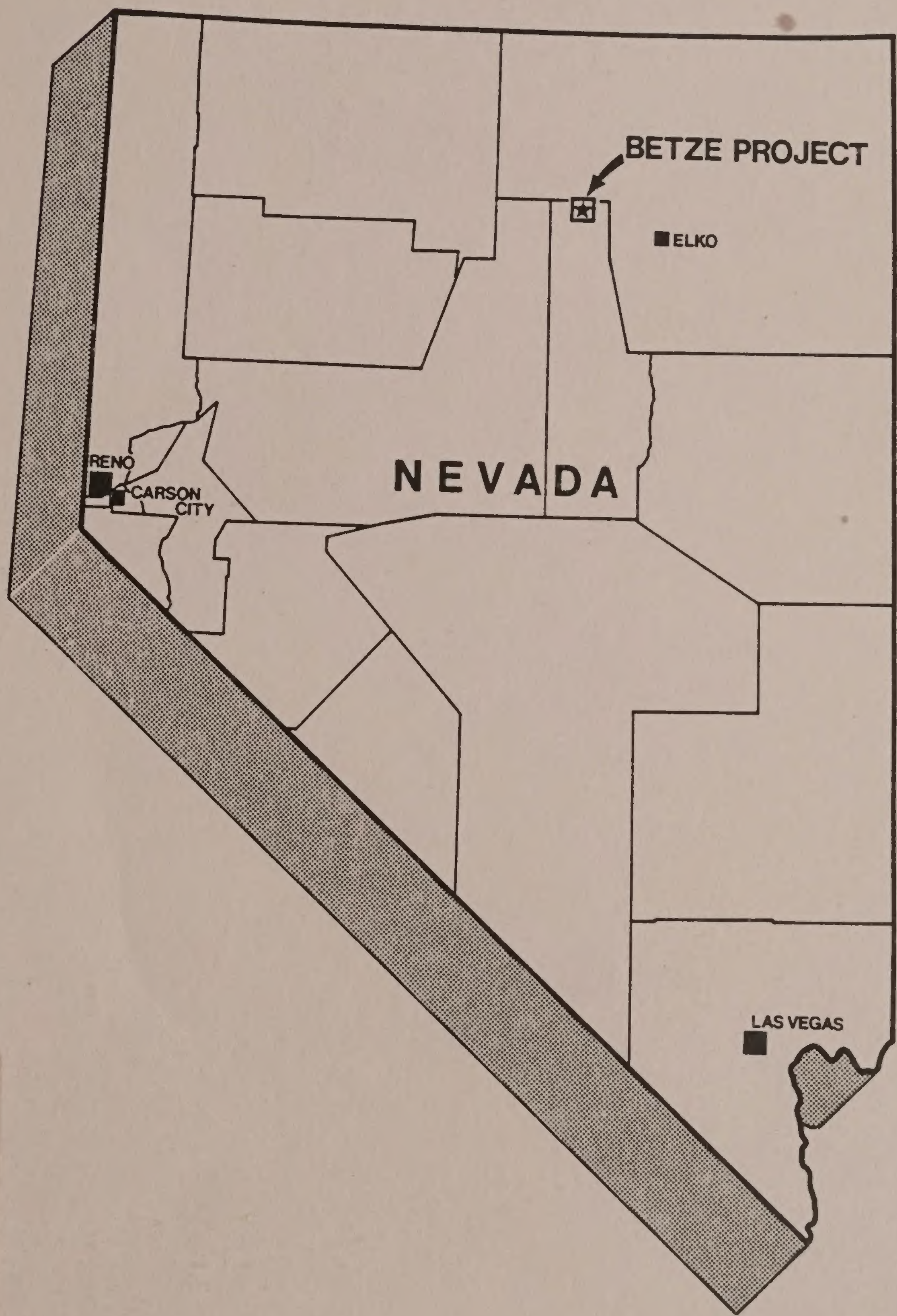
United States Department of the Interior
Bureau of Land Management

Elko District Office

June 1991

Final
Environmental Impact Statement
Betze Project

Barrick Goldstrike Mines Inc.



BUREAU OF LAND MANAGEMENT

ELKO DISTRICT OFFICE

FINAL
ENVIRONMENTAL IMPACT STATEMENT
BETZE PROJECT

Final

Environmental Impact Statement

Betze Project

Prepared by

U.S. Department of the Interior
Bureau of Land Management
Elko District Office
Elko, Nevada

June 1991

Nevada State Director

6/10/91

Date

FINAL

ENVIRONMENTAL IMPACT STATEMENT
BETZE PROJECT

Lead Agency: U.S. Department of the Interior
Bureau of Land Management
Elko District Office
Elko, Nevada

Project Location: Elko and Eureka Counties, Nevada

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Date Draft EIS was made available to the Environmental Protection Agency (EPA) and the public: January 11, 1991

Date Final EIS was made available to the EPA and the public: June 14, 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 impoundments; water handling and disposal; reclamation; and the No Action alternative.

PREFACE

The Final EIS for the proposed Betze Project has been prepared in an abbreviated format under the Council on Environmental Quality regulations (40 CFR 1503.4) for implementing the National Environmental Policy Act of 1969. Therefore, this document must be used in conjunction with the Draft EIS that was released for public review on January 11, 1991. The Draft EIS and the three Technical Reports (Air Resources, Socioeconomic, and Water Resources) prepared in support of the Draft EIS are available for review at the Elko District Office of the Bureau of Land Management (BLM).

The Final EIS is organized in the same manner as the Draft EIS, i.e., the section and subsection numbers remain the same. The Final EIS contains additions or revisions to the Draft EIS. Sections indicated in *Italics* in the Table of Contents and the text have been revised and are included in the Final EIS; sections which have not changed are incorporated by reference to the Draft EIS.

The following is a summary of the principal additions or revisions to the Draft EIS which have been included in the Final EIS.

- The proposed reclamation plan in Section 2.2.5 has been expanded to include more detailed information in compliance with new BLM guidance regarding cyanide use, reclamation, and bonding, and new State of Nevada laws and regulations.

- The description of the BLM's preferred alternative for implementation of the Betze Project is described in Section 2.3.4 of the Final EIS, including the monitoring and mitigation measures incorporated into the BLM's Record of Decision.

- Section 4.0 of the EIS has been reprinted in its entirety. The principal changes occur in the discussion of mitigation measures and expanded hydrology discussions based on data obtained since publication of the Draft EIS. All mitigation measures which have become stipulations of the BLM's Record of Decision have been removed from the discussion of "potential" mitigation in Section 4.0 and have been included in the Agency Preferred Alternative in Section 2.3.4.

- Sections 5.4 and 5.5 of the Final EIS contain the agency and public comments on the Draft EIS received during the 60-day public review period. Comments received by letter and at the public meetings are included, in addition to the responses to those comments.

PREFACE

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- Sections 5.4 and 5.5 of the Final EIS contain the agency and public comments on the Draft EIS received during the 45-day public review period. Comments received by letter and at the public meetings were included, in addition to the responses to those comments.

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. ***Barrick submitted a revised Plan of Operations amendment in May 1991 to incorporate revisions to the initial plan that were developed since April 1989. The proposed action studied in the Draft and Final EIS is consistent with the revised Plan of Operations.*** Based on a review of the initial proposal, the BLM 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.

<u>Description of Proposed Action</u>

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 remaining ore would be hauled to the existing AA Block leach pads for processing***. 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, expanded 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

<u>Summary of Impacts</u>

Section 2.4 of the Draft 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 *annual average* rate of 29,300 gpm and the subsequent discharge of water at a projected *annual average* 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 evapotranspiration; 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 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 330 acres of riparian vegetation could be temporarily affected by the potential* *decrease in the flow of water from seeps, springs, creeks, and other riparian areas.* 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 exceedence 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.

Agency Preferred Alternative

The lead federal agency is required to identify its preferred alternative for the proposed project in the Draft or Final EIS. The BLM indicated in the Draft EIS that it would select the Agency Preferred Alternative in the Final EIS with the benefit of the comments received on the Draft EIS. The BLM's preferred alternative for the Betze Project is summarized below.

The following major components of the Proposed Action for the Betze Project comprise the Agency Preferred Alternative:

- *Betze Pit*
- *Extended South waste rock disposal area*
- *Expanded dewatering facilities*
- *North Block heap leach facility*
- *Mill facilities expansion*
- *North Block tailings impoundment*
- *Topsoil stockpiles*
- *Haul roads and pipeline corridors*

The Agency Preferred Alternative incorporates the alternative ore stockpile located on top of the existing South Block waste rock disposal area.

The Agency Preferred Alternative incorporates Barrick's proposed reclamation plan with a modification to the slope gradients of

disturbed areas. The overall slopes of reclaimed waste rock disposal areas will be varied between 3.0H:1V and 2.3H:1V. Final slopes will be determined based on the results of the reclamation test plot program.

The Agency Preferred Alternative incorporates the mitigation measures and monitoring requirements described in Section 2.3.4 of the Final EIS.

Sections or subsections indicated in *Italics* have been revised, and the revisions are presented in this Final EIS. With the exception of Section 4.0, which is included in its entirety, other sections have not been repeated in this document and are incorporated by reference to the Draft EIS.

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1.0 INTRODUCTION AND PURPOSE AND NEED

Section 1.0 of the Draft EIS is incorporated herein by reference.

2.0 PROPOSED ACTION AND ALTERNATIVES

Section 2.0 of the Draft EIS is incorporated herein by reference with the exception of Subsections 2.1.4 Existing Processing Operations (expanded), 2.1.8 Existing Environmental Monitoring Programs (new), 2.2.3 Proposed Processing Facilities (expanded), 2.2.5 Proposed Reclamation (expanded), 2.3.4 Agency Preferred Alternative (revised and expanded), and Section 2.4 Summary Comparison of Impacts (revised). The new or revised sections are presented on the following pages with the changes in *Italics*.

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 Heap Leaching Operations. 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.

Barrick has used polypropylene bird netting with grid spacing ranging from 3/4 by 1-1/4 inches to 2-1/2 by 2-3/4 inches to cover the solution ponds. At present, Barrick is purchasing netting with 1-5/8 by 1-5/8 inch grids which will be used in new construction and to replace existing netting. As shown on Figures 2-2 and 2-3 in the Draft EIS, Barrick's existing and proposed solution ponds are located near the adsorption-desorption refinery (ADR) facility (AA ponds) and near the leach pads and mill (expansion ponds). All ponds are 5 acres or less in size, are separately netted, and are fenced with fencing approved by NDOW. The netting on the AA ponds is supported by cables that are attached to a pipe that has been buried in a trench around the perimeter of the ponds. The edges of the netting are secured to the pond liner with sandbags. The netting on the expansion ponds is supported with floating pipe support systems. The edges of the netting are welded to the pond liner. Solution collection areas and ditches are also netted.

- <u>Adsorption</u>. 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.

- <u>Desorption (Carbon Stripping)</u>. 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.

- <u>Electrowinning and Refining</u>. 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.

- <u>Carbon Reactivation</u>. 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.

2.1.8 Existing Environmental Monitoring Programs

Under permits issued by the Nevada State Engineer, NDOW, and NDEP, Barrick monitors groundwater levels, groundwater and surface water quality, and certain process fluids on a regular basis. On a monthly basis, Barrick monitors the flow of and samples Rodeo, Brush, and Boulder Creeks. Results of samples collected at a point upstream and at a point downstream of the mine are reported to the NDEP on a quarterly basis. The quantity of water pumped by Barrick's dewatering program is reported to the State Engineer on a monthly basis. Barrick monitors the quality and temperature of the water at the point of discharge to the unnamed drainage and at the flume above the TS Ranch Reservoir dam. Barrick also monitors a number of observation ports at the leach pads and solution ponds on a weekly basis; samples from the observation ports are collected and analyzed if fluid is detected. Monitoring data for the observation ports are reported to the NDEP quarterly. Barrick monitors process fluids on a semi-annual basis and reports the results to the NDEP. Groundwater monitoring wells are sampled on a monthly basis, and the results are reported to the NDEP. As required by appropriations permits and the water management plan approved by the State Engineer, Barrick monitors the level of a number of additional groundwater monitoring wells on a quarterly basis to characterize the regional groundwater system; these results are also reported to the State Engineer.

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 ***based upon the Cyanide Policy are reflected in the Final EIS and Record of Decision (see Section 2.3.4 of the Final EIS).***

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*, as required by NDOW regulations and the BLM's Cyanide Policy. The fencing and netting of Barrick's existing solution ponds are described in Section 2.1.4.1.*

2.2.5 Proposed Reclamation Plan

BLM policy requires that Barrick have an approved reclamation surety that conforms to the requirements of 43 CFR 3809 and BLM Instruction Memorandum 90-582 (August 14, 1990) and NV-90-412 (August 22, 1990). The amount of the surety and the reclamation plan has been reviewed and approved jointly by the BLM and the NDEP, with the BLM as the lead agency. The surety will be for 100 percent of the projected reclamation costs. The reclamation plan is described below.

The long-term goals for reclamation of the Betze Project and Barrick's operations as a whole are to establish an environment that will support productive post-mining land uses for the Betze Project area that are consistent with the BLM's Elko Resource Management Plan (RMP). The proposed productive post-mining land uses include wildlife habitat, livestock grazing, open space, dispersed recreation, and mineral exploration and development. The proposed post-mining land uses are consistent with the RMP's objective of maintaining the public lands open for mineral development while mitigating conflicts with wildlife, wild horses, recreation, and wilderness resources.

Barrick's proposed reclamation plan is intended to return areas disturbed by mining to a stable configuration that will withstand erosion and prevent slump failure, and to establish diverse self-renewing plant communities that at least equal or exceed the value of plant communities which existed before Barrick's development. The revegetation goals will emphasize species diversity and plant mixes to create a mosaic pattern of plant community types within the project area. Plant selection will emphasize species (preferably native) which will maximize opportunities for wildlife habitat and livestock forage.

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

Specific reclamation procedures that will 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 will be determined by the BLM on a case-by-case basis.

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

Topsoil stockpiles will be located to minimize impacts from the operations and will be graded to slopes no steeper than 2.5H:1V to reduce erosion. The surfaces of the topsoil stockpiles will 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 will be constructed upgradient of the topsoil stockpiles where appropriate to protect the stockpiles from surface water flows. All stockpiles will be marked with appropriate signs.

2.2.5.2 Topsoiling and Surface Preparation. During final reclamation, all areas to be reclaimed will be covered with a layer of approximately 1 foot of topsoil obtained from the topsoil stockpiles. The topsoil will be applied and spread with construction equipment in a manner that will reduce compaction.

Seed bed preparation will include ripping along the contour to a minimum depth of eight inches to loosen compacted soils. Soils will be fertilized with 50 pounds per acre of elemental nitrogen fertilizer if not mulched, and 100 pounds per acre of elemental nitrogen if mulch is used. Forty pounds per acre of elemental phosphorous will be incorporated into all soils. In addition, soils will be analyzed prior to reclamation to identify the need for any further soil amendments. Following fertilization, the areas will then be disced to prepare the seedbed, incorporate the fertilizer, and to promote water infiltration. Contour furrowing, discing, pitting, or dozer basins will be used, singly or in combination, where appropriate, to minimize soil erosion and increase moisture retention.

2.2.5.3 Revegetation. The final seed mixtures and pattern or location of seeding will be determined by the BLM, based on reclamation success to date and the results of the revegetation study plots. At present, Barrick proposes to use the following seed mixture to revegetate reclaimed areas.

Species	*Pure Live Seed (Pounds Per Acre)*
Bluebunch wheatgrass	*4.0*
Basin wildrye	*4.0*
Western wheatgrass	*6.0*
Thickspike wheatgrass	*4.0*
Kochia postrata	*0.5*
Lewis flax	*1.0*
Four-wing saltbush	*1.0*
TOTAL	*20.5*

Because infiltration of snowmelt creates a peak in available moisture in spring, mostly cool-season species are included in the seed mix. Seeding will take place in the fall, before frost prevents proper seed placement, and within 1 week of seedbed preparation.

After seeding, steeper side slopes will be mulched with approximately 2 tons per acre of straw or grass hay; the mulch will be anchored by crimping. The mulch will provide protection from evaporation and soil crusting, and will aid in soil stabilization and natural inoculation with microorganisms.

Boundary fences (3 or 4 - strand barbed wire) will be erected around reclaimed areas and maintained until vegetation re-establishment has occurred to sustain livestock use on a seasonal basis. Fences will be removed only upon concurrence from the BLM.

2.2.5.4 Betze Pit and Other Open Pits. The Betze Pit will remain after mining is completed. Following the termination of dewatering operations, the Betze Pit will begin to fill with water. The water body in the Betze Pit ultimately will cover approximately 355 acres; the remaining areas of the pit and perimeter roads around the pit will comprise 335 acres. Barrick proposes to erect a fence around the entire 690-acre area to preclude access by livestock, wildlife, and the general public. Once the water level in the Betze Pit stabilizes, the BLM will be able to incorporate the Betze Pit water body into its RMP, taking into consideration the then-present management opportunities and public needs.

The final configuration of the proposed Betze Pit, which will wholly encompass the existing Post Pit and other smaller pits (e.g., Long Lac, Bazza, West Bazza), will be approximately 8,000 feet long, 4,500 feet wide, and 1,800 feet deep. Detailed operating information, along with mining experience, has been applied to optimize slope design for current mine development, and for intermediate and long range mine planning. Potential slope failure in the Betze Pit is not considered to be a significant hazard due to Barrick's use of conservative design parameters and sector-by-sector pit wall slope designs that closely address geologic conditions. However, the potential for pit wall instability will temporarily increase following the completion of *mining and the cessation of dewatering operations as the pore pressure on the pit walls increases. As the water level in the pit rises, pit wall stability will increase. Ultimately, the slopes of the open pit will return to natural angles of repose.*

The Betze Pit will begin filling with water following the completion of mining and the cessation of dewatering operations. Modeling of the groundwater system indicates that after 100 years the water level in the Betze Pit will return to within 45 feet of the pre-mining water level. Pit walls ranging from 200 to 400 feet in height will remain above the ultimate water level in the pit. The quality of the water will be monitored by Barrick as the pit begins to fill with water.

The Nevada Department of Minerals uses a rating system to assess dangerous conditions that may result from the abandonment of a mining operation (NAC 513.330 to 513.360). Applied to the Betze Pit, the rating system assigns one point for the location of the pit relative to an occupied structure or a public road and one point for the degree of danger condition. Under the Department of Minerals rating system, the Betze Pit is characterized as a "minimal hazard" (NAC 513.360.1). Nonetheless, Barrick proposes to erect a fence around the Betze Pit, to reclaim or construct berms across access roads to the Betze Pit, and to post signs warning the public of the potential hazards associated with the Betze Pit. Barrick projects that construction of the fence will begin in October 2000 and be completed in October 2001. Barrick will maintain these safety measures until 2040.

As noted above, the Post Pit and other smaller pits that have been mined by Barrick will be encompassed within the ultimate Betze Pit. Waste rock will be placed in the No. 9 and West No. 9 Pits during the recontouring of the South Block waste rock disposal area.

2.2.5.5 Waste Rock Disposal Areas. The waste rock disposal areas will cover approximately 1,632 acres on the South Block. Development of the waste rock disposal areas will create permanent landforms with heights of from 500 to 700 feet above the pre-mining topography. During reclamation, the waste rock disposal areas will be regraded, and then covered with topsoil and revegetated with a seed mixture that will produce vegetation compatible with the post-mining land use of wildlife habitat and livestock grazing.

During mining operations, the waste rock disposal areas will be constructed by dumping laterally in 100-foot vertical lifts. Each succeeding lift will be set back from the previous lift to leave a terrace at its base to control runoff and erosion. The working, or interbench, slope will be at a 1.3H:1V slope, which is at the angle of repose. During reclamation, the slope of each lift will be modified from the natural angle of repose to create an undulating slope from the top of the waste rock disposal area to the original ground surface. The slopes will be developed by cutting the top edges of the benches and pushing the cut material onto the bench below with bulldozers. The overall reclaimed slope will be approximately 2.5H:1V with interbench slopes of 2.3H:1V. The flat surfaces of the waste rock disposal areas will remain level.

The areas covered by the waste rock disposal areas are generally characterized by low sloping topography. No areas that contain structurally weak soils will be covered with waste rock. These characteristics are expected to provide stable foundation conditions. Locally, where the natural topography slopes at horizontal angles in excess of 25 degrees, the toe of the waste rock disposal area will be modified to prevent down slope advance of the waste rock disposal area.

The waste rock materials will be generally competent, with the exception of argillized materials, which will come largely from the major fault zones. This weaker material will not be a significant factor as it will be blended with the more competent waste rock materials. Blending will be achieved with implementation of the dumping plan described above. Analyses performed by Barrick on waste rock models demonstrate that a 2.5H:1V slope composed of blended waste materials will result in a stable overall slope. Some consolidation of materials will be expected during placement of individual lifts, but the displacement rates will be controllable as the dump expands, and will not contribute to any overall instability. Recontouring the slopes to an overall 2.5H:1V slope will create a stable landform with a low potential for slope failure.

After completion of the regrading work, approximately 1 foot of topsoil will be spread over the surface of the waste rock disposal areas. Topsoil will be placed using conventional earthmoving equipment to haul and to place the soil. Traffic on the surfaces on which topsoil has been placed will be kept at a minimum to avoid compaction of the soil. The reclamation program will be developed with the intent of recontouring and placing topsoil in the same year. After the topsoil has been placed, the seedbed will be prepared and the area will be revegetated with approved seed mixtures as described in Sections 2.2.5.2 and 2.2.5.3, respectively.

Barrick projects that reclamation of the east and south faces of the existing South Block waste rock disposal area will begin in May 1995 and will be completed in June 1999. Reclamation of the west and north faces and the top of the existing South Block waste rock disposal area is projected to begin in September 2000 and to be completed in June 2004. Barrick projects that reclamation of the proposed Extended South waste rock disposal area will begin in April 2001 and be completed in June 2005.

2.2.5.6 Heap Leach Facilities. Heap leach facilities, consisting of heap leach pads, ponds, and associated equipment, will be located on the AA Block and the North Block. Spent leach grade ore will remain on the pads and will result in permanent *landforms with heights of up to 200 feet above the pre-mining topography. Barrick proposes to reclaim the spent leach pads in two phases: cyanide stabilization and neutralization (decommissioning), and surface reclamation. The leaching facilities (e.g. carbon columns, pumps, pipes) will be removed, and both the facilities area and the ponds will be graded to blend into the surrounding terrain of the reclaimed surface.*

The AA Block and North Block heap leach pads will be decommissioned as follows. Initially, the pad will be drained for 4 months to allow natural attenuation of residual weak acid dissociable (WAD) cyanide. The draindown effluent will be treated with hydrogen peroxide or an alternative cyanicide to reduce the concentration of WAD cyanide to less than 25 mg/l. The draindown will be pumped to the AA Block tailings impoundment in the case of the AA Block heap leach pads, or to the North Block tailings impoundment in the case of the North Block heap leach pads.

After the initial 4-month draindown period, the AA Block and North Block heap leach pads will be rinsed by recycling solution to reduce the WAD cyanide concentration of the draindown. Once the concentration of the WAD cyanide in the draindown stabilizes, the circulating solution will be treated with hydrogen peroxide or an alternative cyanicide to reduce the WAD cyanide concentration of the draindown to less than 0.2 mg/l. Based on previous pad closure, the pH of the draindown is expected to be between 6 and 9 standard pH units.

Once the draindown standard is met, the area of each pad under rinse will be decreased as solution evaporates to reduce the final draindown volume. The draindown will be transferred to the AA Block or North Block tailings impoundments for ultimate disposal. The AA Block and the North Block tailings impoundments have sufficient capacity to contain draindown from the AA Block and North Block heap leach pads, respectively. The total decommissioning period for each of the spent heap leach pads is expected to be approximately 2 to 2.5 years.

After approval to close the heap leach pads is obtained from the NDEP, Barrick will regrade the side slopes to create an undulating slope from the tops of the pads to the original ground surface. During operations, ore will be stacked on the heap leach pads in 15 to 60-foot lifts at an overall angle of 2.5H:1V. The side slopes will be regraded by pushing material down from the tops of the lifts using conventional earthmoving equipment. When the regrading work is complete, the overall slope angle will be 2.5H:1V with interlift slopes of 2.3H:1V.

The heap leach facilities (e.g., carbon columns, pumps, pipes) will be removed, and the areas affected by the facilities will be graded to blend into the surrounding terrain of the reclaimed surface. Remaining solutions in the solution collection ponds will be transferred to the tailings impoundment. The primary pond liners *will 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 will be breached or backfilled and graded to blend into the surrounding terrain of the reclaimed surface. After completion of the regrading work, no areas will remain where water could be impounded.*

After the regrading work is complete, topsoil will be placed over the spent ore and regraded surface areas and the seedbed will be prepared as described in Section 2.2.5.2, and the area will be revegetated as described in Section 2.2.5.3. Run-on will be controlled by leaving the diversion channels that have been constructed in place. The diversion channels are designed to carry flows from the 100-year, 24-hour storm event.

Barrick projects that decommissioning of the AA Block heap leach pads will begin in January 1996 and be completed in April 1998 and that surface reclamation will begin in April 1998 and be completed in June 2001. Barrick projects that decommissioning of the North Block heap leach pads will begin in January 2004 and be completed in April 2006 and that surface reclamation will begin in April 2006 and be completed in June 2009. However, if decommissioning requires additional time to rinse or drain the heap leach pads, the initiation of surface reclamation will be delayed.

2.2.5.7 <u>Mill and Ancillary Facilities</u>. At the completion of the processing of ore from the Betze deposit, Barrick will attempt to make further use of the existing processing capacity. If no source of additional ore is available, the mill and ancillary facilities will be dismantled for salvage.

Salvageable equipment will include, but not be limited to: crushers, conveyors, lime/cement silos, mills, autoclaves, pumps, tanks, electrical switchgear, office fixtures and furniture, and reagents. Equipment such as the crushers, mills, conveyors, autoclaves will be removed from the site as individual components and sold. Miscellaneous metal work such as floor grating, handrails, and piping will be dismantled and sold to scrap metal dealers. Excess reagents will be returned to the supplier. The non-salvageable items, such as HDPE liner and concrete, will be buried on-site in conformance with the applicable solid waste disposal requirements or removed from the project area in compliance with NDEP regulations. Equipment that was in contact with cyanide or other toxic chemicals will be decontaminated prior to sale or disposal.

Concrete foundations, basements, walls, and sumps will be flattened or covered with earth. The disturbed areas will be graded to blend with the natural topography. No visible structures will remain. The areas then will be covered with topsoil and the seed bed will be prepared as described in Section 2.2.5.2, and the area will be revegetated as described in Section 2.2.5.3. Barrick projects that *reclamation of the mill and ancillary facilities will begin in January 2011 and will be completed in June 2014.*

Barrick has received authorization from the NDEP to operate a Class III landfill which is located on the South Block waste rock disposal area. This landfill and subsequent landfills that will be constructed in the waste rock disposal area, will be closed, and reclaimed in conjunction with the reclamation of the waste rock disposal area. Prior to reclamation, waste rock will be used to fill in any remaining open areas within the landfill so that the landfill's surface will blend in with the surrounding area.

Landfills will be used during milling operations (2001-2010). These landfills will also be located in the existing South Block waste rock disposal area; reclamation of the landfills and access roads will be completed in the same manner as the previous landfills once salvage operations are completed.

2.2.5.8 <u>Tailings Impoundments</u>. Tailings from the existing milling operations are placed in the AA Block tailings impoundment; tailings generated by the proposed milling expansion will be delivered to either the AA Block or the North Block tailings impoundments. The AA Block tailings impoundment is 225 feet at its highest elevation, and will cover 209 acres. The embankment centerline is approximately 1.1 miles. The proposed North Block tailings impoundment will be 255 feet at its highest elevation, and will cover 476 acres. The embankment centerline will be approximately 2.7 miles.

Reclamation of the tailings impoundments will involve two phases: decommissioning and surface reclamation. During decommissioning, the tailings impoundments will drain and the solids will consolidate so that surface reclamation can begin. During the surface reclamation phase, the downstream faces of the two tailings embankments will be regraded and both the embankment faces and the surfaces of the consolidated tailings will be revegetated. Each phase is described more fully below.

From initiation of reclamation, until final surface closure of the impoundments, seepage will be collected in the seepage collection ponds and recycled from the seepage collection ponds back to the surface of the impoundments. While solution is exposed on the surface of the tailings and as it percolates through the tailings solids, the WAD cyanide levels will be degrading. As all fluid in the tailings system will be present initially at a WAD cyanide concentration of less than 50 mg/l, and usually less than 25 mg/l, the natural degradation processes will ensure that the WAD cyanide concentration of fluids in the impoundment is sufficiently low to pose little or no risk of toxicity to waterfowl. The natural degradation that will occur over the period of decommissioning and reclamation is expected to approach the final effluent target of 0.2 mg/l WAD cyanide (NAC 445.24356) with little or no additional treatment. If additional treatment is required, hydrogen peroxide *or an alternative cyanicide will be added periodically to the seepage collection pond before recycling the seepage solution onto the impoundment.*

After milling has ceased and the tailings impoundments have dried sufficiently to allow access of construction equipment, reclamation of the impoundment will begin. The AA Block tailings embankment will be regraded to an overall slope of between 2.0H:1V and 2.5H:1V as stated in the "Final Environmental Assessment for the Proposed Mill and Tailings Pond-Barrick Goldstrike Mine." Material will be dozed from the top of the embankment down, or from intermediate benches down, to create the final slope. During the regrading work, care will be taken to ensure that the design width of the embankment is maintained.

The North Block tailings embankment will be constructed in lifts with an overall downstream slope of 2.5H:1V, in order to facilitate reclamation of the facility. At the time of reclamation, the slopes will be reclaimed using conventional earthwork equipment. The 50-foot high lifts will be regraded to create an undulating slope from the top of the tailings embankment to the original ground surface. The overall reclaimed slope will be 2.5H:1V with interlift slopes of 2.3H:1V. The slopes will be developed by cutting the top edges of the lifts and pushing the cut material on to the lift below with bulldozers.

After each embankment is regraded, topsoil will be placed on the slopes, and the seed bed will be prepared as described in Section 2.2.5.2, and the area will be revegetated as described Section 2.2.5.3.

After the tailings have drained and the surfaces become stable, waste rock will be placed over portions of the impoundments where the finer fractions of the tailings solids collect, as needed to stabilize the surface to allow access of reclamation equipment. Topsoil then will be placed to a depth of approximately 1 foot and the seedbed will be prepared as described in Section 2.2.5.2, and the area will be revegetated as described in Section 2.2.5.3.

There is no diversion ditch for the AA Block impoundment. The impoundment is designed to store, without overtopping, the direct precipitation onto the impoundment and the run-on from the probable maximum precipitation (PMP) event. The 24-hour PMP event is 16.2 inches. The North Block tailings impoundment will also be able to store the PMP resulting from direct precipitation. The North Block tailings impoundment design will include diversion ditches to control run-on. Direct precipitation onto impoundment surfaces will collect within the impoundments and evaporate during summer months.

Barrick projects that decommissioning of the AA Block and North Block tailings impoundments will begin in January 2011 and will be completed on April 2015. Surface reclamation of the tailings *impoundments is projected to begin in April 2015 and to be completed in June 2018. However, surface reclamation of the tailings impoundment cannot begin until the tailings solids drain and consolidate sufficiently to support the equipment and material to be used in the surface reclamation phase. If the draining and consolidation process take longer than projected, the surface reclamation of the tailings impoundments may be delayed. Groundwater monitoring wells located near the tailings impoundments will be monitored by Barrick until 2040.*

2.2.5.9 Roads. There are three types of roads at the Goldstrike Mine: 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 is generally 60 feet wide and has disturbed approximately 37 acres. This access road, pending BLM's concurrence, will not be reclaimed and will be left intact as part of the post-mining land use.

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 18,300 linear feet of major haul roads with an average width of 180 feet. These roads cover approximately 76 acres.

Two new haul roads will be constructed to provide access from the pit in the South Block to the heap leach facilities and the tailings impoundment on the North Block. Both of the roads will be 180 feet in width. The west haul road will be 5,060 feet in length and the east haul road will be 4,070 feet in length. These roads will cover approximately 37 acres.

A pipeline/utility corridor and small vehicle access road will be constructed from the northeast end of the AA Block to the southeast side of the North Block. The total width will be 60 feet and the length will be 3,960 feet; the corridors will cover approximately 5 acres.

Approximately 10 miles of exploration roads exist on the North, South, and Clydesdales Blocks. These one-lane roads are generally 8 to 12 feet wide. The disturbance associated with these roads and exploration drill pads covers about 26 acres.

At the end of the active life of a road, the side berms will be flattened. Where possible, road disturbance will be blended in with natural contours. For most exploration roads, the sidecast material will be pulled back onto the road surface for use as growth medium. Pad reclamation will consist of regrading the drill pads to conform to the surrounding terrain, ripping the pads to enhance revegetation efforts, and seeding, mulching, and fertilizing. In the case of haul roads, cut banks and sidecast materials will be contoured to a reasonable degree prior to topsoil *placement. Unbladed roads will be ripped to loosen the compacted surfaces and equipped with water bars on the steeper slopes to control surface drainage while the vegetation becomes established.*

Topsoil will be applied and spread with conventional earthwork equipment in a manner that will reduce compaction. After resurfacing, the area will be ripped along the contours to a depth of 2 feet. The depth of ripping will 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 will be used, singly or in combination, where appropriate, to minimize soil erosion and increase moisture retention.

If it becomes impractical to reclaim roads to blend in with the natural grade due to steep gradients, the road will be regraded as much as practicable, covered with topsoil when available, and revegetated. Road surfaces will be graded to angle outward and away from banks to reduce the potential of erosion between the road and the slope. Additional erosion control methods such as waterbars and turnouts will be utilized to avoid erosion and gullying. The waterbars and turnouts will be installed in accordance with the following BLM guidelines:

WATERBAR SPACING

Road Grade (percent)	*Spacing Between Waterbars (feet)*
10 to 14	*200 to 100*
6 to 10	*300 to 200*
4 to 6	*400 to 300*
less than 4	*only as needed to allow drainage*

Road fills and drainage crossings will be regraded to a natural shape and gradient, and any culverts will be removed. Drainage crossings will not be regraded if they are part of roads that will have a post-mining use as determined by the BLM. Dikes and ditches that will no longer be 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.

There are no barriers (fences, cattleguards) that will have to be removed to complete reclamation of roads. The access road, which will not be reclaimed pending BLM's concurrence, has a fence and cattleguard; these barriers will not be removed if a post-mining land use is indicated.

After topsoil has been replaced on a regraded road, the seed bed will be prepared as described in Section 2.2.5.2 and the area will be revegetated as described in Section 2.2.5.3. Barrick projects that the roads will be reclaimed as follows:

Area	*Date of Initiation*	*Date of Completion*
South Block	*April 2001*	*June 2004*
AA Block	*April 2011*	*June 2015*
North Block	*April 2011*	*June 2015*
Clydesdales Block	*April 2001*	*June 2004*
Exploration	*April 1998*	*June 2001*

2.2.5.10 Ponds. Seven pond complexes will be reclaimed in conjunction with reclamation of the heap leach, tailings, and water treatment facilities:

Pond	*Acres Affected*
AA Block heap leach solution ponds	*5*
AA Block expansion ponds	*4*
AA Block tailings impoundment seepage collection pond	*2*
North Block heap leach solution ponds	*4*
North Block tailings impoundment seepage collection pond	*2*
Water treatment ponds	*4*
Mill area drainage collection pond	*2*
Total Pond Disturbance	*23*

No cyanide neutralization other than that already proposed for the heap leach pads and the tailings impoundments is proposed for the solution ponds. Any cyanide in the ponds will be neutralized during heap leach pad and tailings impoundment neutralization. The solution and water treatment pond liners will be breached, folded in on themselves, and buried, or will be removed and shipped to an appropriate off-site waste disposal facility as required by the NDEP. Fill material will be either hauled in to backfill the ponds, or dozed in from the surrounding area to approximate the pre-mining topography. The pond areas will be graded to blend into the surrounding terrain of the reclaimed surface. After the areas have been regraded, topsoil will be placed and the seed bed will be prepared as described in Section 2.2.5.2, and the area will be revegetated as described in Section 2.2.5.3. Barrick intends to reclaim the ponds at the same time as the facilities associated with the ponds are reclaimed.

2.2.5.11 Drill Holes. Barrick maintains and installs drill holes for a variety of reasons, such as exploration drill holes, environmental groundwater monitoring ports (wells), water wells, and dewatering wells.

All drill holes will be closed in accordance with NRS 534.420 to 534.428. All wells will be plugged by a licensed driller. If possible, the casing will be removed from the well prior to *plugging. If the casing cannot be removed, it will be perforated or ripped to allow the plugging fluid to penetrate the area between the casing and the wall of the drill hole. The drill holes will be backfilled with drill cuttings, bentonite, or cement as required by NRS 534.425 to 534.428. If groundwater conditions are encountered, the hole will be backfilled with a bentonite slurry or cement and capped as required by NRS 534.425 to 534.428.*

Barrick proposes to plug the existing exploration drill holes on the Clydesdales and North Blocks in the summer of 1991. The dewatering wells will be plugged following the cessation of mining in 2000. The potable water wells and the monitoring wells will be plugged in 2040 upon the conclusion of all active reclamation and monitoring activities.

2.2.5.12 <u>Sediment Control</u>. A sediment control plan will 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 will likely be accomplished through armoring (riprap), run-on diversions, and a series of sediment catchments of an appropriate type and capacity which will be located around the project area. The sediment control plan will be developed by Barrick in 1991 and designed in coordination with the BLM and pursuant to the storm water discharge regulations recently adopted by the U.S. Environmental Protection Agency (EPA).

2.2.5.13 <u>Surety</u>. Barrick has prepared an estimate of the cost of implementing the reclamation plan which is included in this Final EIS as Appendix F. The cost estimate provides per-acre costs for reclamation of specific project components as well as costs for specific elements of the reclamation plan. Barrick proposes that the amount of the surety be established based on the total number of acres affected by existing operations and to be affected by proposed operations. Barrick proposes to identify all reclamation tasks completed or acres of land reclaimed annually. Barrick proposes that the amount of the surety be reduced as reclamation measures are completed. The amount of the initial surety is $20.48 million.

The surety requirement will be satisfied as authorized by Nevada Administrative Code §519A.350 in the form of a corporate guarantee for 75 percent of the total surety amount and a letter of credit for 25 percent of the total surety amount. The letter of credit will be issued in favor of the BLM. As provided in BLM Instruction Memorandum No. 90-453, April 26, 1990, the corporate guarantee will be held by the State of Nevada, Division of Environmental Protection and be accepted by the BLM.

2.3.4 Agency Preferred Alternative

In accordance with the CEQ guidelines (40 CFR 1502.14) for implementation of NEPA, the lead federal agency is required to identify its preferred alternative for the proposed project in the Draft or Final EIS. The BLM indicated in the Draft EIS that it would select the Agency Preferred Alternative for the Betze Project in the Final EIS with the benefit of the comments received on the Draft EIS.

The BLM has reviewed the comments received on the Draft EIS, the project components associated with the Proposed Action and the alternatives, and various monitoring and mitigation measures that could be stipulated in the BLM's Record of Decision. Based upon these considerations, the BLM has selected the Agency Preferred Alternative as described below.

The following major components of the Proposed Action for the Betze Project comprise the Agency Preferred Alternative:

- *Betze Pit*
- *Extended South waste rock disposal area*
- *Expanded dewatering facilities*
- *North Block heap leach facility*
- *Mill facilities expansion*
- *North Block tailings impoundment*
- *Topsoil stockpiles*
- *Haul roads and pipeline corridors*

The Agency Preferred Alternative incorporates the alternative ore stockpile located on top of the existing South Block waste rock disposal area.

The Agency Preferred Alternative incorporates Barrick's proposed reclamation plan with a modification to the slope gradients of disturbed areas. The overall slopes of reclaimed waste rock disposal areas will be varied between 3.0H:1V and 2.3H:1V. Final slopes will be determined based on the results of the reclamation test plot program.

The Agency Preferred Alternative incorporates the following mitigation measures and monitoring requirements:

1. *Barrick will mitigate impacts to riparian and wetland areas potentially affected by its dewatering activities by providing funds for the protection or enhancement of replacement riparian and wetland areas. Barrick's funding obligation will be based upon the maximum projected acreage potentially affected (330 acres). Although most impacts to riparian or wetland areas are not projected to occur until the latter stages of dewatering or during recovery, Barrick will make the funding available in 1991 to maximize the effectiveness of such mitigation and permit an early assessment of success.*

Barrick's obligation will be based upon a 1:1 ratio of acres replaced to acres potentially affected, for a total of 330 acres. The total contribution by Barrick will be $660,000. Barrick will monitor springs and seeps, riparian and wetland areas within the area potentially affected by its dewatering activities, to identify any changes in these areas. Monitoring will continue until at least 2030, and thereafter if determined necessary by the BLM. During operations, monitoring will occur as required by the BLM. Monitoring results will be promptly reported to the BLM. Monitoring activities after 2030 will be funded by the long-term monitoring fund (see paragraph 25).

2. *In addition, Barrick will mitigate impacts to riparian and wetland areas potentially affected by its dewatering activities by funding the post-dewatering revegetation of affected riparian or wetland areas with seedlings or container plants to accelerate revegetation, as required by the BLM. Barrick will provide financial assurances and will contribute, upon completion of dewatering and initiation of recovery, up to $40,000 toward these accelerated revegetation efforts.*

3. *Barrick will mitigate impacts to wildlife from dewatering activities by funding the acquisition and maintenance of alternative sources of water (guzzlers, cisterns, etc.) for wildlife within the vicinity of affected areas. Although impacts to wildlife habitat may not occur until the latter stages of dewatering or during recovery, Barrick will make the funding immediately available to BLM to maximize the effectiveness of such mitigation and permit an early assessment of its success. Barrick will provide financial assurances and contribute up to $50,000 toward such alternative water sources. The nature and location of such sources will be selected by the BLM, in consultation with NDOW. The alternative water sources may also include, but will not be limited to, the purchase of water rights at off-site locations or the acquisition of wildlife easements to water sources.*

4. *Barrick will mitigate projected impacts to wildlife associated with the long-term loss of wildlife habitat within the boundaries of the Betze Pit, by exchanging with BLM, at the option of the BLM, acreage identified by the BLM as valuable wildlife habitat for all or a portion of the surface area of the Betze Pit. The BLM will complete this exchange, if at all, within 3 years of the date of the Record of Decision.*

5. *Barrick will mitigate projected impacts to sage grouse by funding habitat improvement projects as identified by the BLM, in consultation with NDOW, including but not limited to meadow protection or restoration. Barrick will contribute up to $50,000 to these projects.*

6. *Barrick will mitigate projected impacts to mule deer by funding habitat improvement projects as identified by the BLM in consultation with NDOW. Barrick will make such funding immediately available to BLM and will contribute up to $125,000 to these projects.*

7. *Barrick will monitor post-mining pit water quality not less frequently than quarterly to test for arsenic and other constituents identified by the BLM and to identify changes from predicted pit water chemistry. This monitoring will continue until at least 2030, and thereafter if determined necessary by the BLM. Monitoring results will be promptly reported to the BLM. Monitoring activities after 2030 will be funded by the long-term monitoring fund.*

8. *Barrick will mitigate potential adverse water quality impacts associated with a post-mining pit waterbody by funding research generally relating to water quality at other inactive open-pit mines, arsenic geochemistry, pit wall reactions, lake stratification (especially with thermal water input), or pilot remediation studies. This research will be conducted at an accredited college or university mutually agreed upon by Barrick and the BLM, but Barrick will have no control over the content or results of any such research. Barrick will be obligated to contribute $50,000 per year that Barrick is mining, to a maximum of 10 years following the effective date of the Record of Decision.*

9. *Barrick will provide a fund for the review, monitoring, and mitigation of adverse environmental impacts directly associated with its project but not specifically identified in the EIS or covered by Barrick's reclamation plan and bond but which become evident during the course of operations or following reclamation. Barrick will deposit $1,000,000 in an interest-bearing account, which will be administered by BLM and Barrick. The principal and interest in the fund will be available to BLM for implementation of review, monitoring, and/or mitigation of such impacts in the discretion of the BLM, in consultation with Barrick and the NDEP.*

10. *Within 1 year of the effective date of the Record of Decision, Barrick and the BLM will develop a revegetation research report, in consultation with NDOW and the SCS. The report will be based upon information supplied by a qualified expert and will outline additional and alternative revegetation measures that could be selected by BLM to assist in the reestablishment of native vegetation during reclamation of the project site. The report will include a discussion and recommendations concerning the salvaging and stockpiling of individual plant species or seeds from the project area, comparative information concerning reclamation programs in Nevada where native vegetation has been restored, and methods to guard against the invasion of exotic species.*

11. *Barrick will establish test reclamation plots to study the effectiveness of alternative seed mixtures and fertilizer combinations and the ability of the tailings to support revegetation. The initial plots will be established during the first 18 months following the Record of Decision and may be supplemented with additional plots at a later date based upon the results of the report and at the discretion of the BLM. Information developed from the report and the test plots will be periodically reported to and will be utilized by the BLM in the selection of appropriate revegetation measures to be implemented during reclamation. Based upon the conclusions of the test plots concerning the ability of the tailings to support vegetation, Barrick may, at the discretion of the BLM, be required to cover the tailings impoundment area with several feet of coarse waste rock during reclamation to provide adequate rooting depth within the topsoil cover prior to revegetation.*

12. *During operations, all disturbed but unreclaimed areas will be monitored periodically by Barrick to identify whether noxious plant species (as defined by state and federal regulations) have invaded the project area. During operations, an annual report of the results of such monitoring will be provided to BLM. Reasonable measures to eliminate these species within the project area may be imposed as a further condition by the BLM.*

13. *Barrick will mitigate against potential erosion by monitoring creek channels into which dewatering water is discharged and will mitigate incision of creek channels by construction of check dams and channel armor as required by the BLM.*

14. *Barrick will mitigate the impact of the project on visual resources, natural topography, vegetation, soils and wildlife by creating uneven or irregular edges and a more undulating surface on waste rock disposal areas and decommissioned heap leach pads and tailings impoundments. Within 1 year of the effective date of the Record of Decision, Barrick will provide to the BLM a report prepared by an expert in landscape architecture concerning the cost and technical feasibility of contouring, either along existing topography or with hill construction, or both, to reduce the degree of visual contrast to the surrounding environment.*

15. *Barrick will vary the overall sideslope of its waste rock disposal areas with the goals of providing more diversity in vegetative communities, more naturally appearing slopes, and to minimize erosion and excessive soils loss. The overall slopes of reclaimed waste rock disposal areas will vary between 3:0H:1V and 2:3H:1V. Final slopes will be determined based on the results of the reclamation test plot program.*

16. *Following operations, Barrick will mitigate safety hazards posed by pit walls by reclaiming or berming all access roads and fencing portions of the perimeter of the pit as may be directed by the BLM, taking into account post-mining land uses in the area. Signs will be posted by Barrick at the conclusion of mining on access roads in the vicinity of the pit warning visitors of the potential for unstable conditions and of potential hazards.*

17. *Barrick will mitigate potential slump failures in waste rock disposal areas and leach pads by periodically monitoring the facilities during operations. In the event that monitoring identifies advanced signs of potential slump failure, Barrick will take remedial action to alleviate the potential problem, in a manner acceptable to the BLM.*

18. *Barrick will mitigate potential impacts on soils and wildlife by promptly stabilizing all topsoil stockpiles with a form of ground cover and native seed acceptable to the BLM.*

19. *Barrick will install antiperching devices on powerline structures located within 1 mile of documented sage grouse strutting grounds. Electric power distribution poles within the project area will incorporate provisions for raptor safety as may be identified by the BLM.*

20. *Barrick will develop and implement an informational program for employees to increase their awareness of the value of wildlife resources and the need for their preservation. All existing employees and all new employees will be advised in writing of the responsibility of employees to avoid inadvertent harm to such resources.*

21. *Barrick will develop and implement an informational program for employees to increase their awareness of endangered or threatened plant, animal, or fish species that may be periodically present in the vicinity of the project. Barrick will advise its employees to immediately report any sightings of any state sensitive or federally listed threatened or endangered species or candidate species within the project area to the BLM.*

22. *Barrick will implement an informational program for employees to increase their awareness of the value of cultural resources and the need for their preservation. All existing employees and all new employees will be advised in writing of the fragility of the archaeological record and the responsibility of employees to avoid inadvertent harm to such resources.*

23. *Mitigation of fossilized materials may be required by the BLM if vertebrate remains are discovered during construction, operation, or closure activities. If vertebrate remains are discovered, the BLM will be notified. BLM will determine the*

significance of the resources and develop a plan for the mitigation and possible salvage of the vertebrate remains within 48 hours. If required by the BLM, Barrick will avoid and protect the remains until a qualified paleontologist, contracted by Barrick, conducts the investigation.

24. *Barrick will mitigate potential impacts to air pollution and wildlife by limiting traffic to and from the mine. Barrick will provide transportation for 6o to 85 percent of all hourly mine employees depending on shifts.*

25. *Barrick is obligated by various permits issued by the NDEP and the Nevada State Engineer to monitor groundwater elevations and quality, surface water flows and quality, discharges to surface waters, and process component monitoring ports. Unless otherwise agreed in writing by the BLM, Barrick also will conduct monitoring as a condition of the approval of the Plan of Operations, as follows:*

    a. *Surface water flows will be monitored and samples collected from Rodeo Creek at a point upstream and a point downstream of the project area on a monthly basis.*

    b. *Surface water flows will be monitored and samples collected from a point on Brush Creek upstream of its confluence with Rodeo Creek on a monthly basis and from a point on Boulder Creek downstream of the confluence of Boulder and Rodeo Creeks on a monthly basis.*

    c. *Groundwater observation ports will be monitored monthly to determine groundwater elevations and to collect samples for analysis.*

    d. *Observation ports for process components (e.g., leach pads, solution ponds) will be inspected weekly to determine whether any solution is present. If solution is observed, a sample will be collected and analyzed.*

    e. *Barrick will sample solution entering the tailings impoundments and solution contained in any other open process containment or transfer structure that contains concentrations of cyanide that are not lethal to wildlife on a weekly basis. Barrick will immediately report to BLM any analysis that indicates the presence in the solution in any open process solution containment or transfer structure of cyanide in a concentration that is lethal to humans, wildlife, or livestock.*

    f. *All cyanide solution containment facilities will be inspected by Barrick at least weekly for wildlife mortalities. Any wildlife mortalities will be reported to BLM by the end of the next working day following discovery.*

g. Reports of the weekly inspections required by item (e) will be provided to BLM quarterly. The BLM will be provided access to all other monitoring data collected by Barrick's monitoring program on request.

As described in the EIS and in a number of the public comments received by BLM, the potential environmental impacts that may be associated with the Betze Project may persist beyond the completion of project operations. Barrick will conduct the monitoring described above until final reclamation of a particular process component (for process component observation ports) or until December 31, 2030 (30 years after completion of mining), whichever is earlier.

In addition, Barrick will deposit $250,000 into an interest-bearing account to be administered by BLM and Barrick. The purpose of this fund will be to provide for long-term monitoring of potential environmental consequences of the Goldstrike Mine by providing for payment of the direct costs of conducting monitoring at the project after December 31, 2030. In the event that the BLM determines that this monitoring is not required, the funds may be transferred to the environmental monitoring and mitigation fund described in paragraph 9.

26. *In the event the monitoring program described in paragraph 25 or other information available to the BLM demonstrates the impairment of water rights or water sources, the BLM may, in consultation with the Nevada State Engineer, require Barrick to provide alternative water sources or assistance to mitigate or eliminate such impacts.*

27. *Barrick will initiate revegetation efforts for waste rock disposal areas and decommissioned heap leach pads as soon as practicable; revegetation will not be deferred until the conclusion of all mining operations in the project area.*

28. *Barrick will not disturb any area under the authority of this Decision without first complying with the procedures prescribed by the National Historic Preservation Act, including, without limitation, the provisions of the Programmatic Agreement for the Goldstrike Mine between BLM, the State Historic Preservation Officer, the Advisory Council on Historic Preservation, and Barrick.*

2.4 Summary Comparison of Impacts

The text and Table 2-10, Summary of the Proposed Action, which comprise Section 2.4 of the Draft EIS are incorporated herein by reference with the exception of the following two revisions to Table 2-10.

1. Page 2-72 -- the evaporation rate for the Betze Pit water body has been revised from 710 ac-ft/year to *886 ac-ft/year.*

2. Page 2-73 -- the potential temporary change in riparian vegetation has been revised from 271 acres to *330 acres.*

3.0 AFFECTED ENVIRONMENT

Section 3.0 of the Draft EIS is incorporated herein by reference with the exception of revised Table 3-4 which is presented on the following page.

TABLE 3-4

(Revised)

State of Nevada and Federal Air Quality Standards

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

Note: TSP and HCN are State of Nevada standards.

[1]Not to be exceeded

[2]Federal standard not to be exceeded more than once per year.

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

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 not included in Section 2.3.4, Agency Preferred Alternative, 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 <u>Topography and Mineral Resources</u>

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 Ore Stockpiles. 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 Tailings Impoundment. 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 Water Disposal Methods. 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

The monitoring and mitigation measures that will be required by the BLM are presented in Section 2.3.4 as part of the Agency Preferred Alternative.

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

The monitoring and mitigation measures that will be required by the BLM are presented in Section 2.3.4 as part of the Agency Preferred Alternative.

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.

The total emissions of air pollutants from the sources to be constructed as part of the Proposed Action were calculated. The resulting data indicate that the regulatory threshold for a PSD permit would not be exceeded.

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 Particulates. 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

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.

by mining activities (blasting, rock excavation and loading, ore and wasterock 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 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.

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.

