commencing with a discussion of water hydrology (quantity) impacts followed by a discussion of water quality impacts.

#### 4.4.1 Water Quantity Impacts Overview

Impacts from Dewatering and Discharge. Mining of the proposed Betze Pit would require the continuation and expansion of existing pit dewatering operations. The primary impact on water resources, both surface water and groundwater, would result from the withdrawal of substantial quantities of water in the immediate area surrounding the pit and the subsequent discharge of that water west of the Betze Project area into the Boulder Valley drainage. An additional impact to water resources would result from the construction of waste rock disposal areas, ore stockpiles, a heap leach facility, an additional tailings impoundment, and associated ancillary facilities.

The Betze Project is located within the Boulder Creek Basin designated as hydrographic area 61 (Boulder Flat) by the Nevada State Engineer's Office. Surface runoff from the area flows west and southwest via Rodeo Creek, Boulder Creek, and Rock Creek into the Humboldt River; surface flow reaches the Humboldt River only during extreme precipitation events. Groundwater in the project area occurs within shallow alluvium, the Carlin Formation, the Paleozoic metasediments, and the granodiorite stock.

Most of the seeps and springs in the project area are located on the western flank of the Tuscarora Mountains. Sufficient data do not presently exist to determine which of the seeps and springs are perched groundwater discharge zones, isolated from the regional groundwater system by local geologic faults or low permeability zones.

The dewatering operations would impact the hydrologic system in the area. A cone of depression would be created in the water table by dewatering operations. This could potentially reduce or eliminate flow to some of the springs and seeps in the area. Flow in some of the perennial sections of the local creeks, particularly Rodeo Creek and Brush Creek, could also potentially be reduced or eliminated. This cone of depression would continue after dewatering ceases until the hydrologic system returns to equilibrium.

A portion of the water removed during dewatering would be consumed for mining and processing. The remaining water either would flow to the TS Ranch Reservoir where it would be stored for later irrigation use, or, subject to regulatory approval, would be discharged to Rodeo or Boulder Creeks. The transfer of water from the pit area to the reservoir and lower Boulder Valley would result in increases in the groundwater levels due to infiltration at those areas. An increase in the flow of Rodeo or Boulder Creeks would also be expected if water in excess of irrigation demand were to be discharged, subject to regulatory approval, to either or both of those creeks.

### 4.4.2 Impacts from Dewatering and Discharge

4.4.2.1 Proposed Action. Groundwater withdrawal during mining of the Betze Pit would require the continuation and expansion of existing dewatering operations. Projected dewatering rates have been previously discussed in Section 2.2.2.6. The annual average dewatering rates would range from approximately 10,300 gallons per minute (gpm) 1993, to approximately 29,300 gpm in the last year of mining in 2000. A much smaller amount of water, approximately 4,500 gpm, would be withdrawn from 2000 through 2010 in order to supply necessary water for processing and reclamation operations.

The impact from withdrawing these quantities of water from the hydrologic system was simulated using a comprehensive three-dimensional model of Boulder Valley and the related groundwater system. The model was based upon the U.S. Geologic Survey (USGS) three-dimensional finite-difference groundwater program MODFLOW, a modular flow model. The parameter specifications for simulating the hydrologic system using MODFLOW were developed using hydrologic data from the mine site and surrounding area; from hydrologic data published by the Nevada State Engineer's Office, USGS and others; and by calibrating the observed and reported groundwater flows and water levels. A detailed discussion of the application of MODFLOW for this project is provided by Leggette, Brashears & Graham, Inc. (Leggette, Brashears & Graham, Inc. 1990).

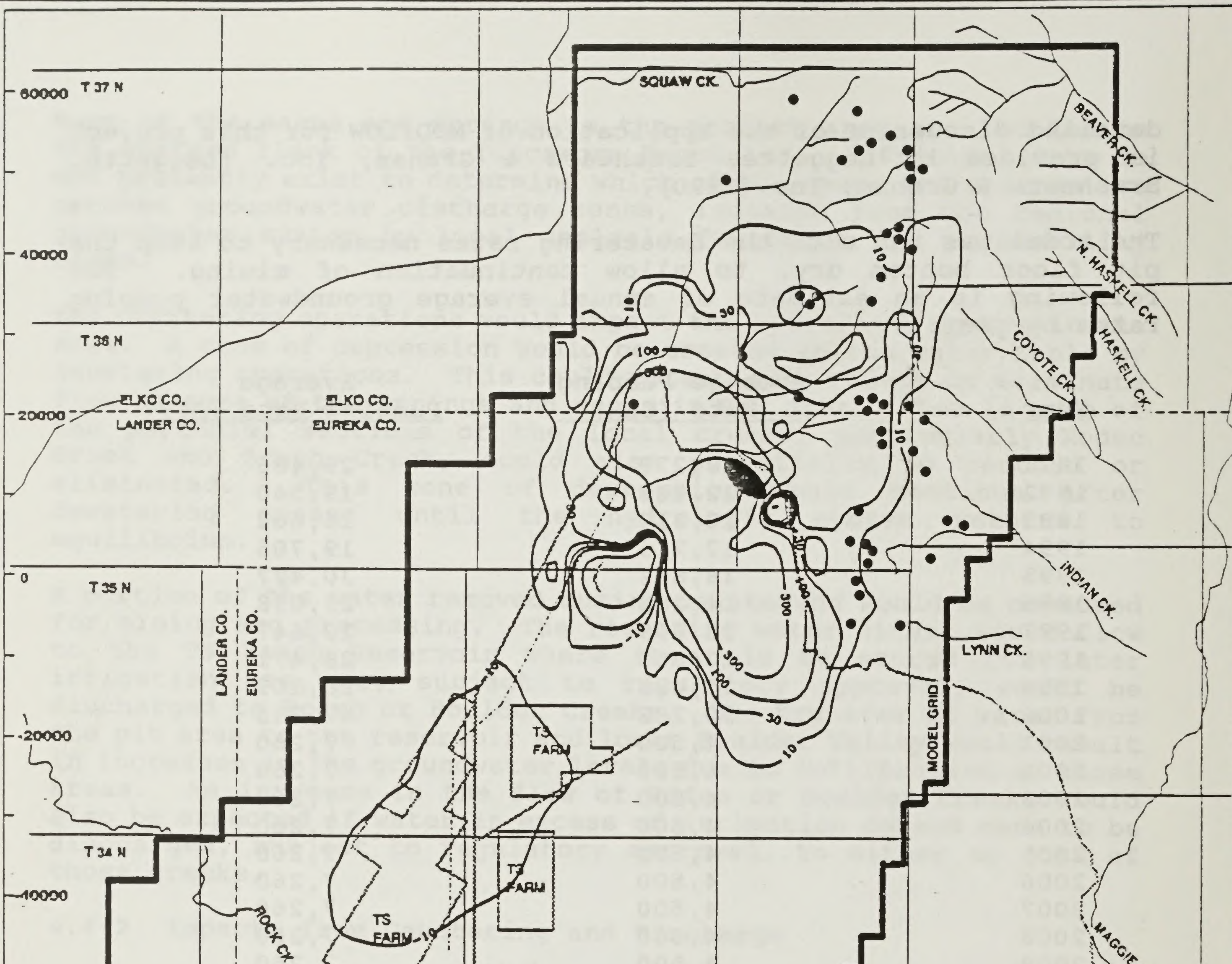
The model was run with the dewatering rates necessary to keep the pit floor bottom dry, to allow continuation of mining. The following is an estimate of annual average groundwater pumping rates by year:

| Year | Average Pumping Rate (GPM) | Average Pumping Rate (AFY) |
|---|---|---|
| 1991 | 18,279 | 29,486 |
| 1992 | 12,126 | 19,560 |
| 1993 | 10,330 | 16,663 |
| 1994 | 12,215 | 19,705 |
| 1995 | 18,862 | 30,427 |
| 1996 | 14,282 | 23,038 |
| 1997 | 12,799 | 20,647 |
| 1998 | 17,650 | 28,471 |
| 1999 | 17,425 | 28,109 |
| 2000 | 29,282 | 47,235 |
| 2001 | 4,500 | 7,260 |
| 2002 | 4,500 | 7,260 |
| 2003 | 4,500 | 7,260 |
| 2004 | 4,500 | 7,260 |
| 2005 | 4,500 | 7,260 |
| 2006 | 4,500 | 7,260 |
| 2007 | 4,500 | 7,260 |
| 2008 | 4,500 | 7,260 |
| 2009 | 4,500 | 7,260 |
| 2010 | 4,500 | 7,260 |

The base model projected that approximately 263,400 acre-feet of water would be pumped by the Betze Pit dewatering operations from 1991 to 2000.

The dewatering operations would result in a cone of depression of the water table. The cones of depression for the years 2000 and 2030 are shown in Figures 4-5 and 4-6, respectively. By the year 2100, groundwater elevations would recover to close to pre-mining levels as shown in Figure 4-7. Seeps and springs with a flow of 1 gpm or greater that are located within the drawdown contours are depicted in Figures 4-5, 4-6, and 4-7.

Sensitivity analyses were also run on the hydrologic model, varying the recharge rate, the fault permeabilities, storage, and transmissivity. The sensitivity analyses indicated that although the projected pumping rates varied, the cone of depression generally corresponded to the cone of depression projected in the base model. The sensitivity analyses indicated that the quantity to be pumped from active dewatering operations from 1991 to 2000,




BETZE PROJECT

**Figure 4-5. Projected Drawdown Contours for the Year 2000, Betze Pit Standard Mine Plan (Leggette, Brashears, and Graham, Inc. 1990)**

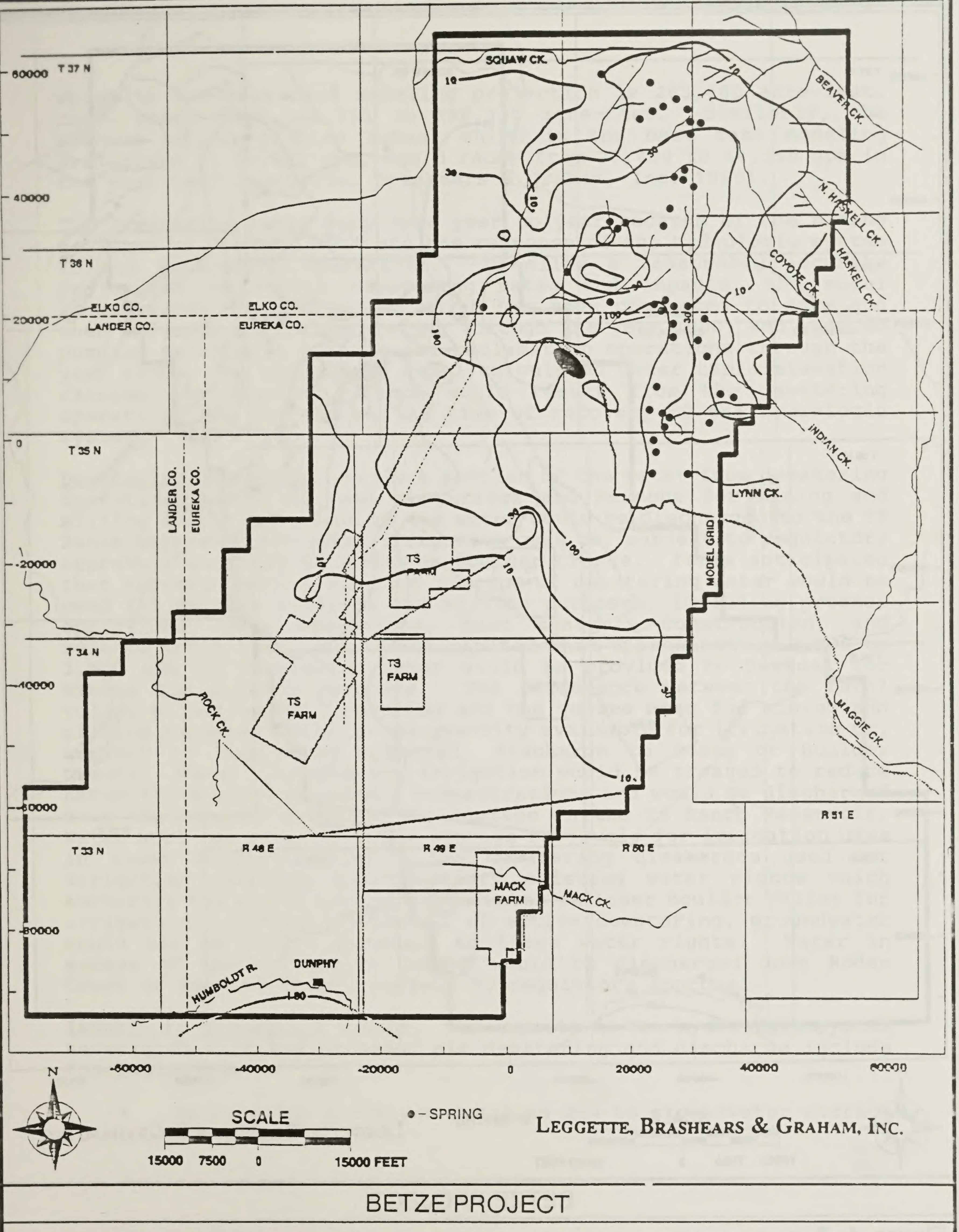
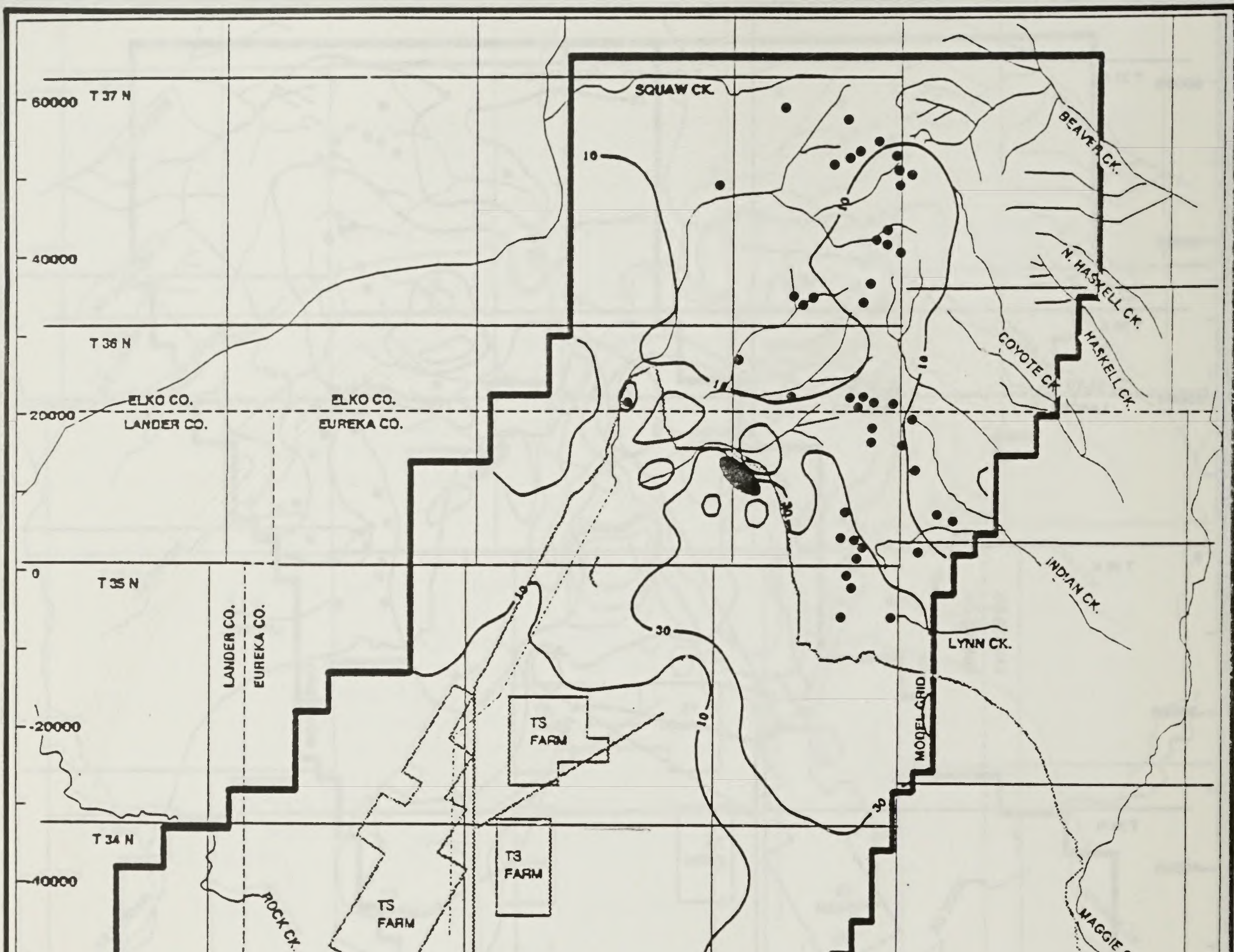



Figure 4-6. Projected Drawdown Contours for the Year 2030, Betze Pit Standard Mine Plan (Leggette, Brashears, and Graham, Inc. 1990)




BETZE PROJECT

Figure 4-7. **Projected Drawdown Contours for the Year 2100, Betze Pit Standard Mine Plan (Leggette, Brashears, and Graham, Inc. 1990)** which in the base case modeling projection is 263,400 acre-feet, could range from 248,781 to 388,369 acre-feet. Similarly, the maximum annual pumping rates, which in the base case modeling projection is 29,282 gpm, could range from 27,429 to 44,550 gpm in the year 2000 (Leggette, Brashears & Graham, Inc. 1990).

The dewatering rates vary from year to year because of the mining sequence of the Betze Pit and the response of the hydrologic system to the dewatering operations. To allow a reasonably accurate projection of future dewatering rates and impacts, the model accounts for the dewatering which has been conducted to date and then projects active dewatering through the year 2000, and reduced pumping to support milling and reclamation operations through the year 2010. The hydrologic model calculated water table elevation changes, or drawdown, which would result from the dewatering operations and throughout the time of recovery of the hydrologic system.

Dewatering Discharge. While a portion of the water from dewatering operations would be used by Barrick and Newmont for mining and milling operations, most of the water would be discharged to the TS Ranch Reservoir for later irrigation uses or, subject to regulatory approval, directly to Rodeo or Boulder Creeks. It is anticipated that approximately 3,500 to 5,000 gpm of dewatering water would be used for Barrick's mining and milling purposes, including process operations, mine operations, dust control, construction, and related activities. It is anticipated that approximately 2,000 to 3,500 gpm of dewatering water would be provided to Newmont for mining and milling purposes. The difference between the total volume withdrawn by dewatering and the volume used for mining and milling purposes would be the quantity available for irrigation or, subject to regulatory approval, discharge to Rodeo or Boulder Creeks. Water intended for irrigation would be treated to reduce naturally occurring arsenic concentrations and would be discharged down the unnamed drainage for storage in the TS Ranch Reservoir. Water would be drawn from the storage reservoir for irrigation uses in lower Boulder Valley. The dewatering discharges used for irrigation purposes would satisfy existing water rights which authorize the withdrawal of groundwater in lower Boulder Valley for irrigation. During the period of active dewatering, groundwater would not be pumped pursuant to these water rights. Water in excess of the irrigation demand would be discharged down Rodeo Creek or Boulder Creek, subject to regulatory approval.

Impacts to Hydrologic System. The impacts to the hydrologic system associated with the proposed pit dewatering and discharge include the following:

- Groundwater elevation drawdown due to groundwater storage depletion.

- Increased flows in the unnamed drainage, Rodeo Creek, and Boulder Creek.

- Increased water storage in the TS Ranch Reservoir resulting in greater evaporation and increased seepage to the groundwater system.

- Groundwater recharge at the irrigation areas resulting in localized groundwater mounding.

- Increased groundwater recharge from creeks, seeps, springs, the unnamed drainage, the TS Ranch Reservoir, and Boulder Creek.

- Increased evapotranspiration due to groundwater mounding in lower Boulder Valley and increased surface water resources in the unnamed drainage, the TS Ranch Reservoir, Rodeo Creek, and Boulder Creek.

Of these impacts, only increased evapotranspiration would result in a loss of water resources from the Boulder Valley system. The remaining effects involve shifting groundwater to the surface water system, or vice versa, but no loss from the hydrologic system.

The cumulative increase in mining and milling water uses, reservoir evaporation and evapotranspiration associated with irrigation in lower Boulder Valley for the period 1987 to 2000, which covers the period of existing and proposed dewatering is approximately 181,000 AF. In addition, evapotranspiration in lower Boulder Valley would increase by a total of 31,000 AF over the same period due to elevated groundwater levels associated with the irrigated area. Nearly all of this water would be derived from groundwater storage. Of the total system water usage, approximately 50 percent would be due to irrigation uses in lower Boulder Valley. The balance would consist of mining and milling uses and evaporation from the TS Ranch Reservoir.

It is anticipated that the water balance at the downstream boundary of Boulder Valley would be essentially unaffected. Groundwater modeling study results (Leggette, Brashears & Graham, Inc. 1990) indicate that it is unlikely that there would be an increase in flow rate in Boulder Creek that would extend to the confluence with the Humboldt River (see section on Impacts to Lower Boulder Valley). Also, groundwater flows out of the Boulder Valley system would increase by 5 AFY due to the groundwater mounding in lower Boulder Flat. In terms of the Boulder Valley Basin water budget, this is an insignificant amount of water and would not adversely affect the water resources of either the Boulder Valley or Humboldt River hydrologic systems.

Impacts to hydrologic features in Boulder Valley that may potentially be affected by the dewatering and discharge are discussed below.

Impacts to Groundwater Elevations. The water level hydrographs for wells in the Humboldt River Basin illustrate a normal seasonal water level variation of 10 to 30 feet (Eakin et al. 1976). The natural range of water level variation is approximately 10 feet in flood plain areas, such as lower Boulder Valley near the Humboldt River, and over 30 feet at higher elevations, such as the Tuscarora Mountains.

The dewatering operations would result in a cone of depression exceeding 10 feet at distances ranging from 2 to 6 miles from the proposed Betze Pit, as shown in Figure 4-5. The projected 10-foot and 30-foot water level drawdown contours would be contained within the hydrographic basin during active dewatering. Infiltration of water at the unnamed drainage, the TS Ranch Reservoir, and the irrigated areas in lower Boulder Valley would limit the southern extent of the cone of depression. In fact, as shown in Figure 4-5, relatively small groundwater mounds would be formed in the reservoir and irrigation areas.

Impacts on Wells. The drawdown of the water table elevations would have an impact on water supply wells and dewatering wells. Drawdown by the end of mining in the year 2000 would reach greater than 1,000 feet at the proposed Betze Pit. Existing wells (refer to Figure 3-8 for locations) would be impacted by the extent of drawdown which occurs at each well site. Barrick's AA Well on the east side of Rodeo Creek would probably experience drawdown of less than 10 feet, because it is located near the granodiorite stock which has a low permeability. The West Bazza Pit, which would become part of the proposed Betze Pit, has currently dried up due to existing dewatering operations.

Newmont has two water supply wells (PPW-1 and PPW-3) located northwest of Mill No. 4, and north of Brush Creek, which are approximately 1,200 feet in depth. Additional drawdown in the vicinity of these wells caused by the Betze Pit dewatering is expected to be on the order of 100 to 200 feet. Therefore, based upon modeling results, there should be no significant loss of water supply from existing water supply wells.

A map of the 10-foot drawdown for the years 2000, 2030, and 2100 (Figure 4-8) shows the extent of potential impacts within the Boulder Flat Hydrographic Area. Within the 10-foot drawdown contour there are approximately 44 wells used by Barrick, Newmont, or Dee for dewatering, mining, or milling purposes, 3 stock water wells, and one surface water irrigation diversion (located on Boulder Creek about 1.5 miles upstream of the Rodeo Creek confluence). The location, ownership, and allowed pumping rate for these wells and surface diversion within the 10-foot drawdown

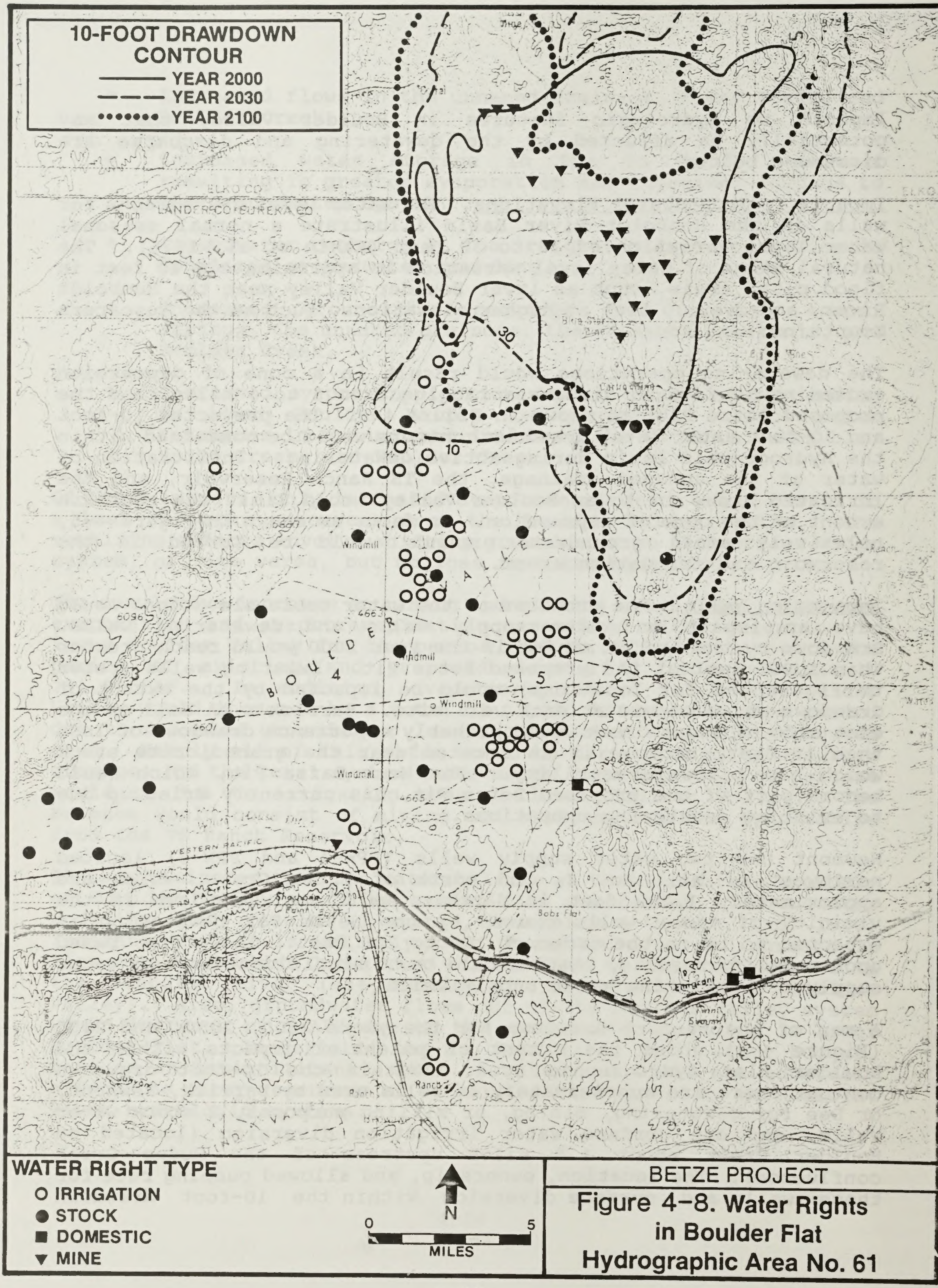



Figure 4-8. Water Rights in Boulder Flat Hydrographic Area No. 61

contour are presented in Table 4-8. Typical mine dewatering wells or water supply wells are relatively deep (several hundred feet to a thousand feet). Impacts to the wells, primarily extra pumping costs because of increased pumping head, would be expected only in close proximity to the Betze Pit. Since Barrick's dewatering operations would remove significant quantities of water from the regional groundwater system, other dewatering operations would need to pump less water to achieve their dewatering objectives. The stock watering wells are shallow and it is likely that these wells would be impacted by moderate drawdown of the groundwater elevations resulting in increased pumping costs. The single surface water irrigation diversion would not be impacted by dewatering, because Boulder Creek is currently ephemeral at this location.

The town of Carlin, Nevada is located approximately 25 miles southeast of the project area on the east side of the Tuscarora Mountains, at the confluence of Maggie Creek and the Humboldt River. The water supply for the city is a spring and well system located several miles west of town. The hydrologic modeling of the Betze Pit dewatering (Leggette, Brashears & Graham, Inc. 1990) indicates that drawdowns would extend to the east of the Tuscarora Mountains. However, the groundwater divide between Boulder Creek and Maggie Creek would not shift in location although it is projected to be slightly lowered in elevation. Therefore, the impacts of Betze Pit dewatering would essentially remain within the Boulder Creek Basin, and the water balance of the Maggie Creek Basin would be maintained, thereby causing no impact on the Carlin spring and well system.

<u>Impacts on Seeps and Springs</u>. A description of the principal seeps and springs which would potentially be affected by dewatering is presented in Section 3.4. Those seeps and springs located at lower elevations, in particular, those springs which contribute to the baseflow of lower Brush and Rodeo Creeks would probably be affected by drawdown beneath the creeks. Those seeps and springs at higher elevations and in close proximity to the divide within the Tuscarora Mountains may not be impacted by the drawdown from dewatering operations if the seeps and springs are perched above the regional groundwater system. It has been shown that perched water table conditions exist in other regions of the Basin and Range Province, although, as discussed in Section 3.4.1.5, there are no field data to support the existence of similar conditions in the Tuscarora Mountains. Perennial reaches of streams in the mountain portions of the study area may represent discharge of perched groundwater, or the reaches could be due to discharge from the regional aquifer.

By the year 2000, the 10-foot drawdown contour projected by the hydrologic model would encompass 57 of the 131 seeps and springs identified in the survey conducted by JBR Consultants Group (1990). Springs with flows greater than 1 gpm are shown on Figures 4-5,

TABLE 4-8

WATER RIGHTS IMPACTED IN THE YEAR 2000
BY DRAWDOWN OF 10 FEET OR GREATER

| STAT | CERT # | SRC | POINT OF DIVERSION Q | Q | SEC | TWP | RNG | DIV RATE CFS | TYPE OF USE | ACRES IRR | ANNUAL DUTY | OWNER OF RECORD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CER | 11160 | STR | SW | SW | 15 | 36N | 49E | 0.000 | IRR | 360.00 | 0.00 AFS | PACKER, RHOADS |
| CER | 5729 | UG | NE | NW | 11 | 36N | 49E | 0.111 | MM | | 80.66 AFS | NEWMONT GOLD COMPANY |
| CER | 7018 | UG | LT | 1 | 20 | 35N | 50E | 1.025 | MM | | 0.00 | NEWMONT GOLD CO. |
| CER | 6682 | UG | NW | NW | 22 | 35N | 50E | 1.000 | MM | | 241.32 AFS | NEWMONT GOLD CO. |
| CER | 7642 | UG | NW | NW | 22 | 35N | 50E | 0.045 | STK | | 5.09 AFS | NEWMONT GOLD CO. |
| CER | 8778 | UG | LT | 1 | 4 | 35N | 50E | 0.056 | MM | | 20.56 AFS | NEWMONT GOLD CO. |
| CER | 9940 | UG | NE | SE | 10 | 36N | 49E | 1.000 | MM | | 199.49 AFS | NEWMONT GOLD CO. |
| CER | 10722 | UG | NW | SE | 30 | 36N | 50E | 0.140 | MM | | 96.80 AFS | POLAR RESOURCES CO. |
| CER | 10865 | UG | SW | SE | 10 | 35N | 50E | 0.160 | MM | | 64.27 AFS | POLAR RESOURCES CO. |
| CER | 10592 | UG | NW | SE | 30 | 36N | 50E | 0.233 | MM | | 394.23 AFS | BARRICK GOLDSTRIKE |
| PER | | UG | NE | SW | 24 | 36N | 49E | 0.000 | MM | | 0.00 AFS | BARRICK GOLDSTRIKE |
| PER | | UG | SE | NW | 12 | 36N | 49E | 1.000 | MM | | 645.25 AFS | EL CORDEX EXPLORATION |
| PER | | UG | SE | SE | 33 | 37N | 49E | 1.000 | MM | | 645.25 AFS | EL CORDEX EXPLORATION |
| PER | | UG | SE | SW | 3 | 36N | 49E | 1.000 | MM | | 645.25 AFS | EL CORDEX EXPLORATION |
| PER | | UG | SW | NW | 29 | 36N | 50E | 0.750 | MM | | 38.36 AFS | BARRICK GOLDSTRIKE |
| PER | | UG | SE | SE | 33 | 37N | 49E | 0.000 | MM | | 0.00 - | EL CORDEX EXPLORATION |
| PER | | UG | NW | NE | 21 | 35N | 50E | 3.000 | MM | | 1613.12 AFS | NEWMONT GOLD CO. |
| PER | | UG | NE | SE | 31 | 36N | 50E | 0.500 | MM | | 100.51 AFS | NEWMONT GOLD CO. |
| PER | | UG | NW | NE | 39 | 36N | 50E | 0.000 | MM | | 0.00 MGA | NEWMONT GOLD CO. |
| PER | | UG | SE | SW | 19 | 36N | 50E | 3.000 | MM | | 153.45 AFS | BARRICK GOLDSTRIKE |
| PER | | UG | NE | NW | 25 | 36N | 49E | 0.750 | MM | | 38.36 AFS | BARRICK GOLDSTRIKE |
| PER | | UG | SW | SW | 18 | 36N | 50E | 0.750 | MM | | 38.36 AFS | BARRICK GOLDSTRIKE |
| PER | | UG | SW | NE | 19 | 36N | 50E | 0.750 | MM | | 38.36 AFS | BARRICK GOLDSTRIKE |
| PER | | UG | NE | NW | 19 | 36N | 50E | 0.500 | MM | | 40.21 AFS | NEWMONT GOLD CO. |
| PER | | UG | NE | SW | 29 | 36N | 50E | 1.000 | MM | | 430.16 AFS | NEWMONT GOLD CO. |
| PER | | UG | SW | SE | 24 | 36N | 49E | 0.000 | MM | | 0.00 - | BARRICK GOLDSTRIKE |
| PER | | UG | NW | SW | 32 | 36N | 50E | 1.000 | MM | | 430.16 AFS | NEWMONT GOLD CO. |
| PER | | UG | SW | NW | 28 | 36N | 50E | 3.000 | MM | | 2172.06 AFS | BARRICK GOLDSTRIKE |
| PER | | UG | NE | SE | 24 | 36N | 50E | 3.000 | MM | | 2172.06 AFS | BARRICK GOLDSTRIKE |
| PER | | UG | SW | SW | 19 | 36N | 50E | 3.000 | MM | | 2172.06 AFS | BARRICK GOLDSTRIKE |
| PER | | UG | NE | NW | 30 | 36N | 50E | 3.000 | MM | | 2172.06 AFS | BARRICK GOLDSTRIKE |
| PER | | UG | SE | SW | 19 | 36N | 50E | 3.000 | MM | | 2172.06 AFS | BARRICK GOLDSTRIKE |
| PER | | UG | SE | SW | 19 | 36N | 50E | 3.000 | MM | | 2172.06 AFS | BARRICK GOLDSTRIKE |
| PER | | UG | SE | SW | 19 | 36N | 50E | 3.000 | MM | | 2172.06 AFS | BARRICK GOLDSTRIKE |
| PER | | UG | SE | SW | 17 | 36N | 50E | 3.500 | MM | | 752.79 AFS | NEWMONT GOLD CO. |
| PER | | UG | SW | SW | 34 | 36N | 49E | 1.000 | MM | | 645.25 AFS | EL CORDEX EXPLORATION |
| PER | | UG | SE | SE | 29 | 36N | 50E | 0.500 | MM | | 215.08 AFS | NEWMONT GOLD CO. |
| PER | | UG | NW | SW | 19 | 36N | 50E | 3.000 | MM | | 2172.06 AFS | BARRICK GOLDSTRIKE |
| PER | | UG | SE | SW | 19 | 36N | 50E | 3.000 | MM | | 2172.06 AFS | BARRICK GOLDSTRIKE |
| PER | | UG | NW | NE | 19 | 36N | 50E | 1.000 | MM | | 215.08 AFS | NEWMONT GOLD CO. |
| PER | | UG | SW | SE | 18 | 36N | 50E | 1.000 | MM | | 215.08 AFS | NEWMONT GOLD CO. |
| PER | | UG | SE | NE | 19 | 36N | 50E | 0.500 | MM | | 107.54 AFS | NEWMONT GOLD CO. |
| PER | | UG | NE | SE | 29 | 36N | 50E | 0.500 | MM | | 215.08 AFS | NEWMONT GOLD CO. |
| PER | | UG | SE | SE | 33 | 37N | 49E | 1.000 | MM | | 645.25 AFS | EL CORDEX CORP. |
| PER | | UG | SE | SW | 19 | 36N | 50E | 3.000 | MM | | 2172.06 AFS | BARRICK GOLDSTRIKE |
| PER | | UG | SW | SE | 19 | 36N | 50E | 3.000 | MM | | 2172.06 AFS | BARRICK GOLDSTRIKE |

4-6, and 4-7. The majority of these seeps and springs are located on the west side of the Tuscarora Mountains within the Rodeo Creek drainage and in the headwaters of Brush and Bell Creeks. The result of lowering the groundwater table beneath the seeps and springs by 10 feet or more would be that most of the 57 potentially affected seeps and springs would have reduced flow or would dry up, if they are hydraulically connected to the regional groundwater system. The 10-foot drawdown contour projected by the hydrologic model does not extend appreciably into the headwaters of Boulder Creek.

The exact number of acres of riparian/aquatic area that may be affected by drawdown of the groundwater table is difficult to determine with accuracy due to the uncertainties regarding perched water tables and aquifer interconnectedness. However, based on the estimate of the total acreage of riparian/aquatic areas associated with the springs and seeps within the drawdown contours projected by the modeling, approximately 134 acres of riparian/aquatic area could be affected by the drawdown of the groundwater table during the active dewatering period.

Riparian/aquatic areas are essential to maintaining biodiversity and healthy wildlife populations in arid regions, such as Nevada. To the extent that the drawdown of the groundwater table adversely affects such areas,the riparian/aquatic habitat, as well as the wildlife that uses the habitat, would be adversely affected.

Impacts on Creeks. None of the creeks in the Betze Project area are perennial over their entire length. Perennial reaches of creeks in the mountain portions of the project area may represent discharge of perched groundwater. Typically flow in the ephemeral reaches of the creeks is the result of snow melt or spring and summer thundershowers. The impact of dewatering on each of Rodeo, Brush, Bell, and Boulder Creeks is described below.

Rodeo Creek is located close to the Betze Pit where drawdowns of 100 to 1000 feet are predicted in the year 2000. However, drawdowns of less than 10 feet are predicted to occur at the granodiorite in the vicinity of Rodeo Creek sampling station RC-A (see Figure 3-4 for location). The upper ephemeral portion of Rodeo Creek upstream of station RC-A would not be impacted by drawdown of groundwater.

The granodiorite is probably the source of groundwater discharge that currently provides perennial surface flow to the section of Rodeo Creek adjacent to Barrick's mining operation. It may be that flow would be maintained through the year 2000 because the low permeability of the granodiorite stock would tend to maintain higher groundwater elevations during dewatering in the Betze Pit. The lower ephemeral portion of Rodeo Creek would not be impacted by drawdown of groundwater.

Brush Creek is perennial in the lower mile of the creek because of groundwater discharge. Drawdown beneath the lower 0.5 to 1 mile of Brush Creek is predicted to be 100 to 300 feet; drawdown in the headwaters would be greater than 30 feet. Therefore, it is probable that the lower, perennial section of Brush Creek would dry up by the year 2000. The ephemeral sections of Brush Creek would not be impacted by groundwater drawdown.

Bell Creek currently has perennial pools of water in its lowermost reaches. Predicted drawdown of greater than 300 feet in that area suggests that these pools would dry up by the year 2000. In the headwaters of Bell Creek, moderate drawdown of about 10 feet is predicted, suggesting that some seeps and springs may maintain flow, perhaps reduced, in upper Bell Creek.

The headwaters of Boulder Creek would not be affected by dewatering drawdown in the year 2000. Boulder Creek is perennial from its headwaters to a point approximately 1 mile above its confluence with Rodeo Creek. Drawdown beneath the lower perennial section is expected to be greater than 100 feet in the year 2000. As a result, some reduction in flow would be expected in this section of Boulder Creek. From the point that Boulder Creek becomes ephemeral, approximately 1 mile above the confluence with Rodeo Creek, to the TS Ranch Reservoir drawdowns of 10 to 30 feet are predicted. Since Boulder Creek is ephemeral in this reach, dewatering would have no effect on this section of Boulder Creek.

Impacts to the Unnamed Drainage. As part of the Proposed Action, dewatering water not utilized for mining and milling purposes would be discharged down the unnamed drainage, a natural drainage channel that flows southwest from the Goldstrike Mine. The base hydrologic model projects dewatering rates from 10,400 to 29,400 gpm in order to maintain a dry floor in the Betze Pit. It is estimated that as much as 8,000 gpm of water would be utilized by both Barrick and Newmont for mining and milling. Therefore, as much as 21,000 to 22,000 gpm (33,875 to 35,489 acre-feet per year) would be discharged down the unnamed drainage. It is probable that the maximum flow rate may approach 25,000 to 30,000 gpm. The sensitivity analyses indicated that maximum annual pumping rates could be as high as 44,500 gpm, which would have a corresponding annual discharge rate to the unnamed drainage of approximately 36,000 to 37,000 gpm (58,072 acre-feet to 59,685 acre-feet). If this annual pumping rate were necessary, the maximum discharge rate could approach 40,000 to 45,000 gpm. The disposal of large volumes of water at these high discharge rates would have the potential to cause significant erosion of the streambed and banks of the unnamed drainage.

Three erosion control structures or check dams have been constructed in the unnamed drainage as mitigation of the potential for channel erosion. In addition, improvements were made to an existing stock pond, and the drainage above the check dams has been riprapped for erosion protection. The check dams and riprap are located in the steeper upstream reaches of the unnamed drainage where the erosion potential is greatest. Each structure consists of an earthen berm across the channel. Each berm contains a spillway sized to convey at least 20,000 gpm in addition to the 10-year, 24-hour flood event. The spillways were excavated into non-erodible bedrock or protected with riprap.

It is anticipated that the existing control structures would need to be modified, or new control structures constructed, if the larger discharge flow rates become necessary. The reaches of the natural channel between the check dams may experience accelerated erosion, and may require lining with riprap or additional check dams. Erosion problems may also develop at higher flows at the transition points where the riprap integrates with the natural channel. Periodic inspection of the unnamed drainage and the check-dam spillways would be conducted as discharge rates increase. Where accelerated erosion is identified, appropriate mitigation would be taken.

If the modification of existing control structures, the construction of additional control structures or the placement of additional riprap were determined to be necessary, the additional work would be performed in compliance with one or more of the nationwide permits issued by the Corps of Engineers under Section 404 of the Clean Water Act, or an individual permit would be sought.

Impacts to the TS Ranch Reservoir. The water discharged down the unnamed drainage would be stored in the irrigation storage reservoir, the TS Ranch Reservoir. Water would be stored during the winter non-irrigation season for use during the following irrigation season. Throughout the irrigation season, water would be released for irrigation in lower Boulder Valley via an existing pipeline. Surplus water above irrigation system capacity would be discharged to Boulder Creek. Every year the plan would be to drain the reservoir completely by the end of the irrigation season, with the exception that a dead storage pool of approximately 500 acre-feet would be maintained. The reservoir storage would cycle every year: the reservoir would be full at the start of the irrigation season, emptied during the irrigation season, and be empty, except for the dead storage pool, at the end of the irrigation season. Because the reservoir is not fully operational, there are no operating data to compare with the projections concerning the operations described above.

After the impoundment area at the TS Ranch Reservoir reaches saturation, there would be mounding of groundwater underneath the reservoir and subsequent migration of approximately 9,450 acre-feet per year of groundwater from the reservoir, based upon the hydrologic model results. In addition, approximately 750 acre-feet of water would evaporate from the reservoir annually. Due to irrigation cycling, the reservoir water surface elevation could rise and fall by as much as 82 feet each year.

Impacts to the Irrigation Area. Water stored in the TS Ranch Reservoir would be piped approximately 6 miles via a 54-inch diameter buried pipeline to irrigation areas in lower Boulder Valley or, subject to regulatory approvals, would be discharged into Boulder Creek. Currently, water for agricultural purposes on the TS Ranch is pumped from groundwater wells in lower Boulder Valley (Boulder Flat).

Approximately 1,800 acres have been irrigated by the TS Ranch Joint Venture in the southeast portion of Boulder Flat. It is anticipated that this area would not be irrigated with water from the TS Ranch Reservoir, but would continue to be irrigated with groundwater pumped from that area.

Approximately 1,040 acres have been irrigated via wells by the TS Ranch Joint Venture in the northern portion of Boulder Flat. It is anticipated that these 1,040 acres of irrigation would be converted to use water from the TS Ranch Reservoir. The dewatering water would allow at least 6,460 additional acres to be irrigated in lower Boulder Valley. The TS Ranch Joint Venture presently holds water rights authorizing the Ranch to appropriate groundwater from lower Boulder Valley for irrigation purposes. During the period of active dewatering, the dewatering discharges would be used to satisfy the TS Ranch Joint Venture's water rights, instead of groundwater from lower Boulder Valley.

The fields in the areas to be irrigated would be graded and center pivot irrigation systems would be installed once dewatering water is available. Hay or other crops would be grown in the irrigated area. The annual water allocation for the TS Ranch is 4 feet of water per acre. This means that approximately 30,000 acre-feet of water from the TS Ranch Reservoir could be used for irrigation.

Approximately 50 percent of the water applied to the irrigated areas would percolate downward to the regional groundwater system, creating a mound or area of increased groundwater elevation. This water, withdrawn during dewatering operations, would be returned to the groundwater system where evaporative losses would be greatly reduced.

Impacts to Lower Boulder Valley. During most years, irrigation uses by the TS Ranch would be able to consume the quantity of water generated by dewatering and not used for mining and milling purposes. However, it is expected that during the last year of active dewatering (2000), approximately 6,500 acre-feet of water in excess of the allowable irrigation consumption would need to be discharged to Rodeo Creek or Boulder Creek, assuming regulatory approvals can be obtained. If such regulatory approvals are not received, one or more of the water discharge alternatives discussed in Section 4.4.2.2 would need to be implemented.

The sensitivity analyses conducted using the hydrologic model indicate that operations may generate as much as 28,950 acre-feet of water per year in excess of the presently allowable use by the TS Ranch. This would increase the amount of water that might need to be discharged to Rodeo Creek or Boulder Creek, if additional irrigation systems are not developed. The surface water infiltration rate in Boulder Creek is approximately one cfs per mile (Leggette, Brashears & Graham, Inc. 1990). Given the distance to lower Boulder Valley from the TS Ranch Reservoir, approximately 15 cfs would naturally infiltrate into the alluvium beneath Boulder Creek. The confluence of Rodeo Creek with Boulder Creek is approximately 1.8 miles above the confluence of the unnamed drainage with Boulder Creek. Accordingly, any direct discharge to Rodeo Creek would be expected to have less impact on lower Boulder Valley than discharges from the TS Ranch Reservoir to Boulder Creek.

Assuming that the water in excess of agricultural consumption is released from the TS Ranch Reservoir at a constant rate, a volume of 6,500 acre-feet for the Proposed Action would generate a continuous flow of about 9 cfs. Where flow occupies the channel on a relatively continuous basis, there would likely be increased bank erosion over that occurring during normal spring runoff. Therefore, it is likely that all of this flow would infiltrate into the Boulder Valley alluvium before reaching lower Boulder Valley. The maximum possible water excess of 28,950 acre-feet could generate a continuous discharge of about 40 cfs which could likely reach Rock Creek and perhaps the Humboldt River despite additional losses due to evaporation and infiltration. Under the worst-case scenario depicted by the sensitivity analyses, flow would potentially reach the Humboldt River only during the final year of mining. The flow rate and duration of surface water reaching the Humboldt cannot be accurately quantified at present due to significant evapotranspiration in lower Boulder Valley (Leggette, Brashears & Graham, Inc. 1990).

#### 4.4.2.2 Alternatives

Water Disposal Methods. This section discusses dewatering discharge alternatives to the Proposed Action of discharge to the TS Ranch Reservoir to satisfy irrigation needs in the lower Boulder Valley, and impacts associated with the alternatives. Potential discharge alternatives include:

- the use of infiltration areas
- reinjection using groundwater injection wells
- direct discharge to Rodeo Creek or Boulder Creek

There are no alternatives to the proposed mine dewatering program because the dewatering operations and the associated groundwater elevation depression are essential to mine the Betze deposit. Without the dewatering operations, the project could not proceed. The No Action alternative is discussed in Section 4.4.2.4.

Infiltration. Infiltration areas would consist of bermed fields which would be graded and ripped, as necessary, to allow the maximum percolation of water. Water would be applied to the fields with subsequent percolation of the water into subsurface soils. Because of the water percolation rates, evapotranspiration losses for this alternative would be somewhat lower than for the Proposed Action. Infiltration would cause localized increases in groundwater elevations beneath the areas utilized for infiltration. Also, the need for excess discharges to Rodeo Creek or Boulder Creek would be reduced or eliminated since the infiltration areas could be designed to handle the larger potential dewatering flows. The use of dewatering water for irrigation in lower Boulder Valley would be reduced or eliminated by this alternative.

Reinjection. This alternative would involve the use of a series of wells to return the water extracted during dewatering operations to the groundwater system. Water would be pumped to the wells where it would be injected into subsurface geologic units. The wells would be placed so that the reinjection activity would not interfere with the dewatering operation. Because the water would be returned to the aquifer at depth, evapotranspiration losses for this alternative would be less than for any of the other alternatives. Reinjection would result in localized increases in groundwater elevations. The need for excess discharges to Rodeo Creek or Boulder Creek would be reduced or eliminated because the reinjection system could be designed to handle the larger potential dewatering flows. This alternative would reduce or eliminate the use of dewatering water for irrigation in lower Boulder Valley.

Discharge to Creeks. This alternative would involve the direct discharge of water from dewatering operations to Rodeo or Boulder Creeks. Discharge would be placed at a location or locations where infiltration and groundwater recharge would not substantially interfere with the dewatering operations. This alternative could cause streambank and channel erosion and sedimentation impacts, particularly during spring flood events. A portion of the discharge flow would be lost due to evapotranspiration. It is likely that most of the water would infiltrate into the stream bed and recharge the groundwater system. The use of dewatering water for the irrigation of lower Boulder Valley would be reduced or eliminated unless surface diversions were constructed.

4.4.2.3 Cumulative Impacts. Although the Betze Project would be located in an area in which there exist several operating mines and developable mineral deposits, the Newmont Genesis Mine, located about 2 miles south of the Post Pit, is currently the only other mine in the immediate area which will definitely be dewatered during the Proposed Action. Dewatering at the Genesis Pit is expected to reach approximately 2,800 gpm by 1995 (see Section 3.12.3.3). It is foreseeable that Newmont could develop the Bootstrap/Capstone deposit during the life of the Betze Project. This development would most likely require dewatering beginning during the second year of mining, although dewatering volumes are not presently available (see Section 3.12.3.3). Other mining operations within the project area are not expected to require dewatering according to present projections. During active dewatering at the Betze Pit, the additional dewatering operations at the Genesis Mine, and perhaps at the Bootstrap/Capstone deposit, should not greatly increase the extent of the cone of depression because of the large quantities of water to be pumped from the Betze Pit in relationship to the much smaller volumes at the other areas. Therefore, the cumulative impacts from dewatering activities at the Betze Pit and other mine operations should be similar to those for the Proposed Action. To simulate the effect of dewatering at other mines in the vicinity of the Betze Pit following completion of mining at the Betze Pit, an additional 6 years of dewatering was analyzed by modeling. The results of this model run are described in Section 4.4.3.3.

Beyond the simulated effects of extended dewatering described in Section 4.4.3.3, it is difficult to quantitatively project future dewatering impacts in a meaningful way. Additional dewatering impacts also would be expected from the development of any of the deep deposits described in Section 3.12.3.3. It appears that eventual development of some of the deep deposits is foreseeable. However, such development is not presently proposed and the fact, order, timing, character, and duration of such development remains extremely speculative. If such deposits are eventually developed, dewatering would be required and would delay or interrupt the recovery of the groundwater aquifer and potentially expand the area affected by dewatering activities beyond that of the Proposed Action.

4.4.2.4 No Action Alternative. Under the No Action alternative, Barrick would continue to mine the Post Pit to the extent authorized by existing approvals. During mining, existing dewatering operations would be continued. At the conclusion of mining in 1991 or 1992, Barrick would have to determine whether to extend dewatering operations as necessary to preserve the structural integrity of the Post Pit. That determination would presumably be based on an evaluation of the likelihood that the Betze deposit would ever be developed and whether the Deep Post deposit could be developed by surface mining methods. In any event, existing water quantity impacts associated with dewatering of the Post Pit would continue, either for the period of mining or some indeterminate period thereafter. Projected impacts from the expansion of dewatering attendant to the Proposed Action would not occur. When dewatering of the Post Pit terminated, the pit would begin to fill with water, ultimately reaching the 5,300 foot level. The quantity of water produced by continued dewatering to maintain the structural integrity of the Post Pit would be less than for the Proposed Action. The volume of water in the water body that would form in the Post Pit once dewatering was terminated would be less than that of the proposed Betze Pit.

Implementing the No Action alternative would, in the absence of other large dewatering activity, mean the reduction of, or the earlier termination of discharges to the TS Ranch Reservoir. There would likely be a continuation of irrigation in lower Boulder Valley, with existing and, perhaps, new wells; however, the expansion of the acreage irrigated may be less than the expansion as a result of the Proposed Action.

Implementing the No Action alternative would probably mean the irrigation demand in lower Boulder Valley would not be exceeded by the dewatering rates. Thus, the likelihood of disposal of excess water by infiltration, reinjection, or discharge to Rodeo or Boulder Creeks would be reduced.

4.4.2.5 Mitigation. Mitigation incorporated into the Proposed Action includes the use of riprapped channels and check-dams in the unnamed drainage to minimize channel and sidebank erosion impacts. The continual monitoring of groundwater levels would allow the State Engineer's Office to assess the impacts of the dewatering operations on other water users. Barrick would be required to mitigate any substantial impacts caused by dewatering of the Betze Pit.

Additional mitigation measures that could be implemented include: 1) monitoring of seeps, springs and creeks during the operations period to determine if significant flow losses have occurred; and 2) flow replenishment at the original location, if necessary and if regulatory approval could be obtained. Replacement of lost spring or stream water sources and associated wildlife habitat could be provided at off-site locations, if required, pending any required regulatory approval.

Barrick has indicated its agreement in principal to implement off-site compensation, such as the creation of new water sources and wetlands or riparian habitat, in those instances where impacts on streams, springs, and seeps would not be able to be avoided and on-site minimization would not be sufficient to adequately offset adverse impacts or habitat losses. Such off-site compensation could be imposed as a condition of Barrick's Plan of Operations and may include the acquisition or construction of new riparian areas in the general vicinity of any such areas as are impacted by the Proposed Action to offset such impacts. Specific sites for any off-site replacement habitat have not been identified, but would be selected from lands located as near as practicable to the affected area, to assure the greatest degree of success and to avoid a net loss of riparian vegetation and adverse impacts to dependent wildlife species.

If mitigation involves off-site compensation, BLM may also require a monitoring program designed to confirm the effectivess of any mitigation that would be selected and implemented.

### 4.4.3 Impacts During Recovery

After termination of pumping for dewatering at the end of mining in 2000, the Betze Pit would begin to fill with water and the areal extent of the water table drawdown would expand. As the pit fills, it would act as a large well; water recharge to the pit would primarily come from water storage within the hydrographic basin. The modeling predicts that the lateral extent of the cone of depression over most of the area would continue to expand until the year 2030, reaching beyond the hydrographic basin only in the Tuscarora Mountains.

#### 4.4.3.1 Proposed Action

Impacts to Hydrologic System. Hydrologic system effects during recovery include:

- Continued depression of groundwater elevations.
- Reduced evapotranspiration due to depressed groundwater elevations.
- Increased groundwater recharge from creeks, seeps, and springs.
- Storage of water in the Betze Pit.
- Groundwater elevation rebound due to increases in groundwater storage.

During the recovery period, the years 2000 to 2100, substantial amounts of water (370,000 AF) would be directed towards the replenishment of groundwater storage that was depleted during dewatering and the subsequent filling of the Betze Pit. This water would be derived from groundwater recharge, induced stream flow depletion, and reduced evapotranspiration losses. Nearly 90 percent of the water would be derived from induced streamflow depletion with the remainder coming primarily from reduced evapotranspiration losses.

The only loss of water from the Boulder Valley system caused by a project-related mechanism during recovery would be the evaporative loss of water from the Betze Pit. This water loss is estimated to be 710 AFY.

The water balance at the downstream boundary of Boulder Valley would be essentially unaffected during the groundwater recovery period. During the period of recovery, water would not be discharged from the TS Ranch Reservoir into Boulder Creek or from dewatering operations to Rodeo Creek because dewatering and irrigation would cease at the end of mining in the year 2000. Natural flows through Boulder Creek to the Humboldt River occur primarily during spring runoff events. The induced streamflow depletion during recovery would not substantially affect flowrates during such events. During the remainder of the year, flows in Boulder Creek would be attenuated by evaporation and groundwater recharge such that no flow would enter the Humboldt River. The current condition would be unchanged during the recovery period. In addition, there may be a minor reduction in groundwater flow of less than 10 AFY out of Boulder Valley due to a reduction in the groundwater gradient in Boulder Flats.

Impacts to hydrologic features in Boulder Valley that may be affected during the dewatering recovery period are discussed below.

Impacts on Wells. During recovery of groundwater elevations, the drawdown at Newmont's existing water supply wells due to dewatering would remain about the same as the drawdown at the shutdown of dewatering, or about 100 feet. By the year 2100, the drawdown at these wells caused by dewatering would be less than 10 feet. Drawdown at the AA Well would increase to about 100 feet in the year 2030, and recover to about 30 feet in the year 2100. The drawdown may have an impact on the production of water from this well, but the well is owned and operated by Barrick. Otherwise there would not be additional impacts to wells during recovery of the groundwater elevations.

The lateral extent of the 10-foot drawdown contour would expand up to the year 2030 and then would start to contract according to model predictions (see Figure 4-8). The increase in lateral extent would encompass additional wells and surface water diversions (Table 4-9). There are two surface water irrigation diversions located along Boulder Creek downstream of the TS Ranch Reservoir. These diversions should not be impacted because Boulder Creek is ephemeral in this area. Three stock watering wells and one well used for mining and milling would be included in the projected 10-foot drawdown contour. The mining and milling well would not be affected by a 10-foot drawdown due to the well's depth. The stock watering wells would be impacted by a drawdown of 10 feet or more, because of the shallow depth of the wells. This would slightly increase pumping costs and may result in reduced flow from the wells, depending on the depth at which pumping occurs.

Impacts to Seeps and Springs. By the year 2030, the cone of depression predicted by the groundwater model shows 111 of the 131 identified seeps and springs encompassed within the 10-foot drawdown contour. Portions of the Boulder Creek and Maggie Creek

TABLE 4-9

ADDITIONAL WATER RIGHTS IMPACTED IN THE YEAR 2030
BY DEWATERING DRAWDOWN OF 10 FEET OR GREATER

| | | | POINT OF DIVERSION | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AT | CERT # | SRC | Q | Q | SEC | TWP | RNG | DIV RATE CFS | TYPE OF USE | ACRES IRR | ANNUAL DUTY | OWNER OF RECORD |
| R | 11162 | STR | NE | NE | 8 | 35N | 49E | 0.128 | IRR | 120.57 | 53.00 AFS | FOX |
| R | 11163 | STR | SE | SW | 8 | 35N | 49E | 1.286 | IRR | 144.25 | 139.44 AFS | FOX |
| R | 11919 | UG | SE | NW | 2 | 34N | 49E | 0.009 | STK | | 6.51 AFS | ELKO LAND & LIVESTOCK |
| R | 11928 | UG | SE | NE | 19 | 35N | 49E | 0.009 | STK | | 6.51 AFS | ELKO LAND & LIVESTOCK |
| R | 11938 | UG | NE | NW | 28 | 33N | 47E | 0.013 | STK | | 9.42 AFS | ELKO LAND & LIVESTOCK |

headwaters would be included within the reach of the 10-foot drawdown contour.

The exact number of acres of riparian/aquatic area that may be affected by drawdown of the groundwater table is difficult to determine with accuracy due to the uncertainties regarding perched water tables and aquifer interconnectedness. Nonetheless, based on the estimate of the total acreage of riparian/aquatic areas associated with the springs and seeps within the drawdown contours projected by the modeling, approximately 271 acres of riparian/aquatic area could be affected by the drawdown of the groundwater table during the recovery period.

Sufficient detailed information on local geologic conditions is not available which could establish whether hydraulic connection exists between springs and the regional aquifer system. If the springs and seeps are hydraulically connected to the regional groundwater system and the groundwater model accurately predicts the drawdown that would be caused by mine dewatering in the mountainous areas, then most of the springs and seeps in the Tuscarora Mountains would experience reduced flows or dry up. Those existing in the northern part of upper Boulder Creek basin likely would not dry up. Some of the springs and seeps may be isolated from the regional aquifer system by local geologic features such as faults and/or low permeability zones and may not be affected by drawdown of the groundwater table. The groundwater model represents only the general variation in groundwater flow and aquifer permeability that may exist within the modeled area and, therefore, would not predict effects due to local variation in geology or structure. Springs and seeps between the 30- and 10-foot drawdown contours in the higher mountains may dry up during drought periods and then regain flow during wetter periods. Therefore, the exact number of springs and seeps that would actually dry up would vary with climatic conditions and local geology. However, it is assumed herein that the springs and seeps encompassed by the 10-foot drawdown contour would experience reduced flows or dry up.

The model predicts recovery of the hydrologic system and a continued reduction in the lateral extent of the cone of depression. However, in year 2100, 84 seeps and springs would still be within the projected 10-foot drawdown contour and, thus, may be dry or would have reduced flow rates. Because the cone of depression would continue to expand for a short period after the end of dewatering pumping, most of the seeps and springs which would be affected would be impacted during the initial recovery time in the higher elevations of the Tuscarora Mountains. These seeps and springs would regain flow sooner than those at lower elevations. Seeps and springs at lower elevations within the creek bottoms would have reduced flows or would dry up early in the dewatering process and would not regain flow until relatively late during the recovery period.

The exact number of acres of riparian/aquatic area that may be affected by the drawdown of groundwater table is difficult to determine with accuracy due to the uncertainties regarding perched water tables and aquifer interconnectedness. Nonetheless, based on the estimate of the total acreage of riparian/aquatic areas associated with the springs and seeps within the drawdown contours projected by the modeling, approximately 159 acres of riparian/aquatic area could be affected by the drawdown of the groundwater table during the recovery period.

Riparian/aquatic areas are essential to maintaining biodiversity and healthy wildlife populations in arid regions, such as Nevada. To the extent that the drawdown of the groundwater table adversely affects such areas, the riparian/aquatic habitat, as well as the wildlife that uses the habitat, would be adversely affected.

Impacts to Creeks. Drawdown within the granodiorite (see Section 3.4.1.2) would continue after the termination of dewatering; it is predicted that drawdown would reach about 100 feet by the year 2030. This would bring the groundwater elevation in the granodiorite to approximately the elevation of Rodeo Creek in the vicinity of monitoring station RC-A (see Figure 3-4), making it likely that groundwater discharge to the creek would be reduced or perhaps cease. Therefore, it is probable that the flow in Rodeo Creek in this area would be reduced or would dry up for a period of time. The flow may become intermittent, with flow occurring only in response to spring snow melt and precipitation events.

As modeled, drawdown beneath the lowermost reaches of Brush Creek would be greater than 100 feet in the year 2030; drawdown would be 10 to 30 feet in the headwaters at the same time. Thus Brush Creek would remain ephemeral throughout its length during most of the recovery period, but may begin to recover perennial flow conditions in its lowermost reaches by the year 2100.

Bell Creek would likewise remain ephemeral throughout its length during the recovery period. By the year 2100, the groundwater elevation recovery would probably cause the perennial pools to be reestablished in the lower reaches of Bell Creek.

Flow from some of the seeps and springs within the Boulder Creek headwaters would be reduced as the proposed Betze Pit refills with groundwater. The lower reach of the perennial section of Boulder Creek may dry up, but some portion of the upper basin would maintain perennial flow unimpacted by dewatering. As recovery would continue toward the year 2100, the reduction of flow of the seeps and springs in the headwater areas would eventually be eliminated, and perennial flow would be reestablished in the creek.

Impacts to Betze Pit. The floor of the Betze Pit would be at an elevation of 4,140 feet, which is 1,160 feet below the original water table elevation of approximately 5,300 feet. After the cessation of dewatering operations, the Betze Pit would begin to fill with water relatively rapidly; the water level in the pit within the first 5 years of recovery would be at about the 4,440-foot elevation, which would result in approximately 300 feet of water in the Betze Pit (Figure 4-9). Within 20 years, the water level would recover to approximately the 4,800-foot elevation. Water would continue to flow from the hydrographic basin into the Betze Pit at a progressively slower rate as the elevation differential between the water elevation in the pit and the elevation of the surrounding water table decreases. The model projects that the water table elevation within the Betze Pit would recover to within 45 feet of the original pre-dewatering water table within 100 years; thereafter, the water table in the pit would eventually reach equilibrium and would be reestablished at the pre-mining water elevation of approximately 5,300 feet.