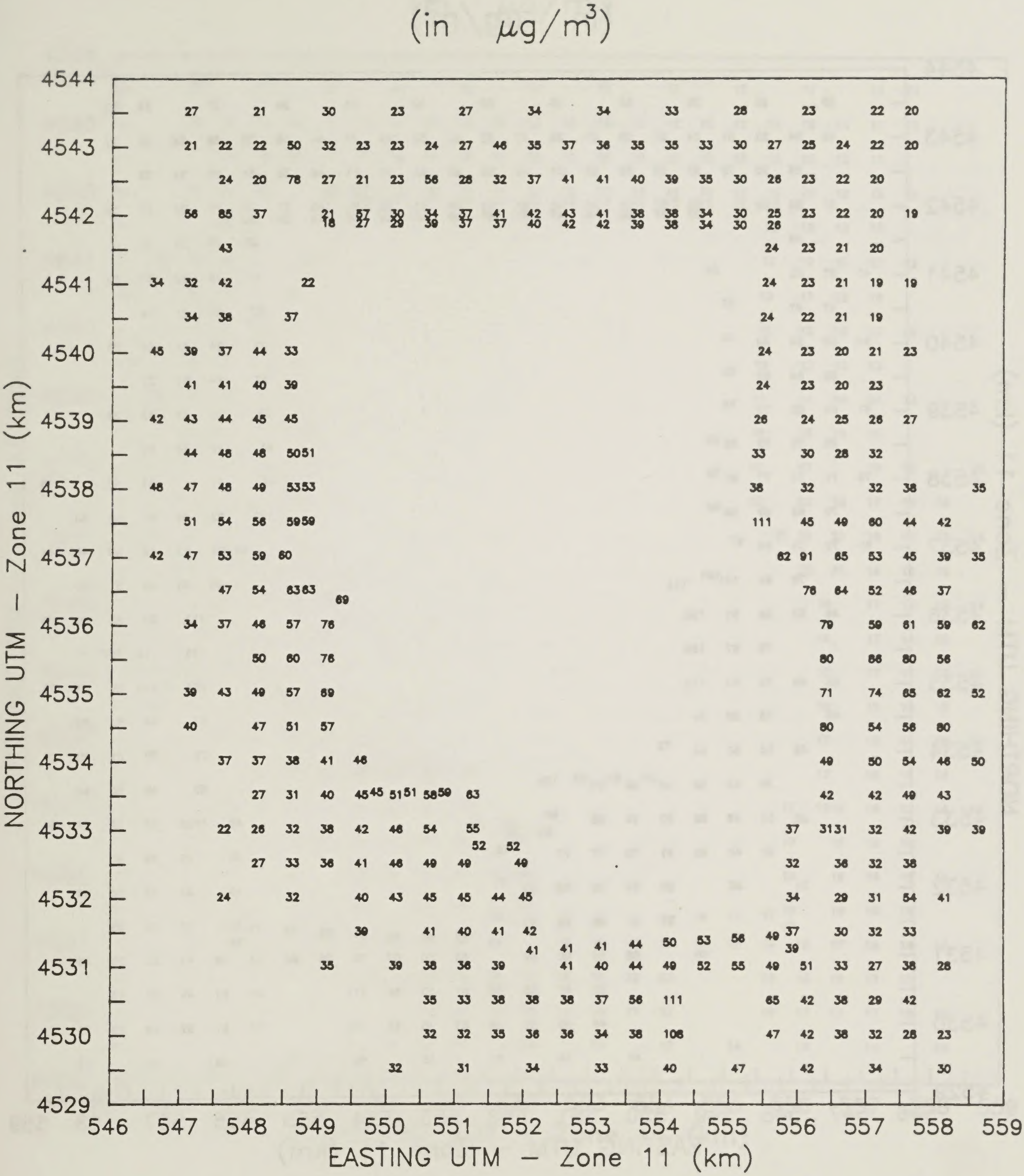


Figure 4-1. Barrick Goldstrike Cumulative PM10 Impacts: 24-Hour

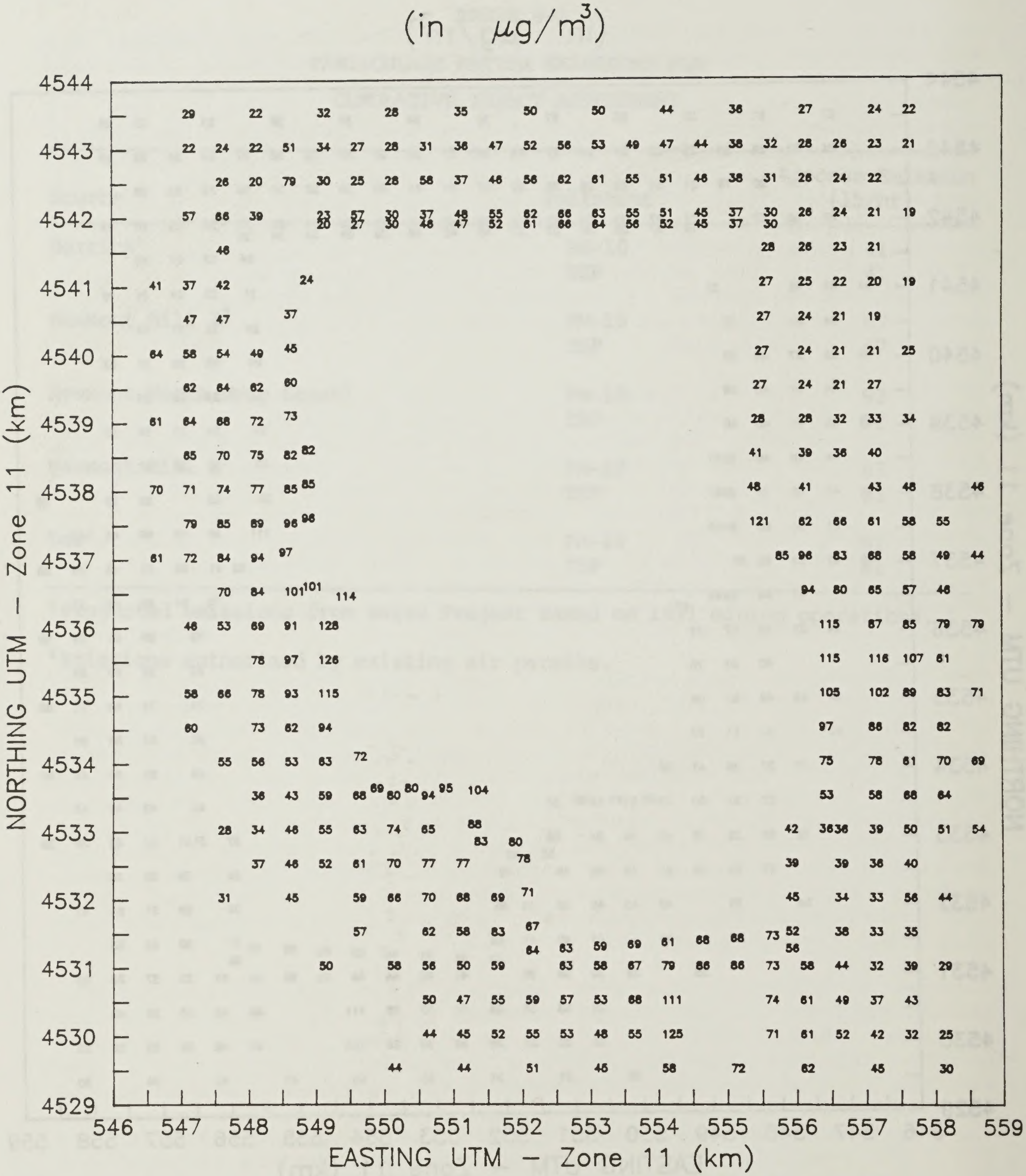


Figure 4-2. Barrick Goldstrike Cumulative TSP Impacts: 24-Hour

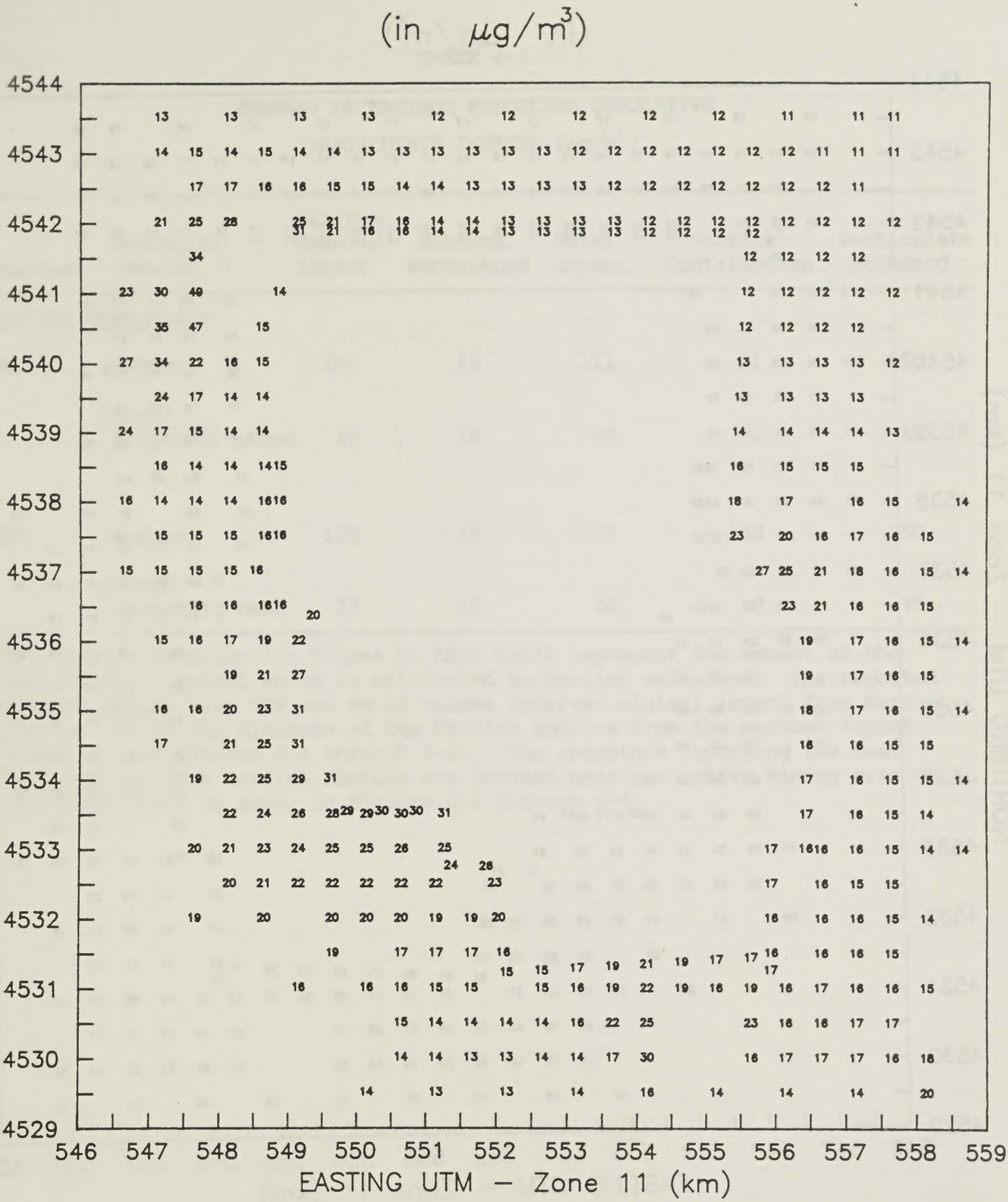


Figure 4-3. Barrick Goldstrike Cumulative PM10 Impact: Annual

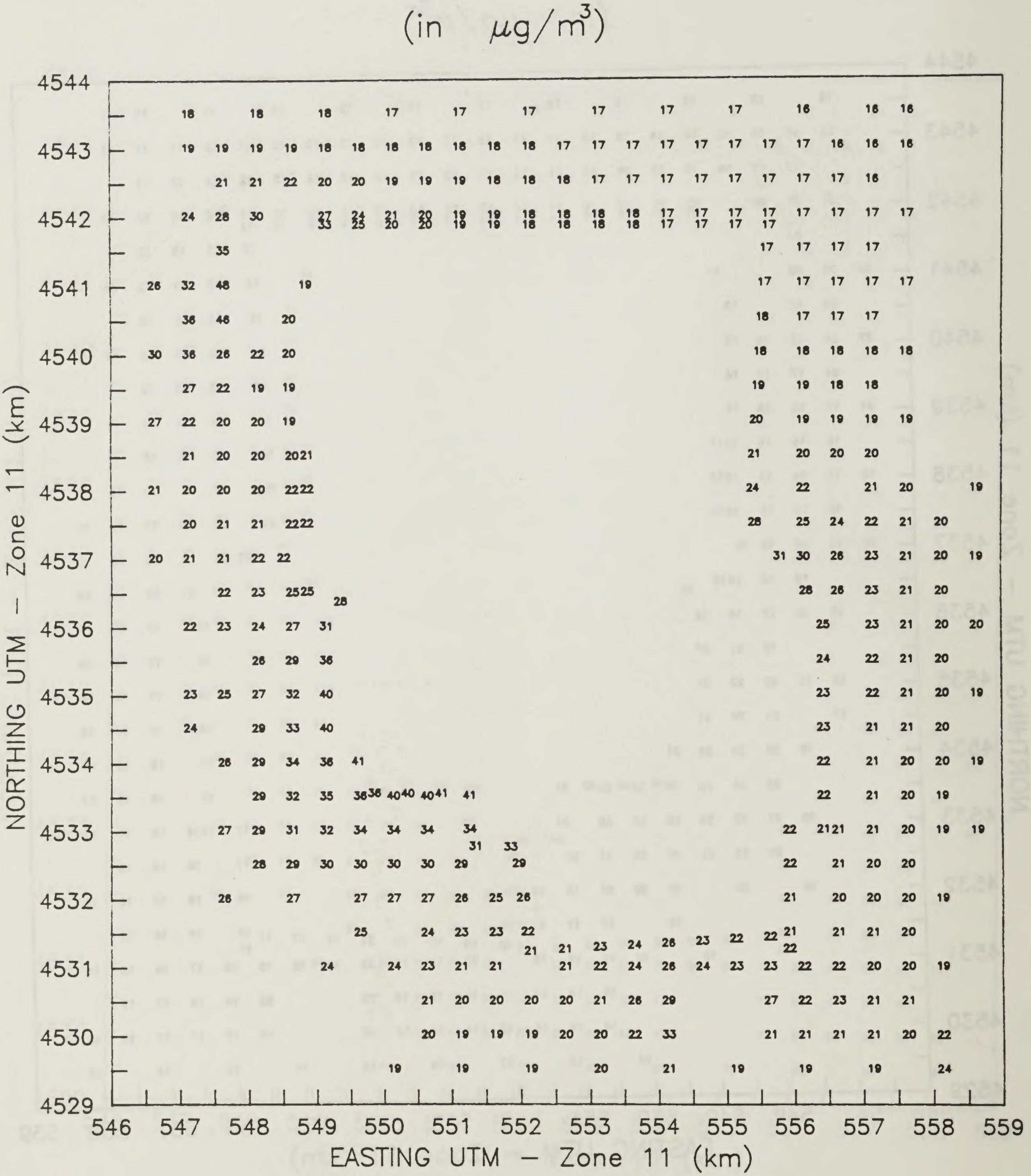


Figure 4-4. Barrick Goldstrike Cumulative TSP Impacts: Annual

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.

4.3.1.2 Gaseous Emissions. 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.

Carbon Monoxide. 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 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.

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.

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

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 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

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.

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.

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.

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 <u>Water Disposal Methods</u>. 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 <u>Partial Pit Backfill</u>. 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 <u>Water Resources</u>

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

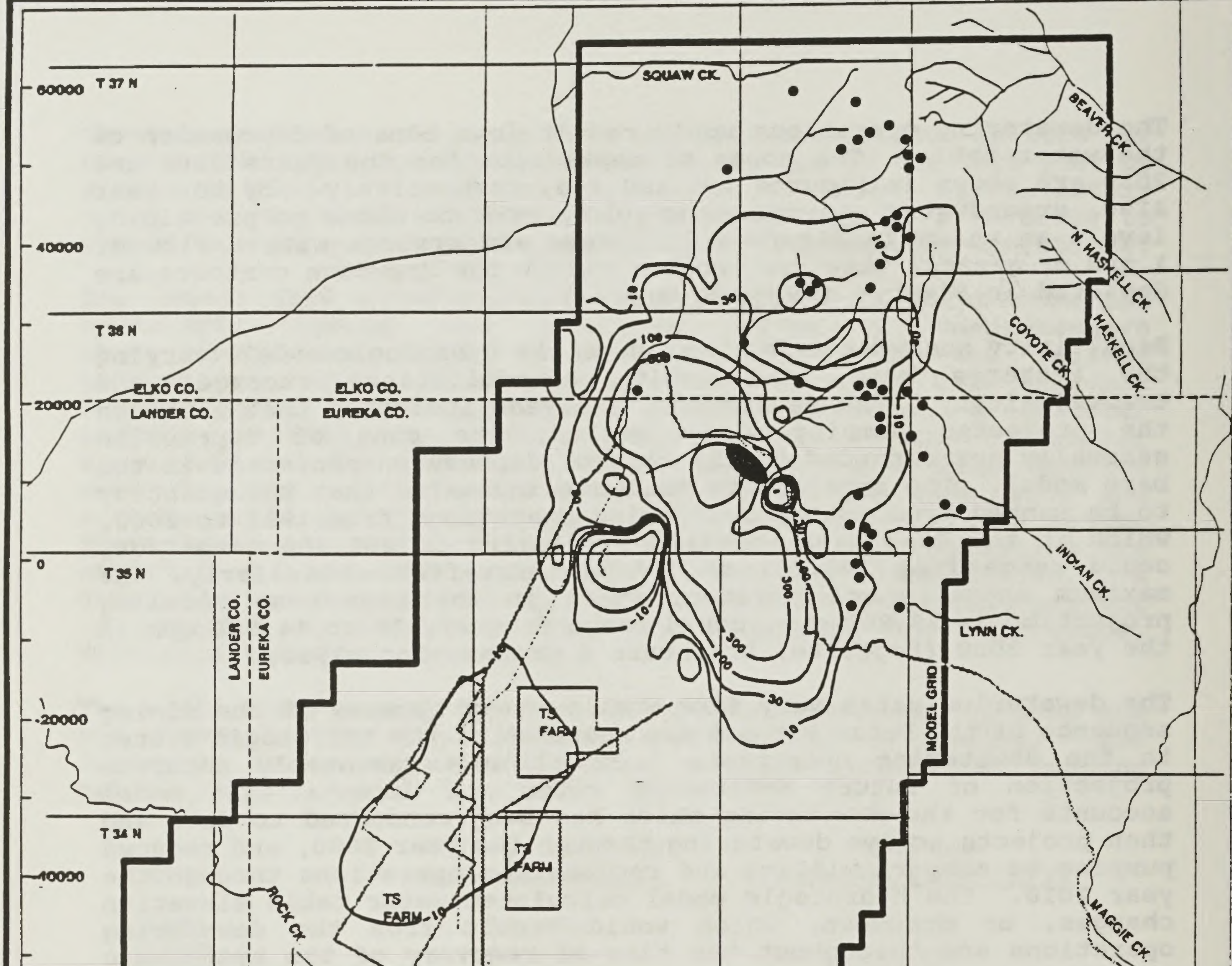
The base model projected that approximately 263,400 acre-feet of water would be pumped by the Betze Pit dewatering operations from 1991 to 2000.

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, 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).

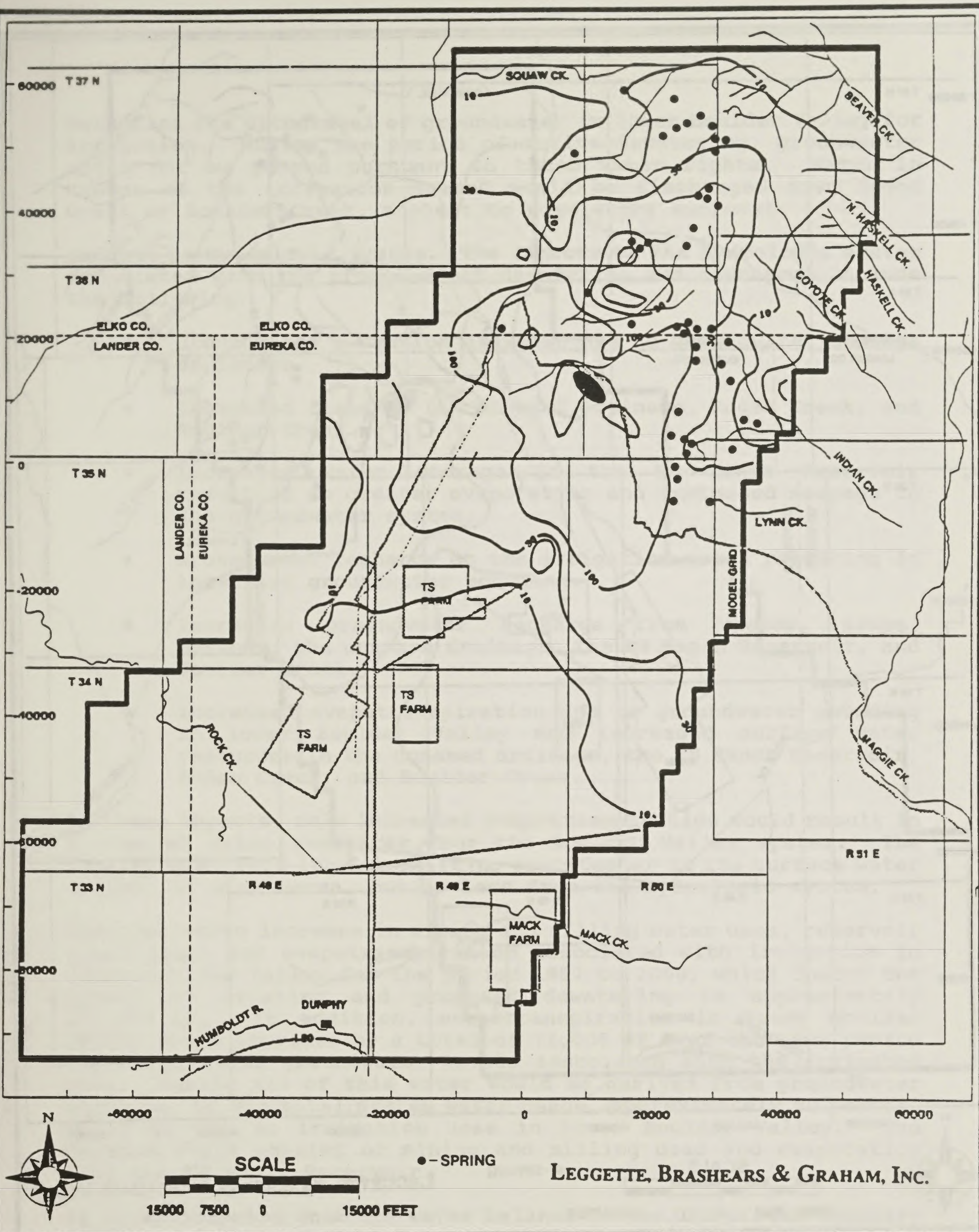
The dewatering rates vary from year to year because of the mining sequence of the Betze Pit and the response of the hydrologic system to the dewatering operations. To allow a reasonably accurate projection of future dewatering rates and impacts, the model accounts for the dewatering which has been conducted 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



BETZE PROJECT

Figure 4-5. Projected Drawdown Contours for the Year 2000, Betze Pit Standard Mine Plan (Leggette, Brashears, and Graham, Inc. 1990)



BETZE PROJECT

Figure 4-6. Projected Drawdown Contours for the Year 2030, Betze Pit Standard Mine Plan (Leggette, Brashears, and Graham, Inc. 1990)

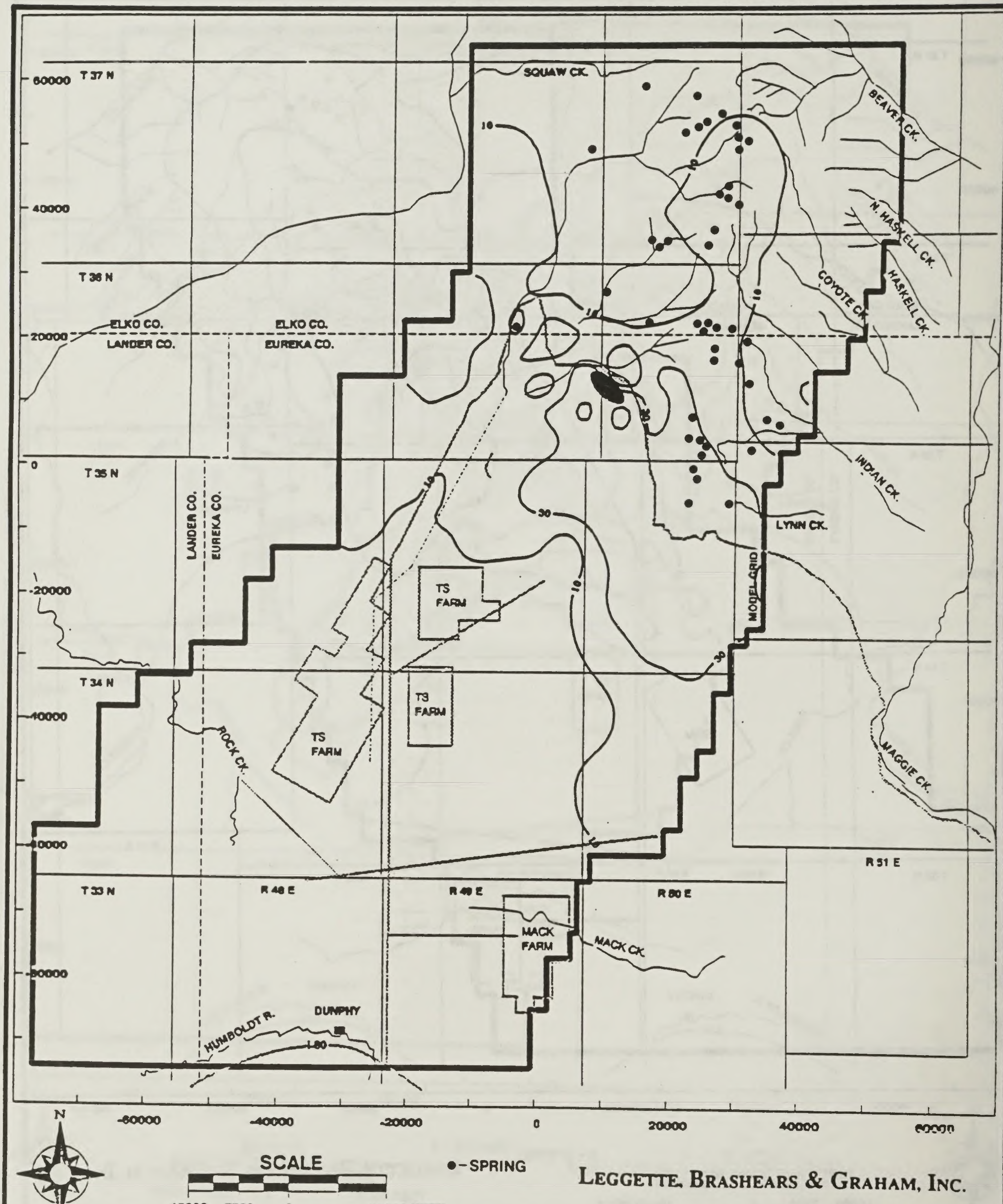


Figure 4-7. **Projected Drawdown Contours for the Year 2100, Betze Pit Standard Mine Plan (Leggette, Brashears, and Graham, Inc. 1990)**

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.

<u>Impacts to Hydrologic System</u>. 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.

<u>Impacts to Groundwater Elevations</u>. 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.

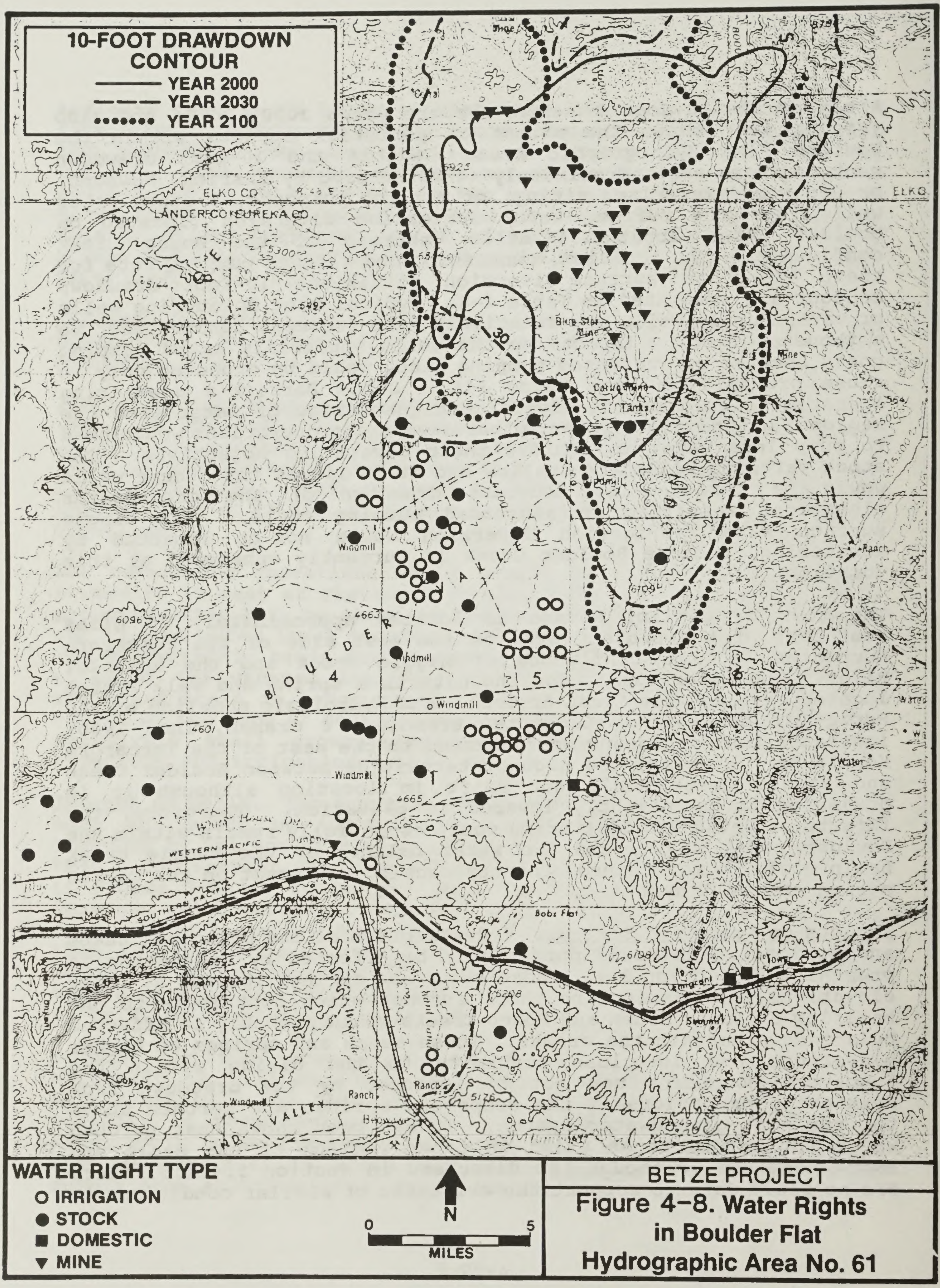
<u>Impacts on Wells</u>. The drawdown of the water table elevations would have an impact on water supply wells and dewatering wells. Drawdown by the end of mining in the year 2000 would reach greater than 1,000 feet at the proposed Betze Pit. Existing wells (refer to Figure 3-8 for locations) would be 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 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



BETZE PROJECT

Figure 4-8. Water Rights in Boulder Flat Hydrographic Area No. 61

TABLE 4-8

WATER RIGHTS IMPACTED IN THE YEAR 2000
BY DRAWDOWN OF 10 FEET OR GREATER

			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	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

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, 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.

<u>Impacts to the Unnamed Drainage</u>. 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.

<u>Impacts to the TS Ranch Reservoir</u>. 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, *upon regulatory approval*. 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

<u>Water Disposal Methods</u>. 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 <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. 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. ***The monitoring and mitigation measures that will be required by the BLM are presented in Section 2.3.4 as part of the Agency Preferred Alternative.***

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.
- *Evaporation from 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 *886 AFY. The water loss from evaporation at the Betze Pit is not expected to affect the water balance of the hydrographic basin as a whole.*

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 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 *in the year 2030* during the recovery period. ***An additional 22 acres of riparian vegetation associated with perennial stream reaches of upper Boulder Creek, Rodeo Creek, Bell Creek, and Brush Creek, and nearly 38 acres associated with riparian areas not located along stream channels and which do not have spring discharge, bring the total number of acres potentially affected to approximately 330.***

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

TABLE 4-9

ADDITIONAL WATER RIGHTS IMPACTED IN THE YEAR 2030
BY DEWATERING DRAWDOWN OF 10 FEET OR GREATER

		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	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	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

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 ***in the year 2100 toward the end of*** 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.

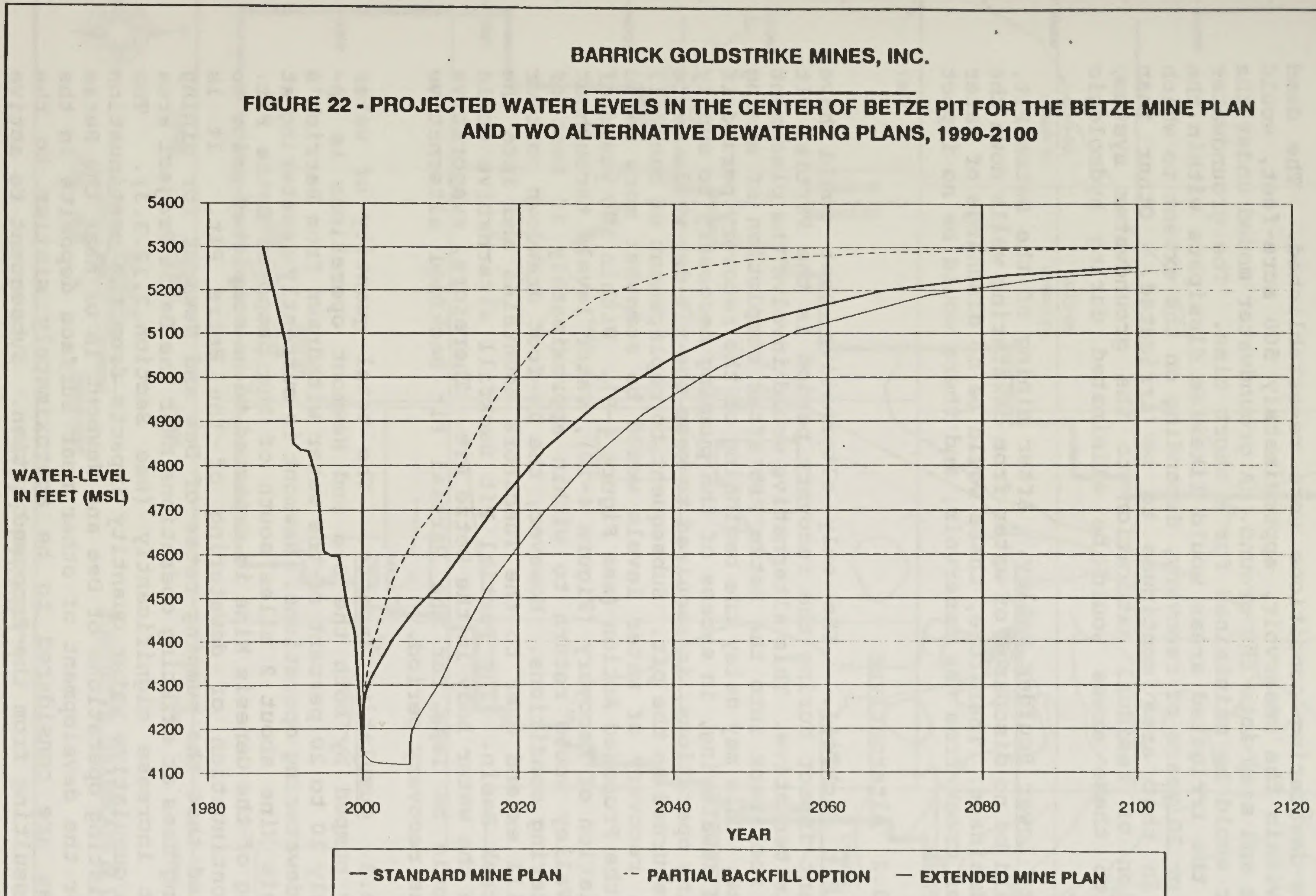
As modeled, drawdown beneath the lowermost reaches of Brush Creek would be greater than 100 feet in the year 2030; drawdown would be 10 to 30 feet in the headwaters at the same time. Thus Brush Creek would remain ephemeral throughout its length during most of the recovery period, but may begin to recover 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



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)

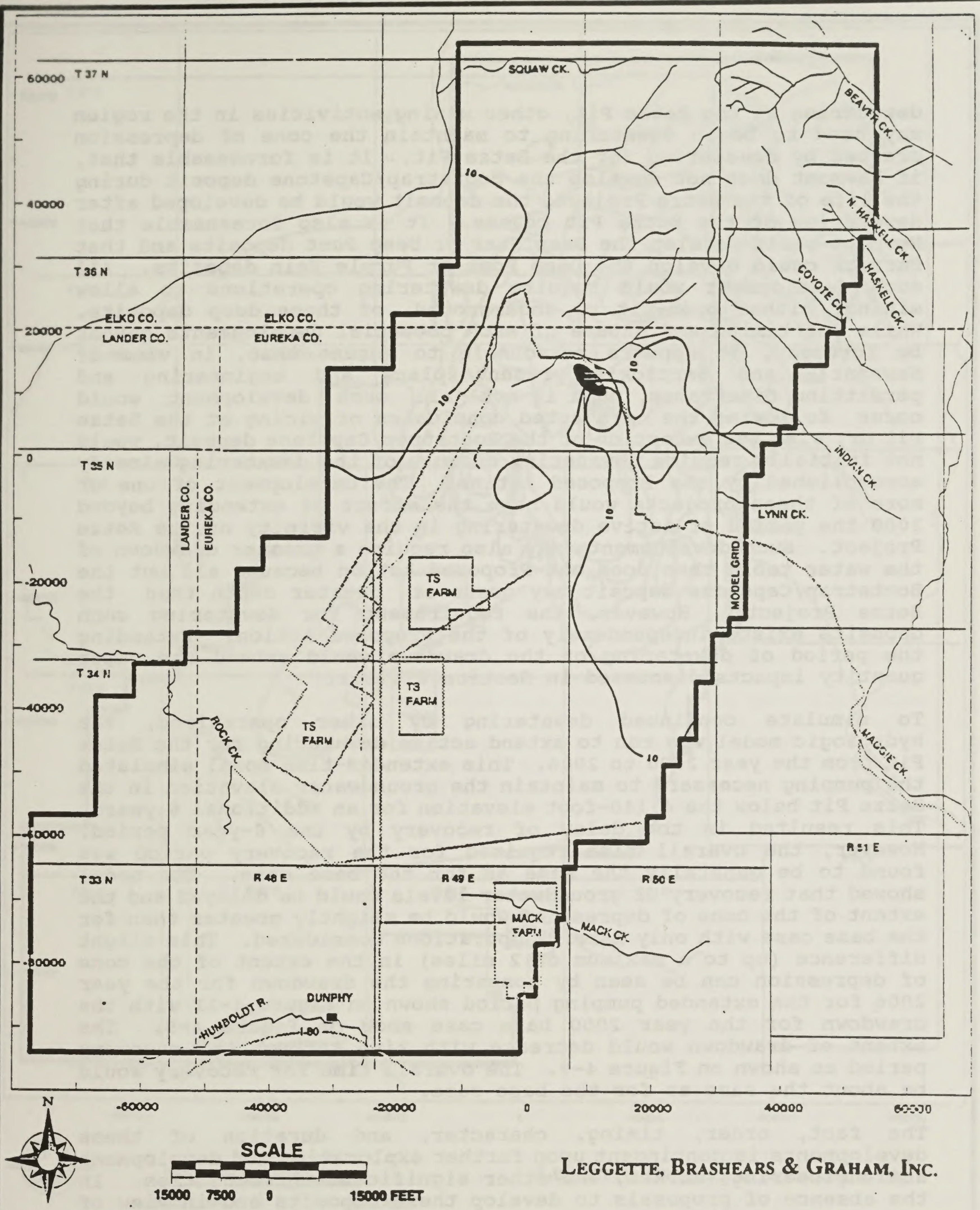
until pre-dewatering conditions were re-established. The dead storage within the reservoir, approximately 500 acre-feet, would evaporate and seep into the ground. A groundwater mound under the reservoir would be maintained for a short time. The groundwater mound at the irrigated areas would likewise 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 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



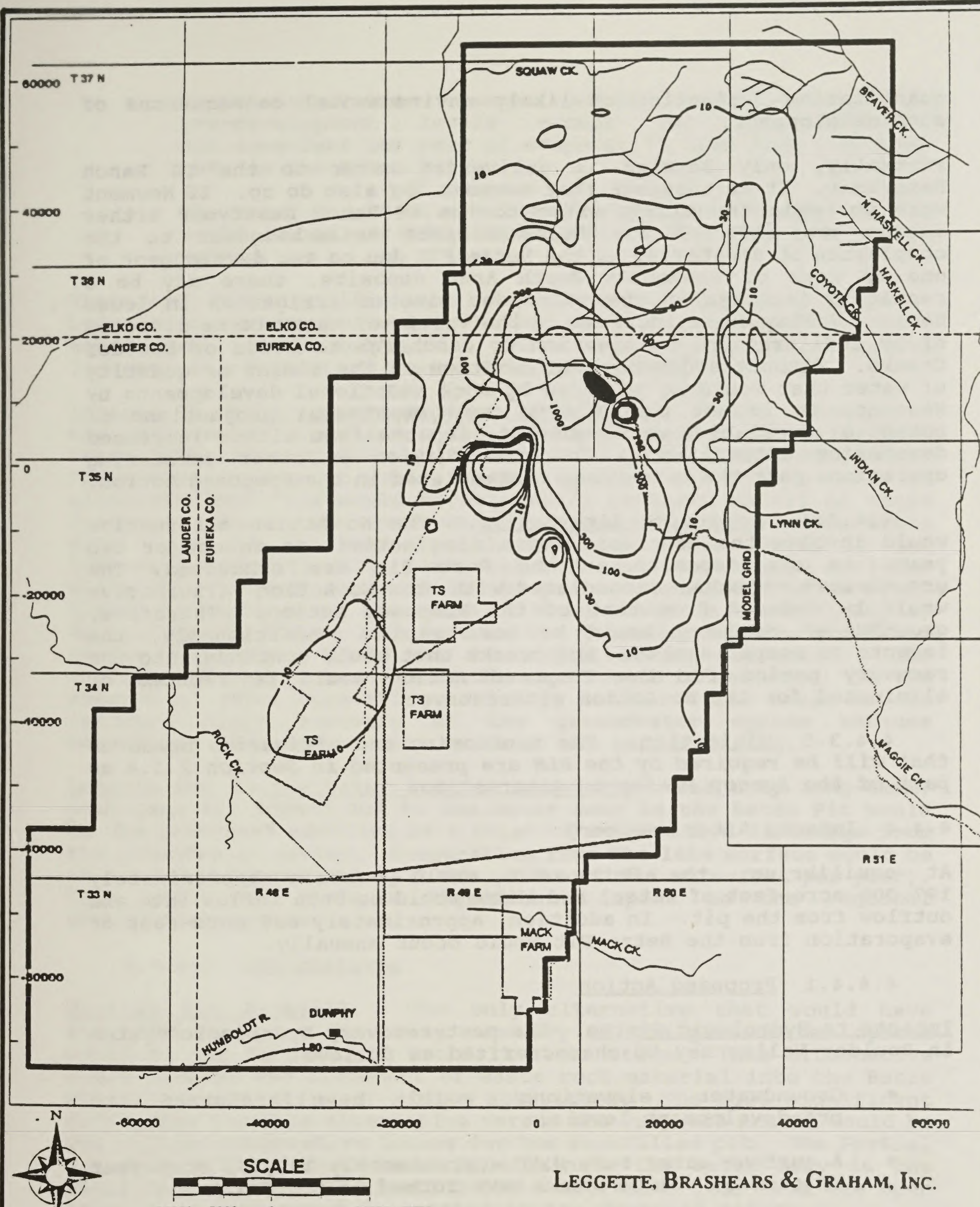
BETZE PROJECT

Figure 4-10. Projected Drawdown Contours for the Year 2100, Betze Pit Partial Backfill Alternative (Leggette, Brashears, and Graham, Inc. 1990)

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 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,



BETZE PROJECT

Figure 4-11. Projected Drawdown Contours for the Year 2006, Betze Pit Extended Dewatering (Leggette, Brashears, and Graham, Inc. 1990)

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 <u>No Action Alternative</u>. 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 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 <u>Mitigation</u>. ***The monitoring and mitigation measures that will be required by the BLM are presented in Section 2.3.4 as part of the Agency Preferred Alternative.***

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 *886* acre-feet of evaporation from the Betze Pit would occur annually.

4.4.4.1 <u>Proposed Action</u>

<u>Impacts to Hydrologic System</u>. 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 *886 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 ***approximately 1 cfs*** (or about ***886 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. Other than the mitigation included in the Proposed Action, no mitigation of impacts to the groundwater system is proposed.

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. ***The monitoring and mitigation measures that will be required by the BLM are presented in Section 2.3.4 as part of the Agency Preferred Alternative.***

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 <u>Proposed Action</u>

<u>Dewatering</u>. 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.

<u>Dewatering Discharge</u>. 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 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.

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.

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.

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

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

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 $CaCO_3$, mg/l	275.625	150.000	120.000	130.000
Ammonia as NH_3-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 HCO_3, 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 CO_3, 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 NO_3-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 SO_4, 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

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.

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 <u>Alternatives</u>. 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.

<u>Waste Rock Disposal Areas, Ore Stockpiles, and Processing Facilities</u>. 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.

<u>Water Disposal Methods</u>. 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.

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 $CaCO_3$, mg/l	275.625	49.000	54.000
Aluminum (T) as Al, mg/l		1.800	1.700
Ammonia as NH_3-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 HCO_3, 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 CO_3, 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 $CaCO_3$, 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 NO_3-N, mg/l	1.194	0.147	< 0.050
Phosphate (Ortho) as PO_4-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 SiO_2, 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 SO_4, 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)

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 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 <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. 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 monitoring and mitigation measures that will be required by the BLM are presented in Section 2.3.4 as part of the Agency Preferred Alternative.***

4.4.8 Impacts During and After Recovery

4.4.8.1 Proposed Action. 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 Alternatives

Water Disposal Methods. 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.

Partial Pit Backfill. 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 <u>Cumulative Impacts</u>. 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 No Action Alternative. 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 Mitigation. ***The monitoring and mitigation measures that will be required by the BLM are presented in Section 2.3.4 as part of the Agency Preferred Alternative.***

4.4.9 Betze Pit Water Quality

4.4.9.1 Proposed Action. 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 projected based upon water quality in wells surrounding the post-mining Betze Pit. The quality of water flowing into the pit would be further modified by concentration due to evaporation, by potential reaction with the pit walls producing acid and releasing trace elements (particularly heavy metals), and *by potential stratification of the waters, thereby limiting the circulation of oxygen throughout the water body. 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) and in the following sections.*

<u>Betze Pit Inflow Rates</u>. Groundwater in the Betze Project area generally flows southwest from the Tuscarora Mountains which are located east of the project area. The three main water-bearing zones 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 area of the proposed Betze Pit 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 expand outward maintaining flow toward 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 continue to flow into and out of the Betze Pit water body. Estimates of groundwater throughflow rates are presented in Table 4-14.

<u>Betze Pit Inflow Water Quality</u>. The pit inflow water quality was projected by identifying groundwater wells which would generally characterize the quality of inflow water. Additional water quality data for existing wells and new wells have been obtained since publication of the Draft EIS, and these data have been incorporated into this revised analysis. An estimate of the chemical composition of the pit groundwater inflow was determined by computing a weighted average of the observed chemical composition of water from nine wells surrounding 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. Table 4-16 presents the average chemical composition of water for each well. In computing the weighted average chemical composition of the inflow water, the level of detection was used as the input for those elements for which concentrations below the level of detection were reported by the analyses. All samples without chain-of-custody records were excluded from the analysis in order to ensure that data quality objectives were met. In addition, samples with a value for total suspended solids greater than 100 mg/l were eliminated from the analysis.

TABLE 4-14

(Revised)

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	1	1.06
4	11.3	12.8	0.5	1	1.08
10	7.2	8.9	0.7	1	1.10
30	5.8	7.3	0.5	1	1.14
100	0.4	2.0	0.6	1	1.39
200	0.0	1.8	0.8	1	1.68
Infinite	0.0	1.8	0.8	1	2.25

[1] Data from Leggette, Brashears & Graham, Inc. 1990.

[2] Multiple for concentration of a conservative tracer over inflow concentration.

TABLE 4-15

(Revised)

GROUNDWATER WELLS UTILIZED TO ESTIMATE COMPOSITION OF PIT INFLOW

Well ID	# of Samples	Total Cased Depth (feet)	Screened Intervals (feet)	Formation/Rock Type
AA Well	16	720	160-700	Carlin/Paleozoic limestone and siltstones
WW-1	6	300	200-300	Granodiorite
Bazza Well	8	613	163-613	Paleozoic limestones and siltstones
BW-3	9	1,282	122 - 742 782 - 1,262	Paleozoic limestones and siltstones
BW-4	3	1,577	310 - 610 650 - 730 790 - 1,530	Paleozoic limestones and siltstones
BW-5	5	1,580	640 - 1,560	Paleozoic limestones and siltstones
BW-6	5	1,650	500 - 920 960 - 1,360 1,410 - 1,610	Paleozoic limestones and siltstones
BW-7	3	1,610	730 - 1,600	Paleozoic limestones and siltstones
PPW-9	4	625	590 - 610	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

(Revised) BETZE PROJECT

Figure 4-12. Pre-Dewatering Groundwater Elevations and Well Locations

TABLE 4-16

(Revised)

ESTIMATED COMPOSITION OF GROUNDWATER INFLOW TO BETZE PIT

PARAMETER	AA WELL	BAZZA WELL	WW-1	PPW-9	BW-3	BW-4	BW-5	BW-6	BW-7	MEAN	INFLOW WEIGHTED
Alkalinity as CaCO3, mg/l	143.500	410.375	147.333	120.000	413.000	450.000	425.000	412.500	445.000	329.634	407.880
Aluminum (T) as Al, mg/l	0.094	0.148	0.103	0.100	0.100	0.100	0.100	0.100	0.100	0.105	0.101
Ammonia as NH3-N, mg/l	0.333	1.184	0.228	0.200	1.590	1.567	1.750	1.325	1.950	1.125	1.526
Arsenic (T) as As, mg/l	0.085	0.030	0.043	0.170	0.031	0.180	0.009	0.018	0.012	0.064	0.054
Barium (T) as Ba, mg/l	0.052	0.127	0.041	0.050	0.143	0.153	0.170	0.120	0.170	0.114	0.143
Bicarbonate as HCO3, mg/l	175.063	499.500	179.167	140.000	500.000	543.333	512.500	502.500	540.000	399.118	493.929
Boron (T) as B, mg/l	0.134	0.783	0.175	0.100	0.780	0.833	0.800	0.775	0.800	0.576	0.750
Cadmium (T) as Cd, mg/l	0.008	0.010	0.009	0.005	0.010	0.005	0.005	0.005	0.005	0.007	0.006
Calcium as Ca, mg/l	30.588	92.263	68.300	61.667	89.300	92.000	88.500	89.500	89.500	77.957	87.003
Carbonate as CO3, mg/l	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Chloride as Cl, mg/l	18.231	16.788	60.950	54.333	14.900	15.333	14.500	15.000	15.000	25.004	16.742
Chromium (T) as Cr, mg/l	0.007	0.008	0.015	0.005	0.005	0.005	0.005	0.005	0.005	0.007	0.005
Conductivity, uhmos/cm	391.813	926.750	805.500	740.000	855.000	880.000	907.500	885.000	905.000	810.729	867.662
Copper (T) as Cu, mg/l	0.014	0.045	0.012	0.005	0.006	0.005	0.007	0.005	0.005	0.012	0.007
Cyanide (T) as CN, mg/l	0.004	0.004	0.056	0.005	0.005	0.005	0.005	0.005	0.005	0.010	0.005
Cyanide (Free) as CN, mg/l	0.063	0.051	0.038	0.100	0.100	0.100	0.100	0.100	0.100	0.084	0.097
Cyanide (WAD) as CN, mg/l	0.005	0.005	0.109	0.005	0.005	0.005	0.005	0.005	0.005	0.017	0.006
Fluoride as F, mg/l	0.451	1.370	0.407	0.500	1.370	1.333	1.350	1.250	1.350	1.042	1.271
Gold as Au, mg/l	0.007	0.008	0.024	0.005	0.005	0.005	0.005	0.005	0.005	0.008	0.005
Hardness as CaCO3, mg/l	157.563	339.500	308.167	296.667	282.000	323.333	307.500	317.500	150.000	275.803	275.354
Hydroxide as OH, mg/l	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Iron (T) as Fe, mg/l	0.573	1.914	0.598	0.113	0.650	0.673	0.210	0.465	0.425	0.624	0.520
Lead (T) as Pb, mg/l	0.051	0.028	0.012	0.005	0.005	0.005	0.005	0.005	0.005	0.013	0.007
Magnesium as Mg, mg/l	15.425	24.800	37.017	34.667	21.900	22.333	21.000	22.750	21.000	24.544	22.234
Manganese (T) as Mn, mg/l	0.053	0.062	0.010	0.014	0.064	0.026	0.016	0.090	0.015	0.039	0.042
Mercury as Hg, mg/l	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Nickel (T) as Ni, mg/l	0.011	0.015	0.013	0.010	0.011	0.010	0.013	0.010	0.010	0.011	0.011
Nitrate as NO3-N, mg/l	0.464	0.061	1.329	0.053	0.050	0.050	0.050	0.050	0.050	0.240	0.076
Phosphate (Ortho) as PO4-P, mg/l	0.171	0.074	0.028	0.037	0.042	0.020	0.020	0.020	0.020	0.048	0.031
Potassium as K, mg/l	6.294	19.413	7.450	6.033	21.600	21.667	20.500	19.500	20.000	15.828	19.615
Selenium (T) as Se, mg/l	0.004	0.004	0.005	0.007	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Silica (T-ICP) as SiO2, mg/l	32.731	25.963	15.683	9.667	16.000	19.000	18.750	14.500	19.000	19.033	17.913
Silver (T) as Ag, mg/l	0.007	0.008	0.008	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.005
Sodium as Na, mg/l	28.613	69.763	37.417	31.667	75.200	73.000	76.250	72.500	74.500	59.879	71.136
Sulfate as SO4, mg/l	47.863	95.925	140.367	166.667	69.600	58.667	61.750	69.000	51.500	84.593	66.610
Settleable Solids , mLs/L/hr	0.110	0.100	0.100	0.100	56.361	0.100	0.900	0.800	0.100	6.519	10.497
Suspended Solids, mg/l	9.925	13.575	4.033	5.333	16.900	9.667	22.250	20.000	5.000	11.854	14.192
Thallium as Tl, mg/l	0.008	0.008	0.009	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.005
Total Dissolved Solids, mg/l	289.750	568.625	557.500	480.000	566.000	573.333	545.000	542.500	555.000	519.745	546.456
Turbidity, NTU	3.117	18.600	0.907	1.000	6.830	8.533	1.825	4.700	4.500	5.557	5.440
Zinc (T) as Zn, mg/l	0.071	0.075	0.029	0.170	0.009	0.015	0.007	0.009	0.005	0.043	0.018
pH Units	7.484	7.268	5.713	7.833	7.420	7.200	7.275	7.300	7.150	7.183	7.277

A number of wells are located within the existing Post Pit and the proposed Betze Pit; however, the rock and the groundwater associated with these wells would be removed by the mining process. The water would be treated and discharged to the TS Ranch Reservoir, and the rock would be removed to either the waste rock disposal areas or to the mill for processing. Groundwater that would enter the pit after mining would come from outside the proposed Betze Pit and would pass through the rocks which outcrop in the pit walls. Therefore, the following assumptions were made in computing the composition of groundwater inflow to the pit:

- *water entering the pit would be similar in composition to water in wells that surround the proposed Betze Pit;*
- *water in the pit would be a mixture of water from the water-bearing rock formations that outcrop in the walls of the proposed pit, i.e., the granodiorite and the paleozoic metasediments; and*
- *water in the pit would be based upon the relative contribution of groundwater inflow from the formations outcropping in the pit wall.*

Based upon the above assumptions, nine wells were selected as representative of water that would refill the pit. The wells represent potential groundwater inflow sources as follows:

- *granodiorite (WW-1);*
- *low-permeability paleozoic metasediments (AA Well, Bazza Well, and PPW-9); and*
- *high-permeability paleozoic metasediments (BW-3, BW-4, BW-5, BW-6, and BW-7).*

Information from the groundwater modeling (Balleau 1991) indicates that most of the inflow would come from the northwest side of the pit where a high-permeability zone of the paleozoic metasediments is located. The granodiorite would contribute minor amounts to the inflow to the pit. Therefore, it was estimated that about 90 percent of the inflow would come from the high-permeability paleozoic metasediments, 1 percent from the granodiorite, and the remainder from the low-permeability paleozoic metasediments. An inflow composition was estimated by computing a flow-weighted average of the nine representative wells (Table 4-16).

The composition of groundwater inflow may also be estimated by considering the arsenic content of the rocks surrounding the proposed Betze Pit. Please refer to Appendix B-4 for a discussion of an alternative method for estimating inflow composition. The results of the analysis are presented in Appendix B-4.

Concentration by Evaporation. 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 39 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 approximately 1 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 (Table 4-14).

Wall Rock Reaction. The water accumulating in the Betze Pit following the end of mining would come into contact with the wall rock 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 presented in Table 4-17. The measured areas have not been corrected to account for pit slope because the values were utilized to compute relative outcrop areas only.

Static Tests of Pit Wall Rocks. Static whole-rock tests of crushed rock samples from the various geologic formations and ore 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 net acid neutralizing potential of a sample based upon the sulfur content and the acid neutralizing potential of the sample. The test represents a conservative evaluation because the actual reaction rates and availability of components to react in the natural environment are not considered. The analytical process used in the static tests is described in greater detail in the Water Resources Technical Report and is based on procedures described by Sobek at al. (1978).

Results of the whole rock analyses for 41 samples from the Betze Pit (Core Laboratories 1990a, 1990b) are presented in Appendix B of the Draft EIS. 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 acid generating potential 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.

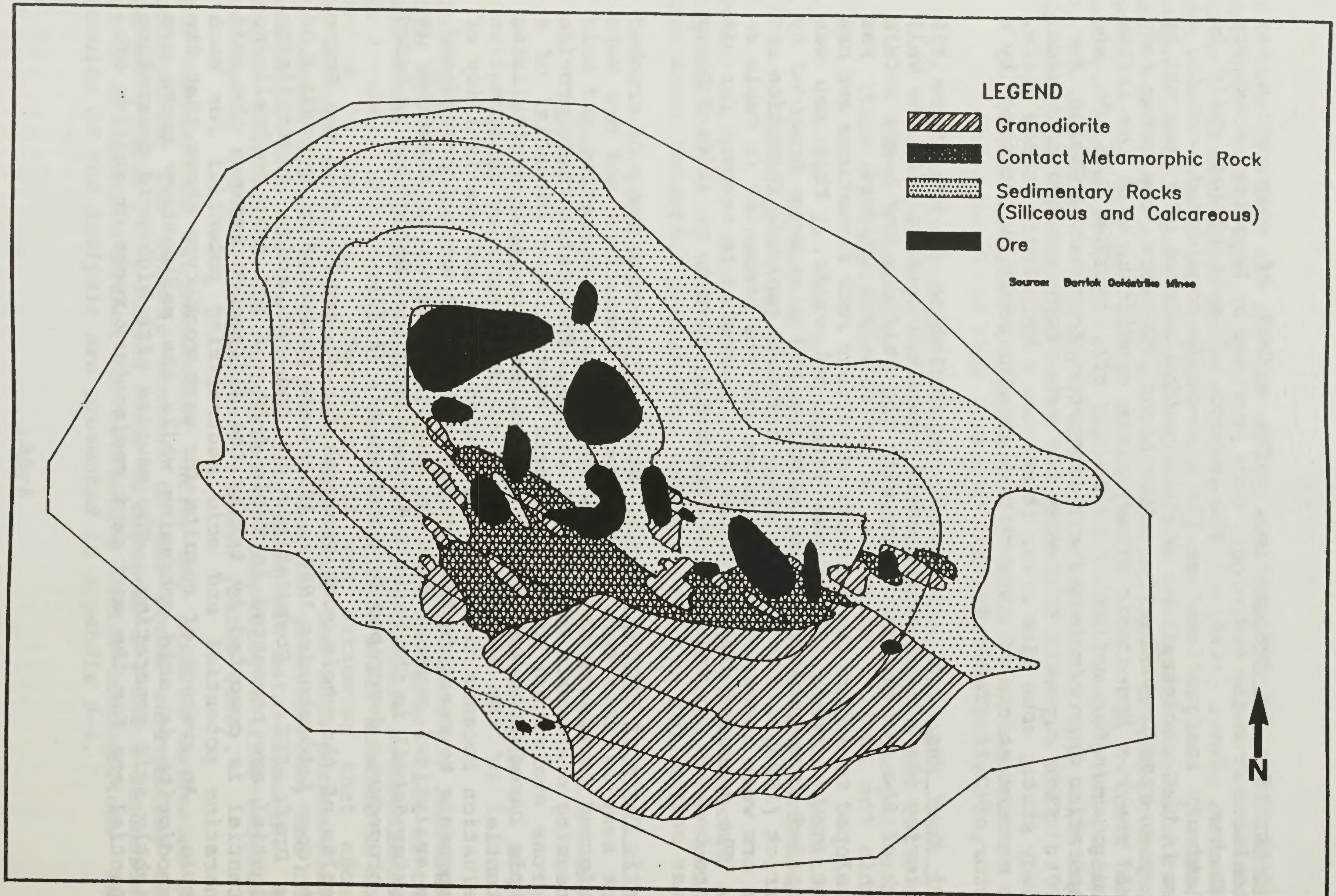


Figure 4-13. Geologic Map of Betze Pit Walls

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

(Revised)

Acid Generating Potential and Acid Neutralizing Potential
from Whole Rock Analyses
(Units in Tons $CaCO_3$/1,000 Tons)

		AGP[3]		ANP[4]	Net ANP			
Sample (Lab ID)[1]	Rock Type[2]	Total S[5]	Per. S[6]		ANP - Total S	ANP/Total S	ANP - Per. S	ANP/Per. S
WR-1	Sed	0.0	0.0	61.3	61.3	∞	61.3	∞
WR-1P	Sed	0.0	0.0	46.4	46.4	∞	46.4	∞
WR-2	Sed/O	45.3	40.0	0.0	-45.3	0.00	-40.0	0.00
WR-2P	Sed/O	31.6	5.0	3.8	-27.8	0.12	-1.2	0.76
WR-3	Gd	0.0	0.0	63.0	63.0	∞	63.0	∞
WR-3P	Gd	0.0	0.0	40.0	40.0	∞	40.0	∞
WR-4	Sed	52.8	43.4	0.2	-52.6	0.00	-43.2	0.00
WR-4P	Sed	136.0	90.3	0.4	-135.6	0.00	-89.9	0.00
WR-5	Gd	13.1	7.2	52.3	39.2	3.99	45.1	7.26
WR-5P	Gd	37.8	18.8	171.4	133.6	4.53	152.6	9.12
WR-6	Gd	22.5	15.0	221.0	198.5	9.82	206.0	14.73
WR-6P	Gd	43.8	13.1	224.2	180.4	5.12	211.1	17.11
WR-7	Gd	49.7	43.4	107.0	57.3	2.15	63.6	2.47
WR-7P	Gd	50.3	21.6	122.1	71.8	2.43	100.5	5.65
WR-8	Sed/O	39.1	20.9	0.0	-39.1	0.00	-20.9	0.00
WR-8P	Sed/O	67.2	18.1	4.8	-62.4	0.07	-13.3	0.27
WR-9	Sed	0.6	0.0	3.2	2.6	5.33	3.2	∞
WR-9P	Sed	0.6	0.0	3.8	3.2	6.33	3.8	∞
WR-10	Sed	0.3	0.0	6.4	6.4	∞	6.4	∞
WR-10P	Sed	0.0	0.0	13.9	13.9	∞	13.9	∞
WR-11	Sed	0.0	0.0	2.4	2.4	∞	2.4	∞
WR-11P	Sed	143.0	74.1	0.4	-142.6	0.00	-73.7	0.01
WR-12	Gd	5.0	3.1	163.0	158.0	32.60	159.9	52.58
WR-12P	Gd(skarn)	17.5	0.6	191.0	173.5	10.91	190.4	318.33
WR-13	Sed	60.0	37.8	7.2	-52.8	0.12	-30.6	0.19
WR-13P	Sed	14.1	12.5	15.0	0.9	1.06	2.5	1.20
B-1	Sed	5.3	0.0	1.8	-3.5	0.34	1.8	∞
B-2	Sed	5.3	0.0	2.0	-3.3	0.38	2.0	∞
B-3	Sed	18.8	9.7	7.2	-11.6	0.38	-2.5	0.74
B-4	Sed	46.9	27.5	17.5	-29.4	0.37	-10.0	0.64
B-5	Sed	13.1	0.3	0.1	-13	0.01	-0.2	0.33

TABLE 4-18 (CONTINUED)

Sample (Lab ID)[1]	Rock Type[2]	AGP[3] Total S[5]	AGP[3] Per. S[6]	ANP[4]	Net ANP ANP - Total S	Net ANP ANP/Total S	Net ANP ANP - Per. S	Net ANP ANP/Per. S
B-6	Sed	69.1	32.3	8.0	-61.1	0.12	-24.3	0.25
B-7	Gd	2.8	0.0	3.6	0.8	1.29	3.6	∞
B-8	Sed	36.2	10.3	1.5	-34.7	0.04	-8.8	0.15
B-9	Sed	30.9	29.1	7.2	-23.7	0.23	-21.9	0.25
B-10	Gd	141.0	98.8	48.3	-92.7	0.34	-50.5	0.49
B-11	Gd	7.2	1.2	107.2	100.0	14.89	106.0	89.33
B-12	Gd	9.4	0.0	125.0	115.6	13.30	125.0	∞
B-13	Gd/O	89.4	35.3	75.1	-14.3	0.84	39.8	2.13
B-14	Gd/O	43.1	12.2	42.4	-0.7	0.98	30.2	3.48
B-15	Sed	67.8	40.6	8.5	-59.3	0.13	-32.1	0.21
Average for granodiorite[2]		37.2	19.2	104.2	67.1	2.80	85.0	5.42
Average for sedim. rocks[2]		31.6	18.8	18.9	-12.7	0.60	2.1	1.13
Average for pit, 24% Gd, 76% Sed.		33.0	17.4	39.4	6.4	1.19	22.0	2.27

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 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; 0 = ore.

[3]AGP = Acid Generating Potential

[4]ANP = Acid Neutralizing Potential

[5]Total S = Total Sulfur

[6]PER. S = Sulfur consumed by hydrogen perioxide oxidation.

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 weighted average net acid neutralizing potential of the wall rock as a whole is slightly acid consuming. 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 ensure neutralization. The static analysis indicates that the pit water would not become acidic under any plausible circumstances.

In considering the potential for acidification of the water body, the acid neutralizing capacity of the inflowing groundwater itself should also be considered. The total alkalinity delivered to the pit as it fills would be 1.36 x 10^8 *kg* $CaCO_3$*. Thus, the alkalinity of the inflow water would provide additional neutralization of the acidity generated by pit wall reactions.*

Kinetic Tests of Pit Wall Rocks. In addition to the static tests, humidity cell tests were performed on samples collected from the various geologic formations and ore. The humidity cell test is a kinetic test method which simulates 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.

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 are summarized as follows:

- *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.*
- *High arsenic concentrations were generated only when the pH was below 5, but not all acid leachates contained high arsenic concentrations.*
- *No trace elements other than arsenic appeared in significant concentrations.*

Arsenic Adsorption. Although arsenic generally tends to be desorbed at high pH, adsorption by iron oxyhydroxides is an important control on arsenic concentrations in oxidizing solutions. A critical question is whether adsorption would occur at the predicted pH of the water in the pit (pH 7.0 to 8.6). Pierce and Moore (1982) show that adsorption of arsenate occurs up to pH 9.8 *(the limit of their data), although adsorption becomes weaker as pH increases. Belzile and Tessier (1990) documented that the arsenic concentrations in pore-waters from 16 lakes in Canada (pH 4.0 to 8.4) were controlled by adsorption on iron oxyhydroxides. Furthermore, they showed that the observed concentrations in the field agreed very well with predictions based on the surface complexation model (as used in MINTEQ2A) and the laboratory-derived constants of Pierce and Moore. Fuller and Davis (1989) documented that adsorption-desorption on iron oxyhydroxides controlled arsenic concentrations in a contaminated stream in South Dakota. They reproduced the field result by coprecipitating arsenic with iron in the laboratory. Under their experimental conditions, 95 percent of the dissolved arsenic was removed at pH 8.0, and 85 percent was removed at pH 9.0. Goldberg and Glaubig (1988) document that As(V) is also adsorbed by clay minerals in the pH range of interest. Studies of cycling of arsenic and iron in the redoxcline of marine anoxic basins (Peterson and Carpenter 1983; Andreae and Froelich 1984) demonstrate that arsenic is effectively sorbed in sea water at pH values around 8.*

The most direct evidence for the adsorption of arsenic under the approximate conditions of the proposed water body is the performance of Barrick's present water treatment plant (see Table 3-11 in the Draft EIS). The input to the treatment plant has a mean pH of 8.02 and arsenic concentration of 0.14 mg/L. The output has a mean pH of 7.75 and arsenic concentration of 0.03 mg/l. The treatment consists of adding ferric sulfate and a flocculant. The iron precipitates as ferric oxyhydroxide scavenging arsenic in the process. The ratio of iron to arsenic used in the process is between 4:1 and 7:1 (Technical Report page 5-13 and Sawyer 1991). Thus arsenic removal by adsorption onto ferric oxyhydroxide occurs under conditions approximating those in the proposed Betze Pit water body.

The average weight ratio of iron to arsenic in the wall rock is 22:1 (the average of the analyses in Water Resources Technical Report Table 4-1), which is well above the ratio used in the treatment plant. It is impossible to predict quantitatively the exact extent to which arsenic would be adsorbed by iron oxyhydroxides during wall rock alteration because both the absolute rate of alteration of wall rock and the relative release rates of arsenic and iron are not known. However, the above information indicates that wall rock alteration should be a net sink for arsenic rather than a net source.

<u>Predicted Betze Pit Water Chemistry</u>. The water quality of the Betze Pit water body was predicted for several potential future scenarios. The results shown in Table 4-19 were computed for the following conditions:

- *oxic conditions;*
- *no reaction with wall rock;*

TABLE 4-19

(Revised)

Predicted Pit Water Composition
Under Oxic Conditions
(mg/l)

Parameter	Inflow Weighting Year 2100	Inflow Weighting Steady State	Geochemical Weighting Year 2100	Geochemical Weighting Steady State
Alkalinity (as Ca CO_3)	258	419	234	302
Aluminum (Al)	0.05	0.05	0.05	0.05
Arsenic (As)	0.075	0.12	0.096	0.155
Boron (B)	1.04	1.69	0.95	1.54
Cadmium (Cd)	0.01	0.01	0.01	0.02
Calcium (Ca)	6.81	2.95	8.5	5.30
Chloride (Cl)	23.3	37.7	22.5	36.4
Copper (Cu)	0.01	0.02	0.02	0.03
Cyanide (CN)	0.01	0.01	0.01	0.01
Fluoride (F)	1.77	2.86	1.67	2.70
Iron (Fe) (T)	0.72	1.17	1.10	1.78
Lead (Pb)	0.01	0.02	0.02	0.03
Magnesium (Mg)	31.0	50.0	30.2	48.8
Manganese (Mn)	0.05	0.05	0.05	0.05
Nickel (Ni)	0.02	0.02	0.02	0.03
Nitrate (NO_3)	0.11	0.17	0.27	0.43
Phosphate (PO_4)	0.04	0.07	0.09	0.14
Potassium (K)	27.3	44.1	25.1	40.6
Silica ($SiSO_2$)	24.9	40.3	27.9	45.2
Sodium (Na)	99.0	160.1	92.3	149.3
Sulfate (SO_4)	92.7	149.9	96.1	155.4
Zinc (Zn)	0.03	0.04	0.04	0.07
Total Dissolved Solids (TDS)	464	743	447	669
pH	8.42	8.60	8.35	8.45

- *conditions at the year 2100 (approximately 100 years in the future) and at chemical steady state; and*
- *groundwater inflow estimated by groundwater inflow weighting and by geochemical weighting (see Table 4-16 and Appendix B-4).*

The predicted composition of the water body in the pit at the year 2100 and under steady 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 increased by 39 percent for the year 2100 and by 125 percent for the chemical steady state condition (see Table 4-14). 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 pH would be approximately 8.3 to 8.6. The predicted arsenic concentration would exceed the drinking water standard. 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 factor associated with the predicted arsenic concentration is about ±3.

As stated in the above section on Static Tests of Wall Rock, acidification of the Betze Pit water body should not occur. As sulfides oxidize, the acidity generated would react with calcite in the wall rock (or alkalinity in solution) to produce a calcium-sulfate type water. Thus, progressive reaction would cause a rise in calcium and sulfate concentrations, a decrease in bicarbonate concentration, and a slight drop in pH. As an extreme end-member, the water could reach gypsum saturation, after which its composition would be essentially unchanged by further reaction with the wall rock. To reach this end-member, the water would have to react with all the sulfide in the pit wall to a depth about 3 meters. This is physically unlikely. The most probable pit water composition is close to that predicted for the assumption of no wall rock reaction, with slightly higher calcium and sulfate values.

The elements discussed here are those which show elevated values in either the rock or groundwater.

- *Arsenic: The predicted concentration at the year 2100 resulting from evaporation of the inflow water is 0.07 to 0.10 mg/L, which is above the drinking water standard. The predicted concentration at steady state is 0.12 to 0.16 mg/L. The uncertainty factor associated with the predicted arsenic numbers is about ±3. Some arsenic is likely to be removed by adsorption/coprecipitation on an* *iron oxyhydroxide, but the amount would be small because the amount of available iron oxyhydroxide is small.*

The wall rock is not expected to be a major source of arsenic to the water. The humidity cell tests (see discussion in the Water Resources Technical Report) showed that a significant release of arsenic occurred only when the environment was acidic. Even though local areas of the pit wall rock have the potential to generate acidity, there should be sufficient mixing of the pit water to neutralize these local "hot spots," so that the pit walls below the level of the water surface should not be a significant source of dissolved arsenic. It is possible that "hot spots" may occur in the pit wall above the water level. In view of the dry climate and the volume and alkalinity of inflow water, it is unlikely that such "hot spots" would have a significant effect on the overall chemistry of the water body in the Betze Pit.

- *Aluminum: Concentrations would be insignificant at pH of about 8 because of the insolubility of aluminum hydroxide or an aluminosilicate. The high values reported in some of the inflow waters probably reflect particulate aluminum rather than dissolved aluminum since the samples were unfiltered.*

- *Barium: Concentrations would be insignificant because of the insolubility of barium sulfate.*

- *Copper, chromium, lead: Concentrations should all be insoluble at pH 8. The humidity cell tests show no significant release of these elements.*

- *Iron and manganese: Concentrations should be low in oxidizing water at pH 8 (insoluble oxides/oxyhydroxides).*

<u>Stratification of Betze Pit Waterbody</u>. Stratification of the Betze Pit is likely as the inflow of thermal water decreases and the volume of the water body increases. At some point in the future, it is likely that a permanently stratified or meromictic condition would occur. However, in the early years of the water body's existence, the smaller volume and larger inflow rate of thermal water would likely result in a well mixed condition. In the period of time between these two conditions, monomictic (turnover once a year) or dimictic (turnover twice a year) conditions which involve annual or semi-annual overturning are likely. An oxidizing environment should be maintained during both the completely mixed period and the period of monomictic/dimictic conditions. Anoxic conditions should not develop during annual (or semi-annual) stratification events because of the relatively low organic content coupled with the large volume of the water body. This conclusion is supported by an analysis of dissolved oxygen dynamics in the

water body which demonstrates that even for worst-case conditions, 2.0 to 3.5 years of continuous stratification would be required for anoxic conditions to develop in the hypolimnion (lower layer). Please refer to Appendix B-2 in the Final EIS, Oxygen Depletion Modeling of Betze Pit.

A permanently stratified water body would most likely have an epilimnion (surface layer) with arsenic concentrations similar to that of a completely mixed water body and a hypolimnion (lower layer) with lower arsenic concentrations due to the formation of insoluble arsenic sulfides. For the situation where mixing occurs infrequently and the hypolimnion varies between anoxic and oxic conditions, it is difficult to predict what the arsenic concentration might be during (and shortly after) the transition period. However, it is likely that such events would be infrequent and relatively short in duration and, therefore, any short-term increase in arsenic concentration should not have any major adverse ecological effects. Additionally, it is believed that redox disequilibria would have no major significance in the determination of arsenic concentrations in the water body. Detailed discussions of the expected effect on arsenic concentration under various potential mixing conditions, and the effects of redox disequilibrium are discussed in Appendix B-6.

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 (+V, +III, 0 [metallic], and -III). Arsenic metal occurs only rarely. The -III state is present in gaseous AsH_3 (arsine) which may form under some natural conditions. In aquatic environments, the +III and +V 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 (+III) or pentavalent (+V), 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 of concern 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.*

The estimated arsenic concentrations in the Betze Pit water body should not result in adverse reactions in higher trophic-level organisms associated with accumulation of arsenic. Studies have shown that high levels of arsenic (dose = 300 ppm As) can significantly affect growth and brain biochemistry when fed to mallard ducklings (Camardese et al. 1990). However, the concentrations predicted for the Betze Pit water body are much lower (0.16 mg/l) than levels necessary to cause adverse effects. It is unlikely that waterfowl could accumulate hazardous levels of arsenic through the food chain. Lindsay and Sanders (1990) found that in a simple food chain, while phytoplankton demonstrated the ability to concentrate arsenic directly from the water column, a herbivore, brine shrimp (Artemia) and a carnivore, grass shrimp (Palaemonetes pugio) accumulated arsenic neither through the food chain nor directly from the water column. Therefore, even though it is likely that algae and vascular plants (growing in the narrow littoral zone) would accumulate some arsenic, organisms ingesting these plants should not be exposed to hazardous levels.

Manganese Toxicity. Nevada has a drinking water standard of 0.05 mg/L and a secondary MCL of 0.02 mg/L. Since drinking water standards are typically less stringent than aquatic life standards, this might appear to indicate potential manganese toxicity problems for organisms in Betze Pit. However, recent research indicates that a value of 0.05 mg/L is a very conservative standard and overly-protective of aquatic life.

To help fill in the data gaps concerning manganese toxicity, acute and chronic toxicity tests were performed on fish and invertebrate species (Stubblefield and Patti 1990). As with many other metals, it was found that manganese toxicity is dependent upon the hardness of the water. Using methods and criteria established by the EPA, equations were developed to calculate a manganese criterion based upon hardness. The hardness-dependency is shown as follows:

Hardness	CMC[1] (µg/L)	CCC[2] (µg/L)
50	648	551
100	1,011	861
200	1,578	1,344

[1]*Criteria Maximum Concentration (Acute criteria).*
[2]*Criteria Continuous Concentration (Chronic criteria).*

The hardness of Betze Pit water can be calculated based upon the revised estimate of Betze Pit water quality presented in Table 4-19. The hardness of Betze Pit water (calculated from calcium and magnesium) will be approximately 145 in the year 2100 and approximately 213 at steady state. Assuming that the hardness of the Betze Pit water may drop as low as 100 mg/L $CaCO_3$, a calculated chronic criterion might range from 861 to over 1,344 µg/L. A value of 861 ug/L is over an order of magnitude greater than the projected manganese concentration of 50 µg/L. For the projected manganese concentration to cause potential chronic toxicity, the hardness would have to be reduced to 1 mg/L or less. These data show that manganese should pose no toxicity problems in the Betze Pit.

Bioconcentration of Manganese. Few data are available on a bioconcentration potential of manganese. Because manganese may be relatively insoluble, depending on its form, benthic organisms may be exposed more than other animals, such as plankton or pelagic nekton (e.g., fish). Patrick and Loutit (1976) found that Tubifex sp. (Tubificidae, Oligochaeta), which is a bottom-dwelling organism, did accumulate manganese from its diet. However, because benthic biomass in Betze Pit should be very low, and manganese concentrations are predicted to be low, food-chain transfer (bioaccumulation) of manganese by higher trophic-level organisms, including waterfowl, should not be of concern.

Betze Pit Water Body Physical Characterization Study. 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 the 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 at the bottom of the water body that would be within the 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 produced during handling and intermediate storage (i.e., sulfates and iron oxyhydroxides with adsorbed trace elements).

When the waste rock is moved to the waste rock disposal areas, the waste rock would be stored in an unsaturated condition. Sulfides in the waste rock would undergo oxidation over time, producing primarily gypsum ($CaSO_4.2H_2O$) and an iron oxyhydroxide phase which binds the arsenic and other trace elements. If the waste rock were returned to the pit and subsequently saturated with inflow waters, the interstitial water would become anaerobic from oxidation of sulfides and ferrous iron, but availability of hydrogen sulfide (H_2S) would be minimal because of the low availability of organic carbon. Under such reducing conditions, iron oxyhydroxides would tend to dissolve, releasing arsenic and other trace elements, and adsorbed arsenic would be reduced from the (+V) to the (+III) state. Arsenic (III) is much more weakly adsorbed than arsenic (V), and hence would probably be present in relatively high concentrations in solution. The water in the refilled material would thus be relatively saline (from dissolution of gypsum) and contain relatively high concentrations of arsenic and possibly other trace elements.

Over the long term, groundwater quality would stabilize as the soluble material generated during above-ground storage and handling is flushed out of the system. As a result, a plume of poor quality water would move downstream through the groundwater system, which would represent an adverse impact.

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 the 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 <u>No Action Alternative</u>. 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 <u>Mitigation</u>. The monitoring and mitigation measures that will be required by the BLM are presented in Section 2.3.4 as part of the Agency Preferred Alternative.

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 <u>Proposed Action</u>. 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 <u>Alternatives</u>

<u>Partial Pit Backfill</u>. 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. ***The monitoring and mitigation measures that will be required by the BLM are presented in Section 2.3.4 as part of the Agency Preferred Alternative.***

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.

<u>Waste Rock Disposal Areas</u>. 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.

<u>Ore Stockpiles</u>. 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.

Laboratory analyses of tailings slurry and ore samples are presented in Appendix B-3 of the Final EIS. The tailings slurry analyses represent constituents within both the solid and liquid phases of the tailings slurry. The ore analyses are representative of the solid material to be deposited in the tailings impoundment. The ore sample analyses are the result of whole rock analysis of cores from exploration and development drilling and are representative of the material feed to the mill. With the exception of gold and silver, constituents of the ore would pass through the mill for disposal in the tailings impoundment.

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 <u>Alternatives</u>

<u>Waste Rock Disposal Areas and Processing Facilities</u>. 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.

<u>Ore Stockpiles</u>. One alternative ore stockpile would be located on the top of the completed South Block waste rock disposal area. ***Based on whole rock analyses for waste rock from the Betze Pit, it is likely that sufficient acid-consuming material is located within the waste rock disposal area to mitigate groundwater impacts from seepage through the ore stockpiles.*** 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 groundwater impacts due to seepage of acidic leachate.

4.4.11.3 <u>Cumulative Impacts</u>. 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 <u>No Action Alternative</u>. 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 <u>Mitigation</u>. ***The monitoring and mitigation measures that will be required by the BLM are presented in Section 2.3.4 as part of the Agency Preferred Alternative.***

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 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

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.

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 Partial Pit Backfill. 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

The monitoring and mitigation measures that will be required by the BLM are presented in Section 2.3.4 as part of the Agency Preferred Alternative.

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

TABLE 4-21

PROJECTED DISTURBANCE OF VEGETATION RESOURCES

PROPOSED ACTION

Proposed Action	Ecological Site Description[1]									Acres Affected
	25-3	25-12	25-14	25-18	25-19	25-21	M	S-I	S-II	
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.

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 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.

Recontour Side Slopes to 2.5H:1V. 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. ***An additional 22 acres of riparian vegetation associated with perennial stream reaches of upper Boulder Creek, Rodeo Creek, Bell Creek, and Brush Creek, and nearly 38 acres associated with riparian areas not located along stream channels and which do not have spring discharge, bring the total number of acres potentially affected to approximately 330.***

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 <u>Waste Rock Disposal Areas</u>. The Far West waste rock alternative could contain the entire quantity of waste rock generated by the Proposed Action. The Clydesdales and North waste

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.

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 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 Leach Pad. 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 Tailings Impoundment.

Expanded North Block. 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).

Central North Block. 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 Water Disposal Methods. 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 Reclamation of Waste Rock Disposal Areas. 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

The monitoring and mitigation measures that will be required by the BLM are presented in Section 2.3.4 as part of the Agency Preferred Alternative.

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

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
S = Sage Grouse
RT = Red-tailed Hawk
HP = Hungarian Partridge
WF = Waterfowl

[3] A variety of wildlife habitats may be disturbed.

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.

Historically, the Little Boulder Valley was an important intermediate range for mule deer that was used until heavy snows forced the deer to the southern winter ranges. The Nevada Department of Wildlife (NDOW) has indicated that mule deer 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. *Now the deer are also forced onto the winter ranges earlier than in the past which has put more pressure on already poor quality winter ranges. This has resulted in increased winter mortalities which has contributed to reduced deer populations within the Tuscarora and Independence Mountain ranges.* 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.

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 <u>Mill Site</u>. The mill site would be located on previously disturbed habitat; therefore, no additional impacts to wildlife are expected.

4.7.1.6 <u>Tailings Impoundment</u>. 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 <u>Topsoil Stockpiles</u>. 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 <u>Mine Dewatering</u>. 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. *An additional 22 acres of riparian vegetation associated with perennial stream reaches of upper Boulder Creek, Rodeo Creek, Bell Creek, and Brush Creek, and nearly 38 acres associated with riparian areas not located along stream channels and which do not have spring discharge, bring the total number of acres potentially affected to approximately 330.*

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 Other Impacts. 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	25-3	25-12	25-14	25-19	25-21	M	S-I	S-II
	Ecological Site Description[1]							
	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 Ore Stockpiles. 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 Leach Pad. 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 Tailings Impoundment

Expanded North Block. 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.

Central North Block. 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 Water Disposal Methods. 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 Reclamation of Waste Rock Disposal Areas. 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 ***and fragmentation*** 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 ***and resulted in a loss of species diversity***. 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

The monitoring and mitigation measures that will be required by the BLM are presented in Section 2.3.4 as part of the Agency Preferred Alternative.

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 and 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 Wilderness. 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

The monitoring and mitigation measures that will be required by the BLM are presented in Section 2.3.4 as part of the Agency Preferred Alternative.

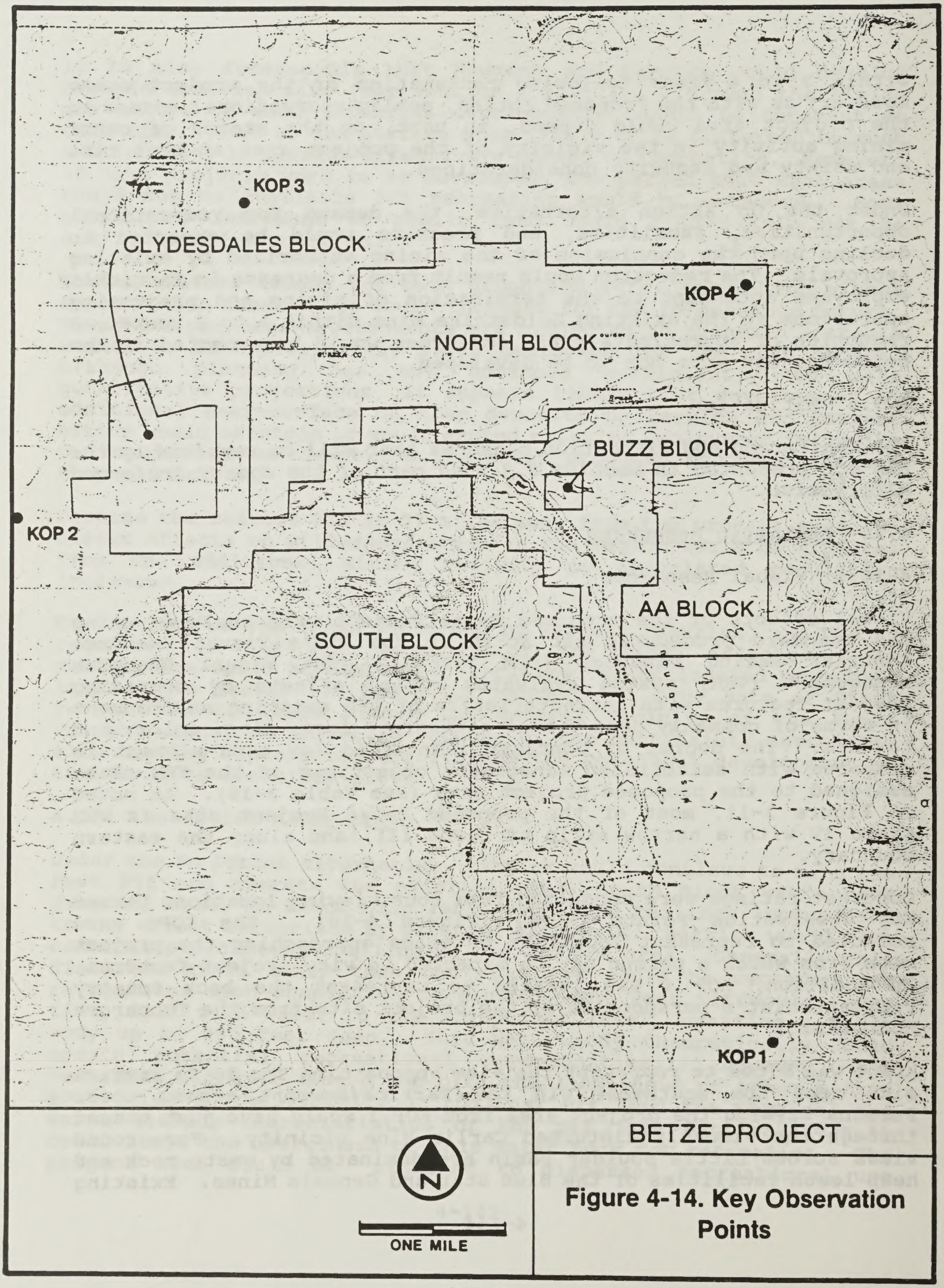
4.10 <u>Aesthetic Resources</u>

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



BETZE PROJECT

Figure 4-14. Key Observation Points

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 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 <u>No Action Alternative</u>. 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 <u>Mitigation</u>. ***The monitoring and mitigation measures that will be required by the BLM are presented in Section 2.3.4 as part of the Agency Preferred Alternative.***

4.10.2 Noise

4.10.2.1 <u>Proposed Action</u>. 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

The monitoring and mitigation measures that will be required by the BLM are presented in Section 2.3.4 as part of the Agency Preferred Alternative.

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. ***Mule deer and antelope depredation of high value forage created by alfalfa fields and stack yards may occur.***

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 Social and Economic Values

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 <u>Population and Demography</u>. 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.

<u>Construction</u>. 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 Housing. 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.

Construction. 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%)		Carlin (15%)	Other (5%)
	Peak	Avg	Peak and Avg	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.

<u>City of Elko</u>. 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.

<u>Carlin</u>. 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 <u>Water Disposal Methods</u>. 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. 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

The following are proposed mitigation measures that could be implemented should potential impacts identified in the impact analysis result from Barrick's proposed project.

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 Possible Conflicts Between the Proposed Action and Federal, State, and Local Land Uses and Policies

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 Unavoidable Adverse Effects

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 than 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.

precious metals contained in the ore would be irretrievably committed, but would be retained and appear in circulation in the world.

A peak annual consumption of 1.1 million gallons of diesel fuel, 115,000 gallons of gasoline and approximately 200,000 kW-hours of electricity constitutes an irretrievable commitment of these resources.

Soil losses from handling, stockpiling, and erosion from topsoil stockpiles would be irreversible. With over 137 acres of topsoil stockpiles on the project site containing over 1.6 million cubic yards, losses from all these sources could be substantial, minimized by limiting handling operations and the implementation of vegetation and erosion control procedures.

The Pete Pit would not be backfilled, but would fill with water; exposed benches and slopes, approximately 84 acres of ... This represents an irretrievable long-term loss of vegetation production and wildlife habitat on approximately 490 acres. If specific project facilities result in abandonment or the use of sage grouse leks, that would constitute an irretrievable impact to the sage grouse population.

The mine site, waste rock disposal areas, and leach heap that, 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, nevertheless, be long-term and essentially irreversible.

Mitigation stipulations have been proposed as part of the project approval, which would not irreversibly affect cultural resources.

If the No Action alternative were to be implemented, the commitment of resources would be similar to (although less than) the Proposed Action. Mining of the Pete Pit would be completed at its present size and a smaller open pit would remain. Reclamation would be initiated sooner than if the Proposed Action were implemented. The resources that would be consumed (e.g., fuel, electricity, reagents) by the Proposed Action would not be consumed; thus the gold contained in the deposit would remain undisturbed. Impacts to various resources (e.g., soils, water, vegetation, and wildlife) would be less extensive than under the Proposed Action. The mining of the Pete 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

Section 5.0 of the Draft EIS is incorporated herein by reference with the exception of Sections 5.3, 5.4, and 5.5 which are presented on the following pages.

5.3 Draft EIS Review

Section 5.0 of the Draft EIS described the process used to solicit input to preparation of the Draft EIS for the Betze Project, including a summary of the BLM's public participation plan for the project.

The BLM distributed approximately 200 copies of the Draft EIS to government agencies, organizations, and individuals in January 1991. During the 60-day public comment period, over 60 individuals submitted written comments and/or presented oral comments at the public meetings held in Elko and Reno, Nevada, on February 27 and 28, 1991, respectively. The comments and responses are presented in the following sections.

The following is a list of the agencies, groups, and organizations who received copies of the Draft EIS in January 1991.

Federal Agencies

Department of Agriculture
- *Humboldt National Forest*

Department of Defense
- *U.S. Army Corps of Engineers*
- *U.S. Air Force*

Department of Energy
- *Office of Environmental Compliance*

Department of the Interior
- *Bureau of Indian Affairs*
- *Bureau of Land Management*
  - *Director, Washington, D.C.*
  - *Nevada State Office*
  - *Battle Mountain District Office*
  - *Boise District Office*
  - *Ely District Office*
  - *Vale (OR) District Office*
- *Bureau of Mines*
- *Bureau of Reclamation*
- *Fish and Wildlife Service*
- *Minerals Management Service*
- *National Park Service*
- *Natural Resource Library*
- *Office of Environmental Affairs*
- *Office of Public Affairs*
- *Office of the Secretary/Pacific Southwest Region*
- *U.S. Geological Survey*

Environmental Protection Agency
Office of Environmental Review
Region IX

State of Nevada Agencies

Bureau of Mines
Department of Water Resources
Department of Wildlife
Indian Commission
State Clearinghouse Coordinator
State Library

Department of Conservation and Natural Resources

Division of Environmental Protection
Division of Historic Preservation and Archeology
Division of Water Planning

Department of Minerals

Regional Agencies

Northeast Nevada Development Authority

County Agencies

Elko County Advisory Board to Manage Wildlife
Elko County Association of Conservation Districts
Elko County Commissioners
Elko County Library
Elko County Manager
Elko County Resource Action Council
Eureka County Commissioners
Eureka County Planning Commission

Local Agencies

Elko Chamber of Commerce
Elko City Planning Board

Elected Officials

Governor of Nevada, Robert Miller
Mayor of Carlin, Lee Griswold
Mayor of Elko, George Corner
State Assemblyman John Carpenter
State Assemblyman John Marvel
State Senator Dean Rhoads
U.S. Representative Barbara Vucanovich
U.S. Representative James Bilbray
U.S. Senator Harry Reid
U.S. Senator Richard Bryan

Organizations

American Mining Congress
Intertribal Council of Nevada
Izaak Walton League
Minerals Exploration Coalition
National Audubon Society
National Wildlife Federation
Natural Resources Defense Council, Inc.
Nature Conservancy
Nevada Mining Association
Shoshone-Paiute Tribes of the Duck Valley Reservation
Sierra Club, Reno
Sierra Club, Toiyabe Chapter
Sierra Club, Utah Chapter
University of Nevada, Las Vegas
Library
University of Nevada, Reno
Department of Government Publications
Department of Range, Wildlife and Forestry

Industries

Cordex Exploration Company
Cortez Gold Mine
Dee Gold Mine
Gold Fields Operating Company
Homestake Mining Company
Independence Mining Company, Inc.
Newmont Gold Company
Pyramid Engineers and Land Surveyors
Sierra Pacific Power Company

Other

Elko Daily Free Press
Elko Independent
High Desert Advocate
Izzenhood Ranch
Las Vegas Review Journal
Maggie Creek Ranch
TS Ranch

5.4 *Written Comments and Responses*

The BLM received 61 letters of comment on the Draft EIS during the 60-day public comment period. The BLM reviewed all letters and identified the substantive comments (those addressing the accuracy or completeness of the Draft EIS) contained in each letter. The BLM has prepared responses for each of the substantive comments identified; the responses are presented in this section. Other comments have been reviewed and considered by the BLM in selecting the preferred alternative for the proposed project.

Table 5-1 lists each of the 61 comment letters by author and the reference number assigned to the letter. All letters have been reproduced in their entirety, and the content of all letters has been reviewed and considered.

Following Table 5-1, the comment letters and responses are presented. Each substantive comment is identified by a bracket, the letter number, and comment number within that letter (e.g., Comment 2-3 refers to the third comment in Letter 2). The response to each comment accompanies the letter and is identified by the reference number of the respective comment (e.g., Response to Comment 2-3).

The reader is reminded that this is an abbreviated Final EIS; therefore, it is necessary to use the Draft EIS in conjunction with the Final EIS in order to fully understand the impact assessment that was conducted for the proposed Betze Project.

TABLE 5-1

List of Comment Letters

1	North East Nevada Development Authority	32	Glenn D. Thackray
2	Pioneer Equipment Company	33	Nevada State Assemblyman John Carpenter
3	Vitality Center	34	U.S. Public Health Service
4	Elko Convention and Visitors Authority	35	State Senator Dean A. Rhoads
5	Wilson and Barrows, Ltd.	36	Elko Senior Citizens Center, Inc.
6	Evergreen Management Consultants	37	Elko County Committee Against Domestic Violence
7	Mayor, City of Carlin	38	Barrick Goldstrike Mines Inc.
8	Brite Stars Sales and Service	39	Nevada Department of Minerals
9	Coastal Chem Sales Company	40	Ducks Unlimited
10	Gallagher Ford	41	Nevada Department of Administration
11	U.S. Environmental Protection Agency	42	Nevada Division of Environmental Protection (T. J. Fronapfel)
12	Arnold Machinery Company	43	Nevada Division of Environmental Protection (D. Zimmerman)
13	Owens Ford-Mercury, Inc.	44	Nevada Division of Environmental Protection (D. Reavis)
14	David T. Grove, Orthodontist	45	Nevada Division of Environmental Protection (J. Johnson)
15	Mayor, City of Elko	46	Nevada Division of Environmental Protection (G. McCleary)
16	Fleischli Oil Co.	47	Nevada Division of Environmental Protection (G. Gentry)
17	Fleetguard Inc.	48	Nevada Division of Historic Preservation and Archeology
18	Elko Chamber of Commerce	49	Nevada Division of Water Planning (T. Taylor)
19	Tricon Metals & Services, Inc.	50	Nevada Division of Water Planning (R. A. Pahl)
20	Cashman Equipment	51	Nevada Department of Wildlife
21	Northern Nevada Community College	52	Elko General Hospital
22	John L. Dobra, Ph.D.	53	Nevada Mining Association
23	Nevada State Assemblyman John Marvel	54	Northern Nevada Community College Foundation
24	Glaser Land and Livestock Inc.	55	Sierra Club
25	TGMD Construction, Inc.	56	U.S. Fish and Wildlife Service
26	Nevada Area Council, Boy Scouts of America	57	Ivory and Company
27	Nevada Chukar Fund	58	Cate Equipment Company
28	Valley Bank of Nevada	59	Coopers & Lybrand
29	First Interstate Bank	60	Valley Bank
30	Turner Gas Company	61	USDI Bureau of Mines
31	Continental Lime Inc.		

Letter 1

NENDA
North East Nevada Development Authority

"Promoting Economic Development and Diversification Throughout Elko County"

Resolution 91-1

Whereas, the North East Nevada Development Authority has reviewed the socioeconomic chapter of the Betze Project Draft Environmental Impact Study, and

Whereas, Barrick Goldstrike Mines, Inc. is currently operating with 1093 employees, and

Whereas, the additional permanent employees will not place a significant impact on our community, and

Whereas, the private sector is attempting to meet the temporary housing needs for the temporary workers of the project, and

Whereas, the facilities have been established and have been in use for the purpose of temporary housing, and

Whereas, the cities which will be affected by the influx of the workers are capable of handling the impacts, and

Whereas, the operations timetable is key to the financial feasibility of this project and thus affects the economic well being of the individuals of Elko County, now therefore,

Be it Resolved, by the Board of Directors of the North East Nevada Development Authority, representing the economic development needs of Elko County, that the Bureau of Land Management should grant Barrick Goldstrike Mines, Inc. the necessary permits, in a timely manner, for the project described in the Betze Project in Northeast Nevada.

Dennis W. Parker
Chairman

2-15-91
Date

P.O. Box 2812 • Elko, Nevada 89801 • (702) 738-2100 • FAX (702) 738-7978

Letter 2

Pioneer Equipment
SERVING MINING & CONSTRUCTION RENO • ELY

RENO
P.O. BOX 11737
RENO, NEVADA 89510
900 MARIETTA WAY
SPARKS, NEVADA 89431
TELEPHONE (702) 356-1334
FAX: (702) 356-2117

ELKO
P.O. BOX 5130
ELKO, NEVADA 89802
4460 PIONEER WAY
ELKO, NEVADA 89802
TELEPHONE (702) 753-7587
FAX: (702) 753-756[illegible]

March 1, 1991

Bureau of Land Management
Elko District Office
Attention: Betze Coordinator
P. O. Box 831
Elko, NV 89801

I am writing to express my support of Barrick Goldstrike Mine's Betze Project.

Barrick has demonstrated a strong commitment to the surrounding communities and the environment. They have made conscientious and sincere efforts to avoid and mitigate undesirable environmental impacts and the Betze Project's Comprehensive Environmental Impact Statement demonstrates Barrick's commitment.

The Betze Project will have a strong and positive economic impact in Northeastern Nevada employing an average of 1200 employees living in Elko contributing to the county's and state's economy. The Project would generate local, state and federal taxes of several million dollars annually. Besides contributing to Nevada's economy, Barrick Goldstrike spends millions of dollars for mining equipment and supplies that are purchased throughout the United States contributing to our national economy.

Because of all the significant contributions and commitments of Barrick Goldstrike Mine's, I urge you to approve the Betze Project as soon as possible.

Sincerely,

PIONEER EQUIPMENT COMPANY

Emil Evasovic
President

EE:cja

Letter 3

Dorothy B. North, C.E.A.P.
Chief Executive Officer

VITALITY CENTER
RECOVERY AND BEYOND...

P.O. Box 2580 • Elko, Nevada 89801 • (702) 738-8004 • Fax (702) 738-2625

Eric G. Easterly
Chairman of the Board

ELKO DIST.	
DM	PA
RES	
ADM	
OPS	
FRA	
WRA	✓
PEC	✓
CF	
Code:	
X=Action	

March 1, 1991
DBN-91-011

Bureau of Land Management
Elko District Office
Post Office Box 831
Elko, Nevada 89801

Attention: Betze Coordinator

Reference: Betze Project

I have been associated with Barrick Goldstrike Mines, Inc. for many years through their support of Vitality Center and our efforts in the community. Additionally, I have served on various community and statewide projects with Barrick employees.

I have been consistently impressed with their concern for the community and welfare of our citizens. I feel secure in recommending support of any plans Barrick has to expand their operation in the Elko area.

The expansion activities will have a positive economic impact on northeastern Nevada and will generate millions of dollars in revenue annually for the city, county and state. I believe that they will make optimum efforts to mitigate or avoid any undesirable environmental impacts.

Because of Barrick's obvious commitment to community and environment, I urge you to approve the Betze Project.

Sincerely,

Dorothy B. North

Dorothy B. North, C.E.A.P.
Chief Executive Officer

DBN:hc

cc: Letter File
Reading File

Letter 4

ELKO

ELKO DIST.	
DM	PA
RES	
ADM	
OPS	
FRA	
WRA	✓
PEC	✓
CF	
Code:	
X=Action	

March 1, 1991

Bureau of Land Management
Elko District Office
ATTN: Betze Coordinator
P.O. Box 831
Elko, Nevada 89801

I am writing to express my support of Barrick Goldstrike Mine's Betze Project.

Barrick has demonstrated a strong commitment to the surrounding communities and the environment. They have made conscientious efforts to avoid and mitigate undesirable environmental impacts and the Betze Project's comprehensive Environmental Impact Statement demonstrates Barrick's commitment.

Also, the Project will have a very positive economic impact in Northeastern Nevada, with a workforce averaging 1,200 employees. The Project is expected to generate local, state and federal tax revenues of several million dollars annually.

Because of Barrick's demonstrated commitment to preserve wildlife habitats, visual and cultural resources and its significant contributions to the local economy, I urge you to approve the project as soon as possible.

Sincerely,

Phyllis Peterson

Phyllis Peterson
Interim Administrator

ELKO CONVENTION & VISITORS AUTHORITY
700 Moren Way · Elko, Nevada 89801
1-800-248-ELKO (702) 738-4091 FAX (702) 738-2420

Letter 5

WILSON AND BARROWS, LTD.
ATTORNEYS AT LAW
442 COURT ST.
ELKO, NEVADA 89801

STEWART R. WILSON
RICHARD G. BARROWS
—
ORVILLE R. WILSON
OF COUNSEL

PHONE# 702-738-7271
—
FAX# 702-738-5041
P.O. Box 389

March 1, 1991

Bureau of Land Management
Elko District Office
ATTN: Betze Coordinator
P. O. Box 831
Elko, Nevada 89801

Re: **Barrick Goldstrike Mine's Betze Project**

I am writing to urge you to approve the Betze Project as described in Barrick's EIS.

Barrick has been a model citizen of northeastern Nevada and occupant of the public domain. The approval of the Betze Project is important to the economy of the City of Elko and northeastern Nevada. Further, it is important to the U.S. economy which has a need for precious metals.

The benefits of the Betze Project to all concerned will far outweigh any adverse impacts.

Sincerely,

RICHARD G. BARROWS

cc:
Barrick Goldstrike Mines Inc.
P. O. Box 29
Elko, Nevada 89801

91030051.jmh

Letter 6

EVERGREEN MANAGEMENT CONSULTANTS
P.O. Box 2556
Elko, Nevada 89801
738-9328

March 5, 1991

Bureau of Land Management
Elko District Office
Post Office Box 831
Elko, Nevada 89801

Attention: Betze Coordinator

Reference: Betze Project

I would like to express my support of the Betze Project that is being proposed by Barrick Goldstrike Mine, Inc.

As Chairman of the Soroptimist Environmental Committee and a member of the Elko City Planning Commission, I have observed the planning and development activities of Barrick in our locale. It is my opinion that they have made conscientious efforts in the past to avoid or mitigate adverse environmental impacts. They obviously are putting the same concern and planning in the Betze Project.

Barrick projects have provided great economic opportunity to this part of Nevada. However, this economic growth has been and must be tempered with sufficient controls so that the negative impact on our environment is minimal.

I appreciate the watchful eye of the Bureau of Land Management and your protection of the country in which I live. With your direction and the commitment that Barrick has demonstrated, I urge you to approve this project as quickly as possible.

Thank you for your time.

Sincerely,

Ester M. Quilici
Owner

EMQ:hc

cc: File

Letter 7

City of Carlin
101 South Eighth Street
P.O. Box 787
Carlin, Nevada 89822
(702) 754-6354

March 4, 1991

Bureau of Land Management
Elko District Office
ATTN: Betze Coordinator
P.O. Box 831
Elko, NV 89801

Greetings:

This letter is being written to express the support of the Carlin City Council regarding the Barrick Goldstrike Mine's Betze Project.

Barrick has demonstrated a strong commitment to the surrounding communities and the environment. They have made conscientious efforts to avoid and mitigate undesirable environmental impacts and the Betze Project's comprehensive Environmental Impact Statement demonstrates Barrick's commitment.

Also, the Project will have a very positive economic impact in the Northeastern Nevada area, with a workforce averaging 1,200 employees. The Project is expected to generate local, state and federal tax revenues of several million dollars annually.

Because of Barrick's demonstrated commitment to preserve wildlife habitats, visual and cultural resources and its significant contribution to the local economy, we urge you to approve the project as soon as possible.

Sincerely,

Lee Griswold/ca

Lee Griswold
Mayor

LG:ca
cc: Council

Letter 8

Gary Heit, Owner
Brite Stars Sales and Service
P.O. Box 2528
Elko, NV 89801

March 1, 1991

Bureau of Land Management
Elko District Office
ATTN: Betze Coordinator
P.O. Box 831
Elko, NV 89801

Dear Sirs;

As a supplier to the mining industry and other area concerns I am writing to express my support of Barrick Goldstrike Mine's Betze Project. Barrick has demonstrated a strong commitment to the surrounding communities and the environment. They have made conscientious efforts to avoid and mitigate undesirable environmental impacts and the Betze Project's comprehensive Environmental Impact Statement demonstrates Barrick's commitment.

Also, the Project will have a very positive economic impact in Northeastern Nevada, with a workforce averaging 1200 employees. The Project is expected to generate local, state and federal tax revenues of several million dollars annually.

Because of Barrick's demonstrated commitment to preserve wildlife habitats, visual and cultural resources and its significant contribution to the local economy, I urge you to approve the project as soon as possible.

Sincerely,

Gary Heit

Gary Heit
Owner

Letter 9

Coastal Chem Sales Company
A SUBSIDIARY OF THE COASTAL CORPORATION

The Energy People

Ronald G. Sutherland
PRESIDENT

March 5, 1991

BUREAU OF LAND MANAGEMENT
ELKO DISTRICT OFFICE
ATTENTION: BETZE COORDINATOR
P O BOX 831
ELKO NV 89801

Gentlemen:

We are writing in support of the Barrick Goldstrike Mine's Betze Project.

We have been dealing with Barrick for the past three years and have observed the progress in their operation. We have observed Barrick's strong concern and commitment to the community and the environment. We do business throughout the West and have access to many mining operations, and it is obvious to us Barrick is a first-class responsible company. They have made a dedicated effort to avoid environmental impact in their project work. The detailed work that has been done on the Betze Project's environmental impact statement is further proof of the responsible attitude and action of Barrick Goldstrike.

Their business operations have had a strong and positive economic impact in northern Nevada. They have invested large amounts of capital and have provided a significant number of jobs in that area. Their positive efforts have also encouraged companies like ours to invest in Nevada in a supporting role for the mining industry. Our investment level is not as large as Barrick's, but our current project at Battle Mountain does consist of a $35,000,000 investment and new jobs. This is further evidence of the confidence other businesses have in the Barrick Goldstrike operation and their reputation in Nevada.

A majority of our employees are from the West and appreciate the beauty of the country and our wildlife, and we feel that Barrick has been very sensitive to these issues. We urge that you approve Barrick Goldstrike Mine's Betze Project as soon as possible.

Sincerely Yours,

Ronald G. Sutherland

RGS:jp
113BC

P. O. BOX 1287
CHEYENNE, WYOMING 82003
307/637-2700

Letter 10

FORD
LINCOLN
MERCURY

GALLAGHER FORD
Lincoln Mercury
650 30th St.-P.O. Box 791 - Elko, Nevada 89801
Phone (702) 738-3147

March 1, 1991

Bureau of Land Management
Elko District Office
P.O. Box 831
Elko, NV 89801

Attn: Betze Coordinator

Gentlemen:

I am writing you to express my support of Barrick Goldstrike's Betze project.

Having toured Barrick's operation, I feel they have made a concerted effort to protect the environment as well as wildlife and wild life habitat.

Barrick has made a strong commitment to Elko and has made numerous contributions to the growth of our community.

For these reasons I urge you to approve the Betze project as soon as possible.

Sincerely,

Michael H. Gallagher
President - Gallagher Ford Linc-Merc

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, Ca. 94105

March 1, 1991

Mr. Nick Rieger
Elko District Office
Bureau of Land Management
3900 E. Idaho Street
P.O. Box 831
Elko, Nevada 89801

Dear Mr. Rieger:

The Environmental Protection Agency (EPA) has reviewed the Draft Environmental Impact Statement (DEIS) for **Betze Project, Barrick Goldstrike Mines, Inc., Elko, Nevada.** Our comments on the DEIS are provided pursuant to the National Environmental Policy Act (NEPA) and EPA's authorities under section 309 of the Clean Air Act.

The Betze Project DEIS identifies and analyzes the proposed expansion of an existing gold mining operation, which would include the additional excavation of a 345-acre parcel to a depth of 1800 feet below ground surface. The proposed operation expansion would also include the disturbance of another 1800 acres for a heap leach pad, tailings impoundment, waste rock disposal area, stockpiles, haul roads, pipeline corridors, and construction areas. The expanded operation would permit recovery of 15.1 million ounces of gold from the excavated and processed ore over a twenty-year period.

We have classified this DEIS as EC-2 -- Environmental Concerns-Insufficient Information (see enclosed "Summary of Rating Definitions and Follow-Up Action"). Our rating reflects our concerns regarding the potential significant impacts to water quality and wetland/riparian habitats as a result of effluent discharge and groundwater drawdown during and after project implementation. We also recommend that BLM select the alternative to place the ore stockpile on the completed South Block waste rock disposal area or on the spent AA Heap Leach pads rather than in the locations of the proposed alternative. In addition, further detail regarding monitoring and mitigation is necessary and should be provided in the Final Environmental Impact Statement (FEIS). Our detailed comments regarding the DEIS are attached.

Printed on Recycled Paper

We appreciate the opportunity to review this DEIS. Please send three copies of the FEIS to this office at the same time it is officially filed with our Washington, D.C., office. If you have any questions, please contact Dr. Jacqueline Wyland at (FTS) 848-1584 or Jeanne Dunn Geselbracht at FTS 848-1576.

Sincerely,

for Deanna M. Wieman, Director
Office of External Affairs

91-025
001010

Enclosures

cc: NDEP

-2-

Letter 11 Continued

Response To Letter 11 Continued

SUMMARY OF RATING DEFINITIONS AND FOLLOW-UP ACTION*

Environmental Impact of the Action

LO—Lack of Objections
The EPA review has not identified any potential environmental impacts requiring substantive changes to the proposal. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal.

EC—Environmental Concerns
The EPA review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impact. EPA would like to work with the lead agency to reduce these impacts.

EO—Environmental Objections
The EPA review has identified significant environmental impacts that must be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no action alternative or a new alternative). EPA intends to work with the lead agency to reduce these impacts.

EU—Environmentally Unsatisfactory
The EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of environmental quality, public health or welfare. EPA intends to work with the lead agency to reduce these impacts. If the potential unsatisfactory impacts are not corrected at the final EIS stage, this proposal will be recommended for referral to the Council on Environmental Quality (CEQ).

Adequacy of the Impact Statement

Category 1—Adequate
EPA believes the draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis or data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

Category 2—Insufficient Information

The draft EIS does not contain sufficient information for EPA to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the EPA reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analyzed in the draft EIS, which could reduce the environmental impacts of the action. The identified additional information, data, analyses, or discussion should be included in the final EIS.

Category 3—Inadequate
EPA does not believe that the draft EIS adequately assesses potentially significant environmental impacts of the action, or the EPA reviewer has identified new, reasonably available alternatives that are outside of the spectrum of alternatives analyzed in the draft EIS, which should be analyzed in order to reduce the potentially significant environmental impacts. EPA believes that the identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. EPA does not believe that the draft EIS is adequate for the purposes of the NEPA and/or Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS. On the basis of the potential significant impacts involved, this proposal could be a candidate for referral to the CEQ.

*From: EPA Manual 1640, "Policy and Procedures for the Review of Federal Actions Impacting the Environment."

Letter 11 Continued

Water Resources Issues

11-1 1. Based on the discussion in the DEIS regarding the ore stockpiles, it appears that the potential adverse impacts to groundwater quality are greater under the proposed ore stockpile alternative than under the South Block or AA Heap Leach Pad alternatives. EPA recommends that the alternatives to place the ore stockpile on the completed South Block waste rock disposal area or on the spent AA Heap Leach pads be selected over the proposed alternative.

11-2 2. Ongoing key monitoring programs are required to pinpoint the location and extent of adverse impacts to water quality that may occur as a result of this project. Monitoring should be conducted for all parameters that have water quality standards. Data from the monitoring programs need to be reviewed frequently throughout the duration of the project for water quality degradation. Violations of water quality standards from the National Pollutant Discharge Elimination System (NPDES) permit could result in enforcement actions. Violation of a nonpoint nature would result in revised best management practices and controls to maintain water quality.

11-3 Should degradation occur with sufficient magnitude and frequency, mitigation should be required. Mitigation would preferably involve providing higher quality water to on-site degraded water to offset the degradation. Another less preferable option would be the creation of a new off-site habitat close to the site of degradation.

11-4 3. Water pumped from deep wells could be as warm as 130° F. The FEIS should discuss monitoring and mitigation measures that would be taken to ensure that water temperatures would not be damaging to beneficial uses, vegetation, or aquatic resources.