Impacts to the Unnamed Drainage, Reservoir, and Irrigation Areas. Upon the cessation of mining within the Betze Pit, dewatering would be reduced to the amount necessary to supply the milling and reclamation operations, and discharge of water down the unnamed drainage would no longer be necessary. Therefore, the reservoir would dry up and irrigation use of water from dewatering would cease. It is not known how many acres, if any, would continue to be irrigated from wells at the irrigation areas. During the very early stages of recovery, the water saturating the ground beneath each of these areas would continue to percolate to the groundwater until pre-dewatering conditions were re-established. The dead storage within the reservoir, approximately 500 acre-feet, would evaporate and seep into the ground. A groundwater mound under the reservoir would be maintained for a short time. The groundwater mound at the irrigated areas would likewise dissipate within the first 20 or 30 years of recovery, depending on the extent to which acreage in that area continues to be irrigated. Other than percolation of residual saturation to the groundwater system, impacts to these areas would be eliminated during hydrologic recovery.

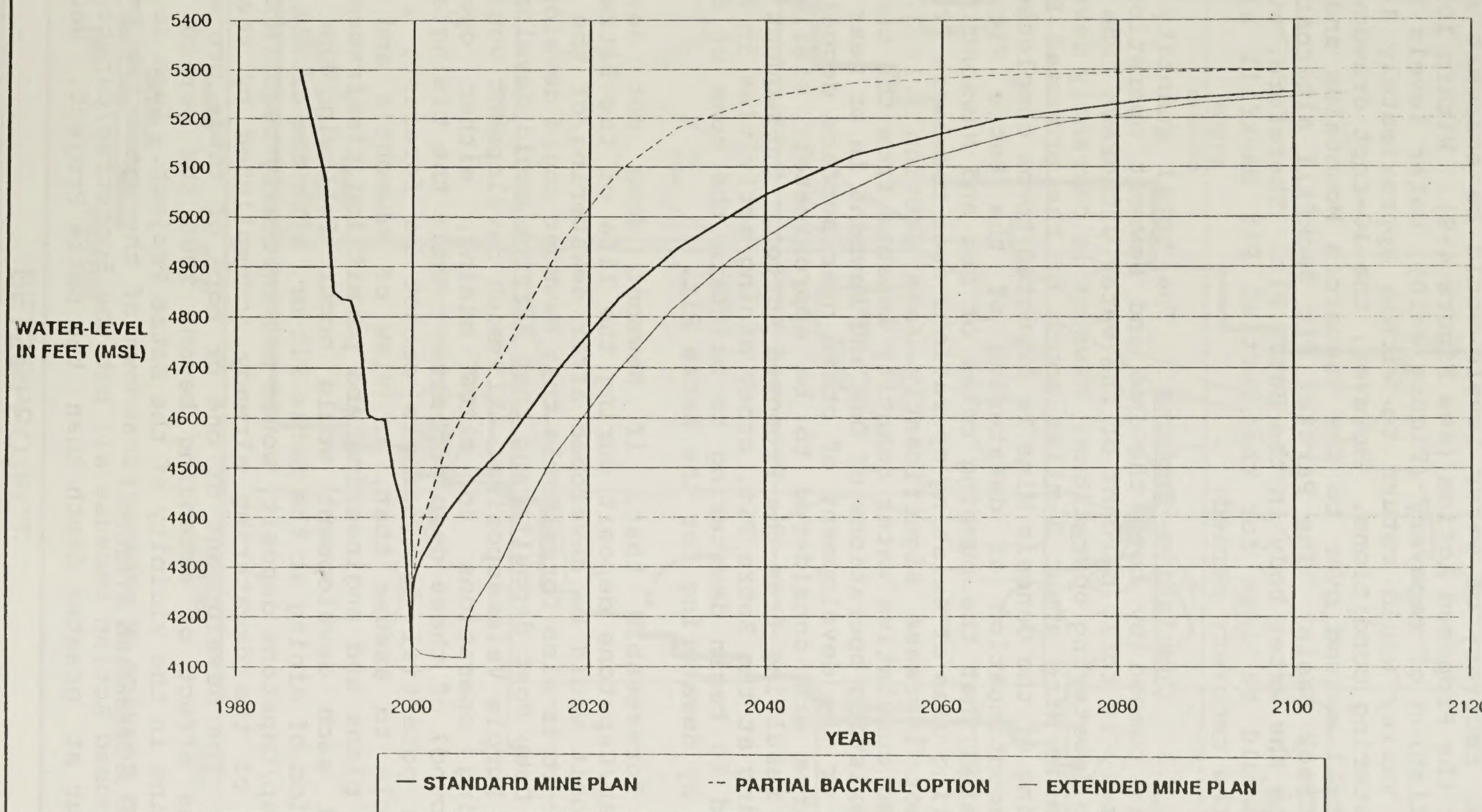
Impacts to Lower Boulder Valley. After mining of the Betze Pit, there would be no discharge of water from dewatering wells down the unnamed drainage. Therefore, there would be no discharge of water to Boulder Creek from the reservoir, and there would be no impact to the creek.

4.4.3.2 Alternatives

Partial Pit Backfill. The only alternative that would have significant impact during the recovery period is the Partial Pit Backfill alternative. This alternative would involve the placement of waste rock back into the Betze Pit after completion of mining activities. This may delay the beginning of the recovery period if continued dewatering, in excess of the pumping necessary to supply the milling operations, is required to keep the pit dry while waste

BARRICK GOLDSTRIKE MINES, INC.

FIGURE 22 - PROJECTED WATER LEVELS IN THE CENTER OF BETZE PIT FOR THE BETZE MINE PLAN AND TWO ALTERNATIVE DEWATERING PLANS, 1990-2100



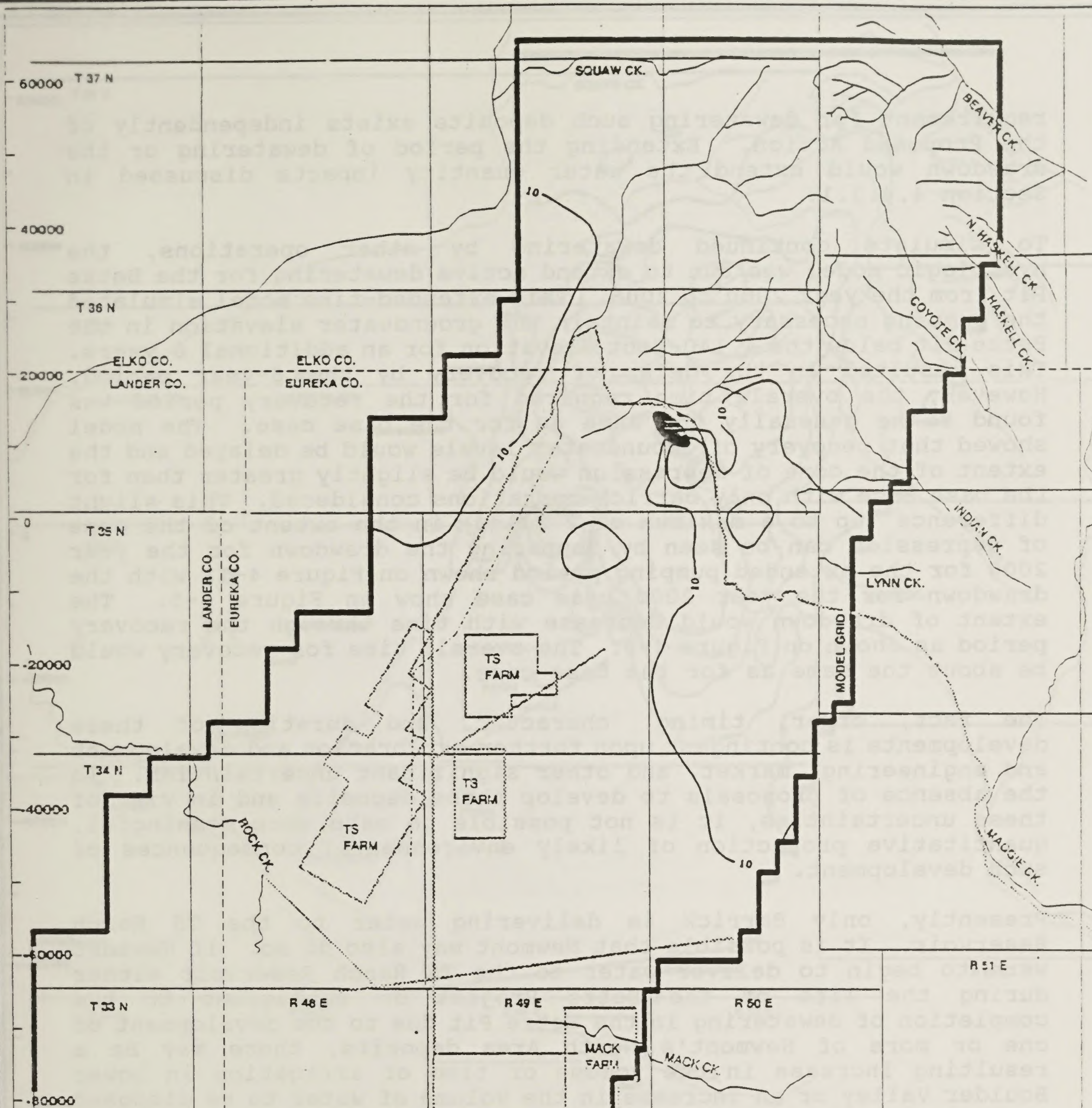

LEGGETTE, BRASHEARS & GRAHAM, INC.

BETZE PROJECT

Figure 4–9. Projected Water Levels in the Betze Pit for Standard Mine Plan and Two Alternatives, 1990-2100 (Leggette, Brashears, and Graham, Inc. 1990) rock is returned to the pit. Subsequent to replacement of backfill material, recovery of water levels would be somewhat more rapid than for the Proposed Action (see Figure 4-9). Within 100 years of the initiation of recovery (Figure 4-10), water levels throughout Boulder Valley would return to within approximately 10 feet of pre-dewatering conditions. However, the 10-foot drawdown contour would still extend over to the Tuscarora Mountains and into the Maggie Creek Basin. The Partial Pit Backfill alternative would eliminate the water body in the Betze Pit. Therefore, evaporative losses would be less for the Partial Pit Backfill alternative during the recovery period.

4.4.3.3 Cumulative Impacts. The total quantity of water currently pumped by both the Dee and Newmont operations is approximately 10 to 20 percent of the water withdrawn from Barrick's existing dewatering operations. Newmont is currently dewatering at the Genesis Mine about 2 miles south of the proposed Betze Pit. Dewatering of the Genesis Mine is expected to be completed prior to the discontinuation of dewatering of the Betze Pit. It is anticipated that the pumping rates of Dee and Newmont for mining and milling uses at existing operations near the Betze Project area would not increase significantly (see Section 3.12.3.3). The projected cumulative water quantity impacts from the continuation of the existing operations of Dee and Newmont in or near the Betze Project or the development of other near surface deposits in the North Area are considered to be approximately similar to the impacts resulting from the Proposed Action. Subsequent to active dewatering at the Betze Pit, other mining activities in the region may need to begin dewatering to maintain the cone of depression created by dewatering for the Betze Pit.

It is foreseeable that, if Newmont does not develop the Bootstrap/Capstone deposit during the life of the Betze Project, the deposit would be developed after dewatering of the Betze Pit ceases. It is also foreseeable that Newmont could develop the Deep Star or Deep Post deposits and that Barrick could develop the Deep Post or Purple Vein deposits. All such development would require dewatering operations to allow mining, either open-pit or underground, of these deep deposits. While the timing and nature of such potential developments cannot be forecast, it appears reasonable to assume that, in view of Newmont's and Barrick's present plans and engineering and permitting timeframes, much if not all such development would occur following the projected conclusion of mining at the Betze Pit or, with the exception of the Bootstrap/Capstone deposit, would not initially require dewatering because of the dewatering already accomplished by the Proposed Action. The development of one or more of these projects would have the effect of extending beyond 2000 the period of active dewatering in the vicinity of the Betze Project. Such developments may also require a greater drawdown of the water table than does the Proposed Action because all but the Bootstrap/Capstone deposit may occur at greater depth than the Betze Project. However, the




BETZE PROJECT

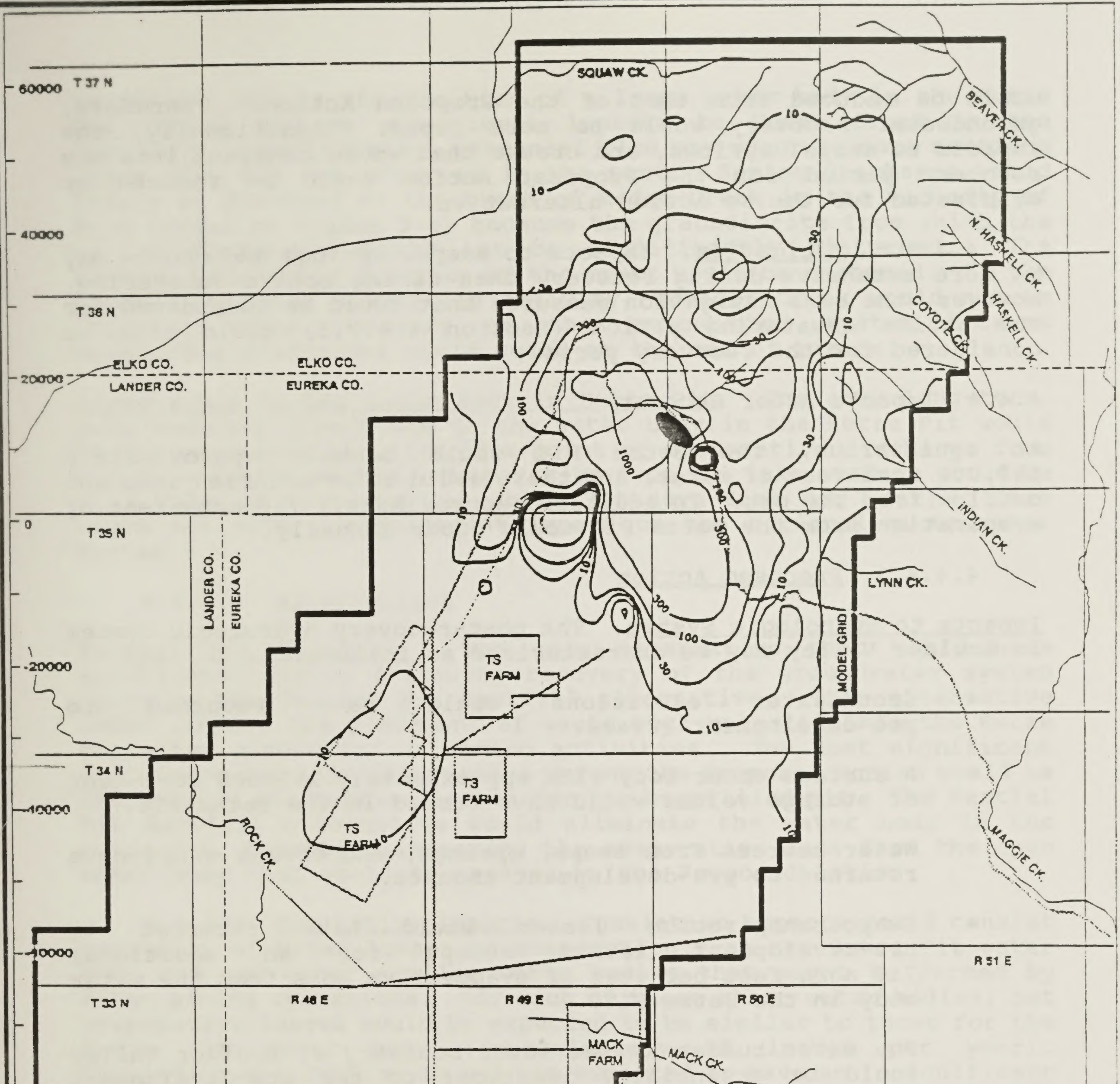
Figure 4-10. Projected Drawdown Contours for the Year 2100, Betze Pit Partial Backfill Alternative (Leggette, Brashears, and Graham, Inc. 1990) requirement for dewatering such deposits exists independently of the Proposed Action. Extending the period of dewatering or the drawdown would extend the water quantity impacts discussed in Section 4.4.3.1.

To simulate continued dewatering by other operations, the hydrologic model was run to extend active dewatering for the Betze Pit from the year 2000 to 2006. This extended-time model simulated the pumping necessary to maintain the groundwater elevation in the Betze Pit below the 4,140-foot elevation for an additional 6 years. This resulted in the delay of recovery by the 6-year period. However, the overall time required for the recovery period was found to be generally the same as for the base case. The model showed that recovery of groundwater levels would be delayed and the extent of the cone of depression would be slightly greater than for the base case with only Barrick operations considered. This slight difference (up to a maximum of 2 miles) in the extent of the cone of depression can be seen by comparing the drawdown for the year 2006 for the extended pumping period shown on Figure 4-11 with the drawdown for the year 2000 base case show on Figure 4-5. The extent of drawdown would decrease with time through the recovery period as shown on Figure 4-9. The overall time for recovery would be about the same as for the base case.

The fact, order, timing, character, and duration of these developments is contingent upon further exploration and development and engineering, market, and other significant uncertainties. In the absence of proposals to develop these deposits and in view of these uncertainties, it is not possible to make more meaningful, quantitative projection of likely environmental consequences of such development.

Presently, only Barrick is delivering water to the TS Ranch Reservoir. It is possible that Newmont may also do so. If Newmont were to begin to deliver water to the TS Ranch Reservoir either during the life of the Betze Project or subsequent to the completion of dewatering in the Betze Pit due to the development of one or more of Newmont's North Area deposits, there may be a resulting increase in the volume or time of irrigation in lower Boulder Valley or an increase in the volume of water to be disposed of by infiltration, reinjection or discharge to Rodeo or Boulder Creeks. Without additional information on the timing or quantity of water that would be produced by such additional developments by Newmont, it is not possible to make meaningful projections of potential cumulative water quantity impacts from either increased dewatering activities or the continuation of other dewatering operations past the time-frame contemplated in the Proposed Action.

4.4.3.4 No Action Alternative. The No Action alternative would involve the conclusion of mining activities in one or two years as ore deposits in the Post Pit are exhausted. The groundwater drawdown associated with the No Action alternative




BETZE PROJECT

**Figure 4-11. Projected Drawdown Contours for the Year 2006, Betze Pit Extended Dewatering (Leggette, Brashears, and Graham, Inc. 1990)**

would be reduced from that of the Proposed Action. Therefore, groundwater recovery would be more rapid. Additionally, the impacts to seeps, springs, and creeks that would continue into the recovery period for the Proposed Action would be reduced or eliminated for the No Action alternative.

4.4.3.5 Mitigation. Impacts to seeps, springs and creeks may be more extensive during recovery than during active dewatering. However, the same mitigation measures that could be considered for the active dewatering period (Section 4.4.2.5) could also be considered for the recovery period.

4.4.4 Impacts After Recovery

At equilibrium, the Betze Pit would contain approximately 197,000 acre-feet of water, and there would be both inflow into and outflow from the pit. In addition, approximately 710 acre-feet of evaporation from the Betze Pit would occur annually.

4.4.4.1 Proposed Action

Impacts to Hydrologic System. The post-recovery hydrologic system in Boulder Valley may be characterized as follows:

- Groundwater elevations would have returned to pre-development levels.
- A surface water body with approximately 197,000 acre-feet of storage volume would have formed in the Betze Pit.
- Water sources from seeps, springs, and creeks would have returned to pre-development amounts.
- Evapotranspiration losses would have returned to pre-development levels except for an additional 710 acre-feet per year of evaporative loss from the water body in the Betze Pit.
- The water budget at the lower boundary of Boulder Valley would be essentially identical to the pre-development budget.

Therefore, the only difference between the pre and post-development hydrologic systems in Boulder Valley would be the existence of a water body in the Betze Pit, which would result in a slight increase in evaporative losses from the system.

Impacts to Wells, Seeps, Springs, and Creeks. After recovery of the groundwater elevations, the hydrologic system within Boulder Creek and Rodeo Creek would return to pre-mining conditions. Therefore, impacts to wells, seeps, springs, and creeks would be eliminated and flow would be completely restored to all of these features. Due to the creation of a large water body in the Betze Pit, there may be some local impacts to Rodeo Creek in the long-term. Specifically, perennial flow may occur in some sections where flow has not occurred in the past. Spring discharge would likely be restored at the reach of Rodeo Creek in the vicinity of RC-A (refer to Figure 3-4) because the granodiorite from which the spring discharges would not be significantly disturbed. The overall hydrologic function of the creek would be restored. In the absence of other dewatering activity, Boulder Creek would not be impacted after recovery of the groundwater system because dewatering discharges would cease at the end of mining.

Impacts Due to the Water Body in Betze Pit. The only long-term, post-recovery impact due to the water body in the Betze Pit would be the permanent addition of a point of evaporative discharge from the groundwater system. Evaporation from the lake surface would be at a rate of 0.98 cfs (or about 710 acre-feet per year). This would not have a significant impact on the regional groundwater system.

4.4.4.2 Alternatives

Partial Pit Backfill. The only alternative that would have significant impact following recovery of the groundwater system would be the Partial Pit Backfill alternative. This alternative would involve the placement of waste rock material into the Betze Pit after completion of mining activities. The most significant difference for this alternative versus the Proposed Action would be the reduced evaporative losses for the backfilled pit. The Partial Pit Backfill alternative would eliminate the water body in the Betze Pit, thereby eliminating the evaporative loss from the open water body that would be created by the Proposed Action.

4.4.4.3 Cumulative Impacts. Cumulative impacts would consist primarily of water losses to evaporation from the Betze Pit water body and any other similar water bodies that might be formed by other mining operations. For each of these other water bodies, net evaporative losses would be expected to be similar to those for the Betze Pit water body (approximately 30 inches per year). Cumulative evaporation losses are expected to have an insignificant effect on the water resources of Boulder Valley.

4.4.4.4 No Action Alternative. The No Action alternative would involve the conclusion of mining activities in one or two years as ore deposits in the Post Pit are exhausted. Long-term hydrological impacts of the No Action alternative would be the formation of a water body that would be smaller in size, with slightly smaller evaporative losses, than for the Proposed Action. Generally, the overall long-term hydrological impacts of the Proposed Action and the No Action alternative are similar.

4.4.4.5 Mitigation. The Proposed Action is not anticipated to have any permanent impacts on the groundwater system and, therefore, no mitigative measures would be necessary.

### 4.4.5 Impacts to Surface Water Hydrology

4.4.5.1 Proposed Action. The Proposed Action includes the disturbance of land in ephemeral drainage basins within the project area which are tributary to Rodeo Creek. Runoff generally occurs in response to snow melt and intense summer rainfall, and the contribution of the ephemeral drainages to total runoff in the project area is negligible (see Sections 3.4.1.1 to 3.4.1.3). Disturbances that would impact the surface water hydrology are the Betze Pit, the waste rock disposal areas, the ore stockpiles, the heap leach facility, and the tailings impoundment. Impacts to surface water quality would be related to activities at project facilities and are discussed in Section 4.4.11.

Waste Rock Disposal Areas. The proposed Extended South waste rock disposal area would cover all or portions of drainage basins SB-1, SB-2, SB-3, SB-4, SB-5, and SB-6 within the South Block (see Figure 3-4). These areas would be reclaimed with topsoil and revegetated such that their hydrologic response would be similar to existing conditions. As contouring of the waste rock disposal areas would be conducted such that existing drainage divides would not be significantly altered, the flow volumes in the natural drainage channels would be expected to be similar to existing conditions. Therefore, it is anticipated that the reclaimed waste rock disposal areas would not significantly impact the runoff from ephemeral drainages in the project area.

During mining, the waste rock disposal areas would not be covered with topsoil while the areas are actively expanded. It is likely that the coarse waste rock would allow more precipitation to infiltrate into the subsurface than under reclaimed conditions. Therefore, runoff would be decreased from these areas. This is supported by field observations of a relative lack of rilling or other surface erosion features on existing, unreclaimed waste rock slopes which would indicate that runoff is not actively occurring. Therefore, it is expected that a moderate decrease in runoff would occur during mining.

Ore Stockpiles. The Proposed Action includes two locations for the stockpiling of ore for batch processing of oxide ore through the mill or for milling after completion of mining. One site is located on the panhandle of the AA Block and the other is located on the south-central side of the North Block (see Section 2.3.1.2, Figure 2-11). The sites would be cleared and compacted prior to placement of ore. A berm would be constructed around each stockpile to contain runoff from the stockpiles. Runoff from the small drainage areas above the two stockpiles would be diverted around the sites by the berm. The southeast corner of the North

Block stockpile would be close to the channel of Brush Creek. Precautions would be taken at this stockpile site to ensure that surface runoff from the ore does not reach the creek, and that the creek does not encroach upon the stockpile or enclosing berms.

The ore stockpiles would remove a small area (total of 140 acres) from drainage to Rodeo Creek. This would not be a significant reduction in drainage area and would not result in a significant change in runoff. These areas would be reclaimed after milling operations cease, and the drainage would be reestablished.

Tailings Impoundment. The proposed tailings impoundment would be constructed within the North Block and would intercept most of the runoff from basins NB-2A and NB-2B (see Figure 3-4). A spring in the upstream portions of basin NB-2A may contribute some surface flow above the tailings impoundment for some portion of the year. This spring would likely dry up during mining and dewatering (before the year 2000) and would regain flow later in the recovery period. The tailings impoundment would permanently remove 476 acres from the drainage basin that contributes surface runoff to Brush Creek.

The tailings impoundment design includes a series of diversion ditches that would be constructed to intercept natural runoff and spring discharge from the drainage area above the tailings impoundment and divert it into an adjacent drainage. The diversion ditches would be sized to convey the 100-year, 24-hour flood discharge as required by the NDEP. Accelerated erosion may occur along steeper portions of the diversion ditches and at points of discharge into natural drainages. These sites would be protected from erosion with properly sized riprap placed in accordance with accepted engineering practice.

The introduction of diverted flow from the drainage area above the tailings impoundment into adjacent natural drainages would increase the drainage area to the receiving stream channel. The drainage area above the tailings impoundment (72 acres) is small compared to the drainage area of the receiving stream (Brush Creek, 3,787 acres). Therefore, the impact of upstream flow diversion would not be significant. Riprap channel-bed and bank protection would be placed where accelerated erosion is observed in receiving streams.

Heap Leach Facility. The proposed heap leach facility would be constructed within the North Block and would temporarily remove 142 acres from the drainage basin that contributes surface runoff to Brush Creek. The heap leach facility design includes a series of diversion ditches to intercept natural runoff and spring discharge from the drainage area above the heap leach facility and divert it into an adjacent drainage. The diversion ditches would be sized to convey the 100-year, 24-hour flood discharge as required by the NDEP. Accelerated erosion may occur along steeper portions of the diversion ditches and at points of discharge into natural drainages. These sites would be protected from erosion with properly sized riprap placed in accordance with accepted engineering practice.

The Betze Pit would create an area of internal drainage that would no longer contribute flow to Rodeo Creek. The total area of internal pit drainage would be 690 acres. This area is small relative to the 23,300 acre drainage area of Rodeo Creek. Therefore, surface water impacts to Rodeo Creek from the Betze Pit would not be significant.

The accidental release of hazardous materials into a natural drainage channel could have detrimental impacts on the environment. The material of greatest concern is the dilute cyanide solution utilized in the heap leaching and milling processes. The heap leach pad, milling operations, and tailings impoundment would be designed and constructed for total containment of process solutions as required by the NDEP. Therefore, the impact of these facilities on surface water resources should not be significant.

#### 4.4.5.2 Alternatives

Waste Rock Disposal Areas. Three alternative locations are presented for waste rock disposal as described in Chapter 2. The North and Clydesdales waste rock disposal areas would not result in impacts which are significantly different from the Proposed Action.

The Far West area is a modification of the Proposed Action to increase the size of the waste rock disposal area by expanding onto adjacent properties. The south side of this disposal area would cover about 2 miles of the existing course of the unnamed drainage, requiring relocation of the channel. The unnamed drainage is currently utilized to convey water to the TS Ranch Reservoir. The impacts of this alternative would require the water to be piped to the TS Ranch Reservoir, or if the channel is relocated, there could be erosion and sedimentation impacts unless the streambed and banks of the relocated channel are lined with riprap or some other appropriate erosion protection.

A potential reclamation alternative considered in the EIS is to leave the slopes of the waste rock disposal areas at the angle of repose, approximately 1.3H:1V. Under this alternative, only the tops and the benches of the waste rock disposal areas would be covered with topsoil and revegetated. This would result in greater infiltration of precipitation into the waste rock and a moderate reduction in surface runoff, relative to the Proposed Action.

Ore Stockpiles. Three alternative ore stockpile locations have been proposed. One site would be located on top of the spent leach pad on the AA Block; another would be located on the waste rock disposal area on the South Block (see Chapter 2 for details and location map). In these cases, the ore stockpile would be placed on an area that is already disturbed. The stockpiles would be constructed with berms to contain runoff from the ore stockpiles and to divert runon from off-site areas.

A third site is proposed between the east side of the South Block and Rodeo Creek. There is a potential for release of runoff from the stockpile into Rodeo Creek in the event that the enclosing berm should fail. This impact would be avoided by proper sizing and construction of the runoff-collection berm around the stockpile.

Tailings Impoundment. The alternatives proposed for the tailings impoundment include an enlargement of the Proposed Action and an alternate site located just to the west of the Proposed Action impoundment within the North Block. In both cases, the alternatives would intercept a drainage area of similar magnitude to the proposed tailings impoundment and the area of impoundment would be larger. However, because the impoundment design would incorporate upstream flow diversion and containment of direct precipitation, the impacts from the alternative tailings impoundments would not differ significantly from the impacts caused by the Proposed Action.

The alternative reclamation measure for the tailings impoundment would place waste rock on the surface of the impoundment in a selective manner to create uneven hills and swales during reclamation. This alternative would reduce the flood storage capacity of the impoundment. The potential consequences due to the loss of flood storage capacity are over-topping and possible erosion of the embankment. This alternative would be technically feasible with implementation beginning only after milling had ceased and the impounded tailings had drained and consolidated to a level where structural stability was assured.

Sufficient drainage and consolidation of the tailings to support a thin layer of waste rock and 8 to 10 inches of topsoil would take approximately 2 to 5 years. It is probable that an additional 10 to 20 years would likely be required to drain and consolidate the tailings sufficiently to support the large volumes of waste rock required by this alternative. Engineering studies would be necessary to determine the geotechnical conditions that would have to be met to allow placement of the waste rock on the impoundment.

At the time waste rock could be placed over the impoundment, mining operations would have been suspended for approximately 15 to 25 years. A source of waste rock would have to be located. If the waste rock from the Proposed Action were to be used, reclamation of a portion of the waste rock disposal area would be delayed for this period of time or previously reclaimed areas would need to be disturbed. An alternate source of waste rock, such as other mining operations in the area, could be used to reclaim the tailings impoundment. The availability of such waste rock would depend on future mining activity in the area. Prior to placement of waste rock, the existing impoundment permit would have to be modified with the State Engineer and the NDEP to allow discharge of runoff, and spillways would then have to be constructed in the existing impoundment. The installation of spillways would increase the risk of erosion.

Partial Pit Backfill. An alternative to allowing the Betze Pit to fill with water is to place waste rock back into the Betze Pit to the pre-mining groundwater elevation. Since the partially backfilled pit would still drain internally, this alternative would not have an impact on surface runoff that is different from the Proposed Action.

4.4.5.3 Cumulative Impacts. The proposed Betze Project would be located in an area in which other mining and processing activities currently are being conducted and in which several minable mineral deposits are known to exist (see Section 3.12.3.3). The existing mining and processing operations include open pits, waste rock disposal areas, heap leach pads, tailings impoundments, mills and administrative facilities (see Figure 3-1). These facilities are located on land within ephemeral drainage basins that are tributary to Rodeo, Brush, Bell, and Boulder Creeks. To the extent that such development has altered flows during snow melt and intense summer rainfall, the flows to the various creeks have been affected. The Proposed Action would increase the impact on flows to Rodeo Creek incrementally.

In addition to the existing operations, it is foreseeable that Newmont would develop the Bootstrap/Capstone, Lantern, Pete, North Star, and Carlin deposits either during the life of the Betze Project or subsequent to active operations in the Betze Pit. It is also foreseeable that Newmont would develop the Deep Star, Deep Post, and Bobcat deposits, and that Barrick would develop the Deep Post and Purple Vein deposits. Development of each of these deposits would involve additional disturbance of the ephemeral drainage basins that are tributary to Rodeo, Bell, Brush and Boulder Creeks. A relatively small percentage of the disturbance would be open pits that would drain internally. In addition, the disturbance would include additional heap leach facilities or tailings impoundment expansions which would be non-discharging. The largest percentage of the disturbance would be waste rock disposal areas. The proposed additional individual disturbances from pits would be smaller than the Betze Pit, and the tailings impoundment expansions, which would be non-discharging, could be incrementally larger than the existing tailings impoundment. The reduction in drainage area to Rodeo Creek due to pits and tailings impoundments would incrementally increase the impact on surface water resources. The cumulative surface water impact of additional waste rock disposal sites would depend upon the nature of cover on the surfaces of the waste rock. If no cover is placed on the waste rock, a moderate reduction in surface runoff may result; whereas if topsoil and vegetative cover were placed on the waste rock, a hydrologic response similar to pre-mining conditions would be produced.

4.4.5.4 No Action Alternative. Under the No Action alternative, Barrick would continue to mine the Post Pit to the extent authorized by existing approvals. There would be no ore stockpiles, the waste rock disposal area would be smaller than the proposed expansion, only the existing tailings impoundment would remain after mining, and the Post Pit would be smaller than the proposed Betze Pit. The reduced area of disturbance due to the Post Pit operation would result in a decreased impact to surface runoff relative to the Proposed Action.

4.4.5.5 Mitigation. Other than the mitigation included in the Proposed Action, no mitigation of surface runoff impacts is proposed.

4.4.6 Water Quality Impacts Overview

The Proposed Action has the potential to affect both surface and groundwater quality in several ways. First, the proposed mine dewatering system may affect the quality of water sources from which water would be withdrawn or to which water would be discharged. Second, facilities that are part of the Proposed Action (e.g., waste rock disposal areas, heap leach pads, ore stockpiles) have the potential to contribute pollutants to the ground or surface waters. Finally, the quality of the water body that would be created by the Betze Project also could affect ground or surface waters.

Mine dewatering operations and subsequent discharge to the TS Ranch Reservoir and to the irrigation areas, or subject to regulatory approval to Rodeo or Boulder Creek, would potentially affect existing surface and groundwater quality. During dewatering and the initial stages of recovery, the groundwater table around the Betze Pit would be lowered, reducing the quantity of water in certain seeps, springs, and creeks. The effects on such seeps, springs, and creeks are expected to be quantity impacts, not quality impacts as described in Sections 4.4.2 and 4.4.3. The discharge of water to the TS Ranch Reservoir for use at the irrigation areas would potentially result in changes to groundwater quality at both the reservoir and irrigation areas as a result of percolation of water into the ground. The discharge of water to Rodeo or Boulder Creeks would be subject to regulatory approval and potentially would cause changes in the surface water quality of these creeks. The impacts from dewatering and discharge are assessed during active dewatering, during the recovery of the hydrologic system, and for long-term impacts after recovery is completed.

The Betze Project would potentially affect ground and surface water quality due to the construction and operation of various project components, e.g., the waste rock disposal areas, the ore stockpiles, the additional tailings impoundment, and the additional heap leach facility. The waste rock and ore stockpiles are reviewed for the potential for increased sediment loading and for leachate production potential. The tailings impoundment and heap leach facility are reviewed to assess impacts from seepage or loss of cyanide solution to either surface water or groundwater.

The Betze Project would result in the creation of a large permanent water body in the Betze Pit, which would contain approximately 197,000 acre-feet of water. The post-mining water body is reviewed both geochemically and physically to determine the potential water quality and the ability of the water body to support vegetation, fisheries, or recreation.

### 4.4.7 Impacts from Dewatering and Discharge

#### 4.4.7.1 Proposed Action

Dewatering. During dewatering, a cone of depression would form around the proposed Betze Pit inducing groundwater to flow toward the pit. The elevation of the bottom of the cone of depression created by dewatering would be lower than the elevation of the wells, seeps, springs, and creeks in the vicinity of the Betze Pit. Groundwater would flow toward this low point, thus precluding the migration of any contaminants from the proposed dewatering operations to these resources. The water quality of these wells, seeps, springs, and creeks would not be affected by the proposed dewatering operations.

Dewatering Discharge. As discussed in Section 2.2.2.6, water from dewatering operations would be used for Barrick's and Newmont's mining and milling operations or would be pumped to the West No. 9 Pit and treated before discharge to the TS Ranch Reservoir via the unnamed drainage. The dewatering water would typically contain elevated levels of naturally occurring arsenic (0.20 to 0.25 mg/l) from arsenic-containing rocks associated with the gold ore deposit. The water pumped to the West No. 9 Pit would be treated at Barrick's existing water treatment facility using ferric sulfate prior to discharge to reduce the naturally occurring arsenic concentrations. Flocculent would be added to aid in the settling of the iron-arsenic complex precipitate in the clarification ponds. The treatment plant would remove arsenic from the water to a level below the drinking water standard of 0.05 mg/l. The treatment plant would be of sufficient capacity to handle the maximum flow rate which would be discharged to the unnamed drainage.

The precipitate from the existing water treatment plant has been analyzed and has been determined not to be a hazardous waste. The analytical results of both Extraction Procedure (EP) and Toxicity Characteristic Leaching Procedure (TCLP) testwork are shown in Table 4-10. The precipitate would be removed from the

TABLE 4-10

ANALYTICAL RESULTS OF TOXICITY CHARACTERISTIC TESTING OF WATER TREATMENT SLUDGE

(mg/l EXCEPT WHERE NOTED)

| Parameter | Regulatory Levels | Header Discharge | | Settling Pond | | High Iron | Low Iron |
|---|---|---|---|---|---|---|---|
| | | EP Tox[1] | TCLP[2] | EP Tox | TCLP | TCLP | TCLP |
| Arsenic (As) | 5.0 | 0.09 | 0.13 | 0.12 | 0.14 | <0.05 | <0.05 |
| Barium (Ba) | 100.0 | 2.4 | 3.0 | 2.4 | 2.6 | 1.8 | 2.0 |
| Cadmium (Cd) | 1.0 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Chromium (Cr) | 5.0 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Lead (Pb) | 5.0 | 0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 |
| Mercury (Hg) | 0.2 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Selenium (Se) | 1.0 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Silver (Ag) | 5.0 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |

[1] Extraction Procedure.

[2] Toxicity Characteristic Leaching Procedure.

clarification ponds on a regular basis and deposited inside the tailings impoundment.

Under the proposed Betze Pit expansion, water quality after treatment would be similar to the water quality from the existing dewatering discharge after treatment. The water quality would be regulated by an NPDES permit that has been issued by the NDEP. The effluent limits in that permit are based on drinking water quality standards or, if a drinking water quality standard has not been established, by other appropriate standards. The water would be discharged via the unnamed drainage to the TS Ranch Reservoir. The quantities which would be discharged are described in Section 4.4.2.

Prior to the initiation of dewatering operations at the Post Pit, the unnamed drainage was an ephemeral drainage that only received flow in direct response to precipitation within its watershed. Flow typically occurred as a result of spring snow melt and high intensity summer thunderstorms and runoff was likely to be high in suspended sediments. Discharge from the treatment plant would be relatively free of suspended solids.

Due to the low levels of suspended solids and to the large volume of flow that would be discharged down the unnamed drainage on a continuous basis, excessive erosion may introduce suspended sediment into the flow. As discussed in Section 4.4.2, three erosion control structures have been constructed to mitigate potential erosion problems. Water quality data for the inflow point to the reservoir indicate that the levels of suspended sediment in the existing flow are relatively low (see Section 3.4.2.3). Under the Proposed Action, the quantity of water discharged to the unnamed drainage would increase as the Betze Pit is expanded to depth and dewatering rates increase. The channel of the unnamed drainage would be inspected regularly to ensure that the additional discharges do not cause excessive erosion. If accelerated erosion were to be observed, the channel would be riprapped or other appropriate mitigation measures would be implemented.

Some water is expected to seep from the reservoir into the underlying groundwater system. The quality of the reservoir water compared to the quality of groundwater from wells drilled in the vicinity of the reservoir is presented in Table 4-11. The concentration of certain constituents in the dewatering water would be slightly higher than levels of constituents in the existing groundwater beneath the reservoir. However, the reservoir water would be better than drinking water quality for those constituents for which drinking water quality standards have been established. Groundwater in the reservoir area would be monitored to ensure that any seepage from the reservoir would not preclude the use of the groundwater underlying the reservoir as a drinking water source.

TABLE 4-11

Water Quality of the Reservoir Water and Groundwater near the TS Ranch Reservoir

| PARAMETER | FLUME ABOVE DAM [1] | NA-20A [2] | NA-20B [2] | NA-21 [2] | NA-19 [2] |
|---|---|---|---|---|---|
| Alkalinity as CaCO3, mg/l | 275.625 | 310.000 | 310.000 | 260.000 | 360.000 |
| Aluminum (T) as Al, mg/l | | 0.400 | 0.100 | | |
| Ammonia as NH3-N, mg/l | 0.506 | < 0.200 | < 0.200 | < 0.200 | < 0.200 |
| Arsenic (T) as As, mg/l | 0.028 | 0.021 | 0.021 | 0.011 | 0.033 |
| Barium (T) as Ba, mg/l | 0.123 | 0.090 | 0.090 | 0.070 | 0.080 |
| Bicarbonate as HCO3, mg/l | 326.875 | 370.000 | 380.000 | 320.000 | 440.000 |
| Boron (T) as B, mg/l | 0.769 | 0.400 | 0.400 | 0.500 | 0.400 |
| Cadmium (T) as Cd, mg/l | 0.003 | < 0.005 | < 0.005 | < 0.005 | < 0.005 |
| Calcium as Ca, mg/l | 57.438 | 69.000 | 68.000 | 59.000 | 48.000 |
| Carbonate as CO3, mg/l | 2.719 | < 5.000 | < 5.000 | < 5.000 | < 5.000 |
| Chloride as Cl, mg/l | 19.063 | 21.000 | 21.000 | 22.000 | 19.000 |
| Chromium (T) as Cr, mg/l | < 0.005 | < 0.005 | < 0.005 | < 0.005 | 0.006 |
| Conductivity, uhmos/cm | 812.500 | 740.000 | 720.000 | 510.000 | 1200.000 |
| Copper (T) as Cu, mg/l | < 0.005 | < 0.005 | < 0.005 | < 0.005 | 0.009 |
| Cyanide (T) as CN, mg/l | < 0.005 | < 0.005 | < 0.005 | | |
| Cyanide (Free) as CN, mg/l | | < 0.100 | < 0.100 | | |
| Cyanide (WAD) as CN, mg/l | | < 0.005 | < 0.005 | | < 0.005 |
| Fluoride as F, mg/l | 1.094 | 0.800 | 0.800 | 0.900 | 18.000 |
| Gold as Au, mg/l | | < 0.005 | < 0.005 | | |
| Hardness as CaCO3, mg/l | | 250.000 | 240.000 | | |
| Hydroxide as OH, mg/l | < 5.000 | < 5.000 | < 5.000 | < 5.000 | |
| Iron (D) as Fe, mg/l | 0.008 | | | | |
| Iron (T) as Fe, mg/l | 0.927 | 0.700 | 0.490 | 2.300 | 1.500 |
| Lead (T) as Pb, mg/l | < 0.005 | < 0.005 | < 0.005 | < 0.006 | < 0.005 |
| Magnesium as Mg, mg/l | 24.000 | 19.000 | 18.000 | 13.000 | 16.000 |
| Manganese (T) as Mn, mg/l | 0.033 | 0.036 | 0.026 | 0.024 | 0.017 |
| Mercury as Hg, mg/l | 0.000 | < 0.000 | < 0.000 | 0.000 | 0.000 |
| Nickel (T) as Ni, mg/l | | < 0.010 | < 0.010 | | |
| Nitrate as NO3-N, mg/l | 1.194 | 0.300 | 0.360 | | 0.580 |
| Phosphate (Ortho) as PO4-P, mg/l | | 0.060 | 0.050 | | |
| Potassium as K, mg/l | 22.813 | 14.000 | 13.000 | 16.000 | 20.000 |
| Selenium (T) as Se, mg/l | < 0.005 | 0.005 | < 0.005 | < 0.005 | < 0.005 |
| Silica (T-ICP) as SiO2, mg/l | | 26.000 | 24.000 | | |
| Silver (T) as Ag, mg/l | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 |
| Sodium as Na, mg/l | 77.813 | 57.000 | 51.000 | 66.000 | 160.000 |
| Sulfate as SO4, mg/l | 79.813 | 63.000 | 60.000 | 70.000 | 69.000 |
| Settleable Solids , mLs/L/hr | | 0.100 | 0.100 | | |
| Suspended Solids, mg/l | 46.469 | 39.000 | 14.000 | 6.000 | 37.000 |
| Thallium as Tl, mg/l | | < 0.050 | < 0.050 | | |
| Total Dissolved Solids, mg/l | | 450.000 | | | |
| Turbidity, NTU | 4.644 | 3.000 | 3.000 | 4.400 | 5.300 |
| Zinc (T) as Zn, mg/l | 0.012 | 0.020 | 0.019 | 0.006 | 0.031 |
| pH Units | 7.981 | 7.400 | 7.600 | 7.400 | 7.500 |

1 Mean values for inflow to TS Ranch Reservoir

2 Groundwater wells located in the vicinity of the TS Ranch Reservoir

The water stored in the TS Ranch Reservoir would be piped to the irrigation areas depicted generally in Figure 4-5, or subject to regulatory approval, would be discharged to Boulder Creek. Approximately 7,500 acres would be irrigated in lower Boulder Valley using water from the dewatering operations. Approximately half of the water applied to the irrigation area would be expected to percolate downward to the regional groundwater system. The quality of water from the TS Ranch Reservoir to be used for irrigation is compared to the quality of the groundwater from wells drilled in the vicinity of the area to be irrigated in Table 4-12. The water to be used for irrigation would be similar in quality to the groundwater within the irrigation area although in some cases constituent levels in the groundwater would be lower. The irrigation water quality would be better than existing drinking water standards for all constituents for which drinking water standards have been adopted. The groundwater in the irrigation area would be monitored to ensure that any percolation of irrigation water into the groundwater does not preclude the use of the groundwater as a drinking water source.

The temperature of dewatering water varies from well to well; water temperatures range from 60°F to 140°F. Water from the various dewatering wells is co-mingled in the West No. 9 Pit, where temperatures ranging from 95°F to 105°F have been measured. The temperature measurements of the water discharged from the water treatment plant to the unnamed drainage have ranged from 90°F to 108°F. The temperature of the water entering the TS Ranch Reservoir ranges from 81°F to 94°F.

These water temperatures are not anticipated to have adverse impacts at the unnamed drainage or at the TS Ranch Reservoir. Comparison of the water quality data collected at the discharge to the unnamed drainage with that collected at the flume above the dam, Table 3-11, indicates that the concentrations of constituents do not vary significantly between the two sampling locations. Thus, the temperature of the water does not appear to result in the concentration or dilution of the chemical constituents of the discharge. Moreover, it is expected that, at these temperatures, freezing at the unnamed drainage and at the TS Ranch Reservoir would either be reduced or would not occur, thereby preventing cold weather impacts to either the unnamed drainage or the TS Ranch Reservoir.

The NPDES discharge permit governing discharges from the existing water treatment plant requires Barrick to sample the water at the point of discharge to the unnamed drainage and at the point that the water enters the TS Ranch Reservoir. If the results of this continued monitoring indicated any changes in the concentration of constituents or water temperature, appropriate mitigation measures would be implemented.

TABLE 4-12

Water Quality of the TS Ranch Reservoir Water and Groundwater Near the Irrigation Areas

| PARAMETER | FLUME ABOVE DAM [1] | NA-32 [2] | NA-34 [2] | NA-26 [2] |
|---|---|---|---|---|
| Alkalinity as CaCO3, mg/l | 275.625 | 150.000 | 120.000 | 130.000 |
| Ammonia as NH3-N, mg/l | 0.506 | < 0.200 | < 0.200 | < 0.200 |
| Arsenic (T) as As, mg/l | 0.028 | < 0.005 | 0.015 | 0.006 |
| Barium (T) as Ba, mg/l | 0.123 | 0.070 | 0.060 | 0.080 |
| Bicarbonate as HCO3, mg/l | 326.875 | 180.000 | 140.000 | 160.000 |
| Boron (T) as B, mg/l | 0.769 | 0.100 | 0.100 | 0.200 |
| Cadmium (T) as Cd, mg/l | 0.003 | < 0.005 | < 0.005 | < 0.005 |
| Calcium as Ca, mg/l | 57.438 | 35.000 | 27.000 | 19.000 |
| Carbonate as CO3, mg/l | 2.719 | < 5.000 | < 5.000 | < 5.000 |
| Chloride as Cl, mg/l | 19.063 | 11.000 | 14.000 | 17.000 |
| Chromium (T) as Cr, mg/l | < 0.005 | < 0.005 | < 0.005 | < 0.005 |
| Conductivity, uhmos/cm | 812.500 | 490.000 | 430.000 | 490.000 |
| Copper (T) as Cu, mg/l | < 0.005 | < 0.005 | < 0.005 | < 0.005 |
| Cyanide (T) as CN, mg/l | < 0.005 | | | |
| Cyanide (WAD) as CN, mg/l | | < 0.005 | < 0.005 | < 0.005 |
| Fluoride as F, mg/l | 1.094 | 0.800 | 0.900 | 0.700 |
| Hydroxide as OH, mg/l | < 5.000 | | | |
| Iron (D) as Fe, mg/l | 0.008 | 0.070 | | |
| Iron (T) as Fe, mg/l | 0.927 | 0.030 | 0.590 | 0.070 |
| Lead (T) as Pb, mg/l | < 0.005 | 0.005 | < 0.005 | < 0.005 |
| Magnesium as Mg, mg/l | 24.000 | 11.000 | 7.000 | 5.800 |
| Manganese (T) as Mn, mg/l | 0.033 | 0.007 | 0.007 | 0.052 |
| Mercury as Hg, mg/l | 0.000 | < 0.000 | < 0.000 | < 0.000 |
| Nitrate as NO3-N, mg/l | 1.194 | 0.950 | 0.730 | 0.900 |
| Potassium as K, mg/l | 22.813 | 7.200 | 7.400 | 7.100 |
| Selenium (T) as Se, mg/l | < 0.005 | < 0.005 | < 0.005 | < 0.005 |
| Silver (T) as Ag, mg/l | < 0.005 | < 0.005 | < 0.005 | < 0.005 |
| Sodium as Na, mg/l | 77.813 | 30.000 | 41.000 | 59.000 |
| Sulfate as SO4, mg/l | 79.813 | 31.000 | 33.000 | 36.000 |
| Suspended Solids, mg/l | 46.469 | < 5.000 | 34.000 | 5.000 |
| Turbidity, NTU | 4.644 | 0.200 | 13.000 | 4.300 |
| Zinc (T) as Zn, mg/l | 0.012 | 0.008 | 0.014 | 0.008 |
| pH Units | 7.981 | 7.100 | 7.500 | 8.000 |

[1] Mean values for inflow to TS Ranch Reservoir

[2] Groundwater wells located in the vicinity of the irrigation areas

The base hydrologic model showed that quantities of water in excess of the anticipated irrigation demand would occur in the last year of dewatering or earlier if the irrigation or mining demand diminishes. The sensitivity analyses indicate that quantities of water in excess of the amount that could be used for irrigation may occur for as many as 3 years, starting in 1991. The Proposed Action, subject to regulatory approval, is to discharge this excess water from the TS Ranch Reservoir to Boulder Creek or directly to Rodeo Creek. Flow in Boulder Creek is intermittent at the confluence with the unnamed drainage. Water quality data for samples collected from Boulder Creek in this area during spring flow events are presented in Table 4-13. The quality of the water in Boulder Creek is slightly better than the quality of the water in the reservoir. Flow in Rodeo Creek is intermittent in the vicinity of the Betze Project. The water quality in Rodeo Creek is slightly better than the water quality of the dewatering water. Any discharges directly to Boulder Creek or to Rodeo Creek would be subject to effluent limits established by an NPDES permit issued by the NDEP.

4.4.7.2 Alternatives. The impacts of alternatives on water quality are described in the following sections. Dewatering is necessary to enable the Betze deposit to be mined. Since there is no technical alternative to dewatering, no alternatives to dewatering, other than the No Action alternative, are described.

Waste Rock Disposal Areas, Ore Stockpiles, and Processing Facilities. The implementation of alternative sites for these project components would not result in significant changes in the anticipated water quality impacts attributable to the proposed dewatering and related discharge.

Water Disposal Methods. The proposed alternative water handling and disposal alternatives are infiltration, reinjection, or direct discharge to Rodeo or Boulder Creeks. Specific sites for the infiltration or reinjection alternatives have not been identified because Barrick has not been able to obtain access to land in Boulder Valley that is owned or controlled by others. Access would be necessary to evaluate the suitability of specific sites for infiltration and reinjection. However, a review of the Boulder Valley basin indicates that a number of areas would be suitable for infiltration or reinjection.

Infiltration. Infiltration fields would be constructed in Boulder Valley. The dewatering water would be piped from either the TS Ranch Reservoir or directly from the dewatering operations to the fields for infiltration. Before implementing an infiltration program, additional environmental review and approval from the NDEP would be required. Since the dewatering water would be treated to be of better quality than drinking water quality, infiltration would not preclude the use of the receiving groundwater as a drinking water source.

Reinjection. A series of injection holes would be drilled in Boulder Valley, cased with perforated casings, and fitted with

TABLE 4-13

Water Quality of the TS Ranch Reservoir Water and Boulder Creek

| PARAMETER | FLUME ABOVE DAM [1] | BC-A [2] | BC-B [2] |
|---|---|---|---|
| Alkalinity as CaCO3, mg/l | 275.625 | 49.000 | 54.000 |
| Aluminum (T) as Al, mg/l | | 1.800 | 1.700 |
| Ammonia as NH3-N, mg/l | 0.506 | < 0.020 | < 0.200 |
| Arsenic (T) as As, mg/l | 0.028 | 0.005 | 0.006 |
| Barium (T) as Ba, mg/l | 0.123 | 0.120 | 0.110 |
| Bicarbonate as HCO3, mg/l | 326.875 | 59.000 | 65.000 |
| Boron (T) as B, mg/l | 0.769 | < 0.100 | < 0.100 |
| Cadmium (T) as Cd, mg/l | 0.003 | | |
| Calcium as Ca, mg/l | 57.438 | 12.000 | 13.000 |
| Carbonate as CO3, mg/l | 2.719 | < 5.000 | < 5.000 |
| Chloride as Cl, mg/l | 19.063 | < 0.005 | 3.600 |
| Chromium (T) as Cr, mg/l | < 0.005 | < 0.005 | < 0.005 |
| Conductivity , uhmos/cm | 812.500 | 196.667 | 195.000 |
| Copper (T) as Cu, mg/l | < 0.005 | < 0.005 | < 0.005 |
| Cyanide (T) as CN, mg/l | < 0.005 | < 0.005 | < 0.005 |
| Cyanide (Free) as CN, mg/l | | < 0.100 | < 0.100 |
| Cyanide (WAD) as CN, mg/l | | < 0.005 | < 0.005 |
| Fluoride as F, mg/l | 1.094 | < 0.500 | < 0.500 |
| Gold as Au, mg/l | | < 0.005 | < 0.005 |
| Hardness as CaCO3, mg/l | | 51.000 | 51.000 |
| Hydroxide as OH, mg/l | < 5.000 | < 5.000 | < 0.500 |
| Iron (D) as Fe, mg/l | 0.008 | | |
| Iron (T) as Fe, mg/l | 0.927 | 1.600 | 1.800 |
| Lead (T) as Pb, mg/l | < 0.005 | < 0.005 | < 0.005 |
| Magnesium as Mg, mg/l | 24.000 | 4.500 | 5.000 |
| Manganese (T) as Mn, mg/l | 0.033 | 0.045 | 0.043 |
| Mercury as Hg, mg/l | 0.000 | < 0.0001 | < 0.010 |
| Nickel (T) as Ni, mg/l | | < 0.010 | < 0.010 |
| Nitrate as NO3-N, mg/l | 1.194 | 0.147 | < 0.050 |
| Phosphate (Ortho) as PO4-P, mg/l | | 0.110 | 0.110 |
| Potassium as K, mg/l | 22.813 | 2.400 | 2.600 |
| Selenium (T) as Se, mg/l | < 0.005 | < 0.005 | < 0.005 |
| Silica (T) as SiO2, mg/l | | 11.000 | 11.000 |
| Silver (T) as Ag, mg/l | < 0.005 | < 0.005 | < 0.005 |
| Sodium as Na, mg/l | 77.813 | 7.300 | 8.100 |
| Sulfate as SO4, mg/l | 79.813 | 19.000 | 21.000 |
| Suspended Solids , mg/l | 46.469 | 8.000 | 8.000 |
| Settleable Solids , ml/l/hr | | 0.200 | < 0.100 |
| Thallium as Tl, mg/l | | < 0.005 | < 0.005 |
| Total Dissolved Solids , mg/l | | 120.000 | 120.000 |
| THP ,mg/l | | 0.500 | |
| Turbidity , NTU | 4.644 | 9.433 | 15.000 |
| Zinc (T) as Zn, mg/l | 0.012 | 0.022 | 0.021 |
| pH Units | 7.981 | 8.467 | 8.400 |

1 Mean values for inflow to TS Ranch Reservoir

2 Mean values for flow in Boulder Creek downstream of confluence with Rodeo Creek (see Figure 3-4 for locations)

pumps mounted on the surface. The water would be piped either from the TS Ranch Reservoir or directly from the dewatering operations to the injection holes. The pumps would apply pressure, injecting the water into subsurface strata. Before implementing a reinjection program, additional environmental review and approval from the NDEP would be required. Since the dewatering water would be treated to be of better quality than drinking water quality, reinjection would not preclude the use of the receiving groundwater as a drinking water source.

Both the reinjection and infiltration alternatives involve the reintroduction of extracted groundwater back into the ground. Although the location at which the water would be reintroduced to the groundwater would be slightly different than that for the Proposed Action, the water quality impacts would be similar to those for the Proposed Action.

Discharge to Creeks. Another alternative would involve the direct discharge of water from dewatering operations to Rodeo or Boulder Creeks. The water quality of the discharged water would be subject to regulation by the NDEP under an NPDES permit. The water quality impacts of this alternative would, therefore, be minimal.

4.4.7.3 Cumulative Impacts. The operations of Dee and Newmont require water for mining and milling purposes, including dust control, milling, leaching, and potable water. To the extent that other operations in the area withdraw water from the regional groundwater or discharge it into the Boulder Valley drainage, potential cumulative impacts to water quality in areas affected by the Proposed Action may occur. Dee does not conduct dewatering operations nor is it expected to do so in the future. Dee currently pumps approximately 550 acre-feet per year from groundwater wells for mining and milling uses. Newmont currently pumps approximately 2,100 acre-feet per year to meet its mining and milling water needs, less than 1,600 acre-feet of which are pumped from the Genesis Pit, where dewatering is necessary.

It is anticipated that the pumping rates of Dee and Newmont at existing operations near the Betze Project area would not increase significantly (see Section 3.12.3.3). The projected cumulative water quality impacts from the continuation of the existing operations of Dee and Newmont in that area or the development of other near surface deposits in the North Area are considered to be indistinguishable from the impacts resulting from the Proposed Action.

It is foreseeable that Newmont would develop the Bootstrap/Capstone deposit during the life of the Betze Project. Development of the Bootstrap/Capstone deposit would require dewatering. The quantity of dewatering required and the extent of the cone of depression that would be created by such dewatering is not known at this time because definitive plans for mining the Bootstrap/Capstone deposit have not been developed. The base case model of the impacts of Barrick's proposed dewatering indicates that the cone of depression from the proposed Betze Project dewatering would cause drawdowns of 100 to 300 feet at the Bootstrap/Capstone deposit.

It is also foreseeable that Newmont would develop the Deep Star and Deep Post deposits and that Barrick would develop the Deep Post and Purple Vein deposits. All such development would require dewatering operations to allow either open-pit or underground mining of these deep deposits. While the timing and nature of such potential developments cannot be forecast, it appears reasonable to assume that much if not all such development would occur following the projected conclusion of mining at the Betze Pit (see Section 3.12.3.3) or, if executed earlier, would not initially require dewatering efforts separate from that of the Proposed Action. The development of one or more of these projects would have the effect of extending beyond 2000 the period of active dewatering in the vicinity of the Betze Project. Beyond the simulated effects of extended dewatering described below and in Section 4.4.3.3, it is difficult to quantitatively project future dewatering impacts in a meaningful way. Any such dewatering would delay or interrupt the recovery of the groundwater table and potentially could expand the cone of depression and area affected by dewatering activities beyond that of the Proposed Action. However, the requirement for dewatering these deposits would exist without regard to the Proposed Action. Extending the period of dewatering or the drawdown would extend the water quality impacts discussed in Section 4.4.7.

To simulate continued dewatering by such other operations, the hydrologic model was run to extend active dewatering for the Betze Pit from the year 2000 to 2006. In the event that mining and dewatering continue to the year 2006, impacts to the unnamed drainage, the reservoir area, and the irrigation area would continue as described in Section 4.4.2.1. The extent of drawdown due to dewatering would expand slightly as described in Section 4.4.3.3. Impacts to wells, seeps, springs, and creeks would remain about the same as in the year 2000 with the exception of lower Boulder Creek. Model projections of dewatering rates indicate that excess flow would not be discharged to Boulder Creek from the reservoir in the years 2001 to 2006.

Presently, only Barrick is delivering dewatering water to the TS Ranch Reservoir. It is possible that Newmont may also do so in the future. If Newmont were to begin to deliver water to the TS Ranch Reservoir during the life of the Betze Project, due to the development of one or more of its North Area deposits, there would be a resulting increase in irrigation in lower Boulder Valley or an increase in the volume of water to be disposed of by infiltration, reinjection or discharge to Rodeo or Boulder Creeks. Without additional information on the timing, quality or quantity of water that would be produced by such additional developments, it is not possible to meaningfully project the potential cumulative water quality impacts from increased dewatering activities.

4.4.7.4 No Action Alternative. Under the No Action alternative, Barrick would continue to mine the Post Pit to the extent authorized by existing approvals. During mining, existing dewatering operations would be continued. At the conclusion of mining in 1991 or 1992, Barrick would have to determine whether to extend dewatering operations as necessary to preserve the structural integrity of the Post Pit. That determination would presumably be based on its evaluation of the likelihood that the Betze deposit would ever be developed and whether the Deep Post deposit could be developed by surface mining methods. In any event, existing water quality impacts associated with dewatering of the Post Pit would continue, either for the period of mining or some indeterminate period thereafter. Projected impacts from the expansion of dewatering attendant to the Proposed Action would not occur. After dewatering of the Post Pit terminated, the pit would begin to fill with water, the water would ultimately reach the 5,300 foot level. The impacts on water quality of continued dewatering to maintain the structural integrity of the Post Pit would be similar to the impacts from the Proposed Action, except that the quantity of water pumped likely would be less. The water quality of the water body that would form in the Post Pit once dewatering was terminated would be different than that of the Betze Pit once it fills with water. The water quality and physical characteristics of the Post Pit water body are discussed in Section 4.4.9.4.

Implementing the No Action alternative would, in the absence of other dewatering activity, mean the earlier termination of discharges to the TS Ranch Reservoir. Although there would likely be a continuation of irrigation in lower Boulder Valley, with existing and perhaps new wells, it is likely that less acreage would be irrigated than if dewatering water from the TS Ranch Reservoir is available.

Implementing the No Action alternative would probably mean the irrigation demand in lower Boulder Valley would not be exceeded by the dewatering rates. Thus, the likelihood of disposal of excess water by infiltration, reinjection, or discharge to Rodeo or Boulder Creeks would be reduced.

4.4.7.5 Mitigation. The primary mitigation method that has been incorporated into the Proposed Action consists of the use of the arsenic treatment system described in Section 4.4.7.1. With the use of this system, water quality of the dewatering discharge would achieve drinking water standards and, therefore, no other mitigation is proposed.

4.4.8 Impacts During and After Recovery

4.4.8.1 <u>Proposed Action</u>. The Proposed Action would require dewatering of the Betze Pit until mining ceases in the year 2000 and continued pumping at reduced rates to supply water for milling operations until the year 2010. The cone of depression created in the water table by dewatering operations would continue to expand for approximately 25 to 30 years after dewatering ceases. The cone of depression would contract once the Betze Pit begins to fill with water and the rate of inflow to the pit declines. Throughout most of the recovery period, groundwater would flow radially into the Betze Pit from the surrounding rock. Therefore, all wells, seeps, springs, and creeks would be hydrologically upgradient of the Betze Pit and would only be affected in terms of quantity by drawdown around the pit. Upon recovery to pre-mining groundwater levels, the surface water features would receive flow from pre-mining sources. The impact of the Betze Pit water body quality on regional groundwater is discussed in Section 4.4.11.

When mining ceases in the year 2000, the dewatering discharge down the unnamed drainage to the TS Ranch Reservoir, Boulder Valley irrigation areas, Rodeo Creek, or Boulder Creek would be discontinued. There would be no water quality impacts to these areas because water would no longer be released and distributed through the reservoir and irrigation system.

After the hydrologic system has recovered and returned to equilibrium, the groundwater quality at the Betze Project area is projected to be generally comparable to pre-mining conditions.

4.4.8.2 <u>Alternatives</u>

<u>Water Disposal Methods</u>. The water quality impacts of the disposal alternatives during dewatering are described in Section 4.4.7.2. The water quality impacts resulting from active dewatering would terminate once dewatering ceases. The water quality impacts from the water disposal options would not be evident after the recovery of the hydrologic system.

<u>Partial Pit Backfill</u>. In the event that the pit is backfilled to the post-mining water table level, the water quality impacts on wells, springs, seeps and streams related to recharge of the pit would be the same as for the Proposed Action. However, impacts to the regional groundwater system following recharge of the aquifer would still be expected (see Section 4.4.10).

The geochemistry of the partially backfilled pit can be predicted qualitatively and is discussed in Section 4.4.9.2. There would be some migration of water through the rock placed in the backfilled pit, and into the regional groundwater system during recovery. The water percolating through the backfilled material would generally be of lesser quality with higher levels of dissolved solids and elevated levels of arsenic somewhat similar to present groundwater. The water would be of lower quality throughout the period of groundwater recovery. As through-flow is re-established within the backfill, there is a potential for water within the backfill to migrate downgradient into the regional groundwater system.

4.4.8.3 Cumulative Impacts. Newmont is currently dewatering at the Genesis Pit about 2 miles south of the proposed Betze Pit. This mine is the only operation, other than the Post Pit, within the Boulder Creek and Rodeo Creek drainages that is presently being dewatered. Rates of dewatering for the Genesis Pit are expected to reach 2,800 gpm by 1995. Newmont's dewatering program at the Genesis Pit is substantially smaller than the dewatering that would occur under the Proposed Action. Newmont uses the water from the Genesis Pit dewatering in its mining and milling operations. As a result, the Genesis Pit dewatering is not anticipated to alter the impacts that would result from the Proposed Action.

Newmont has indicated that it may develop the Bootstrap/Capstone deposit within the next decade. In addition, it is foreseeable that Newmont would develop the Deep Star and Deep Post deposits and that Barrick would develop the Deep Post and Purple Vein deposits. The development of any of these deposits would require dewatering to allow mining to proceed. While the timing and nature of the potential development of the deeper deposits cannot presently be forecast, it is reasonable to assume that much if not all such development would occur following the projected conclusion of mining at the Betze Pit (i.e., during recovery) or would not require a separate dewatering effort until dewatering of the Betze Pit was terminated.

During the life of the Betze Project, dewatering rates necessary to dewater the Betze Pit would likely overshadow other dewatering and consumptive requirements of Dee or Newmont. However, the impacts from the development of the Bootstrap/ Capstone deposit or other deep deposits during the period of recovery would impede recovery and would probably extend the period that water quality impacts may be expected from dewatering operations in the vicinity of the Betze Project. Such developments may also require that the water table be further drawn down, although such a requirement would exist independent of the Proposed Action.

The base hydrologic model was also run with active dewatering of the Betze deposit for an additional 6 years, to simulate continued active dewatering in the vicinity of the Betze Project. The quantity impacts of extended dewatering are described in Section 4.4.7.3. Since the groundwater withdrawal and discharge for the Betze Pit are expected to have minor water quality impacts, it is also anticipated that the water quality impacts for other mining activities would be minimal.

Dewatering of other developments by either Barrick or Newmont would potentially extend the period of discharge to the TS Ranch Reservoir and subsequent delivery of water to the irrigation areas. The impacts of extended irrigation resulting from other dewatering operations are not expected to differ from the impacts expected from the Proposed Action.

If one or more of the deposits located in the vicinity of the Betze Project would be mined by open-pit methods, such action may result in the creation of other water bodies containing large volumes of water. A slight concentration of dissolved salts and metals would occur at these water bodies due to evaporative losses. The water quality of other potential water bodies created by mining and the impacts of such water bodies is discussed in Section 4.4.10.

It is possible that development of the Bootstrap/Capstone deposit by Newmont or the Deep Post deposit by Newmont or Barrick could necessitate the diversion of Rodeo or Boulder Creeks. The diversion of these creeks would require further regulatory approvals and analysis prior to implementation.

4.4.8.4 <u>No Action Alternative</u>. Under the No Action alternative, Barrick would continue to mine the Post Pit to the extent authorized by existing approvals. The impacts of the No Action alternative are described in Section 4.4.7.4.

4.4.8.5 <u>Mitigation</u>. Since there would be no water quality impacts associated with the dewatering and discharge action during and after the recovery period, no mitigation is necessary.

4.4.9 Betze Pit Water Quality

4.4.9.1 <u>Proposed Action</u>. The Proposed Action would result in the creation of a large body of water in the Betze Pit upon the termination of dewatering. The probable quality of the water body was assessed both geochemically and physically. The groundwater inflow rates to the pit over time were calculated using the MODFLOW hydrologic model (Leggette, Brashears & Graham, Inc. 1990). The inflow water quality was then projected after review of the post-mining pit highwall rock characteristics, which included geochemical testing of representative core-holes, and a review of water quality in wells surrounding the post-mining Betze Pit. The water quality of the inflow water would change as chemical and physical reactions take place in the water body; these reaction were modeled to assess both the short-term and long-term water quality in the Betze Pit. A review of the physical characteristics of the water body was also completed to determine the ability of the water body to support vegetation, fisheries, or recreation. A detailed discussion of these analyses is presented in the Water Resources Technical Report (ENSR and Drever 1990).

Betze Pit Inflow Rates. Groundwater in the Betze Project area generally flows southwest from the Tuscarora Mountains, which are located east of the project area. The three main aquifers in the area are the Tertiary Carlin Formation, Paleozoic metasediments, and a Cretaceous granodiorite stock. Minor amounts of groundwater also occur within the recent alluvium adjacent to Rodeo, Bell, Brush, and Boulder Creeks.

The source of groundwater in the Betze Pit area was from the east and northeast under pre-mining conditions. However, since the commencement of dewatering of the Post Pit, a cone of depression has been forming in the groundwater surface in the vicinity of the pit. Predictions of groundwater impacts due to dewatering of the Betze Pit were developed by Leggette, Brashears & Graham, Inc. (1990) utilizing the U.S. Geological Survey computer model known as MODFLOW. The model indicates that a cone of depression would form around the Betze Pit to the pit bottom elevation (4,140 feet) which would be reached in the year 2000. After the completion of mining, as the pit would refill with water, the cone of depression would rise and expand outward maintaining radial flow towards the pit from all directions. The level of water in the pit would be within about 45 feet of pre-mining water levels by the year 2100. At a future point, the water level would rise to the pre-mining elevation (5,300 feet) and groundwater would flow into and out of the Betze Pit water body. Estimates of groundwater throughflow rates under equilibrium conditions are presented in Table 4-14.

Betze Pit Inflow Water Quality. The pit inflow water quality was projected by identifying groundwater wells which would generally characterize the quality of inflow water. An estimate of the chemical composition of the pit inflow was computed by averaging the observed chemical composition of water from six wells located outside the proposed Betze Pit. Table 4-15 presents geologic information for each of the wells and Figure 4-12 shows the location of each well. The six wells were selected such that the wells were located outside the area to be mined, are roughly equally spaced around the pit, and intercept water from the formations expected to contribute groundwater to the Betze Pit during recovery and filling. Spacing of the selected wells is roughly equal, but there are no wells located to the northwest of the proposed pit. Nevertheless, the six wells represent a reasonable approximation of groundwater that would be expected to recharge the Betze Pit (Table 4-16).

The groundwater flowing into the Betze Pit following the end of mining would pass through the wallrock of the pit and may react with the sulfides and heavy metals within the rock. Therefore, a geologic map (Figure 4-13) was developed to depict the outcrops of various rock formations and ore that would remain within the final pit walls. This map was compiled from geologic cross sections and plan maps provided by Barrick (1990b). The outcrop areas for each geologic formation and for ore were measured by planimeter and are

TABLE 4-14

PIT INFLOW, OUTFLOW, AND
CONCENTRATION FACTOR FROM EVAPORATION

| Year | Storage Accretion[1] (cfs) | Groundwater Inflow[1] (cfs) | Groundwater Outflow[1] (cfs) | Evaporation[1] (cfs) | Concentration[2] Factor |
|---|---|---|---|---|---|
| 0 | | | | | |
| 1 | 15.6 | 19.3 | 2.7 | 0.98 | 1.06 |
| 3.5 | 11.8 | 13.3 | 0.5 | 0.98 | 1.07 |
| 10 | 12.8 | 14.9 | 1.1 | 0.98 | 1.07 |
| 30 | 5.7 | 7.2 | 0.5 | 0.98 | 1.12 |
| 100 | 0.4 | 2.0 | 0.6 | 0.98 | 1.35 |
| 200 | 0.0 | 1.8 | 0.8 | 0.98 | 1.61 |
| Infinite | 0.0 | 1.8 | 0.8 | 0.98 | 2.25 |

[1] Data from Leggette, Brashears & Graham, Inc. 1990.

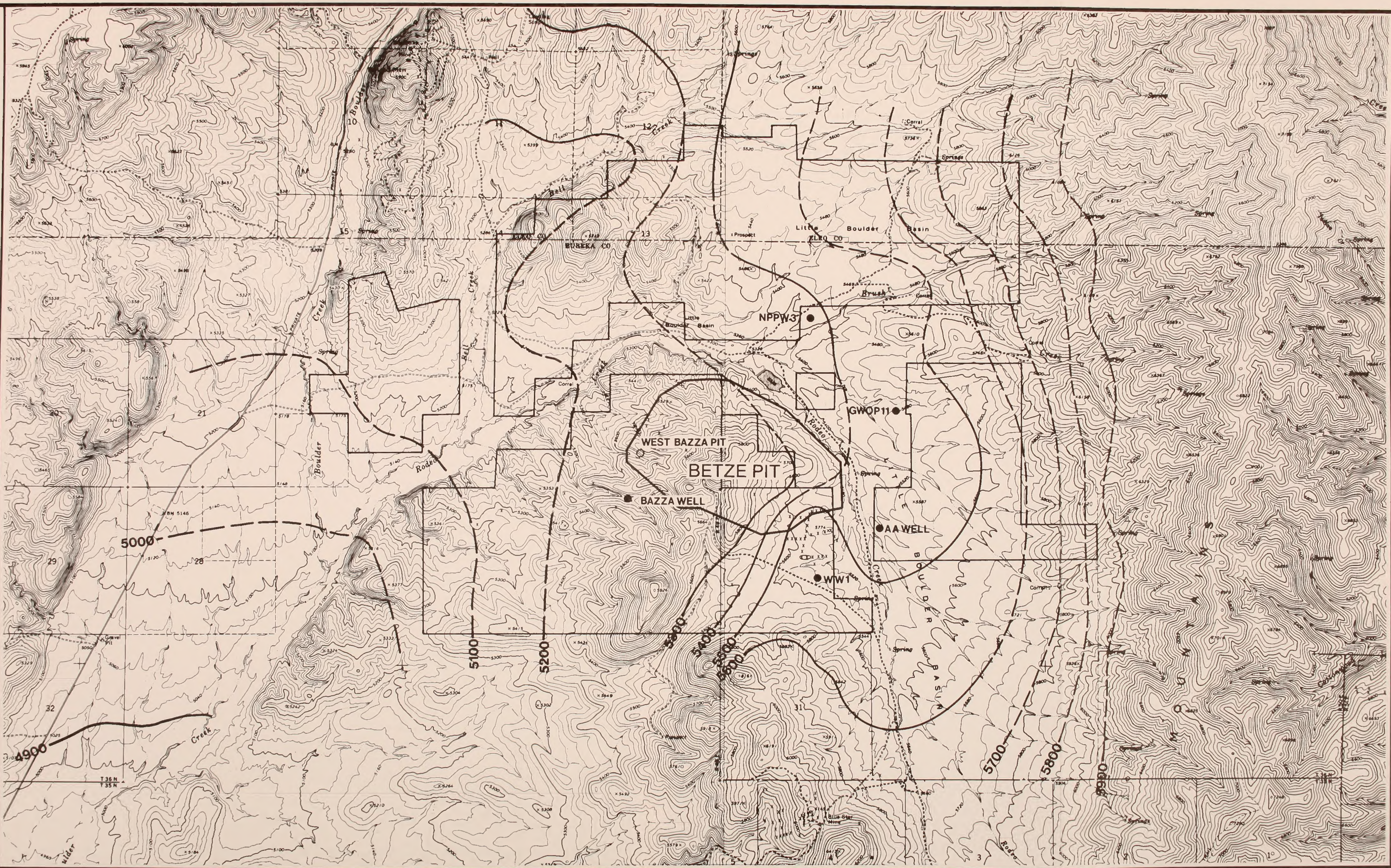
[2] Multiple for concentration of a conservative tracer over inflow concentration.

TABLE 4-15

GROUNDWATER WELLS UTILIZED TO ESTIMATE COMPOSITION OF PIT INFLOW

| Well ID | # of Samples | Total Depth (feet) | Screened Intervals (feet) | Formation/Rock Type |
|---|---|---|---|---|
| AA Well | 17 | 803 | 160-700 | Carlin/Paleozoic limestone and siltstones |
| GWOP-11 | 11 | 80-100 | 2-100 | Carlin |
| WW-1 | 7 | 300 | | Granodiorite |
| Bazza Well | 10 | 613 | 163-613 | Paleozoic limestones and siltstones |
| NPPW-3 | 4 | 1,213 | 538-1,038<br>1,087-1,207 | Carlin/Paleozoic limestones and siltstones |
| West Bazza Pit | 1 | | | Paleozoic limestones and siltstones |

[1] Elevation based on an approximate ground level elevation.




5300———— – – – – GROUNDWATER ELEVATION CONTOUR (Dashed where inferred.)

• WELL LOCATION

0 — 1 miles

N

BETZE PROJECT

**Figure 4-12. Pre-Dewatering Groundwater Elevations and Well Locations**

TABLE 4-16

Estimated Composition of Groundwater Inflow to Betze Pit

| PARAMETER | AA WELL | BAZZA WELL | WW-1 | GWOP-11 | WEST BAZZA PIT | NPPW-3 | PIT INFLOW |
|---|---|---|---|---|---|---|---|
| Alkalinity as CaCO3, mg/l | 153.462 | 421.909 | 143.600 | 176.000 | 409.000 | | 260.794 |
| Aluminum (T) as Al, mg/l | 0.289 | 0.089 | 0.064 | 3.820 | 0.160 | | 0.884 |
| Ammonia as NH3-N, mg/l | 0.332 | 1.688 | 0.166 | 0.100 | 0.650 | | 0.587 |
| Arsenic (T) as As, mg/l | 0.065 | 0.028 | 0.032 | 0.026 | 0.013 | 0.005 | 0.028 |
| Barium (T) as Ba, mg/l | 0.049 | 0.198 | 0.041 | 0.286 | 0.092 | 0.200 | 0.144 |
| Bicarbonate as HCO3, mg/l | 186.846 | 512.636 | 174.400 | 180.600 | 499.000 | | 310.697 |
| Boron (T) as B, mg/l | 0.125 | 0.738 | 0.158 | 0.254 | 0.840 | | 0.423 |
| Cadmium (T) as Cd, mg/l | 0.006 | 0.005 | 0.005 | | 0.005 | 0.005 | 0.005 |
| Calcium as Ca, mg/l | 28.192 | 95.009 | 58.400 | 33.600 | 50.800 | | 53.200 |
| Carbonate as CO3, mg/l | 0.769 | 1.364 | 0.500 | 14.700 | 0.000 | | 3.467 |
| Chloride as Cl, mg/l | 17.677 | 15.982 | 59.760 | 32.200 | 20.000 | | 29.124 |
| Chromium (Hex) as Cr, mg/l | 0.005 | 0.005 | 0.005 | | 0.005 | | 0.005 |
| Chromium (T) as Cr, mg/l | 0.004 | 0.004 | 0.005 | 0.004 | 0.005 | 0.010 | 0.005 |
| Conductivity, uhmos/cm | 451.231 | 945.091 | 767.857 | 561.818 | 904.000 | 538.000 | 694.666 |
| Copper (T) as Cu, mg/l | 0.017 | 0.032 | 0.008 | 0.010 | 0.005 | 0.010 | 0.013 |
| Cyanide (T) as CN, mg/l | 0.001 | 0.002 | 0.035 | 0.003 | 0.001 | | 0.009 |
| Cyanide (Free) as CN, mg/l | 0.016 | 0.026 | 0.009 | 0.050 | 0.001 | | 0.020 |
| Cyanide (WAD) as CN, mg/l | 0.003 | 0.003 | 0.007 | 0.003 | | 0.003 | 0.003 |
| Fluoride as F, mg/l | 0.477 | 1.448 | 0.344 | 1.180 | 1.350 | | 0.960 |
| Gold as Au, mg/l | 0.005 | 0.006 | 0.010 | 0.003 | 0.005 | | 0.006 |
| Hardness as CaCO3, mg/l | 155.538 | 337.364 | 295.200 | 134.200 | 286.000 | | 241.660 |
| Hardness (Non-Carb) as CaCO | 0.000 | 15.800 | 129.250 | | 0.000 | | 36.263 |
| Hardness (T) as CaCO3, mg/l | 130.000 | 339.200 | 304.750 | | 277.000 | | 262.738 |
| Hydroxide as OH, mg/l | 0.769 | 1.364 | 0.500 | 2.500 | 0.000 | | 1.027 |
| Iron (D) as Fe, mg/l | 0.073 | 0.193 | 0.227 | | 0.005 | | 0.125 |
| Iron (T) as Fe, mg/l | 0.657 | 1.669 | 0.828 | 3.436 | 0.075 | | 1.333 |
| Lead (T) as Pb, mg/l | 0.009 | 0.019 | 0.010 | 0.011 | 0.015 | 0.025 | 0.015 |
| Magnesium as Mg, mg/l | 16.192 | 24.500 | 37.140 | 10.420 | 36.200 | | 24.890 |
| Manganese (T) as Mn, mg/l | 0.055 | 0.060 | 0.014 | 0.092 | 0.015 | | 0.047 |
| Mercury as Hg, mg/l | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Nickel (T) as Ni, mg/l | 0.008 | 0.009 | 0.030 | 0.006 | 0.020 | | 0.015 |
| Nitrate as NO3-N, mg/l | 0.479 | 0.044 | 1.018 | 0.595 | 0.700 | 0.525 | 0.560 |
| Nitrite as NO2-N, mg/l | 0.015 | 0.006 | 0.055 | | 0.039 | | 0.029 |
| Phosphate (Ortho) as PO4-P, | 0.108 | 0.051 | 0.021 | 0.122 | 0.005 | | 0.061 |
| Potassium as K, mg/l | 6.346 | 20.555 | 7.540 | 14.400 | 31.200 | | 16.008 |
| Selenium (T) as Se, mg/l | 0.002 | 0.002 | 0.003 | 0.003 | 0.003 | | 0.003 |
| Silica (D) as SiO2, mg/l | 44.133 | 33.560 | 25.625 | | 24.800 | | 32.030 |
| Silica (T-ICP) as SiO2, mg/ | 28.250 | 21.000 | 8.300 | 29.400 | | | 21.738 |
| Silver (T) as Ag, mg/l | 0.007 | 0.004 | 0.005 | 0.003 | 0.005 | | 0.005 |
| Sodium as Na, mg/l | 28.938 | 72.155 | 35.980 | 72.400 | 82.200 | | 58.335 |
| Sulfate as SO4, mg/l | 49.508 | 101.764 | 152.000 | 73.600 | 82.800 | | 91.934 |
| Settleable Solids , mLs/L/h | 0.088 | 0.050 | 0.050 | 0.840 | | | 0.257 |
| Suspended Solids, mg/l | 12.938 | 10.136 | 3.760 | 417.400 | 0.500 | | 88.947 |
| Thallium as Tl, mg/l | 0.004 | 0.004 | 0.005 | 0.003 | 0.005 | | 0.004 |
| Total Dissolved Solids, mg/ | 316.000 | 583.364 | 536.400 | 362.000 | 504.000 | | 460.353 |
| Turbidity, NTU | 4.421 | 15.182 | 4.128 | 62.284 | 0.770 | | 17.357 |
| Zinc (T) as Zn, mg/l | 0.099 | 0.065 | 0.101 | 0.017 | 0.005 | 0.023 | 0.052 |
| pH Units | 7.479 | 7.245 | 7.874 | 8.191 | 7.790 | 8.000 | 7.763 |
| Cations, meq/l | 4.220 | 10.118 | 7.843 | | 9.950 | | 8.033 |
| Anions, meq/l | 4.214 | 10.318 | 7.605 | | 10.550 | | 8.172 |

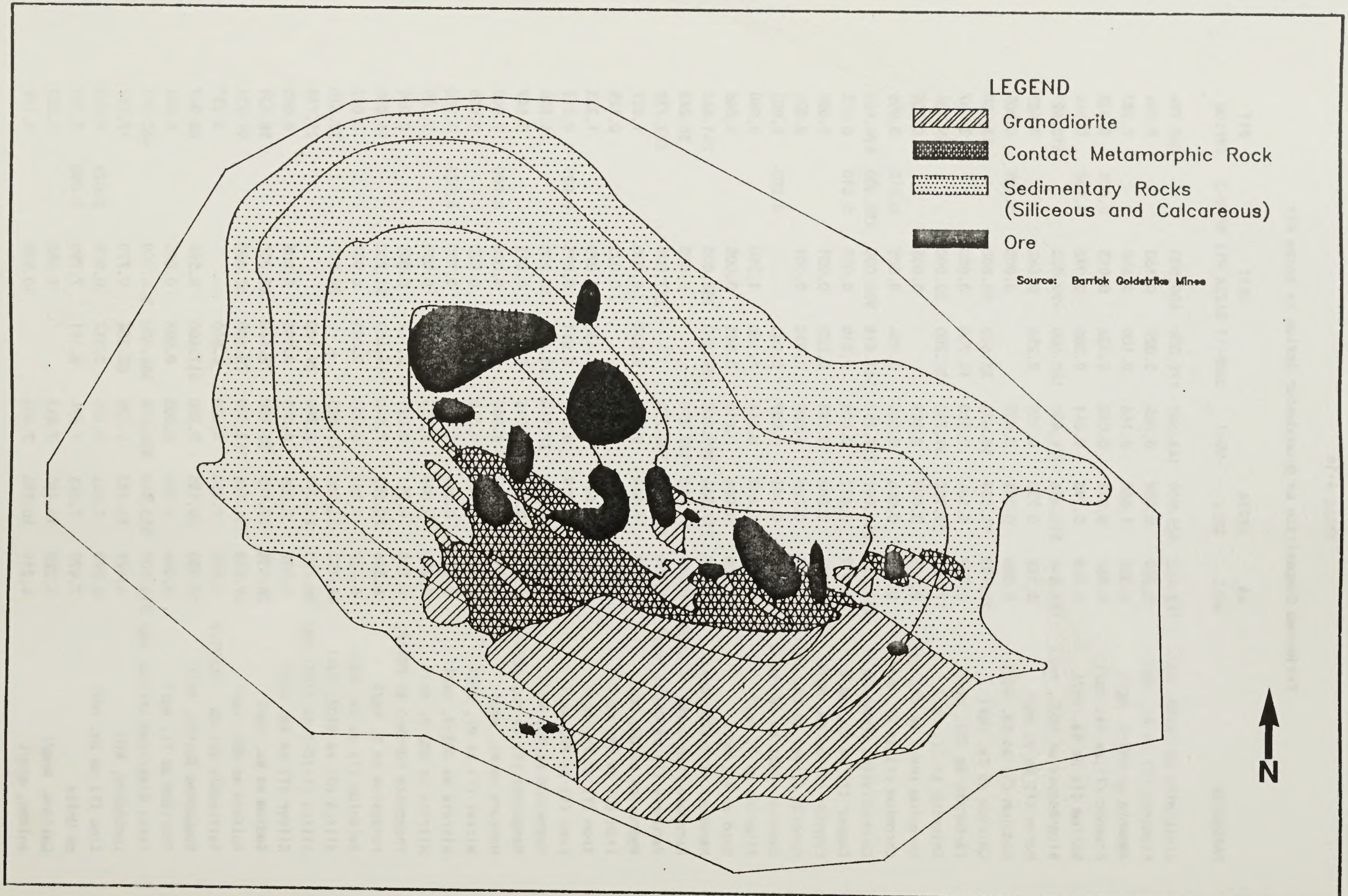



Figure 4-13. Geologic Map of Betze Pit Walls

presented in Table 4-17. The measured areas have not been corrected to account for pit slope because the values are utilized to compute relative outcrop areas only.

Static whole-rock tests of crushed rock samples from the various geologic formations were performed to assess the balance between acid generating and acid consuming components within each sample. The static tests provide a gross evaluation of the acid generating potential of a sample, because in field conditions all of the sulfur, reactive sulfur, or carbonate in the rock may not be available for reaction with percolating waters. The analytical process used in the static tests is described in greater detail in the Water Resources Technical Report.

Results of the whole rock analyses for 41 samples from the Betze Pit are presented in Appendix B. Computations of the net acid neutralizing potential are presented in Table 4-18. A net acid neutralizing potential is computed by taking the difference between the total sulfur content and acid neutralizing potential for each sample. An average of results for each rock type shows that the granodiorite is acid consuming while the sedimentary rocks are slightly acid generating. The samples with high acid generating potential are for the most part sedimentary rocks or sulfide ore. A weighted average of the sample results to account for the greater volume of sedimentary rocks than granodiorite shows that the samples, on the whole, represent a net acid neutralizing potential.

Therefore, a mixture of all rock from the proposed Betze Pit would have the overall ability to consume acid.

In addition to the static tests, humidity cell tests were performed on samples collected from the various geologic formations. The humidity cell test is a kinetic test method which attempts to simulate the acid-producing and acid-consuming processes which occur in the natural environment. The procedures used in conducting the humidity cells tests are described in greater detail in the Water Resources Technical Report.

Results of humidity cell tests on 24 crushed rock samples from drill holes within the area of the proposed Betze Pit are presented in Appendix B. The results generally confirm the static tests or whole rock analysis, in that 8 of the samples generated acid, 13 generated no acid, and 3 were borderline. These relative proportions indicate that taken as a whole, the samples would likely consume acid. During weeks 1, 2, and 10 of the tests the leachate was analyzed for 15 metals (see Water Resources Technical Report, Section 4.1.1, Description of Analysis Procedures) that were tested for in the whole rock analysis. The results indicate that arsenic levels were high only when the pH was below 5.0. Furthermore, no other trace elements were liberated in significant concentrations from the samples.

TABLE 4-17

OUTCROP AREAS FOR ROCK TYPES IN BETZE PIT WALLS

| Depth Interval (ft) | Acres of Outcrops | | | | |
|---|---|---|---|---|---|
| | Dsl[1] | Kgd[2] | Kcs[3] | Ore | Total |
| Bottom to 4,400 | 17.4 | 2.3 | 7.1 | 13.9 | 40.7 |
| 4,400 to 4,800 | 69.1 | 12.9 | 24.0 | 18.3 | 124.3 |
| 4,800 to 5,200 | 118.0 | 36.7 | 8.0 | 2.4 | 165.1 |
| 5,200 to Mapped Boundary[4] | 137.0 | 54.8 | 0.8 | 0.3 | 192.6 |
| TOTAL | 341.5 | 106.7 | 39.9 | 34.9 | 523.0[5] |

[1] Devonian siliceous and/or calcareous fined grained sedimentary rocks.

[2] Cretaceous diorite and granodiorite.

[3] Cretaceous contact metamorphic rock: hornfels, calcsilicate hornfels, and skarn.

[4] See Figure 4-13.

[5] The unmapped area depicted on Figure 4-13 represents approximately 167 acres which when added to the mapped area (523 acres) totals 690 acres.

TABLE 4-18

ACID GENERATING POTENTIAL AND ACID NEUTRALIZING POTENTIAL

FROM WHOLE ROCK ANALYSES

| Sample (Lab ID)[1] | Rock Type[2] | Total $CaCO_3$/kT AGP | Total $CaCO_3$/kT ANP | Net ANP (ANP - AGP) |
|---|---|---|---|---|
| WR-1 | Sed | 0.0 | 61.3 | 61.3 |
| WR-1P | Sed | 0.0 | 46.4 | 46.4 |
| WR-2 | Sed/O | 45.3 | 0.0 | -45.3 |
| WR-2P | Sed/O | 5.0 | 3.8 | -1.2 |
| WR-3 | Gd | 0.0 | 63.0 | 63.0 |
| WR-3P | Gd | 0.0 | 40.0 | 40.0 |
| WR-4 | Sed | 52.8 | 0.2 | -52.6 |
| WR-4P | Sed | 90.3 | 0.4 | -89.9 |
| WR-5 | Gd | 13.1 | 52.3 | 39.2 |
| WR-5P | Gd | 18.8 | 171.4 | 152.6 |
| WR-6 | Gd | 22.5 | 221.0 | 198.5 |
| WR-6P | Gd | 13.1 | 224.2 | 211.1 |
| WR-7 | Gd | 49.7 | 107.0 | 57.3 |
| WR-7P | Gd | 21.6 | 122.1 | 100.5 |
| WR-8 | Sed/O | 39.1 | 0.0 | -39.1 |
| WR-8P | Sed/O | 18.1 | 4.8 | -13.3 |
| WR-9 | Sed | 0.6 | 3.2 | 2.6 |
| WR-9P | Sed | 0.0 | 3.8 | 3.8 |
| WR-10 | Sed | 0.3 | 6.4 | 6.4 |
| WR-10P | Sed | 0.0 | 13.9 | 13.9 |
| WR-11 | Sed | 0.0 | 2.4 | 2.4 |
| WR-11P | Sed | 74.1 | 0.4 | -73.7 |
| WR-12 | Gd | 5.0 | 163.0 | 158.0 |
| WR-12P | Gd(skarn) | 0.6 | 191.0 | 190.4 |
| WR-13 | Sed | 60.0 | 7.2 | -52.8 |
| WR-13P | Sed | 12.5 | 15.0 | 2.5 |
| B-1 | Sed | 0.0 | 1.8 | 1.8 |
| B-2 | Sed | 0.0 | 2.0 | 2.0 |
| B-3 | Sed | 9.7 | 7.2 | -2.5 |
| B-4 | Sed | 46.9 | 17.5 | -29.4 |
| B-5 | Sed | 0.3 | 0.1 | -0.2 |
| B-6 | Sed | 32.3 | 8.0 | -24.3 |
| B-7 | Gd | 2.8 | 3.6 | 0.8 |
| B-8 | Sed | 10.3 | 1.5 | -8.8 |
| B-9 | Sed | 29.1 | 7.2 | -21.1 |
| B-10 | Gd | 98.8 | 48.3 | -50.5 |
| B-11 | Gd | 1.2 | 107.2 | 106.0 |
| B-12 | Gd | 0.0 | 125.0 | 125.0 |
| B-13 | Gd/O | 35.3 | 75.1 | 39.8 |
| B-14 | Gd/O | 12.2 | 42.4 | 30.2 |
| B-15 | Sed | 40.6 | 8.5 | -32.1 |
| Average for Granodiorite[2] | | 20.7 | 104.2 | 83.6 |
| Average for sedim. rocks[2] | | 19.5 | 18.0 | -1.5 |
| Average for pit, 24% Gd, 76% Sed. | | 19.8 | 38.7 | 18.9 |

Source: Core Laboratories 1990a, 1990b, 1990c.

[1]Designation P is a second analysis from a similar core interval. Sample WR-11 is a replicate of sample WR-10, sample WR-11P is a replicate of WR-4P, and sample B-15 is a replicate of B-6. The averaging scheme has been weighted to take replication into account.

[2]Sed = sedimentary rocks; Gd = granodiorite and related rocks; O = ore.

Betze Pit Water Body Geochemistry Study. The water body in the Betze Pit would undergo both geochemical and physical reactions. In addition, the water would react with the rock faces of the pit. To project the effects of these reactions, a number of technical studies were conducted. The concentration of constituents due to evaporation was determined based on the hydrologic data developed by Leggette, Brashears & Graham, Inc. (1990). The reactions in the water body were analyzed using the WATEQ4F model assuming that there would be no reaction with the pit wall rock. The details of each analysis are presented in the Water Resources Technical Report.

The effect of evaporation was calculated from the hydrologic data provided by Leggette, Brashears & Graham, Inc. (1990). The impact of evaporation would be relatively insignificant on the time-scale considered, causing a rise in the concentrations of conservative solutes of 35 percent by the year 2100. Eventually, after about 200 years, the water body would reach a hydrologic steady state condition, with the inflow from groundwater estimated to be 1.8 cfs, outflow 0.8 cfs, and evaporation 0.98 cfs (Leggette, Brashears & Graham, Inc. 1990). This suggests that when the water body reaches a chemical steady state, some time after it reaches a hydrologic steady state, the concentrations of conservative solutes would be increased by a factor of 2.25.

If the reactions between the water in the Betze Pit and the wall rock are ignored, the predicted composition of the water body in the pit at the year 2100 and under study state conditions are as shown in Table 4-19. The concentrations of sodium, potassium, calcium, magnesium, sulfate, fluoride, and most trace elements are equal to the inflow values elevated by 35 percent for the year 2100 and by 225 percent for the chemical steady state condition. Calcium and alkalinity are decreased by precipitation of calcite, aluminum by precipitation of a hydroxide or aluminosilicate, and iron and manganese by precipitation of oxyhydroxides. The modeling of the future water quality is further discussed in the Water Resources Technical Report. The pH would be approximately 8.3 to 8.5. At the year 2100, this water would meet all present primary drinking water standards for constituents that are likely to be present in the water body. The predicted arsenic concentration would approach the drinking water standard in the year 2100 and would be slightly above the standard at the chemical steady state condition. The predicted arsenic values may be slightly high, as some arsenic would coprecipitate with iron and manganese oxyhydroxides (the natural process would be analogous to the water treatment currently used by Barrick to remove arsenic). Arsenic removal by adsorption is further discussed in the Water Resources Technical Report. The uncertainty associated with the predicted arsenic concentration is probably about a factor of 3.

As was done to determine the chemical composition of the water that would enter the Betze Pit following dewatering, both static and

TABLE 4-19

PREDICTED PIT WATER COMPOSITION[1]

(mg/l EXCEPT pH) IN YEAR 2100 AND AT

CHEMICAL STEADY STATE CONDITION

| | Year 2100 | Chemical Steady State[2] | Drinking Water Standards |
|---|---|---|---|
| Alkalinity (as $CaCO_3$) | 194.73 | 299.22 | |
| Aluminum (Al) | 0.05 | 0.05 | |
| Arsenic (As) | 0.04 | 0.06 | 0.05[3] |
| Boron (B) | 0.57 | 0.95 | |
| Cadmium (Cd) | 0.01 | 0.01 | 0.01[3] |
| Calcium (Ca) | 8.96 | 4.44 | |
| Chloride (Cl) | 39.20 | 65.53 | 250.0[4] |
| Copper (Cu) | 0.02 | 0.03 | 1.0[4] |
| Cyanide (CN) | 0.01 | 0.02 | |
| Fluoride (F) | 1.29 | 2.16 | 4.0[3] |
| Iron (Fe) (D) | 0.10 | 0.10 | 0.3[4] |
| Lead (Pb) | 0.02 | 0.03 | 0.05[3] |
| Magnesium (Mg) | 33.50 | 56.00 | 125.0[4] |
| Manganese (Mn) | 0.06 | 0.10 | 0.05[4] |
| Nickel (Ni) | 0.02 | 0.03 | |
| Nitrate ($NO_3$) | 0.75 | 1.26 | 10.0[3] |
| Phosphate ($PO_4$) | 0.08 | 0.14 | |
| Potassium (K) | 21.55 | 36.02 | |
| Silica ($SiO_2$) | 43.11 | 72.07 | |
| Sodium (Na) | 78.52 | 131.25 | |
| Sulfate ($SO_4$) | 123.74 | 206.85 | 250.0[4] |
| Zinc (Zn) | 0.07 | 0.12 | 5.0[4] |
| Total Dissolved Solids (TDS) | 470.00 | 759.00 | 500.0[4] |
| pH | 8.30 | 8.48 | 6.5-8.5[4] |

[1] Assuming no reaction between inflow and pit wallrock.

[2] More than 200 years into the future.

[3] Primary Drinking Water Standard, Maximum Contaminant Levels. The Primary Drinking Water Standards are intended to regulate the quality of water flowing from the tap to the ultimate user.

[4] Secondary Drinking Water Standard, Secondary Maximum Contaminant Levels. The Secondary Drinking Water Standards are intended to regulate contaminants that primarily affect the aesthetic qualities relating to the public acceptability of drinking water.

humidity cell tests were performed on rock samples characteristic of the final pit wall rock. The details of the testing procedures are presented in the Water Resources Technical Report.

For the static tests, an average acid neutralizing potential for the rocks that would comprise the pit wall was calculated by computing averages for the sedimentary rock and for the granodiorite based upon whole rock analyses (Core Laboratories 1990a, 1990b) (see Table 4-18). For the sedimentary rocks, the acid generating potential and acid neutralizing potential are approximately equal; for the granodiorite, however, the acid neutralizing potential is much greater than the acid generating potential. The mean net acid neutralizing potential for the pit wall was calculated as being 24 percent of the granodiorite value plus 76 percent of the sedimentary rock value (see Table 4-17). When these proportions are used, the acid neutralizing potential of the wall rock as a whole is approximately twice the acid generating potential. The relative proportion of sedimentary rock and granodiorite in contact with water would vary somewhat as the pit fills, but sufficient granodiorite would be in contact with the water at any level to assure neutralization. The static analysis indicates that the pit water would not become acidic under any plausible circumstances.

Humidity cell tests were conducted on 24 composite rock samples (Core Laboratories 1990c). Leachates were analyzed for acidity and sulfate weekly for 10 weeks, and for arsenic and other trace elements after 1, 2, and 10 weeks. The results of this test work can be summarized as follows:

1. Of the 24 samples, 8 generated significant acid, 13 generated no acid, and 3 were borderline. These relative proportions are consistent with what would be predicted from the static tests.

2. High arsenic concentrations were generated only when the pH was below 5, and not all acid leachates contained high arsenic concentrations.

3. No trace elements other than arsenic appeared in significant concentrations.

Oxidizing conditions are expected for the water body since organic content is low and biological activity is at a minimum. Also, thermally driven water circulation would probably maintain oxidizing conditions throughout the water body. Mobilization of arsenic as organo-arsenic complexes would not be likely given the low dissolved organic carbon content.

Arsenic Toxicity. Arsenic is a trace element of concern due to its toxicity and its presence in naturally occurring rock formations and aquifers in the region. The chemistry of arsenic in aquatic systems is unusually complex with oxidation-reduction, ligand exchange, precipitation, and adsorption reactions all taking place (Ferguson and Gavis 1972). Arsenic is stable in four oxidation states (+5, +3, 0 [metallic], and -3). Arsenic metal occurs only rarely. The -3 state is present in gaseous AsH3 (arsine) which may form under some natural conditions. In aquatic environments, the +3 and +5 valence states are common and occur in a variety of complex minerals and in dissolved salts.

Predictions of arsenic concentrations in the Betze Pit water body have been previously presented for total arsenic, regardless of the oxidation state. Therefore, in order to make conservative estimates as to the potential toxicity of arsenic, it will be assumed that the all of the arsenic would be in the most toxic form, either trivalent (+3) or pentavalent (+5), depending upon whether acute or chronic endpoints are being assessed.

The predicted arsenic concentrations for the water in the Betze Pit were compared to existing EPA criteria and toxicity values for trivalent and pentavalent arsenic. Based upon the predicted values for arsenic, it is possible that concentrations may be high enough to result in adverse effects on algae or some invertebrates. Faunal toxicity, especially for vertebrates, should not be a problem since the toxic levels of arsenic for animals are generally much higher than for plants. It is also likely that at least some of the arsenic would be lost as a result of complexion with metals and other substances. Accumulation of arsenic in organisms (bioaccumulation) and transfer through trophic levels (biomagnification) should not be a problem. Arsenic exhibits a low bioconcentration factor (less than 20 in various organisms) and rapid depuration (loss from an organism).

<u>Betze Pit Water Body Physical Characterization Study</u>. In addition to the chemical composition of the water, the physical characteristics of the Betze Pit water body would affect its potential uses as part of the post-mining environment. The water body created by inflow of groundwater to the pit would be deep, with steep sides as a result of the mine benches constructed during the active operations. The area available for shoreline and subsurface vegetative growth would be limited because of the shape of the pit, and would be very low compared to the quantity of water which would be contained within the pit. Using these physical data and chemical data to project nutrient presence, the water body's potential for productivity was analyzed.

The potential productivity of the Betze Pit water body was estimated from both the physical characteristics (e.g., mean depth and shoreline development index) and the predicted chemical (in particular, phosphate) concentrations (see Water Resources Technical Report). Phosphate levels were used to predict algal concentrations and fish production. Analysis of both the predicted physical and chemical characteristics of the Betze Pit water body indicate the water would be oligotrophic in nature; that is, both primary and secondary biotic production would be quite low. Although no attempt was made to estimate secondary production of benthic organisms, this should also be low due not only to low primary productivity but also to the relatively small colonization area of the lake bottom that would be within the lake's trophogenic zone (zone of food production).

4.4.9.2 Alternatives

Partial Pit Backfill. The Partial Pit Backfill alternative would require the placement of waste rock back in the Betze Pit to the pre-mining water table elevation of 5,300 feet. This would preclude the creation of a water body in the pit; however, the inflow of groundwater to the pit would still occur. The effect of backfilling the pit on water quality can be predicted qualitatively. The major differences from an open water body would be the much greater amount of rock available to react with the water, and the decreased contact with the atmosphere. The backfill material would contain sulfides, and products of sulfide oxidation during handling and intermediate storage (sulfates, iron oxyhydroxides with adsorbed trace elements).

Any sulfates present in the waste rock would dissolve rapidly, causing an immediate increase in the salinity of the water within the backfilled material. Sulfides in the waste rock would oxidize until oxygen in the water became depleted. This would tend to increase calcium and sulfate concentrations. After oxygen was depleted, the water would become reducing; iron oxyhydroxides would tend to dissolve, releasing adsorbed arsenic, and arsenic would tend to be reduced from the +V to the +III oxidation state, which would result in desorption and elevated concentrations in solution.

The water in the backfill material would be of relatively poor quality. It would be more saline than present-day groundwater and would contain elevated concentrations of arsenic.

4.4.9.3 Cumulative Impacts. As previously noted, it is probable that other mining in the vicinity of the Betze Pit would continue, and it is probable that the development of one or more open-pit mines would result in the creation of water bodies following active mining and dewatering. Newmont's Genesis Mine is currently being dewatered and will be an open water body in the future.

Development of Newmont's Deep Post or Barrick's Deep Post deposit by open pit methods would increase the volume and size of the Betze Pit water body. Mining of the Newmont Capstone/Bootstrap deposit by open-pit mining would also create an open water body; however, such a water body would probably be much smaller than the Betze Pit water body. It is uncertain whether or not Newmont's Deep Star or Barrick's Purple Vein deposits could be mined by open-pit methods.

If the deposits were to be dewatered and mined by underground methods, subsurface water reservoirs would be created after mining is completed.

The groundwater quality inflow to and resulting water quality of water bodies created by dewatering and mining of these other deposits may be similar to the water quality in the Betze Pit water body. If similar to the Betze Pit water body, other pit water bodies should be of good water quality with slightly elevated Total Dissolved Solid levels over the long-term due to evaporation from the open pits. The physical characteristics of the other open pits would be similar to the Betze Pit. As would be the case for the Betze Pit water body, the resulting water bodies would be expected to be oligotrophic in nature. The quality of the water that would fill any areas that would be mined by underground mining methods cannot be predicted without site specific data that presently are not available.

4.4.9.4 No Action Alternative. The No Action alternative would involve continued mining of the Post Pit for one or two additional years resulting in a pit that would be smaller than the proposed Betze Pit. Water would accumulate in the pit over a number of decades to form a water body that would be similar to the future Betze Pit water body but smaller in size. The quality of this water body can be estimated qualitatively.

The Post Pit is presently below the groundwater level of about 5,300 feet and is excavated into sulfide and oxide ore of the Post deposit. Although the Post deposit would be depleted by the present operation, the Betze deposit with associated high arsenic-containing rocks would remain in place. Therefore, groundwater refilling the Post Pit may come in contact with high arsenic rocks and may contain higher levels of arsenic than the water body which would form under the Proposed Action. The inflow, outflow, and evaporation from the No Action alternative would be roughly the same as for the Proposed Action and would result in similar concentrations of constituents other than arsenic. The potential for increased concentrations of arsenic in the Post Pit water body could result in a significant impact to water quality under the No Action alternative.

The Post Pit would have physical characteristics similar to those of the proposed Betze Pit. The pit water body would be approximately 750 feet deep with steep slopes at the edge and a shoreline which would be approximately round. There would be little area for littoral development and macrophytic growth would be minimal. With the exception of arsenic, the chemical composition of the Post Pit water body would be similar to the Betze Pit water body resulting in similar productivity. The Post Pit water body would most likely resemble an oligotrophic system and there would be limited potential for the development of aquatic life.

4.4.9.5 Mitigation. Predictions of pit water quality indicate the potential for elevated levels of arsenic in water that would refill Betze Pit and concentrate due to evaporation. Sampling and analysis of pit water could be conducted as the pit refills to monitor arsenic levels and to confirm water chemistry predictions. Arsenic can be precipitated out of solution by addition of ferric sulfate, the same process that is presently utilized to remove arsenic from dewatering discharge. Treatment of the Betze Pit water body could be undertaken in the event that arsenic levels exceed standards applicable to the expected use of the water body.

4.4.10 Impacts to Regional Groundwater Quality

The probable water quality of the Betze Pit water body and other water bodies are presented in Section 4.4.9. There would be long-term inflow to and outflow from these water bodies once the regional hydrologic system returns to balance. These water bodies would have some impact on the regional groundwater quality because of the outflow, albeit small, from these pits.

4.4.10.1 Proposed Action. During recovery of the regional groundwater system, water levels would rise in the Betze Pit. Flow would occur radially into the pit through most of the recovery period. Once the original groundwater levels are reached, there would be about 0.8 cfs flow out of the pit and into the regional groundwater system. During refilling of the pit, evaporation would cause constituents to be concentrated within the pit water (see Section 4.4.9.1). By the year 2100 the pit water would meet all present drinking water standards with the possible exception of arsenic concentrations. Water from the pit could potentially seep through the pit walls into the groundwater system and move downgradient in a southwesterly direction. Wells, springs, seeps, creeks, and other surface water features connected to the regional groundwater system downgradient from the pit may receive water from the pit. The water quality of the receiving features would be affected by the elevated concentrations of constituents in water from the pit.

4.4.10.2 Alternatives

Partial Pit Backfill. An alternative to leaving the Betze Pit open would be to partially backfill the pit with waste rock. As discussed in more detail in Section 4.4.9.2, water within the backfilled pit would be of relatively poor quality, would be more saline than present-day groundwater, and would contain elevated concentrations of arsenic. Pre-mining groundwater flow conditions would be approximately restored so that constituents within the water in the backfill would flow into regional groundwater system. The impact to groundwater quality would be greater than for the Proposed Action because levels of constituents would be higher, which would be unavoidable under this scenario.

4.4.10.3 Cumulative Impacts. The water quality of water bodies other than the Betze Pit was discussed in Section 4.4.9.3. Other than the water body which would be created by the cessation of dewatering in the Genesis Pit, it is difficult to forecast which deposits would be mined in the future by open-pit methods. However, it is probable that one or more of the deposits occurring beneath the water table would be developed and would result in a long-term water body.

The Genesis Pit is expected to be an open pit which would fill with groundwater and which may have water quality conditions similar to the Betze Pit. The impacts to groundwater quality from this operation may be similar to the impacts from the Betze Pit. Data are presently unavailable to assess the potential for elevated levels of arsenic in the Genesis Pit.

4.4.10.4 No Action Alternative. Under the No Action alternative, operations within the Post Pit would cease within the next 1 or 2 years and the pit would be allowed to refill with groundwater. Presently, dewatering operations are pumping water with arsenic levels of 0.20 to 0.25 mg/l from the rock around the Post Pit. This water may be representative of groundwater that would refill the pit which is higher in arsenic than what is predicted for the Betze Pit. The potential impact of the No Action alternative on regional groundwater quality would be greater than that for the Betze Pit.

4.4.10.5 Mitigation. Water with slightly elevated levels of arsenic may migrate from the Betze Pit water body following recovery of groundwater to pre-mining elevations. Mitigation is proposed in Section 4.4.9.5 to monitor the quality of water that accumulates in the pit during recovery. The water in the pit could be treated to remove arsenic should concentrations exceed acceptable limits. This mitigation procedure would also mitigate potential impacts to groundwater because the arsenic in the pit water would be removed before the water would migrate into the regional groundwater system.

4.4.11 Water Quality Impacts from Betze Project Facilities

4.4.11.1 Proposed Action. Cyanide would be used as the agent for leaching gold from the ore mined from the Betze deposit. Cyanide is toxic to most forms of life above varying threshold concentrations. An accidental release of solution containing cyanide from the proposed processing facilities could cause significant environmental effects depending on the quantity of solution released and the concentration of cyanide in the solution. The various forms and toxicities of cyanide are discussed in this section.

In addition, the construction, operation, and reclamation of the waste rock disposal areas, the ore stockpile areas, the additional tailings impoundment, and the additional heap leach facility would potentially affect surface and groundwater quality. These potential impacts were assessed to determine short-term, localized effects and longer-term, regional effects on water quality.

Cyanide. Cyanide occurs in several forms and its toxicity varies with the form in which it occurs. Free cyanide includes both the cyanide ion (CN-) and hydrogen cyanide (HCN) in solution. The relative concentrations of CN- and HCN are dependent upon the pH of the solution, with HCN being more abundant below a pH of about 9.4. A simple cyanide salt is produced by the combination of the cyanide ion (CN-) with an alkali (sodium or potassium) or metal cation. Sodium cyanide (NaCN) is used in the process solutions. Complex cyanides are formed by the combination of heavy metal ions with two or more cyanide radicals. The stability of complex cyanides varies according to the metal to which the cyanide is bonded; weak complexes are formed with cadmium or zinc, moderate complexes are formed with copper, nickel or silver, and strong complexes are formed with iron, cobalt or gold.

Cyanide is toxic to most forms of life above varying threshold concentrations. Free cyanide is the most toxic form of cyanide. The toxicity of other forms of cyanide depends upon the ease with which free cyanide is liberated from the cyanide compound. Free cyanide and hydrogen cyanide are readily absorbed by living tissue and interfere with the process of respiration. The cyanide ion reacts with the metal constituents of enzymes, especially cytochrome oxidase, inactivating the enzymes and preventing the utilization of oxygen by cells. Cells of the nervous system are particularly sensitive to reduced levels of oxygen, and therefore, death may result from depression of the central nervous system.

The lethal level of cyanide concentration varies for living organisms, mostly as a function of body weight. The lethal concentration for fish varies from about 25 ug/l to about 300 ug/l. Cyanide also has deleterious effects on fish reproduction and the growth and development of offspring. Toxic levels of cyanide for plants are not well documented. Reported concentrations that are lethal to various mammals include 3 mg/kg for mice, 0.1 mg/kg for birds, and 100 to 300 mg/l hydrogen cyanide vapor for humans. Ingestion of cyanide substances in the range of 50 to 200 mg is lethal to adult humans and the lethal dose for absorption through the skin is 100 mg/kg body weight (Huiatt et al. 1983).

The EPA recommends a concentration not to exceed 0.2 mg/l Weak Acid Dissociable (WAD) CN for ambient water quality standards to protect humans from direct consumption of contaminants within the water or from fish within contaminated water. The concentration of sodium cyanide typically utilized at Barrick's heap leach operation is 120 mg/l to 400 mg/l or an equivalent concentration of about 64 mg/l to 212 mg/l of free cyanide. A well-operated heap leach facility should pose little hazard to humans. The most likely result of a major release of cyanide solution would be the poisoning of aquatic species. Animal species that drink process solution would suffer severe effects or death depending on the concentration and volume of the solution. Animals that survive an acute cyanide poisoning recover rapidly due to natural detoxification processes within the body that remove the contaminant from the body. Environmental effects of cyanide spills or leaks would be limited in extent and time of contamination due to the rapid degradation of cyanide within the environment.

Cyanide is a highly reactive substance and is, therefore, short-lived in the environment. It is degraded or transformed by the processes of volatilization (of hydrogen cyanide), formation of ammonia and formate, oxidation, complexation with heavy metals, biological activity, conversion to thiocyanate (SCN-) and sorption. Some iron cyanide complexes decompose in the presence of sunlight. Natural degradation through volatilization of hydrogen cyanide accounts for 90 percent of the decrease in cyanide concentration at mine sites in Canada (Simovic et al. 1985; Schmidt et al. 1981). Other processes are responsible for the degradation of lesser amounts of cyanide.

Sodium cyanide is designated as a "hazardous substance" for purposes of the release reporting requirements of the Comprehensive Environmental Response, Compensation and Liability Act (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 NDEP. The reportable quantity for sodium cyanide is 10 pounds. Barrick would report the release of 10 or more pounds of sodium cyanide to the National Response Center and the NDEP. 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 10 milligrams of cyanide per kilogram of soil. Barrick would comply with these provisions of federal and state law and ensure that all significant releases of cyanide would be reported promptly and thoroughly cleaned up.

A more complete discussion of cyanide chemistry and toxicity is included in the Water Resources Technical Report. Potential impacts associated with the tailings impoundment or heap leach facilities are discussed later in this section.

Waste Rock Disposal Areas. Under the proposed plan to develop the Betze Pit, approximately 781 million tons of waste rock would be deposited in the existing South Block and the proposed Extended South waste rock disposal areas. The waste rock would contain some sulfide minerals from the ore deposit. The waste rock would also contain locally high levels of arsenic excavated during the mining process. Some seepage of precipitation through the waste rock may become acidic due to oxidation of sulfide minerals in the rock. This acidic seepage may then dissolve heavy metals, such as arsenic, from the rock that would otherwise have remained immobile.

The acidic seepage may percolate through the waste rock into the groundwater beneath the site or it may seep out the base of the waste rock to a surface water drainage.

Water quality impacts due to the waste rock disposal areas would depend on the rate of seepage through the waste rock and on the occurrence of acid generating materials within the waste rock. The modeling process used to estimate the amount of seepage or runoff from the waste rock and the laboratory analyses used to estimate the potential of the waste rock to generate acid are described in the Water Resources Technical Report.

The Hydrologic Evaluation of Landfill Performance (HELP) model indicates that there would be no surface runoff from the waste rock areas whether or not the surfaces of the waste rock are topsoiled and reclaimed. This would indicate that the waste rock disposal areas would have no impact on surface water resources within the project area. The HELP modeling study also indicates that about 10 percent of the annual precipitation at the project area would percolate through the waste rock to the regional groundwater system. The remainder of the precipitation would be lost to the atmosphere via evapotranspiration. Therefore, a relatively small volume of water would be available for oxidation of sulfide minerals and subsequent percolation from the waste rock areas.

Results of the geochemical laboratory analyses indicate that the waste rock as a whole would not generate acidic seepage. This assumes that the waste rock would be mixed so that seepage from areas that generate acid would subsequently pass through neutralizing waste rock. Any arsenic that would be liberated during acid generation likely would be adsorbed to iron oxyhydroxide compounds upon neutralization of acidic leachate. The water chemistry of waste rock seepage can only be discussed qualitatively. After passage through the waste rock, seepage likely would be somewhat similar to existing groundwater with some possible exceptions. Sulfate and TDS may be somewhat elevated over existing levels due to oxidation of some of the waste rock material.

Ore Stockpiles. The Proposed Action would require the construction of two ore stockpiles: one located south of the proposed heap leach pad on the North Block and one located east of the existing heap leach pads on the AA Block panhandle. These ore stockpiles were reviewed to determine the impacts from leachate generated by the ore contained in the stockpiles. The analyses performed with respect to the ore stockpiles are described in detail in the Water Resources Technical Report.

The impacts of seepage from ore stockpiles on water quality of groundwater and surface water resources can be evaluated in light of infiltration modeling and geochemical laboratory tests. The HELP modeling study indicates that typically there would be no runoff from the ore stockpiles to collect inside the berm around the stockpiles. Surface water runoff from the watershed above the stockpiles would be diverted around the stockpiles to prevent contamination of unimpacted waters. However, any seepage from the stockpiles would likely be acidic and would contain arsenic. Seepage from the stockpiles could percolate downward to the regional groundwater system causing a reduction in groundwater quality. Once the stock piles are removed, the source of groundwater contamination would be removed but any constituents already in the ground would continue to move downgradient in the regional groundwater system.

Tailings Impoundment. The tailings impoundment would include an earthen embankment to retain the tailings, a tailings slurry pipeline, a water reclaim station and pipeline, a seepage collection pond and return pump system, and water diversion ditches. The preliminary design for the tailings embankment would be an earthfill dam consisting of an upstream silt/sand zone and a downstream zone constructed from mine waste. The two zones would be separated by a filter/drainage geotextile layer. The impoundment would be designed to contain the 100-year, 24-hour storm. In areas within the impoundment having a vertical permeability greater than $10^{-6}$ cm/sec, a clay layer having a thickness of at least 1 foot would be installed to restrict seepage into subsoils. Tailings slurry and reclaim water pipelines would be located so that any spills or pipeline breaks would flow into the impoundment or would be contained in shallow trenches that lead to catchment ponds minimizing the potential of accidental spills escaping beyond the area of operation. A seepage collection pond lined with synthetic materials would be excavated at the downstream toe of the embankment to collect any seepage emanating from the embankment drains. This water would be either pumped back into the impoundment or back to the mill. Diversion ditches would be constructed upgradient of the impoundment and slightly above the ultimate dam crest elevation. The ditches would be designed to limit surface water inflow to the impoundment by diverting and discharging storm runoff to the natural drainage areas on each side of the impoundment area.

As a result of the proposed construction methods, and as required by the State of Nevada, the tailings impoundment and pipelines would contain all process fluids under normal operation. In the case of a breach of the pipelines, fluid would be contained in the tailings impoundment or in a trench along the pipelines. A breach of the secondary containment system at the Brush Creek crossing could introduce cyanide-containing water/tailings slurry to the creek.

Aquatic life in Brush Creek and in Rodeo Creek downstream of the Brush Creek confluence would likely be eliminated by cyanide poisoning. Vegetation inundated by the spill would also be adversely affected. Degradation of cyanide that routinely takes place in the pipeline would occur within the spilled tailings slurry. Since the tailings are treated with hydrogen peroxide prior to pumping to the tailings impoundment, the levels of cyanide would be reduced rapidly due to the hydrogen peroxide treatment and to other natural degradation processes. Exposure of animals and humans to cyanide would be unlikely. Aquatic life would likely recolonize within perennial reaches of Brush and Rodeo Creeks during the following spring runoff event. Thus, the impacts of a tailings spill would be short-term.

Heap Leach Facility. The principal components of the heap leach facility consist of a lined leach pad, lined solution collection ponds, a gold recovery facility (carbon columns), and a pipe system to convey solution to and from the leach area, collection ponds, and the recovery plant. The leach pad would be lined with a single layer of 80-mil synthetic liner to prevent solutions from percolating into the foundation subsoils. To keep the solution head to a minimum at the liner, a drain system would be installed on top of the liner which would consist of free draining gravel material and a system of drain pipes interconnected to collect and transport leach solutions to the collection ponds. The ponds would be double-lined with a 12-inch thick clay or a synthetic underliner and a primary synthetic liner with leak detection and collection systems between the primary and secondary liners. The collection ponds would be designed to operate as separate entities. The sizing of the overflow pond capacity has been established by the State of Nevada and is required to meet criteria which includes: 1) containing runoff from the 25-year, 24-hour storm event; 2) containing runoff resulting from a 48-hour power outage; 3) containing any required operating volumes for the ponds; and 4) allowing for 3 feet of freeboard on the overflow pond. Overflow capacity would be provided by raising the berms and lining the side slopes with clay or a synthetic liner. Drainage diversion ditches would be designed and constructed around the leach facility to divert surface water flows resulting from the 100-year, 24-hour storm event. As designed, the heap leach facilities would contain all process fluids and would divert all unimpacted surface waters from the facility.

In the unlikely event that the heap leach facilities were overtopped by runoff from a storm event in excess of the 100-year, 24-hour flood, cyanide-containing fluids could be released into Rodeo Creek. Aquatic life within perennial reaches of the stream would likely be eliminated, and vegetation may be adversely affected. However, considerable dilution of the cyanide-containing fluids would occur through mixing with runoff from areas adjacent to the heap leach pad and farther downstream. Cyanide exposure to animals or humans would be unlikely. Aquatic life would return to Rodeo Creek during the next runoff event, and residual cyanide would degrade by natural processes.

4.4.11.2 Alternatives

Waste Rock Disposal Areas and Processing Facilities. Alternatives for waste rock disposal areas, ore stockpiles, tailings impoundment, and heap leach facilities involve differences in the location of the proposed facilities. The construction process and permitting requirements for the alternative facilities would be the same as for the Proposed Action, and therefore, the water quality impacts of the alternatives would be the same as for the Proposed Action. The only exception to this would be alternative locations of ore stockpiles.

Ore Stockpiles. One alternative ore stockpile would be located on the top of the completed South Block waste rock disposal area. Placement of the stockpile on the waste rock provides the opportunity to selectively place acid consuming material beneath the ore. This could mitigate the impacts of any potentially acidic seepage which could be generated by the ore. A second alternative ore stockpile location is on the spent AA Block heap leach pads. Placement of ore on these pads would take advantage of the existing liner beneath the heap leach pads to mitigate the impacts of any acidic seepage from the ore stockpile. Both alternative locations would provide mitigation of impacts due to seepage of acidic leachate.

4.4.11.3 Cumulative Impacts. All planned facilities to be constructed in the vicinity of the Proposed Action would be constructed and permitted in the same manner as the facilities in the Proposed Action. Therefore, cumulative impacts from construction of similar additional mining facilities in the area would not be different from the impacts associated with the Proposed Action.

4.4.11.4 No Action Alternative. Facilities for the Proposed Action would be constructed in a manner similar to those for the existing operation, which would continue operating under the No Action alternative. The impacts of continuing to operate the existing facilities would not be significantly different from the impacts due to the Proposed Action.

4.4.11.5 Mitigation. The water quality impacts of the Proposed Action would not be significant due to components of the construction methods and permitting requirements that are already a part of the Proposed Action. All process fluids would be contained; all facilities would be non-discharging; fluid containment areas would be lined; and, process areas would be bermed and ditched. Seepage from ore stockpiles, which would likely be acidic and contain heavy metals, may percolate to the groundwater. An alternative to the proposed stockpile locations would be the alternative to place ore on top of spent heap leach facilities which already have a liner underneath. Otherwise, mitigation could be accomplished for the Proposed Action by lining the ore stockpile areas with a clay or synthetic liner to prevent seepage, or with an acid-consuming sub-base. No additional mitigation is required for the Betze Project facilities.

## 4.5 Soils

### 4.5.1 Proposed Action

Potential effects of the Proposed Action on native soil resources were evaluated to determine the extent to which project activities would result in soil losses via disturbance (removal through topsoil salvage) or accelerated erosion. Mining activities remove or disturb extensive areas of soils and vegetation exposing the underlying ground to the erosive effects of wind and water. Both short- and long-term effects can result from the different types of disturbances due to mine, mill, and heap leach development.

The BLM long-term reclamation goals for the area are: 1) to leave mine disturbances in stable configurations and with slopes that will withstand erosion and slump failure, and 2) to establish a diverse self-renewing plant community that equals or exceeds the resource values and land uses that existed before mining development (BLM 1990c).

The Proposed Action would result in the disturbance of approximately 2,189 additional acres of soil resources. The loss of soil resources on such acreage would be minimized because the topsoil horizons from all newly disturbed areas would be salvaged and stockpiled for use in reclamation and revegetation activities.

Upon completion of mining operations, all disturbed areas (e.g., waste rock disposal areas, heap leach pads, and other ancillary facilities with steep cut-and-fill slopes) would be regraded to slopes no steeper than 2.3H:1V (about 23 degrees or 43 percent). Regraded areas would then be covered with a uniform layer of approximately 1 foot of topsoil obtained from the topsoil stockpiles. The topsoil would be applied and spread with construction equipment in a manner to minimize compaction. Prior to seeding in the first fall season following topsoil redistribution, the topsoil would be sampled and supplemented to offset any marked deficiencies in nutrients such as nitrogen, phosphorous, or potassium. The soil would then be ripped and scarified along the contour with a tooth harrow or disc. Seeding with the BLM-prescribed mixtures would follow immediately. These actions would be implemented at a time when the greatest level of reclamation success would be expected, depending primarily on weather conditions.

As indicated in Section 3.5, all soil units, except for the disturbed land unit, contain salvageable topsoil. For the most part, soils within the disturbed mining areas previously have been stripped of topsoil to depths of 6 to 24 inches (see Figure 3-7).

Under the Proposed Action, the mountain soils (all "M" prefix soils) would be salvaged, on average, to depths of between 17 and 30 inches across the project area. The terrace and piedmont soils (all "TP" prefix soils) can be salvaged, on average, to depths between 8 and 24 inches. An indurated hardpan exists within the profiles of many of these soils, and topsoil salvage would not proceed beyond the top of this zone. Disturbances to the two floodplain soils would be restricted to those areas of the drainageway bottoms which would be crossed by haul and secondary access roads. Topsoil salvage of these floodplain soils, when necessary, would entail stripping at least 36 inches of their surface horizons.

All salvaged topsoil would be applied to the disturbed areas during reclamation. A nonweighted average of approximately 16 inches of salvageable topsoil (excluding floodplain soils) exists across the project area. The suitable topsoil depth for stripping in some areas is less than 16 inches, and some of the resulting deficit would be balanced by taking additional topsoil from other disturbed areas having thicker topsoil accumulations.

Approximately 3,710,200 cubic yards of topsoil from the areas to be disturbed by the Proposed Action would be stockpiled (see Table 4-20). The topsoil stockpiles would be located to minimize impacts from operations and would be graded to slopes of 2.5H:1V to reduce erosion. The surfaces of the topsoil stock piles would be reseeded during the first fall season following their construction to minimize soil loss to wind and water erosion. Where appropriate, diversion channels would be constructed upgradient of the topsoil stockpiles to protect the stockpiles from surface water flows. Topsoil stockpile locations would be marked with signs designating them as topsoil stockpiles, not to be disturbed.

During periods of snowmelt, spring rains, and intense thunderstorms, some subsoil loss due to accelerated erosion could be expected from operational areas of the mine from which the topsoil had been removed.