11-5 4. Water quality of the inflow to the TS Ranch Reservoir appears to violate existing water quality standards for the following toxic pollutants as contained in Nevada Administrative Code (NAC) 445.1339: boron, cyanide, fluoride, and thallium. BLM should consult with the Nevada Department of Environmental Protection (NDEP) to ascertatin the applicability of these standards to this reservoir.

11-6 5. The proposed action would result in a large body of water in the Betze Pit. This body of water would be classified by NDEP and subject to water quality standards. In addition to class standards or specific standards assigned to the Betze Pit waterbody, statewide toxic standards contained in the NAC 445.1339 would apply. Also, federal water quality standards may be promulgated that expand the list of water quality standards for

1

Response To Letter 11 Continued

11-1 Your recommendation has been noted; the alternative of placing the ore stockpile on the South Block waste rock disposal area has been incorporated into the Agency Preferred Alternative (see Section 2.3.4 of the Final EIS).

11-2 The BLM agrees that regular and continuing monitoring programs are appropriate for this project. An expanded description of the monitoring requirements with which Barrick presently complies under the terms and conditions of permits issued by NDEP, NDOW, and the Nevada State Engineer is presented in Section 2.1.8 of the Final EIS. Your comment was considered in the development of mitigation measures and the selection of the Agency Preferred Alternative; additional long-term monitoring and mitigation measures have been incorporated into Section 2.3.4 of the Final EIS.

11-3 The BLM agrees that mitigation should be required if monitoring indicates that undue and unnecessary degradation is occurring or may occur; therefore, specific monitoring and mitigation measures are addressed in Section 2.3.4 of the Final EIS.

11-4 Section 2.1.8 of the Final EIS has been expanded to include provisions concerning the monitoring of the discharge of water with elevated temperatures into the TS Ranch Reservoir. Data collected from existing operations indicate that the temperature at the point of discharge to the unnamed drainage ranged from 25°C to 42°C and that the temperature at the reservoir ranged from 22°C to 36°C. These data indicate that the temperature of the water decreases sufficiently after discharge so that downstream beneficial uses would not be adversely affected. Vegetation in the unnamed drainage and the reservoir would not be affected by the higher temperatures. The temperature of the water at the point of discharge to the unnamed drainage, however, is expected to preclude the establishment of certain aquatic biota in the upper reaches of the drainage. There is not a significant amount of aquatic biota present in the unnamed drainage. Prior to the use of the drainage as a conduit for the dewatering discharge, it was an intermittent stream that did not support an aquatic ecosystem. Presently the drainage is a relatively straight channel lined with rip-rap and does not provide a physical habitat conducive to the establishment or maintenance of an aquatic ecosystem. Thermal effects on the TS Ranch Reservoir should be limited due to heat loss as the discharge water travels down the unnamed drainage and due to dilution with reservoir water. It should also be noted that the TS Ranch Reservoir is not anticipated to support a substantial amount of aquatic biota. Significant variations in water level of the reservoir will be experienced during the year, thus inhibiting the development of a stable ecosystem.

11-5 The water quality data included in the Draft EIS, Water Resources Technical Report, as well as the data submitted by Barrick to the NDEP, do not indicate any violations of the applicable water quality standards at the inflow to the reservoir for the constituents identified in the comment. All reported analyses of water flowing into the reservoir for cyanide and thallium have been below the detection limit. The standards BLM applied to the dewatering discharge are based on drinking water quality criteria. The fluoride concentrations are less than the drinking water standard for fluoride, and no drinking water standard has been adopted for boron. The BLM has confirmed the applicability of these standards with the NDEP.

Letter 11 Continued

11-6 (Cont.) toxic pollutants in waters of Nevada. Long-term compliance with existing and proposed water quality standards in this newly created waterbody should be addressed in the FEIS.

11-7 6. Increases in construction activity could result in increased erosion and surface water quality degradation. The FEIS should address procedures that would be used to minimize these adverse impacts.

Wetland and Riparian Issues

1. EPA is extremely concerned about the substantial volume of water that would be drawn from the aquifer in order to dewater the Betze Pit. Groundwater drawdown could have significant long-term adverse impacts on up to 271 acres of wetland and riparian habitats as well as on the wildlife that use them. Wetland and riparian areas are essential to maintaining biodiversity and healthy wildlife populations in Nevada. EPA urges BLM to require monitoring and mitigation of the wetland and riparian losses as a condition to the permit or operating plan. A habitat replacement fund or other mitigation, such as acre-for-acre replacement of wetland and riparian habitat losses, would be appropriate in light of the potentially extensive losses that could result to the project vicinity. The FEIS should discuss in detail a monitoring program to ensure the detection of sites as they become affected, as well as an enforceable mitigation plan (e.g., location and acreage of replacement land, quality/value of replacement habitat, specific measures to enhance or create replacement habitat, long-term monitoring to ensure success of the measure). 11-8

11-9 2. According to page 4-52 (paragraph 1) of the DEIS, 271 acres of riparian/aquatic habitat could be affected by drawdown of the groundwater during the recovery period. According to page 2-53 (paragraph 1), however, only 159 acres could be affected. The FEIS should clarify this discrepancy.

2

Response To Letter 11 Continued

11-6 The BLM agrees. Nevada water quality regulations establish water quality criteria based on the beneficial use supported by the waters. NDEP will determine the applicable water quality standards once the water body forms in the Betze Pit. Projections of long-term water quality are addressed in Sections 4.4.9 and 4.4.10 of the EIS. Please also see the response to comment 11-3.

11-7 As described in Section 2.2.5 of the Final EIS, a sediment control plan will be developed by Barrick in compliance with EPA requirements, and reviewed and approved by the BLM.

11-8 The BLM agrees. An expanded discussion of monitoring and mitigation of potential effects on wetlands and riparian areas is found in Sections 2.3.4 of the Final EIS; monitoring and mitigation have been developed in response to this concern and have been incorporated into the Agency Preferred Alternative.

11-9 The BLM agrees. The text in Section 4.4.3.1 of the Final EIS has been revised to clarify this information.

Letter 12

ARNOLD MACHINERY COMPANY

2975 WEST 21ST SOUTH • P.O. BOX 30020 • SALT LAKE CITY, UTAH 84130 • PHONE 801 972 4000

March 4, 1991

Bureau of Land Management
Elko District Office
Attention: Betze Coordinator
P.O. Box 831
Elko, Nevada 89801

I am writing to express the support of myself and our company of the Barrick Goldstrike Mines expansion as generally referred to as the Betze Project.

We feel American Barrick has demonstrated a strong sense of responsibility to the Central Nevada communities and particularly, to the impact their activities may have on the environment. To our knowledge, they have made a conscientious effort to mitigate undesirable impacts on the environment and cooperate in every way with the local, state and federal agencies.

Needless to say, this additional project will have a strong positive economic impact in Northeastern Nevada and be beneficial to Arnold Machinery's investment in people and facilities located in Elko and Reno, Nevada.

Both personally and collectively, we urge you to approve the project as soon as possible.

Sincerely,

Frank Hammond
President
Construction/Mining Div.

ELKO DISTRICT	
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BLM/FH

SALT LAKE CITY, UTAH • BOISE, IDAHO • IDAHO FALLS, IDAHO • TWIN FALLS, IDAHO
ELKO, NEVADA • RENO, NEVADA • CASPER, WYOMING

Letter 13

OWENS FORD-MERCURY, Inc.
3305 Potato Road
WINNEMUCCA, NEVADA 89445
623-5001

March 5, 1991

Bureau of Land Management
Elko District Office
Attn: Betze Coordinator
PO Box 831
Elko, NV 89801

Dea Sirs:

I am writing to express my support of Barrick Goldstrike Mine's Betze Project.

Barrick Goldstrike has demonstrated a strong commitment to the surrounding communities and the environment. They have made conscientious efforts to avoid undesirable envrionmental impacts and the Betze Project's comprehensive Environmental Impact Statement demonstrates Barrick's commitment.

Also, the Project will have a very positive economic impact in Northeastern Nevada with a workforce averaging 1200 employees. The Project is expected to generate several million in local, state and federal tax revenues.

Because of Barrick's demonstrated commitment to preserve wildlife habitats, visual and cultural resources and it's significant contribution to the economy, I urge you to approve the Project as soon as possible.

Sincerely,

Ferrel Owens/President
Owens Ford-Mercur , Inc

ELKO DISTRICT	
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FO/bl

Letter 14

David T. Grove, D.M.D., M.S., M.S.Ed.
Orthodontist
581 12th Street, Elko, Nevada 89801

Mr. Nick Rieger
Betze Project Coordinator
U.S. Bureau of Land Management
Elko District Office
3900 E. Idaho Street
Elko, NV 89801

Dear Mr. Rieger:

There are several reasons why I support the Betze Project; I am detailing some of them below:

1. The Betze Project will have a positive effect on most businesses in Elko county due to an increase in the number of area residents. There will be more spendable income in our locale, which will benefit all of us.

2. As Elko is increasing in population, it can better support medical and dental specialists not currently available in our community. I feel medical and dental specialists would be encouraged to relocate to Elko or establish branch practices here, thus saving Elkoans hours of driving and expenses when traveling to Reno or Salt Lake City, etc. for such services.

3. I realize that a population increase would impact city and county services; however, I feel the city and county are coping well, due to their planning and construction in anticipation of population increases such as this one.

4. The mining industry is critical to the economy and people of Elko county. As I have observed the construction of mining projects, I have seen the reclamation work done by the mines. I do not feel the environment would be adversely affected by this project as adequate safe-guards are presently in place.

Talk with children and see that each day every child is rewarded and recognized as a person

Letter 14 Continued

I see this project as a win-win situation where the result is positive for the community, the people in Elko, American Barrick, and society as a whole.

I urge the BLM to approve the Betze Project.

Sincerely,

David T. Grove

David T. Grove, D.M.D., M.S., M.S.Ed.

Treatment excellence requires additional effort, caring, education and time

Letter 15

CITY OF ELKO

1751 College Avenue • Elko, Nevada 89801 • (702) 738-5176 or

ELKO DISTRICT
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March 6, 1991

Bureau of Land Management
Elko District Office
Attn: Betze Coordinator
P.O. Box 831
Elko, NV 89801

I have reviewed the Draft Environmental Impact Statement and read the comments from the public hearings on Barrick Goldstrike Mine's Betze Project. I will not claim to have completely read the EIS, but I was favorably impressed with the detail and completeness of the report.

Barrick has demonstrated strong commitment to the surrounding communities and the environment. They have been sensitive to the impacts their operations have on the City of Elko, and they have made conscientious efforts to mitigate those impacts.

With assistance and participation from Barrick and the other local gold mining operations, additional housing and the necessary infrastructure in the City of Elko has been and continues to be constructed. I anticipate no major problems housing the projected increases in the City's population through the construction and start of operations of the Project.

The Project will have a positive economic impact on the City. Job opportunities will be made available by the construction and operation of the Project, and also in the support industries. Local, state and federal tax revenues are projected to increase several million dollars annually.

Barrick Goldstrike Mines, Inc. and their employees have been a positive impact on our community. I support their continuing operations and urge you to approve the Betze Project.

Sincerely,

D. George Corner
Mayor - City of Elko

DGC/sw

Letter 16

GUS FLEISCHLI
Chairman

Fleischli OIL CO.

P.O. BOX 487
CHEYENNE, WYOMING 82003-0487
(307) 634-4466

Serving Rocky Mountain Industries Fuel & Lubricant Needs Since 1955

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Code:
X=Action

March 4,1991

Bureau of Land Management
Elko District Office
Attention: BETZE Coordinator
P.O. Box 831
Elko, Nevada 89801

This letter is written to indicate my support of Barrick Goldstrike Mine's Betze Project.

Barrick Goldstrike Mine, Inc. has demonstrated a strong commitment to the surrounding communities as well as the environment. Barrick has made conscientious efforts to avoid and mitigate undesirable environmental impacts. The Betze Project's comprehensive Environmental Impact Statement demonstrates Barrick's commitment.

This Project will have a positive economic impact in Northeastern Nevada with a workforce averaging 1200 employees. The Project is expected to generate local, state and federal tax revenues of several million dollars annually.

Because of Barrick's demonstrated commitment to preserve wildlife habitats, visual and cultural resources and its significant contribution to the local economy, I urge you to approve this project as soon as possible.

Sincerely,

Gus Fleischli
Chairman
GF:r
cc: The Honorable Alan K. Simpson (U.S. Senator)
The Honorable Malcom Wallop (U.S. Senator)
The Honorable Craig Thomas (U.S. Representative)

SIX TERMINALS TO SERVE YOU

CHEYENNE, 2234 W. Lincolnway, Cheyenne, WY 82001, (307) 634-4466
CASPER, 6000 E. Yellowstone, Evansville, WY 82636, (307) 265-3300
ROCK SPRINGS, 151 N. Industrial Drive, Rock Springs, WY 82901, (307) 362-6611
EVANSTON, Industrial Park, Bldg. 305, Highway 89 North, Evanston, WY 82930, (307) 789-5626
CRAIG, 666 W. 1st St., Craig, CO 81625, (303) 824-3223
DENVER, 6170 E. 49th Ave., Commerce City, CO 80022, (303) 286-0432

Letter 17

Fleetguard

Fleetguard Inc.

ELKO DISTRICT	
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Charles M. Huddleston, Manager
Fleetguard, Inc.
4795 Longley Lane
Reno, Nevada 89502

March 5, 1991

Bureau of Land Management
Elko District Office
ATTN: Betze Coordinator
P. O. Box 831
Elko, Nevada 89801

Dear Sirs;

Fleetguard is a supplier to the mining industry as well as other support industries. Therefore, I want to take this opportunity to express my support of the Barrick Goldstrike Mine's Betze Project. Barrick has continually demonstrated an exemplary commitment to both the environment and to the surrounding communities. Their conscientious efforts to avoid and mitigate undesirable environmental impacts has been made in the past and the Comprehensive Environmental Impact Statement of the Betze Project reflects this dedication.

Annually, several million dollars of local, state and federal tax revenues are expected to be generated by this project. The increased workforce of several hundred employees will very definitely have a positive economic impact upon Northeastern Nevada.

Barrick has demonstrated a commitment to preserve wildlife habitats, visual and cultural resources and has made a major contribution to the economy on Northeastern Nevada. Therefore, I urge you to approve the Betze project as expeditiously as possible.

Sincerely,

Charles M. Huddleston
Manager - Fleetguard

FLEETGUARD, INC. · A CUMMINS COMPANY · 4795 LONGLEY LANE · RENO, NEVADA · 89502 · TELEPHONE (800) 777-5315

Letter 18

Elko STAR OF NEVADA

CHAMBER OF COMMERCE
1601 Idaho St. · P.O. Box 470 · Elko, Nevada 89801 · Tel. 702/738-7135

March 4, 1991

Bureau of Land Management
Elko District Office
P.O. Box 831
Elko, NV 89801

Attn: Betze Co-Ordinator

The Elko Chamber of Commerce would like to go on record supporting the Barrick Goldstrike Mines' Betze Project.

Barrick has been and continues to be a strong supporter of the Elko Community. They have understood and made commitments to help reduce the impact that their development has had on Elko. The project will help provide new jobs and also have a positive economic impact on the Elko business community.

I would urge you to approve the project as soon as possible.

Sincerely yours,

Ralph Walborn
President

RW/sh

ELKO DISTRICT	
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TRICON METALS & SERVICES, INC.
P.O. Box 101447 Birmingham, Al. 35210 (205) 956-2567
1355 W. Idaho St. Elko, Nv. 89801 (702) 738-1242

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March 6, 1991

Bureau of Land Management
Elko District Office
P. O. Box 831
Elko, NV 89801

Attention: Betze Project Coordinator

Gentlemen:

Please accept this letter as evidence of our support of the Betze Project proposed by Barrick Goldstrike Mine and as our request for your consideration in approving the project as soon as possible.

Barrick has displayed a concentrated dedication to surrounding communities and to the environment with their efforts to avoid and temper disagreeable environmental consequences. Their support of the Betze Project's Environmental Impact Statement is indicative of that dedication.

19-1 The expected generation of revenue totaling several million dollars each year and a workforce of 12,000 signifies the probability of the Betze Project having an extremely positive impact on northeastern Nevada.

Your consideration and prompt approval of the Betze Project are requested.

Sincerely,

James McGhin
Tricon Metals & Services, Inc.

JM/ch

19-1 Thank you for your letter. As a point of clarification, Barrick's operations work force would be approximately 1,200 workers.

Letter 20

CASHMAN EQUIPMENT

CAT

March 5, 1991

Bureau of Land Management
Elko District Office
ATTN: Betze Coordinator
P. O. Box 831
Elko, NV 89801

I am writing to express support of Barrick Goldstrike Mine's Betze Project.

Barrick has, in the past, demonstrated a strong commitment to the surrounding communities and the environment. They have made conscientious efforts to avoid and mitigate undesirable environmental impacts and the Betze Project's comprehensive Environmental Impact Statement demonstrates Barrick's commitment.

Also, the Project will have a very positive economic impact in Northeastern Nevada, with a work force averaging 1,200 employees. The Project is expected to generate local, state and federal tax revenues of several million dollars annually.

Because of Barrick's demonstrated commitment to preserve wildlife habitats, visual and cultural resources and its significant contribution to the local economy, I urge you to approve the project as soon as possible.

Sincerely,

Robert S. Hartman

Robert S. Hartman
Vice President Sales

RSH:dla

Las Vegas
PO Box 4217
Las Vegas, Nevada 89127
702-649-8777
FAX 702-399-8498

Reno
PO Box 7520
Reno, Nevada 89510
702-358-5111
FAX 702-358-0433

Elko
PO Box 2028
Elko, Nevada 89801
702-738-9871
FAX 702-738-7865

Letter 21

NORTHERN NEVADA COMMUNITY COLLEGE

901 Elm Street Elko, Nevada 89801 (702)738-8493

March 7, 1991

Bureau of Land Management
Elko District Office
ATTN: Betze Coordinator
P. O.Box 831
Elko, NV 89801

I am writing to express my support of Barrick Goldstrike Mine's Betze Project.

Barrick has demonstrated a strong commitment to the surrounding communities and the environment. They have made conscientious efforts to avoid and mitigate undesirable environmental impacts and the Betze Project's comprehensive Environmental Impact Statement demonstrates Barrick's commitment.

Also, the Project will have a very positive economic impact in Northeastern Nevada, with a workforce averaging 1,200 employees. The Project is expected to generate local, state and federal tax revenues of several million dollars annually.

Because of Barrick's demonstrated commitment to preserve wildlife habitats, visual and cultural resources and its significant contribution to the local economy, I urge you to approve the project as soon as possible.

Sincerely,

Ron Remington

Ronald K. Remington, Ph.D.
President

RKR/lc

NNCC A Member College of the University of Nevada System

John L. Dobra, Ph.D.
4435 Canyon Drive
Reno, Nevada 89509
(702) 747-4293

ELKO DISTRICT	
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March 7, 1991

Betze Coordinator
Bureau of Land Management
Elko District Office
P.O. Box 831
Elko, Nevada 89801

Re: Comments on the Draft Environmental Impact Statement for the Barrick Goldstrike Mine's Beta Project

To whom it may concern:

First, I would like to thank the Bureau of Land Management for the opportunity to offer these comments for public consideration. Second, I would like to make it clear that although I am an Assistant Professor of Economics at the University of Nevada, Reno, my comments should not be interpreted as representing the position of the University of Nevada. These are strictly my views as a private citizen.

Because I have a number of academic publications on the economics of the precious metals industry and the socioeconomic impacts of the growth of the industry in Nevada in recent years, I have been asked by Barrick officials to offer some comments on the socioeconomic impacts segment of the DEIS and to be available to answer questions. You will notice that one of these publications is listed in the references section of the DEIS, and that members of the team that put together the socioeconomic analysis in the DEIS have contacted me during its preparation.

The first and most general comment on the discussion of the socioeconomic impacts of the proposed Beta project in the DEIS is that it addresses all of the standard socioeconomic factors and indicators that need to be examined in this type of document. In that respect, I would commend the authors of the DEIS for thoroughness.

Having said that, however, it should be pointed out that while the DEIS cites many relevant facts and figures about the affected local economies and local governments, it really does not offer many conclusions about the impact of the proposed project. This is not intended as a criticism of the DEIS, but to point out that the lack of conclusions is an indication that the proposed project will have minimal socioeconomic impacts. Further, although the DEIS contains few conclusions concerning the potential socioeconomic impacts of the project, most of the conclusions offered are positive in nature. Hence, I would conclude that the proposed project will have a small, but generally positive, socioeconomic impact.

One factor that supports this conclusion is the relatively small number of new jobs in the local economy and, hence, small population increase that will be created by the proposed project. For example, on page x of the summary and later in the document, it is pointed out that the peak population increase resulting from the project would be 723 during the construction phase of the project and 225 during the operational phase. These population estimates reflect increases in employment on the order of 115 to 250 construction workers during construction and less than 100 during mining operations (section 2.2.4, p. 2-42). In addition, these population estimates appear to be based on a standard assumptions about the ratio of jobs per capita.

22-1 There are good reasons to believe, however, that these population estimates probably overstate the impact of the proposed project. For example, the proposed expansion is quite small in comparison to the cumulative socioeconomic impact of the precious metals industry in the region over the past few years. In addition, this expansion at Goldstrike follows on the heels of other expansions that have recently been completed on the Newmont property adjacent to Goldstrike and at other mines in the area. Consequently, it is quite likely that the work force needed to construct and operate the proposed facilities are already in the area, and the project will have an even smaller population impact than indicated in the DEIS.

Another important point made in the DEIS that should be highlighted concerns the impact of the proposed project on the local infrastructure, i.e., its school system, other public services, transportation system, housing stock, etc. As a result of the substantial growth in the industry in the area over the past few years, this infrastructure has clearly been strained. Because tax revenues from the net proceeds of mines tax are based on production and prices, the revenues lagged behind the demand created by the impacts of mine development.

Currently, and into the foreseeable future, the rate of growth will decline, and production will reach a plateau. As a result of reaching this plateau, the infrastructure of the area and the tax revenues needed to finance improvements in the infrastructure will finally be able to catch up with the growth. The proposed Betze project is one of the last major mine expansions anticipated in the area for the foreseeable future of which I am aware.

22-1 The BLM agrees with your assessment of the population growth estimates in the Draft EIS. The socioeconomic impact assessment was based on conservative estimates of population growth.

Letter 22 Continued

As indicated in the DEIS and above, the impact of the proposed project will place minimal demands on the infrastructure. At the same time it will add to the ability of local governments to finance its infrastructure. For this reason I have concur with the major conclusion of the DEIS's discussion of the socioeconomic impacts of the proposal, that it will have a beneficial impact on local government finance.

Sincerely,

John L. Dobra, Ph.D.

Letter 23

Nevada Legislature

SIXTY-SIXTH SESSION

JOHN MARVEL
ASSEMBLYMAN
District No. 34
Humboldt, Pershing
Lander (Part), Washoe (Part)

COMMITTEES:
Member
Ways and Means
Taxation
Labor and Management

ELKO DISTRICT	
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March 8, 1991

Bureau of Land Management
Elko District Office
Attn: Betze Coordinator
Post Office Box 831
Elko, NV 89801

ATTN - BETZE COORDINATOR:

I am writing to express my support of Barrick Goldstrike Mine's Betze Project.

Barrick has demonstrated a strong commitment to the surrounding communities and the environment. They have made conscientious efforts to avoid and mitigate undesirable environmental impacts and the Betze Project's comprehensive Environmental Impact Statement demonstrate Barrick's commitment.

Also, the Project will have a very positive economic impact in Northeastern Nevada, with a workforce averaging 1,200 employees. The Project is expected to generate local, state and federal tax revenues of several million dollars annually.

Because of Barrick's demonstrated commitment to preserve wildlife habitats, visual and cultural resources and its significant contribution to the local economy, I urge you to approve the project as soon as possible.

Sincerely,

John Marvel, Assemblyman
District No. 34

JM:dw

DISTRICT OFFICE:
P.O. Box 1270, Battle Mountain, Nevada 89820 • (702) 635-2538 or 882-2054

Letter 24

GLASER LAND & LIVESTOCK INC.
BOX 1-13
HALLECK, NV 89824

March 7, 1991

Bureau of Land Management
Elko District Office
P.O Box 831
Elko, NV. 89801 ATTN: BETZE COORDINATOR

Dear Sirs;

Please be advised that I strongly support BARRICKS BETZE PROJECT.

It is important not only locally but state wide and nationally. All new wealth is generated from a hole in the ground, off the land or from the sea. Everyone else merely re-circulates it. Wealth generated from the ground helps offset the inflationary effect of excess money printing.

In addition we are still a gold importing nation which helps contribute to our deficit balance of trade. Additional gold production of domestic gold helps reduce the deficit.

Furthermore Barrick has demonstrated that it is a good corporate citizen, and is concerned about the surrounding community and the environment.

I urge you to approve the project.

Sincerely,
Norman Glaser

Letter 25

TGMD Construction, Inc.
Post Office Box 229
Elko, Nevada 89801
(702) 738-5105

ELKO DISTRICT | DM | RES | ADM | OPS | FRA | WRA | PEC | CF | Code: | X=Action

6 March 1991

Bureau of Land Management
Elko District Office
ATTN: Betze Coordinator
P.O. Box 831
Elko, Nevada 89801

Dear Sir:

The purpose of this letter is to express our support for Barrick Goldstrike Mine's Betze Project. Based on rapid growth in the region in the late 1980's we decided to open a branch of our homebuilding company in Elko, Nevada. Since then we have seen many positive things happen in Elko and the surrounding area. Elko is now a thriving, cohesive and positive community poised for continued stable and diversified growth. Barrick Goldstrike has been a major factor in molding the community's economic and social climate.

Clearly Barrick has been a stabilizing influence on the area and has made a tremendous financial commitment to the community. This commitment, along with that of others such as Newmont Gold, encouraged TGMD to completely relocate to Elko in 1991. This same commitment encouraged new businesses such as K-Mart, Shilo Inns and many more to locate facilities here as well. Barrick generates millions of tax dollars. They also generate jobs which not only helps Elko but the economy of all of Northeast Nevada.

As an ardent environmentalist I am of course concerned with the impact of mining in the region. I have visited the mines, reviewed environmental impact and reclamation plans and asked serious questions about the ramifications of mining on the environment. As evidenced by Barrick's past performance I am convinced that they are a "good neighbor" and have and will continue to make a conscientious effort to mitigate undesirable environmental impacts. Because of the relationship between Barrick and the local community, their contributions to the cultural and economic growth of the region and their concern for the environment in which they work, I strongly urge you to approve the Beltze project at the earliest opportunity.

Sincerely

John A. Fericks

Letter 26

Nevada Area Council • Boy Scouts of America
OLDTOWN MALL • 4001 SOUTH VIRGINIA • RENO, NEVADA 89502
702) 829-8400

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March 7, 1991

Bureau of Land Management
Elko District Office
Attn: Betze Coordinator
P.O. Box 831
Elko, Nevada 89801

Gentlemen,

I have reviewed the draft Environmental Impact Statement for the Betze Project issued by your office in January 1991. I would like to comment on the socio-economic issues addressed in the document.

In my role as Overland District Chairman for the Boy Scouts of America, I have had the privilege of working with many of Barrick Goldstrike Mine's employees through their involvement as volunteers in the Scouting movement. The number of Barrick employees involved in our programs exceed those of any other employer by far and on a Scout volunteer per employee basis, lead all other major employers by over a factor of 2. This tremendous level of support to all levels of our programs for boys ages 7-21 has helped the district add and maintain many Elko Scout Packs, Boy Scout Troops, Varsity Teams, and Explorer Posts that would not have been possible otherwise. The positive impact can be demonstrated by the quality of the Overland District Program and the growing participation of youth in the area.

Barrick Goldstrike Mines has assisted financially in some projects and management does recognize the value of Scouting. I am most impressed in their past hiring experience by bringing people to the Overland District Area that substantially contribute to their communities and the youth needs of the entire area. Maintaining Barrick Goldstrike Mine's operation through approval of the Betze project EIS will be a very positive step to support the continual growth of Scouting in the Elko County area.

Sincerely,

D.S. Barr
Overland District Chairman
Boy Scouts of America
3171 Scenic View Dr.
Elko, Nevada 89801

CC: Don York, Scout Executive
Barrick Goldstrike Mines
Don Gilbertson
Ralph Thompson
Dave Schreiter
John Cash
John Parker
John McDonough
Jack Simmons
Valerie Morton

A PARTICIPATING UNITED WAY AGENCY

Letter 27

Nevada CHUKAR Foundation

POST OFFICE BOX 1636 • WINNEMUCCA, NEVADA 89445

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March 4, 1991

Bureau of Land Management
Elko District Office
P. O. Box 831
Elko, NV 89801

Attention: Betze Coordinator

Gentlemen:

The Nevada Chukar Foundation would like to express its support of Barrick Goldstrike Mine's Betze Project.

Barrick has demonstrated a strong commitment to the surrounding communities and the environment. They have made conscientious efforts to avoid and mitigate undesirable environmental impacts and the Betze Project's comprehensive Environmental Impact Statement demonstrates Barrick's commitment.

Also, the Project will have a very positive economic impact in Northeastern Nevada, with a work force averaging 1,200 employees. The Project is expected to generate local, state and federal tax revenues of several million dollars annually.

Because of Barrick's demonstrated commitment to preserve wildlife habitats, visual and cultural resources and its significant contribution to the local economy, we urge you to approve the project as soon as possible.

Sincerely,

Harold Hawkins
President

"Dedicated to the enhancement of our chukar and wildlife resources through habitat improvement."

Letter 28

EXECUTIVE OFFICES

VALLEY BANK OF NEVADA

VALLEY BANK PLAZA • 401 SOUTH VIRGINIA STREET • P. O. BOX 20000 • RENO, NEVADA 81

ELKO DISTRICT	
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March 6, 1991

Bureau of Land Management
Elko District Office
Attn: Betze Coordinator
P.O. Box 831
Elko, Nv. 89801

Gentlemen:

I am sending this letter to express Valley Bank's support of Barrick Goldstrike Mine's Betze Project.

We feel that Barrick has demonstrated a strong commitment to the communities in the area, as well as to the environment. The Betze Project's comprehensive Environmental Impact Statement is evidence of their commitment.

As you are probably aware, the Betze Project will have a significant impact on the economy of Northeastern Nevada. The Project will employ approximately 1,200 employees, and is expected to generate several million dollars annually in local, state and federal tax revenues.

We at Valley Bank support Barrick's Betze Project, and urge your approval of this Project as soon as possible.

Sincerely,

Ernie Martinelli
Vice Chairman of the Board

/do

Letter 29

First Interstate Bank

of Nevada, N.A.
Elko Main
405 Idaho Street
Box 471
Elko, NV 89801-0471

ELKO DISTRICT	
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March 6, 1991

Bureau of Land Management
Elko District Office
ATTN: Betze Coordinator
P.O. Box 831
Elko, NV 89801

I am writing to express my support of Barrick Goldstrike Mine's Betze project.

Barrick has demonstrated a strong commitment to the surrounding communities and the environment. They have made conscientious efforts to avoid and mitigate undesireable environmental impacts and the Betze Project's comprehensive Environmental Impact Statement demonstrates Barrick's commitment.

Also, the project will have a very positive economic impact in Northeastern Nevada, with a workforce averaging 1,200 employees. The Project is expected to generate local, state and federal tax revenues of several million dollars annually.

Because of Barrick's stated and demonstrated commitment to preserve wildlife habitats, visual and cultural resources and its significant contribution to the local economy, I urge you to approve the project as soon as possible.

Sincerely,

Greg Boden
Vice President and
Retail Banking Manager

GB;ca

Letter 30

TURNER GAS CO. • Distributors / PROPANE GAS • APPLIANCES & SERVICE
PHILLIPS PETROLEUM PRODUCTS
Gasoline • Stove Oil • Diesel Fuel

BISHOP, CALIFORNIA 93514 • 872-4461 • P. O. BOX 426

ELKO DISTRICT	
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March 7, 1991

Bureau of Land Management
Elko District Office
ATTN: Betze Coordinator
PO Box 831
Elko, Nevada 89801

Gentlemen:

This letter is written in support of Barrick Goldstrike Mine's Betze Project.

Barrick is a responsible company and has shown that they have an earnest regard for the environment and the communities in the area. Turner Gas Co. believes that they will continue to mitigate undesirable impacts to the environment.

Barrick's Project will employ hundreds of people, create jobs for the companies that supply Barrick and create jobs for the businesses that service all those employees. It will also generate millions of dollars in local, state and federal taxes. Considering the recession that our country is now in, the jobs and taxes this project will create are greatly needed.

I urge the Bureau of Land Management to approve the project as soon as possible.

Sincerely,

Tom Turner

Tom Turner

Letter 31

CONTINENTAL LIME INC.

March 6, 1991

Bureau of Land Management
Elko District Office
ATTN: Betze Coordinator
P. O. Box 831
Elko, NV 89801

Gentlemen:

Continental Lime, with production facilities in Nevada, is a major supplier of lime to the Nevada mining industry and Barrick Goldstrike is one of our valued customers.

As a supplier of a product that is vital to environmental control, we are sensitive to the strong commitment that Barrick Goldstrike is making to the surrounding communities and the environment.

They have made a conscientious effort to avoid and mitigate undesirable environmental impacts. The Betze Project's comprehensive Environmental Impact Statement demonstrates their commitment.

The project will have a very positive economic impact in Northeastern Nevada considering Barrick's workforce of 1,200 employees. The project is expected to generate several million dollars annually in local, state, and federal tax revenues.

Because of Barrick's demonstrated commitment to preserve wildlife habitats, visual and cultural resources, and its significant contribution to the local economy, I urge you to approve the project as soon as possible. We support Barrick Goldstrike's Betze Project.

Sincerely,

J. O. McGuirk
Division Manager

JOM/ees

670 EAST 3900 SOUTH / SUITE #205 / SALT LAKE CITY, UTAH 84107 / PHONE: (801) 262-3942 / FAX: (801) 264-8039

Letter 32

MARCH 4, 1991

(1)

COMMENTS ON DRAFT ENVIRONMENTAL IMPACT STATEMENT, BETZE PROJECT

TO: B.L.M. - ELKO DISTRICT

FROM: GLENN D. THACKRAY
P.O. BOX 3283
IDYLLWILD, CA 92349

1. SECTION 4.4.3.1 DESCRIBES EFFECTS OF THE PROPOSED ACTION ON SURFACE WATER FEATURES. THE MODEL PREDICTS THAT BY THE YEAR 2100, 84 SEEPS AND SPRINGS WOULD STILL LIE WITHIN THE 10-FOOT DRAWDOWN CONTOUR AND "MAY" BE DRY. HOW LONG BEYOND 2100 ARE THESE CONDITIONS LIKELY TO PERSIST? 10 YEARS? 50? 200? THIS ASPECT OF SURFACE WATER IMPACT MERITS FURTHER ATTENTION. **32-1**

2. THE GROUNDWATER RECOVERY MODELS APPEAR TO ASSUME CLIMATIC CONDITIONS SIMILAR TO THOSE OF THE PRESENT. OVER THE COURSE OF 100+ YEARS, CLIMATIC CONDITIONS COULD VARY SIGNIFICANTLY. HOW WOULD AN EXTENDED PERIOD OF WETTER CONDITIONS AFFECT THE LONG-TERM IMPACTS? A PERIOD OF DRYER CONDITIONS? **32-2**

Response to Letter 32

32-1 The exact date by which groundwater elevations will fully recover cannot be determined. As noted in Section 4.4.3.1 of the Draft EIS, the groundwater model projects that groundwater would return to within 45 feet of the pre-dewatering elevations by the year 2100. The model further projects that groundwater levels would be less than 30 feet below pre-dewatering conditions throughout the area modeled by the year 2200. However, as explained in Section 4.4.3.1 of the Draft EIS, due to the lack of detailed information about local geological conditions, the fact that a seep or spring is within the projected drawdown contour does not necessarily mean that the seep or spring will be affected by dewatering operations or groundwater recovery. Please refer to the response to comment 55-18 for further discussion of the hydraulic connection between seeps and springs and the regional groundwater system. Nonetheless, the BLM has incorporated monitoring and mitigation requirements in the Agency Preferred Alternative, Section 2.3.4 of the Final EIS, to ensure that impacts to seeps and springs are addressed.

32-2 For the purposes of modeling it was assumed that future climatic conditions would be similar to those of the present and that variations in climatic conditions would balance out over the time period modeled. Variations in climatic conditions (as discussed on page 4-52 of the Draft EIS) may cause the impact to seeps and springs to increase during droughts or to decrease during wetter periods. As noted in the response to comments 32-1 and 55-18, there is uncertainty in regard to the hydraulic connection between the regional groundwater system and seeps and springs in the area. Nevertheless, the BLM will require monitoring of seeps and springs and mitigation of potential impacts. Please refer to the mitigation measures and monitoring requirements in Section 2.3.4 of the Final EIS.

THACKRAY - BETZE COMMENTS (2)

3. ON PAGE 4-130, IT IS ESTIMATED THAT 271 ACRES OF RIPARIAN HABITAT COULD BE AFFECTED DURING THE RECOVERY PERIOD. BECAUSE RIPARIAN HABITAT COVERS ONLY SMALL AREAS ALONG STREAMS AND AROUND SPRINGS/SEEPS, EXPRESSION OF THE EXTENT OF THIS IMPACT MERELY AS A NUMBER OF ACRES IS MISLEADING. HOW MANY MILES OF STREAM COURSE DOES THIS REPRESENT? WHAT PROPORTION OF THE TOTAL RIPARIAN HABITAT AVAILABLE IN THE SURROUNDING AREA DOES THIS 271 ACRE FIGURE REPRESENT? OVER HOW LARGE AN AREA WOULD THE LOSS OF THIS RIPARIAN HABITAT AFFECT WILDLIFE?

32-3

4. ON PAGE 4-94, IT IS STATED THAT "FAUNAL TOXICITY, ESPECIALLY FOR VERTEBRATES, SHOULD NOT BE A PROBLEM, ..." IN TERMS OF ARSENIC CONCENTRATIONS FOR WATER IN THE BETZE PIT.

32-4 A. AS USED IN THIS CONTEXT, DOES "FAUNAL TOXICITY" INCLUDE LOSS OF REPRODUCTIVE CAPACITY (ESP. WITH BIRDS), OR MERELY DANGER TO INDIVIDUALS CONTACTING THE WATER DIRECTLY? A "LAKE" OF THIS SIZE IN THE DESERT IS LIKELY TO ATTRACT MIGRATORY WATERFOWL, SO ALL POSSIBLE IMPACTS SHOULD ~~BE~~ BE CONSIDERED.

32-5 B. IN CALCULATING POTENTIAL ARSENIC CONCENTRATIONS IN THE PIT WATER, REACTIONS WITH WALL ROCKS WERE IGNORED. WHAT ARE POTENTIAL CONCENTRATIONS IF SUCH REACTIONS ARE CONSIDERED? WHAT TOXIC EFFECTS COULD SUCH CONCENTRATIONS HAVE?

32-3 In response to your comment, the text of the EIS has been revised to clarify that 271 acres of riparian areas are directly associated with seeps and springs; in addition, approximately 22 acres are associated with the perennial reaches of upper Boulder Creek, Rodeo Creek, Bell Creek, and Brush Creek; and 38 acres are associated with riparian areas that are not located along stream channels and have no spring discharge. The total area potentially affected equals approximately 330 acres. Based on the BLM's concern for this important regional resource, an expanded discussion of monitoring and mitigation of wetland and riparian areas is presented in Section 2.3.4 of the Final EIS.

32-4 Predicted arsenic concentrations were evaluated on both an acute and chronic basis. While acute toxicity generally refers to those effects occurring over a short period of time with the endpoint usually being survival, chronic toxicity refers to long-term effects, with a variety of endpoints. Some measured effects include growth, reproduction, egg and sperm production, maturation, spawning success, egg yolk content, hatching success, and survival of larvae or fry (Rand and Petrocelli 1985). Therefore, "faunal toxicity", as used in the report, does refer to effects other than just survival.

32-5 Please refer to the responses to comments 55-14 and 55-23 for a discussion of the effects of pit wall interaction on Betze Pit water quality. Please refer to the response to comment 32-4 and the revised text in Section 4.4.9 of the Final EIS for a discussion of the potential toxic effects of the pit water quality.

Letter 32 Continued

THACKRAT · BETZE COMMENTS

(3)

4C. 32-6 PROJECTED LEVELS OF CADMIUM IN THE PIT WATER EQUAL THE MAXIMUM CONTAMINANT LEVEL FOR THAT ELEMENT, AND PROJECTED LEVELS OF MANGANESE EXCEED THE SECONDARY M.C.L. ALTHOUGH THE M.C.L.'S REPRESENT STANDARDS FOR DRINKING WATER, THE PRESENCE OF THESE ELEMENTS IN THESE AMOUNTS SUGGEST THEY COULD HAVE ADVERSE AFFECTS ON WILDLIFE. WHAT ARE THE POSSIBLE AFFECTS?

5. ON PAGE 4-129, IT IS STATED THAT PONDS AT THE HEAP LEACH FACILITY 32-7 WILL BE FENCED AND NETTED TO PRECLUDE WILDLIFE ACCESS. HAVE FENCING AND NETTING BEEN SHOWN TO EXCLUDE ALL WILDLIFE, ESPECIALLY BIRDS? ARE THERE OTHER MEASURES THAT COULD BE TAKEN TO BETTER INSURE THAT WILDLIFE WILL BE EXCLUDED FROM THE PONDS, SUCH AS SOLID ROOFING?

6. SEVERAL PASSAGES IN THE TEXT OF THE E.I.S. INDICATE THAT MINING THE BETZE DEPOSIT WILL ACTUALLY IMPROVE CONDITIONS IN THE AREA:

A. ON PAGE 4-126, IT IS CLAIMED THAT, FOLLOWING RECLAMATION, DISTURBED AREAS "WOULD YIELD ECOLOGICAL CONDITIONS WHICH WOULD BE MORE VARIED AND MATURE THAN CONDITIONS THAT EXISTED PRIOR TO DEVELOPMENT," AND WOULD "BE EXPECTED TO SUPPORT MORE EXTENSIVE (CONT.)

Response To Letter 32 Continued

32-6 Although the predicted cadmium concentration of the pit water is equal to the EPA's MCL (Maximum Contaminant Level) of 0.01 mg/l, only 1 of the 9 wells that were used to predict cadmium levels in groundwater inflow to the pit (see Final EIS Section 4.4.9, Betze Pit Water Quality, and responses to comments 55-13, 55-22, and 55-31) had cadmium concentrations above the detection limit. In computing cadmium and other constituent levels in the pit inflow water, the detection limit was used as the input value for each sample for which the concentration reported was below the detection limit. Therefore, the actual cadmium concentration of most samples was lower than what was estimated, and the predicted cadmium concentration is likely to overestimate actual levels.

The toxicity of manganese, like many other metals, is hardness-dependent (see Section 4.4.9). A chronic criterion at a hardness of 200 mg/l $CaCO_3$, which will probably be representative of the Betze Pit water body, would be approximately 1,344 µg/l while the acute criterion would be 1,578 µg/l at the same hardness. The predicted manganese concentration of 50 µg/l should, therefore, pose no danger to any aquatic organisms living in the water body. Few data are available on the bioconcentration potential of manganese. However, because it is relatively nontoxic and insoluble and will exist in the Betze Pit at low concentrations, bioconcentration or bioaccumulation should not be of concern.

32-7 NDOW regulations require ponds containing solutions that are toxic to wildlife to be fenced and netted. These measures appear to be more effective than various hazing techniques (e.g., air cannons, loud music). A study conducted by Kilborn Management Services (1991) for Barrick Goldstrike Mines provided an evaluation of bird netting versus floating pond covers for wildlife protection in the North Block leaching facility solution ponds. The Study concluded that netting, rather than VLDPE pond covers, should be used for wildlife protection. The conclusions are based on findings that pond covers are an undemonstrated technology, may reduce the effectiveness of gold recovery by raising solution temperatures, present design difficulties for Barrick's operations where the pumps are located in the ponds, present operational difficulties with respect to solution volumes, are more difficult to maintain and repair, and cost more to purchase and install. The primary benefits of pond covers, which include savings in cyanide consumption, better protection for wildlife, and reduced water evaporation, are mitigated at the Goldstrike Mine because of the small net grid (1-5/8 inches by 1-5/8 inches) being used by Barrick and the ample supply of water at the mine. Please see also the responses to comments 56-11 and 56-13.

THACKRAY - BETZE COMMENTS (4)

32-8 6A. (CONT.) AND DIVERSE WILDLIFE POPULATIONS THAN PRESENTLY EXIST IN THE PROJECT AREA." THIS IMPROVEMENT OF CONDITIONS SEEMS UNLIKELY, AT BEST, BECAUSE OF THE LACK OF WATER SOURCES, THE ARSENIC-LACED LAKE NEARBY, AND BECAUSE OF THE LACK OF PERCHES AND PROTECTIVE COVER ON RECLAIMED MINE DUMPS. WHAT IS MEANT BY "MORE VARIED AND MATURE"? THAT A MINE WOULD IMPROVE AN AREA IS A PRESUMPTUOUS CLAIM.

B. IN A DISCUSSION OF RECREATIONAL IMPACTS ON PAGE 4-139, IT IS STATED THAT "ONCE THE WATER LEVEL IN THE BETZE PIT WOULD RISE TO A STABLE LEVEL, IT MAY PROVIDE ADDITIONAL RECREATIONAL

32-9 OPPORTUNITIES." A LAKE IN THE DESERT MIGHT BE ATTRACTIVE FOR RECREATION, BUT ELEVATED LEVELS OF ARSENIC, CADMIUM, AND MANGANESE (TABLE 4-19) WOULD LIKELY MAKE IT UNSAFE FOR HUMAN USE. THE STATEMENT QUOTED ABOVE APPEARS TO BE AN ATTEMPT TO PAINT A ROSY PICTURE.

C. IN A DISCUSSION OF THE NO ACTION ALTERNATIVE ON PAGE 4-96, IT IS STATED THAT THE POST PIT WATER COULD CONTAIN HIGHER LEVELS OF ARSENIC IF THE HIGH-ARSENIC ROCKS OF THE

32-10 BETZE DEPOSIT ARE LEFT IN PLACE. HOW LIKELY IS IT THAT WATER FILLING THE POST PIT WOULD COME IN CONTACT WITH THESE ROCKS? WHAT IS MEANT BY "HIGHER LEVELS OF ARSENIC"? 1000 TIMES? (CONT.)

32-8 The BLM disagrees with the conclusion that habitat improvement is unlikely. The pre-mining habitat has been adversely affected by range fires, grazing, and previous mining activity. Revegetation of disturbed areas with a variety of seed mixtures, including native species, will likely improve the habitat in the project area. Through the revegetation test plot program and other mitigation measures incorporated into the Agency Preferred Alternative (see Section 2.3.4 of the Final EIS), successful seed mixes and cultural practices will be identified to improve the implementation of the reclamation program.

32-9 The discussion on page 4-139 of the Draft EIS was not intended "to paint a rosy picture" of recreational opportunities in the Betze Pit following the completion of mining. The BLM noted that such opportunities "have not been identified." Because the water level is not projected to be stable for as long as 100 years, and because the character and topography of the area surrounding the pit is likely to be materially impacted during that time frame by other mining developments (see Section 3.12.3.3 of the Draft EIS), BLM decisions concerning long-term land use, including recreational opportunities, if any, must be deferred.

32-10 Please refer to the text on page 4-98 of the Draft EIS for a discussion of the No Action alternative which assumes continued operation of the Post Pit.

THACKRAY - BETZE COMMENTS (5)

6c (cont.) 100 TIMES? 10 TIMES? TO ACCURATELY ASSESS POTENTIAL IMPACTS, THE POST PIT WATER SHOULD BE MODELLED.

32-11 HAVE OTHER HIGH ARSENIC BODIES BEEN IDENTIFIED THAT COULD FURTHER DEGRADE POTENTIAL BETZE PIT WATER? SUCH A POSSIBILITY SHOULD BE THOROUGHLY EXPLORED. FURTHERMORE, THE POSSIBILITY OF HIGH ARSENIC WATER IN THE POST PIT SHOULD NOT BE USED AS JUSTIFICATION FOR MINING THE BETZE DEPOSIT. IF BARRICK HAS CREATED THE POTENTIAL FOR TOXIC WATER IN THE POST PIT, BARRICK HAD BETTER BE PREPARED TO DEAL WITH IT REGARDLESS OF THE STATUS OF THE BETZE DEPOSIT.

7. THERE APPEARS TO BE A TENDENCY IN THE E.I.S. TO USE PREVIOUS AND POTENTIAL FUTURE DISTURBANCES AS JUSTIFICATION OR EXCUSE FOR THE PROPOSED ACTION TO PROCEED:

A. ON PAGE 4-135, IT IS STATED THAT "PREVIOUS DISTURBANCE TO THE AREA FROM OVERGRAZING, MINING, AND FIRES HAS DEGRADED THE QUALITY OF THE EXISTING (WILDLIFE) HABITAT." ON PAGE 4-123, PAST, PRESENT AND FUTURE MINING BY BARRICK, DEE, AND NEWMONT IS DISCUSSED IN TERMS OF THE AMOUNT OF VEGETATION THAT HAS AND WILL BE DEVASTATED.

B. ON PAGE 4-66, THE PAST AND POTENTIAL FUTURE IMPACTS ON DRAINAGE BASINS OF DEE, NEWMONT, AND BARRICK ARE DISCUSSED

(cont)

32-11 Additional information on the anticipated water quality of the Betze Pit is included in Section 4.4.9 of the Final EIS.

THACKRAY - BETZE COMMENTS (6)

32-12 7. (CONT.) IT IS CLEAR FROM THE PASSAGES NOTED ABOVE THAT MUCH OF THE AREA HAS ALREADY BEEN SEVERELY IMPACTED, AND WILL BE FURTHER IMPACTED IF OTHER POTENTIAL MINES ARE ALLOWED TO PROCEED. BUT PREVIOUS DAMAGE CANNOT BE USED AS JUSTIFICATION OR RATIONALE FOR THE BETZE PROJECT TO PROCEED. IF THE BETZE PROJECT IS APPROVED, ITS "INCREMENTAL" IMPACTS MAY BE USED AS JUSTIFICATION OR RATIONALE FOR THE NEXT MINE.

32-13 8. ON PAGE 1-4, IT IS STATED THAT "GOLD IS BECOMING AN IMPORTANT EXPORT COMMODITY FOR THE UNITED STATES..." IS BARRICK A U.S.-BASED COMPANY? ARE THE MAJORITY OF ITS STOCKHOLDERS U.S. CITIZENS? IF BARRICK, LIKE A NUMBER OF COMPANIES MINING GOLD IN THE WESTERN U.S., IS NOT A U.S.-BASED AND OWNED COMPANY, THE GOLD THAT WOULD BE MINED WOULD IN EFFECT ONLY INDIRECTLY BE A U.S. EXPORT COMMODITY.

32-14 9. WHO OWNS AND OPERATES THE TS RANCH AND TS RANCH JOINT VENTURE? IS BARRICK INVOLVED IN ANY WAY? HOW WAS TS RANCH SELECTED AS THE RECIPIENT OF DEWATERING DISCHARGE IN THE PROPOSED ACTION?

32-12 The BLM agrees that previous disturbance should not be used to justify further disturbance. A description of the existing environment serves as the basis for the environmental impact assessment, including the cumulative assessment.

32-13 Barrick is a Colorado corporation that is indirectly owned by American Barrick Resources Corporation, an Ontario corporation with its head office in Toronto, Ontario. American Barrick is a publicly traded company listed on the New York Stock Exchange and other major international stock exchanges. The publicly traded shares of American Barrick are owned by citizens of the United States and many other countries. The text on page 1-4 of the Draft EIS was not intended to necessarily refer to gold produced from the Goldstrike Mine; it is a general discussion of the demand for gold production.

32-14 The ownership of the TS Ranch Joint Venture is described on page 2-2 of the Draft EIS. The agreements between Barrick and the TS Ranch Joint Venture are private agreements. The use of water appropriated by Barrick and the TS Ranch Joint Venture is subject to regulation by the Nevada State Engineer.

THACKRAY - BETZE COMMENTS

(7)

9 BECAUSE OF THE EXTREME ADVERSE IMPACTS THAT WOULD RESULT FROM THE MINING OF THE BETZE DEPOSIT, I FAVOR THE NO ACTION ALTERNATIVE. MY REASONS FOR FAVORING THE NO ACTION ALTERNATIVE ARE AS FOLLOW: (32-15)

A. THE PROBABLE DRY-UP OF CREEKS, SEEPS, AND SPRINGS FOR A PERIOD OF MORE THAN 100 YEARS IS TOO GREAT AN IMPACT ON WILDLIFE AND WILDLIFE HABITAT. PROPOSED MITIGATION MEASURES ARE NOT SUFFICIENT.

~~B. THE PERMANENT, LARGE-SCALE DESTRUCTION OF~~

B. NATURAL FEATURES WILL BE DESTROYED ON A GROSS SCALE, PERMANENTLY.

C. THE PROPOSED ACTION WOULD LEAVE A LARGE LAKE THAT WOULD BE LACED WITH ARSENIC AND OTHER POTENTIALLY HAZARDOUS ELEMENTS AND COMPOUNDS. SUCH A LAKE COULD POTENTIALLY POSE A HAZARD TO WILDLIFE.

D. HAZARDOUS PROCESSING CHEMICALS AND NATURALLY-OCCURRING TOXIC SUBSTANCES MAY BE RELEASED INTO AIR, SURFACE WATER, AND GROUNDWATER.

E. NUMEROUS ARCHEOLOGICAL SITES WILL BE DESTROYED.

F. LARGE AMOUNTS OF FOSSIL FUELS WOULD BE CONSUMED IN MINING OPERATIONS.

G. THE PROJECT WILL CONTRIBUTE TO BOOM/BUST SOCIOECONOMIC IMPACTS IN NEARBY AREAS.

IN SUMMARY, THE BETZE PROJECT REPRESENTS AN EXCHANGE OF SHORT TERM ECONOMIC BENEFITS FOR LONG-TERM AND PERMANENT, LARGE-SCALE ENVIRONMENTAL DESTRUCTION. IF THE MODELS AND PREDICTIONS CONTAINED IN THIS E.I.S ARE ACCURATE, THE IMPACTS WILL BE GREAT ENOUGH. MODELS OF NATURAL SYSTEMS ARE OFTEN FAR OVERSIMPLIFIED AND CAN BE QUITE INACCURATE. THE ACTUAL IMPACTS

32-15 Your comment is noted.

Letter 32 Continued

THACKRAY - BETZE COMMENTS (8)

9. (CONT.) MAY BE SIGNIFICANTLY GREATER, AND MAY NOT BE SEEN, IN SOME CASES, FOR MANY DECADES OR EVEN A CENTURY AND MORE. TO ALLOW A PROJECT SUCH AS THIS TO PROCEED, WITH SUCH EXTREME, LASTING IMPACTS, WOULD BE A TRAVESTY, PARTICULARLY ON LANDS BELONGING TO A PUBLIC WHICH WILL SEE LITTLE GAIN FROM THE GOLD BEING REMOVED.

Letter 33

JOHN C. CARPENTER
ASSEMBLYMAN
District No. 33

COMMITTEES:
Member
Judiciary
Natural Resources, Agriculture and Mining
Transportation
Education

State of Nevada Assembly
Sixty-Sixth Session

DISTRICT OFFICE:
P.O. Box 190
Elko, Nevada 89801
Office (702) 738-9861
Fax No. (702) 738-8733

March 8, 1991

TO: Bureau of Land Management
Elko District Office
ATTN: Betze Coordinator
P.O. Box 831
Elko, NV 89801

I am writing to express my support of Barrick Goldstrike Mine's Betze Project.

Barrick has demonstrated a strong commitment to the surrounding communities and the environment. They have made conscientious efforts to avoid and mitigate undesirable environmental impacts and the Betze Project's comprehensive Environmental Impact statement demonstrate Barrick's commitment.

Also, the Project will have a very positive economic impact in Northeastern Nevada, with a work force averaging 1,200 employees. The Project is expected to generate local, state and federal tax revenues of several million dollars annually.

Because of Barrick's demonstrated commitment to preserve wildlife habitats, visual and cultural resources and its significant contribution to the local economy, I urge you to approve the project as soon as possible.

P.S. On a personal note, I have found Barrick to be more than willing to support local project. They have been a real asset to the community and we need to help them for the long run.

Sincerely,

John c. Carpenter
Assemblyman, Dist. #33

JCC/kd

Letter 34

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Centers for Disease Control
Atlanta GA 30333
March 7, 1991

Bureau of Land Management
Elko District Office
ATTN: Betze Coordinator
P.O. Box 831
Elko, Nevada 89801

Dear Sir:

We have completed our review of the Draft Environmental Impact Statement (DEIS) for the Betze Project, Barrick Goldstrike Mines, Inc. We are responding on behalf of the U.S. Public Health Service.

34-1 A major concern with a project of this magnitude is the prevention of surface and groundwater contamination/depletion. We note, however, that all discharge waters will be treated to meet NPDES requirements, and tailing and heap leach piles will be designed for "zero discharge." These measures are essential in preventing runoff and spills which could result in changes in water quality, and should be monitored to ensure design effectiveness.

Our concern regarding groundwater depletion involves the adequate maintenance of the Basin's water budget, and potential adverse impacts upon water supply wells in the area, especially those used for drinking water. These concerns also involve the potential cumulative effects of other mining operations in the area - effects which are noted to be difficult to quantify at this time. We note with interest that the State Engineer's Office will assess impacts of the dewatering operations on other water users by routinely reviewing the continual monitoring of groundwater levels. We also note, however, that a relatively vague "agreement in principal" has been "indicated" by Barrick (page 4-48) to implement off-site compensation, such as the creation of new

34-2 water sources where necessary. Because of the substantial amount of planned dewatering processes and the expected cone of depression, which it is predicted to require about 100 years to completely recover after project completion, we believe a requirement is warranted to ensure that when the project adversely impacts any existing potable well water quantity or quality, appropriate mitigation will occur in a timely manner to ensure a continual safe drinking water supply to all users.

Because much of the water taken from the ground will actually be treated and stored as surface water, we understand that major effects or changes in the overall water budget of the area is expected to be minimal. Careful monitoring efforts, however, will be necessary to validate previous modelling data. We believe other potential concerns have been addressed in this DEIS.

Response to Letter 34

34-1 The BLM agrees that monitoring is necessary. Please refer to the response to comment 11-2 for a discussion of existing and proposed monitoring programs.

34-2 Section 4.4.7.1 of the Draft EIS notes that the water quality of the wells, including potable water supply wells, would not be impacted by the proposed dewatering operations. However, dewatering operations would impact the water levels of wells within the cone of depression. Impacts to water supply wells, primarily extra pumping costs resulting from increased pumping head, would be expected only in close proximity to the Betze Pit (see Section 4.4.2.1 of the Draft EIS). The only potable water supply well in close proximity to the Betze Pit is Barrick's AA Well, located on the east side of Rodeo Creek near the low permeability granodiorite stock. There would probably be drawdown of less than 10 feet during dewatering (see Section 4.4.2.1 of the Draft EIS) and approximately 100 feet in the early years of recovery (see Section 4.4.3.1 of the Draft FIS). This decline in water levels is not anticipated to impact the ability of the AA Well to supply Barrick's potable water needs.

Page 2 - Bureau of Land Management

Thank you for the opportunity to review and comment on this document. Please insure that we are included on your mailing list to receive a copy of the Final EIS, and future EIS's which may indicate potential public health impact and are developed under the National Environmental Policy Act (NEPA).

Sincerely yours,

Kenneth W. Holt, M.S.E.H.
Special Programs Group (F29)
Center for Environmental Health
and Injury Control

Letter 35

DEAN A. RHOADS
SENATOR
Northern Nevada District

COMMITTEES:
Chairman
Public Lands

Member
Commerce and Labor
Natural Resources
Transportation

State of Nevada
Senate
Sixty-Sixth Session

March 8, 1991

Bureau of Land Management
Elko District Office
ATTN: Betze Coordinator
P. O. Box 831
Elko, Nevada 89801

Dear Sir:

I am writing to express my support of Barrick Goldstrike Mine's Betze project.

Barrick has demonstrated a strong commitment to the surrounding communities and the environment. They have made conscientious efforts to avoid and mitigate undesirable environmental impacts and the Betze Project's comprehensive Environmental Impact Statement demonstrates Barrick's commitment.

Also, the Project will have a very positive economic impact in Northeastern Nevada, with a workforce averaging 1,200 employees. The Project is expected to generate local, state and federal tax revenues of several million dollars annually.

Because of Barrick's demonstrated commitment to preserve wildlife habitats, visual and cultural resources and its significant contribution to the local economy, I urge you to approve the project as soon as possible.

Sincerely,

Dean A. Rhoads
State Senator

DAR/bb

SIXTY-SIXTH LEGISLATURE

Letter 36

Elko Senior Citizens Center, Inc.
P.O. Box 1638 · Elko, Nevada 89801 · (702) 738-5911

Director - Lynne D. McDonough
Board of Directors
Chairman - Wayne Marteney
Members - Charles Knight, Norman Glaser, Phyliss Cash

March 08, 1991

Bureau of Land Management
Elko District Office
P.O. Box 831
Elko, NV 89801

Attn: Bétze Project Coordinator

Dear Sir:

This letter is in support of Barrick Goldstrike Mine's Betze Project.

Barrick's commitment to this community goes beyond the civic minded concern and monetary support they have given to social service agencies, youth programs, law enforcement, and schools. Perhaps less known to the public are Barrick's efforts to protect and maintain the environment as evidenced in the Betze Projects comprehensive Environmental Impact Statement.

While most of the country is in an economic recession we in Elko are fortunate to be experiencing relative prosperity due largely to the mining industry.

It makes sense to support expansion in this industry when the expanding company is as responsible and sensitive to the community environment and wildlife as Barrick has been.

I highly recommend quick approval of Barrick's Betze Project.

Sincerely,

Lynne D. McDonough
Director

LDM/lma

4/1/91 - 1:05 p.m

Letter 37

Elko County Committee Against
Domestic Violence
P.O Box 2531
Elko, Nevada 89801
Hotline: (702) 738-9454
Office: (702) 738-6524

March 8, 1991

Bureau of Land Management
Elko District Office
ATTN: Betze Coordinator
Elko, NV 89801

Dear Sir,

I am writing in support of Barrick Goldstrike Mine Inc.'s Betze Project.

We appreciate the support and commitment to our community and immediate environs. They have been conscientious in avoiding and mitigating undesirable environmental impacts and that is demonstrated in the Betze Project's comprehensive Environmental Impact Statement.

CADV is especially supportive of the positive impact in Northeastern Nevada that will result in about 1200 employees. Our organization can testify to the needs of this area and feel the Betze Project will generate local, state and federal tax revenues of several million dollars annually. We anticipate that many of our clients needs pertaining to unemployment will be alleviated.

Barrick has continually demonstrated a commitment to preserve wildlife habitats, cultural resources and has contributed most generously to the local economy. Barrick has been very supportive of our organization and generous enabling us to be effective in Elko County. For these reasons I urge you to approve the Betze Project immediately.

Sincerely,

Sharon Ernst

Sharon Ernst
Executive Director

BARRICK
GOLDSTRIKE MINES INC.
P.O. Box 29 • Elko, Nevada 89801 • Telephone (702) 738-8043

March 11, 1991

Mr. Nick Rieger
Betze Project EIS Coordinator
Bureau of Land Management
P.O. Box 831
Elko, Nevada 89801

Re: Draft Environmental Impact Statement - Betze Project

Dear Mr. Rieger:

Barrick Goldstrike Mines Inc. submits the following comments on the Draft Environmental Impact Statement ("EIS") for the Betze Project:

1. Barrick appreciates the efforts of the BLM Elko District Office on the EIS. Barrick recognizes the difficulty in preparing a comprehensive review of the environmental impacts of a complex proposal such as the Betze Project. While Barrick does not agree with the entire EIS, we certainly recognize the effort that has gone into BLM's environmental review process.

2. Barrick wishes to confirm that Chapter 2 of the EIS accurately describes all material portions of the proposed Betze Project. As you know, in discussions with BLM, Barrick has modified numerous aspects of the Plan of Operations amendment submitted to BLM in April 1989 as the EIS process has proceeded. Barrick will submit to BLM a modified Plan of Operations amendment in the next several weeks that will conform to the "Proposed Action" as modified during the EIS process and as described in the EIS.

3. While the EIS process has been ongoing, the State of Nevada has enacted a reclamation law and promulgated regulations implementing that law. In addition, the BLM has adopted a new bonding policy requiring the posting of a bond for all mining activities conducted under Plans of Operations. The BLM and the Nevada Division of Environmental Protection have executed a Memorandum of Understanding (MOU) that establishes a procedure for coordinating the implementation of the federal and state reclamation and bonding programs.

Mr. Rieger
March 11, 1991
Page Two

The draft EIS acknowledges Barrick's obligation under the MOU to obtain approval of the reclamation plan and surety prior to implementation of the Betze Project plan amendment (see p. 2-47 of the draft EIS). Barrick will submit to BLM, as part of the modified Plan of Operations amendment, an expanded reclamation plan that should be considered part of the Betze Project proposal; this expanded reclamation plan will comply with the federal and state programs.

The basic elements of Barrick's reclamation plan remain the same as those described on pages 2-46 to 2-51 in the draft EIS. However, the expanded reclamation plan will describe in more detail the specific reclamation measures to be implemented as part of the Betze Project. The expanded reclamation plan will also project dates for initiation and completion of reclamation for each of the major components of the Proposed Action. Barrick requests that BLM take the expanded reclamation plan into account as it formulates its final decision with respect to Barrick's modified Plan of Operations amendment.

4. An element of both the federal and state reclamation programs is the posting of a bond or other form of surety to insure implementation of the reclamation plan. As reflected in the draft EIS, Barrick is committed to achieving reclamation of the various affected areas at the earliest practicable time, and to establishing a surety to do so (see p. 2-47 of the draft EIS). Barrick would like to reaffirm this commitment.

38-1 Barrick is preparing a reclamation cost estimate that will be submitted to the BLM and the Nevada Division of Environmental Protection to be used as the basis for establishing the surety amount. The surety will be for 100 percent of the projected reclamation costs, including neutralization, for those portions of the Proposed Action on which cyanide is used, stored or transported, although it may be less that 100 percent for other areas. Because of the rapidly evolving nature of the reclamation and bonding requirements, a final estimate of reclamation costs has not yet been developed. While the total amount of the surety is likely to be unprecedented in Nevada, Barrick recognizes the public's interest in ensuring that reclamation occurs. Barrick also understands that, under Nevada law, the reclamation cost estimate and surety must be reviewed and revised every three years. Under this requirement, Barrick's surety will be reviewed at least twice before the majority of reclamation is completed. This will provide BLM and the Nevada Division of Environmental Protection a continuing opportunity to review and, if necessary, increase or reduce the amount of the initial surety arrangement.

38-1 Since the close of the public comment period, Barrick has expanded the reclamation plan in compliance with new BLM and State of Nevada regulations (see Section 2.2.5 of the Final EIS); the plan includes the required financial assurances.

Mr. Rieger
March 11, 1991
Page Three

5. Barrick is committed to mitigation of the environmental impacts of its proposal. Barrick recently pledged a $300,000 interest-free loan to the Elko School District, $150,000 of which will be forgiven upon the commencement of the Betze Project. The purpose of the pledge is to mitigate socioeconomic impacts associated with the projected influx of construction workers. While this is not the only such donation that Barrick has made, or would intend to make, it is reflective of Barrick's long-term commitment to the local community.

Although Barrick strenuously disagrees with the projections in the draft EIS concerning potential impacts on springs and seeps in the area (see section 11(g)), Barrick is committed to mitigation of any riparian or wetland areas affected by the Betze Project. Establishment and implementation of final mitigation measures with respect to these impacts may be, in part, within the control of or require approval of state agencies and federal agencies other than BLM. Nevertheless, Barrick wishes to confirm the accuracy of BLM's statement in the draft EIS to the effect that Barrick is committed to the policy of "no net loss" of riparian or wetland areas and that Barrick is committed to working with the relevant agencies to accomplish this goal.

6. With respect to mitigation, Barrick noted the statements of at least one commentor in the public hearings on the draft EIS to the effect that not enough is known about post-mining pit water quality. Barrick believes that the data are adequate to project the consequences of the post-mining Betze Pit water quality; however, Barrick agrees that long-term water quality monitoring should be conducted to further evaluate the projections presented in the draft EIS. Barrick is also willing, in principle, to sponsor additional basic research concerning the quality of post-mining waterbodies.

With respect to the post-mining pit and related issues, it is not possible to accurately project if and when development of deposits in the vicinity of the Betze Project will occur, or, if they occur, how they will affect the post-mining Betze Pit. At this point, the best forecast that can be made is that it is likely that certain other deposits in the area will ultimately be mined by Barrick or others. The work product of research on post-mining water quality may assist BLM or other agencies in their assessment of the likely environmental impacts and the identification of appropriate mitigation measures as other deposits are developed.

Mr. Rieger
March 11, 1991
Page Four

7. Barrick would like to reiterate the facts previously described to the BLM with respect to plans for Barrick's other deposits in the area. First, Barrick presently has several other deposits in the vicinity of the Betze Project. The description of these deposits on page 3-84 of the draft EIS is correct in all material respects. Second, while these deposits may ultimately be developed, Barrick has no current plans for their development, other than to vigorously pursue further exploration and engineering that will define the nature and extent of the deposits and the manner and sequence in which they may be most efficiently mined. Barrick recognizes that the Plans of Operation for the development of such deposits will require additional environmental analysis if and when such plans are proposed. Finally, Barrick believes that the Betze Project will provide a great deal of information that will contribute to future evaluations of potential mining and processing methods for other developments. Information collected from the Betze Project will also assist BLM and other regulatory agencies in the environmental assessment of future mining developments involving Barrick or others.

38-2 8. Barrick strongly disagrees that the partial backfill alternative is reasonable (see p. 2-65 of the draft EIS). Barrick and its neighbor, Newmont Gold Company, have discovered several significant gold deposits located at depth adjacent to the Betze Pit. Although Barrick and Newmont are currently evaluating these deposits, it is premature to predict whether these deposits could be developed by open pit or underground mining methods. It would be inappropriate to foreclose the possibility of utilizing the post-mining Betze Pit for access to such deposits, regardless of the method of mining ultimately chosen for the deposits. Barrick also believes that the cost of partial backfill, some 423 million dollars, adversely impacts the economics of the Betze Project and cannot be justified based on the adverse environmental impacts of the alternative.

38-3 9. Barrick also disagrees with the proposed alternative of dumping waste rock at the Clydesdales, Far West, or North Block sites. These sites would involve additional disturbance of land. Barrick believes that the incremental costs and fuel consumption associated with the additional hauling distance to the Clydesdales site, previously described to you, are not justified. The Far West alternative involves lands that Barrick does not own or control. Barrick believes that the North Block waste rock disposal area alternative is not reasonable because it conflicts with Barrick's proposal for the development of heap leach facilities in that portion of the North Block.

38-2 Your comment is noted and was considered in the selection of the Agency Preferred Alternative (see Section 2.3.4 of the Final EIS). The impacts of the partial pit backfill alternative on mineral resources beneath the Betze Pit are addressed in Section 4.1.2.5 of the Final EIS.

38-3 Your comment was considered by the BLM in selecting this alternative as part of the Agency Preferred Alternative (Section 2.3.4 of the Final EIS).

Mr. Rieger
March 11, 1991
Page Five

38-4 10. Barrick notes the preference of the U. S. Environmental Protection Agency for the selection of alternative ore stockpiles, as expressed in its comments on the preliminary draft EIS. However, because of the increased costs involved, Barrick disagrees that selection of the South Block ore stockpile alternative is warranted. Barrick agrees that there may be a potential for impacts to water resources from the proposed ore stockpiles. Barrick would meet Nevada Division of Environmental Protection requirements for no surface or ground water degradation by incorporating seepage control measures into the design and construction of the ore stockpiles to mitigate potential impacts.

11. Barrick has several comments concerning specific sections of the draft EIS:

38-5 (a) Underground Mining Alternatives - The discussion of underground mining alternatives on pages 2-67 and 2-68 of the draft EIS should be revised to clarify that block caving or other underground mining methods may be appropriate for other deposits in the vicinity of the Betze deposit, but that block caving was determined not to be feasible for the Betze deposit for the reasons outlined on pages 2-67 and 2-68.

38-6 (b) Tailings Impoundment Reclamation Alternative - The description of the reclamation alternative for the surface of the tailings impoundment on page 2-65 of the draft EIS should clarify that the likely 10 to 20 year period for consolidation applies only to this reclamation alternative. The proposed reclamation action could be implemented within three to five years after the cessation of milling operations.

(c) Existing Habitat - Barrick would like to emphasize the nature of the existing wildlife habitat in the vicinity of the Betze Project. Most of the native vegetation has been replaced by annuals or introduced grasses, with the associated impact on wildlife habitat. This change has occurred because of grazing, range fires, and the previous exploration and mining efforts of Barrick and its predecessor, Western States Minerals JV-1, and other mining operations in the area. For example, local sage grouse populations have been significantly affected by the alteration of habitat resulting from extensive range fires during the 1960's and subsequent BLM re-seeding programs. The sage grouse also have been affected by the loss of brood rearing meadow habitat in creek bottoms due to stream entrenchment related to livestock grazing.

38-4 Your comment is noted. However, due to the additional groundwater protection provided by placement of the ore stockpile above the existing South Block waste rock disposal area, the BLM has selected this alternative as part of the Agency Preferred Alternative (see Section 2.3.4 of the Final EIS).

38-5 The discussion of the infeasibility of this alternative presented on pages 2-67 and 2-68 of the Draft EIS was intended to be limited to the Betze deposit; a text change in the Final EIS was not considered necessary.

38-6 The reference on page 2-65 of the Draft EIS to the 10- to 20-year drainage required for the tailings impoundment applies only to the alternative of covering the impoundments with waste rock. As described in Section 2.2.5 of the Final EIS, under the Proposed Action reclamation of the tailings impoundments is projected to begin in the spring of 2015, approximately 4 years after the start of decommissioning of the facilities. Please also see the response to comment 56-7.

Mr. Rieger
March 11, 1991
Page Six

Barrick believes that the post-mining wildlife habitat at the site will be superior to the existing environment once the disturbed terrain is recontoured and revegetated.

38-7 (d) Socioeconomic Impacts - Barrick believes that the socioeconomic impact discussion in Section 3.12 of the draft EIS may have overstated the existing impacts from mining development on governmental services and housing in Elko County. During the period of preparation of the draft EIS, the tight housing market in Elko has eased somewhat and the infrastructure of city and county governments has been further developed. Consequently, Section 4.12 appears to overstate certain socioeconomic impacts from the Betze Project. While the existing mining operations in the area have had an impact on the socioeconomic resources, Barrick believes that the additional 77 permanent employees will have less socioeconomic impact than portrayed in Section 4.12 of the draft EIS.

As indicated by the commitment described in Section 5 above and by the favorable comments of the Elko County School District representatives at the public meetings, Barrick has cooperated with local officials to identify and meet community needs related to the expansion of mining operations along the Carlin Trend. As the draft EIS notes on pages 3-95 and 4-169, Barrick has assisted in the development of housing units to accommodate workforce expansions. Such efforts, in addition to other direct financial commitments, demonstrate Barrick's commitment to the social and economic stability of the local area.

38-8 (e) Air Quality Modeling - Barrick believes that the air quality modeling may have also overstated the contributions of Newmont Gold Company and Dee Gold Company to particulate concentrations. The model apparently utilized maximum permitted process emissions rates for the Newmont and Dee facilities that were based on emission rates that are higher than those currently permitted these facilities. While it may not be inappropriate to utilize maximum permitted emissions to construct an estimate of expected particulate concentrations, we note that Newmont's and Dee's permits contain lower maximum permitted emissions rates than are presented on page 4-14 of the draft EIS. Specifically, the Newmont North Area Leach maximum permitted emissions are 30 pounds per hour, rather than 92 pounds per hour. Newmont's Mill No. 1 maximum permitted emissions are 39 pounds per hour, rather than 83 pounds per hour. Dee Gold's maximum permitted emissions are 52 pounds per hour, rather than 81 pounds per hour.

38-7 The socioeconomic impacts projected in the Draft EIS were based on the data available at the time of the analysis. As explained in the response to comment 22-1, the socioeconomic impact assessment was based on conservative estimates of population growth in the Elko area.

38-8 The emissions listed in Table 4-2 on page 4-14 of the Draft EIS represent the permitted "allowable" particulate emission rates for Newmont Gold Company and Dee Gold Company based on data provided by the NDEP as of January 1990 when the emissions inventory was prepared. A source-by-source breakdown of these emissions is provided in Table 3-1 on page 3-4 of the "Air Resources Technical Report for the Betze Project Environmental Impact Statement." The permitted "allowable" emission rates are, with few exceptions, higher than the "actual" emissions for the subject facilities. It is standard practice to use "allowable" emissions since a facility would be "allowed" to have emissions up to that limit. The use of "allowable" emission rates is a conservative analytic approach; while lowering the emission rates to "actual" emissions rates would reduce the predicted impacts near these facilities, the conclusions presented in the Draft EIS would remain unchanged.

Mr. Rieger
March 11, 1991
Page Seven

38-9 (f) Post-Mining Reclamation - Barrick has three comments with respect to post-mining reclamation. First, Barrick agrees with the goal of returning the land to a condition that is at least a productive as its pre-mining status. Second, Barrick, as previously discussed with BLM, intends to employ a consultant that is an expert in post-mining topography, to assist Barrick and BLM in developing refinements to the proposed post-mining landforms that may reduce further the visual impact of Barrick's operations on the post-mining topography. Third, Barrick does not agree with the discussion in the draft EIS that calls into question the viability of reclamation on slopes that are at overall side slopes of 2.5H:1V.

Based on practical experience, Barrick believes that the erosion model used in the draft EIS tends to overstate the likely soil loss on overall 2.5H:1V slopes. In addition, Barrick's topsoil stripping operations demonstrate that equipment can function effectively on 2.5H:1V and steeper slopes. Barrick agrees that the RUSLE model is an indicator of erosion and can be used to assist BLM in looking at potential erosion rates. However, Barrick's experience at the Goldstrike Mine and demonstrated successful reclamation at 2.5H:1V or steeper slopes at other mining operations are more compelling than the predicted results of such a modeling effort.

38-10 (g) Impacts on Seeps and Springs - Barrick believes that the draft EIS dramatically overstates the potential impact of dewatering of the Betze Pit on seeps and springs located within the projected cone of depression. An analysis of the seeps and springs that potentially may be affected, based on sampling data, geohydrologic review, and a review of the associated vegetation, supports the conclusion that most of the seeps and springs are not directly connected to the regional ground water system. Instead, most of these seeps and springs are perched above and isolated from the ground water table as depicted in Figure 3-7 of the draft EIS. As a result, these seeps and springs most likely will not be affected by Barrick's dewatering operations. Moreover, recent surveys of some of the seeps and springs in the projected cone of depression and in other areas within the Elko Resource Area suggest that several years of drought conditions have reduced the flow from or dried up many of the seeps and springs. The reduced flows support the conclusion that most of the seeps and springs are in fact perched, are not connected to the regional groundwater table, and most likely will not be affected by dewatering.

38-9 The issue of whether 2.5H:1V slopes can be effectively reclaimed is a matter which the BLM, in coordination with Barrick, will address through the test plot program (see Section 2.2.5 of the Final EIS). The discussion in the Draft EIS and the use of the RUSLE model was not meant as a categorical statement that erosion losses would exceed acceptable levels. Rather, the modeling effort indicates that erosion losses could be of concern on these slopes. The test plot program would address this concern and identify potential equipment constraints, and surface treatments and slope adjustments necessary for stabilization and revegetation of these side slopes.

38-10 As described in Section 3.4.1.5 of the Draft EIS, whether there is a hydraulic connection between the regional groundwater system and the seeps and springs in the area is not known for certain. Please refer to the response to comment 55-18. Therefore, the BLM took a conservative approach in the assessment of the effects of pit dewatering by evaluating the potential effects on the seeps and springs if in fact they are connected to the groundwater system. This uncertainty was also considered in the development of monitoring and mitigation measures incorporated into the Agency Preferred Alternative (see Section 2.3.4 of the Final EIS).

Mr. Rieger
March 11, 1991
Page Eight

38-11 (h) Groundwater Modeling - Barrick believes that the groundwater model used for the draft EIS presents a conservative evaluation of the effect of dewatering on the local groundwater system. While conservative modeling can imbue mine planning with a measure of safety, such modeling is likely to overstate environmental impacts. Given the geology and geohydrology of the area, in particular the Range Front faulting along the flanks of the Tuscarora Range, Barrick does not believe that the cone of depression will be as extensive as depicted in the draft EIS, and most probably will be confined within the Boulder Basin. Consequently, there should be less potential for the dewatering of the Betze Pit to affect springs and seeps and to affect the overall water balance.

12. The Proposed Action will have impacts on environmental resources. Barrick is agreeable to implementing monitoring programs. We believe that monitoring programs will provide Barrick, the BLM, and other regulatory agencies with data to accurately assess the impacts to resources and to determine appropriate mitigation measures.

Barrick would again like to acknowledge the efforts of the BLM, and appreciates the opportunity to comment on the draft EIS. If you have any questions concerning our comments, please contact Bob Ingersoll or me.

Very truly yours,
BARRICK GOLDSTRIKE MINES INC.

John T. McDonough
General Manager

JTM/ckb

cc: Bob Ingersoll

38-11 As described in Section 4.4.2.1 of the Draft EIS, the three-dimensional model used to project the effects of dewatering the Betze Pit was based on site-specific hydrologic data and other regional data. The model was calibrated using observed drawdown at existing monitoring wells and estimated total groundwater flow through the Boulder Valley hydrologic basin. In addition, sensitivity analyses were conducted on the hydrologic model to project the range of variance in the cone of depression. Hence, the model represents the best quantitative representation of the groundwater system in the project area currently available for evaluating impacts. Please also see the response to comments 47-1 and 55-18. Recognizing that the groundwater model results are projections, a monitoring and mitigation plan has been incorporated into the Final EIS (Section 2.3.4).

Letter 39

BOB MILLER
Governor

STATE OF NEVADA

DEPARTMENT OF ADMINISTRATION
Capitol Complex
Carson City, Nevada 89710
Fax (702) 687-3983
(702) 687-4065

March 12, 1991

Bureau of Land Management
Elko District Office
Attn: Betze Coordinator
P.O. Box 831
Elko, NV 89801

Re: SAI NV # 91300071 Project: Draft EIS -- Betze Mine

Dear Betze Coordinator:

Attached is an additional comment from the Nevada Department of Minerals that was received after our previous letter to you. Please incorporate this comment in your decision making process.

Sincerely,

John B. Walker, Coordinator
State Clearinghouse/SPOC

JBW/gd
Enclosure

Letter 39 Continued

BOB MILLER
Governor

STATE OF NEVADA
DEPARTMENT OF MINERALS
400 W. King Street, Suite 106
Carson City, Nevada 89710
(702) 687-5050
Fax (702) 687-3957

Las Vegas Branch
4220 S. Maryland Pkwy.
Suite 304
Las Vegas, Nevada 89119
(702) 486-7250
Fax (702) 486-7252

RUSSELL A. FIELDS
Executive Director

March 11, 1991

To: John Walker, Coordinator
Nevada State Clearinghouse
Department of Administration
Blasdel Bldg., Rm. 204
Carson City, NV 89710

Re: NV SAI #91300071

The draft EIS for the Betze Mining Project presents a vast amount of information in a logical, well developed format. By virtue of the size and duration of the proposed expansion there exist some areas of environmental impacts that cannot be fully understood or concisely predicted until the project is in progress. The fact that some uncertainty exists is not surprising nor is it uncommon in large complex development projects.

Two areas of uncertainty are the Cumulative Impacts and the Water Quality Impacts. The cumulative impacts will be driven, to a large extent, by market conditions, advancing technology and environmental sensitivities. The water quality questions and answers on this project will unfold as the project develops.

This EIS represents a correct scientific procedure of 1) documenting existing conditions, 2) forecasting expected impacts, 3) identifying uncertainties and 4) planning for field adjustment to conditions as needed. The employment of qualified engineers and scientists assures a dynamic approach to mitigation.

Barrick Goldstrike Mines Inc. is a responsible corporate citizen in Nevada and will be accountable for environmental conditions that result from the development of the Betze Mine.

Letter 39 Continued

The Nevada Department of Minerals encourages the responsible management and development of the states natural resources. We recognize the uniqueness of each site as requiring a level of engineering to address site specific concerns and economics.

The Nevada Department of Minerals fully supports the development of the Betze Mine Project.

Sincerely,

Dennis Anderson, P.E.
Resource Engineer

DA:lc
cc: John McDonough, Operations Manager
Barrick Goldstrike Mines Inc.

wp\DA60

Letter 40

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DUCKS UNLIMITED INC.

JOHN LUDWIG, PH.D.
REGIONAL DIRECTOR
NEVADA
1595 Watt Street
Reno, Nevada 89509
(702) 786-1021

11 March 1991

Bureau of Land Management
Elko District Office
Attn: Betze Coordinator
Box 831
Elko, NV 89801

I am writing to express my support for Barrick Goldstrike Mine's Betze Project.

It is obvious that the project will have a positive economic impact in northeastern Nevada through jobs and tax revenues. Also, Barrick has demonstrated concern for the environment in the past and I'm sure will continue to do so with the Betze project. We have hopes that some of the water emanating from the project can be used for wetlands creation or enhancement.

Thus I urge you to approve the Betze project.

Sincerely yours,

John Ludwig

John Ludwig

Letter 41

BOB MILLER
Acting Governor

STATE OF NEVADA

JUDY MATTEUCCI
Director

DEPARTMENT OF ADMINISTRATION
Capitol Complex
Carson City, Nevada 89710
(702) 885-4065

ELKO DISTRICT		
DM		
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PEC		
CF		
Code:		
X=Action		

March 11, 1991

Bureau of Land Management
Elko District Office
Attn: Betze Coordinator
P.O. Box 831
Elko, NV 89801

Re: SAI NV # 91300071 Project: Draft EIS -- Betze Mine

Dear Betze Coordinator:

Attached are the comments from the Nevada Divisions of Environmental Protection, Historic Preservation and Archeology, Water Resources, Water Planning and the Department of Wildlife concerning the above referenced project. We expect to see these comments addressed in the final EIS for the Betze Mine.

Sincerely,

John B. Walker, Coordinator
State Clearinghouse/SPOC

jbw
cc: State Agencies
Fred Wolf, BLM
D. Wieman, EPA\SF
Enclosures

Letter 42

PETER G. MORROS
Director

STATE OF NEVADA
BOB MILLER
Governor

L. H. DODGION
Administrator

Administration	(702) 687-4670	Wastewater Treatment Services	687-5870
Air Quality	687-5066	Water Permits and Compliance	687-4670
Mining Regulation and Reclamation	687-4670	Water Quality Planning	687-4670
Waste Management	687-5872	FAX	885-0868

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL PROTECTION
123 W. Nye Lane
Carson City, Nevada 89710

March 7, 1991

MEMORANDUM

To: John B. Walker, Coordinator, Nevada State Clearinghouse

From: Thomas J. Fronapfel, P.E., Nevada Division of Environmental Protection

Subject: Comments on Draft EIS for the Betze Mining Project, Nevada SAI #91300071

The Division has reviewed the Draft EIS for the Betze Mining Project. It appears that there are significant potential environmental impacts that will result from this project. Impacts to water quality and quantity and to riparian habitat are

42-1 the most prevalent. Little supporting information regarding mitigation measures has been provided.

A major question which should be considered is "Are the potential long-term impacts to the State and to the environment worth 15 million ounces of gold?"

Attached are the Division's specific comments regarding the Draft EIS for this project.

Please contact me at 687-4670 if you have any questions concerning these comments.

Attachments (memos from Doug Zimmerman, Dick Reavis, Jolaine Johnson, Gay McCleary and Glen Gentry)

TJF:wp1:betze

Response to Letter 42

42-1 Please refer to Section 2.3.4 of the Final EIS for a more detailed description of mitigation measures.

Letter 43

Administration (702) 687-4670
Air Quality 687-5065
Mining Regulation and Reclamation 687-4670
Waste Management (702) 687-5872

STATE OF NEVADA

Water Permits and Compliance 687-4670
Water Quality Planning 687-4670
Wastewater Treatment Services 687-5870

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL PROTECTION
123 W. Nye Lane
Carson City, Nevada 89710

March 4, 1991

MEMORANDUM

To: Tom Fronapfel

From: Doug Zimmerman Doug

Subject: Comments on the Draft Environmental Impact Statement, Betze Project and the supporting document Water Resource Technical Report for the Betze Project Environmental Impact Statement

I have reviewed the above referenced documents and have concluded that the information presented is insufficient to support the conclusions that insignificant impacts to water resources of the area will occur. Three main subjects of concern are detailed below:

43-1 1) The draft EIS conclusions, relative to water quantity and quality impacts, relied heavily on the results of a groundwater modelling effort performed by Leggette, Brashears & Graham, Inc. 1990. Neither the draft EIS or the supporting technical report contain any documentation of the site-specific application of this model. Model results are entirely dependent on the quality of the data input into the model and the level of understanding the modeler has of the hydrogeologic system. In this case it is impossible to evaluate the accuracy of the conclusions based on the model since no documentation of the modelling effort was presented for review. The final EIS should be supported by a technical document which includes a detailed discussion of this modelling effort so that a reviewer can effectively evaluate the results. The only conclusion that can be drawn at this time is that the model results should not be relied upon to the extent done in the draft EIS. The draft EIS stated that there is insufficient site-specific information to determine the degree of hydraulic connection between springs in the area and the regional hydrologic system. The draft EIS further references USGS personnel statements that hydrologic conditions are not clearly understood. Given these comments and the complexity of the hydrogeologic system it is critical that any model developed for this area be fully documented so that all uncertainties associated with model results can be fairly evaluated;

Response to Letter 43

43-1 A report entitled "Hydrologic Effects of Dewatering Betze Pit" was prepared by Leggette, Brashears & Graham, Inc. (LBG) to fully document the model used to project the Impacts of the Proposed Action. BLM reviewed the LBG report, and it is available for public review at the BLM Elko District Office.

Page -2-

2) Both the draft EIS and the supporting technical report present a table entitled, "Estimated Composition of Groundwater Inflow to Betze Pit", (Tables 4-16 and 3-4, respectively). The data represents water quality from various locations and depths in the Betze pit area. To obtain the estimated pit inflow quality a simple arithmetic average of the data shown in the tables was done. This method is highly suspect in that it completely fails to account for hydrogeologic considerations during backfilling of the pit. The relative contribution of the quantity of water from each hydrologic unit has not been quantified. Therefore it is impossible to predict the expected water quality of pit inflow with the data presented. This data was than apparently used as the input data for modeling by Leggette, Brashears & Graham, Inc. and for modeling utilizing WATEQ4F discussed in the water resources technical report. The modelling efforts have not been adequately documented to allow a precise statement on this matter but if this is the case than the results from the models would be highly suspect. The final EIS should thoroughly and realistically evaluate this issue; and

43-2

3) The evaluation of the potential for waste rock and ore stockpiles to degrade waters of the State and the conclusion that no hazard exist is unacceptable. The analysis presented in the EIS was based on the results of a computer simulation from the model HELP (Hydrologic Evaluation of Landfill Performance). The modelling effort did not utilize site-specific data but instead relied entirely upon the internal database of the model. This resulted in the use of rainfall data from Ely, Nevada which is 150 air-miles form the site and characterization of the waste rock and ore as "loam, sand and coarse sand" for infiltration properties. There has been no demonstration that these data are valid for the site. Conclusions drawn from results of the model can not be accepted as a realistic evaluation of the potential of these materials to degrade waters of the State. The final EIS should re-evaluate this issue and present conclusions based on a site-specific investigation.

43-3

43-2 Please refer to the responses to comments 55-13 and 55-22.

43-3 The meteorological conditions at Ely, Nevada are very similar to those at the site, located near Elko, Nevada. Nonetheless, the HELP model was reapplied using data from Elko. The results of this analysis are provided in Appendix B-1 of the Final EIS, Revised HELP Modeling. The results are similar to those obtained previously (ENSR and Drever 1991) except that slightly less infiltration resulted. The soil profiles that most closely match the waste rock and soil characteristics of the site were used in the HELP modeling study.

It is not expected that reasonable changes in the soil characteristics would significantly affect model results. This is confirmed by the results of the analysis which included a sensitivity study in which the hydraulic conductivity of the waste rock was varied from 6.6 to 11.95 inches per hour. These results verify that infiltration is not highly sensitive to variations in the value of hydraulic conductivity.

Letter 44

BOB MILLER, Governor

STATE OF NEVADA

Administration (702) 687-4670
Air Quality 687-5065
Mining Regulation and Reclamation 687-4670
Waste Management (702) 687-5872

Water Permits and Compliance 687-4670
Water Quality Planning 687-4670
Wastewater Treatment Services 687-5878

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL PROTECTION
123 W. Nye Lane
Carson City, Nevada 89710

March 7, 1991

MEMORANDUM

TO: Tom Fronapfel

FROM: Dick Reavis DER

SUBJECT: Comments on Draft EIS - Betze Project

I. Draft is well-written; covers areas of concern:

A. Hydrogeological regime

44-1 1. Groundwater levels will recover within 100 years. What happens in the meantime if the state needs that water? Would re-injection of the total amount of dewatered fluids be feasible to mitigate this impact?

B. Riparian Habitat

44-2 1. No mitigation measures are proposed for the destruction of aquatic life or riparian habitat.

C. Water quality of pit after recovery

44-3 1. What effects will elevated arsenic have on ground waters intercepted by pit? The mitigation described on page 4-98 is weak. Who would provide treatment and for how long?

DR/sld:#8

Response to Letter 44

44-1 Section 2.2.2.6 of the Draft EIS described the uses of the water to be produced by Barrick's dewatering operations. As noted in that section, a portion of the water would be used for mining, milling, and processing purposes. Barrick proposes to make the balance of the water available for irrigation uses in satisfaction of existing water rights or other beneficial uses in lower Boulder Valley. The use of the water in lower Boulder Valley would be expected to generally maintain the hydrologic balance within the Boulder Flat Hydrographic Basin. Once dewatering ceases, the groundwater system would begin to return to pre-mining conditions. The recovery period does not involve the loss of water, but rather the re-establishment of pre-existing groundwater contours. Due to the need to lower the water table in the immediate vicinity of the Betze Pit, reinjection of dewatering water in the immediate area of the Betze Pit would not be feasible. If the water were to be reinjected at some greater distance from the pit, a period of groundwater recovery would still exist. This option was discussed in Section 4.4.2.2 of the Final EIS.

44-2 The Final EIS (Section 2.3.4) has been expanded to include a more complete description of additional monitoring and mitigation measures. Your comment was considered in the incorporation of monitoring and mitigation into the Agency Preferred Alternative. Please refer also to the response to comment 11-8.

44-3 The data and analysis concerning pit water quality presented in the Draft EIS were supplemented based upon additional data not available for use in the Draft EIS and in response to comments received on the Draft EIS. The expanded analysis is presented in Section 4.4.9 of the Final EIS. The additional analysis illustrates that predicted arsenic concentrations may be slightly higher than those presented in the Draft EIS. However, the impacts to water quality of the Betze Pit remain essentially unchanged.

It appears that once the groundwater system has returned to equilibrium, water would continue to flow into and out of the pit. As is presently the case, some water containing elevated arsenic levels would exist and could migrate into the groundwater system at the mine. However, it is unlikely that any increase in groundwater arsenic concentrations would occur due to the existence of the water body. The need for any water body treatment or mitigation of the pit water is uncertain and would be established during long-term monitoring of the system. It should be noted that additional research on the physical and chemical characteristics of water bodies such as the Betze Pit is necessary in order to develop a practical mitigation or treatment program, and such research will be funded in conjunction with this project. Section 2.3.4 of the Final EIS has been expanded to provide a more complete description of additional monitoring and mitigation measures. Your comment was considered in the incorporation of monitoring and mitigation into the Agency Preferred Alternative.

Letter 45

PETER G. MORROS
Director

STATE OF NEVADA
BOB MILLER
Governor

L. H. DODGION
Administrator

Administration (702) 687-4670
Air Quality 687-5066
Mining Regulation and Reclamation 687-4670
Waste Management 687-5872

Wastewater Treatment Services 687-5870
Water Permits and Compliance 687-4670
Water Quality Planning 687-4670
FAX 885-0868

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL PROTECTION
123 W. Nye Lane
Carson City, Nevada 89710

March 1, 1991

MEMORANDUM

TO: Thomas J. Fronapfel

FROM: Jolaine A. Johnson
Bureau of Waste Management

SUBJECT: EIS - Barrick Goldstrike Betze Pit

I have reviewed the subject document and have no comments from the perspective of waste management for the proposed activities.
45-1 Of course, the operation must adhere to all local, state and federal solid and hazardous waste regulations.

Response to Letter 45

45-1 The Betze Project will be required to comply with all applicable laws and regulations.

Letter 46

BOB MILLER, Governor

STATE OF NEVADA

Administration (702) 687-4670
Air Quality 687-5065
Mining Regulation and Reclamation 687-4670
Waste Management (702) 687-5872

Water Permits and Compliance 687-4670
Water Quality Planning 687-4670
Wastewater Treatment Services 687-5870

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL PROTECTION
123 W. Nye Lane
Carson City, Nevada 89710

March 6, 1991

MEMORANDUM

TO: Tom Fronapfel

FROM: Gay McCleary, Gay McCleary

SUBJECT: Comments on EIS, Barrick's Betze Project

46-1 Page 2-8: The listed existing major facility disturbance table acreage cannot be reconciled with the acreage currently permitted. This issue must be resolved prior to any new disturbance being approved.

46-2 Page 3-15: Footnote 2 is incorrect as the Nevada 24-hour ambient air quality standard for particulate must not be exceeded at all.

46-3 Overall, the EIS is very thorough. However, it is strongly suggested that the Prevention of Significant Deterioration regulations, 40 CFR 52.21, especially the provisions for a major modification, be reviewed. If the expansion is subject to PSD, it could have a significant impact on any time schedules that Barrick may have regarding construction.

Response to Letter 46

46-1 The existing surface disturbance permit issued by the NDEP to Barrick authorizes the disturbance of 2,822 acres. The permit was obtained based on the total projected disturbance that would occur during the 5-year life of the permit and includes more area than is included as "existing disturbance" in Table 2-1 of the Draft EIS. The permit describes disturbed areas by section location and type of disturbance. The type of disturbance categories described in the permit differ from those used in Table 2-1, but in no case does the actual existing disturbance exceed the total disturbance authorized in the permit.

46-2 The comment is correct. The footnotes in Table 3-4 of the Final EIS have been revised to correct the Nevada 24-hour ambient air quality standard for TSP, in compliance with Nevada Administrative Code 445.843.1.

46-3 The BLM agrees that Barrick must comply with PSD requirements if Barrick's emissions exceed the regulatory thresholds. In response to your comment, BLM has again reviewed Barrick's emissions data, including the emissions data in Tables 4-1 and 4-2 of the Draft EIS, and additional data contained in Barrick's air quality applications to permit construction of the facilities discussed in this EIS and the supporting air quality modeling. These data do not indicate that the regulatory thresholds have been exceeded. Section 4.3.1 of the Final EIS has been supplemented to document that conclusion. The BLM has also advised Barrick of the existence of these requirements and the possible impact on scheduling should the thresholds be exceeded.

Letter 47

BOB MILLER, Governor

STATE OF NEVADA

Administration (702) 687-4670
Air Quality 687-5065
Mining Regulation and Reclamation 687-4670
Waste Management (702) 687-5872

Water Permits and Compliance 687-4670
Water Quality Planning 687-4670
Wastewater Treatment Services 687-5870

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL PROTECTION
123 W. Nye Lane
Carson City, Nevada 89710

MEMORANDUM

Date: February 22, 1991

From: Glen Gentry

To: Thomas J. Fronapfel through Wendell McCurry

Subject: Barrick Goldstrike Betze Pit

47-1 After review of the DEIS the lowering of the water table including recovery time (100 years) will have the greatest impact on surface waters and has so many unknowns associated with it that the DEIS admits that the impacts can not be fully assessed.

47-2 The earthen embankment or bridge structure across Brush Creek must follow BMP's and could require a separate discharge permit from DEP's BWPC. A discussion of all road construction or other construction activities and their effects on stream channel crossings should be included and detailed. (pg 2-42)

Construction of sediment controls in stream channels should be reviewed by this office. (pg 2-49)

47-3 If construction impacts wetlands or stream channels of one to ten acres a Nationwide Permit from US Army Corps of Engineers would be required. If greater then ten acres are impacted an individual 404 permit would be required.

47-4 Is the discharge to TS Ranch Reservoir already permitted by DEP? Will the increase flows require a new or revised permit from DEP? (pg 2-61)

47-5 Under Agency Preferred Alternatives, could an artificial wetlands be made with the infiltration water and maintained during operation and after closure by agreements between Barrick and a government agency such as NDOW or BLM, etc. (pg-2-69)

47-6 Reduction of springs and surface flows in the area should be mitigated and no mitigation plans are presented in the DEIS. (pg 2-71)

Response to Letter 47

47-1 The BLM agrees that there are uncertainties associated with the groundwater impacts from the proposed dewatering operations. The BLM reviewed the model and report prepared by Leggette, Brashears & Graham, Inc. and believes that it presents a meaningful analysis of the dewatering impacts. In recognition of the uncertainties that remain, specific monitoring and mitigation measures have been incorporated into the Agency Preferred Alternative in the Final EIS (see Section 2.3.4).

47-2 The BLM agrees that stream crossings and sediment control structures must comply with all applicable state laws and regulations.

47-3 The BLM agrees with this comment. A Nationwide Permit is identified in Table 1-1 of the Draft EIS as one of the principal authorizing actions required to implement the Proposed Action.

47-4 Barrick has been issued an NPDES permit by NDEP that authorizes the discharge of dewatering water. The discharge quantity authorized in the existing permit is adequate to cover the projected volume of dewatering discharges.

47-5 Subject to regulatory constraints, temporary artificial wetlands could be created with dewatering water. The BLM considered creation of artificial wetlands but decided this would be a short-term solution. Instead, the Agency Preferred Alternative incorporates mitigation measures, e.g., enhancement or replacement of other riparian habitat, that provide benefits that are not dependent on the availability of dewatering discharges; see Section 2.3.4 of the Final EIS.

47-6 Please refer to the response to comment 11-8.

Letter 47 Continued

-2-

47-7 Runoff waters should be monitored. A potential exists for the runoff to be acidic and if this is the case it should be treated before entering any surface waters. (pg 2-72)

47-8 A definite mitigation plan for effects to Rodeo, Boulder, Bush Creeks, dried up springs and wetlands and damage to riparian habitat needs to be developed prior to beginning this project. (pg 4-78)

47-9 Some type of monitoring during and immediately following the recovering period should be conducted to show that impacted waters at least return to normal conditions. Areas that are improved by the project should be maintained at the higher quality levels. (pg 4-81)

47-10 Another alternative should be to change the final pit design to provide increase shoreline, primary and secondary biotic production and create larger productive trophogenic zones (zone of food production). (pg 4-95)

47-11 The effects due to dewatering should be considered Long term and not short term effects. There could be permanent alteration to surface and groundwater conditions.

Response to Letter 47 Continued

47-7 An analysis using the HELP model (ENSR and Drever 1991) developed by the U.S. Army Corps of Engineers indicated that it is unlikely that any significant amount of surface water runoff will occur from the waste rock disposal areas or ore stockpiles. Any runoff from ore stockpiles would be contained in a berm surrounding the stockpile.

The results of the static and kinetic testing of the waste rock indicate that on the average, any runoff water that might occur should not be acidic. There is a potential that localized areas of the waste rock disposal areas may generate acid; however, this is not expected to have a significant impact on runoff water quality due to the presence of substantial quantities of acid neutralizing material. Should acid runoff be generated, Barrick will be required by the BLM and NDEP to remediate the situation and prevent flow from contaminating surface water or groundwater resources.

Presently, Nevada's water quality regulations require the use of best management practices to control discharges from diffuse sources, including mining activities. The U.S. Environmental Protection Agency promulgated storm water discharge regulations in November 1990 that require industrial facilities, including mining activities, to obtain permits if storm water runoff is discharged to waters of the United States. The regulations require complete permit applications to be filed by May 18, 1992. The permit will regulate the quality of the discharge allowed and will establish monitoring and other compliance requirements. The BLM understands that the NDEP will administer the storm water discharge program in Nevada. The BLM will require Barrick to comply with storm water regulations. At this time, it is not possible to predict precisely what monitoring and controls will be required. If in the BLM's judgment the required monitoring is inadequate, the BLM retains the right to take action as may be required to prevent undue and unnecessary degradation of surface waters.

47-8 In response to this and other similar comments, additional mitigation and monitoring measures have been incorporated into Section 2.3.4 of the Final EIS, Agency Preferred Alternative.

47-9 In response to this and other similar comments, the BLM has incorporated into the Agency Preferred Alternative a requirement for a long-term monitoring program (see Section 2.3.4 of the Final EIS).

47-10 The BLM considered but rejected a potential mitigation measure of requiring Barrick to change the proposed action to provide for a shoreline in the post-mining Betze Pit. Under the Proposed Action, the projected high wall would extend at least 200 feet above the ultimate water level, which is not projected to be reached for at least 100 years. Under these circumstances, and in view of the fact that additional mining activities are likely to affect the topography of the Betze Pit (see Section 3.12.3.3 of the Draft EIS) during the recovery period, the BLM concluded that it was not reasonable to require Barrick to create a shoreline as part of its reclamation.

47-11 Please refer to the response to comment 47-1.

Letter 48

BOB MILLER
Governor

STATE OF NEVADA

RONALD M. JAMES
State Historic Preservation Officer

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF HISTORIC PRESERVATION AND ARCHEOLOGY
123 W. Nye Lane, Room 208
Capitol Complex
Carson City, Nevada 89710
(702) 687-5138

February 27, 1991

M E M O R A N D U M

TO: John Walker, Dept. of Administration

FROM: Alice M. Baldrica, Deputy SHPO *Alice M. Baldrica*

SUBJECT: Draft EIS for the Betze Mining Project, NV SAI#91300071

48-1 The Division has reviewed the draft EIS and has been consulted by the BLM regarding the treatment of historic properties within the area of potential effect. We both agree that not all properties have been identified, many remain to be evaluated and treatment must be determined. Therefore, as per 36CFR800.13, the BLM has decided to develop and implement a programmatic agreement regarding the treatment of historic properties in consultation with this office, interested parties, Native Americans, the Advisory Council on Historic Preservation and Barrick Goldstrike Mines, Inc.

We have reviewed a draft of the agreement, have approved the concept, and forwarded our comments to the Elko District. We anticipate participation in a dialogue to achieve a final draft for submission to the Advisory Council.

In conclusion, consideration of historic properties in accordance with the National Historic Preservation Act is proceeding however, is far from concluded.

If you have any questions regarding these comments please call me.

/AMB

Response to Letter 48

48-1 The BLM agrees that not all areas have been surveyed to determine the presence of cultural resources. The BLM has negotiated a programmatic agreement for the Goldstrike Mine with the State Historic Preservation Officer, the Advisory Council on Historic Preservation, and Barrick. Compliance with the programmatic agreement satisfies the requirements of Section 106 of the National Historic Preservation Act (NHPA) for this project. Compliance with the NHPA will be required before any resources subject to the NHPA could be disturbed.

Letter 49

Nevada State Clearinghouse

RECEIVED

MAR -

Department of Administration
Planning Division
Blasdel Bldg, Rm. 204
Carson City, Nv. 89710
687-4065

FROM: John B. Walker, Coordinator DATE: January 24, 1991

TO:

____ Governor's Office	XXX Legislative Counsel Bureau	Conservation-Natural Resources:
____ Agriculture	XXX ____ Minerals	XXX Director's Office
____ Colorado River Cmsn.	____ Nuclear Projects Ofc.	XXX State Lands
____ Communications Bd.	____ PSC	XXX Environmental Protection
____ Community Services	____ Tourism	____ Forestry
____ Economic Development	XXX Transportation	XXX Historic Preservation
____ Fire Marshal	XXX UNR Mines Bureau	XXX Conservation Districts
____ Human Resources	XXX UNR Library	____ State Parks
____ Aging Services	____ Wild Horse Commission	XXX Water Resources
____ Health Division	XXX XXX Wildlife	XXX Water Planning
XXX Consumer Health	____ ____________	

Nevada SAI #91300071 Project: Draft EIS for the Betze Mining Project

CLEARINGHOUSE NOTES:

Please advise if you would like a State Clearinghouse Briefing on this project

Attached, for your review and comment, is a copy of the above mentioned project. Please evaluate it with respect to its effect on your plans and programs; the importance of its contribution to state and/or local areawide goals and objectives; and its accord with any applicable laws, orders or regulations with which you are familiar.

Please submit your comments no later than March 7, 1991. Use the box below for short comments. If significant comments are provided, please use agency letterhead and include the Nevada SAI number and comment due date for our reference.

THIS SECTION TO BE COMPLETED BY REVIEWING AGENCY:

____ No comment on this project
____ Proposal supported as written
_XX_ Additional information below

____ Conference desired (See below)
____ Conditional support (See below)
____ Disapproval (Explain below)

AGENCY COMMENTS:

49-1 Permits have been issued for this project for the pumping of water not to exceed 2,238 million gallons annually. The permit terms allow for the water to be stored in a storage reservoir for use on the lands of the TS Ranch. Any water from this dewatering operation shall not be discharged to any natural drainages or man made drainages. Monitoring plans is required by the State Engineer along with a monthly pumpage report. The State Engineer retains the right to regulate the pumping from the dewatering project to protect the public's interest and existing rights.

Signature [signature] Date 03/05/91

TRACY TAYLOR, HYDRAULIC ENGINEER IV
SPECIAL PROJECTS

Response to Letter 49

49-1 The comment indicates that Barrick has been issued appropriations authorizing the pumping of 2,238 million gallons of water annually. This is the quantity of water that Barrick is authorized to use for mining, milling, and processing uses. The Nevada State Engineer has issued to Barrick appropriations that increase Barrick's total permitted pumping capacity to 72,000 acre-feet per year. The majority of the water covered by Barrick's appropriations also is subject to a primary storage permit issued by the State Engineer. Use of the water stored under the authority of that permit must be approved through a secondary permit issued by the Nevada State Engineer. Barrick may not release any of the appropriated water to flow freely to a surface water system without approval of the State Engineer. The comment correctly notes that the appropriations require Barrick to conduct regular monitoring and to submit monitoring reports to the State Engineer.

Letter 50

BOB MILLER
Governor

STATE OF NEVADA

PETER G. MORROS
Director

EVERETT A. JESSE, P.E.
Administrator

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF WATER PLANNING
Capitol Complex
123 W. Nye Lane
Carson City, Nevada 89710
(702) 687-3600

March 6, 1991

MEMORANDUM

TO: John B. Walker, Coordinator
Nevada State Clearinghouse

FROM: Randy A. Pahl, P.E.
Hydraulic Engineer III

SUBJECT: Comments on Draft EIS Betze Project

1. On page 4-43, Impacts to the TS Reservoir, the fourth sentence should be changed to:

50-1 "Surplus water above irrigating system capacity would be discharged to Boulder Creek, upon regulatory approval."

2. In Section 4.4.2.5, The Draft EIS states that possible releases into Boulder Creek (during periods when dewatering flows exceed milling and irrigation demands) would increase bank erosion in Boulder Creek. Required mitigation measures need to be discussed. 50-2

Response to Letter 50

50-1 The BLM agrees with this comment. Section 4.4.2.1 of the Final EIS has been revised in response to this comment.

50-2 As noted in Section 4.4.2.5 of the Draft EIS, any discharges of excess dewatering water to Boulder Creek would require additional regulatory review and approval by the Nevada State Engineer and the NDEP. Mitigation measures to address bank erosion and other impacts of such discharges would be addressed as part of that additional regulatory review.

Letter 51

STATE OF NEVADA
DEPARTMENT OF WILDLIFE
1100 Valley Road
P.O. Box 10678
Reno, Nevada 89520-0022
(702) 688-1500

BOB MILLER
Acting Governor

WILLIAM A. MOLINI
Director

February 25, 1991

John B. Walker
Nevada State Clearinghouse
Division of State Planning
Blasdel Building, Room 204
Carson City, NV 89710

RE: NV 91300071, Draft EIS - Betze Project (Barrick Goldstrike) - BLM

Dear Mr. Walker,

We appreciate the opportunity to review and provide comments on the subject document.

The Nevada Department of Wildlife concurs with the overall scope of the information contained within the Draft Environmental Impact Statement (DEIS) prepared for the proposed Betze Project. We would like to take this opportunity to express some concerns about specific elements of the proposal.

51-1 On Page ix of the Summary there is a discussion that indicates that the area to be disturbed will be moderate to low quality wildlife habitat. Historically the Little Boulder Valley was a very important intermediate range for mule deer. They would stay in the area until heavy snows forced them to the southern winter ranges. With the cumulative impacts of several mining operations within the valley, the area is now of little value to mule deer. Now the mule deer are forced onto the winter ranges earlier than in the past. This has put more pressure on already poor quality winter ranges. Ultimately this has resulted in increased winter mortalities, which has contributed to the reduced deer populations within the Tuscarora and Independence Mountain Ranges.

51-2 In Section 2.2.3, Proposed Processing Facilities, there is no mention of the Industrial Artificial Pond Permit required by the Nevada Department of Wildlife to operate ponds that contain chemicals lethal to wildlife.

Response to Letter 51

51-1 The text of the Final EIS has been expanded in Sections 4.7.1 and 4.7.3 to reflect this comment. Mitigation measures that include mule deer habitat improvement projects have been incorporated into the Agency Preferred Alternative (see Section 2.3.4 of the Final EIS).

51-2 The Industrial Artificial Pond Permit required by NDOW is identified in Table 1-1 of the Draft EIS as one of the principal authorizing actions required to implement the Proposed Action. An Industrial Artificial Pond Permit has been issued for Barrick's existing operations, and a permit would be obtained for the tailings and solution ponds that would be constructed as part of the Proposed Action.

Letter 51 Continued

John B. Walker
February 25, 1991
Page 2

51-3 In Section 2,2,5.3, Revegetation, the Nevada Department of Wildlife suggests that the seed mix that is used to reclaim the mining disturbances be oriented towards the habitat type that existed in that area prior to the disturbance caused by overgrazing, fires and mining. The reclamation goal should be to restore the disturbed habitat to its potential natural state to ensure that wildlife can be supported. The reclaimed habitat should be capable of supporting an abundance of wildlife species.