Wind erosion would be expected for exposed areas where topsoil had been removed. The quantity of subsoil lost would be limited by two factors. First, surface crusting of soil is a common occurrence after rain falls on native and disturbed lands in the semi-arid and arid West. The crusting would act to consolidate and to protect the soil surface from wind erosion. Secondly, all trafficked mine areas would be regularly watered for dust suppression, which would also protect against wind erosion. The proposed erosion and sediment control measures would cause most of the exposed soils to be retained on site.

The amount of potential erosion to be expected from reclaimed areas was modeled for comparison with natural erosion losses from undisturbed areas. This was done to determine whether additional

TABLE 4-20

ESTIMATED TOPSOIL VOLUMES FOR PROPOSED AND ALTERNATIVE PROJECT COMPONENTS

| Mine Component | Disturbed Acres | Average Topsoil Depth (feet)[1] | Cubic Yards |
|---|---|---|---|
| Betze Pit | | | |
| Proposed Action | 345 | 1.1 | 612,260 |
| Waste Rock Disposal Areas | | | |
| Extended South (Proposed Action) | 912 | 1.3 | 1,912,768 |
| North | 430 | 1.0 | 693,733 |
| Clydesdales | 642 | 1.0[2] | 1,035,760 |
| Far West | 1,713 | 1.3[3] | 3,592,732 |
| Tailings Impoundment | | | |
| North Block (Proposed Action) | 476 | 1.0 | 767,947 |
| Expanded North Block | 703 | 1.1 | 1,247,591 |
| Central Area | 650 | 0.9 | 943,800 |
| Heap Leach Pads | | | |
| North Block (Proposed Action) | 142 | 0.9 | 206,184 |
| Western North Block | 145 | 1.2 | 280,720 |
| Ore Stockpiles | | | |
| North Block (Proposed Action) | 94 | 1.0 | 151,653 |
| AA Block | 46 | 0.8[4] | 59,371 |
| South Block | 102 | 0 | 0 |
| AA Block Leach Pads | 37 | 0.6 | 35,816 |
| South Block - Rodeo Creek | 74 | 1.1 | 131,325 |

[1] Assumes all previously disturbed areas (m) do not have previously salvaged topsoil available for Betze Project reclamation activities.

[2] Assumes the 97-acre area, for which detailed Order 2 soil mapping is not available, is similar to adjacent soil map unit TP6.

[3] Assumes the 673-acre area, for which detailed Order 2 soil mapping is not available, is similar to adjacent soil map unit TP10.

[4] Assumes the 46-acre area, for which detailed Order 2 soil mapping is not available, is similar to adjacent soil map unit TP13.

erosion above normal losses from native areas could be expected after completion of reclamation. Increased erosion from reclaimed areas could effect future soil productivity. The Revised Universal Soil Loss Equation (RUSLE) was used for this comparison (USDA-ARS 1990). For the purposes of this comparison, the reclaimed areas were modeled as rolling hills with overall slopes of 20 percent. Undisturbed areas were modeled as surfaces of the same rolling topography, but with overall slopes of 10 percent. The values for erosion parameters used in RUSLE for both native and reclaimed areas were obtained through field work and consultation with Barrick and BLM personnel. Appendix D discusses the model and values used for RUSLE. Results of laboratory analyses of the field samples are included in Appendix D.

Model results indicate approximately 0.05 tons of soil per acre per year could erode from undisturbed native areas within the Betze Project area compared to 0.2 tons per acre for reclaimed areas. Both values are well within the soil loss tolerance of 2 tons per acre per year which has been established by the U.S. Soil Conservation Service for shallow soils (see Appendix D).

In the Proposed Action, slopes of the waste rock disposal areas would be reclaimed to an overall side slopes of 2.5H:1V, or 40 percent. The 100-foot high benches or lifts would be reclaimed to slopes of 2.3H:1V or 43 percent. The heap leach pads would be reclaimed to slopes of 2.5H:1V. At grades of 40 to 43 percent, equipment may have limited success in reseeding, ripping, and discing on the contour. As a result, the overall success of reclamation and revegetation on these slopes could be reduced due to incomplete surface preparation.

Results of the RUSLE analysis for these 2.3H:1V (or 43 percent) slopes indicate that modeled erosion losses would range from approximately 2.6 to 4.0 tons per acre. This range would at the low end barely exceed and at the high end exceed by double the acceptable soil loss tolerance for shallow soils of 2 tons per acre, but would be less than the soil loss tolerance for deep soils of 5 tons per acre. These results tend to indicate that there may be erosion losses on the 43 percent slopes which would exceed acceptable soil losses for shallow soils.

Barrick intends to construct several revegetation test plots to assess the viability of various seed mixtures and agricultural practices. Based on the results of the test plots, a final reclamation program would be implemented under BLM direction which would meet the goals of long-term stability and establishment of desirable, self-renewing plant communities.

The potential for reclamation and revegetation is generally affected by the quality and depth of the soil material available for reclamation and by the characteristics of the material (waste rock, leached ore, or tailings) that would be reclaimed. Based upon past stripping and the proposed stripping depths, mining disturbances would be resurfaced with approximately 1 foot of medium to moderately textured topsoil. This topsoil should provide good revegetation results. In general, waste rock and leached ore with textures that are extremely gravelly loams would have roughly similar characteristics. Neither waste rock nor leached ore would be expected to contain materials which would be harmful to plants. The Cominco revegetation plots, for example, which were established in 1985 in the BLM Elko District, showed that good revegetation results could be obtained by seeding directly into heap leach ore with or without the use of topsoil (BLM 1990d).

Under the Proposed Action, the surface of the tailings impoundment would be covered with topsoil prior to revegetation. The proposed topsoil cover may not provide an adequate growth medium for plants because tailings located within the proposed impoundment have the potential to inhibit plant growth. Because the tailings are an end product of the milling process, they may have a high pH and contain metals and other materials in quantities which may be toxic to plants. The fine texture of the tailings may also promote capillary action which could concentrate salts and other plant inhibitors at the surface of the tailings impoundment.

### 4.5.2 Alternatives

Several alternative locations for the waste rock disposal areas, ore stockpiles, leach pad, and tailings impoundment have been proposed. The main differences in impacts to soil resources between the alternatives and the proposed locations involve the total number of disturbed acres and the total number of cubic yards of topsoil material available for salvage. Table 4-20 summarizes this information for each proposed and alternative component location.

4.5.2.1 Waste Rock Disposal Areas. The Far West waste rock disposal area is the only alternative waste rock disposal area with sufficient capacity in itself to contain the quantity of waste rock to be generated by the Proposed Action. The North and Clydesdales waste rock disposal areas could contain a maximum of 24 and 40 percent, respectively, of the waste rock to be generated by the Proposed Action. Selection of these two alternatives alone or in combination, however, would reduce the height and possibly the area of the Extended South waste rock disposal area. As shown in Table 4-20, the greatest quantity of topsoil would be stripped and salvaged for reclamation uses under the Proposed Action or the Far West waste rock disposal alternative.

In selecting the North or Clydesdales waste rock alternatives, the Extended South waste rock disposal area would still be required, although it would be lower in height by 200 and 300 feet, respectively. The North waste rock disposal area would disturb a total of 430 acres, and the Clydesdales waste rock disposal area would disturb 642 acres. Therefore, selection of either of these alternatives would result in additional soil disturbance.

If both the Clydesdales and North waste rock disposal areas were selected, the Extended South waste rock area disturbance would be reduced 550 acres from a total of 912 acres as described in the Proposed Action; the Extended South waste rock disposal area would, in addition, be reduced by an overall height of 300 feet. This would result in the disturbance of a total of 1,400 acres of surface disturbance if both the North and Clydesdales areas were selected, which is an additional 578 acres of soil disturbance over the Proposed Action.

4.5.2.2 Ore Stockpiles. The alternative ore stockpiles, with the exception of the South Block - Rodeo Creek site which would disturb 24 acres, would be located primarily in areas of previous disturbance. In contrast, the Proposed Action would result in the temporary disturbance of 140 acres of presently undisturbed land.

4.5.2.3 Leach Pad. The alternative leach pad site would be similar to the proposed location and would be of sufficient size to contain the projected volume of heap leach grade ore. Topsoil to a depth of approximately 1 foot would be placed on the surface from proposed topsoil stockpiles. Slopes of 2.5H:1V would have the same impacts as discussed in the Proposed Action. At grades of 2.5H:1V or 40 percent, equipment may have limited success in reseeding, ripping, and discing on the contour. The end result could be to reduce the overall success of revegetation and reclamation on these slopes. There would be no other significant differences with respect to impacts to soils between the proposed and alternative heap leach pad locations.

4.5.2.4 Tailings Impoundment. The alternative tailings impoundment sites would be similar to the site chosen for the Proposed Action. Each would be of sufficient size to accommodate the projected volume of tailings. Each would have approximately 1 foot of topsoil placed on the surface from the proposed topsoil stockpiles. Apart from variations in the total area of new disturbance, there would be no significant differences in impacts to soils among the Proposed Action and alternative tailings impoundment areas.

The alternative reclamation procedure for the tailings impoundment would be to place waste rock on the surface of the impoundment during reclamation in a selective manner to create uneven hills and swales. This alternative would have the advantage of covering the tailings with several feet of waste rock before topsoil would be applied. If the tailings are toxic to plants, then this alternative would substantially increase the reclamation potential of the site by creating a capillary block and neutral zone between the tails and the topsoil. The North waste rock disposal area would have the advantage of placing waste material within a shorter haul distance of the tailings impoundment as compared with the proposed Extended South waste rock disposal area.

4.5.2.5 Water Disposal Methods. Reinjection or infiltration of water from the proposed dewatering program would necessitate the disturbance of additional surface area to accommodate the facilities to be used for reinjection or infiltration. The extent of surface disturbance for the reinjection alternative would be limited to the area occupied by pumping stations. The surface area that would be disturbed under the infiltration alternative would depend on the infiltration capacity of the area and the volume of water to be infiltrated. Direct discharge of dewatering volumes to Rodeo Creek or Boulder Creek would contribute significant channel erosion, bank cutting, and downstream accretion and deposition. Channel cutting and erosion could significantly redistribute soils in the floodplains of Rodeo and Boulder Creeks.

4.5.2.6 Reclamation of Waste Rock Disposal Areas. The Proposed Action involves regrading the side slopes to overall slopes of 2.5H:1V; applying topsoil; and revegetating the tops, side slopes, and benches of the Extended South waste rock disposal area. The most significant potential for erosion off the dumps would come from the side slopes of the waste rock disposal areas. For the reclamation of waste rock disposal areas, two alternative side slope configurations and topsoiling scenarios were evaluated for erosion potential:

1. Angle of Repose. This alternative would leave side slopes at the angle of repose of approximately 1.3H:1V (about 35 degrees, or 72 percent). The benches and tops of the disposal areas would be covered with topsoil and revegetated; the sides would not be reclaimed. Under this alternative, the waste rock dumped off the side of the disposal area would grade itself from finer textured waste material near the crest of the disposal area, to boulders and coarse rock at the foot of the slope. The coarse rock and boulders at the foot of the slope would tend to trap sediment generated by erosion of the slopes above, making these angle-of-repose slopes fairly stable compared to the topsoiled slopes where erosion from the finer textured soils has the potential to create sedimentation problems downslope of the waste rock disposal area side slopes.

2. Recontour Side Slopes to 3.0H:1V. Under this alternative, side slopes would be flattened to overall slopes of approximately 3.0H:1V (about 18 degrees, or 33 percent). The tops, benches, and side slopes would be covered with topsoil and revegetated. The 100-foot high interbench would be regraded upon final reclamation to slopes of 2.7H:1V, or 37 percent. Using RUSLE to model erosion losses on a 37 percent slope yields a soil loss ranging

from 0.9 to 1.4 tons per acre. The acceptable soil loss for shallow soils is approximately 2 tons per acre. Therefore, the alternative of regrading slopes to an overall angle of roughly 3.0H:1V should result in soil losses at a level where soil production would be maintained.

A variation of these alternatives to the side slope design would be to slope the benches toward the interior of the waste rock disposal area rather than to slope them outward. Insloping of benches would have the advantage of trapping sediment while retaining more moisture in the soil. The disadvantage of insloping would be to increase slope instability; water ponding on the benches could cause zones of saturation which could then lead to mass wasting.

The proposed Extended South waste rock disposal area and the alternative Far West waste rock disposal area each could accommodate the total quantity of waste rock that would be generated by the Proposed Action under either alternative side slope configuration. Neither the North nor the Clydesdales waste rock disposal area could contain all of the waste rock that would be generated by the Proposed Action. To achieve the 3.0H:1V side slope alternative at either of these alternative waste rock disposal areas, the area disturbed by the alternative waste rock disposal areas probably would not be increased, rather additional waste rock would be placed in the Extended South waste rock disposal area. As a result, lessening the side slopes of the North and the Clydesdales waste rock disposal areas to 3.0H:1V would not increase the quantity of soil resources disturbed by the alternative disposal areas, but would increase the quantity of waste rock placed in the Extended South waste rock disposal area.

4.5.2.7 <u>Partial Pit Backfill</u>. Under this alternative, waste rock would be hauled from waste rock disposal areas back to the Betze Pit to partially fill it. This alternative would reduce the overall height of, or eliminate portions of, those waste rock disposal areas from which rock would be removed for use in backfilling the pit. The effect of this alternative on soils would be essentially the same as the Proposed Action since reclamation would still extend to all disturbed areas. In addition, the partial pit backfill alternative would involve the surface grading and spreading of topsoil on approximately 490 acres of the pit surface. The topsoil volumes available from the stockpiles for reclamation of the other sites would be proportionately reduced by the need to topsoil the additional 490 acres.

Approximately 452 million tons of waste rock would be returned to the pit from the waste rock disposal area(s) under this alternative. Removal of this material from the proposed Extended South waste rock disposal area would either reduce the size of that waste rock disposal area or reduce its ultimate height, or both. To the extent that the height of a waste rock disposal area would be reduced, a portion of the side slope, which would be the more erosive and less easily revegetated portion of the dump would also be eliminated.

If an alternative to the Extended South waste rock disposal area were to be selected, waste rock would most likely be removed from the existing South Block and the proposed Extended South waste rock disposal areas first because these disposal areas are closer to the Betze Pit than are the alternative waste rock disposal areas. As a result, the configuration of the alternative waste rock disposal areas would not differ under the partial backfill alternative.

4.5.3 Cumulative Impacts

To date, the operating mines and related processing facilities of Barrick, Dee, and Newmont have disturbed approximately 5,500 acres of soil in an area extending from the Carlin Mine to the Dee Mine (see Figure 3-1). The impacts to soils of the Betze Project described in Section 4.5.1 would contribute incrementally to these disturbances.

It is foreseeable that Newmont would continue to mine and expand the Genesis, Blue Star, and Post Pits, and begin to develop by surface mining methods, the Bootstrap/Capstone, North Star, Carlin, Lantern, Pete, and Bobcat orebodies during the life of the Betze Project (see Section 3.12.3.3). Newmont also proposes to expand the tailings facility at its Mill No. 4. The continued development of the Genesis, Blue Star, Post, Carlin, and Bootstrap Pits would occur on land on which the soils have already largely been affected by mining. The expansion or development of all of the projects listed above would, together with the Proposed Action, collectively result in a disturbed area that is projected to be approximately 53 percent larger than the existing area of disturbance.

It is also foreseeable that Newmont could develop the Deep Star and Deep Post deposits, and that Barrick could develop the Deep Post and Purple Vein deposits, although the timing and nature of such potential developments cannot be forecast at this time. It is not presently known whether any of the Deep Post, Deep Star, or Purple Vein deposits would be mined by surface or underground methods. If the Deep Post deposit were to be mined by surface mining methods, it would result in an expansion of the Betze Pit. If the Deep Star and Purple Vein deposits were to be mined by surface mining methods, large areas of the surface south and north of the Betze Pit would be impacted. Most of the surface areas which would be affected by the open-pit mining of these deep deposits would be areas which have either been previously affected by mining or which would be affected by the Proposed Action. However, some incremental disturbance of existing soils would occur as a result of the development of one or more of these deposits.

Reclamation of the disturbed areas for the Newmont, Dee and Barrick projects is required by current laws and regulations for the majority of the lands, both private and public, affected by mining and processing. Many of the disturbed areas would be reclaimed and revegetated in accordance with individual reclamation plans directed by the State of Nevada and the BLM. Approximately 60 percent of all mining operations that have been developed in the vicinity of the Betze Project have not had topsoil stripped and stockpiled prior to disturbance. Therefore, reclamation of many disturbed areas, especially those on private land, would have to be accomplished in the absence of an adequate soil cap. The potential for revegetation in the absence of topsoil is probably only fair. In addition, the plant species that could be established on these reclaimed surfaces would be different than the species that presently grow or could grow in the area. In those cases where the topsoil has been stripped and can be used to resurface and reclaim mining disturbances, the long-term impacts on soils would be less significant and the productivity of these reclaimed sites would probably be fair to good.

### 4.5.4 No Action Alternative

Under the No Action alternative, Barrick would continue to mine the Post Pit and operate the existing mill, South Block waste rock disposal area, AA Block heap leach pads, and tailings impoundment to the extent authorized by existing approvals. Additional soil disturbance would be minimal because Barrick's current operations have disturbed virtually all of the area that is to be disturbed under the authorization granted by the existing plans of operation. Existing operations would be continued for an additional 1 to 2 years. Reclamation of these features would be conducted in accordance with the terms of existing approvals. Generally, all disturbed areas other than the Post Pit would be regraded and revegetated upon completion of mining. At closure, topsoil from the existing topsoil stockpiles would be spread over the disturbed area. The majority of the disturbed areas would be revegetated as required by the existing plans of operation.

### 4.5.5 Mitigation

To evaluate the effectiveness of alternative seed mixtures and fertilizer combinations, several test reclamation plots could be established and studied during the period of active mining. Information gathered from these test plots could be incorporated into the selection of appropriate seed and fertilizer mixtures to be used in reclamation.

Tailings in the impoundment could be analyzed for their ability to support plant growth. Vegetation test plots could also be used to demonstrate whether there would be any problems with plant growth on the tailings. If the tailings were to prove to be deleterious to plant growth then a potential mitigating measure could be to cover the tailings with coarse waste rock, which would act as a capillary block. Before topsoil is placed, several feet of less coarse waste rock or subsoil could then be placed above the waste rock to provide adequate rooting depth.

A possible mitigating measure for steep side slopes would be to cover these slopes with coarse waste rock. If this were done, then these slopes would be capable of supporting only minor amounts of vegetation; however, the slopes would tend to be more stable and would not become potential sources of increased erosion and sedimentation.

Waste rock disposal area lifts could be reduced to 50-foot lifts. This would have the effect of reducing the length of side slopes of the waste rock disposal areas following recontouring by about half relative to the 100-foot lifts as stated in the Proposed Action. Reduction of length of these side slopes would, in turn, reduce the erosion potential on these slopes.

## 4.6 Vegetation

In the short-term, vegetation impacts would consist of disturbances to varying acreages of existing plant communities. In the long-term, impacts to vegetation would depend on the reclamation potential of the disturbed sites and mechanical treatment practices implemented to establish vegetation.

Areas that would be disturbed by the various proposed mining components are listed in Table 4-21. As described in Section 3.6, the project area has been altered by repeated range fires, overgrazing, seeding, and mining disturbances. These events and actions have resulted in a mixture of seeded areas intermingled with monocultures of annual vegetation. Range fires have destroyed most of the shrub stands, which has resulted in the invasion of these areas by cheatgrass. As a result, the ecological status of the plant communities is predominantly early to mid-seral stages because of a lack of plant diversity and because of dominance by annual vegetation. The seedings in the project area also represent vegetation types of low species diversity although such seeded areas have high value for livestock grazing.

The reclamation plan calls for placing approximately 1 foot of topsoil over the areas to be reclaimed (waste rock, leached ore, and tailings material), as discussed in Section 4.5. The topsoil should provide good revegetation results. Neither the waste rock nor leached ore, which would be located below the soil material, should cause problems with plant growth. The BLM established a research plot which showed that vegetation could be successfully established on the heap leach ore, with or without topsoil (BLM 1990d); the study was conducted in 1985 at the Cominco American Buckhorn mine site located 90 miles southwest of the Betze Project in a 10-inch precipitation zone. Fourwing saltbrush, basin

TABLE 4-21

PROJECTED DISTURBANCE OF VEGETATION RESOURCES

PROPOSED ACTION

| Proposed Action | Ecological Site Description[1] 25-3 | 25-12 | 25-14 | 25-18 | 25-19 | 25-21 | M | S-I | S-II | Acres Affected |
|---|---|---|---|---|---|---|---|---|---|---|
| Betze Pit | 3 | | | | 201 | | 141 | | | 345 |
| Ore Stockpiles | | | | | | | | | | |
| North Block | 2 | | | | 6 | | | | 86 | 94 |
| AA Block | | | | | | | | | | 46[2] |
| Waste Rock Disposal Area | | | | | | | | | | |
| Extended South | | | | | 574 | | 68 | 270 | | 912 |
| Topsoil Stockpiles | | | | | | | | | | |
| Seven New Stockpiles | | | | | | | | | | 82[3] |
| Heap Leach Pad | | | | | | | | | | |
| North Block | | | | | 55 | | | | 87 | 142 |
| Tailings Impoundment | | | | | | | | | | |
| North Block | | 17 | 10 | | | | | | 449 | 476 |
| Haul Roads, Pipelines, Construction Areas | | | | | | | | | | 92[3] |

[1] Ecological Site Description
25- 3 = Loamy Bottom 8-14" p.z.
25-12 = Loamy Slope 10-16" p.z.
25-14 = Loamy 10-12" p.z.
25-18 = Claypan 10-12" p.z.
25-19 = Loamy 8-10" p.z.
25-21 = Shallow Gravelly Loam 8-10" p.z.
M = Mined Land
S-I = Seeding Excellent Condition
S-II = Seeding Good Condition

[2] Not surveyed.

[3] This disturbance would affect most ecological sites.

wildrye, streambank wheatgrass, and crested wheatgrass were all established on plots and averaged over 40 percent ground cover in areas where 2.5 tons per acre of straw mulch was incorporated into the surface prior to seeding.

In general, reclamation of the waste rock, leached ore, or tailings sites would yield ecological surface conditions at these sites which would have a different potential for plant growth then the ecological conditions which would have existed at these sites prior to mining. The placement of 1 foot of topsoil over waste rock or leached ore would yield sites with a potential that would be most similar to Loamy (25-19) or Loamy (25-14) ecological sites. For the tailings impoundment, the placement of 1 foot of soil material over tailings would produce an ecological site that would resemble a claypan 10-12 precipitation zone site.

The reclamation sites would vary, in terms of depth of topsoil, aspect, and slope. This variance would produce a diversity of plant types rather than monotypic plant communities. As stated in the Proposed Action, the goal of revegetation would be to emphasize the establishment of three to four plant communities planted in a mosaic pattern. Compared to the early- to mid-seral stages and the monotypic crested wheatgrass seedings that presently exist in the project area, reclamation would most likely result in sites having greater species diversity and which would be in a later seral stages of ecological development.

## 4.6.1 Proposed Action

The Proposed Action would directly disturb approximately 2,189 additional acres of vegetation. Table 4-21 lists the disturbances to vegetation types by major components of the Proposed Action. The vegetation types comprising the project area are described in Section 3.6. Vegetation would be eliminated in each area from the period of first disturbance until the completion of reclamation. For most areas this period would be on the order of 10 to 15 years.

In addition to the vegetation affected by direct disturbance, riparian/aquatic vegetation associated with springs, seeps and creeks in the vicinity of the project area also may be affected by the drawdown of the groundwater table that would be caused by the dewatering of the Betze Pit. The loss of such vegetation would continue until the groundwater table would recover or an alterative source of water were developed.

<u>Recontour Side Slopes to 2.5H:1V</u>. This scenario is the Proposed Action. Waste rock area side slopes would be flattened from the natural angle of repose to overall slopes of approximately 2.5H:1V. The tops, benches, and side slopes would be covered with topsoil and revegetated. As discussed in Section 4.5.1, erosion losses modeled through RUSLE indicate that soil placed on these slopes may

be lost through accelerated erosion. If this were to happen, the productivity of these sites would eventually suffer as the soil mantle is thinned and removed, exposing the underlying waste rock.

An additional concern associated with this alternative is that most equipment used for ripping and preparing seed beds would be limited to some degree in traversing these side slopes. For this reason, the establishment of vegetation may be more difficult because of poorer seed bed preparation.

#### 4.6.1.1 Mine Components

Various mine components would disturb a variety of ecological sites which are discussed in this section.

Betze Pit. The Betze Pit development would affect an additional 345 acres of vegetation including approximately 3 acres of Loamy Bottom (25-3) range site, 201 acres of early seral Loamy (25-19), and 141 acres of previously mined lands.

Extended South Waste Rock Disposal Area. The disposal of waste rock would affect 912 acres of vegetation. Impacts would include disturbance of 270 acres of excellent crested wheatgrass seedings, as well as 574 acres of early seral Loamy (25-19) range site. Approximately 68 acres of previously disturbed mining lands also would be impacted.

Ore Stockpiles. The two proposed ore stockpiles would impact approximately 2 acres of loamy bottom (25-3), 6 acres of early seral loamy (25-19) range site, 86 acres of good condition crested wheatgrass seedings, and a 46-acre unsurveyed area. Proposed containment of any runoff from the stockpiles should preclude impacts to adjacent vegetation.

Heap Leach Pad. The proposed heap leach pad in the North Block would disturb 87 acres of good condition crested wheatgrass seedings, and 55 acres of Loamy (25-19) range site.

Tailings Impoundment. The vegetation that would be impacted by the construction of the tailings impoundment includes 449 acres of good condition crested wheatgrass seedings. In addition, 17 acres of mid-seral loamy slope and 10 acres of early seral Loamy (25-14) would be eliminated from the eastern boundary area of the impoundment. Water diversions around the impoundment could influence sediment loads channeled into Brush Creek and which could, in turn, impact riparian vegetation adjacent to the creek.

Topsoil Stockpiles. Proposed new stockpiles are located in seven areas and would impact approximately 82 acres of most of the vegetative types.

4.6.1.2 Mine Dewatering. Proposed mine dewatering would affect certain riparian vegetation along creeks, springs, and seeps as a result of drawdown of the groundwater table (see Section 4.4.2 and Figure 4-8). In areas where perennial flows would be lost, riparian vegetation would be reduced or eliminated and replaced by upland species.

The exact number of acres of riparian/aquatic area that may be affected by drawdown of the groundwater table is difficult to determine with accuracy due to the uncertainties regarding perched water tables and aquifer interconnectedness. However, based on the estimate of the total acreage of riparian/aquatic areas associated with the springs and seeps within the drawdown contours projected by the modeling, approximately 134 acres of riparian/aquatic area could be affected by the drawdown of the groundwater table during the active dewatering period and up to 271 acres during recovery.

Riparian/aquatic areas are essential to maintaining biodiversity and healthy wildlife populations in arid regions, such as Nevada. To the extent that the drawdown of the groundwater table adversely affects such areas,the riparian/aquatic habitat, as well as the wildlife that uses the habitat, would be adversely affected.

Water discharged into the unnamed drainage to the TS Ranch Reservoir could change the amount, character, and duration of vegetative communities along the unnamed drainage, around the shores of the TS Ranch Reservoir, and in any irrigated areas in Boulder Valley. The sustained flow of water down the unnamed drainage would create a saturated zone along the drainage that would be present for the period that discharge would occur. The discharge would result in the replacement of dryland species (e.g., sagebrush, Sandberg's bluegrass, and cheatgrass) by wetland species (e.g., sedges and bluegrass) within this zone. Willow, rose, and other typical riparian species are not expected to become established during the life of the Betze Project along the drainage because a seed source for such species is not present. After the cessation of dewatering, vegetation associated with the unnamed drainage would revert to upland plant species. Effects to vegetation associated with the development and maintenance of the TS Ranch Reservoir are discussed in the TS Ranch Reservoir Environmental Assessment NV-010-90-017. In general, vegetation along the edge of the TS Ranch Reservoir would be subject to large fluctuations in the water level, and to intensive livestock use. As a result, existing vegetation within the high and low water levels of the reservoir would be replaced by bare ground and sparse patches of emergent annuals.

The increase in the water supply to the irrigation areas downstream of the TS Ranch Reservoir would increase the agricultural production in Boulder Valley of hay and other crops by approximately 6,500 acres.

There may be water in excess of the mining, milling, and irrigation demands, especially during the last year of dewatering operations. Unanticipated reduction in mining or irrigation demand may also result in excess discharge beyond the capacity of the reservoir. Subject to regulatory constraints, this water could be discharged directly from dewatering operations to Rodeo Creek or from the reservoir to Boulder Creek. The excess water discharged to Boulder Creek would be approximately 10 cfs in the final year of mining. Due to the variation in such flow, additional riparian vegetation would not be established in Rodeo Creek or Boulder Creek, however, some fluctuation in populations could occur.

4.6.2 Alternatives

Several alternative locations for waste rock disposal areas, ore stockpiles, a leach pad, and a tailings impoundment have been proposed. The main differences in impacts to vegetation resources involve the total number of acres disturbed, the vegetation communities disturbed, and the revegetation potential of disturbed sites. The type and total amount of various vegetation types that could be disturbed by proposed alternatives are displayed in Table 4-22.

4.6.2.1 Waste Rock Disposal Areas. The Far West waste rock alternative could contain the entire quantity of waste rock generated by the Proposed Action. The Clydesdales and North waste rock disposal area alternatives could contain 24 percent and 40 percent, respectively, of the waste rock generated by the Proposed Action. Selection of the Clydesdales and North waste rock disposal areas would result in the need to construct at least a portion of the Extended South waste rock disposal area.

Selection of the Far West alternative would result in the disturbance of approximately 1,713 acres. Of this disturbance, 708 acres of Loamy (25-19), 8 acres of Loamy Bottom (25-3), 74 acres of mined land (m), and 278 acres of excellent condition seeding (S-I) would be affected. The Clydesdales waste rock disposal alternative would result in the disturbance of approximately 642 acres. Of this disturbance, 4 acres of Loamy Bottom (25-3) would be affected, 114 acres of Loamy (25-19), 399 acres of good condition seeding (S-II), and 22 acres of Shallow Gravelly Loamy (25-21). Approximately 103 acres of this alternative have not been surveyed. The North waste rock disposal alternative would disturb 430 acres of which 2 acres would be in Loamy Bottom (25-3), 225 acres would be early seral Loamy (25-19), 173 acres of good condition seedings (S-II), and 29 acres would be in Shallow Gravelly Loam (25-21).

4.6.2.2 Ore Stockpiles. The South Block ore stockpile alternatives would be located within already disturbed areas; therefore, no new areas of existing vegetation would be disturbed. The AA Block stockpile would remove approximately 27 acres of good

TABLE 4-22

PROJECTED DISTURBANCE OF VEGETATION RESOURCES

ALTERNATIVES

| Alternative | Ecological Site Description[1] 25-3 | 25-12 | 25-14 | 25-19 | 25-21 | M | S-I | S-II | Acres Affected |
|---|---|---|---|---|---|---|---|---|---|
| Waste Rock Disposal Areas | | | | | | | | | |
| North | 2 | | | 225 | 29 | | | 173 | 430 |
| Far West | 8 | | | 708 | | 74 | 278 | | 1,713[2] |
| Clydesdales | 4 | | | 114 | 22 | | | 399 | 642[3] |
| Ore Stockpiles | | | | | | | | | |
| South Block | | | | | | 102 | | | 102 |
| AA Block Leach Pads | | | | | | 37 | | | 37 |
| Rodeo Creek | | | | 24 | | 50 | | | 74 |
| Tailings Impoundment | | | | | | | | | |
| Expanded North Block | | 48 | 30 | 6 | | | | 619 | 703 |
| Central Area | | | | 167 | 5 | | | 478 | 650 |
| Alternative Leach Pad | | | | | | | | | |
| North Block - SW Corner | 6 | | | | | | | 139 | 145 |

[1] Ecological Site Description

25- 3 = Loamy Bottom 8-14" p.z.
25-12 = Loamy Slope 10-16" p.z.
25-14 = Loamy 10-12" p.z.
25-19 = Loamy 8-10" p.z.
25-21 = Shallow Gravelly Loam 8-12" p.z.
M = Mined Land
S-I = Seeding Excellent Condition
S-II = Seeding Good Condition

[2] 645 acres of the Far West waste rock disposal area have not been surveyed.

[3] 103 acres of the Clydesdales waste rock disposal area have not been surveyed.

condition seeding (S-II). The Alternative stockpile location at the Rodeo Creek site would disturb 9 acres of previously disturbed ground and 24 acres of Loamy (25-19) range site. The Rodeo Creek site would also have the potential of disturbing loamy bottom and riparian vegetation, directly or indirectly, because of the proximity of the stockpile to Rodeo Creek.

4.6.2.3 <u>Leach Pad</u>. This alternative leach pad location would disturb a total of 139 acres of good condition seedings (S-II) and 6 acres of Loamy Bottom (25-3).

4.6.2.4 <u>Tailings Impoundment</u>.

<u>Expanded North Block</u>. This impoundment would be located in the same area as the proposed tailings impoundment but the acreage impacted by this alternative would be larger. It would disturb about 703 acres. Vegetative sites would include 619 acres good condition seedings (S-II), 6 acres Loamy (25-19), 30 acres of Loamy (25-14), and 48 acres of Loamy Slope (25-12).

<u>Central North Block</u>. This tailings alternative would disturb approximately 650 acres, of which 478 acres would be good condition seeding (S-II), 167 acres would be early seral Loamy (25-19), and 5 acres would be shallow gravelly loam (25-21).

Tailings material generated by the milling process could affect plant growth because heavy metals and other substances may be concentrated at toxic levels to plants. As an alternative reclamation measure for the tailings impoundment, coarse waste rock would be placed between the topsoil and the tailings to act as a capillary block. Roughly 3 to 5 feet of waste rock would be placed over the tailings to prevent vegetative root penetration into the material (see Section 4.4.5.2).

4.6.2.5 <u>Water Disposal Methods</u>. Reinjection would result in limited surface disturbance for reinjection facilities. Existing vegetation would be eliminated at the sites of such facilities, but reinjection would not otherwise be expected to have impacts on vegetation. Vegetation would be eliminated in areas used for infiltration fields. As a result of an infiltration program and the creation of groundwater mounds, riparian vegetation would be expected to become established at any resulting spring or seep that would be developed as a result of mounding. Since neither the quantity nor frequency of discharge have been determined, the possibility or extent of changes to riparian vegetation cannot be identified at this time.

4.6.2.6 <u>Reclamation of Waste Rock Disposal Areas</u>. Two different configurations of side slope angles were analyzed for reclamation of waste rock disposal areas. These different scenarios could have impacts on the success of revegetation.

Angle of Repose. Under this alternative, waste rock slopes would be left at the natural dump angle of repose of approximately 1.3H:1V. The benches and tops of the disposal areas would be covered with topsoil and revegetated; the side slopes would not be reclaimed. As observed within the Carlin Trend, waste rock side slopes at their angle of response are fairly stable features (BLM 1990). These slopes are composed of coarse waste rock which normally resists erosion and the effects of sedimentation.

This alternative would eliminate the revegetation of side slopes. This loss could be calculated in terms of surface acres that would not be reclaimed. As a worst case scenario, average overall slopes of 2.7H:1V could be assumed for the side slopes. In this case, 1,200 surface acres of the Extended South waste rock disposal area would not be reclaimed or revegetated.

Recontour Side Slopes to 3.0H:1V. Under this alternative, waste rock disposal area side slopes would be graded to overall slopes of 3.0H:1V. The tops, benches, and side slopes would be covered with topsoil and revegetated. This alternative would present a better opportunity for reclamation success then the other alternatives presented. The side slope angle could be more easily worked with a variety of heavy equipment. Side slopes of 3.0H:1V would be less susceptible to erosion than the Proposed Action or the Angle of Repose alternatives.

4.6.2.7 Partial Pit Backfill. The implementation the Partial Pit Backfill alternative would have similar effects on vegetation as the Proposed Action, except that reclamation of the areas from which waste rock would be removed would be delayed for as long as 9 years. The limited amount of vegetation that may otherwise become established around the Betze Pit water body would not occur. The surface of the backfilled pit would be covered with topsoil and revegetated.

4.6.3 Cumulative Impacts

To date, the operating mines and related processing facilities of Barrick, Dee, and Newmont, together with the TS Ranch Reservoir, have disturbed some 5,500 acres of vegetation in an area extending approximately 11 miles from the Carlin Mine to the Dee Mine (see Figure 3-1). The impacts of the Proposed Action or alternative actions would contribute incrementally to these existing vegetation disturbances.

It is foreseeable that Newmont would continue to mine and expand the Genesis, Blue Star, and Post Pits, and begin to develop by surface mining methods, the Bootstrap/Capstone, North Star, Carlin, Lantern, Pete, and Bobcat orebodies during the life of the Betze Project (see Section 3.12.3.3). Newmont also proposes to expand the tailings facility at its Mill No. 4. The continued development of the Genesis, Blue Star, Post, Carlin, and Bootstrap Pits would occur on land on which the vegetation has already largely been affected by mining and associated operations. The expansion or development of the projects listed above would, together with the Proposed Action, collectively result in a disturbed area that is projected to be approximately 2,856 acres larger than the existing area of disturbance.

It is also foreseeable that Newmont would develop the Deep Star and Deep Post deposits, and that Barrick would develop the Deep Post and Purple Vein deposits, although the timing and nature of such potential developments cannot be forecast at this time. It is not presently known whether any of the Deep Post, Deep Star, or Purple Vein deposits would be mined by surface or underground methods. If the Deep Post deposit were to be mined by surface mining methods, such mining would result in an expansion of the Betze Pit. If the Deep Star or Purple Vein deposits were to be mined by surface mining methods, large areas of the surface south and north of the Betze Pit would be impacted. Most of the surface areas which would be affected by the open-pit mining of these deep deposits have either been affected previously by mining or would be affected by the Proposed Action. However, some additional incremental disturbance of existing vegetation would occur as a result of the development of one or more of these deposits.

It is foreseeable that the development of the Bootstrap/Capstone deposit or any of the deep deposits would also result in dewatering beyond that of the Proposed Action. If such deposits eventually were to be developed, dewatering would be required. Such dewatering would delay or interrupt the recovery of the groundwater table and potentially could expand the cone of depression and area affected by dewatering activities beyond that of the Proposed Action. Beyond the simulated effects of extended dewatering described in Section 4.4.3.3, it is difficult to quantitatively project future dewatering impacts in a meaningful way. However, in general, an expansion of the drawdown would increase the area affected during active dewatering and would expand the area affected during the recovery period, increasing both the duration and extent of the impacts to riparian/aquatic vegetation beyond that of the Proposed Action.

Reclamation of the disturbed areas for the Newmont, Dee, and Barrick projects is required by current laws and regulations for the majority of the lands affected by mining and processing. Many of the disturbed areas would be reclaimed and revegetated in accordance with individual reclamation plans directed by the NDEP and the BLM. In such cases, this reclamation would result in improved vegetative communities compared to those which existed prior to mining.

4.6.4 No Action Alternative

Under the No Action alternative, Barrick would continue to mine the Post Pit and operate the existing mill, South Block waste rock disposal area, AA Block heap leach pads, and tailings impoundment to the extent authorized by existing approvals. Reclamation of these features would be conducted in accordance with the terms of existing approvals. Generally, all disturbed areas other than the Post Pit would be regraded and revegetated upon completion of mining. Additional disturbance relating to the Proposed Action would not occur.

4.6.5 Mitigation

On a long-term basis, most of the vegetation impacts would be mitigated through reclamation of the disturbed areas. Associated impacts may occur depending upon the final vegetative communities that become established. Details of the reclamation process are discussed in Section 2.1.7.

Specific potential mitigation measures that are not part of the Proposed Action include the following:

- All disturbed areas could be revegetated, as soon as possible, to limit invasion of undesirable plant species and reduce erosion.

- The disturbed areas could be periodically monitored for any invasion of noxious plant species (as defined by state and federal regulations). An annual report of findings could be provided to the BLM. Measures to eliminate occurrences of these species could be developed and affected areas could be treated.

- Off-road vehicle traffic could be limited during facility construction and operation.

Barrick has indicated its agreement in principal to implement off-site compensation, such as the creation of new water sources and wetlands or riparian habitat, in those instances where impacts on streams, springs, and seeps cannot be avoided and on-site minimization is not sufficient to adequately offset adverse impacts or habitat losses. Such off-site compensation could be imposed as a condition of Barrick's Plan of Operations and may include the acquisition or construction of new riparian areas in the general vicinity of any such areas as are impacted by the Proposed Action to offset such impacts. Specific sites for any off-site replacement habitat have not been identified, but would be selected from lands located as near as practicable to the affected area, to assure the greatest degree of success and to avoid a net loss of riparian vegetation or wetlands and averse impacts to dependent wildlife species.

## 4.7 Wildlife Resources

### 4.7.1 Proposed Action

As discussed in Section 4.6.1, the Proposed Action would disturb approximately 2,189 acres of vegetation. Table 4-23 describes the wildlife species that would be impacted by particular components of the Proposed Action. Vegetation would be eliminated, and wildlife would be displaced from the period of first disturbance until reclamation, a period of approximately 10 to 15 years. Following completion of reclamation, the areas disturbed by mining and processing operations would yield ecological conditions which would be more varied and mature then the conditions that existed prior to the development of the Proposed Action. Such reclaimed areas would be expected to support more extensive and diverse wildlife populations than presently exist in the project area.

Wildlife species that would not be affected by individual components of the Proposed Action but which would be affected by general mining activity are discussed below.

The Nevada Department of Wildlife (NDOW) has indicated that mule deer historically used migration routes along the western side of the Tuscarora Range (Erickson 1990). The mule deer migrate between winter forage areas in the Dunphy Hills and summer forage areas in the Independence Range east of the Tuscarora Range. Existing mining activity in Little Boulder Basin has shifted the migration route to the east side of the Tuscarora Range. Additional mining activities associated with the Proposed Action would reinforce the shift in migration routes during the period from first disturbance until reclamation. Following reclamation of the Betze Project, the mule deer may move back into the area and resume migration along the western slope of the Tuscarora Range, depending upon the activities at adjacent mining operations.

Antelope do not use much of the project area other than the extreme western portion of the South Block and the Clydesdales Block. The antelope would not be affected other than to a minor extent by the Proposed Action.

A sage grouse lek is located on the north central area of the North Block. The proposed North Block heap leach pad would be located less than 500 feet south of the lek, and the proposed North Block tailings impoundment would be located less then 400 feet south of the lek. The northern portion of the Betze Pit would be approximately 1.5 miles south of the lek. Although the grouse continue to use the lek at the present, the additional disturbances from the Proposed Action would be much closer to the lek. As a result, the sage grouse may abandon the lek; however, due to the marginal quality of the surrounding habitat, the sage grouse may tolerate the disturbance and continue to use the lek.

TABLE 4-23

WILDLIFE HABITAT DISTURBANCE

PROPOSED ACTION

| Proposed Action | Ecological Site Description[1] 25-3 | 25-12 | 25-14 | 25-19 | 25-21 | M | S-I | S-II |
|---|---|---|---|---|---|---|---|---|
| | | | | Wildlife Habitat[2] | | | | |
| Betze Pit | W | | | HP | | C | | |
| Ore Stockpiles | | | | | | | | |
| North Block | HP, S | | | S | | | | HP, S |
| AA Block | | | | | | | | |
| Waste Rock Disposal Area | | | | | | | | |
| Extended South | | | | RT | | | RT | |
| Topsoil Stockpiles | | | | | | | | |
| Seven New Stockpiles[3] (Locations Unknown) | | | | | | | | |
| Heap Leach Pad | | | | | | | | |
| North Block | | | | S | | | | S |
| Tailings Impoundment | | | | | | | | |
| North Block | | S | S | | | | | S |
| Haul Roads, Pipelines, Construction Areas[3] | | | | | | | | |

[1]Ecological Site Description
25- 3 = Loamy Bottom 8-14" p.z.
25-12 = Loamy Slope 10-16" p.z.
25-14 = Loamy 10-12" p.z.
25-19 = Loamy 8-10" p.z.
25-21 = Shallow Gravelly Loam 8-12" p.z.
M = Mined Land
S-I = Seeding Excellent Condition
S-II = Seeding Good Condition

[2]Wildlife Habitat
C = Chukar
HP = Hungarian Partridge
S = Sage Grouse
WF = Waterfowl
RT = Red-tailed Hawk

[3]A variety of wildlife habitats may be disturbed.

Four satellite leks occur within a 1-mile radius of the lek. It is unlikely that the grouse would use these leks because of their proximity to the proposed activities. The disturbances likely would cause some reduction in sage grouse breeding and nesting, with corresponding reductions in local populations.

4.7.1.1 Betze Pit. The Betze Pit would encroach into historical chukar habitat. Since most of the area has been previously disturbed by mining activities, additional impacts to this habitat would not be expected; however, approximately 45 acres of chukar habitat and 5 acres of Hungarian partridge habitat (ecological site 25-19) that previously have been disturbed by mining activities would be impacted.

4.7.1.2 Waste Rock Disposal. The Extended South waste rock disposal area would expand current waste rock disposal from the Post Pit mining operation, subsequently displacing some wildlife species.

A pair of red-tailed hawks was observed nesting in the south wall of the West No. 9 Pit in the South Block in May 1988. Young were fledged from this location (JBR Consultants 1989). Mine personnel have not observed red-tailed hawk nesting activity at this location since 1988. Mining activities nearby did not appear to discourage nesting; however, expansion of the proposed waste rock disposal area would result in loss of habitat for rodents and lagomorphs, the hawk's primary prey species. Approximately 160 acres of this raptor's territory would be disturbed. This represents less than 5 percent of the hawk's hunting range; therefore, no additional impacts would be expected.

Approximately 130 acres of chukar habitat would be disturbed by this waste rock disposal area.

4.7.1.3 Ore Stockpiles. The North Block ore stockpile covering 94 acres in ecological sites 25-3, 25-19, and Seeding II would be located approximately 1 mile south of a known sage grouse lek. Creation and operation of the stockpile could impact the lek. However, it is possible that the grouse would tolerate the disturbance rather than be displaced into nearby, poorer quality habitat. Virtually the entire North Block ore stockpile would occur in sage grouse habitat. The stockpile also would affect approximately 30 acres of Hungarian partridge habitat.

The area around the proposed AA Block ore stockpile is already heavily used by the current mining operations. No additional impacts to wildlife are anticipated.

4.7.1.4 Heap Leach Pad. The 142-acre North Block heap leach pad would be located less than 500 feet from the major sage grouse lek in potential nesting and brood-rearing habitat. In addition to impacting the lek, the leach pad would remove 142 acres of sage grouse nesting and brooding habitat in ecological sites 25-19 and Seeding II. Sage grouse occupying the site would be displaced and would either compete with other sage grouse for the limited sagebrush habitat nearby or would occupy poorer quality habitat. Either response would lead to a decrease in the local population of sage grouse. The ponds to be constructed at the proposed heap leach facility would be fenced and netted to preclude access by wildlife. As a result no impacts to wildlife are expected from the operation of these ponds.

4.7.1.5 Mill Site. The mill site would be located on previously disturbed habitat; therefore, no additional impacts to wildlife are expected.

4.7.1.6 Tailings Impoundment. The 476-acre North Block tailings impoundment would eliminate 476 acres of poor quality sage grouse nesting and brooding habitat in ecological sites 25-12, 25-14, and Seeding II. The impoundment would be located less than 400 feet from the existing sage grouse lek in potential nesting and brood-rearing habitat. Two grouse broods have been observed in this area (JBR Consultants 1989). As discussed above, disturbance from mining activities may cause the grouse to abandon the lek.

Waterfowl could be impacted by the tailings impoundment due to the presence of chemicals in the tailings solution, particularly cyanide solution. Migratory and resident birds could be attracted to the impoundment and could be poisoned by the chemicals present. In 1989, Barrick installed a hydrogen peroxide treatment process to neutralize cyanide in the tailings solution. It is anticipated that the majority of waterfowl would be attracted to the TS Ranch Reservoir, and Barrick has committed to the neutralization of the proposed tailings impoundment in compliance with NDOW permit requirements.

4.7.1.7 Topsoil Stockpiles. The proposed addition of seven new topsoil stockpiles in various locations would result in the temporary loss of approximately 82 acres of various types of habitat.

4.7.1.8 Mine Dewatering. Mine dewatering, as discussed in Sections 4.4 and 4.6, would affect the flow of water in seeps, springs, and streams, and any associated riparian area. The cone of depression could result in reduced flow or the cessation of flow at some of the seeps and springs. Species composition of riparian vegetation found in and around intermittent streams would not likely change if water were reduced on a seasonally intermittent basis. Emergent vegetation, however, would likely be lost in the absence of water. The exact number of acres of riparian/aquatic area that may be affected by drawdown of the groundwater table is difficult to determine with accuracy due to the uncertainties regarding perched water tables and aquifer interconnectedness. Nonetheless, based on the estimate of the total acreage of riparian/aquatic areas associated with the springs and seeps within the drawdown contours projected by the modeling, approximately 134 acres of riparian/aquatic area could be affected by the drawdown of the groundwater table during active dewatering and up to 271 acres during recovery.

Riparian/aquatic areas are essential to maintaining biodiversity and healthy wildlife populations in arid regions, such as Nevada. For example, sage grouse, chukar, and Hungarian partridge require large quantities of water to digest their main diet of grass and forb seeds. Lack of water would impact the development of sage grouse leks as well as any chukar and Hungarian partridge populations. Lack of water would also impact mule deer and riparian species of songbirds. Aquatic wildlife would not survive in any streams or seeps which would dry up.

Discharge of water into the unnamed drainage that flows into the TS Ranch Reservoir could change the amount, character, and duration of wildlife habitat along the unnamed drainage, around the reservoir, and in irrigated areas in Boulder Valley. Any increase in riparian vegetation which might occur in the drainage would likely attract wildlife. The increase in size of the irrigated areas downstream of the TS Ranch Reservoir would result in enhancement of the area for wildlife use. Discharge of excess water from pit dewatering operations into Rodeo Creek or Boulder Creek would be infrequent and limited in duration and quantity. Consequently, such discharges are not expected to wildlife habitat.

4.7.1.9 <u>Other Impacts</u>. Impacts to wildlife from power line construction, operation, and maintenance include displacement, habitat degradation, habitat loss, and increased predation. The wildlife species most often affected by power equipment are raptors. Raptor mortality from physical collisions with power lines and poles or electrocution are expected to be low since the electrical equipment would not be located in a high density wintering or nesting area, and the power poles would be raptor-proofed. Moreover, physical collisions have been determined to be an inconsequential mortality factor in raptor populations (Olendorff and Lehman 1986).

Power lines may benefit raptors by providing perching and nesting sites, especially in homogeneous habitats. The success of power line nests varies by location and between species and may result only in a local increase in raptor density within a species' general range (Olendorff and Lehman 1986). Power poles would be perch-proofed within 2 miles of sage grouse leks to prevent excessive predation on sage grouse.

Indirect impacts to wildlife that result from illegal hunting or from traffic to and from the mining area would continue. Traffic results in direct losses of wildlife (road kill) and some reduction in the carrying capacity of wildlife habitat adjacent to the access roads. It is not possible to quantify the extent of these impacts. The incremental changes in wildlife mortality due to traffic levels or illegal hunting that would be a consequence of the Proposed Action would not be expected to be significant due to Barrick's policies of busing employees to the mine and preventing weapons on the mine site. The Proposed Action would have the effect of extending any existing impacts for some 20 years.

4.7.2 Alternatives

Alternative locations for various components of the Proposed Action are described in Section 2.3. Table 4-22 describes the ecological sites and total acres that would be impacted by the alternative water disposal methods, waste rock disposal areas, ore stockpile locations, leach pad locations, and the tailings impoundment locations. Table 4-24 summarizes the corresponding wildlife habitat that would be affected.

4.7.2.1 Waste Rock Disposal Areas. The North waste rock disposal area would remove approximately 430 acres of ecological sites 25-3, 25-19, 25-21, and Seeding II. The North waste rock disposal area would not contain all of the waste rock that would be generated by the Proposed Action. If this alternative were selected, an additional 430 acres of land would be disturbed, but the ultimate height of the proposed Extended South waste rock disposal area would be reduced by approximately 200 feet. Impacts resulting from this alternative would be similar to those described for the proposed North Block heap leach facility in 4.7.1.4. The North waste rock disposal area would be located closer to the sage grouse lek and would disturb approximately 335 acres of grouse habitat. It is likely that the grouse would abandon the lek in either case; however, abandonment is more likely to occur with disturbance closer to the lek. In addition, approximately 35 acres of Hungarian partridge habitat would be disturbed.

The Far West waste rock disposal area would remove 1,713 acres of ecological sites 25-3, 25-19, Seeding I, and previously mined land. This alternative would remove more acres of wildlife habitat than would the Proposed Action. Wildlife species including chukar would be displaced, but it is not possible to fully assess potential impacts outside of Barrick's claim block since site-specific information is not available for the adjacent private land.

The Clydesdales waste rock disposal area would remove approximately 642 acres of ecological sites 25-3, 25-19, 25-21, and Seeding II. Unlike the Proposed Action, this alternative would not remove any territory favorable for raptor habitation. Approximately 10 acres of existing chukar range would be impacted. Additional chukar habitat would be available north of the Clydesdales Block onto which the birds would most likely move.

TABLE 4-24

WILDLIFE HABITAT DISTURBANCE

ALTERNATIVES

| Proposed Action | Ecological Site Description[1] 25-3 | 25-12 | 25-14 | 25-19 | 25-21 | M | S-I | S-II |
|---|---|---|---|---|---|---|---|---|
| | | | | Wildlife Habitat[2] | | | | |
| Waste Rock Disposal Areas | | | | | | | | |
| North | HP, S | | | S | S | | | HP, S |
| Far West | | | | C, RT | | C, RT | C, RT | |
| Clydesdales | | | | C | C | | | |
| Ore Stockpiles | | | | | | | | |
| South Block | | | | | | C | | |
| AA Block Leach Pads | | | | | | | | |
| Rodeo Creek | | | | C | | | | |
| Tailings Impoundment | | | | | | | | |
| Expanded North Block | | S | S | S | | | | S |
| Central Area | | | | HP, S | S | | | S |
| Alternative Leach Pad | | | | | | | | |
| North Block - SW Corner | HP | | | | | | | |

[1] Ecological Site Description
25- 3 = Loamy Bottom 8-14" p.z.
25-12 = Loamy Slope 10-16" p.z.
25-14 = Loamy 10-12" p.z.
25-19 = Loamy 8-10" p.z.
25-21 = Shallow Gravelly Loam 8-12" p.z.
M = Mined Land
S-I = Seeding Excellent Condition
S-II = Seeding Good Condition

[2] Wildlife Habitat
C = Chukar
HP = Hungarian Partridge
S = Sage Grouse
WF = Waterfowl
RT = Red-tailed Hawk

The Clydesdales waste rock disposal area would not have sufficient capacity to contain the total volume of waste rock that would be generated by the Proposed Action. If this alternative were selected, an additional 642 acres of wildlife habitat would be disturbed.

The alternative Clydesdales and North waste rock disposal areas together would not have sufficient capacity to contain the total volume of waste rock that would be generated by the Proposed Action. If these alternatives were selected, 1,072 acres of wildlife habitat would be disturbed, but the total area disturbed by the Extended South waste rock disposal area would be reduced by approximately 360 acres.

4.7.2.2 <u>Ore Stockpiles</u>. The South Block ore stockpile and the AA Block ore stockpile would not impact any additional acreage since these alternatives would be located on the topped-out sections of existing waste rock disposal area or leach pads. No impacts to terrestrial wildlife would be expected. The Rodeo Creek ore stockpile would be located west of Rodeo Creek in partially disturbed habitat. Approximately 24 acres of chukar habit would be disturbed by this alternative.

4.7.2.3 <u>Leach Pad</u>. This alternative leach pad location would remove 139 acres of ecological site Seeding II and approximately 2 acres of Hungarian partridge habitat.

4.7.2.4 <u>Tailings Impoundment</u>

<u>Expanded North Block</u>. The Expanded North Block tailings impoundment would remove approximately 703 acres of ecological sites 25-12, 25-14, 25-19, and Seeding II. Impacts from this alternative would be similar to those described for the proposed North Block tailings impoundment except for the removal of approximately 140 additional acres of sage grouse nesting and brood-rearing habitat.

<u>Central North Block</u>. The Central North Block alternative location for the tailings impoundment would impact approximately 650 acres of ecological sites 25-19, 25-21, and Seeding II. This alternative would not remove any historic sage grouse summer habitat, while the Proposed Action would remove approximately 476 acres. However, this alternative would remove approximately 625 acres of sage grouse winter habitat and 2 acres of Hungarian partridge habitat.

4.7.2.5 <u>Water Disposal Methods</u>. Reinjection of water and direct discharge of pit water to Rodeo Creek or Boulder Creek would not disturb significant areas of wildlife habitat. Implementation of infiltration would disturb areas of soil and vegetation during construction of the facility. The most likely ecological sites that would be disturbed are 25-18, 25-19, Seeding I and Seeding II.

This disturbance would result in a commensurate decrease in wildlife habitat.

During the dewatering period of the Betze Pit (i.e., 10 years), a variety of waterfowl, shorebirds, nongame, and game bird species as well as big game species would utilize and become dependent on the TS Ranch Reservoir as a watering source. However, the lack of vegetation for nesting and rearing habitat would limit the reservoir's usage such that it would only serve as a watering point for the majority of wildlife species and would act as a staging and resting area for waterfowl. The vegetation that would develop around the reservoir perimeter and along the unnamed drainage would mitigate, to some extent, impacts of the Proposed Action to wildlife habitat. The vegetation would provide a diversity of habitats for a variety of species. Short-term increases in reproduction of species that utilize the vegetated areas for nesting, brood rearing, and foraging areas would occur. The vegetated areas would also provide escape and thermal cover for wildlife. Following completion of the Betze Pit dewatering program, any such vegetation would be replaced by upland vegetation as dewatering water would no longer be discharged to the unnamed drainage and the TS Ranch Reservoir.

The discharge of water into Rodeo Creek or Boulder Creek would potentially create riparian habitat for a period of approximately 1 to 2 years, especially if livestock use is limited. Additionally, because of the elevated water temperature of any such discharges, the live water discharged into the creek would be expected to remain open throughout the year. An increase in riparian habitat would result in an increase in production of riparian-dependent species during the nesting and brood rearing periods. Those species attracted to the riparian habitat during the fall and winter months could potentially attract migrating bald eagles and peregrine falcons.

Following the termination of dewatering operations, all riparian habitat created from dewatering discharge into Rodeo Creek or Boulder Creek most likely would be converted back to the previous ecological site habitat.

4.7.2.6 <u>Reclamation of Waste Rock Disposal Areas</u>. Reclamation scenarios for waste rock disposal area side slopes range from angle of repose of 1.3H:1V to overall side slopes of 2.5H:1V and 3.0H:1V. As discussed in Section 4.5.2.2, reclamation would be somewhat more successful with overall side slopes of 3.0H:1V than with the steeper overall side slopes of 1.3H:1V or 2.5H:1V. Therefore, recovery of wildlife habitat would likely be somewhat more successful with overall side slopes of 3.0H:1V.

### 4.7.3 Cumulative Impacts

The cumulative impacts of the Proposed Action and foreseeable expansions by the Barrick and Newmont mining operations to vegetation resources are discussed in Section 4.6.3. All actions would result in the loss of wildlife habitat, primarily food resources and protective cover. Previous disturbance to the area from overgrazing, mining, and fires has degraded the quality of the existing habitat. The impacts of the Proposed Action would be temporary since virtually all of the operational areas would eventually be reclaimed, and the Betze Pit would fill with water.

Increased impact on wildlife populations from traffic, noise, and consumptive uses would be expected. Local wildlife populations have adapted to mining activities to some extent. The number of personal vehicles used on the site would be limited and firearms would be prohibited. These actions would mitigate the impacts from traffic and illegal hunting.

It is foreseeable that the development of the Bootstrap/Capstone deposit or any of the deep deposits identified in Section 3.12.3.3 would also result in dewatering beyond that of the Proposed Action. If such deposits eventually were to be developed, dewatering would be required. Such dewatering would delay or interrupt the recovery of the groundwater table and potentially could expand the cone of depression and area affected by dewatering activities beyond that of the Proposed Action. Beyond the simulated effects of extended dewatering described in Section 4.4.3.3, it is difficult to quantitatively project future dewatering impacts in a meaningful way. However, in general, an expansion of the drawdown would increase the area affected during active dewatering and would expand the area affected during the recovery period, increasing both the duration and extent of the impacts to riparian/aquatic vegetation beyond that of the Proposed Action.

Additional wildlife stress would result from any incremental impacts to springs, seeps, and associated riparian/aquatic vegetation due to the dewatering of other deep deposits. Wildlife using these springs would have to travel greater distances to water, or relocate to areas with more available water or as a form of offsite mitigation artificial water sources (e.g., guzzlers) would be constructed within areas of dried up springs. Without an available water source, upland game birds such as grouse, chukar, and Hungarian partridge would leave the area. Big game, such as mule deer, and riparian songbirds would also be impacted by lack of water.

### 4.7.4 No Action Alternative

Under the No Action alternative, Barrick would continue to mine the Post Pit and process ore as authorized by existing approvals. Barrick's current operations have disturbed virtually all of the area that is to be disturbed under existing approvals. The No Action alternative would not result in any additional impacts to terrestrial wildlife resources beyond what has occurred during the current mining operation.

4.7.5 Mitigation Measures

Potential measures to minimize effects on wildlife are listed below:

- Temporary disturbances could be reclaimed as soon as possible.

- Topsoil stockpiles could be stabilized with some form of ground cover and re-seeded with a variety of native browse. Seeds could be harvested from the stockpiles for use in further reclamation.

- Access to mine roads could be limited to mining operations. All off-road vehicular traffic other than that necessary for mine operations could be limited. A maximum speed limit could be posted and enforced by Barrick on all new roads. These mitigation measures would limit the potential for harassment and wildlife/vehicle collisions.

- Informational bulletins and other educational means could be used to discourage employees from inadvertent or purposeful harassment of wildlife.

- Artificial water sources (e.g., guzzlers) could be constructed within mining project areas to provide a source of water for wildlife; i.e., tops of waste piles and leach pads.

- Install anti-perching devices on powerline structures located within 1 mile of documented sage grouse strutting grounds.

Barrick has indicated its agreement in principal to implement off-site compensation, such as the creation of new water sources and wetlands or riparian habitat, in those instances where impacts on streams, springs, and seeps cannot be avoided and on-site minimization is not sufficient to adequately offset adverse impacts or habitat losses. Such off-site compensation could be imposed as a condition of Barrick's Plan of Operations and may include the acquisition or construction of new riparian areas in the general vicinity of any such areas as are impacted by the Proposed Action to offset such impacts. Specific sites for any off-site replacement habitat have not been identified, but would be selected from lands located as near as practicable to the affected area, to assure the greatest degree of success and to avoid a net loss of riparian vegetation or wetlands and averse impacts to dependent wildlife species.

4.8 Threatened or Endangered Species

4.8.1 Plants

4.8.1.1 Proposed Action. No impacts are expected to occur to threatened or endangered plants as a result of the Proposed Action since no such species are known to occur in the project area.

4.8.1.2 Alternatives. No impacts are expected to occur to threatened or endangered plants as a result of the alternatives since no such species are known to occur in the project area.

4.8.1.3 Cumulative Impacts. No cumulative impacts are expected to occur to threatened or endangered plants as a result of the Newmont, Dee, or Barrick existing or proposed mining operations since no such species are known to occur in the area of these operations.

4.8.1.4 No Action Alternative. This alternative would not result in any impacts to threatened or endangered plants.

4.8.1.5 Mitigation. No mitigation is required for threatened or endangered plants.

4.8.2 Animals

4.8.2.1 Proposed Action. No impacts are expected to occur to threatened or endangered wildlife as a result of the Proposed Action. Although peregrine falcons and an occasional bald eagle may migrate through the area, no important habitat would be lost. The Lahontan speckled dace, which occurs in the area, is not federally listed as threatened or endangered but is considered to be a "sensitive" species by the State of Nevada. The proposed dewatering of the Betze Pit would have the potential to affect the flow of Rodeo Creek and associated seeps and springs. Diminution or elimination of creek flow would possibly eliminate the dace from Rodeo Creek. However, the dace would likely remain in Brush and Boulder Creeks.

4.8.2.2 Alternatives. No impacts are expected to occur to threatened or endangered wildlife as a result of the alternatives. The alternative of directly discharging dewatering water to Rodeo Creek or Boulder Creek would significantly alter the flow regime of Rodeo and Boulder Creeks, thereby altering the habitat of the Lahontan speckled dace. The resulting high flow conditions in Rodeo Creek or Boulder Creek would be less suitable for the small dace than the existing, low-flow conditions.

4.8.2.3 Cumulative Impacts. No populations or habitat of threatened or endangered species are known to occur in or near the vicinity of the Newmont, Dee, or Barrick existing or proposed mining operations. The TS Ranch Reservoir, however, could attract avian species that, in turn, could attract peregrine falcons, which migrate through the area. While bald eagles may also migrate through the area, no impacts are expected.

Barrick voluntarily donated funds ($45,000) to NDOW to support a project to rehabilitate critical native Lahontan cutthroat trout habitat in Mary's River in north central Elko County. This was mitigation resulting from a previous Barrick project.

4.8.2.4 No Action Alternative. This alternative would not result in any impacts to threatened or endangered wildlife.

4.8.2.5 Mitigation. No mitigation would be required for threatened or endangered wildlife.

## 4.9 Recreation and Wilderness

### 4.9.1 Proposed Action

4.9.1.1 Recreation. The Proposed Action would result in the expansion of the Goldstrike Mine to affect an additional 2,189 acres. That additional acreage would not be available for recreation during the period that mining and reclamation activities are ongoing. Outdoor recreational resources including dispersed recreation, hunting, off-road vehicle (ORV) use, and rockhounding would not be significantly adversely affected by the Proposed Action because existing use in the area of the proposed expansion is relatively light. Recreation opportunities are limited in the area immediately adjacent to existing operations because much of the local area is now intensively utilized for exploration and mining activities. In addition, access by the public to the mining area has generally been restricted for safety and security reasons. The Elko Resource Area has abundant acreage of open space lands available to the public for dispersed recreational opportunities.

The closest BLM Special Recreational Management Area (SRMA) is the South Fork Canyon, approximately 30 miles southeast of the project area. The Proposed Action would have no impact on the South Fork Canyon SRMA.

The projected increase in population due to the Proposed Action of approximately 225, with the majority expected to locate in Elko or Carlin, would cause an increase in demand on local community recreational facilities and programs. Section 4.12.1 provides a discussion of potential impacts to public facilities and services, including community recreation facilities, from the Proposed Action.

As reclamation is completed for project lands, reclaimed areas could become available for general public recreational use. Reclamation would facilitate the development of a diverse, self-sustaining vegetation resource that would provide an opportunity for natural reintegration of wildlife displaced by the Proposed Action and other mining activity in the area. The presence of such wildlife would create additional opportunities for hunting. In part, public access for recreational use would depend on the status of other mining activity in the vicinity of the project area at that time.

The Betze Pit would begin filling with water following the completion of mining in the year 2000. After approximately 100 years, the water level in the Betze Pit would reach the pre-mining water level at the 5,300-foot elevation. Pit walls of up to 200 feet in height would remain above the ultimate water level in the pit. Access to the water body in the Betze Pit would be restricted during the foreseeable future due to safety concerns. However, once the water level in the Betze Pit would rise to a stable level, it may provide additional recreational opportunities. Such opportunities have not been identified because the hydrologic model runs have projected that the water level would not reach a stable level for as much as 100 years following completion of mining. At that time, the BLM's decision regarding recreational opportunities at the Betze Pit would be developed, taking into consideration the recreational opportunities and needs of the population.

4.9.1.2 <u>Wilderness</u>. The closest potential wilderness area is the Little Humboldt River Wilderness Study Area (WSA), located approximately 27 miles northwest of the project area. The Proposed Action would have no impact on the Little Humboldt River WSA.

4.9.2 Alternatives

With the exception of the Partial Pit Backfill alternative, the project alternatives, other than the No Action alternative, would result in the same impacts to recreation and wilderness as the Proposed Action. The Partial Pit Backfill alternative would eliminate the creation of a 350-acre water body within the Betze Pit and the possibility of any associated recreational development.

4.9.3 Cumulative Impacts

Cumulative demand for recreation opportunities, facilities, and programs results from the population increase associated with the immigration of construction and operation workers for the various existing and foreseeable projects in the vicinity of the Betze Project. In addition to the direct impacts on recreation caused by the land disturbances and limitations on access for safety and security reasons, the additional traffic associated with the projects also would tend to deter recreational use of the lands in the vicinity of the Betze Project.

To date, the operating mines and related processing facilities of Barrick, Dee, and Newmont have disturbed some 5,500 acres in an area extending from the Carlin Mine to the Dee Mine (see Figure 3-1). The TS Ranch Reservoir, located approximately 3.0 miles southwest of the Betze Project area, has disturbed an additional 218 acres. While much of the land upon which Newmont's operations are conducted is private, part of Newmont's, Barrick's, and Dee's operations, and a portion of the TS Ranch Reservoir affect public lands that previously were open space available for dispersed recreation opportunities. The conversion of these lands to mining or agricultural related uses has effectively precluded use of these lands for recreation, and made access to some adjacent lands more difficult. Hunters, in particular, have been denied the opportunity to hunt on fenced lands or on lands upon which access has been otherwise barred for safety and security reasons (see Section 3.12.3.3). The proposed Betze Project, which would disturb an additional 2,189 acres, would contribute incrementally to these impacts.

Mine-related traffic, including construction traffic, haul trucks, and employee busses for the Betze Project is discussed in Section 4.13.1.6. This incremental increase in traffic, when added to traffic from Newmont's, Barrick's, and Dee's existing operations, may further deter recreationists from traveling in the vicinity of the project area.

It is foreseeable that, during the life of the Betze Project, Newmont would continue to expand its existing mines and processing facilities and begin to develop certain new near surface oxide deposits (see Section 3.12.3.3). While much of this expansion would occur on areas that are effectively closed to recreation at this time, the expansion or development of such projects, together with the Betze Project, could collectively disturb an additional 2,855 acres. The proposed expansions and developments that may be undertaken by Newmont would not be expected to significantly increase traffic or recreation demand because such actions would largely replace existing production, and for the most part would not require an increase in work (see Section 4.13.1.6).

It is also foreseeable that Newmont and Barrick could develop certain deep deposits (see Section 3.12.3.3), although the timing and nature of such potential developments cannot be forecast at this time. Most of the surface area likely to be disturbed by such developments is already effectively closed to recreation. However, if such projects were to be developed, the period that such areas would not be available for recreation would be extended. Some additional increment of public land would also likely not be available for recreation.

The cumulative demand for both urban and rural recreation either would remain constant or would increase for the foreseeable future. Newmont's proposed developments are projected to maintain a stable workforce of approximately 2,100 employees for the next decade. Although planning has not advanced sufficiently to make quantitative projections, it appears likely that development of additional near-surface or deep deposits by Barrick and Newmont either would maintain or would expand existing employment following the completion of Newmont's presently proposed projects and the Proposed Action.

Because the nearest WSA is 27 miles away from the project area, no direct effects on wilderness areas in the region would be expected from the additional mining activity or associated population increases.

Reclamation of the areas disturbed by Newmont, Barrick, and Dee is required for the vast majority of the lands affected. As reclamation would be completed, reclaimed areas located on public lands could become available for recreation. The date of final reclamation of lands within the general vicinity of the Betze Project cannot be projected because of the uncertainty associated with ongoing exploration efforts and the potential development of the deposits described above.

4.9.4 No Action Alternative

Under the No Action alternative, Barrick would continue to mine the Post Pit and operate the existing mill, South Block waste rock disposal area, AA Block heap leach pads, and tailings impoundment to the extent authorized by existing approvals. Barrick would also continue exploration drilling in the project area. Generally, all disturbed areas other than the Post Pit would be regraded and revegetated upon completion of mining. The Post Pit would, over time, fill with water to the 5,300 foot level, creating a water body up to 750 feet deep. This water body theoretically could create potential recreational opportunities. However, the remaining highwall around the pit, the likelihood of other mining activities in the vicinity of the Post Pit, and the physical and water quality characteristics of the pit (see Section 4.4.9.4) could limit the usefulness of this water body for recreation. The project area could be returned to dispersed recreational use within 3 to 4 years following reclamation of the project area. However, as with the Proposed Action, public recreational access to the project area would depend, in part, on the status of other mining activity in the vicinity of the project area at that time and safety and security considerations.

Under the No Action alternative, the demand for recreational opportunities, facilities, and programs would be expected to decline upon the conclusion of the mining authorized by existing approvals. The reduction would result from a decrease in Barrick's employees attendant to the termination of mining and processing operations at the existing Goldstrike Mine within 1 to 2 years. A reduction of approximately 850 employees would be expected if the Betze Project were not to be developed.

### 4.9.5 Mitigation

Public safety concerns would be the greatest during the period between the time immediately following completion of mining and the time at which the Betze Pit would fill with water. To mitigate the potential safety hazards to the public, all access routes into the pit could be bermed and the perimeter of the pit could be fenced to prevent vehicular entry. Warning signs could also be strategically placed advising the public of the risk. Additionally, the pit walls could be blasted to further discourage access.

## 4.10 Aesthetic Resources

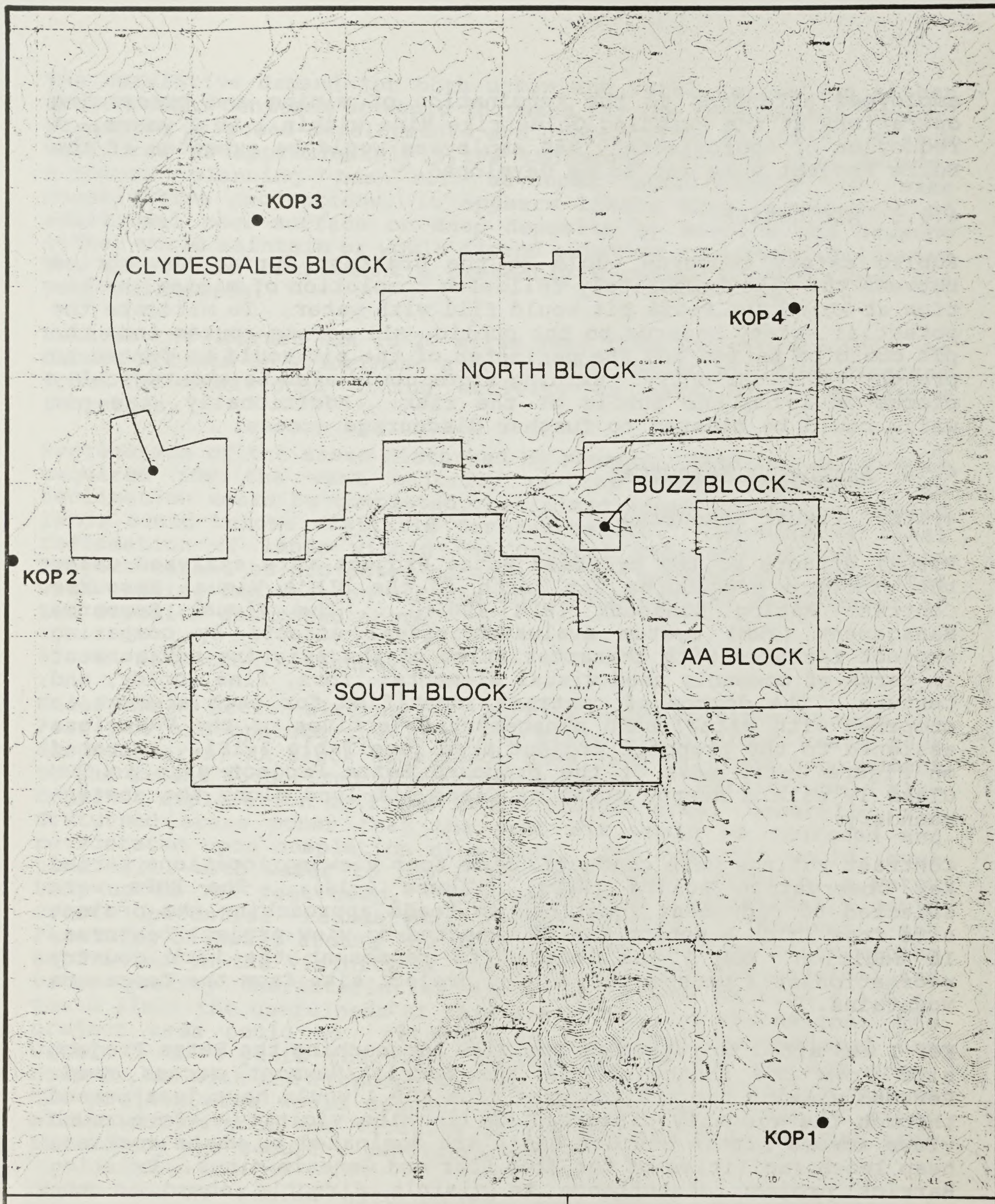
### 4.10.1 Visual Resources

Visual effects of the proposed Betze Project were analyzed using the standard procedures set forth in the BLM's Visual Resource Contrast Rating handbook (BLM 1986b). The Visual Resource Management (VRM) system evaluates visual effects by comparing project features with characteristics of the existing environment in terms of commonly used visual elements: form, line, color, and texture. The degree of contrast identified for each element is compared with established management objectives of the VRM class assigned to the proposed project area (see Table 3-18). As noted on Figure 3-11, most of the proposed Betze Project site is VRM Class IV with a narrow strip of Class III land along the eastern boundary.

Contrast ratings were conducted from four viewing locations termed Key Observation Points (KOPs) (Figure 4-14). The KOPs were selected to represent locations on roads approaching the project site from which a person may be expected to view project features. In addition, KOP 4 was located to represent the back country recreationist's perspective of the project site from the Tuscarora Mountains.

KOP 1 was sited to represent the view approaching the Betze Project site from the southeast via the Barrick/Newmont access road. Persons viewing the project area from KOP 1 would have just passed through the visually disturbed Carlin Mine vicinity. Foreground views across Little Boulder Basin are dominated by waste rock and heap leach facilities of the Blue Star and Genesis Mines. Existing Barrick project disturbance is visible directly ahead in the middle-ground view.

KOP 2 represents the view approaching the area on the Boulder Valley Road from the south-southwest. Foreground views between




BETZE PROJECT

**Figure 4-14. Key Observation Points**

KOP 2 and the Barrick properties include rangeland cut by Boulder, Bell, and Rodeo Creeks.

KOP 3 represents the view approaching the project site from the northwest, which is a remote area. KOP 3 is on the eastern edge of the existing Bootstrap Mine, and viewers approaching from the north would pass the Dee Gold Mine to the northwest.

KOP 4 was sited to represent the view from the Tuscarora Mountains to the north and northeast. There is no road access to KOP 4. Viewers from this perspective would be back-country hikers or perhaps ORV recreationists who would have gained entry from a few limited access points.

4.10.1.1 Proposed Action. Most types of visual effects expected from development of the Betze Project would be similar, regardless of the specific alternatives selected. The most prominent visual feature of the proposed project would be large-scale modification of landforms. The natural low, rounded, rolling hills would be moved, flattened, and terraced similar to what has been done for the existing Goldstrike Mine and for other operations both north and south of the Betze Project site. The Betze Pit would be a large, concave, near "mirror image" of the above-ground features with a series of horizontal benches continuing the strong horizontal line elements that are prominent in existing disturbance areas.

After completion of mining, the side slopes of above ground features would be reduced from angle of repose (approximately 1.3H:1V) to approximately 2.5H:1V, and the shoulders and toes of the slopes would be rounded. The resulting land masses would contrast moderately to strongly with the existing natural landscape in terms of both form and line. However, the viewshed is currently dominated by existing mining-related land feature modifications very similar to those proposed for the Betze Project. It is assumed that some of the mining-disturbed lands will be reclaimed under Nevada statutes, but the nature and extent of the reclamation will vary. The Betze Project would expand the existing disturbance but would not contrast with it. After project closure and reclamation, the partially recontoured Betze Project slopes would be discernible from natural slopes but would not provide as strong a visual contrast as does the existing disturbance in the area.

The Betze Pit would not be reclaimed under the Proposed Action. The strong horizontal lines introduced by benches and high walls would contrast strongly with the natural landscape and moderately with reclaimed project features. The effect of the contrast would be minimized by the sub-surface nature of the pit and by natural and man-made above-ground landforms flanking three sides of the pit. The pit would be visible from only one of the four selected key observation points, KOP 4.

Land clearing and waste rock dumping would expose earth and rock in a variety of colors from light grayish tan to almost black. Indications are that most would be middle shades of tans and browns. Contrast between these colors and characteristic colors in the natural landscape would range from moderate in bright sunlight during spring and early summer to weak in overcast conditions during fall and winter. Color contrast would be reduced following successful reclamation and revegetation.

Visual effects related to vegetation would result mainly from the difference between cleared and vegetated lands. This difference would be manifested mainly as color contrasts, which would be moderate to weak as described above. New lines would be introduced demarking the edges of cleared areas and some change in texture would be seen, but the resulting contrast would be weak.

New structural features associated with the Betze Project would be limited to the expansion of the existing mill site. Because of their close proximity to existing structures, the new structural features would not attract attention. Also, these structures would be very small when compared to the visually dominating nearby pit and waste rock disposal areas. Consequently, visual contrast introduced by new structures would be weak.

Specific visual effects and conformance with VRM objectives are discussed below for each Key Observation Point.

Viewed from KOP 1, the Proposed Action would introduce moderate to weak visual contrast as compared with existing conditions. While the Extended South waste rock disposal area would be massive, much of the disposal area would be screened from view by existing hills along the west flank of Little Boulder Basin. The expanded mill facilities would be screened from view by existing heap leach pads. The North Block heap leach pad and the North Block tailings impoundment would be visible but at a distance of 5 miles as a backdrop behind other Barrick and Newmont project features. The pit would be largely screened from KOP 1 by the waste rock disposal area. Ore stockpiles would be small in comparison with other project features and natural terrain features. The ore stockpiles would contribute little to overall visual impression of the Proposed Action. The visual disturbance as viewed from KOP 1 would be substantial, caused mainly by landform modification; however, the project would be visually coherent with existing modifications that currently dominate views from KOP 1. The project would increase the physical extent of visual effects somewhat but would not introduce a stronger degree of contrast than currently exists nor would it introduce new types of landforms, lines, colors, or textures. The proposal to use 2.5H:1V slopes and rounded side slope shoulders and toes on waste rock disposal areas would reduce the visual effects following reclamation.

The project as viewed from KOP 1 would be consistent with the objectives for VRM Class IV areas, which permit visual modifications to dominate the view. Project features extend only a small distance into the VRM Class III area. As proposed, the project features would be located on the edge of a major disturbance area. The project features would not be visually dominant and would be acceptable under Class III objectives.

Views of the Proposed Action from KOP 2 would be dominated by the towering west face of the Extended South waste rock disposal area, which would rise above existing terrain by over 400 feet. The disposal area would be silhouetted against the sky, blocking views of the Tuscarora Mountains in the background over about 40 degrees of the viewshed. Linear elements would be introduced along the waste rock disposal area boundaries, in addition to the pyramidal shape of the waste rock disposal areas. The North Block heap leach pad, one ore stockpile, and the North Block tailings impoundment would be visible from KOP 2; however, they would be small, low features against the Tuscarora Mountains backdrop and would be scarcely noticeable compared with the Extended South waste rock disposal area. The Betze Pit, the AA Block ore stockpile, and the mill expansion would not be visible behind the Extended South waste rock disposal area.

The Proposed Action would dramatically increase visual contrast from KOP 2. Nevertheless, the project would be consistent with VRM Class IV management objectives.

The Proposed Action would also dominate views from KOPs 3 and 4. Viewers from KOP 3 would benefit from partial screening afforded by low hills in the foreground. The Extended South waste rock disposal area would be visible beyond the hills through the Bell Creek Valley and to some extent through the saddle in the hills. The North tailings facility would be visible but would be overshadowed by the much higher and more visually dominant Tuscarora Mountain backdrop. The Betze Pit and most, if not all, AA Block facilities would be completely screened by terrain.

KOP 4, on the other hand, would have an unobstructed view of the entire Proposed Action. The large scale of the overall project would be especially apparent from KOP 4, but the effect would be mitigated slightly by the perspective of viewers looking down on the project. This higher viewpoint affords a greater sense of the pit depth but, in combination with hills to the southwest, reduces the amount of silhouetting from the waste rock facilities. An important additional consideration for KOP 4 is that it was sited as the closest point where the public could approach the project area from the northeast. Actual viewers would be much more likely to view the project from higher elevations in the Tuscarora Mountains, farther from project facilities.

As from other view points, views from KOP 3 and KOP 4 would be dominated by project features. Nevertheless, VRM Class IV management objectives permit high levels of change to the characteristic landscape and visually dominating project activities. Consequently, the Proposed Action would comply with these standards. Class IV management objectives do, however, require that "every attempt should be made to minimize the impact through... repeating the elements of line, form, color, and texture." This aspect of visual management planning for the Betze Project is addressed further in Sections 4.10.1.2 and 4.10.1.5.

#### 4.10.1.2 Alternatives

Waste Rock Disposal Areas. Development of the North waste rock disposal area would increase the visual scale of the project on the North Block to a notably greater degree than would the heap leach facility included in the Proposed Action. The waste rock disposal area would be visible from all four KOPs but would have the greatest effect from KOP 3 and KOP 4. This partial alternative, by itself, would meet the Class IV VRM management objectives.

Use of the Clydesdales waste rock disposal area would expand the visual scope of the project approximately 0.75 mile to the west and 1.75 miles to the northwest. The disposal area would substantially increase the visual dominance of project features as viewed from KOPs 2 and 3. Although partially screened by terrain from viewers at KOP 4, enough of the Clydesdales site would be visible to make the total project look larger from KOP 4. The Clydesdales waste rock disposal alternative would not be visible from KOP 1. This partial alternative, by itself, would meet the Class IV VRM objectives.

The North and Clydesdales waste rock disposal area alternatives together with the Existing South waste rock disposal area would have insufficient combined capacity to contain the volume of waste rock that would be generated by the Proposed Action. Thus, Barrick would need to construct at least a portion of the Extended South waste rock disposal area if one or both of these partial alternatives were to be selected. If the North and Clydesdales disposal area alternatives were to be used, the ultimate height of the Extended South area would be reduced from 5,900 feet to 5,600 feet. Employing any combination of these alternatives would increase the areal extent of the visual effects although the vertical profile of the Extended South waste rock disposal area would be reduced. Use of the Clydesdales partial alternative in any combination would increase the scale and scope of visual effects on KOPs 2, 3, and 4, compared with the Proposed Action. There would be a minor decrease in visual effect on KOP 1 due to the reduced scale of the Extended South waste rock disposal area.

Use of the North waste rock disposal area partial alternative in any combination would increase the scope of visual effects on all four KOPs, compared with the Proposed Action. The counteracting effect of decreasing the height of the Extended South waste rock disposal area would be minor as, for example, views of the Tuscarora Mountains from KOP 2 would still be blocked by the waste rock disposal area.

The Far West waste rock disposal area alternative would be very similar to the Proposed Action except that the waste rock disposal area would be spread out in a less geometric pattern. Visual effects would be the relaxation of the artificial property boundary line constraint would permit more flexibility in the final design of the waste rock disposal area. If this opportunity were utilized, the long-term visual effect would be minimized in conformance with VRM management objectives for Class IV areas.

Ore Stockpile. The ore stockpile would be a relatively small feature in the visual context of the overall Betze Project. None of the alternatives would be visually problematic. Any of the three would be somewhat preferable to use of the AA Block ore stockpile site because the site is a largely undisturbed area in a VRM Class III area. As such, the AA Block ore stockpile site is considered somewhat more sensitive than most other project areas.

Leach Pad. This alternative would decrease the visual effects of the project somewhat from KOPs 1, 3, and 4 but would increase them from KOP 2. The alternative leach pad location would result in a slightly more visually compact disturbance area; therefore, it would be preferable to the Proposed Action, though the difference would not be significant.

Tailings Impoundment

Expanded North Block. This alternative would notably increase the visual effects of the tailings impoundment by raising the dam 45 feet, lengthening it by 0.5 mile, and increasing the pond area by 227 acres. Although this alternative, by itself, would still meet the VRM Class IV standards, the net effect would be visible from all four KOPs, especially KOP 4.

Central North Block. This alternative would employ the lowest and shortest dam embankment. In addition, it would permit the most natural looking dam structure of the three alternatives. Thus, it would go further than other alternatives to meet the VRM Class IV objective of minimizing visual contrast.

Water Disposal Methods. Reinjection of the pit dewatering volumes would not have significant visual effects, as the required facilities would be relatively small. Visual effects would result from the disturbance of soils and vegetation to create infiltration fields. Direct discharge of pit water to Rodeo Creek or Boulder Creek would change the visual character of the streams from small intermittent streams to that of larger, perennial streams. The creeks also would display increases in riparian vegetation.

Reclamation of Waste Rock Disposal Areas. Use of the Angle of Repose alternative for side slopes on waste rock disposal areas would notably increase the long-term visual effects of the project. The forms and lines of the project would be less consistent with natural features. Successful revegetation of the side slopes would be less likely, thus prolonging color and texture contrast between the project and the natural environment. In short, this alternative would not satisfactorily minimize visual effects.

Recontouring side slopes to 3.0H:1V on waste rock disposal areas would reduce the contrast between the natural terrain and the waste rock disposal areas. However, the visual difference in landform between a 2.5H:1V slope and a 3.0H:1V slope in the project area would be minor. To the extent, however, that use of the 3.0H:1V slope would improve the likelihood of revegetation success on the side slopes, the slope would contribute to reductions in visual effects by facilitating faster elimination of color contrast from reclamation.

Partial Pit Backfill. Partially backfilling the pit would have little effect on the visual impact of the pit itself from any perspective beyond the very edge of the pit. It would, however, reduce the amount of material permanently stored in waste rock disposal areas. Because the waste rock disposal areas would be the largest and most dominant visual feature of the project, reducing the size of the areas would reduce the visual effect of the project to some degree. The amount of improvement would be roughly proportional to the replacement of 452 million tons of the 780.6 million tons of waste rock. Given the proximity of the existing South Block and the proposed Extended South waste rock disposal areas to the Betze Pit, it is probable that waste rock would be excavated from these waste rock disposal areas to backfill the Betze Pit.

4.10.1.3 Cumulative Impacts. To date, the operating mines and related processing facilities of Barrick, Dee, and Newmont, together with the TS Ranch Reservoir, have disturbed some 5,500 acres in an area extending from the Carlin Mine to the Dee Mine (see Figure 3-1). It is foreseeable that Newmont would continue to mine and expand certain near-surface ore bodies during the life of the Betze Project (see Section 3.12.3.3). Newmont also proposes to expand the tailings impoundment at its Mill No. 4. Existing and continued development of these projects would result in continued visual disturbance of an approximately 11-mile strip along the Carlin Trend. Upon completion of the projects, modifications to the characteristic landscape caused by mining activities would appear to be almost continuous along that strip. The Betze Project would be situated just northwest of the middle of the disturbance strip (see Figure 3-1).

It is also foreseeable that Newmont and Barrick may develop certain deep deposits, although the timing and nature of such developments cannot be forecast at this time. Most such development would occur on areas previously affected by mining.

Existing and future views of the disturbance strip would vary somewhat from the four KOPs. From KOP 1, current views to the northwest take in the Blue Star/Genesis ridge, the Post Pit, and existing Barrick activity. In addition, a viewer approaching KOP 1 from the southeast would pass very near the mill and some related mine disturbances are visible looking back uphill to the southeast. Intervening terrain blocks views of projects northwest of the Betze Project area. The Betze Project would extend visible disturbance farther north into the North Block, but the fore- and middle-ground views are already substantially disturbed by existing mining activity and would be further modified by proposed expansion.

Views from KOP 2 are the least affected by existing development. The TS Ranch Reservoir dam is visible, though fairly subtle, to the southeast. The Dee Gold and Bootstrap projects are partially visible to the north. Some of the existing Barrick and Newmont activities are visible to the east. The proposed Extended South waste rock disposal area would substantially increase the disturbance visible from KOP 2.

KOP 3 is located on the existing disturbance strip. Existing Bootstrap activity is less than 0.25 mile to the west and is a dominating disturbance feature. Views to other projects are limited and would continue to be so, although the proposed Betze Project would substantially increase disturbance visible to the southeast.

KOP 4 has a panoramic view over 100 degrees wide of the existing Carlin Trend disturbance from the Dee Mine to Mill No. 1 in the distance to the south. The Betze Project would bring substantial disturbance very close into the foreground, and other interrelated projects would extend and fill in the visual disturbance visible from the KOP 4 vantage point.

Cumulative development of mining projects would intensify existing major modifications to the characteristic landscape. Existing disturbance dominates views of the area and is a major focus of viewer attention; continuing development would increase the visual dominance. Most, if not all, of the development is, and would be, located in a VRM Class IV area which "provides for management activities (such as mining projects) which require major modification of the existing character of the landscape," and specifically, permits visually dominant activities. The VRM system provides no guidance as to whether limits to this dominance are intended except that "every attempt should be made to minimize the impact through... repeating the elements of line, form, color, and texture." It is assumed, therefore, that the cumulative development activities would be acceptable in the Carlin Trend area. VRM objectives suggest, however, that mitigation measures should be adopted that would minimize the long-term residual effects of mining on the visual environment.

4.10.1.4 No Action Alternative. Under the No Action alternative, Barrick would continue to mine the Post Pit and would operate existing processing facilities to the extent authorized by existing approvals. The No Action alternative would substantially avoid the visual contrast that would be introduced by the Betze Project. It would not, however, reduce the degree of visual disturbance already existing in the project vicinity from ongoing mining activity by Barrick, Newmont, and others. As mining in the project area would terminate, much of the landscape would be reclaimed and revegetated, tempering the visual contrast of reclaimed lands and the surrounding environment.

4.10.1.5 Mitigation. Contouring, either along existing topography or with hill construction, or both, would reduce the long-term visual effects of the Betze Project. Contouring could be encouraged to minimize long-term visual effects, but it would need to be designed with professional landscape design assistance to maximize the benefit of the effort.

4.10.2 Noise

4.10.2.1 Proposed Action. The major sources of noise from the proposed Betze Project would be the same as the current sources from the existing mining and processing operations: rock drilling, blasting, loading of rock and ore, truck hauling, ore crushing, milling, and ore handling and distribution. The same types of equipment currently in use would continue to be used but there would be more machines in operation.

The large geographic spread of the Betze Project facilities suggests there would be several focal points of activity generating noise. The nearest such center to a sensitive receptor (line shack on TS Ranch) would be the westerly node of the waste rock disposal area, where major activity would entail large haul trucks dumping rock and some dozer activity. Estimated worst-case noise levels from this activity would be approximately 96.6 dBA at a 50-foot reference distance. Conservatively assuming attenuation only from noise spreading over distance, the noise level experienced at the line shack would be approximately 56.6 dBA. For analytical purposes, noise levels from a worst-case scenario at the pit were calculated and added to the noise from the waste rock area. This scenario assumed pit noise emissions of 110 dBA at 50 feet. Even though pit noise generally would be screened by terrain from the line shack, this worst-case analysis assumed no screening effect. The results indicated noise levels at the line shack from combined rock dumping and pit operations would be approximately 62.5 dBA. This level of noise would exceed the noise level that would be expected in an undeveloped rural environment. However, the noise level would be consistent with existing noise levels, and less than 65 dBA, which is a generally acceptable exterior noise level at a residential area (24 CFR 51). Other noise-sensitive receptors are several miles farther away from the proposed Betze Project and likely would not experience perceptible changes in ambient noise levels as a result of the project. Other mining operations near the project area were not considered to be sensitive receptors for purposes of this analyses.

The highest noise levels to which on-site personnel would be exposed would occur in the pit, the crushing areas, and within the mill building. The highest noise levels in these areas would range from approximately 80 to 95 dBA, based on noise monitoring by Barrick. On-site personnel are required by Barrick policy and MSHA regulations to wear hearing protection in high noise level areas.

4.10.2.2 Alternatives. The only alternatives that would increase noise levels at the line shack receptor location, compared with levels expected from the Proposed Action, would be the Clydesdales waste rock disposal alternative. Because of its close proximity to the line shack, under the worst-case analysis, the Clydesdales alternative would raise noise levels at the line shack during peak dumping activity to approximately 64.6 dBA. In combination with other noise sources, this could result in occasional noise levels slightly above 65 dBA. However, because of the worst-case scenario employed to generate these noise levels and the seasonal use pattern of the line shack, the noise effect would not be expected to cause significant interference with use of the line shack.

4.10.2.3 Cumulative Impacts. Existing and reasonably foreseeable developments (see Section 3.12.3.3.) have the potential to generate cumulative noise impacts with the Betze Project at sensitive receptors outside of the active mining area. The location of existing and proposed processing facilities is relatively fixed. However, if the mining operations of Newmont or Barrick occur in close proximity to the Betze Project (e.g., as the Genesis Pit expands or the North Star deposit is developed), cumulative noise impacts from drilling, blasting, loading, and hauling would be expected. Because the timing and nature of such activities cannot presently be forecast, quantitative projections about the level of such impacts at a given receptor (e.g., line shack on the TS Ranch) are not possible.

4.10.2.4 No Action Alternative. The No Action alternative would result in a continuation of existing noise levels over the short term and an eventual decline in noise as existing mining activities phase out. No significant adverse noise effects would be expected.

4.10.2.5 Mitigation. No mitigation is recommended for noise impacts.

## 4.11 Cultural Resources

### 4.11.1 Proposed Action

The Proposed Action would result in the expansion of the Goldstrike Mine to encompass an additional 2,189 acres. Cultural inventories completed to date have identified 64 archaeological sites that would be affected by the Proposed Action. Approximately 22 acres, or 1 percent of the area controlled by Barrick that would be affected by the Proposed Action, has not been inventoried. The proposed haul road to the North Block crosses the private lands of Newmont. See Figure 2-5. Inventories for the lands affected by the haul road have not been completed. Available information concerning a larger area which encompasses the Betze Project area suggests that the incidence of sites in the uninventoried areas would be similar to that in areas for which detailed inventories on public lands have been completed. Under this assumption, an estimated one additional site on public land could be affected. Because the private land of Newmont is located along Rodeo Creek, the incidence of sites on the uninventoried Newmont lands could be greater than on the affected public lands. Inventories of these areas will be completed and, to the extent available, the results will be reported in the Final EIS.

The known sites are generally the remains of open campsites or use areas and consist of lithic scatters, including chipped and ground stone artifacts, fire hearths, and other features, dating from the Pre Archaic (5000 B.C.) to the Late Prehistoric (A.D. 1850) period. Specific descriptions of these sites can be found in the various reports identified in Section 3.11. Without mitigation, implementation of the Proposed Action would destroy most if not all of the sites, resulting in an irretrievable loss of physical cultural resources and potentially valuable scientific information. Even with mitigation through data recovery and analysis, it is possible that information would be destroyed that would be important to future researchers using research methods not available today.

In terms of the number of sites affected, the Extended South waste rock disposal area would have the greatest impact on known cultural resources, as 23 sites would be impacted. A total of 22 sites would be affected by the North Block tailings impoundment. Impacts also would be caused by other project components, including the heap leach pad (6 sites), the soil stockpiles (2 sites), and the ore stockpiles (4 sites). The impacts of each major component of the Proposed Action are presented in Table 4-25.

One additional site, CRNV-12-5682, which would be affected by a haul road, has been determined by the BLM and the Nevada State

TABLE 4-25

CULTURAL RESOURCE IMPACTS

| | Proposed Action | Alternative |
|---|---|---|
| Waste Rock Disposal Areas | | |
| Extended South Area | 23U[1] | |
| Far West Area | | 23U[2] |
| Clydesdales Area | | 11U[2,3] |
| North Block Area | | 3N[1], 8U |
| Tailings Impoundment | | |
| North Block | 6N, 16U[1] | |
| Expanded East North Block | | 4N, 17U |
| Central North Block | | 1N, 9U |
| Ore Stockpiles | | |
| AA Block Panhandle | 0 | |
| North Block | 4N[1] | |
| AA Block Heap Leach Area | | 0 |
| South Block Waste Rock Disposal Area | | 0 |
| South Block, near Rodeo Creek Area | | 0 |
| Soil Stockpiles | | |
| Extended South Waste Rock Disposal Area | 1U[1] | |
| North Waste Rock Disposal Area | 1U[4] | |
| Heap Leach Facilities | | |
| North Block | 6U | |
| Western North Block | | 6U |
| Roads | 10U | 2U |
| TOTAL | 64[5] | 68[5] |

[1] U = unevaluated for NRHP; N = not NRHP eligible.

[2] Inventory effort is incomplete.

[3] Alternative requires construction of a haul road, which impacts two additional unevaluated sites not included in this total.

[4] Impact from development is close enough that impact may occur.

[5] Sites impacted by more than one facility are counted only once.

Historic Preservation Office (SHPO) to be eligible for the National Register of Historic Places (NRHP) based on the potential of the site to yield important information about the past. This site was occupied from the Middle Archaic to the Late Prehistoric period. It is an extensive artifact scatter along a stream channel. One subsurface cultural feature was identified at this site: a shallow basin containing numerous cobbles as well as fill flecked with charcoal. This feature was most likely used for baking or heating a structure. The BLM and the Nevada SHPO have determined that this site is of value only for archeological research as identified in the Nevada State Historic Preservation Plan and that such value can be substantially preserved through data recovery and analysis, as discussed below in Section 4.11.5.

Of the remaining inventoried sites, 17 have been determined not to be eligible for the NRHP and 46 have not yet been evaluated. Previous surveys and evaluations are adequate to make some projections. Cultural resources in the area are primarily aboriginal as opposed to Euro-American and represent Pre-Archaic through Late Prehistoric periods. Sites determined to be eligible for the NRHP are likely to be significant for their value for archeological research. An evaluation of NRHP eligibility could establish other sites as being NRHP-eligible.

Prior to permitting any disturbance of these 46 sites, and any other sites discovered in further inventories, the BLM and the Nevada SHPO must determine whether the sites are eligible for the NRHP. For any site determined to be NRHP-eligible, the BLM and the Nevada SHPO would determine whether any adverse effects could be mitigated through data recovery and analysis or through avoidance, as discussed in Section 4.11.5. Preservation in place through avoidance would be considered as a first alternative for cultural properties eligible for listing on the NRHP. In some cases, avoidance may not be practical due to other constraints such as topography or land ownership.

In such cases, impacts would be mitigated as determined by the BLM in consultation with the Nevada SHPO. A written treatment plan would be prepared and reviewed by the BLM and the Nevada SHPO prior to implementation of any mitigative action. The treatment plan would describe how the attributes of NRHP-eligible sites which make them significant would be preserved. As stated in section 4.11.1, significance would be expected to be attributed to the ability of a property to yield scientific information about the past. The treatment program would therefore likely entail surface examination, mapping, artifact collection, excavation, laboratory analysis, and reporting. The BLM would afford interested persons the opportunity for participation in development of the treatment plan.

If it is determined that adverse impacts cannot be adequately mitigated, the BLM would consult with the Advisory Council on

Historic Preservation prior to allowing any disturbance, as required by the National Historic Preservation Act. The BLM would afford interested persons an opportunity to review and comment on eligibility and adverse effect determinations.

### 4.11.2 Alternatives

4.11.2.1 Component Location Alternatives. Intensive cultural resource inventories have been completed for many of the areas that would be affected by the component location alternatives. The impacts to known cultural resources from the proposed alternatives are summarized in Table 4-25. The areas for which inventories have not been completed include portions of the Far West and Clydesdales waste rock disposal areas, haul roads, and transmission line and pipeline corridors. Available information suggests that the incidence of cultural resources in uninventoried areas would be similar to those areas for which detailed inventories have been completed. Inventories of the areas that would be affected by alternatives, NRHP eligibility determinations, and, for eligible properties, mitigation plans, would be completed before actions affecting such areas could proceed.

Selection of the North or Clydesdales waste rock disposal area alternative would impact more cultural resources sites than the Proposed Action because either alternative would require disturbance of additional acreage without a corresponding decrease in the acreage disturbed by the Extended South waste rock disposal area that is part of the Proposed Action (see Section 2.3.1.1).

4.11.2.2 Water Disposal Methods. Reinjection and infiltration fields could have potential effects on cultural resources because facility construction could disturb new areas. The significance of these potential impacts cannot be determined until sites are selected and cultural surveys conducted. NRHP determination would be required before action affecting such areas could proceed.

Direct discharge of pit water to Rodeo Creek should not affect any cultural resources because no such resources have been found in the active stream channel. Higher perennial flow associated with discharges to Rodeo Creek would be contained within the present deeply incised stream channel. However, a discharge that has the effect of changing Rodeo Creek to a higher flow perennial stream would affect any cultural resources that may exist in the Rodeo Creek floodplain.

4.11.2.3 Alternative Reclamation Measures. The various reclamation alternatives would not disturb any new areas and would not have effects on cultural resources significantly different than would the Proposed Action.

### 4.11.3 Cumulative Impacts

To date, the operating mines and related processing facilities of Barrick, Newmont, and Dee have, together with the TS Ranch Reservoir, disturbed approximately 5,500 acres of land in an area extending from the Carlin Mine to the Dee Mine (See Figure 3-1). Cultural resource inventories have not been completed for the majority of lands affected by existing mining development because much of it has occurred on the private lands of Newmont and not through a federal undertaking. Existing information suggests that the frequency of sites within this larger area is similar to the frequency of sites in the Betze Project area. This provides a reasonable basis for extrapolating the total number of sites affected to date, which is projected to be on the order of 165. In the absence of mitigation, mining activities typically destroy sites, limiting future research opportunities. Impacts to cultural resources would be minimized to the extent that mitigation would be implemented (see Section 4.11.5).

It is foreseeable that Newmont would continue to mine and expand certain existing mines and begin to develop by surface mining methods certain near-surface orebodies during the life of the Betze Project (see Section 3.12.3.3). Newmont also proposes to expand the tailings impoundment at its Mill No. 4. The continued development of its existing mines would largely occur on land on which the cultural resources have already been affected by mining. The expansion or development of the Newmont projects would, together with the Betze Project, collectively result in a disturbed area that is projected to be approximately 53 percent larger than the existing area of disturbance.

It is also foreseeable that Newmont could develop the Deep Star and Deep Post deposits, and that Barrick could develop the Deep Post and Purple Vein deposits, although the timing and nature of such potential developments cannot be forecast at this time. It is not presently known whether any of the Deep Post, Deep Star, or Purple Vein deposits would be mined by surface or underground methods. If these deposits were mined by surface mining methods, large areas of the surface south and north of the Betze Pit would be impacted. Underground mining presumably would disturb a smaller area. Most of the surface areas surrounding these deep deposits which may potentially be affected by mining have previously been affected or would be affected by the Proposed Action. However, some incremental disturbance of existing cultural resources would occur as a result of the development of one or more of these deposits. NRHP compliance, including mitigation, would be required for any project which requires federal authorization.

Reclamation of the disturbed areas for the Newmont, Dee and Barrick projects is required by law for the vast majority of the lands affected by mining and processing. Reclamation would not, however, replace cultural resources previously impacted by mining.

There is a cumulative impact from reducing the total number of sites in existence in the vicinity of the Betze Project. Archaeological properties can be used to address a variety of research topics in both the social and earth sciences (climate and ecology, for example). Technologic advances continually enhance and expand these possibilities. Mitigation through data recovery would necessarily be focused to address specific questions identified in a treatment plan. Important comparative information would be generated for the short term, but in the long term the net reduction of prehistoric sites in this area would limit future research opportunities. Mitigation through appropriate data recovery would greatly lessen but could not eliminate this effect. It is also possible that the significance of certain sites that would not be directly affected by the Proposed Action may never be identified if the importance of such sites is dependent upon their relationship to other cultural resources that have been or would be destroyed by other mining activity in the area or by the Proposed Action. This would constitute an irretrievable loss of scientific information.

4.11.4 No Action Alternative

Under the No Action alternative, Barrick would continue to mine the Post Pit and operate existing processing facilities to the extent authorized by existing approvals. Barrick would also continue exploration drilling in the Betze Project area. The No Action alternative would preclude ground disturbance by project-related activities beyond those activities presently approved. In the absence of other activities that would disturb the project area, the integrity of cultural resources would remain as at present, and no impacts would occur. The mitigation effort which could produce important scientific information about the prehistory of northern Nevada would not occur. Potentially useful comparative data and the opportunity to increase public knowledge about regional prehistory would not be developed. Although these cultural resources would be preserved for future researchers, the sites might continue to be the objects of unauthorized collection and vandalism, as well as natural processes of erosion. Due to these factors, there may be some loss of the archaeological record whether or not the Proposed Action is approved.

4.11.5 Mitigation

Preservation in place through avoidance would be considered as a first alternative for cultural properties eligible for listing on the NRHP. In some cases, avoidance may not be practical due to other constraints such as topography or land ownership. In such cases, impacts would be mitigated as determined by the BLM in consultation with the Nevada SHPO. A written treatment plan would be prepared and reviewed by the BLM and the Nevada SHPO prior to implementation of any mitigative action. The treatment plan would describe how the attributes of NRHP-eligible properties which make them significant would be preserved. As stated in Section 4.11.1, significance would be expected to be attributed to the ability of a property to yield scientific information about the past. The treatment program would, therefore, likely entail surface examination, mapping, artifact collection, excavation, laboratory analysis, and reporting.

BLM could also require Barrick to mitigate impacts to any cultural properties found on private lands of Newmont that would be affected by the haul road as a condition of the Plan of Operations. Such mitigation would be determined by the BLM in consultation with the Nevada SHPO, as described above.

## 4.12 Land Use

### 4.12.1 Proposed Action

4.12.1.1 Land Status and Ownership. The Proposed Action would affect both private land and unpatented mining and millsite claims. The vast majority of the project would be located on unpatented mining and millsite claims administered by the BLM pursuant to 43 CFR 3809, the BLM's regulations governing mining on public lands. The Proposed Action would not result in a change in the land status or ownership in the project area.

4.12.1.2 Land Use Plans. The Proposed Action would be consistent with the BLM's Elko Resource Management Plan (RMP). The overall objective of minerals management in the Elko Resource Area is to maintain the public lands open for exploration, development, and production of mineral resources while mitigating conflicts with wildlife, wild horses, recreation, and wilderness resources. The short- and long-term management actions include designating the Resource Area open to mineral entry for locatable minerals, except for an 11-acre administrative site. Given the existing mining activity in the project area, the Proposed Action would be consistent with the BLM's minerals management objective. No inconsistency between the Proposed Action and local land use plans or designations has been identified.

4.12.1.3 Land Use. The principal land uses in the immediate area of the Betze Project have included ranching, mineral exploration, and mining. Gradually, the ranching uses in the project area (grazing) have given way to mining. Approximately 2,189 additional acres of land would be affected by the Proposed Action. Historical uses of the project area, other than mining uses, e.g., grazing, wildlife habitat, open space, and dispersed recreation, would be eliminated by the Proposed Action, pending reclamation of the Betze Project area. The Proposed Action would also result in increased irrigated agriculture in lower Boulder Valley for the period of mine dewatering.

Ranching. The project area is located within the 72,928-acre T Lazy S Grazing Allotment and is within the T Lazy S Ranch (see Section 3.12.3.1). A fence has been constructed that encompasses the proposed Betze Project area. Also, by agreement with the TS Ranch Joint Venture, the federal livestock grazing preference (2,965 AUMs) for the fenced area has been removed from active status. Until mining operations in the area cease, livestock grazing has been eliminated as a use of the land in and around the proposed Betze Project area.

Reclamation of the Betze Project area would include reseeding all disturbed acreage except for the pit. Reseeding would increase vegetative cover and make the area suitable for livestock grazing.

Agriculture. Barrick proposes to continue to deliver mine dewatering water to the TS Ranch Reservoir for ultimate use for irrigation, or subject to regulatory approval, to discharge the water directly to Rodeo or Boulder Creeks. The quantity of water to be delivered to the reservoir would vary (see Section 4.4.2). At present, a pipeline approximately 6 miles long exists that can transport water from the TS Ranch Reservoir to lands owned or controlled by the TS Ranch Joint Venture for irrigation use in satisfaction of the ranch's existing water rights. Thus, the Proposed Action would provide water to irrigate approximately 6,500 acres of land that otherwise would be irrigated with groundwater pumped from wells in lower Boulder Valley.

Mining. The Proposed Action would result in the expansion of the area affected by mining activity as well as a 20-year extension of the term of such activity. That development generally would preclude any public use of the affected lands. For both safety and security reasons, public access to the active mining and processing areas within the project area would be precluded to the maximum extent permitted by law during the life of the Betze Project.

The construction of the waste rock disposal areas, tailings impoundment, and leach pad could also inhibit or preclude the future surface mining of other mineral resources, if any were discovered, that are located beneath or adjacent to such facilities.

### 4.12.2 Alternatives

The alternative component locations would generally result in the same impacts to existing land status and ownership, land use plans, and land use as the Proposed Action would. The following sections describe potential differences in impacts from the various facility location alternatives in terms of areas disturbed, livestock grazing, and land ownership.

4.12.2.1 Waste Rock Disposal Areas. The impact on grazing would not materially differ if any of the alternative waste rock disposal areas were selected for three reasons. First, grazing has previously been eliminated as an existing use on all of the land that would be affected by the proposed or alternative waste rock disposal areas. Second, the Extended South waste rock disposal area would still need to be constructed if the North or Clydesdales alternatives were selected because only the Far West alternative (which includes the Extended South waste rock disposal area) would contain sufficient capacity, either alone or in combination with another alternative, to handle the volume of waste rock that would be generated by the Proposed Action. Finally, reclamation of the waste rock disposal areas would provide similar opportunities for resumed grazing use of the land following completion of mining.

Both the Clydesdales and the Far West waste rock disposal areas would extend beyond property owned or controlled by Barrick. Selection of either of these alternatives would require Barrick to make arrangements with the owners of the additional lands.

Selecting one or more of the alternative waste rock disposal locations would vary the areas of potential mineral development that could be inhibited or foreclosed from development by surface mining.

4.12.2.2 Ore Stockpiles. The alternative ore stockpile areas would be located on lands previously disturbed by mining activity and would not result in any additional land use impacts.

4.12.2.3 Tailings Impoundment. The selection of one or more of the alternative tailings impoundment locations would vary the areas of potential mineral development that could be inhibited or foreclosed from development by surface mining. Since grazing is no longer an existing use in the area that would be affected by the alternative tailings impoundment locations, the impact on grazing in the short term from any of the alternative tailings impoundment locations would not vary. Similarly, once reclamation is completed, the impact of the alternative tailings impoundment on grazing would be the same as the impact of the proposed North Block tailings impoundment.

4.12.2.4 Water Disposal Methods. Reinjection and infiltration of dewatering water would mean such water would not be delivered to lower Boulder Valley for irrigation uses, thus reducing the area of land that would be irrigated with dewatering water. The location of areas for reinjection or infiltration have not been specifically identified. The likely locations, however, are not within the fence that has been constructed to exclude livestock from active mining operations. To the extent that such alternatives would disturb additional land presently used for grazing, additional AUMs would be lost, at least during the period of active dewatering. Provided it meets applicable water quality standards, water discharged directly to Rodeo or Boulder Creeks could benefit livestock grazing downstream of the active mining areas by making Rodeo or Boulder Creeks more dependable sources of water.

4.12.2.5 Partial Pit Backfill. This alternative would preclude development of the Deep Post deposit by surface mining methods as an expansion of the Betze Pit.

### 4.12.3 Cumulative Impacts

The operating mines and related processing facilities of Barrick, Newmont, and Dee occur over an area extending from the Carlin Mine to the Dee Mine (see Figure 3-1). The impacts of the Betze Project on competing land uses described in the preceding sections would contribute incrementally to resulting dominance of mining as the principal land use in the area.

It is foreseeable that Newmont would continue to mine and expand its existing mines and begin to develop by surface mining methods certain other orebodies during the life of the Betze Project (see Section 3.12.3.3). The expansion by Newmont of its existing pits and tailings impoundments would generally occur on land that is already effectively dedicated to mining. Development of certain new near-surface deposits, however, would continue to expand the area where mining has become the dominant or exclusive land use.

It is foreseeable that Newmont could develop the Deep Star and Deep Post deposits, and that Barrick could develop the Deep Post and Purple Vein deposits. Each of the Deep Star, Deep Post (Newmont), Deep Post (Barrick), and Purple Vein deposits appear to have gold resources in excess of 4 million ounces. While the timing and nature of such potential developments cannot presently be forecast, it is clear that such developments would have the effect of extending the period that the area in the vicinity of the Betze Project would be dominated by mining. In view of the lack of concrete plans for development of any of these deposits and the companies' statements that their short-term priorities for mining are elsewhere (e.g., Newmont -- near-surface oxide reserves; Barrick -- the Betze development) it is reasonable to assume that much, if not all, of this development would occur following the projected conclusion of mining of the Betze deposit.

Presently, Barrick is the only company that is delivering water to the TS Ranch Reservoir for irrigation use in lower Boulder Valley. If additional dewatering were to occur during the life of the Betze Project (see Section 4.2.4.2) as a result of other mineral development, it is possible that more water would be available for irrigation and that there would be a corresponding increase in lands dedicated to irrigated agriculture in the Boulder Valley area, or that more water would be disposed of by infiltration, reinjection, or direct discharge to Rodeo or Boulder Creeks.

The cumulative impacts of expanded mining operations would also include the disturbance of grazing patterns and the potential increase cattle mortality due to an increase in vehicles and other equipment. Barrick and Newmont presently have an agreement with the principal grazing permittee in the area, the TS Ranch Joint Venture. The agreement minimizes but does not eliminate these potential land use conflicts.

### 4.12.4 No Action Alternative

Under the No Action alternative, Barrick would continue to mine the Post Pit and operate the existing mill, South Block waste rock disposal area, AA Block heap leach pads, and tailings impoundment to the extent authorized by existing approvals. This would result in no change to existing land uses during the period in which these mining activities continue. However, upon the conclusion of authorized mining activities in the Post Pit, the No Action alternative could result in a change in land use in the Betze Project area. It is possible, although unlikely, that upon termination of authorized activities, mining would cease to be the principal land use in the Betze Project area. However, the existence of several mines and potentially minable deposits (see Figure 3-1) suggest that Barrick and Newmont would continue to use the land for exploration and mining purposes for at least the next decade. Over the longer term, the No Action alternative would potentially result in the resumption of other land uses at an earlier date than if the Proposed Action were to occur.

Implementation of the No Action alternative may mean that existing dewatering would be continued only until the end of Barrick's development of the surface Post deposit. If so, discharges to the TS Ranch Reservoir may terminate, and the resulting use of such water for irrigation in lower Boulder Valley would not occur. Although the TS Ranch Joint Venture would likely continue to irrigate certain lands with water from existing wells rather than mine dewatering water, a smaller amount of irrigation is likely to result. These projections assume that Barrick or Newmont would not choose to continue to dewater the Post Pit in conjunction with the potential development of the Deep Post deposit, and would not discharge water to the TS Ranch Reservoir from other operations such as the Genesis or Bootstrap Mines.

### 4.12.5 Mitigation

No mitigation is recommended for land use.

## 4.13 <u>Social and Economic Values</u>

This section evaluates the effects of the Proposed Action within the context of social and economic changes in the affected area. The tables referenced in this section are located in Appendix E of this EIS. A more detailed socioeconomic technical report is available for review by the public in the BLM's Elko District Office.

Evaluation of the impacts associated with the proposed Betze Project must consider the existing social and economic environment of the local area, including the considerable growth that has occurred during the past 10 years.

The project-related impacts, both temporary and permanent, must also be related to changes in the overall economic picture of the area, including continued mining exploration, expansion, and development, and construction of other projects such as the Thousand Springs Power Plant. Cumulative effects may compound or offset one another and these effects may vary through different phases of development. Future changes in employment and phasing of other projects may result in changes to the impacts presented.

Major construction for the proposed project is scheduled to begin in early 1991 and continue until completion of all phases in November 1992, with peak employment occurring from mid-May through mid-September in 1991 and 1992. The actual construction and operations schedule would depend on completion of the permitting process.

Calculations of impacts were based on known characteristics of the affected area, supported by professional planning standards, and empirical data from other mining projects in Nevada. Tables E-15, E-16, and E-17 reflect the projections of impacts from project development during peak and average construction and during operations.

4.13.1 Proposed Action

4.13.1.1 Population and Demography. Elko County has shown considerable growth since 1985 and will likely continue to increase in population until 1992 or beyond, if current levels of activity continue in the mining industry. An additional impact on population would occur in the Elko County area during the period of construction of the Betze Project.

Construction. Currently there are an estimated 1,093 mine workers and 65 to 115 construction workers on site. The 1991 peak construction workforce is estimated to be 750 workers, with an estimated 525 (70 percent) of those workers coming from outside the local area. The resulting peak non-local construction population, including families of construction workers and indirect labor, would be a maximum of 723 people from mid-May through mid-September 1991. This population level would remain for approximately 4 months and then decline. However, there would be overlapping impacts from the presence of both construction workers and new operations workers in 1992. In 1992, the oxygen plant construction workforce would peak at 105 in the first quarter, and the construction workforce for the autoclaves would peak in the third quarter at 250. In addition to construction activities, the new operations workforce would be on line in 1992. The peak new population impact (including workers' families and indirect labor) in 1992 is estimated to be 189 for the construction workforce and 225 for the operations workforce, for a total of 414 new temporary and permanent residents in the area. Peak construction employment levels would occur for 4 months and then decline rapidly.

The construction workforce would average 370 workers over the 1991 11-month construction period. As illustrated in Table E-16 (Appendix E), the average increase in area population generated by this workforce would be 280 new people. Due to the limited availability of housing in the Elko and Carlin areas, indirect employment and population generated by the Betze Project could be limited; average indirect employment is estimated to be 12 non-local employees. The associated increase in population would be 31. The average increase in population in the area would be less than 1 percent. In 1992, the estimated average new population in the area associated with direct and indirect construction activity (14) and direct and indirect operations activities (225), would be 239 new temporary and permanent residents. This total would equal less than 1 percent of the Elko-Carlin area population.

Operations. Employment during operation of the Betze Project would peak at 1,170 during 1992 through 1993. Barrick currently employs 1,093 workers; therefore, an increase of 77 workers would be expected during the 2-year period. This operations workforce would remain fairly constant through the year 2000, dropping a maximum of 20 workers by the year 2000. In 1992, the new population in the Elko-Carlin area associated with the proposed level of operations would be 225 (Table E-17). In the year 2001, due to the completion of open-pit mining and associated operations, the operations workforce would decrease to 407 workers and remain at this level through the year 2010. The new population increase projected during full operation represents less than a 1 percent increase to Elko County and the City of Elko.

The new population related to operations is expected to locate primarily in or near Elko and Spring Creek. A smaller portion of the population would locate in the Carlin area. Although the project-related increase in new population would be small, the overall cumulative impact to Elko and Carlin may be significant considering the anticipated population increases from other mining, exploration, and production activities and their indirect effects. These cumulative impacts are discussed further in Section 4.13.3.

Mine production would be completed by the year 2001, with a corresponding reduction in the workforce to 407. If no additional economic activity were occurring in mining or related fields in Elko County in the year 2001, people directly or indirectly employed by the project would probably leave the area. The loss of population at that time would substantially higher than the projected increases shown in Table E-17 associated with the incremental increase of 77 operations workers because the existing workforce also would be affected by the completion of mining.

4.13.1.2 Economy and Employment. The principal economic effects of the proposed project would be additional mining employment in Elko County and some growth in the retail and service economy. Total income in the area would increase since the mining sector provides the highest wage rate of any wage and salary employment sector in Nevada (Nevada Department of Employment Security 1990). Most of the economic impact would occur in Elko. The influx of new population and new employment would continue to stimulate the local economy. A continuation of the existing trend of economic growth would be sustained. Projected employment impacts of the proposed project are summarized in Tables E-15 to E-17.

Construction. Based on existing state labor force and unemployment figures for Elko County and communication with local Employment Security Division personnel and construction contractors, it is estimated that 45 percent (166 employees) of the average construction employment level of 370 workers projected for 1991 would either be current residents of the Elko-Carlin area or the immediate vicinity.

Secondary employment related to construction of the mine complex was estimated using a construction sector multiplier of 1.2 (Isard 1976; BEA 1980; ERT 1980; Dobra 1988a). An average of 411 new direct and indirect jobs would be created during the construction phase, of which 195 are projected to be filled by local area residents or second persons in a non-local household. In 1992, although the average construction workforce would be smaller than the 1991 construction workforce, additional new operations personnel would also be hired. The average number of new jobs created in 1992 would total 194, which would include 102 construction-related direct and indirect workers and 92 operations-related direct and indirect workers.

Operations. The increase in the permanent operations workforce is expected to total 77 workers. Table E-18 shows projected manpower requirements throughout the operations period. Any carryover of workers from construction would be so small as to be insignificant for analytical purposes. The increase in jobs that would be created by the Proposed Action would represent a 5.7 percent increase in the estimated mining employment in Elko County between 1989 and 1992. Indirect employment associated with the increase in the operations workforce would be 15 new workers. These jobs would represent less than a 1 percent increase in the workforce employed in the services and trade sectors in Elko County. The indirect employment generated during operations was estimated using an employment multiplier of 1.2 (Dobra 1988b).

Despite the local and non-local employment estimates shown on Tables E-15 through E-17, the production status of other mining projects in the near future would determine the availability of local labor that could be hired by Barrick. If mineral exploration and production stabilizes as is predicted for the future, a higher percentage of local labor may be available. If the reverse is true, the overall non-local impact of the proposed project would be greater.

Higher direct cumulative employment figures may increase the indirect employment multiplier. Losses in direct and indirect employment would result upon project completion in 2010. Since the existing workforce also would be affected, the total reduction in employment would be substantially greater than the new employment estimates presented in Table E-17.

4.13.1.3 <u>Housing</u>. As described in Chapter 3, the existing housing market throughout the Elko County area is generally very tight for lower-cost and temporary housing such as rentals and mobile homes. Future prospects for a change in this situation depend on the development of new rental units or a shift from owner-occupied to renter-occupied homes for sale.

<u>Construction</u>. The Betze Project would create estimated average and peak totals of 120 and 311 new construction-related households in 1991. In 1992, the estimated peak total households related to construction would be 81; the estimated construction-related average would be 6; and the operations-related households would be 63. During the period of overlap between the peak construction and operations phases, the housing demand would be 144 units. These estimates are based on single construction workers doubling up due to the lack of available rental housing in the Elko area. If workers prefer not to share housing, the estimated housing impact would be substantially greater.

If the temporary rental housing stock remains at the current level, construction workers would have a difficult time finding housing for rent in Elko, Carlin, and Spring Creek. Most construction workers prefer rental units which provide some kitchen facilities, so motel rooms are generally less desirable than RV parks or mobile homes. Table E-19 shows potential housing surpluses and deficits during the peak and average construction periods. Note that the vacancy survey was conducted in the fall when most temporary accommodations have more vacancies. However, new school teachers moving to the area have also impacted the rental market at this time. Some of the assumptions used in the housing impact assessment are as follows:

- The average construction work force would be 370 for the 11-month construction period in 1991. The peak work force of 750 would occur starting in mid-May 1991 and continue through mid-September 1991.

- The peak construction work force would be 30 percent local and 70 percent non-local (Hertzog 1990; Lattin 1990).

- A construction employment multiplier of 1.2, based on 1978 employment location quotients and basic/non-basic employment, was used to calculate indirect construction employment.

- Seventy percent of the indirect labor force would be either second persons in the direct labor households or current residents of the Elko-Carlin area.

- The construction work force would be composed of 90 percent single workers or married workers without family, and 10 percent married workers with family (Hertzog 1990).

- Single workers would double up due to the lack of rental housing in the area.

- Both husband and wife of 1 percent of the married workforce would work at the mine during construction.

The household allocation used was based on two scenarios: the first case assumed two single workers per household; the second case assumed one single worker per household. The second case would represent a worst-case housing situation. A discussion of housing demand is presented in Table E-19 and Section 4.13.1.3.

Population estimates were based upon 2 persons per household for single households with direct workers, 2 persons per household for single households with indirect workers, and 3.5 persons per household for married households (Hertzog 1990).

The number of school-age children were estimated to be 1.0 per married household. Eighty percent of school-age children would be primary students and 20 percent would be secondary students.

Housing preferences were based on the following percentage distribution.

| | Elko (80%) Peak | Elko (80%) Avg | Carlin (15%) Peak and Avg | Other (5%) Peak and Avg |
|---|---|---|---|---|
| Single Family (SF) | 5 | 10 | 10 | 10 |
| Multi-Family (MF) | 15 | 20 | 0 | 0 |
| Mobile Home (MH) | 10 | 20 | 20 | 20 |
| Other (RV site or Motel) | 70 | 50 | 70 | 70 |

A mancamp located in Carlin can house approximately 400 workers. Currently the occupancy is estimated to be 25 percent (100 workers). If temporary rental housing were not to be available for construction workers in Elko or Carlin in 1991 and 1992, the mancamp facility could be leased for the duration of the construction period. Housing availability for the peak construction workforce would be limited.

Operations. Based on information provided by Barrick and local realtors, the availability of housing for sale appears adequate for the new permanent operations workforce. Barrick currently has 37 single-family homes under construction in two of its subdivisions - North Fifth and Mountainview. An additional 94 houses could be constructed if needed. It is anticipated that there would be more than adequate housing available for operations workers who would intend to purchase homes in the Elko area.

Carlin has the tightest housing market for both rentals and houses for sale. There are no single-family, multi-family, or mobile homes currently for rent (Wanda's Reality 1990). There are very few RV space rentals; however, there are RV parks or lots for sale in Carlin. It is estimated that there are currently 12 homes on the market either by owner or listed in the MLS (Wanda's Realty 1990).

#### 4.13.1.4 Public Facilities and Services

Eureka County. Public services and facilities such as police, fire, medical, sewer, water, solid waste, schools, recreation, and library services would not be impacted in Eureka County by the proposed expansion. Because of the proximity of Elko and Carlin to the project area, it is not anticipated that any of the construction or operations workforce would temporarily or permanently locate in Eureka County.

Elko County. Public facilities and services in Elko County would be affected by the increase in population associated with the proposed project, particularly in the City of Elko. It is anticipated that most of the population from construction and operation activities would reside in the City of Elko. The average increase in population related to construction activities is estimated to be 224 in Elko, 42 in Carlin, and 14 in other locations. The average increase in population related to operations is estimated to be 191 in Elko, 27 in Carlin, and 7 in other locations. Services provided in the unincorporated county either by the county or other private businesses which would not be impacted by the proposed project include water, sewer, electricity, and natural gas.

Sheriff's Department. The proposed Betze Project is not anticipated to impact either the Sheriff's Department staffing or equipment needs if the current personnel and equipment requests are granted by the county (Watson 1990b). Currently the department believes that an additional six enforcement (two positions have been approved) and five civilian (one position has been approved) staff members are needed to meet current service demands. The department also believes that six patrol vehicles (two vehicles have been funded) are needed. If these service level requests are met, the Sheriff's Department believes that the effects of 100 to 150 new primary jobs in the Elko County area could be managed. Without these additions to the department, additional population from the Barrick project would exacerbate the current staffing and equipment needs of the department (Watson 1990b).

County Jail. If personnel requests are met for jail operations (5 civilian personnel), the Sheriff's Department believes that the jail would be able to handle existing needs and the increased population effects of the proposed project during both the construction and operations periods; without the requested additional personnel, the jail staff would not be adequate (Watson 1990b).