51-4 In Section 2.2.5.7, Sediment Control, the Nevada Department of Wildlife suggests that planting native vegetation can provide dual purpose in controlling sediment loss and provide adequate habitat for wildlife. This would be particularly true of the unnamed drainage that is being used to transport the water pumped from the pit dewatering program. Fencing the unnamed drainage and the dewatering reservoir to limit livestock use on the riparian vegetation should be considered. This would protect those areas from erosion caused by livestock use. Willow plantings and other riparian plant species have been successfully introduced at other mining operations in the Region.

51-5 In Section 2.3.1.6, Reclamation Alternatives, the Nevada Department of Wildlife would support use of a combination of several of the slope alternatives. The ensuing variation in slope configurations would provide more diversity in the vegetative communities that establish following the reclamation of the mining activity.

51-6 In Section 4.4.2.5, Mitigation, the Nevada Department of Wildlife supports including the additional mitigation measures 1 and 2 in the Plan of Operation for the proposed project. We feel that these measures are not potential mitigation, but should be included as Standards for Operating in the Plan of Operation. A monitoring program to determine the flow losses at springs and seeps in the vicinity of the proposed project is essential to quantify the level of impact the dewatering program has on the area's water resources. Implementing alternative water sources, dedicated to wildlife, should be identified specifically in the Plan of Operation for the proposed project.

51-7 In Section 4.6.1, the DEIS indicated that an additional 2,189 acres of wildlife habitat will be disturbed by the proposed project for the life of the project. The Nevada Department of Wildlife is concerned with the continued increase in the loss of wildlife habitat and the resulting loss of wildlife and recreational opportunities associated with that habitat. Mitigation for the loss of habitat, wildlife and recreational opportunities should include but not be limited to:

Response to Letter 51 Continued

51-3 The BLM agrees. The reclamation plan included in Section 2.2.5 of the Final EIS identifies a proposed seed mix. The final seed mix will be selected by the BLM, in consultation with NDOW, based on the results of a revegetation study and the success of the revegetation test plot program. Selection of plant species for use in the test plots will include species which existed in the area prior to historical disturbance. This comment was considered in the development of additional mitigation measures which were incorporated into the Agency Preferred Alternative (See Section 2.3.4 of the Final EIS).

51-4 A portion of the unnamed drainage is within the fence erected to exclude livestock from the active mining area (see Figure 3-12 of the Draft EIS). However, the reservoir and a portion of the unnamed drainage are situated on private land that is not controlled by Barrick. The BLM agrees that planting native vegetation along those portions of the unnamed drainage that are under BLM or Barrick control would improve sediment control and wildlife habitat during the period of dewatering discharges. The BLM considered your comment in identifying additional mitigation measures in the Final EIS and in selecting the Agency Preferred Alternative (see Section 2.3.4 of the Final EIS).

51-5 The BLM agrees with this comment. In response to this suggestion, this mitigation has been incorporated into the Agency Preferred Alternative (see Section 2.3.4 of the Final EIS).

51-6 Although the number of water sources that would be affected by the Betze Project remains uncertain, the BLM agrees that it may have an impact on wildlife numbers. Monitoring programs and mitigation measures, including replacement of water sources, replacement or enhancement of riparian areas, and habitat improvement projects have been incorporated into the Agency Preferred Alternative (see Section 2.3.4 of the Final EIS). These mitigation measures would be implemented in consultation with NDOW.

51-7 Please refer to the response to comment 51-6.

John B. Walker
February 25, 1991
Page 3

developing additional riparian areas

providing alternate water sources dedicated to wildlife use in the surrounding area

improving habitat conditions for wildlife in surrounding key habitats

providing an adequate conservation pool at the TS Ranch reservoir for wildlife purposes.

51-8 In Section 4.7.1, the DEIS discusses the shift in mule deer migration from the west side of the range to the east side of Tuscarora Range. It is important that the parties involved with disturbing the deer migration routes be aware that continued loss of access to historical winter ranges could prove to be of serious consequence to the mule deer resource in the Tuscarora and Independence Ranges.

51-9 In Section 4.7.1, the DEIS makes a statement that "due to the marginal quality of the surrounding habitat, the sage grouse may tolerate the disturbance and continue to use the lek." We disagree with this conclusion. It is our opinion that sage grouse will discontinue the use of this lek and this population of sage grouse will be lost.

51-10 A additional concern that needs to be addressed is the problem of wildlife depredation on the alfalfa fields and stack yards that will be created by irrigating Boulder Valley with water from the pit. The expected increase in acres of alfalfa will undoubtably create sources of high value forage for mule deer and antelope in the area unless protective fencing is installed during development to eliminate wildlife use on the fields. This issue is not addressed in the DEIS.

51-11 The potential elimination or reduction in flows to springs, seeps and creeks as a result of the dewatering program will undoubtedly cause a reduction in wildlife numbers unless alternative water sources are developed. The DEIS indicates that Barrick is committed to providing this mitigation and it is suggested that this occur as a condition of the Plan of Operation. The Nevada Department of Wildlife supports this concept and suggest that we are in a position to provide the expertise to develop, in coordination with the Bureau of Land Management and Barrick, a plan to provide alternate water sources dedicated to wildlife in the areas impacted by the proposed project.

51-8 Please refer to the response to comment 51-1.

51-9 The BLM agrees that use of the lek may be discontinued; however, the population would not necessarily be lost. The sage grouse may disperse to other satellite leks in the area. Exclusion of livestock grazing from the mining area, which began in 1990, will also help in the improvement of sage grouse habitat. The BLM is, however, concerned with the cumulative impact of mining disturbance on sage grouse and is requiring mitigation for enhancement of sage grouse habitat. This mitigation has been developed and incorporated into the Agency Preferred Alternative (see Section 2.3.4 of the Final EIS).

51-10 Your comment is addressed in the revised text in Section 4.12.1.3 of the Final EIS.

51-11 Please refer to the response to comment 51-6. The BLM agrees and mitigating measures have been developed for replacement of water sources that include the acquisition of water rights, wildlife easements, and installation of guzzlers. The BLM agrees that the combination of mitigation measures identified in the Agency Preferred Alternative in the Final EIS (Section 2.3.4) could ultimately improve the quality and diversity of habitat in the area.

John B. Walker
February 25, 1991
Page 4

In addition, the Nevada Department of Wildlife suggests the purchase of water rights at off-site locations to be dedicated to wildlife could be used for mitigating the loss of springs and seeps to the proposed project. This concept could include the purchase of wildlife easements to protect important wildlife habitat on private lands.

The Nevada Department of Wildlife suggests developing wetlands and riparian areas utilizing some of the water removed from the proposed pit by the dewatering plan. This would mitigate the expected loss of 134 acres of riparian/aquatic habitat associated with the dewatering plan during the operational life of the proposed pit. This concept would, if implemented in a substantial fashion, improve considerably the quality and diversity of the habitat available to wildlife in the vicinity of the proposed project. This idea was also identified in the DEIS as consideration Barrick would commit to.

These wetlands could provide recreational opportunities for both consumptive and non-consumptive interest groups.

51-12 An additional project to contemplate to mitigate the loss of riparian habitat would include protecting the riparian vegetation on Barrick Goldstrike's properties on the South Fork of the Humboldt River. This could be accomplished by fencing the riparian areas along the river and eliminating livestock grazing to permit this area to return to a more natural state.

51-13 Habitat improvement projects to offset the loss of sage grouse resource should be considered as a mitigation for the proposed project in the event that the existing population is eliminated as a result of the disturbance from the proposed project. Meadow protection and restoration projects in adjoining sage grouse habitats could be considered mitigation for the loss of the sage grouse lek to the proposed project.

51-14 Habitat improvement projects designed to improve the quality of rangeland areas of critical use by mule deer could be implemented in the Dunphy Hills area. There is an opportunity to combine the efforts of several of the mining companies on the Carlin Trend to improve a substantial amount of badly degraded deer winter range in the Dunphy Hills.

51-15 The Nevada Department of Wildlife suggests that Barrick Goldstrike consider incorporating the use of the latest technology in heap leach pad pond design to protect wildlife from cyanide solutions. This includes the use of VLDPE material as a cover over the ponds. This technique provides several benefits over the use of netting. There are savings from:

51-12 In response to comments concerning projected impacts to riparian habitat, the BLM has expanded the monitoring and mitigation measures described in the Final EIS and taken such comments into account in the selection of the Agency Preferred Alternative (see Section 2.3.4 of the Final EIS). The mitigation measures include replacement of riparian habitat and riparian habitat enhancement projects. Without the consent of Barrick, the BLM cannot require Barrick to implement specific mitigation measures on private lands of Barrick located away from the project site. The BLM will, however, request that Barrick consider your suggestion in the implementation of the various mitigation measures to be imposed as conditions to the approval of Barrick's plan of operations.

51-13 Please refer to the response to comment 51-9.

51-14 Please refer to the response to comment 51-1.

51-15 Please refer to the response to comments 32-7, 56-11, and 56-13.

John B. Walker
February 25, 1991
Page 5

the reduction in the loss of cyanide from ultra-violet degradation of the cyanide in solution,

the reduction of water loss due to evaporation,

improved efficiency in gold extraction year-round as a result of the solutions being warmed by the radiant properties of the cover,

complete elimination of access by wildlife to the solutions.

51-16 The Nevada Department of Wildlife suggests considering the idea that the Betze Pit be constructed in a fashion that upon the cessation of mining activity, the pit would support both a viable fishery and recreational area. This could be accomplished by sloping one or more sides at less of an angle to provide for a shallow water area. This area would then support a viable fishery, which in turn would support a recreational opportunity where none is presently planned.

51-17 The scope of this proposed project, when added to the existing disturbances and the potential for even more activity in the area by both Barrick Goldstrike and Newmont, will impact the wildlife habitat and associated wildlife for a over a human life span. There exists and opportunity to design the proposed project to minimize the long term effects on wildlife. For the short term, off site mitigation can be a chance to create beneficial changes in habitat that will provide opportunity for wildlife to thrive in areas away from the mining disturbances.

If you have any questions, pleased contact Rory Lamp at our Elko Office.

Sincerely,

William A. Molini, Director

Terry R. Crawforth
Deputy Director

RL

51-16 Please refer to the response to comment 47-10.

51-17 The BLM agrees. Mitigation for long- and short-term impacts has been incorporated into the Agency Preferred Alternative (see Section 2.3.4 of the Final EIS).

Letter 52

ELKO GENERAL HOSPITAL
1297 College Ave.
Elko, Nevada 89801
738-5151

March 11, 1991

Bureau of Land Management
Elko District Office
Attn: Betze Coordinator
P.O.Box 831
Elko, Nevada 89801

I am writing to express my support of Barrick Goldstrick Mine's Betze Project.

Barrick has demonstrated a strong commitment to the surrounding communities and the environment. They have made conscientious efforts to avoid and mitigate undesirable environmental impacts and the Betze Project's comprehensive Environmental Impact Statement demonstrates Barrick's commitment.

Also, the Project will have a very positive economic impact in Northeastern Nevada, with a workforce averaging 1,200 employees. The Project is expected to generate local, state and federal tax revenues of several million dollars annually.

Because of Barrick's demonstrated commitment to preserve wildlife habitats, visual and cultural resources and it's significant contribution to the local economy, I urge you to approve the project as soon as possible.

Sincerely,

Jerry D. Sommerville
Administrator

JDS:mr

THE BEST CARE FOR THOSE YOU CARE FOR...

Letter 53

NEVADA MINING ASSOCIATIC

3940 SPRING DRIVE, SUITE 11 · RENO, NEVADA 89502
RENO: (702) 829-2121 · FAX: (702) 829-2148
LAS VEGAS: (702) 388-2068

Marcl

Mr. Nick Rieger
Project Manager & Betze Coordinator
Bureau of Land Management
Elko District Office
P.O. Box 831
Elko, Nevada 89801

Re: Nevada Mining Association Comments on the Drait Environmental Impact Statement, Betze Project

Dear Mr. Rieger,

The Nevada Mining Association (NMA) appreciates this opportunity to comment on the Draft Environmental Impact Statement (DEIS) for the Betze Project.

NMA represents over 700 companies and individuals involved and interested in the business of mining in Nevada. NMA not only promotes the industry of mining but also promotes among its members the principles of maximizing the utility of Nevada's mineral resources with an high regard for the environment. With that in mind, NMA is pleased to have among its membership Barrick Goldstrike Inc. (Barrick). The proposed action developed by Barrick for the Betze Project, as presented in the DEIS, represents a careful and well conceived plan to properly develop and utilize the mineral resources of the area. In addition, the proposed action reflects the appropriate sensitivity and concern for the environmental and socio-economic needs of the area and local communities.

NMA found the DEIS to be a well crafted and written document. We, however, are concerned that the socio-economic evaluation does not appear to be favorably characterized in the DEIS, and, in reality, should better support the proposed action.

53-1 The DEIS identifies some of the socio-economic problems, and supports such with general county-wide data, related to the growth and development of the mining business in the area. The infrastructure needs and problems of the Elko area are collectively driven by the entire growth of the industry and other local businesses, such as new casinos. To single out Barrick's proposed operation as the cause that will further exacerbate the local infrastructure and other socio-economic problems, as does the DEIS, is incorrect and misleading.

Response to Letter 53

53-1 Please refer to the response to comment 22-1.

Letter 53 Continued

Mr.Nick Rieger
NMA Comments on DEIS - Betze Project
March 11, 1991
Page 2

The Final EIS should reflect that the gross data and conclusions reflected in the DEIS are a result of the total business growth of the area. Moreover, it should more clearly point out that Barrick has been more than a good corporate citizen and community neighbor by having recognized the infrastructure difficulties experienced in the area. The Final EIS should then clearly establish that Barrick has taken extra steps to assist the community, its leaders, and its employees in resolving those matters, and is not the single factor that has created the infrastructural problems that exist. but has been part of the solution to these problems in the area. The DEIS alludes to the fact that Barrick has been a willing corporate citizen in the area, and the Final EIS should emphasize that fact.

In conclusion, the Nevada Mining Association urges the BLM, in the development of the Final EIS, to incorporate the above comments. More importantly, the Nevada Mining Association recommends and strongly urges the Bureau of Land Management to adopt the proposed alternative as presented in the DEIS. To do anything less would not be in the best interest of the resources of the area, the local communities and Nevada. The proposed action best serves the short- and long-term interests of the Bureau, local communities, Nevada and Barrick Goldstrike, Inc.

The Nevada Mining Association appreciates this opportunity to comment. If the Bureau has any questions related to NMA's comments or if NMA can be of any further assistance to the Bureau, please do not hesitate to contact Paul A. Scheidig at NMA (702-829-2121).

Respectfully submitted,

NEVADA MINING ASSOCIATION

Michael J. Doyle
President

cc: John McDonough

Letter 54

Foundation

NNCC **Northern Nevada Community Coll**

901 Elm Street - Elko, Nevada 89801

March 8, 1991

Bureau of Land Management
Elko District Office
Attn: Betze Coordinator
P.O. Box 831
Elko, NV 89801

Dear Coordinator:

I am writing in support of Barrick Goldstrike Mine's Betze Project. Barrick has been very supportive of the communities surrounding its operation and will continue to generate income for this area.

They have made conscientious efforts to avoid and mitigate undesirable environmental impacts. The Betze Project's comprehensive Environmental Impact Statement demonstrates Barrick's commitment to the environment. The Project will also have a positive economic impact in Northeastern Nevada. Several million dollars annually will be generated in local, state, and federal taxes.

I feel that Barrick has demonstrated commitment to preserve wildlife habitats, visual, and cultural resources. Because of this commitment and the financial impact that Barrick has on our economy, I urge you to approve the Project as soon as possible.

Sincerely,

Jeanne Blach

Jeanne Blach
NNCC Foundation Chair

ds

Letter 55

SIERRA CLUB

Toiyabe Chapter — Nevada and Eastern California
P.O. Box 8096, Reno, Nevada 89507

March 9, 1991

Bureau of Land Management
Elko District Office
ATTN: Betze Coordinator
P.O. Box 831
Elko, NV 89801

Dear Nick,

These comments represent the review of the Betze Project Draft EIS by the Sierra Club, the Wilderness Society and the Natural Resources Defense Council. Additional comments are attached which were developed by a consultant who has reviewed the geochemistry.

55-1 In general, the EIS offers a substantial amount of information, and we appreciated the willingness on the part of the BLM and Barrick to supply information in an open fashion. However, it is also our opinion that the EIS was written by a consultant who was overly sympathetic to the mine proponents. The document presents the least environmentally damaging scenario on many issues, even though the same set of data could argue that the mine will have a much greater negative impact on the environment for those issues. This is perhaps a general comment on the preparers of the EIS, but we feel that a completely unbiased analysis of the mine would be presented with a different set of conclusions as to the likely and potential impacts. We feel that the BLM should submit this document to a review team that has no relationship to either the company or most of the mines in Nevada. It would be appropriate to discuss this with scientists in the Environmental Protection Agency for a recommendation of such a review team. This mine and associated disturbance presents a fundamentally new type of mining impacts in Nevada, and this is the first major document to assess those impacts. The BLM must be very careful that these impacts are assessed fully and the proper analysis is completed.

Specific comments include the following:

55-2 1. p. viii. Why would the As levels be enhanced in groundwater by refilling the pit. The As levels are very likely to exceed the drinking water standards if the pit is not filled, and this body of water is substantially greater than would exist in the interstitial volume of the refilled pit. It is also possible that options would exist to seal the refilled pit to minimize the extent of water intrusion into the pit. Over the long term, the water quality in the groundwater is likely to stabilize, and ultimately

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P.O. Box 19777
Las Vegas, Nevada 89119

To explore, enjoy, and protect the wild places of the earth . . .

GREAT BASIN GROUP
P.O. Box 8096
Reno, Nevada 89507

Response to Letter 55

55-1 The EIS was prepared by an independent environmental consultant under the direction of the Bureau of Land Management. The technical specialists who conducted the impact assessments worked closely with their BLM counterparts who reviewed and approved the analyses. Consistent with your comment, the EPA was asked to review the Draft EIS prior to publication; the comments of EPA's scientists were incorporated into the Draft EIS. The draft document was then published and circulated for public review. As identified in Sections 5.3 and 5.4 of the Final EIS, the document was reviewed by and comments were received from numerous state and federal agencies, including the EPA, and interested parties without any relationship to the project proponent. The purpose of circulating the Draft EIS was to provide the BLM with an objective and critical evaluation of the Draft EIS from a broad range of parties.

Consistent with your comment at the public hearing in Reno, the EIS concludes that certain impacts cannot be predicted with complete certainty. Therefore, the BLM has incorporated additional mitigation and monitoring measures designed to assist in eliminating areas of uncertainty (e.g., by research), to identify any differences between projected impacts and actual impacts (e.g., by extensive monitoring), and to reduce impacts from levels that might otherwise occur (with mitigation). See Section 2.3.4 of the Final EIS.

55-2 While the waste rock is stored in an unsaturated condition in the waste rock disposal areas, some oxidation of sulfides and release of trace metals such as arsenic adsorbed to an iron oxyhydroxide phase, would occur. Although the arsenic would likely remain immobile within the waste rock storage areas, if the waste rock were backfilled into the pit and saturated with groundwater, the arsenic would be released as the oxidation products are dissolved. This process would release a plume of arsenic and other trace metals into the groundwater system. Please refer to a revised discussion of the partial pit backfill alternative in Section 4.4.9.2 of the Final EIS. The BLM does not believe that the pit could be sealed to significantly reduce water intrusion.

Letter 55 Continued

the impacts on the groundwater system will be less by refilling the pit compared to not refilling the pit.

55-3 2. Fig. 2.5 It makes no sense to put waste rock dumps on section lines. State law allows disposal of waste rock on private land via condemnation. This is a very real alternative which should be addressed.

55-4 3. p 2-47. Mining disturbances would be sloped to blend and match with the natural surrounding topography. Where does the present operation stop and the new one begin?

55-5 4. p. 2-51. See comment #2. The EIS states that location of the mining deposit is limited by the location of the ownership of the ore deposit. Condemnation is a reasonable alternative which not only could be environmentally advantageous, but would be less expensive due to the lower heights needed to raise the waste rock.

55-6 5. p.2-47. How much is the surety? The reclamation costs should be included in the EIS, since reclamation must be part of the plan of operation. If the bonding cannot be determined, that suggests that the impacts cannot be assessed, which implies that the environmental impacts are not being adequately analyzed, contrary to NEPA.

55-7 6. p.2-47. A reclamation plan is not included in the EIS. Without a detailed reclamation plan, the ultimate impacts on the land cannot be assessed, and the EIS is not adequate. A reclamation plan must include the following:

a. Final topography of the disturbed areas
b. Diversity and density of vegetation
c. Objective standards for vegetation density and diversity
d. The productive land use of the water body and the land.
e. Monitoring plan and funding for ensuring that the water quality in the pit and the potential release of contaminants from the heaps and waste rock dumps does not pose a significant risk
f. Time-frame for reclamation

55-8 7. p.2-48. The suggestion is made that plots will be established. Where will these plots be located, and when will they be established.

55-9 8. p.2-49. A sediment control plan should be established now, not later.

55-10 9. p.2-50. The seepage control ponds indicate and intentional leakage of the tailings impoundment. How will that seepage be controlled after the ponds are reclaimed? Does this present a long-term threat that will require long-term monitoring?

Response to Letter 55 Continued

55-3 As this comment suggests, the Draft EIS did consider a waste rock disposal alternative that was not constrained by property boundaries; please see the discussion of the Far West Waste Rock Disposal Area in Section 2.3.1.1 of the Draft EIS. The Far West Waste Rock Disposal Alternative, however, was not selected because the third parties who own or control the land adjacent to Barrick's proposed waste rock disposal area may use the property in their own mining and ranching operations. The BLM agrees that this option should be considered, if an agreement between Barrick and the other land owners for the mutual use of these lands is reached.

55-4 The reclamation plan for the Proposed Action will encompass disturbances associated with both the existing and proposed operations. The components of the existing and the proposed operations are separately described in Sections 2.1 and 2.2 of the Draft EIS, respectively.

55-5 Please refer to the response to comment 55-3.

55-6 A more detailed description of Barrick's reclamation program, including a form and amount of surety, is included in Section 2.2.5 of the Final EIS.

55-7 Please refer to the response to comment 56-3.

55-8 The discussion of revegetation plots has been expanded in Section 2.2.5 of the Final EIS, in response to your comment. In addition, the BLM has developed the revegetation research project as an additional mitigation measure which has been incorporated into the Agency Preferred Alternative (see Section 2.3.4 of the Final EIS). The location of test plots will be varied, at the discretion of the BLM and in consultation with the SCS and NDOW, to test various conditions throughout the project area. Results obtained from the test plots will be used to select final seed mixture and a specific reclamation and revegetation program.

55-9 The BLM agrees. As described in Section 2.2.5.12 of the Final EIS, the sediment control plan will be submitted by Barrick to the BLM in 1991.

55-10 Reclamation of the tailings impoundments is described in greater detail in the expanded reclamation plan which is included in Section 2.2.5 of the Final EIS. Reclamation of the tailings impoundments will proceed in two phases: decommissioning and surface reclamation. During decommissioning, the tailings will drain and the solids will consolidate. Seepage from the tailings impoundments will be collected in the seepage collection pond until final closure of the tailings impoundments is completed. At that time, the concentration of cyanide will be at or below the closure standard, and further collection of the seepage, if any, will not be necessary.

55-11 10. The most significant issue which requires further analysis is the pit water quality. The Water Resources Technical Report suggests that the pit water will be oxic. It is our opinion that this hypothesis is fundamentally incorrect. If, in fact, the water is anoxic, the chemistry of the pit, particularly with respect to arsenic, is also incorrect.

There is a very high likelihood that the pit water will not turnover. This is a relatively deep water body (1160') which will be sheltered from wind mixing by approximately 300' from the surrounding surface. Although geothermal water is present at the base of the pit, there is no treatment in the EIS which demonstrates that the water will be efficiently mixed by thermal mixing, other than by simple assertion. On page 4-93 of the EIS the statement is made that "oxidizing conditions are expected for the water body since organic content is low and biological activity is at a minimum." First, 0.08 mg/L is not a low concentration of phosphorus, and over time is sufficient to produce organic substances sufficient to affect the oxygen content in the lower reaches of the pit water. Although the nitrogen levels are not high, nitrogen-fixing microorganisms can add usable nitrogen into the system as long as sufficient phosphorus is present. Second, the oxygen deficit would be enhanced by the reaction of pit walls with the water body in addition to the organic oxygen demand.

As indicated above, if the water is anoxic, arsenic III will be a significant species, which will result in higher concentrations in the water column than when the water is oxic.

55-12 11. No water quality measurements were made of the water at the final depth of the pit. The EIS argues that the water will be thermally mixed, yet no water quality measurements are presented for this very important water. Is the sulfide concentration significant? What is the TDS of this water? Since the water from the geothermal aquifers is reported to be up to 140°C, it is likely that higher concentrations of certain species will be present.

55-13 12. The water wells selected were some of the best wells in the area, and it is doubtful whether the water in the pit will be as pure as suggested. This is especially the case when the water presently being handled in the present receiving pit has to be treated to bring the As concentration down. The averaging method used is highly suspect, and should instead be based on the relative productivity of each aquifer.

55-14 13. For the long term water quality of the Betze Pit, the wall reactions are essentially ignored in the EIS. The Technical Report does discuss pit wall reactions, and this discussion suggests that it is possible that the water body will be highly saline. This discussion should be included in the EIS. The probable pit water quality will be somewhere between that presented in the EIS and that shown in Table 5-2 in the Technical Report. At any rate, the

55-11 As noted in your written and oral comments, some impacts of the project cannot be predicted with complete certainty. In those situations, assumptions were made to enable an assessment of the potential impacts to be presented. The Betze Pit water was assumed to be oxic for the purposes of predicting future water quality within the pit. Oxic conditions were assumed because such conditions were believed to represent the condition that would result in the highest concentrations of metals in the pit water. The assumption implies that the waters in the pit would be completely mixed. In response to your comment, several possible stratification scenarios were analyzed to determine whether any other scenario could represent a worst-case condition for prediction of future pit water quality. Please refer to the responses to comments 55-29 and 55-30 for a detailed discussion of the analysis of pit water quality assuming stratification.

The question of whether a phosphorus concentration of 0.08 mg/l is "high" or "low" is relative. It is true that nitrogen-fixing organisms could add usable nitrogen into the system, however, this prediction cannot be verified with currently available information. Some studies have shown that phosphorus can control lake productivity, regardless of whether phosphorus or nitrogen is the limiting nutrient (Schindler 1977); phosphorus was used to predict the chlorophyll a concentration.

55-12 Since completion of the Draft EIS a number of deep wells have been drilled and sampled in the area of the proposed Betze Pit. Water quality samples from these wells characterize the quality of water from the deeper zones. Please refer to Section 4.4.9 of the Final EIS, Betze Pit Water Quality, for water quality data obtained from these wells (Table 4-16) and to Figure 4-12 depicting the location of these wells. Please also refer to the response to comments 55-15 and 55-18 for a discussion of whether there is a distinct geothermal aquifer.

55-13 Additional water quality data from new and existing wells in the vicinity of the Betze Pit have been incorporated into a revised analysis of the pit inflow composition (see Section 4.4.9, Betze Pit Water Quality). The results indicate a predicted arsenic concentration within the pit inflow within the range described in the Draft EIS. As suggested by your comment, the revised calculations include weighting of the wells used in the analysis based upon the relative productivity of the water-bearing zones that outcrop in the pit walls. Please refer to Appendix B-4 for a discussion of an alternative method of estimating arsenic concentrations in the pit inflow.

55-14 In response to your comment, Section 4.4.9 of the Final EIS has been revised to include discussion of pit wall reactions. Table 5-2 of the Water Resources Technical Report, which shows a TDS of 2,800 mg/l, is described in the report as an extreme estimate that is physically unlikely. The most probable pit water composition is close to that predicted assuming no wall rock reaction (Table 5-1 of the Water Resources Technical Report; see also Table 4-19 of the Final EIS) with slightly higher calcium and sulfate. Please refer to the response to comment 11-6 for a discussion of water quality criteria for the Betze Pit.

Letter 55 Continued

water quality will be sufficiently degraded that it will not meet drinking water criteria. Thus, it will violate Nevada Water Quality regulations and should not be permitted.

55-15 14. An alternative to the suggestions presented is to refill the pit to above the geothermal aquifer with material that does not liberate arsenic or acid. From the discussion presented in the EIS, there is likely to be sufficient material for this to be undertaken. But it is not acceptable to allow a water body of this size to become seriously degraded, and the BLM has the authority to deny this option. At any rate, further studies should be undertaken to ensure that this water body does not have the same fate as the Ruth Copper pit or the Weed Heights copper pit.

55-16 15. Based on the data presented in the EIS, a high potential exists for arsenic or acid containing runoff from the waste rock dumps and ore stockpiles which will affect both water and soil quality. However, the EIS argues that refilling the pits with waste rock will have a substantial and negative impact on groundwater quality (see page 4-95), but leaving the rock on the surface will supposedly not affect the water quality, even though recharge water will likely pass through the waste rock dumps under both oxic and anoxic conditions. Local hotspots for acidity (and arsenic) are likely, as has been reported by Newmont at one of their mines. It appears that the EIS was written to justify rather than analyze the impacts.

55-17 16. No discussion is presented on the chemistry of the tailings impoundments. What will the primary constituents be in the tailings, i.e. cyanide complexes, heavy metals and other potentially toxic substances? This impoundment will be one of the largest in the U.S. and deserves a detailed analysis of the type and concentration of materials that will be present essentially for the foreseeable future.

55-18 17. A discussion on the impact of mixing the various aquifers could not be found in the EIS. Below the pit, geothermal water will be mixed with near surface aquifers. How will that affect the hydrologic systems downgradient from the pit. We disagree that only 710 acre feet will be lost due to evaporation. It is likely to be closer to 1000 acre feet, which is more than an insignificant impact on the regional groundwater system. It is likely to have a substantial impact on springs in the vicinity. By creating a new evaporative water surface, the mine will consumptively use large quantities of water. This is not a beneficial use of water and may violate state water law.

55-19 18. The "what if" questions need to be raised. How will the dumps and pit water be monitored to detect any differences from those expected in the EIS? What will be the remediations. Who will perform the monitoring, and for how long (years)? Who will pay for the monitoring?

19. The public lands in question will receive impacts that will

Response to Letter 55 Continued

55-15 Please refer to the response to comment 55-36 for a discussion of the impact of the partial pit backfill alternative on water quality. The BLM does not agree that there is a distinct "geothermal" aquifer. The BLM agrees that additional information on potential pit water quality impacts is desirable, and this issue was taken into consideration in the identification of mitigation measures and the selection of the Agency Preferred Alternative (see Section 2.3.4 of the Final EIS). Please refer to response to comment 55-18 for further discussion of this matter.

55-16 As stated in the response to comment 47-7, there is a very small potential for water runoff from the waste rock disposal area or ore stockpiles. Nonetheless, BLM has incorporated surface water monitoring and mitigation measures in the Agency Preferred Alternative (Section 2.3.4 of the Final EIS) that address the potential of acidic runoff.

An infiltration analysis performed using the HELP model (ENSR and Drever 1991) indicated that infiltration through the waste rock disposal areas and ore stockpiles would likely be relatively low (approximately 1 inch/year). Also, as demonstrated by the static and kinetic test results, the water that infiltrates through the waste rock material is unlikely to be acidic. Infiltration through the ore stockpiles would be potentially acidic. However, due to the low infiltration rate, it is unlikely that any significant groundwater contamination would occur. Nevertheless, to reduce the potential for groundwater contamination, the ore stockpiles will be placed on the South Block waste rock disposal area.

Please refer to the response to comment 55-2 for a discussion of the effects of pit backfill on water quality.

55-17 In response to your comments, analyses of tailings slurry and ore samples are presented in Appendix B-3 of the Final EIS. The tailings slurry analyses represent constituents within the liquid and solid phases of the tailings slurry. The ore analyses are representative of the solid material to be deposited in the tailings impoundment. The ore sample analyses are the result of whole rock analysis of cores from exploration and development drilling and are representative of the material feed to the mill. With the exception of gold and silver, constituents of the ore would pass through the mill for disposal in the tailings impoundment.

55-18 The BLM disagrees with the comment that distinct aquifers exist in the immediate vicinity of the Betze Pit. The area is characterized by numerous northeast and northwest trending faults that have produced extensive fracturing and jointing. Groundwater migrates vertically and horizontally through these fault systems, which precludes the existence of distinct, isolated aquifers and creates one continuous groundwater system. As discussed in Section 3.4.2.5 of the Draft EIS, groundwater quality appears to be directly related to the mineralogy of the host rock.

The evaporation rate of water from the Betze Pit has been recalculated and is estimated to be 886 acre-feet. This calculation is based on 30 inches net evaporation over 355 acres. The text in Section 4.4.3.1 of the Final EIS has been revised to reflect this recalculation. The effect of evaporation on pit water quality was discussed in Section 4.4.9.1 of the Draft EIS. Higher evaporation rates would slightly increase the concentration of chemical constituents in the pit; however, this increase is not considered significant.

55-20 last for thousands of years. How will the mine proponent mitigate those impacts. One potential method is for the company to purchase other high-value lands and donate them to the public. Several riparian areas are candidates. Has the BLM asked them to mitigate impacts as the U.S. Forest Service has done with mining in the Independence Range? How does the BLM define mitigation?

55-21 20. Clearly, much is not known about the impacts of the mine, particularly on groundwater systems and the pit water. NEPA requires a research effort be undertaken to develop information on the areas where all is not known. How will the mine proponent develop these research projects? What is the BLM requiring in this regard to comply with NEPA?

Thanks for the opportunity to provide these comments.

Sincerely,

Glenn C. Miller, Chair
Toiyabe Chapter Mining Committee

For: The Sierra Club
Natural Resources Defense Council
Wilderness Society

581 Creighton Way
Reno, NV 89503

55-18 (Cont.) The Nevada State Engineer must approve the appropriations filed by Barrick for dewatering operations and mining, milling, and processing uses. Water loss incidental to beneficial uses is a recognized element of water appropriations. The predicted evaporative loss from the Betze Pit water body is approximately 2 percent of the total annual evapotranspiration from the Boulder Flat Hydrographic Basin (LBG 1990). See also the response to comment 49-1.

A recent study (Adrian Brown Consultants, Inc. 1991) of spring water chemistry in the Tuscarora Range supports the hypothesis that many of the springs are perched above the regional groundwater. For the springs that are perched, dewatering of the Betze Pit should have no impact on the discharge or water quality of the springs.

55-19 The BLM believes the Final EIS accurately assesses the environmental impacts of the Proposed Action and alternatives. The BLM recognizes, as your comment suggests, that monitoring of the environmental impacts is important. The existing monitoring programs are described in the response to comment 11-2. Additional monitoring has been incorporated into the Agency Preferred Alternative (see Section 2.3.4 of the Final EIS), in response to this and other similar comments. The Agency Preferred Alternative includes long-term pit water quality monitoring and a long-term monitoring fund. Additional mitigation incorporated into the Agency Preferred Alternative includes a research program that is intended to help identify, in advance, potential long-term water quality impacts and appropriate new mitigation options. It also includes a long-term monitoring and mitigation fund that is intended to permit the BLM to identify, monitor, study, and/or mitigate impacts that are presently unforeseen.

55-20 Mitigation is defined by the Council on Environmental Quality regulations (40 CFR 1508.20) for implementing the National Environmental Policy Act as avoiding an impact by not implementing a certain action, minimizing an impact by limiting the degree or magnitude of an action, rectifying the impact through rehabilitation, reducing or eliminating an impact by preservation or maintenance actions, or compensating for an impact through replacement of the affected resource. BLM considered this comment in identification of mitigation measures and selection of the Agency Preferred Alternative.

55-21 The BLM believes that existing data are adequate to project the environmental impacts of the Proposed Action, including pit water quality. The BLM disagrees that NEPA requires an additional research project to be conducted or that the BLM could require Barrick to do so as a condition of its Plan of Operations. Nevertheless, Barrick has indicated its agreement to underwrite research at an accredited college or university with respect to pit water chemistry or related issues identified by the BLM, in consultation with NDEP, that may assist in the future evaluation of impacts from the Betze Pit or other similar mineral developments. This agreement is described in Section 2.3.4 of the Final EIS as a mitigation measure which has been incorporated into the Agency Preferred Alternative.

Comments on the Betze Project's Draft Environmental Impact Statement and the Water Resources Technical Report

Prepared for

The Sierra Club
Toiyabe Chapter, Nevada

Prepared by

Dr. Ann Maest
Environmental Geochemist

Introduction

The following comments address inadequacies in the Draft Environmental Impact Statement and the Water Resources Technical Report for Barrick Goldstrike Mines' Betze Project. These comments focus on water quality aspects of the project, including the chemical composition of pit inflow water, the use of static and kinetic methods to predict acid mine drainage generation, data quality issues, assumptions used for geochemical computations, interpretation of arsenic geochemistry, and choices of alternative disposal and reclamation methods.

Chemical Composition of Pit Inflow Water

Choice of wells

55-22 Table 3-3 lists the six wells chosen to estimate the composition of pit inflow waters to the Betze pit. Because the composition of water in the pit is one of the most critical aspects of water quality for the project, it is important that conservative estimates are used to calculate potential concentrations of toxic constituents, especially arsenic. Several of these wells have very few samples and cannot be considered representative of local groundwater. Three of the wells chosen are in the Carlin formation. Although Carlin rocks are upgradient from the proposed pit during premining conditions, there are no Carlin rocks in the pit walls (EIS, pg. 4-87). Table 3-5 in the Technical Report shows that the pit walls would be comprised of Devonian sedimentary rocks (65.3%), Cretaceous diorite and granodiorite (20.4%), Cretaceous contact metamorphic rock (7.6%) and ore (6.7%). The heavy weighting of wells in Carlin material to predict pit inflow concentrations is unwarranted; more wells from the paleozoic sediments and the granodiorite should be substituted for one or more of the Carlin wells.

Unfortunately, wells in the Betze Pit area (see Figure 3-8 and Table 3-12, EIS) have the lowest number of samples per well and cannot be considered representative of groundwater quality in the Paleozoic limestones and siltstones. Of the three wells chosen that are at least partially in the Carlin formation (AA Well, GWOP-11, NPPW-3), GWOP-11 and NPPW-3 should be removed. GWOP-11 is a shallow well in the Carlin only and NPPW-3 has too much missing data to be representative of that well's water quality (Table 3-4, Technical Report). Superior and more conservative choices would be GWOP-4, which is in the granodiorite and has 16 samples and P-181, which is in the Paleozoic limestones and siltstones and has 8 samples. Similarly, the West Bazza Pit well has only 1 sample, and no information on total depth or screened intervals. A better and more conservative choice would be well BW-1 in the granodiorite and

55-22 Additional wells have been completed and sampled since the Draft EIS was published, and these wells have been included in the revised estimates of pit inflow composition (see Section 4.4.9). As suggested by your comment, the water quality data were weighted based on the relative productivity of the different water-bearing zones in computing the revised pit inflow water quality analyses. Please see the response to comment 55-13 and the complete discussion of the revised analyses in Section 4.4.9 of the Final EIS.

paleozoic limestones and siltstones.

With the new well choices (AA Well, Bazza Well, WW-1, GWOP-4, BW-1 and P-181) the average arsenic inflow concentration is 0.291 mg/l. This value exceeds the federal drinking water standard for arsenic by nearly six times -- even when interaction with wall rock in the pit is not considered. It is also very close to the arsenic concentration from the dewatering wells currently under operation in the adjacent Post Pit (0.2 to 0.25 mg/l -- pg. 3-50, Technical Report).

Interaction with Betze Pit Walls

55-23 The Technical Report purportedly examines the effect of interaction with Betze Pit walls on the composition of pit inflow water. Tables 5-1 and 5-2 list the predicted concentrations of chemical constituents and pH for the assumptions of no reaction and reaction, respectively, with the pit wallrock. Miraculously, even after considering reaction with the pit walls, the only constituents and parameters that change are alkalinity, calcium, sulfate, TDS and pH. This is accomplished by assuming that *some* acid is generated via dissolution of pyrite from the pit walls and that *all* of the acid reacts *only* with calcite, which is dissolved until gypsum saturation is achieved.

Even if this reaction could occur in isolation (which is geochemically impossible), the dissolution of pyrite would at least increase the concentration of dissolved iron:

$$FeS_2 + 7/2\ O_2 + H_2O = Fe^{2+} + 2SO_4^{2-} + 2H^+$$

$$Fe^{2+} + H^+ + 1/4\ O_2 = Fe^{3+} + 1/2H_2O$$

unless the entire reaction went to completion *and* all the acid was consumed:

$$2Fe^{3+} + 3H_2O = 2Fe(OH)_3 + 6H^+$$

$$6H^+ + 6CaCO_3 = 6Ca^{2+} + 6HCO_3^-.$$

The more likely scenario is that pyrite in the wallrock would be dissolved and generate acid, which in turn would dissolve other sulfides and calcite and liberate high concentrations of heavy metals, arsenic and acid. As discussed below, the acid neutralization potential of the pit wallrock has been severely underestimated in the Technical Report by both the static and the kinetic tests employed. Therefore, if acid is generated in the pit, it is unlikely that there will be sufficient ability to neutralize the acid generated. This acid will then cause the release of heavy metals and arsenic from minerals in the Betze Pit wallrock.

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55-23 The comment with respect to the potential for acid generation due to wall rock interaction is addressed in detail in the response to comment 55-24. In response to the comment with respect to dissolved iron, it would be expected that the iron would precipitate as $Fe(OH)_3$ unless the water became acidic or anoxic.

<u>Use of Static and Kinetic Methods to Predict Acid Mine Drainage Generation</u>

Static Methods

55-24 Neither the Technical Report nor the EIS state explicitly how the static tests were conducted or whether the acid generation potential (AGP) and acid neutralizing potential (ANP) were determined experimentally or from whole rock analyses (the implication from the table is that the latter method was used). The Technical Report defines net ANP as the "difference between the total sulfur content and acid neutralizing potential for each sample" (pg. 4-2). By their own definition, then, the net ANP was not determined correctly because APP/P values were often used instead of total sulfur content.

Table 4-2 in the Technical Report lists the AGP, ANP and the Net ANP for 41 samples of sedimentary rocks, granodiorite and ore. From their definition, the AGP should be equal to the Total Sulfur content (in tons $CaCO_3$/1,000 tons). Of these values, 26 were not chosen from the Total Sulfur values but instead were picked haphazardly from APP/P values (see EIS, Appendix B, Whole Rock Analysis table). Although the APP/P method is not described in either the EIS or the Technical Report, it is assumed that this is hydrogen peroxide oxidation for FeS_2 estimation. The 26 APP/P values chosen were always less than the Total Sulfur values. This, of course, will underestimate the potential of these rocks to generate acid.

Substituting back in the appropriate Total Sulfur values from the Appendix B table changes the final results considerably. Averages for AGP were determined by inputting the Total Sulfur values and weighing all samples equally; net ANP was determined using the same weighting procedure used in the Technical Report (24% Gd, 76% Sed). The average AGP for the granodiorite increases from 20.7 to 33.3; the average AGP for the sedimentary rocks increases from 19.5 to 35.4, and the weighted average AGP for the pit increases from 19.8 to 34.9. The ANP values remain the same. The Net ANP [=(ANP - AGP)] consequently decreases from 83.6 to 70.9 for the granodiorite; from -1.5 to -17.4 for the sedimentary rocks, and from 18.9 to 3.8 for the pit weighted average. This value of +3.8 for the average overall net acid neutralizing potential for the pit is dangerously close to making the pit walls acid generating instead of acid neutralizing.

The same problem applies to the calculations of AGP and ANP of waste rock (Table 5-3, Technical Report) and of ore samples (Table 5-4, Technical Report). The corrected average AGP for ore samples becomes 52.6, and the Net ANP is reduced from -9.4 to -36.4. This implies that the ore will very likely generate acid and should be handled and stored in a way that minimizes potential for seepage to contaminate groundwater.

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Response to Letter 55 Continued

55-24 The comment correctly points out that there was a data entry error for one set of AGP values. A corrected version of Table 4-18 is included in the Final EIS. The revised table shows APP values calculated from total sulfur concentrations and from APP/Peroxide numbers. Please refer to the response to comment 55-28 for a discussion of the APP/P analysis technique. The values calculated from total sulfur represent the worst-case scenario and are qualitatively similar to the values in the Water Resources Technical Report, i.e., the sedimentary rocks are slightly acid producing, the granodiorite is acid consuming, and the weighted average is slightly acid consuming (+6.4 $TCaCO_3$/kT or a ratio ANP/APP of 1.2). The small differences between the numbers in the revised table and those presented in the comment probably represent differences in averaging methods. The averaging method used in preparing the revised table recognized that certain samples were replicates.

Opinions differ on how to interpret the results of net acid neutralizing potential calculations. Lapakko (1990a) cites numerous studies (Sobek et al. 1978; Lawrence et al. 1989; Day 1989) that suggest a variety of threshold values for predicting acid production potential. Ferguson (as cited by Lapakko 1990a) suggests that it is difficult to predict acid production potential for samples with net ANP ranging from -20 to +20 kilograms $CaCO_3$/ton. Although the number is within the range of difficulty suggested by Ferguson, the pit wall as a whole will probably not be acid generating.

If the APP Peroxide number is used to predict acid generating potential, the average of the sedimentary rocks shows a slight neutralizing potential, and the granodiorite a large neutralizing potential.

In considering the potential for acidification of the water body, the acid neutralizing capacity of the inflowing groundwater itself should also be considered. The total alkalinity delivered to the pit as it fills will be 1.36×10^8 kg $CaCO_3$. Thus, the alkalinity of the inflow water would provide additional neutralization of the acidity potentially generated by pit wall reactions.

As discussed in Section 5.4.2 of the Water Resources Technical Report and in Section 4.4.11.1 of the Final EIS, seepage from the ore stockpile would likely be acidic. The Agency Preferred Alternative (See Section 2.3.4 of the Final EIS) includes placement of the ore stockpiles on the South Block waste rock disposal area for additional groundwater protection. Please also refer to Appendix B-1 of the Final EIS for a discussion of revised infiltration modeling which indicates that seepage through the waste rock disposal area and ore stockpiles would be minimal.

55-25

It has been proposed that if ANP does not exceed AGP by at least 3:1, there is not a clear margin of safety and kinetic testing should be performed (Lawrence, 1990). With the corrected AGP, the weighted average ANP for the pit exceeds the AGP be only a factor of 1.11. Although kinetic testing was performed, the following section highlights inadequacies in the approach presented in the Technical Report. In addition, laboratory static prediction tests should be performed. It is not clear whether the ANP values were arrived at by dissolving whole rock samples with acid (and if so, which acid and at what normality...) or by using an estimate from analytical concentrations of calcite. Lawrence (1990) suggests using a modification of the Sobek et al. (1978) method which is carried out under milder conditions (no boiling) so that the neutralization capacity of the material is not overestimated.

Kinetic Methods

Humidity cell tests are used to evaluate the effect of long term weathering on acid generation potential. These tests are appropriate for mining wastes deposited as waste rock or tailings in the unsaturated zone, but are less appropriate for materials that will be in the saturated zone or continually exposed to water (Lawrence, 1990). For these subaqueous materials, including the Betze pit walls that will be below water, it may be more appropriate to use either an extended Method 1312 leaching (EPA, 1989), or lysimeters. Humidity cell tests will likely underestimate the potential to generate acid waters for materials that are subaqueously deposited.

In addition, when humidity cell tests are used, it is becoming clear that the results will underestimate acid generation potential unless they are conducted for sufficiently long time periods (Lawrence, 1990; Lapakko, 1990; Ziemkiewicz et al., 1990). Lengths of at least 3 monthe (12 weeks) are recommended, although Lapakko recommends a 20-week period to aseure that the depletion of neutralization potential is exceeded. Other recommendations include using the Method 1312 leaching solution (a dilute acid) instead of distilled water and conducting the tests at 30°C to accelerate the weathering process.

The humidity cell tests conducted and reported in the Technical Report may severely underestimate the acid generation potential of the Betze pit wallrock because they were only conducted for 8 to 10 weeks, distilled water was used, and they may be less predictive of subaqueous waste materials than using a leaching procedure for an extended time frame. The results of the humidity cell tests indicate that of the 24 samples within the proposed Betze Pit, 8 generated acidity, 13 generated no acidity, and 3 were borderline (Technical Report, pg. 4-6; EIS, Appendix B, Humidity Cell Test Results). The lack of correlation between pH or arsenic concentration and Pyr S%, ANP or APP/P indicate that the reaction did not go to completion (Doyle and Mirza, 1990) and the time

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55-25 There is uncertainty in the literature concerning the interpretation of kinetic tests in general, and of humidity cell tests in particular. The uncertainty is exemplified by the articles cited in the comment. There is also the question of whether the humidity cell test, which is designed to simulate the unsaturated zone, is appropriate for the subaqueous environment. As discussed below (response to comment 55-36) the humidity cell test should represent the worst case, as acid generation under water should be much less than in the unsaturated zone. Therefore, the BLM does not feel that it is necessary to conduct additional testing of waste materials in a subaqueous environment.

The humidity cell tests produced two very important results: 1) significant amounts of arsenic are only liberated at a pH of 5.0 or less, and 2) the relative proportion of humidity cell tests which generate significant acidity is consistent with the static test results.

Recognizing the uncertainty in the interpretation of both static and kinetic test results, the BLM will require the implementation of a monitoring and mitigation plan. Please refer to Section 2.3.4 of the Final EIS for a more detailed description of the pit water monitoring and mitigation requirements.

period should have been extended to at least 12 or preferably 20 weeks. Even then, this would be a better estimate of the acid generating potential of tailings and waste rock piles than of Betze Pit wallrock for the reasons listed above. Consequently, the results of the humidity cell tests must be discounted and cannot be used to predict the acid generating potential of materials in the Betze Pit. Given the extremely high concentrations of arsenic and heavy metals in many of the rock samples (EIS, Appendix B, Whole Rock Analysis), it is imperative that accurate and conservative tests of the acid generation potential of these rocks are conducted.

Data Quality Issues

55-26 In the beginning of the Water Quality section in the EIS (pg. 3-36) it is stated that "Quality assurance/quality control procedures were not always utilized in the collection, transportation, or analysis of the samples...Therefore, some of the data may be inconsistent or inaccurate." It is hardly worth examining the water quality data if QA/QC procedures were not used. This is especially important in collection of samples that are anoxic (because if samples are not kept anoxic, Fe oxyhydroxides will precipitate and adsorb/coprecipitate arsenic and heavy metals, resulting in an underestimation of solution metal concentrations).

55-27 It does not state anywhere in the EIS or the Technical Document which analytical methods were used to determine chemical constituents in the waters. If the hydride generation technique was used for arsenic, concentrations could easily be underestimated if improper reduction methods were used (Tallman and Shaikh, 1980).

55-28 As mentioned previously, there is also no mention of how Total S, Total Pyritic S, APP/P or ANP were determined. Were marcasite and pyrrhotite included in Total Pyritic S? Was ANP determined by dissolving rock samples in acid or simply by estimating the amount of calcite present in the rock. If acid was used, which type of acid was used and what concentration? How was the peroxide digestion performed? An independent consultant or organization (not Barrick) should resample waters and rocks using QA/QC techniques, and all analytical methods should be clearly presented.

Assumptions Used for Geochemical Computations

55-29 Redox conditions in the Betze Pit were determined using WATEQF, assuming that the waters are in equilibrium with atmospheric oxygen. No specific redox states of constituents in inflow groundwaters were determined. Even if there is low organic matter and frequent turn over of the Betze Lake, it is unlikely that the redox species in the lake will be in equilibrium (Lindbergh and Runnells, 1984). The only way to know this is to measure individual redox species of arsenic, iron, etc. in the lake itself. Since this cannot be done, the next most reasonable assumption is

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55-26 In response to your comment, the sampling procedures and laboratory analytical practices and techniques used in developing the water quality database for the project were reviewed. Adherence to procedures has not been verified via a Quality Assurance (QA) audit; however, the BLM believes that the sampling and laboratory procedures used are appropriate and adequate for the data uses employed for this project, i.e., baseline characterization and modeling studies to evaluate general system response at future times. The modeling studies performed for the project included sensitivity studies or other evaluations of the effects of data uncertainty. The data generated by the sensitivity studies provided results that are consistent with the conclusions and recommendations of the Final EIS.

55-27 A table is provided in Appendix B-5 of the Final EIS showing the analytical methods used to determine the constituents of the waters sampled by Barrick. Please refer to Section 2.1.8 the Final EIS for a more detailed description of existing monitoring programs. The graphite furnace method, as opposed to the hydride generation technique, was used to determine levels of arsenic in water samples. Therefore, it is unlikely that arsenic concentrations were underestimated.

55-28 Total sulfur, pyritic sulfur, and sulfate sulfur were determined by methods described in ASTM D2492-72 (American Standards for Testing and Materials), Methods for Determining Forms of Sulfur in Coal. APP/P (Acid Producing Potential by Peroxide Oxidation) and ANP (Acid Neutralizing Potential) were determined by methods described by Sobek et al. (1978). Total sulfur was determined by Leco Furnace method which identifies all sulfur within the sample regardless of mineralogic form. Pyritic sulfur was determined by leaching the crushed rock sample with nitric acid, and sulfate sulfur was determined by leaching the sample with hydrochloric acid (both described by Sobek et al. 1978, Section 3.2.6). APP/P provides an estimate of the acid generation potential by measuring the amount of sulfur consumed by oxidation of the sample with hydrogen peroxide (see Sobek et al. 1978, Section 3.2.11). Reaction occurs with oxidizable forms of sulfur, although not all this sulfur in the sample may be consumed. Therefore, APP/P values are lower than total sulfur values. The method is seen as a quick test to estimate the amount of sulfur actually available during weathering of the sample. ANP is determined by a method described in Sobek et al. (1978), Section 3.2.3, in which the calcium carbonate equivalent of the sample is estimated by treating the sample with hydrochloric acid.

Humidity cell testing, whole rock analyses, and acid-base accounting were conducted by an independent laboratory (Core Laboratories, Aurora, Colorado) under the direction of BLM's consultant. Water samples are collected and analyses are submitted to the Nevada Department of Environmental Protection as described in more detail in Section 2.1.8 of the Final EIS. For additional discussion in regard to the water quality data, please refer to the response to comment 55-26.

Letter 55 Continued

that the lake will be monomictic (stratified in the summer, turning over once a year) or permanently stratified, as are many other lakes in the area (Mono Lake, Pyramid Lake, Big Soda Lake, Walker Lake). This implies that below the oxycline (depth at which oxygen = 0), reduced forms of iron, arsenic, nitrogen and sulfur will exist. Arsenic concentration are actually more likely to be lower under anoxic conditions as a result of precipitation with dissolved sulfide. Adsorption onto iron oxyhydroxides is unlikely, especially because the predicted pH of the lake is near or above the pH were As(V) will no longer be strongly adsorbed.

55-30 The assumption that thermal waters will cause the lake to turn over frequently (Technical Document, pg. 6-3) and maintain oxidizing conditions throughout the water column is entirely unfounded. The depth at which thermal waters were discovered was not revealed in the EIS or the Technical Document. Even if there are some thermal waters entering the proposed lake, dilution by non-thermal groundwaters will counteract the thermal effect. The proposed lake will most likely be monomictic and develop anoxic bottom waters each summer.

55-31 The effect of the choice of groundwater wells on pit inflow chemistry has been discussed. The more realistic inflow concentration of 0.291 mg/l As should be the input value used in the geochemical computations. After reaching steady-state, using the same assumptions in the Technical Report, the lake would have a concentration of 0.655 mg/l, which is over 13 times the arsenic maximum contaminant level. Again, this assumes no reaction with pit wallrock, which as discussed above is unrealistic and not environmentally conservative.

55-32 The assumption that the proposed Betze Lake waters will be neutral to alkaline cannot be used in the geochemical computations. Leach and humidity cell tests conducted for extended periods of time (20 weeks) must be performed so that a more accurate estimate of acid generation and neutralization potential can be determined.

<u>Interpretation of Arsenic Geochemistry</u>

55-33 In the section on Arsenic Geochemistry (Technical Report, pg. 6-1), it is stated that the lake will maintain a neutral to alkaline pH and arsenic will stabilize in solution at low concentrations. In fact, higher concentrations of arsenic are expected under more alkaline conditions because adsorption decreases with increasing pH. As with other oxyanions, there are very few limits on the concentrations and mobilities of these constituents in oxidizing, alkaline waters (Deverel and Millard, 1988; Welch et al., 1988). Ferric arsenate, $FeAsO_3$, is common only at low pH values if Fe^{3+} concentrations are greater than 10^{-4} M (Hem, 1977). The predicted geochemical conditions for Betze Lake are exactly those under which the highest concentrations and mobility of arsenic can be expected.

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Response to Letter 55 Continued

55-29 The BLM agrees that the Betze Pit water body may become stratified at some point in the future. However, even in a stratified water body, the upper layer of the water body would turn over, thereby maintaining oxic conditions as described in the EIS.

During the period of time that the water body is filling, four different conditions may exist, as follows:

1) complete mixing during the first few decades of filling when the volume of inflow is large relative to the total volume of the water body;

2) annual (monomictic) or semi-annual (dimictic) turnover of the water body as the inflow decreases and the water body volume increases;

3) intermittent stratification where turnover or mixing occurs infrequently and the lower layer (hypolimnion) of the water body cycles between oxic and anoxic conditions; and

4) permanent stratification (meromictic) as the water body surface approaches the pre-mining groundwater elevations and the hypolimnion remains anoxic.