Fire Services. There would be impacts to the unincorporated Elko County fire operation providers (Nevada Division of Forestry and Northeastern Fire Protection Department) but they would not be considered significant (Kightlinger 1990). Currently fire protection to the mines in Eureka County is limited to the on-site facilities that the mines provide. The Nevada Division of Forestry believes that their current manpower and equipment is inadequate to handle the proposed expansion at the Barrick mine. The division believes that one full-time employee and a combination engine stationed at the Carlin volunteer fire department would more adequately provide fire protection to the area. In addition, as the proposed facilities would be built, Barrick would need to increase the capabilities of the on-site fire brigade to handle structure fires and to assist the first-response volunteer fire department.

Emergency Response. Emergency response capability in the county would be adequate to respond to any increase in emergency response demand caused by the proposed expansion of the workforce at the mine.

Medical Services. The Elko General Hospital would have adequate facilities, personnel, and beds to handle the estimated increase in population in the Elko area; current occupancy at the hospital averages 47 to 57 percent (Welsh 1990).

Solid Waste. The increased population in the unincorporated areas of Elko County would have minor impacts on county landfills. The mine expansion activity itself would not affect any of the disposal facilities in the county, as there is a Class III landfill on-site.

Recreation Services. See the discussion for the City of Elko.

Library. The librarian believes that one additional staff member and an average of 2 volumes per person, or 450 books for circulation requirements would be needed to serve a project-related population of 225 persons (Madsen 1990). Recent surveys have shown that 65 percent of new registration at the library is composed of mining-related residents (Madsen 1990).

Schools. Currently the school district is stabilizing from the substantial growth experienced between 1987 and 1989. However, the district is behind in completing capital project plans. Schools within the Elko area are typically over capacity, with an Elko and Carlin area capacity deficiency of 188 students based on 1989 enrollment. Mountainview Elementary School in Elko is scheduled for construction in 1991 and should be operational in the fall of 1991. This should alleviate some of the elementary school overcrowding. The Elko Junior High needs immediate capital project planning; it is currently 172 students over capacity (Harris 1990).

During the average project construction phase, 21 new students would attend schools in Elko and 5 new students would attend schools in Carlin. The peak construction activity would occur during the summer months; therefore, the population growth associated with peak construction activity would not impact the school district. However, if the peak construction workforce were to arrive during the school year or if the completion schedule were delayed, the impact to the district would be significant. During operations, the estimated project-associated student population of 66 in Elko and 12 in Carlin would require a minimum of two new teachers and two new classrooms in Elko and one elementary teacher in Carlin. These numbers could be higher depending on which grade levels were most affected (Ridgeway 1990). Mountainview Elementary School should have adequate capacity for the new elementary school students. More pressure on the junior high school would likely occur.

City of Elko. Public services in the City of Elko would be affected by the increase in population from an estimated 224 new residents related to construction activities and an estimated 191 new residents related to operations. However, the project would not impact the electricity, telephone, or natural gas suppliers in the area.

Police. The Elko Police Department would have adequate personnel and equipment to serve the additional population estimated from the proposed project (Kirby 1990b).

Fire Services. The Elko Fire Department needs additional staff to serve the current population as well as the increase associated with the project-related population. The facilities and equipment would be adequate to serve the increased population.

Emergency Response. Emergency response by the City of Elko would not be affected by the proposed project (Garvie 1990).

Medical Services. See Elko County.

Public Utilities

Water. The population increase related to the proposed project would have an impact on the City of Elko water system but it would not be considered significant (Williams 1990). Currently, water supply is adequate to handle the increased population.

Sewer. The population increase related to the proposed project would have an impact on the City of Elko sewer system but it would not be considered significant (Williams 1990). The system has recently been expanded to a current treatment capacity of 3.3 million gallons per day (mgd); treated sewage demand is currently 2.6 mgd.

Solid Waste. The Elko city landfill is nearing capacity; the remaining life of the landfill is estimated to be between 5 and 7 years (Williams 1990). This city service would be affected by the project-related population; however, the impact is not considered significant (Williams 1990).

Municipal Airport. The project-related population and mine activities would have a minimal impact on the operations of the municipal airport.

Recreation. Recreation services in Elko County are under the jurisdictions of the Elko Area Recreation Commission (EARCO), city recreation departments, private groups, and the school district. Recreational services in the area are currently inadequate for the existing population, and an additional 191 people in Elko would further exacerbate the current demand for recreational services and facilities (Klien 1990).

Library. See Elko County.

Carlin. Public services and facilities in Carlin are limited. The city provides police, fire services, water, sewer, solid waste, and minimal recreation facilities.

Due to the limited housing available in Carlin, it is not anticipated that a large population influx would occur in Carlin due to the project. The average construction period impact would be approximately 42 new residents for 11 months. The estimated operations workforce impact would be approximately 27 new residents.

Based on these estimates, it is not anticipated that police, fire, water, sewer, or solid waste services in Carlin would be significantly impacted by the proposed project (Aiazzi 1990; Ankrum 1990b).

Carlin has limited recreational facilities primarily consisting of a 32-acre park with playground, basketball courts, a baseball field, and tennis courts. These facilities serve the entire Town of Carlin and are currently operating at capacity. Therefore, additional demands for recreational use would impact the existing facilities.

4.13.1.5 Government and Public Finance. The proposed project is principally located in Eureka County; therefore, most direct property tax and net proceeds revenues would accrue to Eureka County. However, most sales tax revenues would accrue to Elko County and its communities. Table E-20 shows revenue projections for property tax and net proceeds tax for Eureka County. The revenue projections are estimates based on current tax rates and assessment practices. Actual taxes may vary.

The principal revenue change to Eureka County would result from an increase in assessed valuation attributable to the mine, processing facilities, and other support facilities. Property taxes are estimated on Table E-20 based on capital expenditures incurred annually for project development. Real property is assessed at 35 percent of market value; a 0.0155 mill tax rate (1990-1991) is applied in Eureka County. Receipt of the revenues would lag 1 year behind installation of improvements because of conventional assessment and collection practices.

In addition to mine and processing facilities construction activity, other commercial and residential activity would be occurring in Elko and the surrounding areas. These developments would contribute to the tax base and add property tax and sales tax revenues to the cities of Elko and Carlin and to the Elko County treasury. Tax revenues have not been estimated for these developments due to their uncertainty at this time.

A net proceeds tax is collected on the production of gold and silver at property tax rates. This tax is based on estimated mining profits, which depend on gold and silver prices in the market. Tax revenues to Eureka County would be $2,280,000 the first year during full production based on a net proceeds of $147 million per year.

Under the Proposed Action, the development of the mine would also generate sales and use tax revenues to the state and local governments. Total operating expenses related to the Betze Project are not available at this time but would contribute to net receipts of the Elko County local governments. These sales tax receipts would somewhat offset the impacts associated with growth. However, they would not be sufficient to offset all fiscal impacts.

The proposed expansion of the workforce would generate an annual new payroll ranging from $2.7 million in 1992 to $1.3 million in 2000. Comparable figures for the construction workforce include an average construction payroll of approximately $17.9 million for the 1991 11-month construction period. A portion of this total income would be spent in the area and would result in increased sales tax receipts throughout the area.

The increase in population and in school-age children associated with the Proposed Action would generate increased demand for government services and facilities requiring county, town, and school district expenditures. Typically, government entities would experience increased expenditures with little increase in revenues during the construction phase. Because Eureka County collects all of the property tax and net proceeds revenues from the project, Elko County and its impacted communities would incur increased expenditures throughout the operations without the benefit of such revenues. Increases in expenditures would occur primarily in public safety, schools, welfare, and community support activities during 1991, 1992, and 1993. There would likely be a financial shortfall for all government entities affected during this period.

During operations, the most significant increases in expenditure requirements would occur in schools, public safety, road maintenance, and recreational services. The effects of the less than 1 percent increase in population and 1.5 percent increase in school-age children on public services and facilities are discussed above.

In summary, it is anticipated that the proposed project would result in public revenue deficits throughout Elko County.

4.13.1.6 Transportation. Development of the proposed Betze Project would generate both direct increases in traffic to the project site and indirect increases in local and regional traffic caused by project-related population growth. Direct effects would be most notable in the immediate project vicinity on the state highway north of Interstate Highway 80 (I-80) at Carlin. On I-80 between Carlin and Elko, direct traffic impacts would be absorbed into much higher background traffic levels and would be difficult or impossible to differentiate from existing traffic. The proposed project would generate an estimated peak level of 54 vehicle trips per day on the state highway north of Carlin, including 20 delivery and service trips, 28 worker bus trips, and fewer than 6 private vehicle trips. This peak during the 4-month peak construction period in mid-1991 would constitute an increase of 2.4 percent over 1989 average daily traffic on the road. Approximately 15 to 20 of the total project-related trips may occur during a peak-hour period. Combined with estimated 1989 peak-hour traffic of 332 vehicle trips, total peak-hour traffic would be 342 vehicle trips, well within the capacity of the state highway and the road from the state highway to the Barrick access road, except in the most rugged section where that road crosses the summit of the Tuscarora Mountains. The average level of activity during project construction would generate traffic at about 74 percent of the peak level. Project operations would generate even less traffic.

Indirect traffic increases would be most noticeable in downtown Elko, where existing traffic levels and congestion have triggered extensive street and traffic control improvements. Project-related indirect traffic increases in Elko would be a function of population. The projected maximum population increase in the Elko vicinity from development of the Betze Project would be 579 people, a 3.9 percent increase over the estimated existing City of Elko population. Using a simple ratio approach, this would result in 927 additional vehicle trips per day on Idaho Street, the main street in downtown Elko. This increase would aggravate existing downtown traffic problems somewhat. The maximum project-related traffic increase would be very short-term, however, lasting approximately 4 months from mid-May through mid-September 1991. After the peak construction activity, project-related traffic on Idaho Street would decrease to about 1.5 percent above the existing traffic levels. The spike in traffic would not be sufficient, by itself, to trigger a need for major street improvements because of its short duration.

Projections of overall traffic growth have indicated a need for substantial additional street improvements over the next 10 years because of anticipated population growth well above the levels associated with the proposed Betze Project. The project-related peak in mid-1991 may affect the timing of planned improvements, even though it would not be sufficient to warrant the improvements in the absence of other expected growth.

### 4.13.2 Alternatives

Socioeconomic impacts associated with the location of various project components (e.g., waste rock disposal areas, ore stockpiles, heap leach pad, and tailings impoundment) would be the same as those of the Proposed Action. Socioeconomic impacts associated with partial backfill of the Betze Pit and alternative methods of water disposal are summarized below. See Section 4.13.4 for a discussion of the No Action alternative.

4.13.2.1 Water Disposal Methods. The three water disposal methods would have similar socioeconomic impacts, with one exception: if the water from the pit were not discharged to the TS Ranch Reservoir and were disposed of by an alternative method, it would not be available for irrigation in the lower Boulder Valley. The potential economic benefit of the increase in irrigated area would be lost; however, the TS Ranch could use groundwater for additional irrigation.

4.13.2.2 Partial Backfill Backfill. The socioeconomic impacts of this alternative would be similar to the Proposed Action; however, a portion of the employment, salary, and tax benefits would continue for an additional 9 years of mining operations. Transportation impacts associated with the mining workforce would also continue for an additional 9 years.

4.13.3 Cumulative Impacts

Cumulative socioeconomic impacts would result from construction or operation of all projects which contribute to changes in local population, employment, housing, public facilities and services, the economy, and the transportation network. These projects potentially include other existing and proposed mining operations and the Thousand Springs Power Plant. The project factors influencing interrelated socioeconomic impacts include project construction and operations schedules, number of workers, and capital investments in the local area. The lack of specific information regarding projected construction and operations schedules, workforce requirements, and fiscal data precludes a quantitative assessment of future cumulative socioeconomic impacts. However, the following is a qualitative assessment of cumulative socioeconomic impacts based on existing and reasonably foreseeable projects in the affected area.

Companies involved in precious metals exploration and development have been very active in the area encompassing Elko and Eureka Counties since the early 1980s. As discussed previously in this EIS, Newmont and Dee Gold are currently involved in mineral exploration and development in the area and have indicated plans for continued activity at various levels. Barrick and Newmont currently employ approximately 3,200 workers at their mines in Elko and Eureka Counties. These employees, together with their families and the associated indirect employment, comprise approximately 9 percent of the current population of Elko County, where the majority of the workforce resides.

The larger mining companies, with significant ore reserves and lower average mining and processing costs, are likely to continue exploration, operation, and expansion of their projects at a relatively consistent rate into the future, despite fluctuations in the market price of gold. Newmont and Barrick have indicated their operations are likely to maintain their current levels of employment of approximately 2,100 and 1,100 workers, respectively. Dee Gold does not anticipate an increase in their current staffing level of 95 workers. It is assumed that these operations would employ workers already located in the area; no significant increase in the local population from out-of-area labor is anticipated.

The Betze Project would employ approximately 1,100 workers for the next 10 years until the completion of mining in the year 2000, followed by employment of approximately 400 workers until milling ceases in 2010. This level of employment, together with Newmont's proposed continued employment of approximately 2,100 workers, would ensure the continued contribution to the local economy of purchases and sales tax revenues associated with the Betze Project.

Table E-21 summarizes estimated cumulative growth projections for Elko County over the next 10 years. This table is based on the assumption that employment would remain relatively constant for other projects in the area, with the exception of Barrick and the Thousand Springs Power Plant. Due to changes in investors and environmental controversies, the feasibility and schedule for the Thousand Springs Power Plant are extremely speculative.

Development of the proposed Betze Project together with potential interrelated projects in the vicinity would have minimal direct effect on traffic flows on the road network between Carlin and the project site. The interrelated mining projects are largely locational shifts of activity now occurring within this segment of the Carlin Trend. Except for the Betze Project, employment is not proposed to increase in the area and will, in fact, decline over the life of the Betze Project. Quantitative emissions of cumulative truck traffic are not available, but major increases are not anticipated. The total cumulative effect on county road traffic would be minor and only slightly greater than traffic effects from the Betze Project alone. Traffic would be expected to decline somewhat as the ore bodies are mined out and the mine projects are closed down.

Cumulative effects on traffic in Elko are more difficult to estimate. Projections indicate that substantial population growth is expected to continue through the life of the Betze Project. However, very little of the growth would derive from interrelated project activity. Only the Thousand Springs Power Plant would generate a notable population increase, estimated at 139 people in the year 2000. The substantial projected baseline population growth would certainly contribute to ongoing traffic congestion problems in Elko, but indications are the interrelated projects would contribute only a small portion of the increase traffic. The net cumulative effect would be a small aggravation of existing and continuing problems that are being addressed through a proposed transportation master planning effort and several major street improvement projects by the city and the state.

### 4.13.4 No Action Alternative

The No Action alternative would preclude expansion of the Betze Project. Thus, both the beneficial and adverse socioeconomic impacts listed in Section 4.13.1 would not occur. The current 1990 Barrick Goldstrike workforce is estimated at 1,093. With the No Action alternative, this level of employment would remain stable until the time when the current ore reserve is mined out. Once the ore is depleted, the current staff would be reduced by 843 employees to 250, which would be an adequate workforce to decommission the operation. Once the mine, mill, and leach pads were decommissioned, the majority of the remaining workforce would be laid off.

The adverse impacts associated with population growth due to out-of-area labor would be avoided with the No Action alternative. The already tight rental and temporary housing market would not experience the increased pressure from the project-related demand of 311 to 554 units during peak construction and 120 to 214 units during the average construction period. Anticipated increases in the demand for police and sheriff services related to the construction period of the Betze Project would not occur with the No Action alternative.

Potential increased pressures on capital infrastructure and operations in the Elko School District would be reduced with the No Action alternative. The Elko-Carlin area currently has a capacity deficiency of 188 students, based on 1989 enrollment. The two new teachers and two new classrooms in Elko and one teacher in Carlin, necessary to support the estimated 78 new students associated with the operation of the Betze Project, would not be required with the No Action alternative. Once Barrick had completed mining the existing ore body, the school district would likely experience excess capacities associated with the movement of Barrick Goldstrike employees out of the area.

Fiscal impacts to local governments from increased demands on public services and facilities would be avoided with the No Action alternative.

The beneficial impacts of increased employment during both the 2-year construction period and 18-year operations period would not occur. An estimated 166 new direct jobs to local residents during the average construction period and 225 new direct jobs during peak construction would not be created. An estimated 77 direct jobs during operations would not be created.

Increased incremental annual income from construction and operations employment payroll ($17.9 million during construction and $2.7 million during operations) would not be generated in the Elko area. Once the mine had shut down, the total annual compensation package for all Barrick employees of $51.1 million would no longer be generated. Associated induced economic effects of local spending by construction and operations workers would not occur. Additional Barrick Goldstrike expenditures in the local area would also be foregone, which would preclude collection of additional sales and use tax for the state, county, and local communities.

Estimated property and net proceeds taxes of approximately $3.4 million in 1992 to Eureka County would not occur. Once Barrick would complete mining of the existing ore body, a substantial decrease in the Eureka County tax base would occur.

4.13.5 Mitigation - Housing

This section identifies possible mitigation measures designed to minimize significant adverse housing impacts identified in the environmental impact analysis.

1. Lease, purchase, or build a mancamp facility for the duration of the construction period.

2. Purchase or lease RV lots or small park in Elko or Carlin.

3. Prelease apartment units as they become available. Average monthly turnover of apartments in complexes throughout Elko is estimated at three per month.

## 4.14 <u>Possible Conflicts Between the Proposed Action and Federal, State, and Local Land Uses and Policies</u>

No conflicts have been identified in the Little Boulder Basin between any land use management plans or policies of federal, state, or local agencies.

## 4.15 <u>Unavoidable Adverse Effects</u>

Implementation of the Proposed Action (and to a lesser extent, the No Action alternative) would cause some adverse effects during the life of the project that cannot be avoided. The intensity of these unavoidable effects may be lessened to acceptable levels by mitigation measures. Adverse effects which cannot be entirely mitigated include short-term and long-term alteration of landforms and surface drainage patterns. There would be short-term alteration of surface water flow rates in local springs, seeps, and Rodeo and Brush Creeks resulting from area dewatering. Short-term consumption of groundwater by the mill and mining processes would not affect any current groundwater users. Much of the groundwater removed by the dewatering operation would be transferred from the TS Ranch Reservoir to lower Boulder Valley, where resulting groundwater levels would be increased over the short-term, just as groundwater levels in the Little Boulder Basin would be lowered over the short-term. Recovery of groundwater levels at the project site is estimated to require over 100 years.

Local air quality would be affected over the short-term by particulates created by mining and processing operations. However, such impact would be minor and resulting air quality would not violate Nevada or federal air quality standards.

Increased soil erosion from wind and water would occur over the short-term from the project site. Barrick's erosion control program would minimize this erosion to acceptable levels but, because of the magnitude of the site, cannot completely eliminate such erosion.

For the short term, impacts to vegetation cannot be mitigated. The length of time that these impacts remain unmitigated would depend on the specific component location, the length of the mining operation, and the time necessary to re-establish vegetation. This time period would extend from initial disturbance through the successful establishment of a self-sustaining vegetation community.

Vegetation would be disturbed or removed from approximately 2,189 acres. Revegetation would be implemented on all but approximately 690 acres, but the resulting vegetation communities would be different from original communities for the long-term.

Wildlife communities would be affected in both the short- and long-term. Site development would displace wildlife onto adjacent habitats in the short-term, particularly mule deer and sage grouse. Following closure and revegetation, wildlife would be expected to return to the site.

There would be a long-term alteration of viewsheds in the Little Boulder Basin caused by the introduction by the project of contrasting colors, lines, and landforms. Over time, these introduced elements would become less noticeable.

A short-term increase in the population of Elko County would result from the project implementation. This effect can be considered both beneficial and adverse. The current shortage of housing units would be aggravated by the increased population.

## 4.16 Short-Term Use Versus Long-Term Productivity

This section discusses the balance between the short-term use of the site by the project and the long-term productivity provided by the site without the project. In this discussion, short-term is defined as the life of the project (20 years); long-term is defined as beyond the proposed life of the project.

The current uses of the site include mining, milling, waste rock disposal, tailings disposal, cattle grazing, and wildlife habitat. Current productivity from the site includes production of gold metal, approximately 1,100 jobs with an annual payroll of approximately $28 million, and ad valorem and net proceeds taxes to Elko and Eureka Counties in the amount of $3.5 million by 1993. The site is also producing some commercially important wildlife such as partridge, sage grouse, and mule deer. However, hunting is restricted in the vicinity of the Betze Project area. The resultant actual harvest of this wildlife resource is unknown but is estimated to be minimal. If the proposed project were not implemented, these uses and levels of productivity would continue until mining of the Post Pit ceased.

If the Betze Project is implemented, some of the short-term uses of the site would be changed or altered for the 20-year life of the project. Wildlife habitat would be reduced, as the site disturbances would cause a loss of forage.

Currently, Barrick is dewatering the Post Pit. Approximately 2,500 gpm is being used by the mill and other project facilities. The remainder, up to 15,000 gpm, is being discharged to an unnamed drainage which is tributary to Boulder Creek. The TS Ranch Reservoir currently stores that water for irrigation use. This dewatering operation is a short-term effect and could be considered as productivity from the site. The production of the water would continue for the life of the Post Pit. If the Proposed Action is implemented, the rate of water production could increase up to 30,000 gpm, and the amount discharged to the unnamed drainage and TS Ranch Reservoir could increase by as much as 20,000 to 22,000 gpm; this too, would be a short-term use of the site.

If the project is implemented, there would be additional productivity from the site for the life of the project. Included in the new productivity would be the production of an additional 15.1 million ounces of gold, the creation of over 700 construction jobs and over 70 operations jobs with an annual payroll of approximately $28 million, and additional tax support for Elko and Eureka Counties.

Following closure and revegetation, land use and productivity of the site would be similar to the conditions that existed prior to project construction. The open pit would be permanently removed from vegetation production, but the remainder of the site would be revegetated with a seed mix recommended by the BLM, a seed mix which may include species that are more productive than those presently on site. Therefore, there is the potential that vegetation productivity may equal or exceed pre-project levels even without the contribution of the 690 acres of the Betze Pit.

## 4.17 Irreversible and Irretrievable Commitment of Resources

An irreversible commitment of resources results when actions alter an area to the point where it cannot ever be restored to its undisturbed condition. Also, a commitment that completely consumes or removes a non-renewable resource is considered an irretrievable commitment of that resource. The following section discusses irreversible or irretrievable commitments of the Proposed Action and the No Action alternative.

The excavation of approximately 916.7 million tons of waste rock and ore from the Betze Pit would be an irreversible commitment of public land resources as a result of project implementation. The precious metals contained in the ore would be irreversibly committed, but would be retrieved and placed in long-term circulation in the world.

A peak annual consumption of 13 million gallons of diesel fuel and 312,000 gallons of gasoline and approximately 500,000 MW-hours of electricity constitutes an irretrievable commitment of these resources.

Soil losses from handling, stockpiling, and erosion from topsoil stockpiles would be irreversible. With more than 157 acres of topsoil stockpiles on the project site containing over 4.6 million cubic yards, some erosional losses would occur but would be minimized by seeding the stockpiles for stabilization, by minimizing handling operations, and by implementing Barrick's existing erosion control procedures.

The Betze Pit would not be reclaimed, but would fill with water; exposed benches and slopes would rely on natural revegetation. This represents an irreversible long-term loss of vegetation production and wildlife habitat on approximately 690 acres. If specific project facilities result in elimination of the use of sage grouse leks, that would constitute an irreversible impact on the sage grouse population.

The mine pits, waste rock disposal areas, and leached ore heaps that remain after closure would constitute an irreversible alteration of the landforms, lines, and, in the short-term, color of the landscape. These alterations of the visible quality of the area would soften over the long-term, but are considered irreversible.

Mitigation stipulations have been proposed as part of the project approval which would the irreversible loss of cultural resources.

If the No Action alternative were to be implemented, the commitment of resources would be similar in nature, but less extensive. Mining of the Post Pit would be completed in 1 to 2 years and a smaller open pit would remain. Reclamation would be initiated sooner then if the Proposed Action were to be implemented. The resources that would be consumed (e.g., fuel, electricity, reagents) by the Proposed Action would not be consumed, but the gold contained in the Betze deposit would not be recovered. Impacts to various resources (e.g., air, water, soils, vegetation, wildlife) would be less extensive then under the Proposed Action. The mining of the Post Pit would irreversibly alter the landforms, lines, and color of the landscape. As with the Proposed Action, such changes would soften over the long-term.

# 5.0 CONSULTATION AND COORDINATION

## 5.1 Scoping Summary

### 5.1.1 Introduction

The Elko District of the Bureau of Land Management (BLM) prepared this environmental impact statement (EIS) for an amendment to the plan of operations for the Goldstrike Mine located in Elko and Eureka Counties, Nevada. The BLM has solicited public comments on the scope of the issues, concerns, and alternatives to be addressed in the EIS.

Barrick Goldstrike Mines Inc. is presently authorized to operate an open-pit mine, heap leach facilities, crushing and agglomeration plant, mill, tailings impoundment, and administrative and maintenance buildings involving approximately 2,400 acres, of which approximately 1,800 are public lands administered by the BLM. The company is proposing to expand open-pit mining and heap leaching and increase the milling operation from approximately 6,000 tons per day to approximately 13,000 tons per day. It is anticipated that this would result in additional disturbance on approximately 2,150 acres of public land. Under federal regulation, the proposed expansion may not proceed without BLM approval.

### 5.1.2 Summary of the Scoping Process

Two Notices of Intent to prepare the EIS were published in the Federal Register on April 19 and June 29, 1989. The BLM sent notification letters to approximately 65 potentially interested parties selected from existing BLM mailing lists. The BLM gave personal notification to the Elko County Commission, the Eureka County Commission, Elko County Manager, Elko City Manager, Elko City Planning Commission and Elko City Council. In addition, the BLM issued a news release to numerous newspapers and radio and television stations in Nevada, Idaho, and Utah.

The BLM held public meetings in Elko and Reno on July 19 and 20, 1989, respectively, to solicit public comments on issues, concerns, and alternatives to be addressed in the EIS. Briefings were held for the Elko and Eureka County Commissioners and the Elko City Planning Commission. The BLM also solicited written comments on the scope of the EIS and requested that comments be submitted by September 5, 1989. Twelve letters were received, including comments from the Nevada State Clearinghouse.

### 5.1.3 Summary of Comments

All substantive public comments regarding the scope of the EIS are grouped according to subject matter and summarized below. Further refinement and screening to determine which issues, concerns, and alternatives are appropriate for consideration in an EIS was completed and presented in the Preparation Plan.

Letters received during scoping on the Betze Project EIS are listed below.

| Date Received | | Individual and Affiliation |
|---|---|---|
| 1. | May 15, 1989 | David Clapp, Department of Health and Human Services, Centers for Disease Control |
| 2. | May 23, 1989 | Glenn Miller, Sierra Club, Toiyabe Chapter |
| 3. | June 19, 1989 | Deanna Wieman, U.S. Environmental Protection Agency (EPA), Office of External Affairs |
| 4. | June 22, 1989 | Chester Buchanan, U.S. Fish and Wildlife Service, Reno Field Station |
| 5. | July 19, 1989 | Duane Erickson, Nevada Department of Wildlife |
| 6. | August 1, 1989 | Joanna Wald, Natural Resources Defense Council, San Francisco Office |
| 7. | August 31, 1989 | Richard Navarre, U.S. Fish and Wildlife Service, Reno Field Station |
| 8. | Sept. 1, 1989 | Glenn Miller, Sierra Club, Toiyabe Chapter |
| 9. | Sept. 5, 1989 | Gil Hernandez, Elko County Game Management Board |
| 10. | Sept. 5, 1989 | John Walker, Nevada State Clearinghouse<br>a. Terry Crawforth, Dept. of Wildlife<br>b. Christopher Freeman, Conservation Districts<br>c. Various, Division of Environmental Protection<br>d. Alice Becker, State Historic Preservation Office<br>e. Mike DelGrosso, Division of State Lands<br>f. Stephen Walmsley, Division of Water Resources |
| 11. | Sept. 7, 1989 | Jacqueline Wyland, U.S. EPA, Office of Federal Activities |
| 12. | Sept.15, 1989 | Patricia Schifferle, The Wilderness Society, California/Nevada Regional Office |

The following is a list of the subjects comprising the scoping comments received on the Betze Project EIS.

- Water resources
- Air resources
- Hazardous waste and other waste disposal
- Wildlife and wildlife habitat
- Social and economic issues
- Cultural resources
- Soils, reclamation, and vegetation
- Cumulative impacts
- Proposed alternatives
- Miscellaneous issues

## 5.2 Public Participation Plan Summary

### 5.2.1 Introduction

The BLM developed a public participation plan to indicate the means of public contact, identify potential individuals and organizations from which to solicit comments, and time frames for accomplishment in accordance with 43 CFR 1506.6. The plan is a formal commitment to involve the public in the development of the EIS at all important steps as determined by regulation or policy. It outlines the individual steps for public involvement in the EIS process to identify and deal with public concerns and needs. This process assists the BLM in: 1) broadening the information base for decision making, 2) informing the public of the proposal and long-term impacts resulting from the action, and 3) ensuring that public needs and desires are understood by the BLM. This plan is in compliance with the Freedom of Information Act (5 U.S.C. 552).

Public notice and opportunity for participation are mandated at three specific points in the EIS process.

- The scoping period started with the Notices of Intent and included formal public scoping meetings (held in Elko and Reno, Nevada on July 19 and 20, 1989, respectively) and briefings for the Elko and Eureka County Commissioners and the City Planning Commissioners. The Nevada State Clearinghouse has been provided specific scoping information. A period for accepting public comments for scoping was held until September 5, 1989.

- There will be a 60-day review period for the Draft EIS, which includes a notice of availability published in the Federal Register. During the review period, public hearings will be held in Elko and Reno to obtain comments.

- A 30-day review period will be held following publication of the Final EIS which includes a Notice in the Federal Register.

5.2.2 Implementation

The BLM's public participation includes the following activities.

1. Two Notices of Intent (NOI) were published. All appropriate news media and publics were notified of the periods available for comment. Those contacted with a news release included: Elko Daily Free Press, Elko Independent, Elko Radio Stations (KELK, KLKO, and KRJC), Wells Progress, The Wendover Relay, Twin Falls Times News, Reno Gazette-Journal, Reno area radio and television stations, Salt Lake Tribune, and The Idaho Statesman. The second notice period notification was provided through Certified Mail.

   Also, personal notification of the scoping period and public meetings was given to: Elko County Commissioners, Eureka County Commissioners, Elko County Manager, Elko City Manager, Elko City Planning Commissioners, and Elko City Council.

2. The BLM prepared a Summary of Scoping for distribution to those individuals who provided comments and to those individuals, groups, and agencies who the BLM determined to be prudent to retain on the mailing list.

3. A mailing list of interested publics has been developed. At least 60 days prior to release of the Draft EIS and as necessary throughout the public involvement process, the list has been and will continue to be updated.

4. A notice of availability has been published in the Federal Register for the Draft EIS comment period which identifies the schedule of the comment period and the dates, times, and locations of the public hearings.

   a. At least 60 days prior to release of the Draft EIS, a mailout was conducted, in postcard format, to determine the individuals, groups, or organizations interested in reviewing the draft and final documents. Those individuals, groups, and organizations (as determined by the BLM) who are either directly affected or have demonstrated interest in the project were automatically sent copies of all public documents. Entities not responding were removed from the list.

b. In conjunction with the following three periods: the 60-day comment period on the Draft EIS, the 30-day period following the protest period, and the distribution of the Record of Decision, a news release will be developed and submitted to all of the above noted news outlets (at a minimum) through the Elko District Office, BLM.

c. Comment letters received during review of the Draft EIS will be acknowledged by the BLM as they are received.

d. Public meetings will be held in Elko and Reno to obtain comments on the Draft EIS approximately 30 days following publication of the Federal Register Notice.

e. Briefings for the Nevada BLM State Director, Congressional Representatives, and State Clearinghouse will be held, as required.

5. At least 90 days prior to publication of the Draft EIS, the contractor provided the BLM the alternatives to be considered in the EIS. The BLM will determine the Bureau's preferred alternative in the Final EIS (DM 516, 4.10A[2] and 43 CFR 1502.14[e]).

6. When the Final EIS is completed, a notice of availability will be published in the Federal Register.

   a. Copies of the final document will be sent to those on the mailing list.

   b. A news release will be issued to all above noted news outlets (at a minimum) through the Elko District Office, BLM.

   c. Offers will be made to brief local and regional government representatives, Congressional Representatives, and State Clearinghouse, and briefings will be conducted, as necessary.

7. Should changes from the Draft EIS to the Final EIS be determined as significant, the Draft EIS will be reissued to the public requiring the same or similar public involvement steps as with the original draft publication.

8. Distribution of the Record of Decision will be to those on the mailing list, as amended. Briefings will be offered to the Nevada State Clearinghouse.

5.2.3 Criteria and Methods by Which Public Input is Evaluated

All letters and testimony will be reviewed by the BLM to determine if they meet the required criteria for response, discussion of the adequacy of each document produced for public comment, etc. Substantive comments include presentation of new data, questions, facts, or analyses and comments on issues directly associated with the Proposed Action.

## 6.0 LIST OF PREPARERS AND REVIEWERS

The following people had primary responsibilities for development and review of this environmental document, including conducting technical analyses; writing, reviewing, and editing draft documents; and managing the administrative process for this document.

### 6.1 USDI Bureau of Land Management, Elko District, Interdisciplinary Team

The interdisciplinary team members for the Betze Project EIS are identified below.

| | |
|---|---|
| Project Manager | Nancy Phelps-Dailey |
| Assistant Project Manager/Reclamation | Nick Rieger |
| Technical Coordinator | John Barss |
| Wildlife/Fisheries/T&E | Jeff Gardetto |
| Cultural Resources/Socioeconomics | Stanley Jaynes |
| Soils/Air/Water | Steve Kiracofe |
| Ecology/Vegetation/Land Use | Hank Riek |
| Recreation/Visual/Noise/Access | Evelyn Treiman |
| Geology/Engineering | Richard Young |
| Air Quality Specialist | Al Riebau (Wyoming State Office) |
| Groundwater Hydrologist | Paul Summers (Denver Service Center) |

### 6.2 List of Preparers

#### 6.2.1 ENSR Consulting and Engineering

- Valerie Randall, Project Manager

  12 years of experience in the design, implementation, and management of multidisciplinary environmental studies for mining projects, including preparation of EISs and permit applications.

- Sophie Sawyer, Assistant Project Manager

  11 years of experience in the coordination and management of multidisciplinary environmental projects including 13 third-party EAs or EISs.

- Dehn Solomon, Assistant Project Manager

  19 years of experience in project management, design and management of environmental studies, regulatory analysis, and environmental documentation.

- Robert Hammer, Air Resources

  7 years of experience in air quality modeling and permitting, air emissions inventories, atmospheric chemistry studies, acid deposition technology, and industrial meteorology forecasting.

- Donald Galya, Water Resources

  16 years of experience in mathematical modeling and field studies of surface and groundwater hydrology and chemistry contaminant fate and transport, and hazardous waste investigations.

- Dan Gregory, Water Resources

  12 years of experience in the preparation of EISs, geomorphic and geologic investigations, surface mining regulatory compliance, hydrologic and hydraulic modeling, hydrogeologic investigations, and geophysical field data collection and interpretation.

- James Nyenhuis, Soils

  12 years of experience in soil surveys, mine reclamation plans, soil baseline reports for multidisciplinary environmental studies, and wetland soils mapping.

- Christie Riebe, Wildlife/Threatened and Endangered Species

  6 years of experience in aquatic and terrestrial invertebrate, vegetation, and vertebrate sampling and censusing; writing, coordinating, and editing multidisciplinary studies; and aerial photo interpretation and radiotelemetry.

- William Theisen, Land Use and Recreation

  8 years of experience in socioeconomic impact assessment, land use and recreation planning, comprehensive community planning, resource management, public opinion and attitudinal surveys, research planning and coordination, and technical writing and editing.

- Jennifer Kathol, Socioeconomics

  12 years of experience in socioeconomic impact analysis, urban/regional economics and local public finance, local government policy development, fiscal impact analysis, market analysis, and financial feasibility analysis.

- Bernhard Strom, Noise and Visual Resources

  19 years of experience in comprehensive community planning, land use planning and regulation, industrial site selection, socioeconomic impact assessment, community noise studies, visual resource assessment, and transportation studies.

- Donald Trueblood, Ecology/Vegetation

  11 years of experience in environmental assessment, permitting and permit negotiations, regulatory affairs, environmental compliance, environmental monitoring, disturbed land reclamation, and vegetation ecology.

- Mark Wood, Geology/Mineral Resources

  13 years of experience in hydrogeologic characterization, groundwater monitoring and sampling, and geophysical measurements and interpolations.

6.2.2 Contributing Consultants

- James Drever, Ph.D., Geochemist, University of Wyoming

  22 years of experience in geochemistry, geology, and geophysics. Author of numerous technical publications and professor/associate professor for various universities.

- Archaeological Research Services, Inc. - Tom Burke, Ph.D., Cultural Resources

  21 years of experience in cultural resource inventories and evaluations, report preparation, implementation of provisions for state archaeological legislation, and archaeological excavations.

- Earth Science Associates - Douglas Yadon, Engineering Design Review

  13 years of experience in engineering geology and related geoscience disciplines, designing earthen structures and appurtenant reports, dam and reservoir feasibility studies, and stability and seepage analyses.

- Core Laboratories - Whole Rock Geochemistry Analyses

6.3 List of Reviewers

6.3.1 Barrick Goldstrike Mines Inc., Document Reviewers

- Bob Ingersoll, Environmental Director
- Valerie Sawyer, Environmental Coordinator
- Patrick J. Garver, Attorney
- David L. Deisley, Attorney

6.3.2 Environmental Protection Agency, Region IX

- Jeanne Dunn Geselbracht

## REFERENCES


Algerio Real Estate. 1990. Personal communication with J. Kathol, July 1990.

Algermissen, S. T., D. M. Perkins, P. C. Thenhaus, S. L. Hanson, and B. L. Bender. 1982. Probabilistic estimates of maximum acceleration and velocity in rock in the contiguous United States. U.S. Geological Survey Open-File Report 82-1033. 99 pp. 6 plates.

American Conference of Governmental Industrial Hygienists (ACGIH). 1990. Threshold limit values and biological exposure indices for 1990-1991. Cincinnati, OH.

Ankrum, S. City of Carlin. Personal communication with J. Kathol, August 1990.

Archibald, E. M. and G. F. Lee. 1981. Application of the OECD eutrophication approach to Lake Ray Hubbard, Texas. Jour. Amer. Wat. Wks. Assoc., 73:590-599.

Ariazzi, C. 1990a. City of Carlin. Personal communication with L. Lindsay, ENSR, May 1990.

_____. 1990b. City of Carlin. Personal communication with J. Kathol, August 1990.

Armstrong, N. E., J. D. Miertschin, K. D. Cleveland, R. A. L. Svatos, H. W. Goyette, V. N. Gordon, R. J. Thomann, and D. L. Tupa. 1987. Eutrophication analysis procedures for Texas lakes and reservoirs. Tech. Rep. CRWR 214. Dept. of Civil Eng. and Center for Research in Water Res. Univ. of Texas, Austin. 1,025 p.

Barrick Goldstrike Mines, Inc. 1989. Plan of Operations Amendment for Barrick Goldstrike Mines Inc. Proposed Betze Pit Development, April 17, 1989.

_____. 1990a. Mine slope design information letter from Bob Ingersoll to Mark Wood, March 15, 1990.

_____. 1990b. Summary of Newmont Gold Company North Area Operations. July 1990.

Barss, J. 1990. BLM Elko Resource Area, Personal observation.

Boucher, G. 1990. Elko County Manager's Office. Personal communication with L. Lindsay, ENSR, May 1990.

Bureau of Economic Analysis (BEA). 1980. Employment by Type and Broad Industrial Sources, U.S. Department of Commerce.

Bureau of Land Management. 1985. Draft resource management plan and environmental impact statement. Elko Resource Area. Elko District Office. Elko, Nevada.

_____. 1986a. Final Elko proposed resource management plan and final environmental impact statement. Elko Resource Area. Elko District Office. Elko, Nevada.

_____. 1986b. Visual Resource Contrast Rating: BLM Manual Handbook 8431-1.

_____. 1987a. Elko resource management plan record of decision. Elko Resource Area. Elko District Office. Elko, Nevada.

_____. 1987b. Elko resource management plan rangeland program summary. Elko Resource Area. Elko District Office. Elko, Nevada.

_____. 1988a. Final environmental assessment for the Barrick Goldstrike Mines, Inc. South Block operations. Prepared for Barrick Goldstrike Mines, Inc. December 1988.

_____. 1988b. Final environmental assessment for the proposed mill and tailings pond, Barrick Goldstrike Mine - Eureka County, Nevada. Prepared for Barrick Goldstrike Mine. June 1988.

_____. 1988c. Environmental assessment for the Newmont Mining Company Mill No. 4, Post Project - Eureka County, Nevada. Prepared for Newmont Gold Company. April 1988.

_____. 1989a. Environmental assessment for the Newmont Gold Company's Blue Star operations area, Eureka County, Nevada, May 31, 1989.

_____. 1989b. Final environmental assessment for the Dee Gold Mining Company Ren Project. Prepared for Dee Gold Mining Company. February 1989.

_____. 1990a. Environmental Assesmsent for the TS Ranch reservoir and pipeline. Prepared by JBR Consultants Group.

_____. 1990b. Thousand Springs Draft EIS. Northeastern Nevada Socioeconomics Technical Report. U.S. Department of the Interior, Bureau of Land Management, Elko District.

_____. 1990c. Elko District reclamation goals for project area. Letter from Rodney Harris, District Manager to V. Randall, ENSR. January 29, 1990.

_____. 1990d. Personal communication between N. Reiger, BLM-Elko, and J. Nyenhuis, ENSR. September 1990.

_____. No date. Coyote Creek 120 kV line extension environmental assessment. Prepared for Sierra Pacific Power Company.

Burke, T. D. 1988. Cultural Resources Inventory of the No. 4 Mill Project, Eureka County, Nevada. Archaeological Research Services, Inc., Report 477. Bureau of Land Management Cultural Resources Report No. 1-1142(P), ms. on file, Elko District Office.

Burt, W. H. and R. P. Grossenheider. 1976. A field guide to the mammals - North America, north of Mexico. Houghton Mifflin Company, Boston.

Century 21/Jensen Realty. 1990. Personal communication with J. Kathol, September 1990.

Chilton Engineering. 1989. Wastewater Facilities Planning Treatment Plant Expansion.

City of Elko Engineering Department. 1990. Personal communication with D. Park, ENSR, May 1990.

Community Inventory, Mountain West Research Associates 1989.

Core Laboratories. 1990a. Analytical Report No. 900318, April 4, 1990.

_____. 1990b. Analytical Report No. 900804, July 30, 1990.

_____. 1990c. Analytical Report No. 900805, August 31, 1990.

Coulam, N. J. 1988. Cultural Resource Inventory of the Barrick-Goldstrike Access Road in the Tuscarora Mountains, Eureka County, Nevada. P-III Associates, Inc., Report No. 430-08-8817. Bureau of Land Management Cultural Resources Report No.__, ms. on file, Elko District Office.

CP National Telephone Company. Personal communication with D. Park, ENSR, May 1990.

Cross, S. 1990. Southern Oregon State College, Ashland, OR. Personal communication with C. Riebe, ENSR, January 23, 1990.

Darnell, C. 1990. Elko County Engineering Department. Personal communication with W. Gorham, ENSR, July 1990.

Dobra, G. 1988a. Economist, University of Nevada, Reno. Personal communication with J. Kathol, ENSR, June 1988.

Dobra, G. 1988b. The Economic Impacts of Nevada's Mineral Industry. Nevada Department of Minerals. Department of Economics, University of Nevada, Reno.

Eakin, T. E., D. Price, and J. R. Harrill. 1976. Summary appraisals of the nation's groundwater resources - Great Basin Region: U.S. Geological Survey, professional paper 813-G.

Earth Info, Inc. USA. 1989. U.S. Geological Survey, Daily Streamflow Values, West. Volume 3.0.

Elko City Fire Department. 1990. Personal communication with D. Park, ENSR, May 1990.

Elko County School District, Student Profile Charts, 1989.

Elko Daily, "Eureka Commissioners Oppose School-Tax Plan." October 2, 1989.

Elko Daily, "County Voters Approve Increased School Levy." May 29, 1989.

Elpers, M. J. 1990. U.S. Fish and Wildlife Service, Reno, NV. Personal communication with C. Riebe, ENSR Consulting and Engineering. January 17, 1990.

Engineering Science. 1986. Heap leach technology and potential effects in the Black Hills. Prepared for U.S. Environmental Protection Agency, contract no. 68-03-6289, document no. EPA 908/3-86-002, with assistance from Hammer, Siler, George Associates, Denver, CO.

Environmental Research and Technology (ERT). 1980. Anaconda Nevada Moly Project. Socioeconomics Technical Report.

Erickson, D. 1990. Nevada Department of Wildlife, Elko, NV. Personal communication with C. Riebe, ENSR Consulting and Engineering. January 17, 1990.

ESA Consultants. 1990. Geotechnical review of AA Block tailings dam design and alternative tailings locations. Report to ENSR Consulting and Engineering by D. M. Yadon, P.E. Fort Collins, Colorado, April 1990.

Evans, C. 1990. Bureau of Land Management, Elko, NV. Personal communication with C. Riebe, ENSR, January 17, 1990.

Federal Emergency Management Agency. 1982. Flood Hazard Boundary Map, Eureka County, Nevada, Unincorporated Area. Panel 1 of 43, Community Panel Number 320028-0001A. Effective date: December 21, 1982.

Federal Reserve Bank of St. Louis. 1990. National Economic Trends.

Fenneman, N. M. 1931. Physiography of the Western United States. McGraw Hill Book Company, Inc. New York.

Ferguson, J. F. and J. Gavis. 1972. A review of the arsenic cycle in natural waters. Wat. Res. 6:1259-1274.

Firby, J. R. and H. E. Schorn. 1983. Paleontological Inventory of the Elko Bureau of Land Management District. BLM Contract YA553 CTI-108, available in Elko District Office and Nevada State Museum, Carson City.

Garvie. 1990. City of Elko. Personal communication with L. Lindsay, ENSR, May 1990.

Gill, P. 1990. Acting District Ranger. Nevada Division of State Parks. Personal communication with B. Theisen, ENSR, December 1990.

Giraudo, L. 1990. Barrick Goldstrike Mines, Inc. Personal communication with D. Gregory, ENSR, September 5, 1990.

Goldfields Mineral Services Limited. 1990. Gold 1990. London, England.

Goodwith, G. 1990. Barrick. Personal communication with J. Kathol, July 1990.

Grable, J. 1990. Nevada Department of Revenue. Personal communication with J. Kathol, July 1990.

Harrill, J. R., J. S. Gates, and J. M. Thomas. 1988. Major ground-water flow systems in the Great Basin region of Nevada, Utah, and adjacent states. U.S. Geological Survey, Hydrologic Investigations Atlas, HA-694-C.

Harris, D. 1990. Elko County School District. Personal communication with L. Lindsay, ENSR, May 1990.

Harris, R. 1990. Elko School District, Finance Director. Personal communication with J. Kathol, July 1990.

Hertzog, G. 1990. T.I.C Construction Company. Personal communication with J. Kathol, July 1990.

Hicks, P. A. 1989. A Class III Cultural Resources Inventory of 3,698 Acres in Elko and Eureka Counties, Nevada, for Barrick Goldstrike Mines, Inc. Desert Research Institute, Quaternary Sciences Center, Short Report 88-6. Bureau of Land Management Cultural Resources Report No. __, ms. on file, Elko District Office.

Hoffman, L. 1990. Elko Recreation Commission. Personal communication with L. Lindsay, ENSR, May 1990.

Holtz, R. D. and W. D. Kovacs. 1981. An introduction to geotechnical engineering. Pretice-Hall, Inc., Englewood Cliffs, NJ.

Homer, T. 1990. Lipparelli & Associates Real Estate, Elko. Personal communication with J. Kathol, July 1990.

Horizon Air Measurement Services. 1990. Particulate, selected metals, and sulfur compound emissions from an autoclave. Prepared for Barrick Goldstrike Mines Inc. Newbury Park, California.

Huiatt, J. L., J. E. Kerrigan, F. A. Olson, and G. L. Potter (eds.). 1983. Proceedings of a Workshop: Cyanide From Mineral Processing 1982. Printed by Utah Mining and Mineral Resources Research Institute, College of Mines and Minerals Industries, Salt Lake City, UT.

Ingersoll, B. 1990. Barrick Goldstrike. Personal communication with J. Kathol, June 1990.

Isard. 1976. Methods of Regional Analysis. MIT Press Cambridge, MA.

James, S. R. 1981. Prehistory, Ethnohistory, and History of Eastern Nevada: A Cultural Resources Summary of the Elko and Ely Districts. Cultural Resources Series No. 3. Bureau of Land Management, Reno.

Jarvie, V. 1990. City of Elko Fire Department. Personal communication with J. Kathol, August 1990.

Jaynes, S. 1990. BLM, Elko District. Personal communication with T. Burke, ARS, July 1990.

JBR Consultants Group. 1989. Baseline Reports, Little Boulder Basin, Revised 2/89. Prepared for Barrick Goldstrike Mines, Inc. and Newmont Mining Company, October 1988.

_____. 1990. Seep and Spring Inventory Data Report. Prepared for Barrick Goldstrike Mine, Elko, Nevada. January 11, 1990.

Jones, R. A. and G. F. Lee. 1982. Recent advances in assessing impact of phosphorus loads on eutrophication-related water quality. Water Res. 16:503-515.

Johnson, R. B. and J. V. DeGraff. 1988. Principles of engineering geology. John Wiley and Sons, New York, NY.

Johnston, P. 1990. Wells Rural Electric Company. Personal communication with D. Park, ENSR, May 1990.

Kiracofe, S. 1990. Bureau of Land Management, Elko, Nevada. Written communication with J. Nyenhuis, ENSR, February 1990.

Kirby, B. 1990a. City of Elko Police Department. Personal communication with D. Park, ENSR, May 1990.

_____. 1990b. City of Elko Police Department. Personal communication with J. Kathol, July 1990.

Kitlinger, A. 1990. Nevada Division of Forestry. Personal communication with J. Kathol, July 1990.

Klein, M. 1990. City of Elko, Assistant City Manager. Personal communication with J. Kathol, July 1990.

Koenig, D. 1990. City of Elko Chamber of Commerce. Personal communication with J. Kathol, July 1990.

Kolar, C. 1990. Nevada Natural Heritage Program, Carson City, NV. Personal communication with C. Riebe, ENSR Consulting and Engineering. January 4, 1990.

Kranovich, M. 1990. Chief of Police, City of Carlin. Personal communication with D. Park, ENSR, May 1990.

Lee, G. F. and R. A. Jones. 1979. Effect of eutrophication on fisheries. Submitted for publication, American Fisheries Society.

_____. 1984. Summary of U.S. OECD eutrophication study. Results of their application to water quality management. Verhandlungen Internationale Verein Limnology 22:261-267.

Lee, G. F., R. A. Jones, and W. Rast. 1981. Alternative approach to trophic state classification for water quality management. Occasional Paper No. 66, July 1981. International Joint Commission, Washington, D.C.

Lenz, A. 1990. Elko General Hospital. Personal communication with D. Park, ENSR, May 1990.

Lattin, D. 1990. Nevada Employment Security Department, Elko. Personal communication with J. Kathol, September 1990.

Leggette, Brashears, and Graham, Inc. 1990. Barrick Goldstrike Mine Pumpage History, Water Levels and Betze Pit Dewatering Calculations, January 1990.

Lipparelli and Associates Real Estate. 1990. Personal communication with J. Kathol, ENSR, June 1990.

Listerud, W. 1990. Barrick geologist. Personal communication with D. Gregory, ENSR, February 1990.

Lucy, K. 1990. NENDA, Executive Director. Personal communication with J. Kathol, July 1990.

Madsen, C. 1990. Elko County Library. Personal communication with J. Kathol, August 1990.

Manning, D. 1990. Traffic Analyst, Nevada Department of Transportation. Personal communication with B. Strom, July 1990. (Data from 1988 and 1989 Annual Traffic Reports by NDOT.)

McKelly, R. 1990. Carlin Combined School. Personal communication with D. Park, ENSR, May 1990.

Melcher, K. 1990. Principal, Carlin Combined School. Personal communication with L. Lindsay, ENSR, May 1990.

Mifflin, M. D. 1988. Region 5, Great Basin, In W. Back, J. S. Rosenshein, and P. R. Scaber, eds. Hydrogeology: Boulder, Colorado, Geological Society of America, The Geology of North America, V.O-2.

Miller, J. F. et al. 1973. Precipitation Frequency Atlas of the Western United States: Volume VII, Nevada. NOAA Atlas 2. National Oceanic and Atmospheric Administration, National Weather Service, Silver Springs, Maryland.

Miller, J. G. 1990. Elko County Sheriff, 1989 Community Inventory, Mountain-West Research.

Minton, R. 1990. Spring Creek Real Estate. Personal communication with J. Kathol, July 1990.

Mohsen, A. 1990. BLM. Personal communication with M. Wood, ENSR, May 1990.

Mountain West. 1989. Community Inventory.

Murphy, J. 1990. City Clerk, City of Elko. Personal communication with D. Park, ENSR, May 1990.

Murphy, M. 1990. Elko County Public Works Department. Personal communication with D. Park, ENSR, May 1990.

Murphy, M. 1990. Nevada Division of Forestry; Northeastern Fire Protection Department. Personal communication with D. Park, ENSR, May 1990.

Naroll, M. 1990. Nevada State Demographer. Personal communication with J. Kathol, July 1990.

National Oceanic and Atmospheric Administration (NOAA). 1973. Earthquake history of the United States. NOAA Environmental Data Service Publication 41-1.

Nevada Department of Taxation. 1990a. Population of Nevadas Counties and Incorporated Cities 1980-1989. U.S. Census and State Estimates.

_____. 1990b. Schedule S-1 Summary of County Revenues and Expenditures 1985-1990.

_____. 1990c. Local Government Finance. 1985-1989. Ad Valorem Tax Rates for Nevada Local Governments.

Nevada Department of Transportation (NDOT). 1988. 1987 Annual Traffic Report. Nevada Department of Transportation. Carson City, NV.

Nevada Employment Security Department. 1987-1990. Employment and Labor Force 3-year Monthly Comparisons.

Nevada State Governor's Office/UNR. 1990. Bureau of Business Research Population Estimates.

Newmont Gold Company. 1990. Carlin Area Properties and Operations. July 1990.

Northeast Nevada Development Authority (NENDA) Area Profiles. 1988/1989.

Olendorff, R. R., A. D. Miller, and R. N. Lehman. 1981. Suggested practices for raptor protection on power lines: the state of the art in 1981. Raptor Research Report No. 4, Raptor Research Foundation, Inc.

Olendorff, R. R. and R. N. Lehman. 1986. Raptor collisions with utility lines: an analysis using subjective field observations. Prepared by: U.S. Department of the Interior, Bureau of Land Management. For: Pacific Gas and Electric Co., San Ramone, CA.

Omernik, J. M. 1977. Non-point source-stream nutrient level relationships: a nationwide study. EPA-600/3-77-105. United States Environmental Protection Agency. 151 pp.

Papadopulos & Associates, Inc. 1988. Interim report No. 3, hydrogeologic evaluation of Post and Betze deposits relative to mine dewatering. Prepared for Barrick Goldstrike Mines, Inc., November 1988, Project No. SSP-708.

Plumb, E. 1990. Southwest Gas Company. Personal communication with D. Park, ENSR, May 1990.

Plume, R. W. and S. M. Carlton. 1990. Map of Hydrogeology of the Great Basin Region of Nevada, Utah, and Adjacent States.

Rast, W., R. A. Jones, and G. F. Lee. 1983. Predictive capability of U.S. OECD phosphorus loading-eutrophication response models. Jour. Wat. Pollut. Contr. Fed. 55:990-1003.

Ridgeway, H. 1990. Elko School District. Personal communication with J. Kathol, August 1990.

Riggs, H. C., and D. O. Moore. 1965. A method of estimating mean runoff from ungaged basins in mountainous regions. U.S. Geological Survey Prof. Paper 525-D, pp. D199-D202.

Ritter, L. 1990. Elko County Comptroller. Personal communication with J. Kathol, July 1990.

Roberts, R. J., K. M. Montgomery, R. E. Lehner. 1967. Geology and Mineral Resources of Eureka County, Nevada: Nevada Bureau of Mines and Geology, Bulletin 64, 152 pp.

Rusco, M. K. 1982. The Humboldt River Basin Study Units. In An Archaeological Element for the Nevada Historic Preservation Plan, coordinated by M. M. Lyneis, pp. 35-91. Nevada Division of Historic Preservation and Archaeology, Carson City.

Russell, K. W., A. M. Tratebas, and A. R. Schroedl. 1986. Cultural Resource Inventory and Testing in Little Boulder Basin, Eureka County, Nevada. P-III Associates, Inc., Report No. 416-27-8624. Bureau of Land Management Cultural Resources Report No.__, ms. on file, Elko District Office.

Sawyer, V. 1990a. Barrick Goldstrike Mines, Inc. Personal communication with J. Kathol, July 1990.

_____. 1990b. Barrick Goldstrike Mines, Inc. Personal communication with D. Gregory, ENSR, October 12, 1990.

Schaffran, G. 1990. Recreation Planner. Humboldt National Forest. Personal communication with B. Theisen, ENSR, September 5, 1990.

Schmidt, J. W., L. Simovic, and E. E. Shannon. 1981. Development studies for suitable technologies for the removal of cyanide and heavy metals from goldmilling effluents. In Proceedings of the 36th Industrial Waste Conference. Purdue University. Lafayette, IN. pp. 831-846.

Schroedl, A. R. 1986. Cultural Resources Inventory in Little Boulder Basin, Eureka County, Nevada. P-III Associates, Inc., Report No. 416-24-8619. Bureau of Land Management Cultural Resources Report No. ___, ms. on file, Elko District Office. [Initial results of this report were subsequently incorporated into the report by Russell, et al. 1986.]

_____. 1990. Class III Cultural Resource Inventory of the Santa Fe Pacific Parcel, Eureka County, Nevada. P-III Associates, Inc. Report 448-02-9004. Bureau of Land Management Cultural Resources Report No. 1-1323(P), ms. on file, Elko District Office.

Segerio, K. 1990. Algerio Recal Estate. Personal communication with J. Kathol, July 1990.

Sierra Pacific Electric Company. Personal communication with D. Park, ENSR, May 1990.

Simovic, L., W. J. Snodgrass, K. L. Murphy, and J. W. Schmidt. 1985. Development of a model to describe the natural degradation of cyanide in gold mill effluents. In D. Van Zyl (ed.) cyanide and the environment. Proc. of the Conference. Tuscon, AZ. Dec. 11-14, 1984. Department of Civil Engineering, Colorado State University, Fort Collins, CO.

Sobek, A. A., W. A. Shuller, J. R. Freeman, and R. M. Smith. 1978. Field and laboratory measurements applicable to overburden and minesoil, EPA-600/2-78-054, March 1978, pp. 182-185.

Soil Conservation Service. 1972. National Engineering Handbook, Section 4: Hydrology. U.S. Department of Agriculture.

Soil Conservation Service (U.S.D.A) and Bureau of Land Management (U.S.D.I.), in cooperation with University of Nevada Agricultural Experiment Station. 1980. Soil survey of Tuscarora Mountain Area, Nevada, parts of Elko, Eureka, and Lander Counties.

Spring Creek Real Estate and Homeowners Assoc. 1990. Personal communication with J. Kathol, ENSR, July 1990.

Steward, J. H. 1938. Basin-Plateau Aboriginal Sociopolitical Groups. Bureau of American Ethnology Bulletin 120, Washington, D.C.

Thomas, B. E. and K. L. Lindskov. 1983. Methods for estimating peak discharge and flood boundaries of streams in Utah: U.S. Geological Survey, Water Resources Investigations Report 83-4129.

Thomas, J. M., J. L. Mason, and J. D. Crabtree. 1986. Groundwater levels in the Great Basin Region of Nevada, Utah, and adjacent states. U.S. Geological Survey, Hydrologic Investigations Atlas, HA-694-B.

Thompson, G. 1990. Elko County Board of Realtors. Personal communication with J. Kathol, July 1990.

Tipps, B. L. and N. J. Coulam. 1988. Archaic and Numic Encampment in the Little Boulder Basin, Eureka County, Nevada. P-III Associates, Inc., Report No. 424-1-8805. Bureau of Land Management Cultural Resources Report No. ___, ms. on file, Elko District Office.

Togurelli, M. 1990. Carlin Fire Department. Personal communication with D. Park, ENSR, May 1990.

Treiman, E. 1990. Outdoor Recreation Planner. Bureau of Land Management, Elko Resource Area. Personal communication with B. Theisen, ENSR, August 30, 1990.

TS Ranch Joint Venture. 1989. Draft Environmental Assessment for the TS Ranch Reservoir and Pipeline. September 1989.

Uniform Building Code. 1985. Copyrighted by International Conference of Building Officials. ICBO: Whittier, CA.

U. S. Department of Agriculture, Agricultural Research Service. 1990. Predicting Soil Erosion by Water - A Guide to Conservation Planning with the Revised Universal Soil Loss Equation.

U.S. Department of the Interior. n.d.a. How to Apply the National Register Criteria for Evaluation. National Register Bulletin 15 [draft]. National Park Service, Washington, D.C.

_____. n.d.b. Traditional Cultural Properties: Guidelines for Evaluation (draft). National Register Bulletin 38. National Park Service, Washington, D.C.

_____. 1982. Guidelines for Applying the National Register Criteria for Evaluation. National Register Bulletin 15. National Park Service, Washington, D.C.

_____. 1985a. Cultural Resources Inventory General Guidelines. Bureau of Land Management, Reno.

_____. 1985b. Guidelines for Counting Contributing and Noncontributing Resources for National Register Documentation. National Register Bulletin 14. National Park Service, Washington, D.C.

_____. 1989. Cultural Resources Inventory General Guidelines. Bureau of Land Management, Reno.

U.S. Environmental Protection Agency (USEPA). 1986. Quality criteria for water. EPA-440/5-86-001.

U.S. Fish and Wildlife Service. 1989. Federal Register. Endangered and threatened wildlife and plants; animal notice of review. 50 CFR Part 17. Vol. 54, No. 4. Friday, January 6, 1989.

von Hake, C. A. 1974. Earthquake history of Nevada: Earthquake Information Bulletin, Volume 6, Number 6, pp. 27-29.

Wagemann, R. 1978. Some theoretical aspects of stability and solubility of inorganic arsenic in the freshwater environment. Wat. Res. 12:139-145.

Wanda's Real Estate. 1990. Carlin, Nevada. Personal communication with J. Kathol, September 1990.

Watson, C. 1990a. Elko County Sheriff's Department Lieutenant. Personal communication with D. Park, ENSR, May 1990.

_____. 1990b. Elko County Sheriff's Department Lieutenant. Personal communication with J. Kathol, July 1990.

Welch, B. 1990. Former administrator Elko General Hospital. Personal communication with J. Kathol, ENSR, September 1990.

Welsh Engineering, Inc. 1988. Barrick Heap Leach Expansion Design Report. November 1988.

Welsh, J. D. and Vector Engineering, Inc. 1988a. Tailings Impoundment Site Characterization Report. Prepared for Barrick Goldstrike Mines, Inc. Sparks, Nevada and Nevada City, California.

_____. 1988b. Design and Proposed Construction of Barrick Goldstrike Tailings Impoundment. Prepared for Barrick Goldstrike Mines, Inc. Sparks, NV and Nevada City, CA.

Western States Property Management. 1990. Personal communication with J. Kathol, ENSR, September 1990.

Wetzel, R. G. 1983. Limnology. Saunders College Publishing, Philadelphia. 767 pp.

Williams, C. 1990. City of Elko, Public Works Director. Personal communication with J. Kathol, July 1990.

## ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| AADT | annual average daily traffic |
| AGP | acid generating potential |
| AMSL | average mean sea level |
| ANFO | ammonium nitrate-fuel oil |
| AUM | Animal Unit Month |
| BACT | Best Available Control Technology |
| BLM | Bureau of Land Management |
| BP | before present |
| Btu | British thermal unit |
| CEQ | Council on Environmental Quality |
| cfs | cubic feet per second |
| CIL | carbon-in-leach |
| $Cl_2$ | chlorine |
| $cm^2$ | square centimeters |
| CO | carbon monoxide |
| dBA | decibels, A-weighted |
| DOT | Department of Transportation |
| EARCO | Elko Area Recreation Commission |
| EIS | environmental impact statement |
| ELLCO | Elko Land and Livestock Company |
| EPA | Environmental Protection Agency |
| FEMA | Federal Emergency Management Agency |
| FLPMA | Federal Land Policy and Management Act |
| $ft^3/sec$ | cubic feet per second |
| ft | feet |
| gpd | gallons per day |
| gpm | gallons per minute |
| $H_2S$ | hydrogen sulfide |
| HCN | hydrogen cyanide |
| HELP | Hydrologic Evaluation of Landfill Performance |
| HSWA | Hazardous and Solid Waste Act |
| I-80 | Interstate 80 |
| ISC | Industrial Source Complex |
| ISCLT | Industrial Source Complex Long-Term |
| ISCST | Industrial Source Complex Short-Term |
| kg | kilogram |
| KOP | Key Observation Point |
| kV | kilovolts |
| lb/day | pounds per day |
| lb/hr | pounds per hour |
| $m^3$ | cubic meter |
| MCL | Maximum Contaminant Level |
| mg/l | milligrams per liter |
| MM | million |
| MSHA | Mining Safety and Health Administration |
| mph | miles per hour |
| NAAQS | National Ambient Air Quality Standards |
| NDCNR | Nevada Department of Conservation and Natural Resources |
| NDEP | Nevada Division of Environmental Protection |
| NDOW | Nevada Department of Wildlife |
| NEPA | National Environmental Policy Act |
| $NO_2$ | nitrogen dioxide |

| | |
|---|---|
| $NO_x$ | nitrogen oxides |
| NOI | Notice of Intent |
| NPDES | National Pollution Discharge Elimination System |
| NRHP | National Register of Historic Places |
| NWS | National Weather Service |
| OSHA | Occupational Safety and Health Administration |
| PM-10 | particulate matter 10 microns or less in aerodynamic diameter |
| ppb | parts per billion |
| ppm | parts per million |
| PSD | Prevention of Significant Deterioration |
| psi | pounds per square inch |
| RCRA | Resource Conservation and Recovery Act |
| RMP | Resource Management Plan |
| ROW | right-of-way |
| RUSLE | Revised Universal Soil Loss Equation |
| SAG | semi-autogenous |
| SCS | Soil Conservation Service |
| SDWA | Safe Drinking Water Act |
| SHPO | State Historic Preservation Office |
| $SO_2$ | sulfur dioxide |
| SPCC | Spill Prevention, Control, and Countermeasures Plan |
| SRMA | Special Recreation Management Area |
| tpd | tons per day |
| tpy | tons per year |
| TSP | total suspended particulates |
| $\mu g/m^3$ | micrograms per cubic meter |
| U.S. | United States |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | U.S. Geological Survey |
| USLE | Universal Soil Loss Equation |
| VMT | vehicle miles traveled |
| vph | vehicles per hour |
| VRM | Visual Resource Management |
| WAD | weak acid dissociable |
| WHHA | Wild Horse Herd Area |
| WMA | Wildlife Management Area |
| WSA | Wilderness Study Area |

INDEX

# APPENDIX A

## SUMMARY OF BARRICK GOLDSTRIKE MINES, INC. PRIOR PLANS OF OPERATIONS AND ENVIRONMENTAL ASSESSMENTS, 1981-1989

APPENDIX A

SUMMARY OF BARRICK GOLDSTRIKE MINES, INC. PRIOR PLANS OF OPERATIONS AND ENVIRONMENTAL ASSESSMENTS, 1981-1989

1. Change in operational status from a "notice to a plan of operation" dated 7-13-87, by Western States Minerals Corporation. (Case file # NV-010-1n-81)

   Proposed operation:

   - Expand exploration on public lands (Goldstrike, Bazza, Stewart, SJ claim groups)

   - Continue mining from existing pit with dump expansion as needed

   - Leave open drill roads and drill sites with evidence of mineralization

   - Build leach system on fee land

   Approved: 8-7-81 (Case file # NV-010-11p-88)

2. Amend "plan of operation," dated 12-31-81 by Western States Mineral Corporation. (Case file # NV-010-11p-81)

   Proposed operation:

   - Expand exploration onto claims west of the original plan (Pandora, Weimer, and Corbett claim groups)

   Approved: 1-7-82 (Case file # NV-010-11p-81)

3. Amend "plan of operation," dated 9-9-83 by Western States Mineral Corporation (Case file # NV-010-11p-81)

   Proposed operation:

   - Mine 3 new pits; Bazza Point Pit, West Bazza Pit, and New Pancana Pit

   Approved: 10-11-83 (Case file # NV-010-11p-81)

4. Amended "plan of operation," dated 6-30-86 by Western States Minerals Corporation (Case file # NV-010-11p-81)

   Proposed operation:

   - Mine 2 new pits; Post Dump Pit and Lost Pancana #2 Pit

   - Mine new Post Pit on fee land

- Construction 3 additional leach ponds and associated recovery equipment

- Construction office and lab/recovery building

Approved: 9-9-86 (Case file # NV-010-11p-81 and EA # EA-NV-010-6-109)

5. Amended "plan of operation," dated 10-2-86 by Western States Minerals Corporation (Case file # NV-010-11p-81)

   Proposed operation:

   - Construct 4 leach pads, 4 ponds, roads, recovery plant, and ancillary facility (AA claim group)

   Approved: 11-26-86 (Case file # NV-010-11p-81) except leach pad D, contingent upon salvage of archaeological site and final plans for diversion ditch.

6. Amended "plan of operation," dated 5-21-87 (Case file # NV-010-11p-81)

   Proposed operation:

   - Short term dewatering of West Bazza Pit

   Approved: 6-16-87 (Case file # N16-81-011p)

7. Amended "plan of operation," dated 5-29-87 (Case file # NV-010-11p-81)

   Proposed operation:

   - Backhoe trenching to prove up potential gravel pit (Royal claim group)

   Denied: 6-24-87 (alternate location proposed)

8. Amended "plan of operation," dated 7-16-87 (Case file # NV-010-11p-81)

   Proposed operation:

   - 2 new pits; Powerline Pit and No. 5 Pit

   - Reclaim 2 dumps

   - Partial backfill 1 pit

   - Underground test mine in Long Lac Pit

   Approved: 7-23-87 (Case file # NV-010-11p-81, Case file # N16-81-11p)

9. Amend "plan of operation," dated 7-30-87

Proposed operation:

- Geotechnical and hydrologic study for tailings impoundment (AA claim group), drill holes, and backhoe trenching

Approved: 8-28-87 (Case file # N-16-81-011p)

10. Proposal, dated 7-30-87

Proposed operation:

- Haul Rossi Jig Tails to Barrick for use as leach pad liner

Proposal accepted: 8-27-87

11. Amend "plan of operation," dated 9-18-87 (Case file # NV-010-11p-81)

Proposed operation:

- Mine "chert knob" for road material

Approved: 9-25-87

12. Amend "plan of operation," dated 9-87

Proposed operation:

- Construct mill, tailings impoundment, and related facilities (AA and WS claim groups)

Approved: 12-14-87 (Case file # N16-88-002p; EA # NV-010-88-011)

13. Amend "plan of operation," dated 10-15-87 (Case file # NV-010-11p-81)

Proposed operation:

- Sink shaft and exploratory drifts to evaluate "Deep Post" and "Betze" ore bodies

- (1-11-88 revision) Decline added

Approved: 3-11-88 (Case file # NV-010-81-011, 88-1A, 88-2A; EA # NV-010-88-015)

14. Amend "plan of operation," dated 5-5-88

Proposed operation:

- Continue exploration drilling west of active operations (Wildcat, Pandora, Corbett, Bazza)

Approved 5-27-88 (Case file # N16-81-11p, 88-2A)

15. Final design for "plan of operation," dated 7-1-88 (Case file # N16-88-002p)

    Submittal:

    - Final design for "future" leach pad submitted

    Approval: 7-22-88

16. Amend "plan of operation," dated 12-22-88

    Proposed operation:

    - Expansion of the Post Pit
    - Mine dewatering operation
    - Expansion of the South Waste Rock Disposal Area
    - Mining of the Shop Pit
    - Mining of the Winston Pit
    - Mining of the Skarn Hill Decline
    - Update of the Long Lac Pit Decline
    - Expansion of exploration drilling

    Approval: 1-10-89

APPENDIX B

WATER RESOURCES DATA

- Continue exploration drilling west of current operations (Wildcat, Pinchota, Cornell, Bethel)

Approved 5-27-88 (Case File # N16-83-31p, 88-24)

15. Final design for "plan of operation," dated 3-3-88 (Case File # N16-88-002p)

Submittal:

- Final design for "Cornell" leach pad expansion

Approval: 7-15-88

16. Amend "plan of operations"

Proposed operation:

- Expansion of the Post Pit
- Mine dewatering operation
- Expansion of the South Waste Rock Disposal area
- Mining of the Gen Pit
- Mining of the Winston Pit
- Mining of the Sharp Hill Section
- Update of the Long Lac Pit Section
- Expansion of exploration drilling

Approval: 6-19-89

APPENDIX B

CERTIFIED AND PERMITTED WATER RIGHTS
IN BOULDER VALLEY HYDROGRAPHIC AREA ON
COMPUTER FILE WITH NEVADA STATE ENGINEER

POINT OF DIVERSION

| STAT | CERT # | SRC | Q | Q | SEC | TWP | RNG | DIV RATE CFS | TYPE OF USE | ACRES IRR | ANNUAL | DUTY | OWNER OF RECORD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CER | 1903 | STR | SE | NE | 18 | 33N | 50E | 1.250 | IRR | 124.96 | 455.00 | AFS | THORNTON. ASH |
| CER | 11160 | STR | SW | SW | 15 | 36N | 49E | 0.000 | IRR | 360.00 | 0.00 | AFS | PACHER, RHOADS |
| CER | 11162 | STR | NE | NE | 8 | 35N | 49E | 0.128 | IRR | 120.57 | 53.00 | AFS | FOX |
| CER | 11163 | STR | SE | SW | 8 | 35N | 49E | 1.286 | IRR | 144.25 | 139.44 | AFS | FOX |
| CER | 1913 | SPR | NW | NW | 18 | 33N | 50E | 0.025 | DOM | | 0.00 | * | WEBER |
| CER | 1624 | SPR | NE | NE | 14 | 32N | 50E | 0.025 | DOM | | 5.9 | MGA | PRIMEAUX |
| CER | 2517 | SPR | SW | SE | 12 | 32N | 50E | 0.006 | DOM | | 1.42 | MGA | LEWIS |
| CER | 4872 | UG | SE | SE | 25 | 33N | 48E | 6.087 | IRR | 312.99 | 938.97 | AFS | MARVEL. MARVEL |
| CER | 4458 | SPR | NE | NE | 14 | 32N | 50E | 0.007 | DOM | | 0.00 | * | TRANSPORTATION DEPT |
| CER | 5605 | UG | NE | NW | 5 | 34N | 49E | 3.500 | IRR | 170.48 | 681.92 | AFA | ELKO LAND & LIVESTOCK |
| CER | 5606 | UG | NE | NE | 6 | 34N | 49E | 3.500 | IRR | 148.00 | 592.00 | AFA | ELKO LAND & LIVESTOCK |
| CER | 5729 | UG | NE | NW | 11 | 36N | 49E | 0.111 | MM | | 80.66 | AFS | NEWMONT GOLD COMPANY |
| CER | 6214 | UG | NW | SW | 24 | 33N | 48E | 5.998 | IRR | 361.20 | 1444.80 | AFA | MARVEL. MARVEL |
| CER | 7306 | UG | NW | NE | 26 | 33N | 48E | 0.334 | MM | | 241.97 | AFS | NATIONAL LEAD CO. |
| CER | 7018 | UG | LT | 1 | 20 | 35N | 50E | 1.025 | MM | | 0.00 | | NEWMONT GOLD CO. |
| CER | 6682 | UG | NW | NW | 22 | 35N | 50E | 1.000 | MM | | 241.32 | AFS | NEWMONT GOLD CO. |
| CER | 7642 | UG | NW | NW | 22 | 35N | 50E | 0.045 | STK | | 5.09 | AFS | NEWMONT GOLD CO. |
| CER | 8461 | UG | NE | NE | 23 | 33N | 48E | 3.686 | IRR | 253.50 | 760.50 | AFA | DUNPHY RANCH |
| CER | 8778 | UG | LT | 1 | 4 | 35N | 50E | 0.056 | MM | | 20.56 | AFS | NEWMONT GOLD CO. |
| CER | 9940 | UG | NE | SE | 10 | 36N | 49E | 1.000 | MM | | 199.49 | AFS | NEWMONT GOLD CO. |
| CER | 8659 | UG | LT | 1 | 20 | 35N | 50E | 0.025 | STK | | 12.03 | AFS | ELKO LAND & LIVESTOCK |
| CER | 8973 | UG | SE | SW | 26 | 33N | 49E | 0.006 | STK | | 3.93 | AFS | ELKO LAND & LIVESTOCK |
| CER | 8972 | UG | SW | NE | 28 | 35N | 49E | 0.008 | STK | | 3.93 | AFS | ELKO LAND & LIVESTOCK |
| CER | 10722 | UG | NW | SE | 30 | 36N | 50E | 0.140 | MM | | 96.30 | AFS | POLAR RESOURCES CO. |
| CER | 10226 | UG | SE | NE | 7 | 34N | 49E | 0.600 | IRR | 254.47 | 1017.88 | AFS | ELKO LAND & LIVESTOCK |
| CER | 10227 | UG | SE | NW | 8 | 34N | 49E | 5.106 | IRR | 255.36 | 1021.44 | AFS | ELKO LAND & LIVESTOCK |
| CER | 9282 | UG | NW | SE | 30 | 36N | 50E | 0.009 | STK | | 6.72 | AFS | ELKO LAND & LIVESTOCK |
| CER | 10228 | UG | LT | 4 | 19 | 34N | 50E | 0.012 | STK | | 17.92 | AFS | ELKO LAND & LIVESTOCK |
| CER | 10043 | UG | SW | NW | 2 | 33N | 49E | 5.124 | IRR | 2,495.29 | 2794.25 | AFS | ELKO LAND & LIVESTOCK |
| CER | 10044 | UG | SE | NW | 3 | 33N | 49E | 4.902 | IRR | 2,495.29 | 2673.19 | AFS | ELKO LAND & LIVESTOCK |
| CER | 10046 | UG | SW | NW | 3 | 33N | 49E | 4.233 | IRR | 3,123.69 | 2308.35 | AFS | ELKO LAND & LIVESTOCK |
| CER | 10047 | UG | SW | NW | 1 | 33N | 49E | 5.793 | IRR | 3123.69 | 3159.06 | AFS | ELKO LAND & LIVESTOCK |
| CER | 10048 | UG | SW | NE | 2 | 33N | 49E | 5.347 | IRR | 3123.69 | 2915.85 | AFS | ELKO LAND & LIVESTOCK |
| CER | 10229 | UG | SE | NE | 7 | 34N | 49E | 4.524 | IRR | 254.47 | 1017.38 | AFS | ELKO LAND & LIVESTOCK |
| CER | 10865 | UG | SW | SE | 10 | 35N | 50E | 0.160 | MM | | 64.27 | AFS | POLAR RESOURCES CO. |
| PER | | UG | NE | NW | 17 | 34N | 49E | 8.000 | IRR | 640.00 | 2560.00 | AFA | ELKO LAND & LIVESTOCK |
| PER | | UG | NE | SW | 4 | 34N | 49E | 8.000 | IRR | 640.00 | 2560.00 | AFA | ELKO LAND & LIVESTOCK |
| PER | | UG | NE | SW | 28 | 32N | 49E | 0.000 | IRR | 3185.00 | 0.00 | AFS | ZEDA CORP. |
| PER | | UG | SW | SW | 2 | 33N | 49E | 6.000 | IRR | 5222.48 | 4342.77 | AFA | ELKO LAND & LIVESTOCK |
| PER | | UG | SW | SE | 2 | 33N | 49E | 6.000 | IRR | 5222.48 | 4342.77 | AFA | ELKO LAND & LIVESTOCK |
| PER | | UG | SW | SE | 3 | 33N | 49E | 6.000 | IRR | 5222.48 | 4342.77 | AFA | ELKO LAND & LIVESTOCK |
| PER | | UG | SE | NW | 1 | 33N | 49E | 6.000 | IRR | 5222.48 | 4342.77 | AFA | ELKO LAND & LIVESTOCK |
| PER | | UG | SW | SW | 3 | 33N | 49E | 6.000 | IRR | 5222.48 | 4342.77 | AFA | ELKO LAND & LIVESTOCK |
| PER | | UG | SW | NE | 10 | 33N | 49E | 6.000 | IRR | 5222.48 | 4342.77 | AFA | ELKO LAND & LIVESTOCK |
| PER | | UG | SW | NW | 11 | 33N | 49E | 6.000 | IRR | 5222.48 | 4342.77 | AFA | ELKO LAND & LIVESTOCK |
| PER | | UG | SW | NW | 10 | 33N | 49E | 6.000 | IRR | 5222.48 | 4342.77 | AFA | ELKO LAND & LIVESTOCK |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PER | | UG | SW | NE | 23 | 34N | 49E | 0.000 | IRR | 2513.60 | 0.00 AFA | ELKO LAND & LIVESTOCK |
| PER | | UG | NE | SE | 29 | 35N | 49E | 0.000 | IRR | 2513.60 | 0.00 AFA | ELKO LAND & LIVESTOCK |
| PER | | UG | NE | NE | 29 | 35N | 49E | 0.000 | IRR | 2513.60 | 0.00 AFA | ELKO LAND & LIVESTOCK |
| PER | | UG | SW | SE | 23 | 34N | 49E | 0.000 | IRR | 2513.60 | 0.00 AFA | ELKO LAND & LIVESTOCK |
| PER | | UG | NE | SW | 25 | 35N | 48E | 0.000 | IRR | 2513.60 | 0.00 AFA | ELKO LAND & LIVESTOCK |
| PER | | UG | SW | SW | 25 | 34N | 49E | 0.000 | IRR | 2513.60 | 0.00 AFA | ELKO LAND & LIVESTOCK |
| PER | | UG | SW | NW | 25 | 34N | 49E | 0.000 | IRR | 2513.60 | 0.00 AFA | ELKO LAND & LIVESTOCK |
| PER | | UG | NE | NE | 30 | 35N | 49E | 0.000 | IRR | 2513.60 | 0.00 AFA | ELKO LAND & LIVESTOCK |
| PER | | UG | NW | NW | 24 | 34N | 49E | 0.000 | IRR | 2513.60 | 0.00 AFA | ELKO LAND & LIVESTOCK |
| PER | | UG | SW | SW | 24 | 34N | 49E | 0.000 | IRR | 2513.60 | 0.00 AFA | ELKO LAND & LIVESTOCK |
| PER | | UG | LT | 3 | 4 | 34N | 49E | 5.400 | IRR | 640.00 | 2560.00 AFA | ELKO LAND & LIVESTOCK |
| PER | | UG | NE | SW | 17 | 34N | 49E | 8.000 | IRR | 640.00 | 2560.00 AFA | ELKO LAND & LIVESTOCK |
| PER | | UG | SE | NE | 8 | 34N | 49E | 8.000 | IRR | 960.00 | 3840.00 AFA | ELKO LAND & LIVESTOCK |
| PER | | UG | NE | NE | 6 | 34N | 49E | 5.400 | IRR | 640.00 | 2560.00 AFA | ELKO LAND & LIVESTOCK |
| PER | | UG | NE | NW | 5 | 34N | 49E | 6.000 | IRR | 640.00 | 2560.00 AFA | ELKO LAND & LIVESTOCK |
| CER | 10592 | UG | NW | SE | 30 | 36N | 50E | 0.233 | MM | | 394.23 AFS | BARRICK GOLDSTRIKE |
| CER | 10875 | UG | SW | SE | 8 | 33N | 49E | 0.031 | STK | | 22.40 AFS | ELKO LAND & LIVESTOCK |
| CER | 10876 | UG | SE | NW | 1 | 33N | 48E | 0.062 | STK | | 44.81 AFS | ELKO LAND & LIVESTOCK |
| PER | | UG | SW | NW | 1 | 33N | 48E | 0.062 | STK | | 8.96 AFS | ELKO LAND & LIVESTOCK |
| CER | 12278 | UG | LT | 8 | 22 | 32N | 49E | 0.011 | STK | | 13.57 AFS | BLM - U.S. |
| PER | | UG | NE | SW | 24 | 36N | 49E | 0.000 | MM | | 0.00 AFS | BARRICK GOLDSTRIKE |
| PER | | UG | SE | NW | 12 | 36N | 49E | 1.000 | MM | | 645.25 AFS | EL CORDEX EXPLORATION |
| PER | | UG | SE | SE | 33 | 37N | 49E | 1.000 | MM | | 645.25 AFS | EL CORDEX EXPLORATION |
| PER | | UG | SE | SW | 3 | 36N | 49E | 1.000 | MM | | 645.25 AFS | EL CORDEX EXPLORATION |
| PER | | UG | NW | NE | 28 | 32N | 49E | 5.400 | IRR | 2895.00 | 2634.22 AFS | ZEDA CORP. |
| PER | | UG | NW | SW | 28 | 32N | 49E | 5.400 | IRR | 3325.00 | 2634.22 AFS | ZEDA CORP. |
| PER | | UG | NE | SW | 28 | 32N | 49E | 5.400 | IRR | 3185.00 | 2634.22 AFS | ZEDA CORP. |
| PER | | UG | SW | NW | 29 | 36N | 50E | 0.750 | MM | | 38.36 AFS | BARRICK GOLDSTRIKE |
| CER | 11919 | UG | SE | NW | 2 | 34N | 49E | 0.009 | STK | | 6.51 AFS | ELKO LAND & LIVESTOCK |
| CER | 11928 | UG | SE | NE | 19 | 35N | 49E | 0.009 | STK | | 6.51 AFS | ELKO LAND & LIVESTOCK |
| CER | 11938 | UG | NE | NW | 28 | 33N | 47E | 0.013 | STK | | 9.42 AFS | ELKO LAND & LIVESTOCK |
| CER | 11937 | UG | SE | NW | 27 | 33N | 47E | 0.011 | STK | | 7.95 AFS | ELKO LAND & LIVESTOCK |
| CER | 11921 | UG | NW | SW | 4 | 34N | 49E | 0.009 | STK | | 6.51 AFS | ELKO LAND & LIVESTOCK |
| CER | 11939 | UG | SW | NW | 29 | 33N | 47E | 0.016 | STK | | 11.57 AFS | ELKO LAND & LIVESTOCK |
| CER | 11917 | UG | NE | NW | 30 | 34N | 49E | 0.016 | STK | | 11.57 AFS | ELKO LAND & LIVESTOCK |
| CER | 11940 | UG | NE | SE | 11 | 32N | 49E | 0.009 | STK | | 6.51 AFS | ELKO LAND & LIVESTOCK |
| CER | 11927 | UG | NE | NE | 23 | 35N | 49E | 0.009 | STK | | 6.51 AFS | ELKO LAND & LIVESTOCK |
| CER | 11920 | UG | NE | SE | 8 | 34N | 49E | 0.009 | STK | | 6.51 AFS | ELKO LAND & LIVESTOCK |
| PER | 11929 | UG | SE | NE | 10 | 34N | 50E | 0.013 | STK | | 9.42 AFS | ELKO LAND & LIVESTOCK |
| CER | 11941 | UG | NE | SW | 1 | 34N | 48E | 0.013 | STK | | 9.42 AFS | ELKO LAND & LIVESTOCK |
| CER | 11934 | UG | NW | SW | 1 | 33N | 47E | 0.013 | STK | | 9.42 AFS | ELKO LAND & LIVESTOCK |
| CER | 11933 | UG | SW | SE | 10 | 33N | 47E | 0.013 | STK | | 9.42 AFS | ELKO LAND & LIVESTOCK |
| CER | 11915 | UG | LT | 4 | 5 | 33N | 48E | 0.011 | STK | | 7.95 AFS | ELKO LAND & LIVESTOCK |
| CER | 11945 | UG | NW | NW | 21 | 34N | 48E | 0.011 | STK | | 7.95 AFS | ELKO LAND & LIVESTOCK |
| PER | 11943 | UG | SE | SE | 34 | 35N | 48E | 0.013 | STK | | 9.42 AFS | ELKO LAND & LIVESTOCK |
| CER | 11918 | UG | SE | NW | 34 | 34N | 49E | 0.016 | STK | | 11.57 AFS | ELKO LAND & LIVESTOCK |
| CER | 11916 | UG | NE | SE | 16 | 34N | 49E | 0.009 | STK | | 6.51 AFS | ELKO LAND & LIVESTOCK |
| CER | 11932 | UG | SE | NE | 14 | 33N | 47E | 0.013 | STK | | 9.42 AFS | ELKO LAND & LIVESTOCK |
| CER | 11936 | UG | SW | NE | 21 | 33N | 47E | 0.011 | STK | | 7.95 AFS | ELKO LAND & LIVESTOCK |
| CER | 11935 | UG | SW | SE | 17 | 33N | 47E | 0.013 | STK | | 9.42 AFS | ELKO LAND & LIVESTOCK |
| CER | 11944 | UG | NW | SW | 15 | 33N | 49E | 0.016 | STK | | 11.20 AFS | ELKO LAND & LIVESTOCK |
| CER | 11942 | UG | SE | SE | 34 | 34N | 48E | 0.011 | STK | | 7.95 AFS | ELKO LAND & LIVESTOCK |
| PER | | UG | SE | NW | 1 | 33N | 48E | 0.125 | STK | | 89.62 AFS | ELKO LAND & LIVESTOCK |
| PER | | UG | SE | SE | 33 | 37N | 49E | 0.000 | MM | | 0.00 - | EL CORDEX EXPLORATION |
| PER | | UG | NW | NE | 21 | 35N | 50E | 3.000 | MM | | 1613.12 AFS | NEWMONT GOLD CO. |
| PER | | UG | NE | SE | 31 | 36N | 50E | 0.500 | MM | | 100.51 AFS | NEWMONT GOLD CO. |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PER | UG | NW | NE | 39 | 36N | 50E | 0.000 | MM | | 0.00 | MGA | NEWMONT GOLD CO. |
| PER | UG | SE | SW | 19 | 36N | 50E | 3.000 | MM | | 153.45 | AFS | BARRICK GOLDSTRIKE |
| PER | UG | NE | NW | 25 | 36N | 49E | 0.750 | MM | | 38.36 | AFS | BARRICK GOLDSTRIKE |
| PER | UG | SW | SW | 18 | 36N | 50E | 0.750 | MM | | 38.36 | AFS | BARRICK GOLDSTRIKE |
| PER | UG | SW | NE | 19 | 36N | 50E | 0.750 | MM | | 38.36 | AFS | BARRICK GOLDSTRIKE |
| PER | UG | NE | NW | 19 | 36N | 50E | 0.500 | MM | | 40.21 | AFS | NEWMONT GOLD CO. |
| PER | UG | NE | SW | 29 | 36N | 50E | 1.000 | MM | | 430.16 | AFS | NEWMONT GOLD CO. |
| PER | UG | SW | SE | 24 | 36N | 49E | 0.000 | MM | | 0.00 | - | BARRICK GOLDSTRIKE |
| PER | UG | NW | SW | 32 | 36N | 50E | 1.000 | MM | | 430.16 | AFS | NEWMONT GOLD CO. |
| PER | UG | SW | NW | 28 | 36N | 50E | 3.000 | MM | | 2172.06 | AFS | BARRICK GOLDSTRIKE |
| PER | UG | NE | SE | 24 | 36N | 50E | 3.000 | MM | | 2172.06 | AFS | BARRICK GOLDSTRIKE |
| PER | UG | SW | SW | 19 | 36N | 50E | 3.000 | MM | | 2172.06 | AFS | BARRICK GOLDSTRIKE |
| PER | UG | NE | NW | 30 | 36N | 50E | 3.000 | MM | | 2172.06 | AFS | BARRICK GOLDSTRIKE |
| PER | UG | SE | SW | 19 | 36N | 50E | 3.000 | MM | | 2172.06 | AFS | BARRICK GOLDSTRIKE |
| PER | UG | SE | SW | 19 | 36N | 50E | 3.000 | MM | | 2172.06 | AFS | BARRICK GOLDSTRIKE |
| PER | UG | SE | SW | 19 | 36N | 50E | 3.000 | MM | | 2172.06 | AFS | BARRICK GOLDSTRIKE |
| PER | UG | SE | SW | 17 | 36N | 50E | 3.500 | MM | | 752.79 | AFS | NEWMONT GOLD CO. |
| PER | UG | SW | SW | 34 | 36N | 49E | 1.000 | MM | | 645.25 | AFS | EL CORDEX EXPLORATION |
| PER | UG | SE | SE | 29 | 36N | 50E | 0.500 | MM | | 215.08 | AFS | NEWMONT GOLD CO. |
| PER | UG | NW | SW | 19 | 36N | 50E | 3.000 | MM | | 2172.06 | AFS | BARRICK GOLDSTRIKE |
| PER | UG | SE | SW | 19 | 36N | 50E | 3.000 | MM | | 2172.06 | AFS | BARRICK GOLDSTRIKE |
| PER | UG | NW | NE | 19 | 36N | 50E | 1.000 | MM | | 215.08 | AFS | NEWMONT GOLD CO. |
| PER | UG | SW | SE | 18 | 36N | 50E | 1.000 | MM | | 215.08 | AFS | NEWMONT GOLD CO. |
| PER | UG | SE | NE | 19 | 36N | 50E | 0.500 | MM | | 107.54 | AFS | NEWMONT GOLD CO. |
| PER | UG | NE | SE | 29 | 36N | 50E | 0.500 | MM | | 215.08 | AFS | NEWMONT GOLD CO. |
| PER | UG | NE | SE | 30 | 35N | 49E | 0.000 | IRR | 2513.60 | 0.00 | - | ELKO LAND & LIVESTOCK |
| PER | UG | NE | NW | 25 | 35N | 48E | 0.000 | IRR | 7600.00 | 0.00 | - | ELKO LAND & LIVESTOCK |
| PER | UG | NE | NW | 36 | 35N | 48E | 0.000 | IRR | 2513.60 | 0.00 | - | ELKO LAND & LIVESTOCK |
| PER | UG | NE | SW | 36 | 35N | 48E | 0.000 | IRR | 2513.60 | 0.00 | - | ELKO LAND & LIVESTOCK |
| PER | UG | SW | NE | 13 | 34N | 49E | 0.000 | IRR | 2513.60 | 0.00 | | ELKO LAND & LIVESTOCK |
| PER | UG | SW | NW | 26 | 34N | 49E | 0.000 | IRR | 2513.60 | 0.00 | | ELKO LAND & LIVESTOCK |
| PER | UG | NE | NE | 31 | 35N | 49E | 0.000 | IRR | 2513.60 | 0.00 | | ELKO LAND & LIVESTOCK |
| PER | UG | NW | SW | 13 | 34N | 49E | 0.000 | IRR | 2513.60 | 0.00 | | ELKO LAND & LIVESTOCK |
| PER | UG | SW | SW | 26 | 34N | 49E | 0.000 | IRR | 2513.60 | 0.00 | | ELKO LAND & LIVESTOCK |
| PER | UG | NE | SE | 19 | 35N | 49E | 0.000 | IRR | 2513.60 | 0.00 | | ELKO LAND & LIVESTOCK |
| PER | UG | SE | SE | 33 | 37N | 49E | 1.000 | MM | | 645.25 | AFS | EL CORDEX CORP. |
| PER | UG | SE | SW | 19 | 36N | 50E | 3.000 | MM | | 2172.06 | AFS | BARRICK GOLDSTRIKE |
| PER | UG | SW | SE | 19 | 36N | 50E | 3.000 | MM | | 2172.06 | AFS | BARRICK GOLDSTRIKE |

WHOLE ROCK ANALYSIS

| Sample I.D. | TOT S% | PYR S% | SUL UNID% | SUL S% | APP/P % | TOT S* | PYR S* | APP/P* | ANP* | TOT As mg/kg | TOT Ba mg/kg | TOT B mg/kg | TOT Cd mg/kg | TOT Cr mg/kg | TOT Cu mg/kg | TOT Fe mg/kg | TOT Pb mg/kg | TOT Hg mg/kg | TOT Mg mg/kg | TOT Mn mg/kg | TOT Ni mg/kg | TOT Se mg/kg | TOT Ag mg/kg | TOT Tl mg/kg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WR-1 | <0.01 | 0.12 | — | <0.01 | <0.01 | <0.3 | 3.8 | <0.1 | 61.3 | 39 | 227 | <10 | <0.5 | 40 | 40 | 26,100 | 14 | <0.15 | 3,680 | 346 | 32 | <10 | <1 | <20 |
| WR-1P | <0.01 | 0.05 | <0.01 | <0.01 | <0.01 | <0.3 | 1.6 | <0.1 | 46.4 | 442 | 169 | <5 | <1.0 | 19 | 26 | 19,800 | 30 | 0.23 | 4,440 | 545 | 28 | <10 | <1 | <20 |
| WR-2 | 1.45 | 1.23 | — | 0.09 | 1.28 | 45.3 | 38.4 | 40.0 | <0.1 | 1,790 | 515 | <10 | 4.8 | 56 | 66 | 25,600 | 14 | 10.60 | 427 | 96 | 127 | <10 | 2 | <20 |
| WR-2P | 1.01 | 0.62 | 0.37 | 0.02 | 0.16 | 31.6 | 19.4 | 5.0 | 3.8 | 845 | 150 | <5 | 3.0 | 84 | 56 | 16,700 | 8 | 2.04 | 485 | 78 | 114 | 10 | <1 | <20 |
| WR-3 | <0.01 | 0.01 | — | <0.01 | <0.01 | <0.3 | 0.3 | <0.1 | 63.0 | 24 | 197 | <10 | <0.5 | 68 | 30 | 29,500 | 6 | <0.15 | 15,500 | 306 | 36 | <10 | <2 | <20 |
| WR-3P | <0.01 | 0.02 | <0.01 | <0.01 | <0.01 | <0.3 | 0.6 | <0.1 | 40.0 | 60 | 119 | <5 | <1.0 | 42 | 60 | 27,600 | <5 | 0.18 | 12,000 | 275 | 26 | <10 | <1 | <20 |
| WR-4 | 1.69 | 1.49 | — | 0.08 | 1.39 | 52.8 | 46.6 | 43.4 | 0.2 | 674 | 1,490 | <10 | <0.5 | 34 | 34 | 23,200 | 26 | 5.47 | 385 | 65 | 83 | <10 | <2 | <20 |
| WR-4P | 4.35 | 3.54 | 0.75 | 0.06 | 2.89 | 136.0 | 111.0 | 90.3 | 0.4 | 4,700 | 120 | 7 | 5.0 | 3 | 24 | 46,800 | 36 | 2.19 | 285 | 12 | 42 | 10 | <2 | 30 |
| WR-5 | 0.42 | 0.26 | — | <0.01 | 0.23 | 13.1 | 8.1 | 7.2 | 52.3 | 44 | 430 | <10 | <0.5 | 65 | 9 | 35,800 | 7 | <0.15 | 19,500 | 561 | 14 | <10 | <2 | 40 |
| WR-5P | 1.20 | 0.96 | 0.25 | <0.01 | 0.42 | 37.8 | 30.0 | 18.8 | 171.0 | 1,910 | 255 | <5 | <1.0 | 46 | 14 | 36,500 | 10 | <0.15 | 14,500 | 776 | 22 | <10 | <1 | 40 |
| WR-6 | 0.72 | 0.65 | — | 0.02 | 0.48 | 22.5 | 20.3 | 15.0 | 221.0 | 158 | 306 | <10 | <0.5 | 22 | 23 | 16,600 | <5 | 0.77 | 8,380 | 288 | 34 | <10 | <1 | <20 |
| WR-6P | 1.40 | 1.32 | 0.06 | 0.02 | 0.69 | 43.8 | 41.2 | 13.1 | 224.0 | 709 | 140 | <5 | 1.0 | 8 | 30 | 26,300 | 7 | 0.48 | 10,500 | 432 | 46 | <10 | <1 | <20 |
| WR-7 | 1.59 | 1.30 | — | 0.01 | 1.39 | 49.7 | 40.6 | 43.4 | 107.0 | 727 | 247 | <10 | <0.5 | 37 | 20 | 42,200 | 49 | 0.34 | 17,700 | 612 | 11 | <10 | <1 | <20 |
| WR-7P | 1.61 | 1.66 | <0.01 | 0.01 | 0.58 | 50.3 | 51.9 | 21.6 | 122.0 | 1,170 | 189 | <5 | <1.0 | 20 | 8 | 40,700 | 6 | <0.15 | 13,900 | 579 | 8 | <10 | <1 | <20 |
| WR-8 | 1.25 | 0.89 | — | 0.11 | 0.67 | 39.1 | 27.8 | 20.9 | <0.1 | 835 | 224 | <10 | 2.7 | 58 | 69 | 29,800 | 11 | 18.80 | 478 | 116 | 250 | <10 | 2 | <20 |
| WR-8P | 2.15 | 1.90 | 0.33 | 0.16 | <0.01 | 67.2 | 59.4 | 18.1 | 4.8 | 1,010 | 32 | <5 | 38.0 | 40 | 192 | 23,900 | 13 | 16.60 | 524 | 30 | 216 | 20 | 4 | <20 |
| WR-9 | 0.02 | 0.01 | — | 0.02 | <0.01 | 0.6 | 0.3 | <0.1 | 3.2 | 88 | 197 | <10 | <0.5 | 30 | 110 | 9,440 | 34 | 2.74 | 357 | 40 | 10 | <10 | 1 | <20 |
| WR-9P | 0.02 | 0.02 | <0.01 | 0.05 | <0.01 | 0.6 | 0.6 | <0.1 | 3.8 | 113 | 179 | <5 | <1.0 | 32 | 146 | 15,000 | 40 | 1.83 | 353 | 36 | 8 | 10 | <1 | <20 |
| WR-10 | 0.01 | <0.01 | — | <0.01 | <0.01 | 0.3 | <0.3 | <0.1 | 6.4 | 1,500 | 283 | <10 | 13.5 | 29 | 44 | 19,500 | 9 | 4.74 | 401 | 41 | 32 | <10 | <2 | <20 |
| WR-10P | <0.01 | 0.03 | <0.01 | 0.01 | <0.01 | <0.3 | 0.9 | <0.1 | 13.9 | 1,070 | 400 | <5 | 20.0 | 17 | 66 | 16,000 | 10 | 8.00 | 1,400 | 222 | 68 | <10 | <1 | <20 |
| WR-11 | 0.01 | 0.01 | — | 0.01 | <0.01 | 0.3 | 0.3 | <0.1 | 2.4 | 1,260 | 374 | <10 | 16.0 | 31 | 44 | 18,400 | 13 | 4.72 | 387 | 41 | 35 | <10 | <2 | <20 |
| WR-11P | 4.57 | 3.29 | 1.22 | 0.06 | 2.37 | 143.0 | 103.0 | 74.1 | 0.4 | 5,290 | 155 | <10 | 6.0 | 4 | 32 | 43,300 | 44 | 2.46 | 315 | 16 | 48 | 10 | 2 | 20 |
| WR-12 | 0.16 | 0.13 | — | <0.01 | 0.10 | 5.0 | 4.1 | 3.1 | 163.0 | 10 | 242 | <10 | <0.5 | 76 | 76 | 32,700 | <5 | <0.15 | 19,200 | 461 | 44 | <10 | <2 | <20 |
| WR-12P | 0.56 | 0.47 | 0.09 | <0.01 | 0.02 | 17.5 | 14.7 | 0.6 | 191.0 | 273 | 118 | <5 | <1.0 | 72 | 20 | 33,600 | 6 | <0.15 | 15,500 | 562 | 66 | <10 | <1 | <20 |
| WR-13 | 1.92 | 1.22 | — | 0.06 | 1.21 | 60.0 | 38.1 | 37.8 | 7.2 | 223 | 130 | <10 | <0.5 | 25 | 27 | 24,400 | 15 | 1.59 | 1,250 | 224 | 34 | <10 | <2 | <20 |
| WR-13P | 0.45 | 0.49 | <0.01 | 0.10 | 0.40 | 14.1 | 15.3 | 12.5 | 15.0 | 96 | 92 | <10 | <1.0 | 42 | 44 | 22,400 | 9 | 1.35 | 224 | 135 | 37 | <10 | <1 | <20 |
| B-1 | 0.17 | 0.06 | 0.07 | 0.04 | <0.01 | 5.3 | 1.9 | <0.1 | 1.8 | 596 | 92 | <5 | 3.0 | 15 | 39 | 9,690 | 20 | 4.00 | 107 | 10 | 51 | <10 | <1 | <20 |
| B-2 | 0.17 | 0.02 | <0.01 | 0.17 | <0.01 | 5.3 | 0.6 | <0.1 | 2.0 | 292 | 156 | <5 | <1.0 | 11 | 42 | 13,200 | 85 | 1.72 | 434 | 43 | 4 | <10 | <1 | <20 |
| B-3 | 0.60 | 0.69 | <0.01 | 0.05 | 0.31 | 18.8 | 21.6 | 9.7 | 7.2 | 586 | 774 | <5 | 3.0 | 12 | 90 | 23,300 | 16 | 2.91 | 1,600 | 81 | 96 | 10 | <1 | <20 |
| B-4 | 1.50 | 1.37 | 0.07 | 0.06 | 0.88 | 46.9 | 42.8 | 27.5 | 17.5 | 2,000 | 150 | — | 4.7 | 23 | 96 | 45,600 | 9 | 1.79 | 4,000 | 1,050 | 240 | <20 | <1 | <20 |
| B-5 | 0.42 | 0.24 | 0.04 | 0.14 | 0.01 | 13.1 | 7.5 | 0.3 | 0.1 | 1,450 | 287 | <5 | <1.0 | 6 | 92 | 18,500 | 7 | 3.00 | 165 | 260 | 24 | <10 | <1 | <20 |
| B-6 | 2.21 | 1.99 | 0.02 | 0.20 | 1.03 | 69.1 | 62.2 | 32.3 | 8.0 | 1,950 | 165 | <5 | 5.0 | 10 | 56 | 30,700 | 14 | 6.40 | 4,100 | 176 | 118 | <10 | <1 | <20 |
| B-7 | 0.09 | 0.06 | 0.03 | <0.01 | <0.01 | 2.8 | 1.9 | <0.1 | 3.6 | 210 | 190 | — | <0.5 | 10 | 25 | 6,200 | 5 | 0.80 | 107 | 490 | 8 | <10 | <1 | <10 |
| B-8 | 1.16 | 0.93 | 0.12 | 0.14 | 0.33 | 36.2 | 29.1 | 10.3 | 1.5 | 1,440 | 404 | <5 | 1.0 | 11 | 29 | 15,600 | 27 | 1.80 | 286 | 9 | 73 | <10 | <1 | <20 |
| B-9 | 0.99 | 0.46 | 0.52 | 0.01 | 0.93 | 30.9 | 14.4 | 29.1 | 7.2 | 442 | 462 | <5 | 4.0 | 17 | 33 | 12,000 | 45 | 1.37 | 437 | 13 | 79 | 10 | <1 | <20 |
| B-10 | 4.52 | 3.70 | 0.72 | 0.10 | 3.16 | 141.0 | 116.0 | 98.8 | 48.3 | 4,790 | 46 | <5 | <1.0 | 29 | 73 | 47,500 | 11 | 7.40 | 6,790 | 497 | 77 | <10 | <1 | <20 |
| B-11 | 0.23 | 0.41 | <0.01 | <0.01 | 0.04 | 7.2 | 12.8 | 1.2 | 107.0 | 697 | 283 | <5 | <1.0 | 32 | 11 | 33,100 | <5 | <0.15 | 16,600 | 539 | 17 | <10 | <1 | <20 |
| B-12 | 0.30 | 0.49 | <0.01 | 0.01 | <0.01 | 9.4 | 15.3 | <0.1 | 125.0 | 706 | 269 | <5 | <1.0 | 26 | 12 | 34,600 | 5 | <0.15 | 17,100 | 541 | 7 | <10 | <1 | <20 |
| B-13 | 2.86 | 1.68 | 1.10 | 0.08 | 1.13 | 89.4 | 52.5 | 35.3 | 75.1 | 5,080 | 223 | <5 | <1.0 | 15 | 39 | 26,100 | 14 | 52.20 | 4,770 | 195 | 103 | <10 | <1 | 40 |
| B-14 | 1.38 | 0.83 | 0.52 | 0.03 | 0.39 | 43.1 | 25.9 | 12.2 | 42.4 | 1,450 | 147 | <5 | <1.0 | 8 | 20 | 30,600 | 13 | 19.20 | 2,970 | 168 | 26 | <10 | <1 | 40 |
| B-15 | 2.17 | 1.46 | 0.54 | 0.17 | 1.30 | 67.8 | 45.6 | 40.6 | 8.5 | 2,250 | 145 | <5 | 4.0 | 9 | 62 | 30,600 | 3 | 8.00 | 3,530 | 160 | 118 | <10 | <1 | <20 |

**FOOTNOTES:**

TOT – Total
S – Sulfur
PYR – Pyritic
SUL – Sulfate
UNID – Unidentified
APP/P – APP/Peroxide
* – Tons $CaCO_3$/1,000 tons
ANP – Acid Neutralizing Potential

As – Arsenic
Ba – Barium
B – Boron
Cd – Cadmium
Cr – Chromium
Cu – Copper
Fe – Iron
Pb – Lead

Hg – Mercury
Mg – Magnesium
Mn – Manganese
Ni – Nickel
Se – Selenium
Ag – Silver
Tl – Thallium

## HUMIDITY CELL TEST RESULTS

| Sample I.D. | Rock Type | Ox/Ref | Core Length Feet | Humidity Cell Test Results | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Acidity (filt.) mg/l - $CaCO_3$ | Conduct. (filt.) umhos/cm @ 25dF | pH (filt.) | Sul (filt.) mg/l | As Diss. mg/l | Ba Diss. mg/l | B Diss. mg/l | Cd Diss. mg/l | Cr Diss. mg/l | Cu Diss. mg/l | Fe Diss. mg/l | Pb Diss. mg/l | Hg Diss. mg/l | Mg Diss. mg/l | Mn Diss. mg/l | Ni Diss. mg/l | Se Diss. mg/l | Ag Diss. mg/l | Tl Diss. mg/l |
| WR-1P | Sed | Ox | 100 | <10 | 336.0 | 6.24 | 131 | 0.83 | 0.02 | <0.05 | <0.005 | <0.01 | <0.01 | <0.03 | <0.05 | <0.0015 | 4.32 | 0.73 | <0.04 | <0.1 | <0.01 | <0.1 |
| WR-2P | Sed/O | Ref | 100 | 24 | 601.0 | 6.21 | 275 | 0.16 | 0.02 | <0.05 | <0.005 | <0.01 | <0.01 | <0.03 | <0.05 | <0.0015 | 8.52 | 0.11 | <0.04 | <0.1 | <0.01 | <0.1 |
| WR-3P | Gd | Ref | 100 | <10 | 75.0 | 7.46 | <10 | 0.08 | <0.01 | <0.05 | <0.005 | <0.01 | <0.01 | <0.03 | <0.05 | <0.0015 | 1.37 | <0.01 | <0.04 | <0.1 | <0.01 | <0.1 |
| WR-4P | Sed | Ox | 65 | <10 | 74.0 | 7.21 | <10 | <0.05 | <0.01 | <0.05 | <0.005 | <0.01 | <0.01 | <0.03 | <0.05 | <0.0015 | 1.48 | <0.01 | <0.04 | <0.1 | <0.01 | <0.1 |
| WR-5P | Gd | Ref | 150 | 14 | 1,000.0 | 6.23 | 528 | 0.47 | 0.03 | <0.05 | <0.005 | <0.01 | <0.01 | 0.03 | <0.05 | <0.0015 | 65.00 | 0.64 | <0.04 | <0.1 | <0.01 | <0.1 |
| WR-6P | Gd | Ref | 75 | <10 | 98.0 | 5.85 | 35 | <0.05 | 0.05 | <0.05 | <0.005 | <0.01 | <0.01 | <0.03 | <0.05 | <0.0015 | 1.70 | 3.02 | 0.09 | <0.1 | <0.01 | <0.1 |
| WR-7P | Gd | Ref | 70 | <10 | 275.0 | 6.27 | 110 | <0.05 | 0.05 | <0.05 | <0.005 | <0.01 | <0.01 | <0.03 | <0.05 | <0.0015 | 1.78 | 0.66 | <0.04 | <0.1 | <0.01 | <0.1 |
| WR-8P | Sed/O | Ref | 60 | 167 | 790.0 | 3.26 | 386 | 3.14 | <0.01 | <0.05 | 0.107 | <0.01 | 0.75 | 26.00 | <0.05 | <0.0015 | 15.50 | 1.14 | 2.42 | <0.1 | <0.01 | <0.1 |
| WR-9P | Sed | Ox | 100 | 11 | 64.0 | 5.41 | 20 | 0.07 | 0.01 | <0.05 | <0.005 | <0.01 | <0.01 | <0.03 | <0.05 | <0.0015 | 0.93 | 0.13 | <0.04 | <0.1 | <0.01 | <0.1 |
| WR-10P | Sed | Ox | 100 | 35 | 319.0 | 4.10 | 120 | 0.10 | 0.01 | <0.05 | <0.005 | <0.01 | 0.71 | 1.35 | <0.05 | <0.0015 | 6.93 | 0.37 | 1.37 | <0.1 | <0.01 | <0.1 |
| WR-11P | Sed | Ox | 65 | | | | | | | | | | | | | | | | | | | |
| WR-12P | Gd | Ref | 80 | <10 | 18.0 | 6.60 | <10 | 0.06 | <0.01 | <0.05 | <0.005 | <0.01 | <0.01 | 0.12 | <0.05 | <0.0015 | 0.07 | <0.01 | <0.04 | <0.1 | <0.01 | <0.1 |
| WR-13P | Sed | Ox | 100 | <10 | 70.0 | 5.73 | 23 | 0.41 | <0.01 | <0.05 | <0.005 | <0.01 | 0.04 | 0.05 | <0.05 | <0.0015 | 1.13 | 0.12 | 0.10 | <0.1 | <0.01 | <0.1 |
| B-1 | Sed | Ox | 200 | <10 | 191.0 | 5.54 | 70 | <0.05 | 0.02 | <0.05 | <0.005 | <0.01 | <0.01 | <0.03 | <0.05 | <0.0015 | 3.06 | 3.06 | 0.15 | <0.1 | <0.01 | <0.1 |
| B-2 | Sed | Ox | 165 | <10 | 125.0 | 6.87 | 30 | 0.11 | <0.01 | <0.05 | <0.005 | <0.01 | <0.01 | <0.03 | <0.05 | <0.0015 | 1.61 | 0.03 | <0.04 | <0.1 | <0.01 | <0.1 |
| B-3 | Sed | Ox | 200 | <10 | 22.0 | 6.55 | <10 | 0.13 | <0.01 | <0.05 | <0.005 | <0.01 | <0.01 | <0.03 | <0.05 | <0.0015 | 0.19 | <0.01 | <0.04 | <0.1 | <0.01 | <0.1 |
| B-5 | Sed | Ox | 150 | <10 | 24.0 | 6.61 | <10 | <0.05 | <0.01 | <0.05 | <0.005 | <0.01 | <0.01 | <0.03 | <0.05 | <0.0015 | 0.02 | <0.01 | <0.04 | <0.1 | <0.01 | <0.1 |
| B-6 | Sed | Ox | 250 | 292 | 1,230.0 | 3.26 | 696 | 0.21 | <0.01 | <0.05 | 0.777 | 0.03 | 5.19 | 22.00 | <0.05 | <0.0015 | 12.00 | 5.23 | 3.76 | <0.1 | <0.01 | <0.1 |
| B-8 | Sed | Ref | 100 | <10 | 123.0 | 6.69 | 30 | 0.15 | <0.01 | <0.05 | <0.005 | <0.01 | <0.01 | <0.03 | <0.05 | <0.0015 | 2.32 | 0.02 | <0.04 | <0.1 | <0.01 | <0.1 |
| B-9 | Sed | Ref | 150 | <10 | 165.0 | 6.78 | 48 | 0.07 | <0.01 | <0.05 | <0.005 | <0.01 | <0.01 | <0.03 | <0.05 | <0.0015 | 3.98 | <0.01 | <0.04 | <0.1 | <0.01 | <0.1 |
| B-10 | Gd | Ref | 150 | <10 | 87.0 | 7.12 | 11 | 0.13 | <0.01 | <0.05 | <0.005 | <0.01 | <0.01 | <0.03 | <0.05 | <0.0015 | 2.63 | 0.06 | <0.04 | <0.1 | <0.01 | <0.1 |
| B-11 | Gd | Ref | 325 | 102 | 483.0 | 3.56 | 207 | 19.40 | 0.02 | <0.05 | <0.005 | <0.01 | 0.07 | 65.00 | <0.05 | <0.0015 | 7.50 | 6.50 | 0.42 | <0.1 | <0.01 | <0.1 |
| B-12 | Gd | Ref | 75 | <10 | 64.0 | 7.75 | <10 | <0.05 | <0.01 | <0.05 | <0.005 | <0.01 | 0.01 | 0.22 | <0.05 | <0.0015 | 1.18 | 0.02 | <0.04 | <0.1 | <0.01 | <0.1 |
| B-13 | Gd/O | Ref | 180 | 21 | 133.0 | 4.76 | 48 | 0.47 | 0.05 | <0.05 | 0.006 | <0.01 | 0.05 | 0.79 | <0.05 | <0.0015 | 2.46 | 11.30 | 0.80 | <0.1 | <0.01 | <0.1 |
| B-14 | Gd/O | Ref | 200 | <10 | 64.0 | 7.43 | 10 | <0.05 | 0.01 | <0.05 | <0.005 | <0.01 | <0.01 | <0.03 | <0.05 | <0.0015 | 0.65 | 0.04 | <0.04 | <0.1 | <0.01 | <0.1 |
| B-15 | Sed | Ox | 250 | | | | | | | | | | | | | | | | | | | |

Sed - Sedimentary Rocks
O - Indicates Ore
Gd - Granodirite and Relate Rocks
Ox - Oxidized
Ref - Refactory
Net ANP - Net Acid Neutralizing Potential (ANP-AGP)
AGP - Acid Generating Potential
Conduct. - Conductivity
Sul - Sulfate
filt. -
Diss. - dissolved
* - Tons $CaCO_3$/1,000 Tons

As - Arsenic
Ba - Barium
B - Boron
Cd - Cadmium
Cr - Chromium
Cu - Copper
Fe - Iron
Pb - Lead

Hg - Mercury
Mg - Magnesium
Mn - Manganese
Ni - Nickel
Se - Selenium
Ag - Silver
Tl - Thallium

## APPENDIX C

## ECOLOGICAL SITE DESCRIPTIONS

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

Ecological Site Description

A. PHYSICAL CHARACTERISTICS

1. Physiographic Features

This site occurs on axial-stream floodplains and inset fans. Slopes range from 0 to 8 percent, but slope gradients of 2 to 4 percent are most typical. Elevations are 4,500 to 7,000 feet (1,375 to 2,135 meters).

2. Climatic Features

Average annual precipitation is 8 to 14 inches (20 to 36 cm). Mean annual temperatures are 42 to 48 degrees F (6 to 9 cegrees C). Extreme temperatures are 105 to -35 degrees F (40 to -37 degrees C). Average frost-free season is 80 to 120 days.

3. Potential Native Vegetation

a. The plant community is dominated by basin wildrye. Although big sagebrush is prevalent, grasses dominate the aspect. Potential vegetative composition is about 70% grasses and grass-like plants, 10% forbs and 20% shrubs.

This site is commonly associated with perennial or intermittent streams. Where riparian plant communities typical of such streams are of limited extent, they are recognized as inclusions within this site. The percent species composition and annual yield are not included here and an on-site investigation is recommended for a suitable interpretation where these small riparian areas are encountered.

7. Potential Native Vegetation (continued)

b. Major plant species and percentages of the total community by air-dry weight:

| Grasses & Grass-like Plants | Plant Symbol | Percent |
|---|---|---|
| basin wildrye | ELCI2 | 50-60 |
| Nevada bluegrass | PONE3 | 5-15 |
| mat muhly | MUPI | 2-10 |
| sedge | CAREX | 1-5 |
| other perennial grasses- | PPGG | 15-20** |
| bluebunch wheatgrass | AGSP | |
| bottlebrush squirreltail | SIHY | |
| Sandberg bluegrass | POSE | |
| pine bluegrass | POSC | |
| streambank wheatgrass | AGRI | |
| slender wheatgrass | AGTR | |

**Allow no more than 5% of each species of this group in the potential plant community.

| Forbs | | |
|---|---|---|
| lupine | LUPIN | 2-5 |
| other perennial forbs | PPFF | 5-10** |
| povertyweed | IVAX | |
| daisy | ERIGE2 | |
| bluebells | MERTE | |
| penstemon | PENST | |
| groundsel | SENEC | |

**Allow no more than 2% of each species of this group in the potential plant community.

| Shrubs | | |
|---|---|---|
| basin big sagebrush | ARTRT* | 10-15 |
| rubber rabbitbrush | CHNA2 | 2-5 |
| Douglas rabbitbrush | CHVI8 | 1-2 |

3. Potential Native Vegetation (continued)

c. Approximate ground cover (basal and crown) 35-60%.

d. As ecological condition deteriorates, basin big sagebrush and rubber rabbitbrush become dominant with increases of povertyweed, Sandberg bluegrass and bottlebrush squirreltail in the understory. Cheatgrass, halogeton and Russian-thistle are the species most likely to invade this site.

4. Total Annual Production (weight per acre air-dry)

| | | |
|---|---|---|
| Favorable years | - | 2,500 pounds (2,800 kg/ha) |
| Normal years | - | 1,900 pounds (2,130 kg/ha) |
| Unfavorable years | - | 1,200 pounds (1,345 kg/ha) |

5. Soils

a. The soils in this site are deep to very deep and moderately well to somewhat poorly drained. Surface soils are thick, fertile and moderately fine to medium textured. The available water capacity is moderate to high. Some soils have a seasonally high water table at depths of 30 to 60 inches (75 to 150 cm) which allows for significant fluctuations in herbage production. Additional moisture is received on this site as overflow from adjacent streams or as run-in from higher landscapes. In some areas, this site occurs where a meadow has deteriorated due to stream channel entrenchment and resultant lowering of the water table. These soils are susceptible to gullying which intercepts normal overflow patterns causing site degradation.

b. Soil taxonomic unit representative of this site:*

| Series | Survey Areas | Classification |
|---|---|---|
| Welch, silt loam, drained, 0-4% slopes | 763<br>765<br>767 | Fine-loamy, mixed, frigid Cumulic Haplaquolls |

*For additional soils in this site, see Item 8. 9.

c. Complete soil survey descriptions are available in the soil survey descriptive legend.

6. Location of Typical Example of the Site

Sec. 33, T37N, R52E - Approximately 25 miles north of Carlin, NV.

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

Ecological Site Description

A. PHYSICAL CHARACTERISTICS

1. Physiographic Features

This site occurs on sideslopes of mountains, hills, erosional fan remnants and partial ballenas. It also occurs on north exposures at lower elevations than normal for the site. Slopes range from 8 to 75 percent, but slope gradients of 15 to 50 percent are most typical. Elevations are 5,500 to 8,000 feet (1,675 to 2,440 meters).

2. Climatic Features

Average annual precipitation is 10 to 16 inches (25 to 41 cm). Mean annual temperatures are 43 to 47 degrees F (6 to 8 degrees C). Extreme temperatures are 100 to -40 degrees F (37 to -40 degrees C). Average frost-free season is 75 to 100 days.

3. Potential Native Vegetation

a. The plant community is dominated by Idaho fescue, bluebunch wheatgrass and antelope bitterbrush. Slopes of southerly exposure will normally express a higher percentage of bluebunch wheatgrass while north facing slopes will support a higher component of Idaho fescue. Big sagebrush is usually prevalent enough to dominate the aspect. Potential vegetative composition is about 60% grasses and grass-like plants, 15% forbs and 25% shrubs.

3. Potential Native Vegetation (continued)

b. Major plant species and percentages of the total community by air-dry weight:

| Grasses & Grass-Like Plants | Plant Symbol | Percent |
|---|---|---|
| Idaho fescue | FEID | 15-40 |
| bluebunch wheatgrass | AGSP | 15-30 |
| basin wildrye | ELCI2 | 2-10 |
| Nevada bluegrass | PONE3 | 2-5 |
| Thurber needlegrass | STTH2 | T-10 |
| bulbous oniongrass | MEBU | 0-5 |
| other perennial grasses & grass-like plants | PPGG | 5-10** |
| western needlegrass | STOC2 | |
| bottlebrush squirreltail | SIHY | |
| sedge | CAREX | |
| Columbia needlegrass | STCO3 | |
| mountain brome | BRMA4 | |
| bluegrass | POA++ | |

**Allow no more than 2% of each species of this group in the potential plant community.

| Forbs | | |
|---|---|---|
| arrowleaf balsamroot | BASA3 | 5-10 |
| tapertip hawksbeard | CRAC2 | 1-5 |
| helianthella | HELIA | 1-2 |
| white stoneseed | LIRU4 | 1-2 |
| other perennial forbs | PPFF | 5-15** |
| lupine | LUPIN | |
| phlox | PHLOX | |
| eriogonum | ERIOG | |
| penstemon | PENST | |
| aster | ASTER | |
| paintbrush | CASTI2 | |

**Allow no more than 2% of each species of this group in the potential plant community.

| Shrubs | | |
|---|---|---|
| mountain big sagebrush | ARTRV | 10-15 |
| antelope bitterbrush | PUTR2 | 5-15 |
| other shrubs | SSSS | 5-15** |
| serviceberry | AMELA | |
| Douglas rabbitbrush | CHVI8 | |
| snowberry | SYMPH | |
| lanceleaf rabbitbrush | CHVIL | |
| basin big sagebrush | ARTRT* | |

**Allow no more than 5% of each species of this group in the potential plant community.

3. Potential Native Vegetation (continued)

c. Approximate ground cover (basal and crown) 35-55%.

d. As ecological condition deteriorates, big sagebrush and rabbitbrush species become dominant. Cheatgrass is the species most likely to invade this site.

4. Total Annual Production (weight per acre air-dry)

| | | |
|---|---|---|
| Favorable years | - | 1,200 pounds (1,345 kg/ha) |
| Normal years | - | 900 pounds (1,010 kg/ha) |
| Unfavorable years | - | 600 pounds ( 670 kg/ha) |

5. Soils

a. The soils in this site are moderately deep to deep and are well drained. Surface soils are medium to moderately fine textured and normally more than 10 inches (25 cm) thick. Subsoils range from medium to fine texture and the soil profile may be modified with 30-75% rock fragments. Most soils have a mollic epipedon more than 15 inches (38 cm) thick which may extend into the argillic horizon. The available water capacity is moderate and runoff is medium. The potential for sheet and rill erosion is moderate but will vary with slope.

b. Soil taxonomic unit representative of this site:*

| Series | Survey Areas | Classification |
|---|---|---|
| Loncan, gravelly loam, 15-30% slopes | 763<br>765<br>767 | Loamy-skeletal, mixed, frigid Aridic Haploxerolls |

*For additional soils in this site, see Item B. 9.

c. Complete soil survey descriptions are available in the soil survey descriptive legend.

6. Location of Typical Example of the Site

Sec. 34, T35N, R54E - North of Elko, NV across from Barrel Springs along west side of highway.

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

Ecological Site Description

A. PHYSICAL CHARACTERISTICS

1. Physiographic Features

This site occurs on summits and sideslopes of ballenas, alluvial fans, fan piedmonts and bordering mountains on all exposures. Slopes range from 4 to 30 percent. Elevations are 5,500 to 7,000 feet (1,675 to 2,135 meters).

2. Climatic Features

Average annual precipitation is 10 to 12 inches (25 to 30 cm). Mean annual temperatures are 43 to 47 degrees F (6 to 8 degrees C). Extreme temperatures are 100 to -35 degrees F (37 to -37 degrees C). Average frost-free season is 80 to 100 days.

3. Potential Native Vegetation

a. The plant community is dominated by bluebunch wheatgrass and big sagebrush. Other important species associated with this site are Thurber needlegrass and Nevada bluegrass. Potential vegetative composition is about 65% grasses, 15% forbs and 20% shrubs.

3. Potential Native Vegetation (continued)

b. Major plant species and percentages of the total community by air-dry weight:

| Grasses | Plant Symbol | Percent |
|---|---|---|
| bluebunch wheatgrass | AGSP | 20-30 |
| Thurber needlegrass | STTH2 | 15-25 |
| Nevada bluegrass | PONE3 | 2-10 |
| other perennial grasses | PPGG | 10-15** |
| basin wildrye | ELCI2 | |
| bottlebrush squirreltail | SIHY | |
| thickspike wheatgrass | AGDA | |
| bluegrass | POA++ | |
| Idaho fescue | FEID | |
| Indian ricegrass | ORHY | |

**Allow no more than 5% of each species of this group in the potential plant community.

| Forbs | | |
|---|---|---|
| tapertip hawksbeard | CRAC2 | 2-5 |
| arrowleaf balsamroot | BASA3 | 2-5 |
| lupine | LUPIN | 2-5 |
| white stoneseed | LIRU4 | 1-5 |
| other perennial forbs | PPFF | 2-5** |
| phlox | PHLOX | |
| eriogonum | ERIOG | |

**Allow no more than 2% of each species of this group in the potential plant community.

| Shrubs | | |
|---|---|---|
| sagebrush | | 10-15 |
| basin big sagebrush | ARTRT* | |
| mountain big sagebrush | ARTRV | |
| antelope bitterbrush (1) | PUTR2 | 0-10 |
| other shrubs | SSSS | 5-10** |
| rabbitbrush | CHRYS9 | |
| rubber rabbitbrush | CHNA2 | |
| Douglas rabbitbrush | CHVI8 | |
| Wyoming big sagebrush | ARTRW* | |

**Allow no more than 5% of each species of this group in the potential plant community.

(1) Antelope bitterbrush rarely occurs on sites within MLRA D-24.

3. Potential Native Vegetation (continued)

c. Approximate ground cover (basal and crown) 20-40%.

d. As ecological condition deteriorates, big sagebrush and Douglas rabbitbrush become dominant with increases of bottlebrush squirreltail and Sandberg bluegrass in the understory. Cheatgrass and annual mustards are plants likely to invade this site.

4. Total Annual Production (weight per acre air-dry)

| | | |
|---|---|---|
| Favorable years | - | 1,000 pounds (1,120 kg/ha) |
| Normal years | - | 800 pounds ( 895 kg/ha) |
| Unfavorable years | - | 600 pounds ( 670 kg/ha) |

5. Soils

a. The soils in this site are moderately deep to deep and are moderately well to well drained. Surface soils are moderately fine to medium textured and normally more than 10 inches (25 cm) thick to the subsoil or underlying material. The available water capacity is low to moderate and some soils are modified with high volumes of rock fragments through the soil profile. Soil reaction increases with soil depth. In some soils slight or moderate concentrations of salts and sodium may accumulate in the lower subsoil or in the substratum. Soils having a high percentage of rock fragments on the surface are less subject to soil erosion losses. Runoff is slow to moderate and the potential for sheet and rill erosion varies with slope gradient.

b. Soil taxonomic unit representative of this site:*

| Series | Survey Areas | Classification |
|---|---|---|
| Stampede, gravelly loam, 4-15% slopes | 612<br>763<br>765<br>767 | Fine, montmorillonitic, frigid Aridic Durixerolls |

*For additional soils in this site, see Item B. 9.

c. Complete soil survey descriptions are available in the soil survey descriptive legend.

6. Location of Typical Example of the Site

Sec. 35, T29N, R56E - Approximately 3/4 mile northwest of Zaga Ranch House, Jiggs, NV.