An oxidizing environment would be maintained during the first two conditions due to frequent mixing within the water body. As shown by the dissolved oxygen modeling in Appendix B-2 of the Final EIS, 2.0 to 3.5 years of continuous stratification would be required to develop anoxic conditions in the hypolimnion. The third condition where the hypolimnion cycles between oxic and anoxic conditions may produce higher arsenic or other trace element concentrations during turnover events that would likely be infrequent and of short duration. The fourth condition would produce anoxic conditions in the hypolimnion under which arsenic and other trace elements may precipitate as sulfides. The surface layer (epilimnion) would maintain oxidizing conditions. Please refer to Appendix B-6 for an expanded discussion of the geochemical conditions that could occur under the four water body stratification scenarios. Please also refer to revised Section 4.4.9 in the Final EIS.

55-30 As suggested by your comment, stratification of the Betze Pit water body may occur as the inflow of thermal water decreases and the volume of the water body increases. At some point in the future, a permanently stratified or meromictic condition may occur. However, in the early years of the water body's existence, the smaller volume and larger inflow rate of thermal water will likely result in a well mixed condition. In the period of time between these two conditions, monomictic or dimictic conditions which involve annual or semi-annual overturning are likely. An oxidizing environment should be maintained during both the completely mixed period and the period of monomictic/dimictic conditions. Anoxic conditions will not develop during annual (or semi-annual) stratification events because of the relatively low organic content coupled with the large volume of the water body. This conclusion is supported by the analysis of dissolved oxygen dynamics in the water body which demonstrated that even for worst-cast conditions, 2.0 to 3.5 years of continuous stratification would be required for anoxic conditions to develop in the water body hypolimnion. Please refer to Appendix B-2 in the Final EIS, Oxygen Depletion Modeling of Betze Pit.

Letter 55 Continued

55-34 The toxicity of arsenic is dependent upon its chemical speciation. The biggest difference in toxicity, however, is between organically-bound and inorganic forms of arsenic. Organically-bound arsenic is considerably less toxic than inorganic forms (Bernhard and George, 1986). The prediction that there will be low concentrations of organic carbon and low productivity in the proposed Betze Lake suggest that the more toxic inorganic arsenic species will dominate.

55-35 Big Soda Lake in Fallon, Nevada, is an alkaline crater lake with many similarities to conditions predicted for Betze Lake in the Technical Report, including a very small littoral zone. This lake has low algal biomass but high bacterial concentrations (Cloern et al., 1983). A thick plate of purple sulfur photosynthetic bacteria has developed just below 20 m. The assumption that Betze Lake will have low biological productivity may severely underestimate the viability of this proposed lake to support a bird and fish population in the future. It is therefore critically important that the potential to develop high concentrations of toxic compounds such as inorganic arsenic is completely investigated.

<u>Alternative Disposal and Reclamation Methods</u>

55-36 Given the potential of the proposed Betze Lake to be acidic and have high arsenic concentrations, the partial backfill alternative should be considered more extensively. Extended duration pilot-scale tests of the interaction of waste rock with local groundwaters (leach or lysimeter tests to simulate the saturated zone) should be conducted. Although it is true that more surface area of waste rock would be available to interact with inflow water, if reducing conditions are developed (a likely scenario), high concentrations of dissolved sulfide would be able to immobilize arsenic via precipitation of arsenic sulfide. The acid generation potential of the waste rock under saturated conditions would be the critical test. If acid waters are generated under long time frames, an acid plume of groundwater could form. The human and environmental consequences of both scenarios (partial pit backfilling and no reclamation of the Betze Pit) must be weighed after more accurate tests of acid generation potential and arsenic mobilization are conducted.

55-37 The seepage from ore piles that are proposed to be stored unlined and uncovered will certainly be acidic and contain high concentrations of heavy metals and arsenic. As discussed above, the Net ANP for these rocks after corrections for AGP is -36.4. Even though the Technical Report admits that the ore stockpiles will generate acid and will have a significant impact on groundwater quality, lining and capping is not recommended. At a bare minimum, sulfide ore (the vast majority of ore in the Betze deposit) should be separated from oxide ore, placed on lined pads and capped while being stored.

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Response to Letter 55 Continued

55-31 Additional data have been incorporated into the estimate of pit inflow composition as described in the response to comments 55-13 and 55-22 (see Section 4.4.9 of the Final EIS, Betze Pit Water Quality). Estimates of pit water quality have also been revised based upon the new pit inflow composition, and the results are presented in Section 4.4.9 of the Final EIS. Projected arsenic concentrations range from 0.07 mg/l by the year 2100 to 0.12 mg/l at steady state (more than 200 years in the future). The revised arsenic concentrations are within the range described in Section 4.4.9 of the Draft EIS. As with the original estimates of pit water quality, there is a conservative uncertainty factor of ± 3 associated with these estimates. Therefore, arsenic concentrations could range from 0.04 mg/l to 0.36 mg/l, although the range extremes would be unlikely. As stated in the Draft EIS, the projected arsenic concentrations exceed the drinking water standard of 0.05 mg/l. Please refer to Section 4.4.9 of the Final EIS for a revised discussion of potential arsenic toxicity based upon the revised estimates of pit water quality. Also refer to the response to comment 55-14 for a discussion of pit wall reactions.

55-32 Please refer to the response to comment 55-25 for a discussion of the interpretation of humidity cell tests and the projected acidity of the pit waters.

55-33 Although arsenic generally tends to be desorbed at high pH, adsorption by iron oxyhydroxides is an important control on arsenic concentrations in oxidizing solutions. Numerous studies (Pierce and Moore 1982; Belzile and Tessier 1990; Fuller and Davis 1989; Goldberg and Glaubig 1988) indicate that adsorption can be an important control on arsenic concentrations at a pH similar to what is predicted for the Betze Pit water. Direct evidence of arsenic adsorption under the conditions predicted for the Betze Pit water body is provided by the existing treatment plant which successfully reduces arsenic concentrations by adsorption on ferric oxyhydroxide. For further discussion please refer to Section 4.4.9 of the Final EIS.

55-34 The BLM acknowledges that organically bound arsenic is less toxic than inorganic forms. The lowest LC_{50} reported in the EPA arsenic criteria document for monosodium methanearsonate is 1,921 μg/L for bluegill (<u>Lepomis macrochirus</u>) (Johnson and Finley 1980). This value is significantly higher than other LC_{50} values for inorganic forms. The availability of organic materials in the Betze Pit water body to form inorganic arsenic complexes was discussed in the Water Resources Technical Report, Section 6.2. However, it should also be pointed out that complexation of both arsenate and arsenite with dissolved organic matter prevents sorption and coprecipitation with solid-phase organics and inorganics, thus increasing arsenic mobility (Lyman et al. 1987).

Because of the many possible interactions between arsenic and organic materials (including organism-mediated methylation of arsenic; see Anderson and Bruland 1991), the predicted arsenic concentration was assumed to represent all available and toxic forms, even though some of this arsenic will probably be unavailable or less toxic either through binding to solid-phase inorganic or organic materials and conversion to less toxic organic forms.

Conclusions

* Most of the conclusions drawn in the Technical Report (pg. 9-1) are inaccurate as a result of poor data quality, poor choice of groundwaters to represent Betze pit water concentrations, incorrect assumptions about geochemical conditions potentially present in Betze pit water, and problems with laboratory tests used to predict the potential for acid mine drainage generation and mobilization of arsenic and heavy metals.

* Several of the wells chosen to represent Betze pit inflow water have an unacceptably low number of samples or are not representative of future pit inflow waters. Alternative wells are suggested. The average arsenic concentrations from these wells is 0.291 mg/l, even when interaction with pit wallrock is not considered. This suggests concentrations of at least 13 times the arsenic drinking water standard could develop under steady state conditions in the future.

* The data used to predict acid mine drainage generation uses a mix of values for acid generation potential (AGP). According to the definition in the Report, Total S values should be used, yet the lower APP/P values are used for 26 of the 41 samples. This underestimates static AGP and overestimates the net ANP.

* The humidity cell tests were not conducted for long enough time periods. Recent evidence in the literature suggests that a minimum of 12 weeks, or preferably 20 weeks, should be used. In addition, extended duration leach test should be performed to evaluate the potential of subaqueously exposed rocks, such as those in the Betze Pit, to form acid.

* The water quality data suffer from a lack of QA/QC and cannot be used to accurately estimate pit inflow water composition. Analytical methods for Total S, Total Pyritic S, App/P and ANP should be clearly presented.

* The assumptions that the lake will be oxic because of thermally-driven waters, that the redox species of arsenic and other constituents are in redox equilibrium and that the proposed Betze Lake will be of low biological productivity are unwarranted.

* The predicted geochemical conditions in Betze Lake are those under which arsenic can form the highest dissolved concentrations will be the most mobile.

* Partial pit backfilling, and lining and capping of ore stockpiles should be investigated further using pilot-scale tests, especially considering the potential of Betze Lake to

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55-35 Although some aspects of Big Soda Lake are similar to the Betze Pit water body (e.g., surface area and small littoral zone), they are dissimilar in other ways:

Parameter	Big Soda Lake	Betze Pit
Max Depth	65 m	353 m
Mean Depth	26 m	172 m
TDS	26,000 mg/L (Mixolimnion)	500 mg/L (Predicted)

Because of the numerous dissimilarities between these two water bodies, caution should be employed in any comparisons.

Regardless of similarities to Big Soda Lake, if the Betze Pit does develop greater-than-expected populations of phytoplankton and/or bacteria, then the possibility of methylation of arsenic and organic bonding also increases; therefore, the potential arsenic toxicity and bioavailability decreases. As described in the Water Resources Technical Report, Section 6.2, the potential does exist for adverse effects on some algal species. However, the predicted concentrations should be well below the toxic levels indicated by current data for nearly all tested species.

55-36 Please see response to comment 55-2 for a discussion of the partial backfill alternative and 55-25 for a discussion of the humidity cell test results. Production of sulfide in the partial pit backfill alternative would be limited by the availability of organic carbon. Consumption of sulfide by reaction with iron oxyhydroxides would also be rapid. The geochemical environment in which arsenic is most mobile is a strongly reducing environment with sulfide absent. The partial pit backfill alternative would likely be a reducing environment. It is probable that arsenic would be present in the groundwater in the backfill, and that a plume of groundwater with higher arsenic concentrations would migrate down-gradient from the pit.

55-37 Seepage from sulfide ore stockpiles would be acidic and would contain elevated levels of heavy metals as discussed in the Water Resources Technical Report (see page 5-16) and the Draft EIS (see page 4-102). Therefore, the stockpiles would be placed on the South Block waste rock disposal area as presented in Section 2.3.4, Agency Preferred Alternative.

be acidic and high in arsenic concentration.

References

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TOTAL P.11

Letter 56

United States Department of the Interior
FISH AND WILDLIFE SERVICE

911 N.E. 11th Avenue
Portland, Oregon 97232-4181

RES
ADM
OPS
FRA
WRA
PEC
CF
Code:
X=Action

Memorandum

To: District Manager, Bureau of Land Management
Elko District, Elko, Nevada

From: Regional Director, Fish and Wildlife Service
Region 1, Portland, Oregon

Subject: Review of Draft Environmental Impact Statement for Betze Project, Barrick Goldstrike Mines, Inc., Eureka and Elko Counties, Nevada

The U.S. Fish and Wildlife Service (Service) has reviewed the January 1991 Draft Environmental Impact Statement (DEIS) for the Betze Project, Barrick Goldstrike Mines, Inc., Eureka and Elko Counties, Nevada. The following comments are provided for your use and information when preparing the final documents.

GENERAL COMMENTS

The Service found that the DEIS provides a general description of the impacts to fish and wildlife resources, water quantity and quality, and other resources found within the project area. The Service's primary concerns with the DEIS include: (1) long-term losses to wildlife habitat and populations; (2) inadequacy of data to predict impacts resulting from dewatering; (3) potential long-term impacts to seeps, springs, and other wetland and riparian areas from dewatering operations; (4) lack of information on the direct impacts of the project to wetlands and the need for a permit from the Army Corps of Engineers (Corps) pursuant to Section 404 of the Clean Water Act; (5) lack of substantive mitigation and compensation for impacts to fish and wildlife resources; (6) absence of an adequate reclamation plan; (7) uncertainty regarding future use of the site for mining which could affect reclamations plans; and (8) cumulative impacts to fish and wildlife resources throughout the area.

SPECIFIC COMMENTS

Alternatives: The Service feels that considering only the alternative components, while valuable to some extent, may not provide a thorough

56-1 assessment of all of the less damaging alternatives available. Other less damaging alternatives, which should be considered, include: (1) reducing the scope of the proposed project; and (2) phasing ore removal to keep pace with ore processing. These two alternatives would respectively result in less surface disturbance and ore stockpile impacts

Endangered and Threatened Species: Section 3.8.2 of the DEIS addresses endangered and threatened species that may be found on the project site or may be affected by the project activities. In the Service's August 28, 1989,

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Response to Letter 56

56-1 Your comment is noted; however, the BLM did not believe that any alternative that would substantially reduce the existing production rate would be reasonable. It would require Barrick to eliminate a large part of its existing work force, prevent it from efficiently utilizing its existing mining equipment, and would extend the period of dewatering. The BLM did not consider the alternative of phasing ore production to avoid a large ore stockpile because 1) the vast majority of the ore stockpile would be created in the final year of production, when Barrick would mine as much ore as it had in the preceding 7 years combined, and 2) the ore would be placed on spent waste rock disposal areas, as specified in the Agency Preferred Alternative (see Section 2.3.4 of the Final EIS).

memorandum on the notice to prepare an environmental impact statement, we provided a list of endangered, threatened, and candidate species that may be found in or adjacent to the proposed Goldstrike Mine expansion. However, the DEIS does not address the two candidate species, the ferruginous hawk, and the Columbian sharptailed grouse. We also recommended making a determination whether the proposed project may affect federally listed candidate species. Although candidate species are not protected under the Endangered Species Act of 1973, early detection may avoid conflicts if a candidate species would become listed before completion of the project. If a candidate species may be affected, the Service's Reno Field Station is available to assist in developing the necessary planning alternatives. **56-2**

Reclamation

General concerns. The intent of the project proponent to implement a reclamation plan is indicated in the DEIS. However, only minimal information is provided on the specifics of the proposed reclamation. Without a detailed reclamation plan being available, the overall long-term impacts of this proposed mining project are difficult to assess. We recommend inclusion of a detailed reclamation plan in the final documents. The reclamation plan should identify: (1) the overall goals of the reclamation effort; (2) site-specific measures for restoration of disturbed areas; (3) composition of seed mixtures; (4) other measures for restoration of wildlife habitat; (5) offsite mitigation for areas where significant restoration is unlikely (such as the pit) and where original wildlife use cannot be fully restored; (6) a detailed monitoring plan with compliance deadlines during and after the project; (7) a contingency plan for revegetation in the event the restoration effort fails; and (8) cost estimates and performance bonding requirements which would assure full restoration and final inspection 5 years after the initial restoration is completed. **56-3**

Topsoil stripping and stockpiling: The seed mixture for seeding topsoil stockpiles for controlling erosion on soil stockpiles during the fall season needs to be specified in the final document. We are concerned that use of non-native species in revegetating stockpiles may exacerbate the existing problems of exotic plant species. A mix of indigenous species is recommended. We also recommend using vegetation removed from cleared areas, if it is composed of native species, as a source of seed and organic matter for the reclamation effort. **56-4**

Revegetation of disturbed areas: According to Section 3.6.4, Mined Lands, revegetation of previously mined lands has consisted of seeding topsoil stockpiles and one small waste disposal area. Plants that have become established are all exotic species which include the pubescent wheatgrass, crested wheatgrass, and yellow sweet clover. The Service is also concerned with the continued introduction and maintenance of non-native vegetation on public lands, not only in mining reclamation but also in establishment and maintenance of crested wheatgrass seedings which occurred on the project site for livestock grazing, prior to mining. **56-5**

Non-native species often outcompete native vegetation, reducing plant diversity with concomitant reduction in faunal species diversity. Executive

56-2 Interviews with local wildlife biologists conducted during preparation of the Draft EIS and additional investigations following receipt of your comment indicate that neither of these candidate species are likely to be affected by the proposed Betze Project.

The ferruginous hawk (Buteo regalis), a federal candidate 2 species, usually nests in juniper stringers on west slopes and close to valley bottoms (Perkins 1991). Although the Betze Project occurs within the hawk's nesting range and at the appropriate elevation, the presence of serviceberry and bitterbrush habitat suggests that nesting habitat is not likely to occur in the project area (Perkins 1991). According to Erickson (1990) and Perkins (1991), the Columbian sharptail grouse (federal candidate 2) is not known to occur in Nevada.

56-3 Section 2.2.5 of the Draft EIS contained a discussion of the reclamation plan contained in Barrick's Plan of Operations, which discussed all of the reclamation elements then required by 43 CFR 3809. Following preparation of the Draft EIS, and in compliance with additional reclamation requirements of state and federal law, Barrick has provided the BLM with a more detailed statement of its plan, together with financial assurences now required by the BLM and the State of Nevada. Although the basic elements of the reclamation plan have not changed, the text of Section 2.2.5 of the Final EIS has been supplemented to reflect your comment and Barrick's more detailed submittal. The more detailed plan, associated financial assurances, and the suggestions raised in your comment were also considered in the development of monitoring and mitigation measures and in the selection of the Agency Preferred Alternative (see Section 2.3.4 of the Final EIS).

56-4 Please refer to the response to comment 51-3. Because of previous grazing and fires in the area, most of the existing vegetation is composed of non-native species.

56-5 Please refer to the response to comment 51-3.

Order 11987 requires Federal agencies to restrict the introduction of exotic species into the lands or waters which are held in trust.

The reclamation of mined lands in Nevada, particularly those that were previously converted to crested wheatgrass or otherwise degraded by livestock grazing, presents an opportunity to restore valuable wildlife habitat and biodiversity on public lands. Such restoration, which is consistent with multiple-use legislation, may in part mitigate impacts to fish and wildlife resources from mining operations. The Service recommends that the overall goal of the mining reclamation program for the Betze project be restoration of native ecosystems and biodiversity throughout the project area, using indigenous plant species. The reclamation plan should include but not be limited to use of container plants, reestablishment of soil micorrhizae as appropriate, control of exotic plant species, and use of mulch and other erosion control measures.

56-6 The project proponent should demonstrate the potential for a successful reclamation program and provide comparative information of other mining reclamation programs in northeastern Nevada where native ecosystems have been restored.

56-7 Topography: Several sections of the DEIS address an alternative reclamation proposal which would distribute waste rock over tailings areas to assist in the establishment of vegetation. Because the tailings may contain substances toxic to plants, revegetation of these areas may be difficult to impossible. In addition, the DEIS specifies that 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. Other sections of the document specify that solutions contained in the tailings impoundment would evaporate and that liquid collected in seepage collection ponds would be pumped back into the impoundment.

The Service supports distribution of waste rock over tailings areas as the preferred alternative for reclaiming these areas. However, we recommend that techniques which would rapidly dewater tailings impoundments to reduce toxicity of materials in the tailings impoundment and to facilitate restoration should be required.

56-8 Riparian and wetland areas: Reclamation should include active measures to reestablish riparian vegetation lost as a result of dewatering operations. Long-term monitoring should be implemented to enable the Bureau of Land Management to determine when groundwater levels have returned to normal or near-normal conditions. Seeding or revegetating affected areas with seedlings or container plants may effectively accelerate restoration of impacted areas when the surface and groundwater regimes provide the necessary environment. We are aware of the Project Proponent's agreement in principle to implement off-site compensation. The details on the proposed compensation and assurances that it would be implemented should be provided in the final documents. The Service supports the mitigation measures listed in Section 4.6.5 of the DEIS.

56-6 Please refer to the response to comment 55-8.

56-7 As indicated in the expanded reclamation plan (see Section 2.2.5 of the Final EIS), Barrick will distribute waste rock over portions of the impoundments where the finer tailings solids collect, as needed, to stabilize the surface for operation of reclamation equipment. The revegetation test plot program will evaluate the feasibility of the tailings material as a growth medium. The reclamation plan projects that surface reclamation will begin approximately 4 years after decommissioning of the tailings impoundments is initiated. The 10- to 20-year period for tailings drainage that is referenced in your comment relates only to the alternative of placing large volumes of waste rock over the tailings impoundment surface.

56-8 Please refer to the response to comment 11-8. The Agency Preferred Alternative (Section 2.3.4 of the Final EIS) also incorporates measures to provide for revegetation of affected riparian or wetland areas with seedlings or container plants to accelerate revegetation.

56-9 Betze Pit: Water quality and hazards to wildlife are our primary concerns with reclamation of the pit. Additional information is needed regarding the anticipated quality of water when the pit is partially backfilled. The anticipated levels and the layering of salts, arsenic, and other potentially hazardous substances may affect different groundwater aquifers need to be specified. If impacts to groundwater would be minor or negligible, then the Service would recommend filling of the pit to the greatest extent possible as the preferred alternative.

56-10 If partial filling of the pit would not be selected as the preferred alternative, final design of the pit contours should be modified to allow wildlife to easily escape from the impounded waters. We also recommend a long-term monitoring program of pit waters because of the potential for toxic elements and salts becoming concentrated over time in the water due to evaporation. In our August 28, 1991, memorandum, we recommended that pit waters would be monitored following project completion.

56-11 Heap leach operation and cyanide ponds: The document states that cyanide solution ponds would be netted and fenced to preclude access by wildlife. However, the type of netting, its anchoring positions, and size of cyanide ponds need to provided in the final documents. We recommend that cyanide ponds be limited to five acres to facilitate netting and that netting would be anchored at the sides of the ponds to prevent wildlife intrusion. We also recommend that collection ditches be covered to preclude bird access.

56-12 The ore characteristics, compaction, cyanide solution distribution methods, and cyanide solution application rates may all influence ponding on heaps. We recommend that cyanide heaps be managed in a manner that precludes ponding.

56-13 Because of the potential for cyanidation heap leach facilities to kill migratory birds and other wildlife, the Service supports technology that eliminates pregnant and barren solution ponds entirely. We recommend that the such technologies would be addressed and evaluated as an alternative to the proposed heap leach operation.

56-14 No discharges, which may be toxic to migratory birds or resident wildlife, should be allowed to enter tailings ponds throughout the life of the milling operation. Frequent spot checks and independent laboratory analyses of both spigot discharge and the pond for weak acid dissociable cyanide concentrations are also recommended.

56-15 Dewatering: The Service has major concerns with the long-term impacts of pit dewatering on springs, seeps, and perennial streams. Information on the cone of depression surrounding the pit is provided, but projected drawdown contours for the years 2000, 2030, and 2100 only extend to the ten-foot contour. Because impacts may extend beyond the 10-foot drawdown contour, the final documents should discuss these impacts and project how far they would occur beyond the 10-foot contour.

56-16 Because the extent which dewatering may affect individual springs, seeps, and perennial sections of streams is uncertain, we recommend that an extensive

56-9 Please refer to the responses to comments 55-2 and 55-36.

56-10 The reclamation plan described in Section 2.2.5 of the Final EIS indicates that Barrick will reclaim or berm all access roads to the Betze Pit and will erect a fence around the pit to discourage people and livestock from attempting to obtain access to the pit. As the Betze Pit fills with water, benches constructed during mining will be covered by the rising water level. Haul roads exiting the pit will provide a means for wildlife egress. Ultimately, the slopes of the high walls remaining above the level of the post-mining water body will return to natural angles of repose and allow the egress of small mammals. Based on these factors, the BLM concludes that it is not necessary to require Barrick to modify the final pit contours to create egress routes for wildlife. A long-term water quality monitoring program for the Betze Pit has been incorporated into the Agency Preferred Alternative (see Section 2.3.4 of the Final EIS).

56-11 All existing solution ponds are 5 acres or less in size, and collection ditches are netted. Text describing the type of netting and anchoring systems used has been added in Section 2.1.4.1 of the Final EIS. Text has also been added in Section 2.2.3.1 of the Final EIS to confirm that the new solution ponds would be fenced and netted.

56-12 The BLM agrees with your comment. Barrick uses drip tubes to distribute cyanide on the heaps which reduces the potential for ponding.

56-13 The only technology that would eliminate solution ponds of which the BLM is aware would be the use of tanks. However, considering the volume of solution that would be managed in Barrick's operations and the measures proposed to protect wildlife, BLM does not consider it practical or necessary to require the use of tanks in this operation. Please refer also to the response to comment 32-7.

56-14 NDOW's Industrial Artificial Pond Permit requires that solutions discharged to ponds that are not fenced or netted to prevent access to wildlife be treated to render the solutions not hazardous to wildlife. Barrick presently treats the tailings with hydrogen peroxide prior to discharge to the tailings impoundment. Barrick monitors the tailings discharge on a regular basis to ensure that the concentration of cyanide is not lethal to wildlife. As described in the mitigation plan included in Section 2.3.4 of the Final EIS, Barrick will continue to monitor the tailings discharge throughout the operation of the mill.

56-15 Please refer to the response to comment 32-1.

56-16 Please refer to the response to comment 11-8.

Letter 56 Continued

monitoring program for these resources be developed and presented in the final document. Our primary concerns are with loss of riparian vegetation and reduction of water sources for wildlife in the arid environments surrounding the project site. Impacts to these resources should be fully compensated until tha ground and surface water systems and vegetation return to pra-project conditions. This may require establishment of a long term funding mechanism to maintain alternative water sources. Further recommendations are provided undar the sections on mitigation and compensation.

56-17 Although the DEIS indicates that dewatering of the Betze Pit likely would overshadow other dewatering requiremants of other mining operations in the area, these other operations may exacarbate the impacts of dewatering from tha Betze Pit operation as well as impede recovery of the ground and surface water systems. The DEIS needs to adequately address this issue. Modaling should be included in the final documents to fully assess the cumulative impacts of groundwater drawdown of all mining operations in the area.

Compensation/mitigation: Several sections of the DEIS indicate the project proponent's willingness to compensate and mitigate for project impacts, but no specific measures are provided. Accordingly, the Service recommends the following measures to compensate and mitigate for impacts to fish and wildlife resources. All off-site and some on-site mitigation should be initiated immediately to allow an early assessment of success.

56-18

1. Temporal loss of upland, wetland and riparian habitats: Compensation should be developed based on the length of time the impacts will occur. Significant mitigation can be developed through implementation of a reclamation plan that has as its stated goal the restoration of natural ecosystems following project completion. However, it is not certain when restoration can be implemented because of uncertainties associated with continued mining on the site over the long-term. Assurances should be provided in the final documents and reclamation plan that full restoration of the habitat would be completed within a specified time-frama. If this assurance cannot ba provided, we recommend that additional off-site compensation should be required.

56-19 Temporal losses to riparian and wetland habitats associated with springs, seeps, and streams should ba compensated by establishment of in-kind habitat near or adjacent to the project site. Maintenance of perennial flows in other portions of affected streams through water diversions may be a feasible means of accomplishing this goal. Revegetation of other areas with willows and other riparian plant species also should be considered. We recommend that estimates of the acreage of affected habitat as provided in the DEIS ba used as a guideline to the extent of habitat compensation that should be provided with the goal of no net loss of habitat values. The final documents should specify areas where habitat would be established as mitigation for temporary impacts, and should identify the means by which this mitigation will be accomplished.

Response to Letter 56 Continued

56-17 Additional modeling of cumulative groundwater impacts from dewatering of other mines in the area is not feasible at this time due to a lack of information concerning future mining projects within the vicinity of the Betze Pit. As discussed in Section 3.12.3.3 (pages 3-82 through 3-92) of the Draft EIS, several ore bodies have been identified in the vicinity of the Betze Pit. However, there are proposals to mine at only two other locations where dewatering is expected to occur (see Section 4.4.2.3). The projected dewatering rate at the nearby Genesis Pit is 2,800 gpm which is only one-tenth the dewatering rate for the Betze Pit, and the dewatering rate at the Bootstrap/Capstone operation is not known at this time. Cumulative impacts were projected in the groundwater model by extending the simulated duration of dewatering at the Betze Pit for an additional 6 years (see Section 4.4.3.3). Given the speculative nature of information regarding other potential future mining projects, further quantitative modeling of the groundwater impacts in the area would not be meaningful. Please refer to the mitigation measures and monitoring requirements (Section 2.3.4) for a discussion of monitoring measures that will be implemented to determine the actual impacts of dewatering of the Betze Pit. Please also refer to Section 2.1.8 of the Final EIS for a description of existing monitoring programs.

56-18 The description of the expanded reclamation plan (Section 2.2.5 of the Final EIS) includes time frames for initiation and completion of reclamation activities with respect to the components of the Proposed Action. In addition, off-site habitat enhancement and other mitigation measures were included in the Agency Preferred Alternative (Section 2.3.4 of the Final EIS).

56-19 Please refer to the response to comment 11-8.

56-20 Temporary loss of upland habitats could be compensated by enhancement of upland habitats off-site. We are particularly concerned with loss of sage grouse habitat and the associated ecosystem. Many acres of public lands have been degraded over time through impacts by livestock. Selected sites can be enhanced by reducing or eliminating livestock grazing or other uses in these areas over the life of the project (ie, until reclamation is completed and wildlife habitats restored). If this measure is not feasible, it may be possible for the project proponent to purchase private lands to protect or restore upland habitats. Other measures also may be found to provide adequate mitigation for these losses. The final documents should specify such mitigation in detail and indicate how it would be implemented.

56-21 Dewatering of springs and seeps may be mitigated by providing other water sources for wildlife in the area of impacted water bodies. Means by which this mitigation would be implemented should be provided in the final documents.

2. Compensation for permanent impacts to habitat: Permanent losses to fish and wildlife resources should be compensated in full. Acres of impacts to wetlands should be calculated and specific compensation developed to ensure no net loss of habitat. Losses resulting from pit development should be compensated by restoration of in-kind habitat outside of the project area. A monitoring program should be developed in association with this restoration program. Compensation sites should be identified in the final documents. 56-22

56-23 Section 404 of the Clean Water Act: The DEIS needs to adequately address the need for a permit from the Corps pursuant to Section 404 of the Clean Water Act. There is an implication, however, that Nationwide Permits have been or will be issued for the proposed action. Section 3.5 and Figure 3-9 of the DEIS indicate that Welch soils are found along Rodeo and Brush creeks. Welch soils are hydric soils, but the presence of regulated wetlands or waters of the United States on the project site is not acknowledged. The final documents should provide this information, discuss measures provided to compensate for impacts, and indicate the status of permits required for the project. The Service will comment on any public notice issued by the Corps for a permit pursuant to Section 404 of the Clean Water Act.

Cumulative Impacts: Under the Council of Environmental Quality's Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act, cumulative impacts are defined as the impacts on the environment which result from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts may result from individually minor but collectively

56-24 significant actions taking place over a period of time. As stated in our August 28, 1989, memorandum, the past, present, and reasonably foreseeable future mining, grazing, and other actions within the resource management area

56-20 Please refer to the responses to comments 51-1 and 51-9.

56-21 Please refer to the response to comment 51-6.

56-22 Mitigation measures have been expanded to include replacement of in-kind habitat lost within the perimeter of the Betze Pit as well as affected wetland and riparian areas. Your comment was considered in the selection of the Agency Preferred Alternative (see Section 2.3.4 of the Final EIS).

56-23 The Draft EIS identified Nationwide Section 404 permits as one of the principal regulatory requirements applicable to the Proposed Action (see Table 1-1). The Draft EIS (page 4-41) discussed the impacts of the Proposed Action on riparian areas. Riparian areas encompass regulatory wetlands and other areas that may not satisfy the regulatory definition of wetlands. A monitoring plan and mitigation measures to compensate for the 330 acres of riparian areas, including areas of hydric soils, that potentially may be affected, are included in the Final EIS and in the Agency Preferred Alternative (see Section 2.3.4 of the Final EIS).

56-24 The cumulative impact assessment in the Draft EIS addressed the potential impact of all reasonably foreseeable future activities in the project area with a focus on mining as the principal land use. As indicated in Section 3.12.3.1 of the Draft EIS, a fence was previously constructed to exclude livestock grazing from the area proposed for disturbance; therefore, significant cumulative impacts to grazing from the Betze Project are not anticipated. Sections 4.7.3 and 4.12.3 of the Draft EIS indicate there would be cumulative impacts to grazing patterns in the area. Section 4.7.3 has been modified in the Final EIS to acknowledge concerns related to fragmentation of wildlife in the habitat and reductions in species diversity.

Letter 56 Continued

and adjacent private land should be considered in this analysis. The cumulative impacts analysis should also address habitat fragmentation and its effect on wildlife populations and species diversity. We recommend that the cumulative impacts sections of the DEIS be expanded to address these issues. 7

The Service appreciates the opportunity to comment on the DEIS for this proposed project. Any questions regarding our comments should be addressed to the Service's Fish and Wildlife Enhancement Reno Field Station, 4600 Kietzke Lane, Building C-125, Reno, Nevada 89502.

WILLIAM E. MARTIN

Letter 57

IVORY AND COMPANY
A NEVADA CORPORATION

102 Chris Avenue, Elko, Nevada 89801
Telephone: (702) 738-9894

March 8, 1991

Bureau of Land Management
Elko District Office
Attention: Betze Coordinator
P.O. Box 831
Elko, NV 89801

Our company has worked with Barrick Goldstrike Mines for the past 3 years in providing new homes for their employees in Elko subdivisions. I write to express our support for Barrick Goldstrike Mines Betze project.

Barrick has been extremely concerned about providing quality housing for their employees. They have developed over 400 lots and worked with us to provide housing for their employees as well as other workers in the Elko community. Together with Barrick, we have cooperated with Elko City in many improvements to the community including new schools, new roadways and utility systems.

I am convinced Elko is a better city today because Barrick came to town. Also, I know Barrick will continue to be sensitive to the needs of their workers and the community as they grow and increase their production.

I have had several meetings with top management people of Barrick and can testify of their long-term concerns for the improvement of the area and the quality of life for all people involved. I hope you will quickly approve the next phase of their development plan for the betterment of the entire Elko community.

Sincerely,

Ellis R. Ivory
Chairman of the Board

ERI/p

cc: John McDonough, Barrick Goldstrike Mines

CORPORATE OFFICE: 127 South 500 East, Suite 110, Salt Lake City, Utah 84102, Telephone: (801) 531-7700

Letter 58

CATE EQUIPMENT COMPANY

CONSTRUCTION, MINING & INDUSTRIAL EQUIPMENT

2055 PIONEER ROAD • PO BOX 27073 • PHONE 973-2900
SALT LAKE CITY, UTAH 84127

March 1, 1991

Bureau of Land Management
Elko District Office
ATTN: Betze Coordinator
P. O. Box 831
Elko, Nevada 89801

I am writing to express my support of Barrick Goldstrike Mine's Betze Project.

Barrick has demonstrated a strong commitment to the surrounding communities and the environment. They have made conscientious efforts to avoid and mitigate undesirable environmental impacts and the Betze Project's Comprehensive Environmental Impact Statement demonstrates Barrick's commitment.

Also, the Project will have a very positive economic impact in Northeastern Nevada, with a workforce averaging 1,200 employees. The Project is expected to generate local, state and federal tax revenues of several million dollars annually.

Because of Barrick's demonstrated commitment to preserve wildlife habitats, visual and cultural resources and its significant contribution to the local economy, I urge you to approve the project as soon as possible.

Sincerely,

CATE EQUIPMENT COMPANY

Frank D. Culbertson
President

FDC/pb

3869 NO. OLD HIGHWAY 91
POCATELLO, IDAHO 83201

CATE

322 SO HWY 50 & 6
PRICE, UTAH 84501

SALES SERVICE RENTAL REPAIRS

Letter 59

Coopers & Lybrand
John M. Morrissey
Partner
1999 Harrison Street
Suite 1100
Oakland, California 94612

March 11, 1991

Bureau of Land Management
Elko District Office
P. O. Box 831
Elko, Nevada 89801

Attn: Betze Coordinator

Gentlemen:

I am writing to express my support of Barrick Goldstrike Mine's Betze Project.

Barrick has demonstrated a strong commitment to the surrounding communities and the environment. They have made conscientious efforts to avoid and mitigate undesirable environmental impacts, and the Betze Project's comprehensive Environmental Impact Statement demonstrates Barrick's commitment.

Also, the Project will have a very positive economic impact in Northeastern Nevada, with a workforce averaging 1,200 employees. The Project is expected to generate local, state, and federal tax revenues of several million dollars annually.

Because of Barrick's demonstrated commitment to preserve wildlife habitats, visual and cultural resources, and its significant contribution to the local economy, I urge you to approve the project as soon as possible.

Sincerely,

John M. Morrissey

JMM:kd/lndmgmtl.ltr

Letter 60

Valley Bank of Nevada
MEMBER FDIC
Elko Branch
605 Idaho Street, P.O. Box 231
Elko, Nevada 89801-0231

March 1, 1991

Bureau of Land Management
Elko District Office
ATTN: Betze Coordinator
P.O. Box 831
Elko, Nevada 89801

I am writing to express my support of Barrick Goldstrike Mine's Betze Project.

Barrick has demonstrated a strong commitment to the surrounding communities and the environment. They have made conscientious efforts to avoid and mitigate undesirable environmental impacts and the Betze Project's comprehensive Environmental Impact Statement demonstrates Barrick's commitment.

Also, the Project will have a very positive economic impact in Northeastern Nevada, with a workforce averaging 1,200 employees. The Project is expected to generate local, state and federal tax revenues of several million dollars annually.

Because of Barrick's demonstrated commitment to preserve wildlife habitats, visual and cultural resources and its significant contribution to the local economy, I urge you to approve the project as soon as possible.

Sincerely,

Terry R. Sullivan
Vice President and
Branch Sales Manager

TRS/kg

Letter 61

United States Department of the Interior

BUREAU OF MINES

WESTERN FIELD OPERATIONS CENTER
EAST 360 3RD AVENUE
SPOKANE, WASHINGTON 99202-1413

TAKE PRIDE IN AMERICA

CC: 93

March 8, 1991

Memorandum

To: Fred Wolf, Acting State Director, Bureau of Land Management, Nevada State Office

From: Chief, Branch of Engineering and Economic Analysis

Subject: Draft Environmental Impact Statement, Betze Project, Barrick Goldstrike Mines Inc.

Thank you for sending us copies of the subject Draft EIS, and for the opportunity to provide suggestions for the Final EIS. In general we review environmental documents from the perspective of supporting the judicious use and conservation of mineral resources.

Our concerns with the Betze project are the placement of overburden, tailings, leach pads, and other facilities over potential mineral deposits. We are pleased that drilling is actively being conducted on these sites in the Betze project; this drilling is essential to ensure that future developable mineral resources are not adversely impacted.

61-1 The final EIS should include in table form, all drilling and analytical data collected from the drilling program. Furthermore, resources discovered from this program, whether potentially economic or uneconomic, should be calculated including tonnage, grade, shape, depth, and a description of the deposit geology.

John R. Norberg

Response to Letter 61

61-1 The BLM determined not to include the information requested by your comment in the Final EIS for two reasons. First, the majority of the information requested is considered by Barrick to be privileged commercial information. Second, the volume of the information requested is substantial. The Draft EIS (Section 3.12.3.3) identifies the significant mineral deposits or resources found within the project area. Consequently, the requested information would add relatively little to the environmental impact analysis. Consistent with the mandate of the Council on Environmental Quality regulations to keep EISs to a manageable length, the BLM determined that including the information requested was not warranted.

5.5 *Public Meeting Comments and Responses*

This section presents the oral comments that were received at the two public meetings for the Betze Project EIS on February 27 and 28, 1991 in Elko and Reno, Nevada, respectively. The oral comments have been abstracted to reduce the volume of the transcripts. Complete copies of the meeting transcripts are available for review at the BLM Elko District Office in Elko, Nevada. Formal responses have been prepared only for those comments or questions that address the accuracy or adequacy of the Draft EIS. However, like the written comments, the BLM has reviewed all statements, opinions, and concerns made at the public meetings; these have been considered in the decision-making process.

The reader is reminded that this is an abbreviated Final EIS; therefore, it is necessary to use the Draft EIS in conjunction with the Final EIS in order to fully understand the impact assessment that was conducted for the proposed Betze Project.

Elko, Nevada - February 27

1. Paul Scheidig, Nevada Mining Association

Comment: *Endorses Barrick's proposed action and encourages the BLM to approve the proposed action in the Final EIS.*

2. Richard Harris, Elko County School District

Comment: *Believes the majority of the 700 to 750 construction workers for the Betze Project probably already reside in the Elko area; believes the 77 new operations workers would have little effect on the schools. Recommends that the BLM approve the project.*

Response: *Please refer to response to comment 22-1 in Section 5.4 of the Final EIS.*

Reno, Nevada - February 28

1. Paul Billings, Superintendent Elko County School District

Comment: *Commends Barrick on its mitigation effort and supports Barrick's expansion. Believes construction workers do not usually impact the school system; the 77 operations workers will have very little impact on the schools.*

Response: *Please refer to response to comment 22-1 in Section 5.4 of the Final EIS.*

2. Glenn Miller, Sierra Club

Comment: *EIS lacks a comprehensive reclamation plan, including a surety, sediment plan, identification of seed mixes, etc. EIS should consider the alternative of waste rock piles that do not follow section lines, i.e., that, subject to condemnation of private land for the purpose, are configured in a more environmentally sound manner. EIS should give additional consideration to the leaching of arsenic from the waste rock piles. EIS should consider the hydrologic effects of the mixing of aquifers. Questions the current arsenic levels in the pit and the expected levels in the ultimate pit water. EIS should examine the pit water below the 1,200-foot level, including the effects of geothermal water. EIS did not consider the geochemistry of the pit walls. Concerned with potentially high levels of TDS in the pit water. Questions whether evaporation of pit water should be considered a beneficial use. EIS should address the "what if" questions concerning elevated arsenic and TDS levels in the pit water; leaching of arsenic from waste rock piles; reclamation; and cumulative impacts in the Carlin Trend. Unresolved questions in an EIS require a commitment to future research.*

Response: *Please refer to the responses to Letter 55 in Section 5.4 of the Final EIS.*

3. Paul Scheidig, Nevada Mining Association

Comment: *Recommends that the BLM approve the proposed action.*

6.0 LIST OF PREPARERS AND REVIEWERS

Section 6.0 of the Draft EIS is incorporated herein by reference.

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APPENDIX B-1

REVISED HELP MODELING

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Revised HELP Modeling of Waste Rock Seepage

Section 5.3.1 of the Betze Project Water Resources Technical Report describes the modeling of seepage through waste rock using the computer program Hydrologic Evaluation of Landfill Performance (HELP). As described in the Technical Report, climatologic data for Ely, Nevada was used to represent conditions at the project site. Precipitation data for Elko, Nevada has since been obtained from the Elko weather station, and the HELP model was rerun using that data. The results are described below.

The record obtained from the Elko weather station includes 16 years of precipitation data, from 1974 through 1989. The average annual precipitation for this period was 9.32 inches. By comparison, the average annual rainfall used in the original modeling was 8.78 inches, for the 5-year period from 1974 through 1978. The Elko average for the same 5-year period was 8.16 inches.

In general, higher precipitation is expected to produce greater percolation through the waste rock. Consequently, for the period from 1974 through 1978, the original HELP modeling which used Ely data was expected to give more conservative predictions than the same analysis using Elko data. Similarly, the average of 16 years of Elko data was expected to predict a more conservative percolation rate than the 5 years of Ely data. To confirm these expectations, the same scenarios originally modeled with the Ely data were rerun with Elko data. Six scenarios were rerun. The first three scenarios represented the waste rock as an exposed pile, 600 feet deep, with a hydraulic conductivity varying from 6.6 to 11.95 inches/hour. The next three scenarios assumed 1, 2, and 10 feet of vegetated, sandy loam on top of the waste rock disposal area. The results are shown below in Table B-1, in terms of average annual percolation rates. The original percolation rates are also shown for comparison.

Table B-1 shows that, in general, an equivalent amount of infiltration or percolation is obtained for the two precipitation record periods. However, contrary to expectation, percolation rate predictions based on the 16-year precipitation record for Elko are somewhat lower than those based on the Ely data. Since percolation is partially a function of quantity, intensity, frequency, and distribution of rainfall, it is likely that a different distribution of precipitation intensities at the two locations accounts for the above results.

TABLE B-1

Comparison of Ely and Elko HELP Results

Case	Description	Average Percolation (in/yr) Ely ('74-'78)	Elko ('74-'89)
1	600' waste rock only; K = 11.95 in/hr	1.31	0.95
2	600' waste rock only; K = 7.09 in/hr	1.15	0.84
3	600' waste rock only; K = 6.62 in/hr	0.97	0.66
4	waste rock overlain by 1' vegetated soil	1.43	1.30
5	waste rock overlain by 2' vegetated soil	1.37	1.30
6	waste rock overlain by 10' vegetated soil	1.33	1.29

APPENDIX B-2

OXYGEN DEPLETION MODELING

TABLE B-[illegible]

Comparisons of Ely and [illegible] Results

Case	Description	Average Percolation (in/yr)	
		Ely ('[illegible]-'[illegible])	[illegible] ('7[illegible]-'89)
1	800' waste rock only; K = 12.29 in/hr	1.31	0.95
2	275' waste rock only; K = 7.56 in/hr	1.15	0.84
3	800' waste rock only; K = 6.65 in/hr	0.97	0.66
4	waste rock overlain by 1' vegetated soil	1.43	1.30
5	waste rock overlain by 2' vegetated soil	1.37	1.10
6	waste rock overlain by 3' vegetated soil	1.31	1.29

Evaluation of Dissolved Oxygen Concentration in Betze Pit under Stratified Conditions

Introduction

The intent of this study was to evaluate the concentrations of dissolved oxygen in the Betze Pit water body under stratified conditions. In particular, the analysis focused on a determination of the period of time required for the hypolimnion, or lower layer, to become anoxic under permanently stratified conditions.

The study was based primarily on results of the Water Resources Technical Report (ENSR and Drever 1991), and it assumed worst-case conditions that could occur in the water body. The study showed that the water body which will be formed in the pit will probably be oligotrophic with low biological activity. It is likely that by the year 2100 permanent stratification or meromictic conditions will occur as the Betze Pit reaches maximum size and thermal water input to bottom layers of the water body decreases. During the early period of formation, continuously mixed conditions in the water body are likely. In the intervening years stratification on an annual or semi-annual basis is probable. The results of the study are significant in demonstrating whether anoxic conditions could occur during the potential annual or semi-annual stratification events.

The water body at year 2100 is schematically presented in Figure B-2-1.

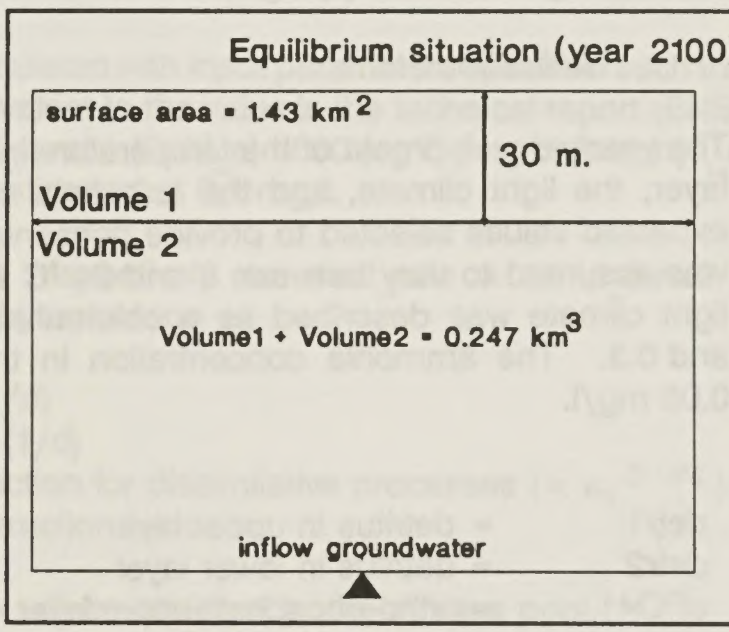

Figure B-2-1. Water Body Characteristics

Model formulations

The analysis was performed using a relatively simple two-layer model. The primary influences on oxygen concentration in the lower layer are: 1) decay of organic matter that settles from the upper layer and, 2) the nitrification process. The model simulates the dynamic behavior of the following variables:

- ortho-phosphate (as a potential limiting nutrient);
- detritus,
- phytoplankton, and
- oxygen.

The following processes were considered (as shown in Figure B-2-2):

- primary production
- respiration
- mortality
- settling of phytoplankton and detritus
- reaeration
- degradation of detritus
- nitrification

The yearly development of the temperature in the upper layer and the temperature in the lower layer, the light climate, and the ammonia concentration were specified in accordance with expected values selected to provide conservative results. The temperature in the upper layer was assumed to vary between 8 and 24 °C and in the lower layer between 4 and 12 °C. The light climate was described as a column averaged light efficiency and varied between 0.1 and 0.3. The ammonia concentration in the lower layer was conservatively estimated at 0.05 mg/l.

detr1	= detritus in upper layer
detr2	= detritus in lower layer
oPO41	= ortho-phosphate upper layer
oPO42	= ortho-phosphate lower layer
NH4N	= ammonia
Phyto	= phytoplankton
oxygen1	= oxygen in upper layer
oxygen2	= oxygen in lower layer

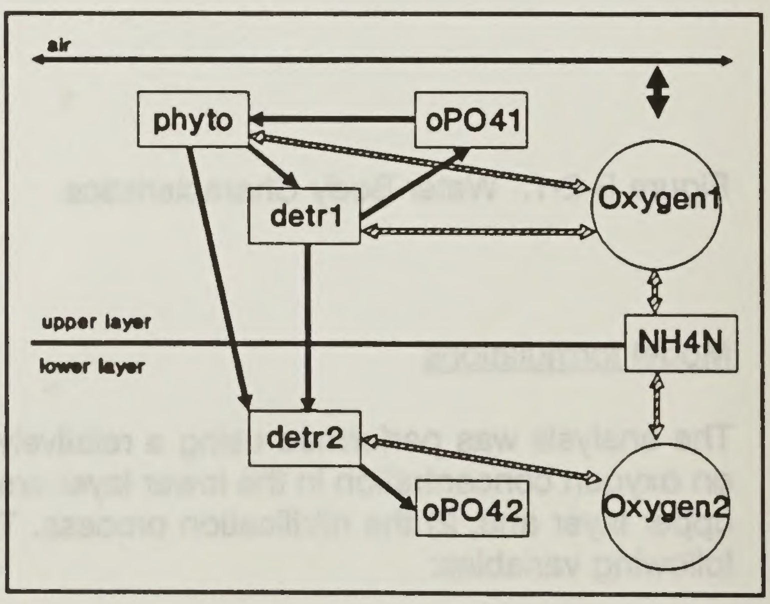

Figure B-2-2. Model structure

The model solves the mass balances for all chosen state variables in both layers, illustrated by the following critical equations.

1) The mass balance equation for phytoplankton is expressed as:

d phytoplankton / dt = **production - mortality - respiration - settling**

2) The primary production is described as:

production = **Light_eff x monod(phosphate) x prod_max x temp_func1 x phytoplankton**

where

light_eff	= 30m. column averaged light efficiency (0 < efficiency < 1)
monod(phosphate)	= monod function for phosphate (= oPO4P / oPO4P + K_oPO4P)
phosphate	= ortho-phosphate concentration in the upper layer (mg P/l)
K_oPO4P	= half saturation coefficient (mg P / l)
prod_max	= maximum primary production rate (1/d)
temp_func1	= temperature function for assimilative processes (= $\varnothing_1^{(T-20)}$)
$\varnothing_1$	= temperature correction factor
T	= actual water temperature for the specific layer (°C)
phytoplankton	= phytoplankton concentration (mg C/l)

Annual variability of primary productivity was calculated with input parameters specified such that the annual average value was more or less equivalent to the value in the technical report (ENSR and Drever 1991). Using a carbon to chlorophyll_a ratio (Cchl_a) of 50 (ug C / ug chlorophyll_a) the initial organic carbon concentrations were estimated at 0.1 mg/l.

The mortality and respiration are described respectively as mort_rate x temp_func2 x phytoplankton and resp_rate x temp_func2 x phytoplankton

where

mort_rate	= mortality rate (1/d)
resp_rate	= respiration rate (1/d)
temp_func2	= temperature function for dissimilative processes (= $\varnothing_2^{(T-20)}$)
$\varnothing_2$	= temperature correction factor

Only a fraction (resp_frac) of the respiration flux will be attached to the detritus pool.

3) The detritus concentration in the hypolymnion is described as:

d detritus2 / dt = **settl_phyto / dil_fact + settl_detr / dil_fact - mineralization**

where

settl_phyto	= (settl_rate / depth) x phytoplankton
settl_detr	= (settl_rate / depth) x detritus1
depth	= depth of the upper layer (m)
detritus1	= detritus concentration in the upper layer (mg C/l)
dil_fact	= dilution factor
mineralization	= min_rate x temp_func2 x monod(oxygen) x detritus2
min_rate	= mineralization rate (1/d)

detritus2 = detritus concentration in the lower layer (mg C/l)

4) The mass balance for oxygen in the lower layer is determined as follows:

d oxygen2 /dt = - conv_fact1 x mineralization - nitrification

where conv_fact1 = oxygen to carbon ratio for mineralization (mg O2 / mg C)

The nitrification is calculated as follows:

nitrification = conv_fact2 x nitr_rate x temp_func2 x ammonium x monod(oxygen)

where

conv_fact2 = oxygen to nitrogen ratio for nitrification (mg O2 / mg N)
nitr_rate = nitrification rate (1/d)
ammonium = ammonium concentration (= forcing function) (mg N/l)
monod(oxygen) = monod function for oxygen

Input parameters

Although actual values for the chosen state-variables are not known, the model makes use of generally accepted ranges of concentrations and process coefficients (EPA 1985), selected to provide conservative results. Major input parameters for the model are provided on Table B-2-1.

Table B-2-1. Critical Process Coefficients

coefficient	unit	
pprod	(1/d)	1.00
mort_rate	(1/d)	0.10
resp_rate	(1/d)	0.05
resp_frac	dimensionless	0.5
min_rate detritus	(1/d)	0.04
settl_phyto	(m/d)	0.15
settl_detr	(m/d)	0.10
conv_fact1	(mg O2 / mg C)	1.87
conv_fact2	(mg O2 / mg N)	4.57
nitr_rate	(1/d)	0.10
ø1	dimensionless	1.02
ø2	dimensionless	1.08
K_O2	(mg O2/l)	1.00
K-oPO4P	(mg P/l)	0.001
Cchl a	(ug C/ ug chla)	50.

Using the total volume of the pit for the equilibrium situation, the mixing depth and the estimated surface area (see Figure B-2-1) the volumes of the two layers were calculated. The volume of the lower layer is about 5.75 times the volume for the upper layer. This value was assumed to be the dilution factor for the settled material.

Model assumptions

The model was applied to estimate how the oxygen concentration would develop under worst-case conditions, involving application of the following assumptions:

- A two-layer permanently stratified system exists
- There is no diffusion of oxygen between the upper and lower layer
- The thickness of the upper mixed layer is 30m.
- There is only primary production in the upper layer
- The phytoplankton biomass does not change over the years; this is a conservative assumption, because with the settling of organic matter and no mixing to provide nutrients from the lower layer, the water body should become increasingly oligotrophic with time
- Oxygen consumption in the lower layer occurs due to decay of organic matter and nitrification.
- The source of organic matter to the lower layer is settling of detritus from the upper layer
- The ammonia concentration in the lower layer remains constant

Model results

The relationship between the uncertainty in process coefficients and model predictions was evaluated by performing a straightforward sensitivity analysis for the most critical coefficients.

For the sensitivity analysis the following scenarios, all based on the base worst-case scenario, were considered:

1. A doubling of the yearly averaged phytoplankton biomass (from about 2 ug/l chlorophyll_a to 4 ug/l),
2. A doubling of the ammonia, NH4N, concentration in the hypolymnion,
3. A doubling of the settling velocities, and
4. A doubling of the mineralization rates.

In Table B-2-2, the simulated critical period of time, i.e., the time required for the hypolimnion to become anoxic, is presented.

Table B-2-2. The Period of Time Required for the Hypolymnion to Become Anoxic for Different Scenarios

Scenario	period of time to reach anoxic conditions (year)
base case	3.3
1	2.8
2	1.8
3	2.8
4	3.4

From the model simulations it can be concluded that:

1. In case of a permanent stratification with no diffusion between the upper and lower layer, the hypolymnion is estimated to become anoxic after about 3.4 years. This means that if there were no turnover within 3.4 years, the water body might become anoxic.

2. The simulated oxygen concentration is most sensitive to the ammonia concentrations. In case of a doubling of the ammonia concentration the period of time to reach the anoxic situation will be reduced to 1.8 years. Due to the constant ammonia concentration, the nitrification rate remains relatively high (i.e., a worst-case approach).

3. A doubling of the mineralization rates has an opposite effect on the period of time. Due to the increased mineralization in the upper layer, less organic matter will be settled and subsequently less oxygen will be consumed.

A relatively simple model approach was used for the Betze Pit. Although the chosen process coefficients are within reasonable literature ranges, the model results should only be considered as indicative of expected future conditions.

References

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APPENDIX B-3

TAILINGS ANALYSES

In Table 5.5.2, the simulated [illegible], i.e., the time required for the hypolimnion to become anoxic, is presented.

Table 5.5.2. The Period of Time Required for the Hypolimnion to Become Anoxic for Different Scenarios

Scenario	period of time to reach anoxic conditions (year)
Base case	3.3
1	2.6
2	1.8
3	2.5
4	3.4

From the model simulations it can be concluded that:

1. In case of a permanent stratification with no diffusion between the upper and lower layer, the hypolimnion is estimated to become anoxic after about 3.4 years. This means that if there were no turnover within 3.4 years, the water body might become anoxic.