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

Ecological Site Description

A. PHYSICAL CHARACTERISTICS

1. Physiographic Features

This site occurs on hills, erosional fan remnants and partial ballenas on all exposures. Slopes range from 2 to 75 percent but slope gradients of 4 to 30 percent are most typical. Elevations are 4,500 to 6,000 feet (1,375 to 1,830 meters).

2. Climatic Features

Average annual precipitation is 8 to 10 inches (20 to 25 cm). Mean annual temperatures are 45 to 50 degrees F (7 to 10 degrees C). Extreme temperatures are 100 to -40 degrees F (43 to -40 degrees C). Average frost-free season is 90 to 115 days.

3. Potential Native Vegetation

a. The plant community is dominated by bluebunch wheatgrass, Thurber needlegrass and Wyoming big sagebrush. Basin wildrye, Webber ricegrass and Indian ricegrass are important species associated with this site. Potential vegetative composition is about 65% grasses, 10% forbs and 25% shrubs.

Potential Native Vegetation (continued)

b. Major plant species and percentages of the total community by air-dry weight:

| Grasses | Plant Symbol | Percent |
|---|---|---|
| bluebunch wheatgrass | AGSP | 10-40 |
| Thurber needlegrass | STTH2 | 10-40 |
| basin wildrye | ELCI2 | 5-15 |
| Indian ricegrass | ORHY | 2-10 |
| Webber ricegrass | ORWE | 2-10 |
| bluegrass | POA++ | 2-10 |
| other perennial grasses | PPGG | 2-15** |
| bottlebrush squirreltail | SIHY | |
| needleandthread | STCO4 | |
| thickspike wheatgrass | AGDA | |

**Allow no more than 5% of each species of this group in the potential plant community.

| Forbs | Plant Symbol | Percent |
|---|---|---|
| globemallow | SPHAE | 2-5 |
| other perennial forbs | PPFF | 2-10** |
| eriogonum | ERIOG | |
| pricklygilia | LEPTO2 | |
| aster | ASTER | |
| arrowleaf balsamroot | BASA3 | |
| penstemon | PENST | |
| lupine | LUPIN | |
| milkvetch | ASTRA | |
| spiny phlox | PHHO | |
| longleaf phlox | PHLO2 | |

**Allow no more than 1% of each species of this group in the potential plant community.

| Shrubs | Plant Symbol | Percent |
|---|---|---|
| sagebrush | | 10-15 |
| basin big sagebrush | ARTRT* | |
| Wyoming big sagebrush | ARTRW* | |
| other shrubs | SSSS | 5-15** |
| Douglas rabbitbrush | CHVI8 | |
| downy rabbitbrush | CHVIP | |
| rubber rabbitbrush | CHNA2 | |
| spiny hopsage | GRSP | |
| littleleaf horsebrush | TEGL | |
| spineless horsebrush | TECA2 | |
| antelope bitterbrush | PUTR2 | |
| winterfat | EULA5 | |

**Allow no more than 2% of each species of this group in the potential plant community.

3. Potential Native Vegetation (continued)

c. Approximate ground cover (basal and crown) 15-30%.

d. As ecological condition deteriorates, big sagebrush and rabbitbrush become dominant with increases of Sandberg bluegrass, bottlebrush squirreltail and phlox in the understory. Cheatgrass, halogeton, Russian-thistle and annual mustards are species likely to invade this site. Utah juniper will invade this site where it is adjacent to woodland areas.

4. Total Annual Production (weight per acre air-dry)

| | | |
|---|---|---|
| Favorable years | - | 800 pounds (895 kg/ha) |
| Normal years | - | 600 pounds (670 kg/ha) |
| Unfavorable years | - | 400 pounds (450 kg/ha) |

5. Soils

a. The soils in this site are moderately deep to deep and well to somewhat excessively drained. The available water capacity varies with soil texture and soil depth, ranging from low to moderate. Surface soils are 3 to 10 inches (8 to 25 cm) thick and are moderately coarse to medium textured. Many soils are modified with a high volume of gravels, cobbles or stones through their profile. Soil reaction increases with soil depth and slight or moderate salts and sodium generally concentrate in the lower subsoil or in the substratum. A high percentage of rock fragments on the soil surface provides a stabilizing affect on surface erosion conditions and helps to reduce evaporation and conserve soil moisture. Runoff is moderate to very rapid. The potential for sheet and rill erosion is moderate to high depending on slope.

b. Soil taxonomic unit representative of this site:*

| Series | Survey Areas | Classification |
|---|---|---|
| Eucan, loam, 15-30% slopes | 763<br>767 | Fine, montmorillonitic, frigid Xerollic Haplargids |

*For additional soils in this site, see Item 8. 9.

c. Complete soil survey descriptions are available in the soil survey descriptive legend.

6. Location of Typical Example of the Site

NE 1/4, Sec. 34, T31N, R47E - Approximately 10 miles southeast of Beowawe, NV.

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

Ecological Site Description

A. PHYSICAL CHARACTERISTICS

1. Physiographic Features

This site occurs on hills, erosional fan remnants, rock-pediment remnants and partial ballenas on all aspects. Slopes range from 4 to 50 percent, but slope gradients are generally less than 30 percent. Elevations are 4,500 to 6,500 feet (1,375 to 1,985 meters).

2. Climatic Features

Average annual precipitation is 8 to 12 inches (20 to 30 cm). Mean annual temperatures are 44 to 47 degrees F (7 to 8 degrees C). Extreme temperatures are 105 to -35 degrees C (40 to -37 degrees C). Average frost-free season is 80 to 110 days.

3. Potential Native Vegetation

a. The plant community is dominated by bluebunch wheatgrass, Thurber needlegrass and big sagebrush. Antelope bitterbrush, arrowleaf balsamroot, Sandberg bluegrass, bottlebrush squirreltail and basin wildrye are other important species usually associated with this site. Potential vegetative composition is about 55% grasses, 25% forbs and 20% shrubs.

3. Potential Native Vegetation (continued)

b. Major plant species and percentages of the total community by air-dry weight:

| Grasses | Plant Symbol | Percent |
|---|---|---|
| bluebunch wheatgrass | AGSP | 15-25 |
| Thurber needlegrass | STTH2 | 15-25 |
| other perennial grasses | PPGG | 10-20** |
| basin wildrye | ELCI2 | |
| Sandberg bluegrass | POSE | |
| bottlebrush squirreltail | SIHY | |
| Nevada bluegrass | PONE3 | |
| pine bluegrass | POSC | |

**Allow no more than 5% of each species of this group in the potential plant community.

| Forbs | | |
|---|---|---|
| tapertip hawksbeard | CRAC2 | 2-5 |
| arrowleaf balsamroot | BASA3 | 2-5 |
| phlox | PHLOX | 2-5 |
| other perennial forbs | PPFF | 5-15** |
| lupine | LUPIN | |
| milkvetch | ASTRA | |
| eriogonum | ERIOG | |
| aster | ASTER | |

**Allow no more than 2% of each species of this group in the potential plant community.

| Shrubs | | |
|---|---|---|
| sagebrush | | 5-10 |
| Wyoming big sagebrush | ARTRW* | |
| mountain big sagebrush | ARTRV | |
| antelope bitterbrush | PUTR2 | 2-5 |
| other shrubs | SSSS | 2-8** |
| Douglas rabbitbrush | CHVI8 | |
| downy rabbitbrush | CHVIP | |
| rubber rabbitbrush | CHNA2 | |
| littleleaf horsebrush | TEGL | |

**Allow no more than 2% of each species of this group in the potential plant community.

3. Potential Native Vegetation (continued)

c. Approximate ground cover (basal and crown) 10-25%.

d. As ecological condition deteriorates, big sagebrush and rabbitbrush become dominant with increases of Sandberg bluegrass, bottlebrush squirreltail, phlox and arrowleaf balsamroot in the understory. Cheatgrass, halogeton, Russian-thistle and annual mustards are species likely to invade this site.

4. Total Annual Production (weight per acre air-dry)

| | | |
|---|---|---|
| Favorable years | - | 500 pounds (560 kg/ha) |
| Normal years | - | 400 pounds (450 kg/ha) |
| Unfavorable years | - | 250 pounds (280 kg/ha) |

5. Soils

a. The soils in this site are shallow to moderately deep and are well drained. Depth to a moderately fine or fine textured subsoil is normally less than 10 inches (25 cm). Some soils have a dense, fine textured subsoil underlying a surface layer 12 to 20 inches (30 to 50 cm) thick. The soils are modified with 35 to 75 percent gravels and other coarse fragments throughout the profile. They have a high amount of gravels, cobbles and stones on the surface which occupy plant growing space yet provide a stabilizing affect on surface erosion conditions. Available water capacity of these soils is low to very low but a surface cover of coarse fragments helps to reduce evaporation and conserve soil moisture. Runoff is medium and potential for sheet and rill erosion is slight to moderate depending on slope.

b. Soil taxonomic unit representative of this site:*

| Series | Survey Area | Classification |
|---|---|---|
| Shalcer, gravelly loam, 4-30% slopes | 765 | Loamy-skeletal, mixed, frigid Lithic Argixerolls |

*For additional soils in this site, see Item 8. 9.

c. Complete soil survey descriptions are available in the soil survey descriptive legend.

6. Location of Typical Example of the Site

Sec. 8, T44N, R62E - Hills west of Black Mountain.

APPENDIX D

SOILS METHODOLOGY
AND LABORATORY RESULTS

# SOIL LOSS CALCULATIONS AND ASSUMPTIONS

The water-induced soil erosion rate for the Betze Project area was estimated using the Revised Universal Soil Loss Equation (RUSLE) developed by the USDA Agricultural Research Service (ARS) and Soil Conservation Service (SCS). Formerly, soil erosion was estimated using the Universal Soil Loss Equation (USLE), as presented in Agricultural Handbook 537 (ARS 1978), as revised. In 1985, ARS, SCS, and several cooperators led by Dr. K.G. Renard, Research Hydraulic Engineer with ARS at the Aridland Watershed Management Center in Tucson, Arizona, began revising and updating the USLE and its documentation. Drafts of the documentation on RUSLE have been reviewed by technical specialists in SCS, BLM, the Office of Surface Mining (OSM), and other agencies. Some of the improvements in RUSLE include a greatly expanded erosivity map for the western United States, expanded information on soil erodibility, a slope length factor that varies with susceptibility of the soil to rill erosion, a nearly linear slope steepness relationship that reduces computed soil loss values for very steep slopes, a subfactor method for computing values for the cover-management factor, and improved factor values for the effects of contouring, terracing, and stripcropping. A computer program implementing RUSLE was released for testing in 1989, and the final version, Version 1.0, is scheduled for release in the spring of 1991 (Renard 1990). Version 9.3 (10-25-89) was utilized for this EIS.

Application of this methodology is intended to provide relative magnitudes of soil losses over the project area; it is not intended to indicate exact soil losses for any specific site.

The Revised Universal Soil Loss Equation (RUSLE) is defined as A = RKLSCP, where:

- A = computed soil loss in tons per acre per year,
- R = measure of the erosive force in a normal year's rain, (i.e., the rainfall-runoff erosivity factor),
- K = soil erodibility factor,
- LS = topographic factor, accounting for the slope length and gradient (i.e., the slope steepness factor),
- C = cover-management factor, and
- P = supporting practices factor.

This empirically based equation, derived from a large base of field data, computes sheet and rill erosion from values representing the four major factors affecting erosion. These factors are: climatic erosivity represented by R, soil erodibility represented by K, topography represented by LS, and land use represented by CP.

In applying this equation to the proposed project, the following assumptions were made:

1. Rainfall-Runoff Factor (R). Two R factors, 10 and 15, were used based on consultation with Dr. D. McCool, Research Hydraulic Engineer, USDA-ARS, Land Management/Water Conservation Research, Washington State University, Pullman, Washington (McCool 1990). Dr. McCool was the principal investigator for the R factor revision for RUSLE. The BLM determined that the reported R factor for Elko, Nevada, as stated in the R factor city file for Elko, was too high based on other SCS information as well as consultation with Dr. Renard and Dr. McCool. Dr. McCool recommended an R factor of 10 or 15 based on his experience in similar areas in the western United States. Therefore, both 10 and 15 were utilized as R factors for application of RUSLE to this project.

2. Soil Erodibility Factor (K). A K factor of 0.39 was used for native soils based on a weighted average calculation of K factors for soil horizons of salvageable soil material of major soils mapped on the project area. This K factor was generated through use of the soil erodibilty factor nomograph contained in the SCS National Soils Handbook (SCS 1983). Particle size data (including percent very fine sand), organic matter content, soil structure, and permeability class, were obtained through ENSR fieldwork and soil laboratory analysis by Colorado State University's Soil Testing Laboratory. ENSR soil sampling of project area soils was conducted at modal sites as originally determined by JBR Consulting Group (JBR 1989). A K factor of 0.30 was estimated for reclaimed soils based on a moderate reduction in K due to addition of coarse fragments (contained in the waste rock pile material) to the reapplied soil material. K factors are adjusted downward (less erosion hazard) if coarse fragments are present in the soil (SCS 1983). Some coarse fragments in the waste rock piles would be included in the reapplied soil as it is applied and prepared for seeding. An estimated 35 percent coarse fragments at the reclaimed waste rock pile surface was used to adjust the reclaimed soil K factor from 0.39 to 0.30.

3. Slope Gradient and Slope Length (LS).

   - 2.3H:1V

     - percent slope = 43 percent
     - slope length = 251 feet for 100-foot lift; 125 feet for 50-foot lift

- 2.7H:1V
  - percent slope = 37 percent
  - slope length = 288 feet for 100-foot lift; 152 feet for 50-foot lift

4. Cover-Management Factor (C). The C factor was based on an estimated 500 lbs. of above-ground biomass for the 2.3H:1V (43 percent) alternative compared to 600 lbs. for the 2.7H:1V (37 percent) alternative. All entries for C factor in the RUSLE computer model were based on consultation with BLM-Elko.

5. Soil Loss Tolerance Factor (T). The T factor represents the soil loss tolerance. In this project, it is assumed to be the maximum annual erosion loss that will permit renewable continuation of a particular land use, which for this project is the establishment and continuation of a diverse, self-renewing plant community that equals or exceeds the resource values and land use that existed before mining development (BLM 1990). There are five classes of T factor ranging from 1 ton per acre per year for shallow or otherwise fragile soils to 5 tons per acre per year for deep soils (>60 inches) that are least sensitive to damage by erosion (SCS 1983). A T value of 2 tons per acre per year was used for this project based on assumptions: (1) that the effective rooting depth in the reclaimed soil material is 20 to 40 inches, and (2) that the reclaimed soil material should be considered nonrenewable. The National Soils Handbook T value for this situation is 2 tons per acre per year (SCS 1983, p. 603-35). The underlying waste rock material should not be considered renewable soil material because it is lacking an equal amount (compared to the reapplied soil material) of organic matter and other microbiological activity which is advantageous for successful reclamation.

Table D-1 provides RUSLE parameter values and estimated soil loss amounts for various reclamation scenarios addressed in this EIS.

References

Agricultural Research Service (ARS). 1978. Predicting rainfall-erosion losses, a guide to conservation planning. Agriculture Handbook No. 537.

BLM. 1990. Elko District reclamation goals for project area. Letter from Rodney Harris, District Manager to V. Randall, ENSR. January 29, 1990.

JBR Consultants Group. 1989. Baseline reports Little Boulder Basin, Revised 2/89. Prepared for Barrick Goldstrike Mines, Inc. and Newmont Mining Company. October 1988.

McCool, D. K. 1990. Research Hydraulic Engineer, USDA-ARS, Land Management/Water Conservation Research, Washington State University, Pullman, WA. Personal communication with Jim Nyenhuis, ENSR soil scientist, October 26, 1990.

Renard, K. G. 1990. Research Hydraulic Engineer, USDA-ARS, Aridland Watershed Management Center, Tucson, AZ. Personal communication with Jim Nyenhuis, ENSR soil scientist, various dates, Fall 1990.

SCS. 1983. National Soils Handbook. 430-VI-NSH, July 1983, plus revisions.

TABLE D-1

RUSLE PARAMETER VALUES

| | R | K | LS | C | P | A |
|---|---|---|---|---|---|---|
| Reclamation (100-Foot Lift Scenario) | | | | | | |
| Native S=10% L=100' | 10 | 0.39 | 1.31 | 0.006 | 1 | 0.031 |
| Native S=10% L=100' | 15 | 0.39 | 1.31 | 0.006 | 1 | 0.046 |
| Reclm S=20% L=218' | 10 | 0.3 | 6.45 | 0.008 | 1 | 0.155 |
| Reclm S=20% L=288' | 15 | 0.3 | 6.45 | 0.008 | 1 | 0.232 |
| 2.7H:1V S=37% L=288' | 10 | 0.3 | 10.79 | 0.029 | 1 | 0.939 |
| 2.7H:1V S=37% L=288' | 15 | 0.3 | 10.79 | 0.029 | 1 | 1.408 |
| 2.3H:1V S=43% L=251' | 10 | 0.3 | 11.78 | 0.075 | 1 | 2.651 |
| 2.3H:1V S=43% L=251' | 15 | 0.3 | 11.78 | 0.075 | 1 | 3.976 |
| 1.3H:1V S=72% L=164' | 10 | 0.3 | 14.76 | 0.12 | 1 | 5.314 |
| 1.3H:1V S=72% L=164' | 15 | 0.3 | 14.76 | 0.12 | 1 | 7.97 |
| 50-Foot Lift Scenario | | | | | | |
| 2.7H:1V S=37% L=152' | 10 | 0.3 | 9.68 | 0.029 | 1 | 0.842 |
| 2.7H:1V S=37% L=152' | 15 | 0.3 | 9.68 | 0.029 | 1 | 1.263 |
| 2.3H:1V S=43% L=125' | 10 | 0.3 | 9.56 | 0.075 | 1 | 2.151 |
| 2.3H:1V S=43% L=125' | 15 | 0.3 | 9.56 | 0.075 | 1 | 3.227 |

S = Slope
L = Length in feet

SOILS LABORATORY RESULTS

Inter·Mountain Laboratories, Inc.

1633 Terra Avenue
Sheridan, Wyoming 82801
Tel. (307) 672-8945

1714 Phillips Circle
Gillette, Wyoming 82716
Tel. (307) 682-8945

ENSR CORP.

April 5, 1990

ENSR
P.O. Box 2105
Fort Collins, Colorado 80522

Attn: Mr. Jim Nyenhuis

Dear Mr. Nyenhuis,

Enclosed are the results, with corrections, for 36 soil samples sent to our laboratory April 5, 1990. All analysis were performed according to the Wyoming DEQ "Guidelines for Topsoil and Overburden Analysis", November 1984, and ASA Monographs, 2nd ed.

If you have any questions or concerns, always feel free to contact me at your convenience.

Sincerely,

Alan Telck

Alan Telck
Senior Soils Chemist

AT/abt
xc: File
Encs.

Inter-Mountain Laboratories, Inc.
1633 Terra Avenue
Sheridan, Wyoming 82801
Tel. (307) 672-8945

ENSR CONSULTING & ENGINEERING
FORT COLLINS, COLORADO

AMERICAN BARRICK
GOLD STIKE PROJECT
ELKO, NEVADA

April 6, 1990



| Lab No. | Location | Depths | Coarse Fragments % | Very Fine Sand % | Sand % | Silt % | Clay % | Texture | Organic Matter % |
|---|---|---|---|---|---|---|---|---|---|
| 35904 | BG-1 BAZZA | 0-3 | 15. | 8.9 | 45.3 | 40.5 | 14.2 | LOAM | 2.4 |
| 35905 | | 3-14 | 15. | 7.6 | 38.9 | 40.6 | 20.5 | LOAM | 1.2 |
| 35906 | | 14-20 | 25. | 2.8 | 45.3 | 26.9 | 27.8 | SANDY CLAY LOAM | 0.4 |
| 35907 | BG-2 CORTEZ | 0-3 | 10. | 18.1 | 27.1 | 60.5 | 12.4 | SILT LOAM | 1.5 |
| 35908 | | 3-12 | 40. | 15.9 | 22.5 | 54.2 | 23.3 | SILT LOAM | 0.7 |
| 35909 | | 12-20 | 10. | 12.9 | 17.1 | 40.5 | 42.4 | SILTY CLAY | 0.5 |
| 35910 | | 20-24 | 40. | 13.1 | 32.5 | 37.9 | 29.6 | CLAY LOAM | 0.5 |
| 35911 | BG-3 CLYESDALES | 0-2 | 15. | 11.2 | 28.9 | 48.7 | 22.4 | LOAM | 2.0 |
| 35912 | | 2-7 | 20. | 8.2 | 18.0 | 38.7 | 43.3 | CLAY | 1.1 |
| 35913 | | 7-14 | 15. | 5.2 | 25.3 | 26.9 | 47.8 | CLAY | 0.8 |
| 35914 | BG-4 SHORTCREEK | 0-3 | 15. | 12.9 | 36.2 | 49.6 | 14.2 | LOAM | 0.9 |
| 35915 | | 3-20 | 10. | 8.7 | 30.7 | 46.9 | 22.4 | LOAM | 0.8 |
| 35916 | | 20-30 | 10. | 11.1 | 30.7 | 42.4 | 26.9 | LOAM | 0.4 |
| 35917 | BG-5 SAGEHILL | 0-4 | 20. | 11.5 | 30.7 | 49.7 | 19.6 | LOAM | 1.3 |
| 35918 | | 4-12 | 10. | 12.4 | 19.1 | 24.0 | 56.9 | CLAY | 0.6 |
| 35919 | | 12-18 | 15. | 15.4 | 40.9 | 22.2 | 36.9 | CLAY LOAM | 0.8 |
| 35920 | BG-6 BRUSHCREEK | 0-4 | 10. | 11.4 | 29.1 | 50.4 | 20.5 | SILT LOAM | 1.8 |
| 35921 | | 4-20 | 5. | 12.0 | 29.1 | 47.6 | 23.3 | LOAM | 0.8 |
| 35922 | | 20-35 | 10. | 9.3 | 28.2 | 42.2 | 29.6 | CLAY LOAM | 0.4 |
| 35923 | BG-7 WELCH | 0-5 | 10. | 17.9 | 30.0 | 57.6 | 12.4 | SILT LOAM | 4.9 |

Coarse Fragment Percent (% by volume), field determinations by Jim Nyenhuis.

Inter·Mountain Laboratories, Inc.
1633 Terra Avenue Sheridan, Wyoming 82801 Tel. (307) 672-8945

ENSR CONSULTING & ENGINEERING
FORT COLLINS, COLORADO

AMERICAN BARRICK
GOLD STIKE PROJECT
ELKO, NEVADA

April 6, 1990



| Lab No. | Location | Depths | Coarse Fragments % | Very Fine Sand % | Sand % | Silt % | Clay % | Texture | Organic Matter % |
|---|---|---|---|---|---|---|---|---|---|
| 35924 | BG-7 WELCH | 5-41 | 10. | 9.4 | 29.1 | 57.6 | 13.3 | SILT LOAM | 1.3 |
| 35925 | BG-8 BLUESTAR | 0-4 | 20. | 12.7 | 38.2 | 46.7 | 15.1 | LOAM | 3.9 |
| 35926 | | 4-30 | 30. | 10.0 | 28.2 | 32.2 | 39.6 | CLAY LOAM | 0.8 |
| 35927 | | 30-35 | 30. | 8.8 | 59.1 | 17.6 | 23.3 | SANDY CLAY LOAM | 1.1 |
| 35928 | BG-9 LONGLAC | 0-3 | 25. | 14.4 | 31.8 | 54.0 | 14.2 | SILT LOAM | 1.4 |
| 35929 | | 3-19 | 30. | 13.3 | 27.3 | 52.2 | 20.5 | SILT LOAM | 0.7 |
| 35930 | | 19-26 | 30. | 15.4 | 30.9 | 38.6 | 30.5 | CLAY LOAM | 0.2 |
| 35931 | BG-10 POST, | 0-6 | 30. | 6.1 | 26.4 | 45.8 | 27.8 | CLAY LOAM | 0.8 |
| 35932 | ROCKY VAR | 6-24 | 10. | 7.9 | 44.5 | 20.4 | 35.1 | CLAY LOAM | 0.3 |
| 35933 | | 24-30 | 40. | 4.2 | 79.1 | 9.4 | 11.5 | SANDY LOAM | < 0.1 |
| 35934 | BG 11 BAZZA | 0-6 | 25. | 12.0 | 18.7 | 52.2 | 29.1 | SILTY CLAY LOAM | 1.0 |
| 35935 | | 6-24 | 10. | 10.6 | 14.9 | 47.6 | 37.5 | SILTY CLAY LOAM | 0.5 |
| 35936 | | 24-35 | 20. | 10.9 | 17.6 | 47.7 | 34.7 | SILTY CLAY LOAM | 0.4 |
| 35937 | BG-12 RAMIRES | 0-3 | 20. | 13.5 | 26.6 | 53.2 | 20.2 | SILT LOAM | 0.9 |
| 35938 | | 3-14 | 10. | 10.8 | 27.6 | 47.7 | 24.7 | LOAM | 0.6 |
| 35939 | | 14-26 | 20. | 11.3 | 35.1 | 41.1 | 23.8 | LOAM | 0.6 |

Coarse Fragment Percent (% by volume), field determinations by Jim Nyenhuis.

# APPENDIX E

# SOCIOECONOMIC TABLES

TABLE E-1

STUDY AREA POPULATION

1985 THROUGH 1990

| | 1985 | 1986 | 1987 | 1988 | 1989 | Projected 1990 | Percent Increase | Average Annual Increase |
|---|---|---|---|---|---|---|---|---|
| Elko County | 22,850 | 23,920 | 25,000 | 27,980<br>32,000[1] | 33,270 | 36,560 | 60.0 | 9.9 |
| City of Elko | 10,800 | 10,980 | 13,310 | 14,620<br>16,393[2]<br>17,500[1] | 18,156[2] | 19,397[2] | 79.6 | 12.4 |
| Carlin | 1,390 | 1,410 | 1,720 | 1,990 | 2,750 | NA | 97.8[3] | 18.6 |
| Eureka County | 1,450 | 1,530 | 1,950 | 2,010 | 2,280 | 2,310 | 59.3 | 9.8 |
| State of Nevada | 967,820 | 1,008,030 | 1,053,230 | 1,095,880 | 1,198,450 | 1,280,380 | 32.3 | 5.8 |

Source: Nevada Department of Taxation, State Demographer.

[1] City of Elko Profile, 1988/1989. Northeast Nevada Development Authority (NENDA).

[2] Wastewater Facilities Planning Treatment Plant Expansion 11/7/88. Kennedy/Jinks/Chilton (Chilton Engineering).

[3] 1985 through 1989.

TABLE E-2

ELKO COUNTY

INDUSTRIAL EMPLOYMENT 3-YEAR/MONTHLY COMPARISON

| | June 1987 | June 1988 | June 1989 | Average Annual Increase | Percent Change |
|---|---|---|---|---|---|
| Total Industries | 11,470 | 13,450 | 14,880 | 13.9 | 29.7 |
| Mining | 950 | 1,080 | 1,340 | 18.8 | 41.1 |
| Construction | 830 | 1,620 | 1,310 | 25.6 | 57.8 |
| Manufacturing | 130 | 130 | 180 | 17.7 | 38.5 |
| TCPU[1] | 640 | 710 | 740 | 7.5 | 15.6 |
| Trade | 2,020 | 2,360 | 2,990 | 21.7 | 48.0 |
| Fire[2] | 250 | 310 | 310 | 11.4 | 24.0 |
| Service | 4,810 | 5,320 | 5,930 | 11.0 | 23.3 |
| Government | 1,840 | 1,920 | 2,090 | 6.6 | 13.6 |

Source: Nevada Employment Security Department (employment by place of work).

[1] Transportation, communication, public utilities.

[2] Finance, insurance, real estate.

TABLE E-3

EUREKA COUNTY

INDUSTRIAL EMPLOYMENT 3-YEAR/MONTHLY COMPARISON

| | June | | | Average Annual Increase | Percent Change |
|---|---|---|---|---|---|
| | 1987 | 1988 | 1989 | | |
| Total Industries | 1,330 | 3,110 | 3,610 | 64.8 | 219.5 |
| Mining | 1,120 | 2,260 | 3,010 | 63.9 | 168.8 |
| Construction | 10 | 660 | 380 | 516.4 | 3,700.0 |
| Manufacturing | 0 | 0 | 0 | 0 | 0 |
| TCPU | 20 | 20 | 20 | 0 | 0 |
| Trade | 40 | 40 | 50 | 11.8 | 25.0 |
| Fire | 10 | 0 | 0 | (100.0) | (100.0) |
| Service | 20 | 20 | 20 | 0 | 0 |
| Government | 120 | 110 | 130 | 4.1 | 8.3 |

Source: Nevada Employment Security Department (employment by place of work).

[1]Transportation, communications, and public utilities.

[2]Finance, insurance, and real estate.

TABLE E-4

ELKO COUNTY

TOTAL LABOR FORCE 3-YEAR/MONTHLY COMPARISON

| | March 1988 | March 1989 | March 1990 | Feb. 1990 |
|---|---|---|---|---|
| Labor Force | 13,230 | 14,980 | 15,930 | 15,700 |
| Employment | 12,370 | 14,090 | 15,020 | 14,780 |
| Nonagricultural | 11,710 | 13,430 | 14,180 | 14,050 |
| Agricultural | 660 | 660 | 840 | 730 |
| Unemployment | 860 | 890 | 910 | 930 |
| Unemployment Rate | 5.3% | 4.8% | 4.6% | 4.3% |

Source: Employment Security Department (employment by place of residence).

TABLE E-5

EXISTING HOUSING STOCK IN ELKO COUNTY

| | City of Elko | Carlin | Elko County |
|---|---|---|---|
| 1989 Estimated Population[1] | 18,000[2] | 2,880 | 33,200[3] |
| Housing Units (1989 estimate)[1] | | | |
| Single-family | 2,431 | 287 | 1,021 |
| Apartments and Multi-family | 1,537 | 279 | 690 |
| Mobile homes | 1,518 | 398 | 1,752 |
| TOTAL | 5,486 | 964 | 3,463 |
| Rental Rates[1] | | | |
| Single-family | $500-700 | | |
| Apartment | 300-650[4] | $325-450 | |
| Multi-family | 200-330[4] | 150-175[5] | |
| Temporary Housing[1] | | | |
| Motels | 1,611 | 17 | |
| RV Spaces[5] | 1,000+ (5 parks) | 83 (1 park) | |
| Housing For Sale[6] | | | |
| Single-family | 64 | 7 | 45 |
| Price Range | $45-200,000 | $35-200,000 | $40-200,000+ |
| Average Price | $90,000 | $72,000 | |

[1] NENDA 1989-1990 Profile.

[2] City of Elko, not including Spring Creek.

[3] Total population of Elko County.

[4] Telephone survey, 1990.

[5] Mountain West Community Inventory, October 1989.

[6] Listed in Multiple Listing Service (MLS) in June 1990.

TABLE E-6

INCIDENT STATISTICS
ELKO COUNTY SHERIFF'S DEPARTMENT
JANUARY THROUGH MAY 1989 AND 1990

| Activity | Elko Area Jan - May 1989 | Elko Area Jan - May 1990 | County Jan - May 1989 | County Jan - May 1990 |
|---|---|---|---|---|
| Crimes | 277 | 402 | 692 | 761 |
| Incidents | 254 | 275 | 689 | 564 |
| Accidents | 52 | 56 | 144 | 148 |
| Citations | 159 | 148 | 589 | 419 |
| Misdemeanor Arrests | 126 | 158 | 349 | 304 |
| Felony Arrests | 24 | 35 | 64 | 73 |
| Civil | 1,284 | 1,686 | 1,804 | 2,225 |
| Total | 2,176 | 2,760 | 4,331 | 4,494 |

Source: Elko County Sheriff's Department.

TABLE E-7

ELKO COUNTY SCHOOL DISTRICT - END OF SECOND WEEK ENROLLMENT

(1989-1990)

| School | 1987 | 1988 | 1989 | 1988-1989 Gain/Loss | 1988-1989 Percent of Increase/ Decrease | 1987-1989 Gain/Loss | Percent of Increase/ Decrease |
|---|---|---|---|---|---|---|---|
| Elko Elementary | | | | | | | |
| Grammar #2 | 591 | 488 | 452 | -36 | -7.4 | -139 | -23.5 |
| Mountain View | --- | 358 | 523 | 165 | 46.1 | --- | -- |
| Northside | 653 | 561 | 500 | -61 | -10.9 | -153 | -23.4 |
| Southside | 867 | 766 | 693 | -73 | -9.5 | -174 | -20.0 |
| Spring Creek | --- | 435 | 827 | 392 | 90.1 | --- | -- |
| TOTAL | 2,111 | 2,608 | 2,995 | 387 | 14.8 | 884 | 41.9 |
| Elko Junior and Senior High | | | | | | | |
| Elko Junior High | 469 | 586 | 720 | 134 | 22.9 | 251 | 53.5 |
| Elko Senior High | 944 | 1,044 | 1,229 | 185 | 17.7 | 285 | 30.2 |
| TOTAL | 1,413 | 1,630 | 1,949 | 319 | 19.6 | 536 | 37.9 |
| Carlin | | | | | | | |
| Carlin Combined | 411 | 473 | 501 | 25 | 5.3 | 90 | 21.9 |
| Other Elko County Schools | | | | | | | |
| Owyhee Combined | 308 | 331 | 362 | 31 | 9.4 | 54 | 17.5 |
| Wells Combined | 396 | 411 | 429 | 18 | 4.4 | 33 | 8.3 |
| Jackpot Combined | 235 | 255 | 256 | 1 | 0.4 | 21 | 8.9 |
| West Wendover Elementary | 450 | 479 | 524 | 45 | 9.4 | 74 | 16.4 |
| Currie | 7 | 8 | 8 | 0 | 0.0 | 1 | 14.3 |

TABLE E-7 (CONTINUED)

| School | 1987 | 1988 | 1989 | 1988-1989 Gain/Loss | 1988-1989 Percent of Increase/ Decrease | 1987-1989 Gain/Loss | Percent of Increase/ Decrease |
|---|---|---|---|---|---|---|---|
| Independence Valley | 17 | 11 | 15 | 4 | 36.4 | -2 | -11.8 |
| Jarbidge | 9 | 5 | 3 | -2 | -40.0 | -6 | -66.6 |
| Montello | 27 | 19 | 26 | 7 | 36.8 | -1 | -3.7 |
| Mound Valley | 11 | 10 | 13 | 3 | 30.0 | 2 | 18.2 |
| O'Neil | 8 | 3 | 3 | 0 | 0 | -5 | -62.5 |
| Ruby Valley | 39 | 34 | 35 | 1 | 2.9 | -4 | 10.3 |
| Total District-wide | 5,442 | 6,277 | 7,118 | 841 | 13.4 | 1,676 | 30.8 |

Source: Elko County School District.

TABLE E-8

IMPACT AREA SCHOOLS, CAPACITY AND ENROLLMENT, 1989

| School | | Current Enrollment[1] | Capacity |
|---|---|---|---|
| Elko High | (9-12) | 1,167 | 1,200 |
| Elko Junior High | (7-8) | 772 | 600 |
| Spring Creek | (K-6) | 880 | 650 |
| Southside | (K-6) | 718 | 650 |
| Grammar School #2 | (K-6) | 475 | 510 |
| Northside | (K-6) | 496 | 550 |
| Mountain View | (K-6) | 550 | 660 |
| Carlin Combined | (K-12) | 475 | 525 |

Source: Harris 1990.

[1]As of April 1990.

TABLE E-9

ELKO COUNTY SCHOOL DISTRICT REVENUES AND EXPENDITURES

| School Year | Year-End Estimated Revenues | Year-End Estimated Expenditures |
|---|---|---|
| 1984-1985 | $11,712,247 | $12,053,441 |
| 1985-1986 | $14,512,161 | $14,543,173 |
| 1986-1987 | $16,515,767 | $16,428,537 |
| 1987-1988 | $19,453,154 | $19,162,286 |
| 1988-1989 | $23,218,304 | $22,986,202 |

Source: Community Inventory 1989.

TABLE E-10

ASSESSED VALUATION OF JURISDICTION

($000)

| | Tax Rate/ $100 Assessed Value | Fiscal Year 1985-1986 | 1986-1987 | 1987-1988 | 1988-1989 | 1989-1990 | % Inc. | Average Annual Inc. |
|---|---|---|---|---|---|---|---|---|
| Elko County | 2.2212 | 360,426 | 388,480 | 424,982 | 444,747 | 534,814 | 48.3 | 10.4 |
| Elko | 2.9296 | 106,457 | 112,133 | 118,132 | 120,728 | 134,833 | 26.7 | 6.1 |
| Carlin | 2.6434 | 6,947 | 6,349 | 7,309 | 9,587 | 11,758 | 69.3 | 14.1 |
| Eureka County | 1.5500 | 72,903 | 112,085 | 188,782 | 234,634 | 421,992 | 478.8 | 55.1 |

Net Proceeds of Mines ($000)

| | Fiscal Year 1985-1986 | 1986-1987 | 1987-1988 | 1988-1989 | 1989-1990 | | |
|---|---|---|---|---|---|---|---|
| Eureka County | | | 100,000 | 130,000 | 220,000 | 120.0 | 48.3 |
| Elko County | | | 41,000 | 41,000 | 92,000 | 124.4 | 49.8 |

Source: Nevada Department of Taxation, Local Government Division.

TABLE E-11

ELKO COUNTY REVENUES AND EXPENDITURES ANALYSIS
1985–1986 TO 1989–1990
($000's)

| | 1985–1986 Actual | 1986–1987 Actual | 1987–1988 Actual | 1988–1989 Estimated | 1989–1990 Budget | 1989–1990 Percentage | Average Annual Percent (Decrease) |
|---|---|---|---|---|---|---|---|
| Revenues | | | | | | | |
| Taxes: Property | 936 | 1,472 | 2,616 | 2,242 | 3,553 | 26.6 | 39.6 |
| Other | 529 | 404 | 13 | 1,064 | 1,449 | 10.9 | 28.6 |
| Licenses, Fees, Permits | 448 | 487 | 572 | 587 | 549 | 4.0 | 5.2 |
| Intergovernmental | 3,752 | 4,200 | 4,640 | 5,258 | 5,678 | 42.6 | 10.9 |
| Charges for Services | 541 | 525 | 919 | 948 | 837 | 6.3 | 11.5 |
| Fines and Forfeits | 948 | 601 | 606 | 742 | 651 | 4.9 | (9.0) |
| Miscellaneous | 386 | 932 | 951 | 644 | 621 | 4.7 | 12.6 |
| TOTAL | 7,540 | 8,623 | 10,317 | 11,483 | 13,339 | 100.0 | 15.3 |
| Expenditures | | | | | | | |
| General Government | 2,472 | 2,273 | 2,447 | 2,801 | 5,821 | 30.4 | 23.9 |
| Judicial | 552 | 582 | 648 | 930 | 1,202 | 6.3 | 21.5 |
| Public Safety | 2,453 | 5,418 | 2,477 | 2,187 | 2,970 | 15.5 | 4.9 |
| Public Works | 1,208 | 1,327 | 1,180 | 1,550 | 5,922 | 30.9 | 48.8 |
| Health | 84 | 84 | 85 | 90 | 90 | 0.5 | 1.7 |
| Welfare | 389 | 419 | 462 | 660 | 1,175 | 6.1 | 31.8 |
| Culture and Rec. | 648 | 1,223 | 924 | 810 | 1,034 | 5.4 | 12.4 |
| Community Support | 135 | 133 | 125 | 140 | 131 | .7 | ( .8) |
| Contingencies | | | | | 291 | 1.5 | |
| Airports | 416 | 806 | 168 | 785 | 0 | | 23.6 |
| Debt Service: Principal Retirement | | 185 | 190 | 200 | 215 | 1.0 | — |
| Interest Cost | | 475 | 345 | 333 | 320 | 1.7 | — |
| TOTAL EXPENDITURES | 8,357 | 12,918 | 9,051 | 10,484 | 19,170 | 100.0 | 23.1 |

Source: Nevada Department of Taxation.

TABLE E-12

CITY OF ELKO REVENUE AND EXPENDITURE ANALYSIS
1985-1986 TO 1989-1990

| | 1985-1986 Actual | 1986-1987 Actual | 1987-1988 Actual | 1988-1989 Estimated | 1989-1990 Budgeted | 1989-1990 Percentage | Average Annual % Increase (Decrease) |
|---|---|---|---|---|---|---|---|
| Revenues | | | | | | | |
| Property Taxes | $ 259,089 | $ 275,943 | $ 368,683 | $ 401,541 | $ 482,889 | 6.5 | 16.8 |
| Other Taxes | 375,832 | 460,541 | 584,245 | 642,000 | 805,000 | 10.8 | 21.1 |
| Licenses and Permits | 446,244 | 472,580 | 555,503 | 638,650 | 661,650 | 8.9 | 10.3 |
| Intergovernmental Resources | 2,467,576 | 2,472,549 | 3,013,456 | 3,294,839 | 3,956,174 | 53.2 | 12.5 |
| Charges for Services | 218,855 | 242,916 | 338,203 | 389,000 | 488,000 | 6.6 | 22.2 |
| Fines and Forfeits | 48,492 | 63,154 | 65,723 | 70,000 | 80,000 | 1.0 | 13.3 |
| Miscellaneous | 959,195 | 969,360 | 1,470,737 | 1,487,548 | 963,780 | 13.0 | 11.9 |
| TOTAL REVENUES | $4,774,283 | $4,957,043 | $6,396,550 | $6,923,578 | $7,437,493 | 100.0 | 11.7 |
| Expenditures-Expenses | | | | | | | |
| General Government | $ 454,175 | $ 380,702 | $ 386,195 | $ 429,537 | $ 498,059 | 3.9 | 2.3 |
| Judicial | 49,674 | 51,328 | 51,878 | 60,000 | 65,450 | .5 | 7.1 |
| Public Safety | 1,574,443 | 1,759,849 | 1,920,888 | 2,257,333 | 2,791,797 | 21.7 | 15.4 |
| Public Works | 984,211 | 967,228 | 941,663 | 1,567,648 | 5,698,223 | 44.4 | 55.1 |
| Sanitation | 112,310 | 64,176 | 155,309 | 294,691 | 256,750 | 2.0 | 27.8 |
| Health | | 21,546 | 27,990 | 36,250 | 43,100 | 0.3 | |
| Welfare | 10,500 | 0 | 7,500 | 12,500 | 12,500 | 0.1 | 4.5 |
| Culture and Recreation | 587,654 | 615,211 | 743,303 | 772,500 | 1,214,150 | 9.5 | 19.9 |
| Community Support | 100,000 | 7,500 | 0 | 100,000 | 52,155 | .4 | — |
| Intergovernmental Expenditures | 282,689 | 287,053 | 306,633 | 300,000 | 270,000 | 2.1 | (1.1) |
| Contingencies | | | | | 160,000 | 1.2 | — |
| Airports | 66,106 | 64,836 | 101,984 | 154,650 | 202,400 | 1.6 | 32.3 |
| Other Enterprises | 413,436 | 505,562 | 1,223,582 | 606,000 | 1,388,000 | 10.8 | 35.4 |
| Debt Service: Principal Retirement | | 350,000 | 369,000 | 19,000 | 163,952 | 1.3 | — |
| Interest Cost | 50,674 | 32,913 | 33,445 | 13,965 | 25,416 | .2 | — |
| TOTAL EXPENDITURES-EXPENSES | $4,685,872 | $5,107,904 | $6,269,370 | $6,624,074 | $12,841,952 | 100.0 | 28.7 |

TABLE E-13

TOWN OF CARLIN REVENUE AND EXPENDITURE ANALYSIS
1985–1986 TO 1989–1990

| | 1985–1986 Actual | 1986–1987 Actual | 1987–1988 Actual | 1988–1989 Estimated | 1989–1990 Budgeted | 1989–1990 Percentage | Average Annual % Increase (Decrease) |
|---|---|---|---|---|---|---|---|
| Revenues | | | | | | | |
| Property Taxes | $ 49,680 | $ 52,350 | $ 60,844 | $ 45,700 | $ 46,600 | 6.9 | (1.6) |
| Other Taxes | 13,209 | | | | | | |
| Licenses and Permits | 21,036 | 30,842 | 77,871 | 83,900 | 49,400 | 7.3 | 23.8 |
| Intergovernmental Resources | 241,607 | 289,311 | 331,017 | 385,800 | 494,800 | 72.8 | 19.6 |
| Charges for Services | 4,866 | 5,553 | 11,165 | 9,800 | 9,800 | 1.4 | 19.1 |
| Fines and Forfeits | 8,789 | 5,853 | 13,670 | 16,000 | 16,200 | 2.4 | 16.5 |
| Miscellaneous | 31,094 | 58,372 | 36,553 | 73,368 | 63,000 | 9.2 | 19.3 |
| TOTAL REVENUES | $370,281 | $442,281 | $531,120 | $614,568 | $679,800 | 100.0 | 16.4 |
| Expenditures–Expenses | | | | | | | |
| General Government | $111,065 | $101,731 | $125,646 | $172,400 | $223,500 | 24.2 | 19.1 |
| Public Safety | 175,525 | 235,778 | 234,252 | 255,500 | 421,500 | 45.7 | 24.5 |
| Public Works | 53,199 | 110,106 | 57,845 | 95,000 | 184,307 | 20.0 | 36.4 |
| Health & Sanitation | 5,776 | 3,650 | 5,936 | 4,050 | 7,550 | .8 | 6.9 |
| Culture and Recreation | 21,717 | 30,365 | 22,390 | 34,500 | 59,350 | 6.5 | 28.6 |
| Contingencies | | | | | 26,000 | 2.8 | — |
| TOTAL EXPENDITURES–EXPENSES | $367,282 | $481,630 | $446,069 | $561,450 | $922,207 | 100.0 | 25.8 |

TABLE E-14

EUREKA COUNTY REVENUE AND EXPENDITURE ANALYSIS
1985-1986 TO 1989-1990

| | 1985-1986 Actual | 1986-1987 Actual | 1987-1988 Actual | 1988-1989 Estimated | 1989-1990 Budgeted | 1989-1990 Percentage | Average Annual % Increase (Decrease) |
|---|---|---|---|---|---|---|---|
| Revenues | | | | | | | |
| Property Taxes | 591,816 | 1,067,412 | 1,267,111 | 2,059,013 | 2,913,856 | 48.4 | 49.0 |
| Taxes | 20,832 | 22,793 | 23,764 | 73,713 | 113,294 | 1.9 | 52.7 |
| Licenses and Permits | 4,962 | 4,110 | 5,766 | 5,560 | 5,570 | .1 | 2.9 |
| Intergovernmental Resources | 966,852 | 1,215,691 | 1,474,478 | 1,437,386 | 2,713,622 | 45.1 | 29.4 |
| Charges for Services | 120,516 | 177,021 | 269,547 | 230,400 | 161,500 | 2.6 | 7.6 |
| Fines and Forfeits | 19,393 | 22,345 | 18,480 | 17,000 | 9,000 | .2 | (17.5) |
| Miscellaneous | 96,427 | 114,392 | 136,690 | 116,764 | 105,200 | 1.7 | 2.2 |
| TOTAL REVENUES | 1,820,798 | 2,623,764 | 3,195,836 | 3,939,841 | 6,022,042 | 100.0 | 34.9 |
| Expenditures-Expenses | | | | | | | |
| General Government | 465,938 | 583,038 | 833,788 | 2,246,600 | 1,715,821 | 33.8 | 38.5 |
| Public Safety | 318,128 | 331,544 | 382,481 | 468,500 | 673,713 | 13.3 | 20.6 |
| Judicial | 171,293 | 174,007 | 191,127 | 259,650 | 339,000 | 6.7 | 18.6 |
| Highways and Streets | 675,573 | 491,531 | 657,548 | 1,015,000 | 1,762,000 | 34.7 | 27.1 |
| Health & Sanitation | 116,750 | 160,747 | 135,863 | 149,000 | 252,500 | 5.0 | 21.3 |
| Welfare | 2,996 | 396 | 126,708 | 137,700 | 205,300 | 4.0 | 20.9 |
| Culture and Recreation | 96,079 | 145,644 | — | — | 60,000 | 1.2 | — |
| Contingencies/Other | 9,185 | — | | | | | |
| TOTAL EXPENDITURES-EXPENSES | 1,855,942 | 1,886,907 | 2,327,812 | 4,295,450 | 5,074,334 | 100.0 | 28.6 |

TABLE E-15

PROJECTED EMPLOYMENT, POPULATION, HOUSING, AND SCHOOL AGE CHILDREN PROJECTIONS
BETZE PROJECT

Peak Numbers - Construction Phase (1991)

| | Peak Annual Employment[1] | Local Direct[2] | Non-Local Direct | Total Direct | Local Indirect | Non-Local Indirect | Total Indirect[3] | Total New Employment |
|---|---|---|---|---|---|---|---|---|
| New Employment | 750 | 225 | 525 | 750 | 73 | 32 | 105 | 855 |

| | Non-Local Direct | Non-Local Indirect | New Households |
|---|---|---|---|
| New Households[4] | | | |
| New Workers | 525 | 32 | |
| Single[5] | 473 | 13 | 243 |
| Married (1 Worker) | 51 | 13 | 64 |
| Married (2 Workers)[6] | 1 | 3 | 4 |
| Total New Households | 288 | 22 | 311 |

| | Elko | Carlin | Other |
|---|---|---|---|
| New Household Allocation[7] | | | |
| 2 Single Workers/Household | 248 | 47 | 16 |
| 1 Single Worker/Household | 443 | 83 | 28 |
| New Population[8] | | | |
| Single Household | 388 | 73 | 24 |
| Married Household | 191 | 35 | 12 |
| Total | 579 | 108 | 36 |
| New School Children[9] | | | |
| Secondary | 35 | 9 | |
| Primary | 139 | 34 | |
| Total | 174 | 43 | |
| Housing Preference[10] | | | |
| Single-Family | 12 | 5 | 2 |
| Multi-Family | 37 | 0 | 0 |
| Mobile Home | 25 | 9 | 3 |
| Other (RV or Motel) | 174 | 33 | 11 |
| Total | 288 | 47 | 16 |

TABLE E-15 (CONTINUED)

Notes:

[1] The average construction work force is 370 over the 10-month construction period. The peak work force of 750 will occur starting in mid-May 1991.

[2] The construction work force is assumed to be 30 percent local, 70 percent non-local (Hertzog, Lattin 1990). Local workers will commute to and from their place of residence to work on a daily basis (Hertzog, TIC 1990).

[3] Indirect construction employment is calculated using a construction employment multiplier of 1.2 based on 1978 employment location quotients and basic/non-basic employment. It is assumed that 70 percent of the indirect labor force are second persons in the direct labor households or current residents of the Elko area (ENSR 1990).

[4] The construction work force is composed of 90 percent single workers or married without family, and 10 percent married workers with family (Hertzog, TIC 1990).

[5] It is assumed that single workers will double up due to the lack of rental housing in the study area.

[6] Both husband and wife of 1 percent of the married workforce are assumed to work at the mine during construction.

[7] Household allocation—shows 2 scenarios: the first scenario with two single workers per household plus married households; the second scenario with one single worker per household plus married households which would represent a worst-case housing situation. See Table S-18 and Section 4.12.2 for a discussion on housing demand.

[8] Population estimates are based on 2 persons per household for single households with direct workers, 2 persons per household for single households with indirect workers, and 3.5 persons per household for married households (ENSR 1990; Hertzog 1990).

[9] School-age children are estimated at 1.0 per married household. Eighty percent of school-age children are primary students, 20 percent secondary students (ENSR 1990).

[10] Housing preferences are shown based on the following percentage distribution.

| | Elko (80%) | Carlin (15%) | Other (5%) |
|---|---|---|---|
| Single Family (SF) | 5 | 10 | 10 |
| Multi-Family (MF) | 15 | 0 | 0 |
| Mobile Home (MH) | 10 | 20 | 20 |
| Other (RV site or Motel) | 70 | 70 | 70 |

[11] Totals on tables may not add up due to rounding errors. All projections on the tables are estimates and do not represent actual figures. These estimates should be used for planning purposes only.

TABLE E-16

PROJECTED EMPLOYMENT, POPULATION, HOUSING, AND SCHOOL AGE CHILDREN PROJECTIONS
BETZE PROJECT

Average Numbers - Construction Phase (1991)

| | Average Annual Employment[1] | Local[2] Direct | Non-Local Direct | Total Direct | Local Indirect | Non-Local Indirect | Total[3] Indirect | Total New Employment |
|---|---|---|---|---|---|---|---|---|
| New Employment | 370 | 166 | 204 | 370 | 29 | 12 | 41 | 411 |

| | Non-Local Direct | Non-Local Indirect | New Households |
|---|---|---|---|
| New Households[4] | | | |
| New Workers | 204 | 12 | |
| Single[5] | 183 | 5 | 94 |
| Married (1 Worker) | 20 | 5 | 25 |
| Married (2 Workers)[6] | 0 | 1 | 1 |
| Total New Households | 111 | 9 | 120 |

| | Elko | Carlin | Other |
|---|---|---|---|
| New Household Allocation[7] | | | |
| 2 Single Workers/Household | 96 | 18 | 6 |
| 1 Single Worker/Household | 172 | 32 | 11 |
| New Population[8] | | | |
| Single Household | 150 | 28 | 9 |
| Married Household | 74 | 14 | 5 |
| Total | 224 | 42 | 14 |
| New School Children[9] | | | |
| Secondary | 4 | 1 | |
| Primary | 17 | 4 | |
| Total | 21 | 5 | |
| Housing Preference[10] | | | |
| Single-Family | 10 | 2 | 1 |
| Multi-Family | 19 | 0 | 0 |
| Mobile Home | 19 | 4 | 1 |
| Other (RV or Motel) | 48 | 12 | 4 |
| Total | 96 | 18 | 6 |

TABLE E-16 (CONTINUED)

Notes:

[1] The average construction work force is 370 over the 10-month construction period. The peak work force of 750 will occur starting in July 1991.

[2] The construction work force is assumed to be 45 percent local, 55 percent non-local (Hertzog, Lattin 1990). Local workers will commute to and from their place of residence to work on a daily basis (Hertzog, TIC 1990).

[3] Indirect construction employment is calculated using a construction employment multiplier of 1.2 based on 1978 employment location quotients and basic/non-basic employment. It is assumed that 70 percent of the indirect labor force are second persons in the direct labor households or current residents of the Elko area (ENSR 1990).

[4] The construction work force is composed of 90 percent single workers or married without family, and 10 percent married workers with family (Hertzog, TIC 1990).

[5] It is assumed that single workers will double up due to the lack of rental housing in the study area.

[6] Both husband and wife of 1 percent of the married workforce are assumed to work at the mine during construction.

[7] Household allocation shows 2 scenarios: the first represents two single workers per household plus married households; the second represents one single worker per household plus married households, a worst-case housing situation. See Table S-18 and Section 4.12.2 for a discussion on housing demand.

[8] Population estimates are based on 2 persons per household for single households with direct workers, 2 persons per household for single households with indirect workers, and 3.5 persons per household for married households (ENSR 1990; Hertzog 1990).

[9] School-age children are estimated at 1.0 per married household. Eighty percent of school-age children are primary students, 20 percent secondary students (ENSR 1990).

[10] Housing preferences are shown based on the following percentage distribution.

| | Elko (80%) | Carlin (15%) | Other (5%) |
|---|---|---|---|
| Single Family (SF) | 10 | 10 | 10 |
| Multi-Family (MF) | 20 | 0 | 0 |
| Mobile Home (MH) | 20 | 20 | 20 |
| Other (RV site or Motel) | 50 | 70 | 70 |

[11] Totals on tables may not add up due to rounding errors. All projections on the tables are estimates and do not represent actual figures. These estimates should be used for planning purposes only.

TABLE E-17

PROJECTED EMPLOYMENT, POPULATION, HOUSING, AND SCHOOL AGE CHILDREN PROJECTIONS
BETZE PROJECT

Operations Phase (1992)

| | Average Annual Employment[1] | Local Direct[2] | Non-Local Direct | Total Direct | Local Indirect | Non-Local Indirect | Total Indirect[3] | Total New Employment |
|---|---|---|---|---|---|---|---|---|
| New Employment | 77 | 4 | 73 | 77 | 11 | 4 | 15 | 92 |

| | Non-Local Direct | Non-Local Indirect | New Households |
|---|---|---|---|
| New Households | | | |
| New Workers | 73 | 4 | |
| Single | 26 | 1 | 27 |
| Married (1 Worker) | 47 | 1 | 48 |
| Married (2 Workers)[4] | 0 | 1 | 1 |
| Total New Households | 73 | 3 | 76 |

| | Elko | Carlin | Other |
|---|---|---|---|
| New Household Allocation[5] | 65 | 9 | 2 |
| New Population[6] | | | |
| Single Household | 23 | 3 | 1 |
| Married Household | 168 | 24 | 6 |
| Total | 191 | 27 | 7 |
| New School Children[7] | | | |
| Secondary | 13 | 2 | |
| Primary | 53 | 9 | |
| Total | 66 | 11 | |
| Housing Preference[8] | | | |
| Single-Family | 25 | 4 | 1 |
| Multi-Family | 17 | 2 | 1 |
| Mobile Home | 14 | 2 | 0 |
| Other (RV or Motel) | 9 | 1 | 0 |
| Total | 65 | 9 | 2 |

TABLE E-17 (CONTINUED)

Notes:

[1] The new operations work force is assumed to be 5 percent local and 95 percent inmigrants.

[2] Indirect operations employment is calculated using an operations employment multiplier of 1.2 (PIC). It is assumed that 70 percent of the indirect labor force are second persons in the direct labor households or current residents of the Elko area (ENSR 1990).

[3] The operations workforce is composed of 35 percent single workers and 65 percent married workers (Elko County Mining Survey 1989). The indirect workforce is composed of 40 percent single workers and 60 percent married with family workers.

[4] Both husband and wife of 1 percent of the married workforce are assumed to work at the mine.

[5] During operations, it is assumed that 100 percent of the new employees would live in the Elko Area.

[6] Population estimates are based on 1 person per household for single households and 4.0 persons per household for married households (Elko County Mining Survey 1989).

[7] School-age children are estimated at 1.0 per household (Elko County Mining Survey 1989). Eighty percent of school-age children are primary students, 20 percent secondary students.

[8] Housing preferences shown are based on the following percentage distribution (Elko County Mining Survey 1989):

| | Elko (85%) | Carlin (12%) | Other (3%) |
|---|---|---|---|
| Single Family (SF) | 38 | 38 | 38 |
| Multi-Family (MF) | 27 | 27 | 27 |
| Mobile Home (MH) | 21 | 21 | 21 |
| Other (RV site or Motel) | 14 | 14 | 14 |

[9] Totals on tables may not add up due to rounding errors. All projections on the tables are estimates and do not represent actual figures. These estimates should be used for planning purposes only.

TABLE E-18

MANPOWER ESTIMATES-OPERATIONS PHASE[1]

| Year | Mine | Process | Admin. | Total |
|---|---|---|---|---|
| 1990 | 719 | 254 | 120 | 1,093 |
| 1991 | 719 | 254 | 120 | 1,093 |
| 1992 | 739 | 311 | 120 | 1,170 |
| 1993 | 739 | 311 | 120 | 1,170 |
| 1994 | 739 | 311 | 110 | 1,160 |
| 1995 | 739 | 311 | 100 | 1,150 |
| 1996 | 739 | 311 | 100 | 1,150 |
| 1997 | 739 | 291 | 100 | 1,130 |
| 1998 | 739 | 291 | 100 | 1,130 |
| 1999 | 739 | 291 | 100 | 1,130 |
| 2000 | 739 | 291 | 100 | 1,130 |
| 2001 | 40 | 291 | 76 | 407 |
| 2002 | 40 | 291 | 76 | 407 |
| 2003 | 40 | 291 | 76 | 407 |
| 2004 | 40 | 291 | 76 | 407 |
| 2005 | 40 | 291 | 76 | 407 |
| 2006 | 40 | 291 | 44 | 375 |
| 2007 | 40 | 291 | 44 | 375 |
| 2008 | 40 | 291 | 44 | 375 |
| 2009 | 40 | 291 | 44 | 375 |
| 2010 | 40 | 291 | 44 | 375 |

[1]Approximately 40 to 60 college students will be employed annually from May until September under Barrick's student hire program. These temporary employees have not been included in the yearly total.

TABLE E-19

EXISTING HOUSING SUPPLY AND ESTIMATED PROJECT-RELATED IMPACTS

| | Existing Rental Units Vacant Supply | | | Project Related Demand | Supply Surplus (Deficit) |
|---|---|---|---|---|---|
| | RV Spaces | Motels | New Housing | | |
| Construction Phase | | | | | |
| Elko/Carlin | | | | | |
| Peak | 70[1]<br>25 monthly[7]<br>20 weekly[7]<br>19[9] | 407[2] | 30 apts[3]<br>18 units[10]<br>300[11] | 311[4]<br>554[8] | 278[5]/(129)[6]<br>35[5]/(372)[6] |
| Average | 70[1]<br>25 monthly[7]<br>20 weekly[7]<br>19[9] | 407[2] | 30[3]<br>18[10]<br>300[11] | 120[4]<br>214[8] | 469[5]/(62)[6]<br>375[5]/(32)[6] |

[1] East Elko RV.

[2] Average occupancy 75 percent (Koenig, Elko Chamber of Commerce). Total units in Carlin and Elko equal 1,628.

[3] Barrick Units.

[4] Assumes single workers double up.

[5] Including motel accommodations.

[6] Excluding motel accommodations.

[7] KOA-Rydon.

[8] Assumes single workers live independently.

[9] Valley View RV.

[10] Elko Daily Freepress (September 1990): single family (4), apartments (8), mobile homes (6).

[11] The existing Carlin mancamp, if available, could accommodate 300 additional workers. The mancamp will not be included as potential housing at this time.

TABLE E-20

ESTIMATED INCREMENTAL PROJECT TAX REVENUES - BETZE PROJECT
(000$)

| | 1990 | | 1991 | | 1992 | | 1993 | |
|---|---|---|---|---|---|---|---|---|
| | Incremental Tax Base | Taxes Generated | Incremental Tax Base | Taxes Generated | Incremental Tax Base | Taxes Generated | Incremental Tax Base | Taxes Generated |
| Ad Valorem - Eureka County | | | | | | | | |
| Assessed Value | | | | | | | | |
| Buildings, Equip., Labor[1] | | | | | | | | |
| 1st year | $ 48,284 | $ 0 | $ 43,456 | $ 748 | $ 43,456 | $ 674 | $ 43,456 | $ 674 |
| 2nd year | | | 29,408 | 0 | 22,692 | 456 | 22,692 | 351 |
| 3rd year | | | | | 36,854 | 0 | 33,123 | 571 |
| Subtotal Ad Valorem Tax Receipts | | | | 748 | | 1,130 | | 1,596 |
| Net Proceeds[2] | NA | 0 | NA | 0 | 147,098 | 2,280 | 123,157 | 1,909 |
| Total Estimated Ad Valorem & Net Proceeds Taxes (Eureka County) | | | | 748 | | 3,410 | | 3,505 |

[1]Capital investment for the 3 years of expansion activities are estimated at: 1990-$137,945,000; 1991-$84,022,000; 1993-$105,298,000. Labor is taxed as a part of capital cost during construction, but is not part of real property tax for subsequent years. Labor cost is estimated to equal 10 percent of total capital investment in 1990 and 1992. In 1991, labor cost is estimated to equal 23 percent of total capital investment (average labor force 1991 = 270 workers x $41 average labor cost/hour x 1,733 hours/year = $19,188,000; average labor force 1992 = 125 workers x $41 average labor cost/hour x 2,080 hours = $10,660,000).

[2]Net proceeds were estimated using average production of 919,360 ozs in 1992 and 769,730 ozs in 1993. The price of gold was estimated at $360 per oz (July 1990). The cost was estimated at $200 per oz. (Ingersoll, Goodworth, Barrick 1990). The 1989-1990 Eureka County tax rate of $1.55/$100 assessed value was applied to these production values.

TABLE E-21

ESTIMATED CUMULATIVE GROWTH PROJECTIONS

EMPLOYMENT, POPULATION, HOUSEHOLDS, AND SCHOOL AGE CHILDREN

ELKO COUNTY

| | 1990 | 1993 | 2000 |
|---|---|---|---|
| Baseline | | | |
| Employment[1] | 14,880 | 16,838 | 20,429 |
| Population[2] | 34,443 | 37,418 | 45,398 |
| Households[3] | 11,481 | 12,473 | 15,133 |
| School Age Children[4] | 7,118 | 7,733 | 9,382 |
| Barrick Goldstrike[5] | | | |
| Employment | NA | 92 | 92 |
| Population | NA | 225 | 225 |
| Households | NA | 76 | 76 |
| School Age Children | NA | 77 | 77 |
| Thousand Springs Power Plant[6] | | | |
| Employment | NA | 805 | 1,100 |
| Population[7] | NA | 139[7] | 356[7] |
| Households | NA | 62 | 143 |
| School Age Children | NA | 35 | 88 |
| Total | | | |
| Employment | 14,880 | 17,735 | 21,621 |
| Population | 34,443 | 37,782 | 45,979 |
| Households | 11,481 | 12,611 | 15,352 |
| School Age Children | 7,118 | 7,845 | 9,547 |

[1] June 1989 estimate. Nevada Employment Security Department. Projections based on 45 percent labor force participation rate. 1989 population and labor force estimates for Elko County.

[2] Northern Nevada Community College. Projections based on 2.8 percent growth rate.

[3] Based on 3 persons per household. Projections based on 1989 total Elko County population estimate (NENDA) divided by total number housing units in County (Building Department).

[4] Elko County School District. Projections based on 1.6 school age children per household (total households ÷ school age children).

[5] ENSR estimates.

TABLE E-21 (CONTINUED)

FOOTNOTES (Continued)

[6]Draft Environmental Impact Statement Thousand Springs Power Plant Northeastern Nevada, BLM, Socioeconomic Technical Report. Proposed Action.

[7]Population estimates are for the City of Elko only.