2. The simulated oxygen concentration is most sensitive to the ammonia concentrations. In case of a doubling of the ammonia concentration, the period of time to reach the anoxic situation will be reduced to 1.8 years. Due to the constant ammonia concentration, the nitrification rate remains relatively high (i.e., a worst case approach).

3. A doubling of the mineralization rates has an opposite effect on the period of time. Due to the increased mineralization in the upper layer, less organic matter will be settled and subsequently less oxygen will be consumed.

A relatively simple model approach was used for the Betze Pit. Although the chosen process coefficients are within reasonable literature ranges, the model results should only be considered as indicative of expected future conditions.

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TABLE B-3-1

Whole Rock Analysis of Ore Samples

Parameter	WR-2	WR-8	B-13	B-14	WR-2P	WR-8P
Arsenic	1,790	835	5,080	1,450	845	1,010
Barium	515	224	223	147	150	32
Boron	<10	<10	<5	<5	<5	<5
Cadmium	4.8	2.7	<1	<1	3	38
Chromium	56	58	15	8	84	40
Copper	66	69	39	20	56	192
Iron	25,600	29,800	26,100	30,600	16,700	23,900
Lead	14	11	14	13	8	13
Mercury	10.6	18.8	52.2	19.2	2.04	16.6
Magnesium	427	478	4,770	2,970	485	524
Manganese	96	116	195	168	78	30
Nickel	127	250	103	26	114	216
Selenium	<10	<10	<10	<10	10	20
Silver	2	2	<1	<1	<1	4
Thallium	<20	<20	40	40	<20	<20

TABLE B-3-2

Tailings Slurry Analyses After Hydrogen Peroxide Treatment
Units of (mg/L) Unless Noted

Parameter	Date Collected 02/28/91	10/18/90	05/05/90	10/12/89
Aluminum-T	520	0.2	500	810
Barium-T	1.7	<0.05	57	0.87
Boron-ICP-T	20	0.4	0.7	0.8
Cadmium-T	3.2	0.012	2.7	
Calcium-T	6,000	600	1,500	1,600
Chromium-T	3.4	0.009	2.6	6.7
Copper-T	24	20	18	72
Iron-T	3,900	0.38	2,300	2,600
Magnesium-T	640	9.0	230	360
Manganese-T	56	0.009	14	57
Nickel-T	15	1.0	3.7	7.3
Potassium-T	120	48	170	82
Silica-ICP-T	220	11	25	150
Silver-T	0.26	0.019	<0.1	0.010
Sodium-T	220	320	170	350
Zinc-T	61	0.31	9.5	110
Gold-T	0.048	0.045	0.20	0.006
Alkalinity, Total (as $CaCO_3$ to pH 4.5)	1,300	85	1,500	1,700
Carbonate (as CO_3)	550	24	73	150
Hardness (as $CaCO_3$)	18,000	1,500	4,700	5,500
Bicarbonate (as HCO_3)	<5	54	1,700	1,700
Hydroxide	390	<5	<5	<5
pH (pH units)	10.1	9.0	9.1	9.8
Specific Conductance (μmhos/cm)	9,800	4,600	2,900	1,900
Turbidity (NTU)	96,000	8.0	44,000	64,000
Arsenic-T	450	0.9	370	170

TABLE B-3-2 (CONTINUED)

Parameter	Date Collected 02/28/91	10/18/90	05/05/90	10/12/89
Mercury-T	1.9	0.016	0.20	1.6
Lead-T	2.4	<0.005	8.2	0.11
Selenium-T	0.80	0.53	0.064	2.4
Thallium-T	1.8	0.006	0.38	6.2
Ammonia (as N)	20	30	19	33
Nitrate (as N)	2.5	5.0	1.9	3.9
Orthophosphate (as P)	0.02	0.30	0.36	1.9
Settleable Solids (MLS/L/hr)	>40	<0.1	220	620
Total Dissolved Solids (at 180°C)	2,300	3,200	3,300	1,400
Total Suspended Solids (at 105°C)	150,000	14	180,000	440,000
Chloride	400	150	82	190
Cyanide, Free	29	17	<0.1	55
Cyanide, Total	29	35	19	160
Cyanide, Weak Acid Dissociable	27	36	17	140
Fluoride	1.9	3.6	1.2	3.2
Sulfate (as SO_4)	980	1,300	1,900	460

APPENDIX B-4

GEOCHEMICAL ARSENIC INFLOW ESTIMATE

ESTIMATION OF THE ARSENIC CONTENT SURROUNDING THE BETZE PIT AND THE IMPACT ON GROUNDWATER FLOWS

Introduction

The rock mass surrounding the Betze Pit will react, to some degree, with the groundwater flowing into the pit after dewatering ceases. The general rock mass contains arsenic in varying quantities. The arsenic concentrations are highest in the ore itself, but arsenic also occurs as a background concentration throughout the rock mass away from the ore body. This background content is approximately 300 mg/kg arsenic.

With the completion of mining, the majority of the arsenic associated with the ore will have been removed; nevertheless, due to the mining limits of the Betze Pit, a thin halo of low-grade mineralization will be left in the bottom of the pit. Contained in this halo will be elevated arsenic values of about 1,375 mg/kg arsenic. The volume of material containing the higher arsenic concentration can be compared to the surrounding rock mass to estimate the geochemical ratios, on an arsenic-weighted basis.

Total Rock Mass

The water quantity necessary to fill the post-mining Betze Pit has been previously estimated (Leggette, Brashears & Graham, 1990), and includes 196,000 acre-feet for filling the pit, and an additional 74,000 acre-feet of water that will be evaporated during pit filling (LBG, 1990, Table 9). The total quantity of water is 270,000 acre-feet of water, or 1.18 X 10^{10} cubic feet of water.

The rock mass containing this volume of water can be calculated using the specific yield of the water storage capacity. The specific yield for the majority of the rock mass surrounding the Betze Pit, low permeability Paleozoic rocks, granodiorite rocks, and Carlin Formation rocks, has a specific yield of 0.02 cubic feet of water per cubic foot of rock (LBG, 1990, Table 2). The rock mass volume containing 270,000 acre-feet of water is 58.81 X 10^{10} cubic feet.

Higher Arsenic Halo

The thin halo of low-grade mineralization contains an average of 1,375 mg/kg arsenic. The volume of the higher arsenic halo has been calculated based on cross-sections. Two representative cross-sections are attached.

The halo, including the Betze Pit, comprises an area approximately 6,500 feet by 3,000 feet by 1,500 foot depth. This volume contains 2.93 X 10^{10} cubic feet of material. Mining of the Betze Pit will remove approximately 0.85 X 10^{10} cubic feet of material below the water table. There will be approximately 2.08 X 10^{10} cubic feet of the higher arsenic material that will remain in the halo near the Betze Pit.

Volume Ratio

The volume of the total rock mass containing the 270,000 acre-feet of water necessary to fill the Betze Pit is 58.81 X 10^{10} cubic feet. The higher arsenic halo, contained in this total rock mass, is 2.08 X 10^{10} cubic feet.

The ratio of the higher arsenic halo to the total rock mass can be calculated.

$$\frac{2.08 \times 10^{10}\ ft^3}{58.81 \times 10^{10}\ ft^3} = 3.5\%$$

$$\frac{56.73 \times 10^{10}\ ft^3}{58.81 \times 10^{10}\ ft^3} = 96.5\%$$

Geochemical Ratios

The percent rock mass was then weighted, based on arsenic concentrations, to calculate a geochemical weighting ratio.

(0.035 X 1,375 mg/kg As) + (0.965 X 300 mg/kg As) =

48.1 + 289.5 = 337.6

The geochemical ratios, on an arsenic-weighted basis, are as follows:

$$\frac{48.1}{337.6} = 14.3\%$$

$$\frac{289.5}{337.6} = 85.7\%$$

The wells were placed into the 14.3 percent group or the 85.7 percent group based on well location and well depth. All shallow groundwater observation ports (GWOPs) were excluded from either group, as was any well with less than three data points.

The average arsenic values for each well was then calculated. These values were then averaged arithmetically to obtain an arsenic concentration for each group.

Wells in the 85.7% Group	Wells in the 14.3% Group
AA Well	BW-1
BW-3	BW-2
BW-4	P-181
BW-5	PPW-2
BW-6	PPW-3R
BW-7	PPW-4
WW-1	PPW-6
Bazza Well	PPW-8
	PPW-9
	PPW-10
	PPW-12
	PPW-13
	PUPW-2

Arsenic Weighted Concentration

The arsenic concentration for each group was then multiplied by the geochemical ratio to obtain an average Betze Pit inflow arsenic concentration. The arsenic calculation value was 0.069 mg/l, as shown in the following table.

Concentrations of Other Parameters

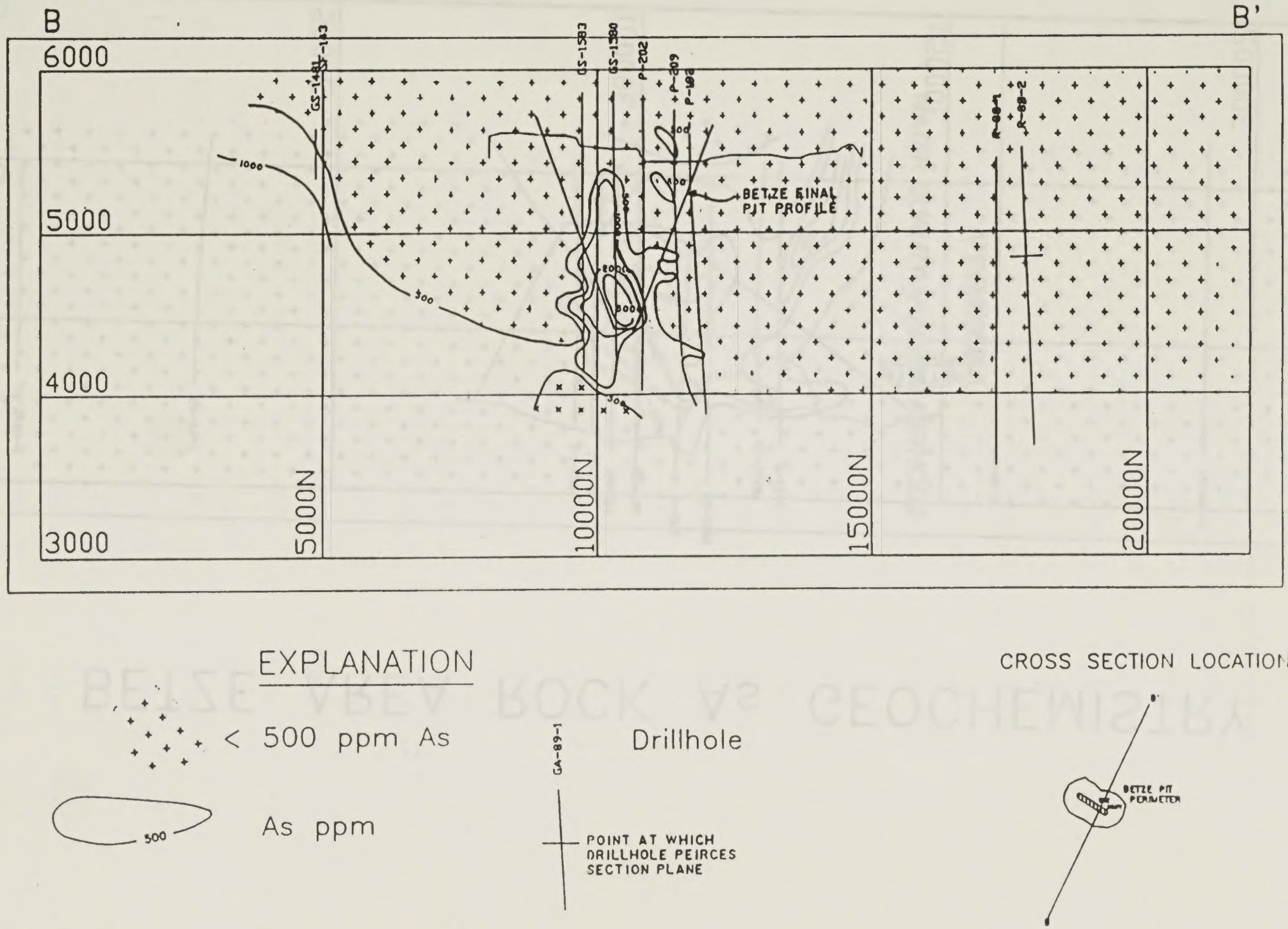
Based on the geochemical ratio, the average Betze Pit inflow concentrations of the other parameters were calculated. The geochemical ratio inflow concentrations are shown in the following table.

TABLE B-4-1

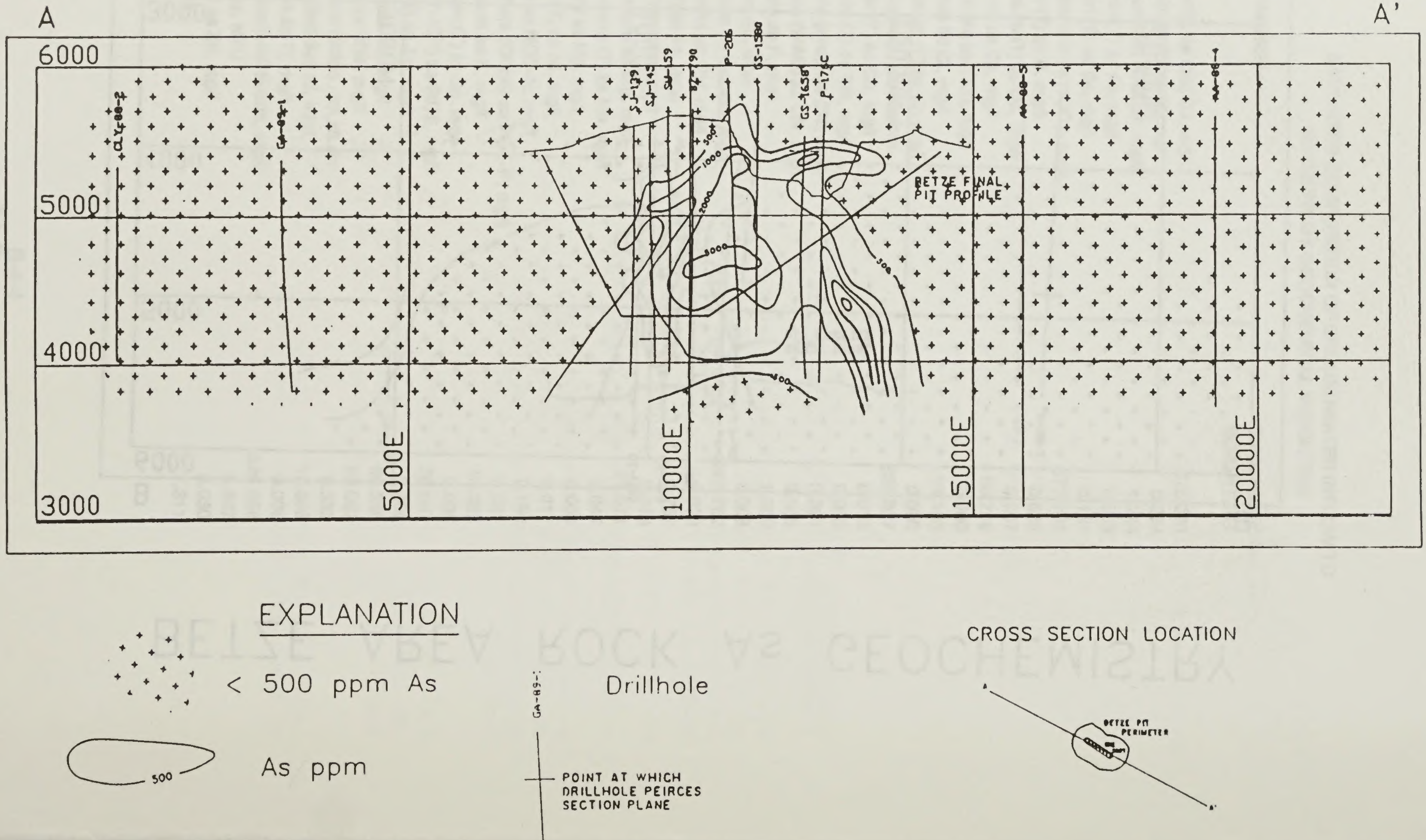
ESTIMATED COMPOSITION OF GROUNDWATER INFLOW TO BETZE PIT BY GEOCHEMICAL WEIGHTING

PARAMETER	GEOCHEMICAL WEIGHTING
Alkalinity as CaCO3, mg/l	375.381
Aluminum (T) as Al, mg/l	0.224
Ammonia as NH3-N, mg/l	1.244
Arsenic (T) as As, mg/l	0.069
Barium (T) as Ba, mg/l	0.131
Bicarbonate as HCO3, mg/l	577.795
Boron (T) as B, mg/l	0.685
Cadmium (T) as Cd, mg/l	0.007
Calcium as Ca, mg/l	80.716
Carbonate as CO3, mg/l	0.000
Chloride as Cl, mg/l	16.190
Chromium (T) as Cr, mg/l	0.006
Conductivity, uhmos/cm	829.937
Copper (T) as Cu, mg/l	0.012
Cyanide (T) as CN, mg/l	0.005
Cyanide (Free) as CN, mg/l	0.091
Cyanide (WAD) as CN, mg/l	0.005
Fluoride as F, mg/l	1.200
Gold as Au, mg/l	0.008
Hardness as CaCO3, mg/l	275.782
Hydroxide as OH, mg/l	0.000
Iron (T) as Fe, mg/l	0.792
Lead (T) as Pb, mg/l	0.013
Magnesium as Mg, mg/l	21.674
Manganese (T) as Mn, mg/l	0.045
Mercury as Hg, mg/l	0.000
Nickel (T) as Ni, mg/l	0.011
Nitrate as NO3-N, mg/l	0.191
Phosphate (Ortho) as PO4-P, mg/l	0.061
Potassium as K, mg/l	18.033
Selenium (T) as Se, mg/l	0.005
Silica (T-ICP) as SiO2, mg/l	20.067
Silver (T) as Ag, mg/l	0.006
Sodium as Na, mg/l	66.335
Sulfate as SO4, mg/l	69.067
Settleable Solids , mLs/L/hr	6.332
Suspended Solids, mg/l	12.859
Thallium as Tl, mg/l	0.006
Total Dissolved Solids, mg/l	526.658
Turbidity, NTU	5.867
Zinc (T) as Zn, mg/l	0.030
pH Units	7.311

BETZE AREA ROCK As GEOCHEMISTRY



BETZE AREA ROCK As GEOCHEMISTRY



APPENDIX B-5

WATER QUALITY ANALYSIS METHODS

BETZE AREA ROCK As GEOCHEMISTRY

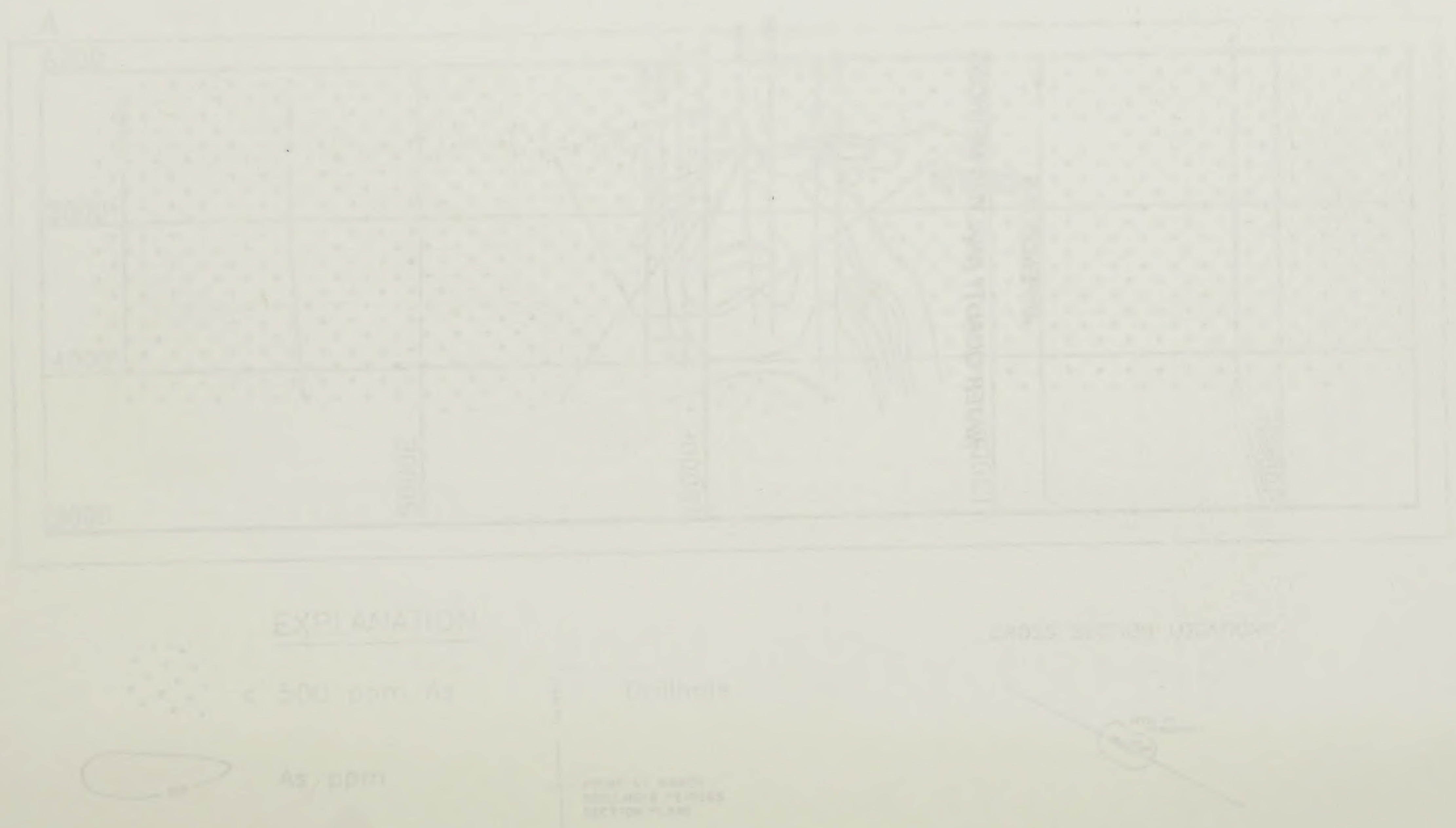


TABLE B-5-1

Water Quality Analysis Methods[1]

Parameter	Chemtech	Acculabs
Alkalinity as CaCO3, mg/l	310.1	310.1
Aluminum (T) as Al, mg/l	202.1	200.7
Ammonia as NH3-N, mg/l	350.3	350.3
Arsenic (T) as As, mg/l	206.2	206.2
Barium (T) as Ba, mg/l	208.1	200.7
Bicarbonate as HCO3, mg/l	310.1	310.1
Boron (T) as B, mg/l	212.3	200.7
Cadmium (T) as Cd, mg/l	213.2	200.7
Calcium as Ca, mg/l	215.1	200.7
Carbonate as CO3, mg/l	310.1	310.1
Chloride as Cl, mg/l	325.1	325.1
Chromium (Hex) as Cr, mg/l	218.4	218.4
Chromium (T) as Cr, mg/l	218.1	200.7
Conductivity, uhmos/cm	120.1	120.1
Copper (T) as Cu, mg/l	220.1	200.7
Cyanide (T) as CN, mg/l	335.2	335.2
Cyanide (Free) as CN, mg/l	335.1	IC[2]
Cyanide (WAD) as CN, mg/l	335.2	335.2
Fluoride as F, mg/l	340.1	340.2
Gold as Au, mg/l	231.1	200.7
Hardness as CaCO3, mg/l	CALC[3]	CALC[3]
Hardness (Non-Carb) as CaCO3, mg/l	CALC[3]	CALC[3]
Hardness (T) as CaCO3, mg/l	CALC[3]	CALC[3]
Iron (D) as Fe, mg/l	236.1	200.7
Iron (T) as Fe, mg/l	236.1	200.7
Lead (T) as Pb, mg/l	239.2	239.2
Magnesium as Mg, mg/l	242.1	200.7
Manganese (T) as Mn, mg/l	243.1	200.7
Mercury as Hg, mg/l	245.1	245.1

TABLE B-5-1 (CONTINUED)

Parameter	Chemtech	Acculabs
Nickel (T) as Ni, mg/l	249.1	200.7
Nitrate as NO3-N, mg/l	353.2	353.2
Nitrite as NO2-N, mg/l	354.1	354.1
Phosphate (Ortho) as PO4-P, mg/l	365.2	365.3
Potassium as K, mg/l	258.1	200.7
Selenium (T) as Se, mg/l	270.2	270.2
Silver (T) as Ag, mg/l	272.1	200.7
Sodium as Na, mg/l	273.1	200.7
Sulfate as SO4, mg/l	375.4	375.4
Settleable Solids , mLs/L/hr	160.5	160.5
Suspended Solids, mg/l	160.2	160.2
Thallium as Tl, mg/l	279.1	200.7
Total Dissolved Solids, mg/l	160.1	160.1
Turbidity, NTU	180.1	180.1
Zinc (T) as Zn, mg/l	289.1	200.7
pH Units	150.1	150.1
Cations, meq/l	CALC[3]	CALC[3]
Anions, meq/l	CALC[3]	CALC[3]

[1]Reference: EPA 1979. Methods for Chemical Analysis of Water and Wastes. U.S. EPA Doc. No. 600/4/79-020 (for all analyses except 200.7).

EPA 1989. U.S. EPA Contract Laboratory Program. State of Work for Inorganic Analysis. EPA Doc. No. ILM010 (for method 200.7 only).

[2]IC: Analysis by ion chromatography.

[3]CALC: These parameters determined by calculations from appropriate results (e.g., hardness is calculated based mainly upon results of calcium and magnesium and somewhat less on other hardness producing cations).

APPENDIX B-6

GEOCHEMICAL CONDITIONS ASSOCIATED WITH STRATIFICATION SCENARIOS

Geochemical Conditions Associated with Stratification Scenarios

It is possible that the Betze Pit water body may become stratified at some point in the future. However, even in a stratified water body, the upper layer of the water body would turn over, thereby maintaining oxic conditions as described in the EIS.

During the period of time that the water body is filling, four different conditions may exist:

1) complete mixing during the first few decades of filling when the volume of inflow is large relative to the total volume of the water body;

2) annual (monomictic) or semi-annual (dimictic) turnover of the water body as the inflow decreases and the water body volume increases;

3) intermittent stratification where turnover or mixing occurs infrequently and the lower layer (hypolimnion) of the water body cycles between oxic and anoxic conditions; and

4) permanent stratification (meromictic) as the water body surface approaches the pre-mining groundwater elevations and the hypolimnion remains anoxic.

The condition of the water body could affect the pit water quality. A continuously overturning water body or overturning with a frequency of greater than once every 3 years (see Appendix B-2, Oxygen Depletion Modeling of Betze Pit) will result in a situation equivalent to that discussed in the Water Resources Technical Report (ENSR and Drever 1991). A permanently stratified water body will most likely have an epilimnion with concentrations of arsenic and other metals similar to that of a completely mixed water body and a hypolimnion with lower concentrations of arsenic and other metals due to the formation of insoluble sulfides.

For the situation where mixing occurs infrequently and the hypolimnion varies between anoxic and oxic conditions, it is difficult to predict what the metals concentrations might be during (and shortly after) the transition period. However, it is likely that such events will be infrequent and relatively short in duration and, therefore, any short-term increase in metals concentrations should not have any major adverse ecological effects. Additionally, the question of redox disequilibrium has no major significance in the determination of metals concentrations in the water body.

The implications of different turnover regimes on concentrations of arsenic and other metals can be evaluated in terms of three scenarios.

1) The water body turns over with sufficient frequency that the hypolimnion remains oxic at all times. This is the expected situation for the first several decades following the cessation of mining and was the assumption in preparing the Water Resources Technical Report. In this situation, the arsenic concentration in the water body would be similar to the concentration in the inflowing groundwater, corrected for the effects of evaporation. Some arsenic removal by biological uptake would probably occur (Crecelius 1975; Seyler and Martin 1989; Andreae and Froelich 1984; Anderson and Bruland 1991), which would cause lower concentrations in solution in the photic zone. Alteration of wall rock could occur at all depths in the water body. Wall rock alteration would not have a major effect on arsenic concentrations because: a) the water would not be acidic; b) wall rock alteration would release a large excess of iron over arsenic, so the arsenic would tend to be adsorbed and not remain in solution; and c) wall rock alteration would be confined to a thin layer in direct contact with the water because of limited oxygen transport in permanently saturated rock.

2) The water body stratifies intermittently, and an anoxic hypolimnion develops during stratification. This situation might occur as a transient condition between the annual overturn early in the life of the water body and permanent stratification at later times (please refer to Appendix B-2 of the Final EIS for a discussion of the length of time required to develop anoxic conditions in the hypolimnion). This is the most difficult scenario to model geochemically because of the possibility of redox disequilibrium and the sensitivity of the result to assumptions regarding the behavior of suspended and sedimented particles.

   A literature search identified three water bodies for which arsenic geochemical reactions have been investigated. Although these water bodies are dissimilar from conditions in the Betze Pit water body, the results of these studies are described below.

   a. Davis Creek Reservoir, a seasonally anoxic reservoir in California (Anderson and Bruland 1991). Arsenic is slightly depleted in the photic zone relative to the deeper water, presumably from biological uptake. When anoxia occurs in the deep water, the speciation changes from As(V) to As(III), but the total arsenic concentration is essentially unchanged.

b. Lake Ohakuri, a seasonally stratified reservoir in New Zealand that receives a high input of arsenic from a geothermal power plant (Aggett and O'Brien 1985). Concentrations of arsenic in the epilimnion were constant (at about 0.04 mg/L) over the period of measurement, but concentrations of dissolved iron and arsenic in the hypolimnion increased dramatically during the period of anoxia. The mechanism was dissolution of iron oxyhydroxides with adsorbed arsenic at the top of the sediments. Sulfate reduction took place only for short periods and only in the deepest part of the reservoir.

c. Lake Pavin, a small, well-stratified crater lake (90 m deep, 0.44 km^2 area) in central France (Seyler and Martin 1989). The deeper part of this lake (> 60 m) is permanently stratified; a seasonal thermocline develops at 30 m, but the interval between 30 and 60 m remains oxic. Arsenic levels in the upper 40 m of the lake are roughly constant at about 75 percent of the inflow value, the decrease probably representing biological uptake. From 40 to 60 m arsenic concentrations decrease to about 45 percent of the input value, then at the redoxcline arsenic concentrations increase by a factor of 30 while iron concentrations increase by a factor of several thousand and manganese by a factor of several hundred. Below the redoxcline, arsenic concentrations decrease towards the lake bottom. The concentration distributions in the region of the redoxcline is explained by a cycle of upward diffusion of arsenic(III), iron(II) and Mn(II); oxidation to As(V), iron(III) and Mn(IV); precipitation of MnO^2 and an iron oxyhydroxide which adsorbs As(V); and settling of the solid particles into the reduced zone, where they dissolve and start the cycle over again. A similar cycle is observed in anoxic marine waters (Peterson and Carpenter 1983; Andreae and Froelich 1984). The decrease in arsenic concentration toward the lake bottom is interpreted as removal of arsenic by formation of a sulfide in the sediments.

Thus, intermittent stratification may or may not result in elevated concentrations of arsenic in the hypolimnion. However, it appears that elevated concentrations of arsenic are accompanied by elevated concentrations of iron (both derive from dissolution of iron oxyhydroxide), so that if the water body turns over and the deep water becomes oxygenated, ferric oxyhydroxide will precipitate rapidly and scavenge the dissolved arsenic. A literature search did not reveal any instance where the existence of an anoxic hypolimnion resulted in elevated concentrations of arsenic in the photic zone. Intermittent stratification is expected to occur for only brief periods of time.

3) The water body stratifies permanently with an anoxic hypolimnion. Chemical equilibrium calculations (WATEQ4F, Plummer et al. 1976) predict that arsenic may precipitate out as a sulfide (As_2S_3) resulting in lower concentrations in solution. There is some question as to whether As_2S_3 would form above pH 5.5 (Spycher and Reed 1989), however a similar phase has been documented in Mono Lake at pH 9.8 (Maest et al. 1987), and arsenic removal seems to be almost universally associated with sulfate reduction in the interstitial water of lacustrine sediments (Aggett and O'Brien 1985; Moore et al. 1988; Seyler and Martin 1989; Belzile and Tessier 1990). Sulfide formation does not necessarily result in low concentrations of arsenic in solution immediately below the redoxcline because of the rapid recycling of iron oxyhydroxides at the redoxcline, as discussed above.

   Two other aspects of a permanently stratified water body should be mentioned: a) wall rocks below the redoxcline would not oxidize, so interaction with the wall rock would not generate acid and the release of arsenic, and b) the water below the redoxcline would be isolated from the surface environment by the overlying oxic water.

Estimates of pit water quality under anoxic conditions are presented in Table B-6-1. The purpose of these calculations was to test the effect of anoxic conditions on the solubilities of trace elements, particularly arsenic. No attempt was made to adjust the concentrations of the major elements to maintain exact equilibrium with calcite or gypsum; minor adjustments were made to approximate the likely effect of reducing conditions. The behavior of the trace elements is highly insensitive to changes in major element chemistry. Note that these calculations apply to the hypolimnion only, and not to the surface waters of a stratified water body. The surface waters (epilimnion) of a stratified water body would remain oxic.

The following assumptions were made:

- Chemical equilibrium was established. Speciation and saturation were calculated with the aid of the computer code WATEQ4F. A temperature of 15°C was assumed.

TABLE B-6-1

(Revised)

Predicted Pit Water Composition
Under Anoxic Conditions
(mg/l)

	Inflow Weighting		Geochemical Weighting	
Parameter	Year 2100	Steady State	Year 2100	Steady State
Alkalinity (as Ca CO_3)	267	430	245	313
Aluminum (Al)	0.05	0.05	0.05	0.05
Arsenic (As)	<0.01	<0.01	<0.01	0.01
Boron (B)	1.04	1.69	0.95	1.54
Cadmium (Cd)	<0.01	<0.01	<0.01	<0.01
Calcium (Ca)	6.81	2.95	8.5	5.30
Chloride (Cl)	23.3	37.7	22.5	36.4
Copper (Cu)	<0.01	<0.01	<0.01	<0.01
Cyanide (CN)	0.01	0.01	0.01	0.01
Fluoride (F)	1.77	2.86	1.67	2.70
Iron (Fe) (T)	<0.01	<0.01	<0.01	<0.01
Lead (Pb)	<0.01	<0.01	<0.01	<0.01
Magnesium (Mg)	31.0	50.0	30.2	48.8
Manganese (Mn)	0.06	0.09	0.06	0.10
Nickel (Ni)	<0.01	<0.01	<0.01	<0.01
Nitrate (NO_3)	<0.01	<0.01	<0.01	<0.01
Phosphate (PO_4)	0.04	0.07	0.09	0.14
Potassium (K)	27.3	44.1	25.1	40.6
Silica ($SiSO_2$)	24.9	40.3	27.9	45.2
Sodium (Na)	99.0	160.1	92.3	149.3
Sulfate (SO_4)	82.7	139.9	86.1	145.4
Zinc (Zn)	<0.01	<0.01	0.04	0.07
Total Dissolved Solids (TDS)	458	732	442	663
pH	7.92	8.10	7.85	7.95

- Eh was varied over the range -0.10 to -0.40 volts.
- Total dissolved sulfide concentration was varied over the range 0.1 to 10 mg/l.
- Compared to the corresponding oxic case, sulfate was decreased by 10 mg/l and alkalinity increased by 10.7 mg/l to reflect some sulfate reduction. The pH was decreased by 0.5 units to reflect carbon dioxide from decay of organic matter.

With these assumptions, the solubilities of As, Cd, Cu, Fe, Ni, Pb, and Zn are all below 0.01 mg/l over the entire Eh and sulfide concentration range examined. The solubilities are limited by highly insoluble sulfides.

The question of redox disequilibrium is complex. Redox equilibrium among arsenic species, iron species, and dissolved oxygen adequately describes the system for the purpose of assessing potential environmental problems. Significant real or apparent redox disequilibrium tends to be associated with:

1) Elements for which redox transformations are exclusively (or almost exclusively) biologically mediated, for example nitrogen, carbon, and sulfur.

2) Dynamic systems where change is rapid and where the energy flux is large.

3) The presence of one member of a redox pair at a very low concentration (say 10^{-6}m) where equilibrium calculations indicate the concentration should be much lower (i.e., 10^{-12}m). This situation would indicate an apparent disequilibrium of six orders of magnitude, but it is extremely sensitive to analytical and sampling artifacts. It is not relevant for the Betze Pit because of the interest in the dominant form of each element.

Regarding the specific question of disequilibrium among arsenic species, there have been several studies of the kinetics of interconversion of As(III) and As(V) in natural waters. Peterson and Carpenter (1983) measured the rate of interconversion between the species in sea water, and obtained reaction times on the order of days, more rapid in the presence of suspended sediment. Oscarson et al. (1980) likewise showed that oxidation of As(III) was rapid (within 48 hours) in the presence of sediments. There have been many studies (e.g., Peterson and Carpenter 1983; Andreae and Froelich 1984; Aggett and O'Brien 1985; Maest et al. 1987; Seyler and Martin 1989; Anderson and Bruland 1991) that showed an abrupt transition from dominantly As(V) above the redoxcline to dominantly As(III) below the redoxcline, indicating that the reaction is relatively rapid and consistent with equilibrium predictions. Disequilibrium is most commonly exhibited as the presence of a minor species in greater than expected concentrations. Thus, in oxic waters the ratio of As(V) to As(III) is often on the order of 10 to 20 rather than the 10^{10} or so predicted from thermodynamic calculations (references cited above). The reverse situation is also common in the anoxic zone. The effect of this type of disequilibrium on water quality in the Betze pit is marginal. The redox state of the bulk of the dissolved arsenic is in accord with thermodynamic predictions, and the exact concentrations of minor species are generally unimportant.

A second situation where disequilibrium involving arsenic appears common relates to the precipitation of solid sulfides. As discussed above, arsenic may be removed from solution as a sulfide, particularly in the pore-waters of sediments. Although none of the studies cited above addresses the kinetics of sulfide precipitation explicitly, the presence of measurable dissolved arsenic concentrations in sulfide-containing waters almost certainly indicates disequilibrium. This type of disequilibrium would affect only the calculation of the arsenic concentration in the hypolimnion of a permanently stratified water body. Arsenic concentrations should be low even if the system is quite far from equilibrium.

APPENDIX B-7

GROUNDWATER QUALITY DATA

BARRICK GOLDSTRIKE MINES
WATER QUALITY DATABASE
(All data are total values)

WELL NUMBER	SAMPLE DATE	TEMP. (C)	Al (mg/L)	Ba (mg/L)	B (mg/L)	Cd (mg/L)	Ca (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Mg (mg/L)	Mn (mg/L)	Ni (mg/L)	K (mg/L)	Si (mg/L)	Ag (mg/L)	Na (mg/L)
AA WELL	06/15/87	NA	0.100	0.110	0.160	0.010	13.1	0.010	0.010	3.120	9.0	0.098	0.010	7.0	37.0	0.010	22.8
	06/30/87	NA	0.100	0.090	0.160	0.010	34.2	0.010	0.045	0.740	16.8	0.053	0.010	6.0	48.5	0.010	25.2
	08/06/87	18.900	0.100	0.045	0.130	0.010	10.3	0.010	0.020	0.330	15.6	0.042	0.010	4.0	46.3	0.010	25.0
	01/28/88	NA	0.100	0.010	0.075	0.010	7.5	0.010	0.010	0.105	14.2	0.120	0.010	6.3	48.1	0.010	25.4
	05/23/88		0.100	0.055	0.130	0.010	15.4	0.010	0.010	0.135	16.0	0.010	0.010	6.2	53.0	0.010	27.6
	05/15/88		0.100	0.010	0.090	0.010	33.9	0.010	0.053	1.140	18.2	0.023	0.025	4.8	51.5	0.010	26.8
	11/21/88			0.110	0.500		61.0	0.005	0.016	1.500	21.0	0.120	0.010	15.0	17.0	0.005	62.0
	01/12/89		0.100	0.050	0.100		34.0	0.005	0.012	0.390	14.0	0.025	0.010	5.7	49.0	0.005	28.0
	04/26/89		0.100	0.002	0.100		34.0	0.005	0.005	0.280	13.0	0.046	0.010	5.4	24.0	0.005	26.0
	07/14/89		0.100	0.050	0.100		34.0	0.005	0.005	0.040	14.0	0.040	0.010	5.8	23.0	0.005	27.0
	11/09/89	18.000	0.100	0.050	0.100		36.0	0.005	0.005	0.180	24.0	0.038	0.010	5.1	24.0	0.005	24.0
	01/25/90	18.000	0.100	0.050	0.100	0.005	34.0	0.005	0.005	0.680	14.0	0.054	0.010	5.3	27.0	0.005	27.0
	06/13/90		0.100	0.050	0.100	0.005	35.0	0.005	0.007	0.100	14.0	0.044	0.010	6.0	5.3	0.005	30.0
	08/01/90	23.000	0.100	0.050	0.100	0.005	35.0	0.005	0.005	0.140	14.0	0.036	0.010	5.8	25.0	0.005	29.0
	10/03/90	17.500	0.100	0.050	0.100	0.005	33.0	0.005	0.005	0.160	14.0	0.048	0.010	5.4	22.0	0.010	25.0
	01/03/91	17.000	0.100	0.050	0.100	0.005	39.0	0.005	0.005	0.120	15.0	0.045	0.010	6.9	23.0	0.005	27.0
			0.100	0.052	0.134	0.008	30.588	0.007	0.014	0.573	15.425	0.053	0.011	6.294	32.731	0.007	28.613
BW-3	03/26/90	49.000	0.100	0.150	0.800	0.050	92.0	0.005	0.005	1.200	22.0	0.084	0.010	22.0	17.0	0.005	74.0
	05/08/90	48.000	0.100	0.140	0.800	0.005	92.0	0.005	0.005	1.200	21.0	0.086	0.010	22.0	17.0	0.005	80.0
	06/14/90	48.000	0.100	0.180	0.800	0.005	88.0	0.005	0.005	0.800	22.0	0.062	0.010	19.0	16.0	0.005	78.0
	07/19/90	47.000	0.100	0.130	0.800	0.005	88.0	0.005	0.009	0.760	22.0	0.068	0.010	25.0	16.0	0.005	83.0
	08/17/90	48.000	0.100	0.130	0.800	0.005	93.0	0.005	0.007	0.850	24.0	0.066	0.020	23.0	15.0	0.005	73.0
	09/20/90	46.000	0.100	0.140	0.800	0.005	93.0	0.005	0.005	0.430	23.0	0.066	0.010	21.0	16.0	0.005	67.0
	10/04/90	46.000	0.100	0.140	0.700	0.005	80.0	0.005	0.005	0.410	20.0	0.056	0.010	21.0	14.0	0.005	70.0
	11/29/90	47.000	0.100	0.160	0.800	0.005	90.0	0.005	0.006	0.360	22.0	0.057	0.010	22.0	16.0	0.005	76.0
	12/20/90	45.000	0.100	0.120	0.700	0.005	85.0	0.005	0.005	0.250	22.0	0.051	0.010	21.0	16.0	0.005	75.0
	02/21/91	45.000	0.100	0.140	0.800	0.005	92.0	0.005	0.005	0.240	21.0	0.047	0.010	20.0	17.0	0.005	76.0
			0.100	0.130	0.709	0.009	81.182	0.005	0.005	0.591	19.909	0.058	0.010	19.636	14.545	0.005	68.364
BW-4	08/17/90	53.000	0.100	0.140	0.800	0.005	97.0	0.005	0.005	0.840	24.0	0.030	0.010	23.0	20.0	0.005	73.0
	11/29/90	47.500	0.100	0.170	0.800	0.005	89.0	0.005	0.005	0.730	21.0	0.026	0.010	21.0	18.0	0.005	72.0
	01/17/91	50.000	0.100	0.150	0.900	0.005	90.0	0.005	0.005	0.450	22.0	0.021	0.010	21.0	19.0	0.005	74.0
			0.100	0.153	0.833	0.005	92.000	0.005	0.005	0.673	22.333	0.026	0.010	21.667	19.000	0.005	73.000

BARRICK GOLDSTRIKE MINES
WATER QUALITY DATABASE
(All data are total values)

WELL NUMBER	SAMPLE DATE	Zn (mg/L)	Au (mg/L)	ALKALINITY as $CaCO_3$	CO_3 (mg/L)	HARDNESS as $CaCO_3$	HCO_3 (mg/L)	OH (mg/L)	pH (s.u.)	E.C. (umhos)	TURBIDITY (mg/L)	As (mg/L)	Hg (mg/L)	Pb (mg/L)	Se (mg/L)	Tl (mg/L)	NH_4 as N (mg/L)
AA WELL	06/15/87	0.053	0.010	129.000	0.000	190.0	157.000	0.000	7.26	414.000	8.2	0.013	0.002	0.020	0.002	0.010	0.10
	06/30/87	0.050	0.010	138.000	0.000	160.0	169.000	0.000	7.77	424.000	4.1	0.010	0.000	0.010	0.002	0.010	0.11
	08/06/87	0.160	0.010	127.000	0.000	150.0	155.000	0.000	7.21	403.000	2.2	0.010	0.000	0.033	0.002	0.010	0.10
	01/28/88	0.260	0.010	129.000	0.000	166.0	158.000	0.000	7.39	392.000	0.4	0.053	0.000	0.010	0.002	0.010	2.80
	05/23/88	0.120	0.010	138.000	0.000	105.0	168.000	0.000	7.61	380.000	0.6	0.040	0.000	0.010	0.002	0.010	0.12
	05/15/88	0.028	0.010	135.000	0.000	160.0	164.000	0.000	7.60	406.000	4.7	0.060	0.000	0.010	0.002	0.010	0.10
	11/21/88	0.040	0.009	340.000	0.000	260.0	410.000	0.000	7.80		5.0	0.300	0.000	0.005	0.005	0.005	0.20
	01/12/89	0.032	0.005	130.000	0.000	140.0	160.000	0.000	7.60	450.000	15.0	0.097	0.000	0.005	0.005	0.005	0.20
	04/26/89	0.060	0.005	130.000	0.000	150.0	160.000	0.000	7.20	400.000	0.8	0.097	0.000	0.005	0.005	0.005	0.20
	07/14/89	0.050	0.005	120.000	0.000	150.0	150.000	0.000	7.20	400.000	1.5	0.088	0.000	0.005	0.005	0.005	0.20
	11/09/89	0.037	0.005	130.000	0.000	190.0	160.000	0.000	7.40	450.000	0.9	0.110	0.000	0.005	0.005	0.005	0.20
	01/25/90	0.036	0.005	120.000	0.000	140.0	150.000	0.000	7.60	430.000	3.1	0.120	0.000	0.680	0.005	0.005	0.20
	06/13/90	0.053	0.005	130.000	0.000	140.0	150.000	0.000	7.30	450.000	0.6	0.084	0.000	0.005	0.005	0.005	0.20
	08/01/90	0.044	0.005	140.000	0.000	140.0	170.000	0.000	7.60	430.000	0.4	0.090	0.000	0.005	0.005	0.005	0.20
	10/03/90	0.072	0.005	130.000	0.000	140.0	160.000	0.000	7.70	420.000	1.2	0.097	0.000	0.005	0.005	0.005	0.20
	01/03/91	0.048	0.005	130.000	0.000	140.0	160.000	0.000	7.50	420.000	1.2	0.090	0.000	0.005	0.005	0.020	0.20
		0.071	0.007	143.500	0.000	157.563	175.063	0.000	7.484	391.813	3.117	0.085	0.000	0.051	0.004	0.008	0.333
BW-3	03/26/90	0.005	0.005	410.000	0.000	320.0	490.000	0.000	7.50	900.000	22.0	0.074	0.000	0.005	0.005	0.005	1.50
	05/08/90	0.005	0.005	400.000	0.000	320.0	490.000	0.000	7.50	900.000	10.0	0.043	0.000	0.005	0.005	0.005	2.20
	06/14/90	0.007	0.005	400.000	0.000	310.0	490.000	0.000	7.20	1100.000	7.1	0.028	0.000	0.005	0.005	0.005	1.50
	07/19/90	0.005	0.005	430.000	0.000	310.0	520.000	0.000	7.30	640.000	8.4	0.024	0.000	0.005	0.005	0.005	1.90
	08/17/90	0.010	0.005	480.000	0.000	330.0	580.000	0.000	7.50	690.000	5.0	0.026	0.000	0.005	0.005	0.005	1.50
	09/20/90	0.005	0.007	440.000	0.000	330.0	530.000	0.000	7.40	810.000	3.7	0.024	0.000	0.005	0.005	0.005	1.30
	10/04/90	0.028	0.005	430.000	0.000	280.0	520.000	0.000	7.10	970.000	3.6	0.020	0.000	0.005	0.005	0.005	1.60
	11/29/90	0.005	0.005	430.000	0.000		520.000	0.000	7.20	920.000	5.1	0.026	0.000	0.005	0.005	0.005	1.30
	12/20/90	0.010	0.005	330.000	0.000	300.0	400.000	0.000	7.80	850.000	2.4	0.020	0.000	0.005	0.005	0.005	1.20
	02/21/91	0.005	0.005	380.000	0.000	320.0	460.000	0.000	7.70	770.000	1.0	0.021	0.000	0.005	0.005	0.005	1.90
		0.008	0.005	375.455	0.000	256.364	454.545	0.000	6.745	777.273	6.209	0.028	0.000	0.005	0.005	0.005	1.445
BW-4	08/17/90	0.032	0.005	490.000	0.000	340.0	590.000	0.000	7.40	710.000	10.0	0.250	0.000	0.005	0.005	0.005	1.40
	11/29/90	0.005	0.005	420.000	0.000	310.0	510.000	0.000	7.00	940.000	8.9	0.150	0.000	0.005	0.005	0.005	1.40
	01/17/91	0.007	0.005	440.000	0.000	320.0	530.000	0.000	7.20	990.000	6.7	0.140	0.000	0.005	0.005	0.005	1.90
		0.015	0.005	450.000	0.000	323.333	543.333	0.000	7.200	880.000	8.533	0.180	0.000	0.005	0.005	0.005	1.567

BARRICK GOLDSTRIKE MINES
WATER QUALITY DATABASE
(All data are total values)

WELL NUMBER	SAMPLE DATE	NO3+NO2 (mg/L)	PO4 as P (mg/L)	SETTLEABLE SOLIDS	TDS (mg/L)	TSS (mg/L)	Cl (mg/L)	FREE CN (mg/L)	TOTAL CN (mg/L)	WAD CN (mg/L)	F (mg/L)	SO4 (mg/L)
AA WELL	06/15/87	0.100	0.360		320.000	32.0	17.5	0.002	0.002		0.360	78.2
	06/30/87	0.723	0.280		320.000	16.0	20.1	0.002	0.002		0.450	45.0
	08/06/87	0.285	0.111		325.000	3.0	25.2	0.002	0.002		0.436	6.8
	01/28/88	0.304	0.085		283.000	1.2	20.1	0.002	0.002		0.460	56.7
	05/23/88	1.273	0.100		228.000	1.0	20.0	0.002	0.002		0.100	21.1
	05/15/88		0.685		240.000	2.6	14.8	0.002	0.002		0.460	50.9
	11/21/88	0.280	0.130	0.100	460.000	26.0	15.0	0.100	0.005	0.005		1.1
	01/12/89	0.800	0.040	0.200	240.000	24.0	17.0	0.100	0.005	0.005	0.500	58.0
	04/26/89	0.420	0.060	0.100	280.000	5.0	17.0	0.100	0.005	0.005	0.500	65.0
	07/14/89	0.390	0.040	0.100	280.000	5.0	18.0	0.100	0.005	0.005	0.500	56.0
	11/09/89	0.460	0.500	0.100	270.000	5.0	18.0	0.100	0.005	0.005	0.500	63.0
	01/25/90	0.410	0.120	0.100	280.000	14.0	17.0	0.100	0.005	0.005	0.500	60.0
	06/13/90	0.390	0.060	0.100	290.000	5.0	18.0	0.100	0.005	0.005	0.500	51.0
	08/01/90	0.390	0.020	0.100	300.000	5.0	18.0	0.100	0.005	0.005	0.500	44.0
	10/03/90	0.360	0.080	0.100	260.000	9.0	18.0	0.100	0.005	0.005	0.500	40.0
	01/03/91	0.370	0.060	0.100	260.000	5.0	18.0	0.100	0.005	0.005	0.500	69.0
		0.464	0.171	0.110	289.750	9.925	18.231	0.063	0.004	0.005	0.451	47.863
BW-3	03/26/90	0.050	0.230	560.000	560.000	56.0	16.0	0.100	0.005	0.005	1.500	80.0
	05/08/90	0.050	0.030	0.100	580.000	5.0	18.0	0.100	0.005	0.005	1.400	83.0
	06/14/90	0.050	0.020	0.100	600.000	5.0	14.0	0.100	0.005	0.005	1.400	74.0
	07/19/90	0.050	0.020	0.100	600.000	5.0	16.0	0.100	0.005	0.005	0.700	66.0
	08/17/90	0.050	0.020	0.100	590.000	8.0	14.0	0.100	0.005	0.005	1.400	71.0
	09/20/90	0.050	0.020	0.100	580.000	5.0	14.0	0.100	0.005	0.005	1.500	63.0
	10/04/90	0.050	0.020	0.100	570.000	5.0	15.0	0.100	0.005	0.005	1.800	56.0
	11/29/90	0.050	0.020	0.100	560.000	5.0	14.0	0.100	0.005	0.005	1.400	59.0
	12/20/90	0.050	0.020	2.900	460.000	70.0	14.0	0.100	0.005	0.005	1.200	79.0
	02/21/91	0.050	0.020	0.010	560.000	5.0	14.0	0.100	0.005	0.005	1.400	65.0
		0.045	0.038	51.237	514.545	15.364	13.545	0.091	0.005	0.005	1.245	63.273
BW-4	08/17/90	0.050	0.020	0.100	620.000	18.0	16.0	0.100	0.005	0.005	1.300	55.0
	11/29/90	0.050	0.020	0.100	520.000	6.0	15.0	0.100	0.005	0.005	1.400	62.0
	01/17/91	0.050	0.020	0.100	580.000	5.0	15.0	0.100	0.005	0.005	1.300	59.0
		0.050	0.020	0.100	573.333	9.667	15.333	0.100	0.005	0.005	1.333	58.667

BARRICK GOLDSTRIKE MINES
WATER QUALITY DATABASE
(All data are total values)

WELL NUMBER	SAMPLE DATE	TEMP. (C)	Al (mg/L)	Ba (mg/L)	B (mg/L)	Cd (mg/L)	Ca (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Mg (mg/L)	Mn (mg/L)	Ni (mg/L)	K (mg/L)	Si (mg/L)	Ag (mg/L)	Na (mg/L)
BW-5	11/29/90	54.800	0.100	0.200	0.800	0.005	87.0	0.005	0.014	0.350	20.0	0.020	0.020	20.0	17.0	0.005	76.0
	12/20/90	54.000	0.100	0.140	0.800	0.005	90.0	0.005	0.005	0.010	22.0	0.015	0.010	22.0	20.0	0.005	80.0
	01/17/91	54.500	0.100	0.170	0.800	0.005	87.0	0.005	0.005	0.240	21.0	0.014	0.010	20.0	19.0	0.005	73.0
	02/21/91	55.100	0.100	0.170	0.800	0.005	90.0	0.005	0.005	0.240	21.0	0.014	0.010	20.0	19.0	0.005	76.0
			0.100	0.170	0.800	0.005	88.500	0.005	0.007	0.210	21.000	0.016	0.013	20.500	18.750	0.005	76.250
	11/29/90	43.000	0.100	0.140	0.800	0.005	89.0	0.005	0.005	0.610	22.0	0.095	0.010	20.0	14.0	0.005	71.0
	12/20/90	40.000	0.100	0.110	0.700	0.005	87.0	0.005	0.005	0.570	23.0	0.088	0.010	20.0	14.0	0.005	74.0
	01/17/91	42.500	0.100	0.110	0.800	0.005	89.0	0.005	0.005	0.440	23.0	0.090	0.010	19.0	15.0	0.005	70.0
	02/21/91	42.500	0.100	0.120	0.800	0.005	93.0	0.005	0.005	0.240	23.0	0.088	0.010	19.0	15.0	0.005	75.0
			0.100	0.120	0.775	0.005	89.500	0.005	0.005	0.465	22.750	0.090	0.010	19.500	14.500	0.005	72.500
BW-7	01/17/91	54.100	0.100	0.170	0.800	0.005	87.0	0.005	0.005	0.550	21.0	0.016	0.010	20.0	19.0	0.005	72.0
	02/21/91	54.000	0.100	0.170	0.800	0.005	92.0	0.005	0.005	0.300	21.0	0.014	0.010	20.0	19.0	0.005	77.0
			0.100	0.170	0.800	0.005	89.500	0.005	0.005	0.425	21.000	0.015	0.010	20.000	19.000	0.005	74.500
WW #1	04/16/87	NA	0.120	0.010	0.280	0.010	62.0	0.010	0.010	1.725	41.7	0.010	0.010	8.7	16.7	0.010	35.8
	06/30/87	NA	0.100	0.060	0.160	0.010	65.0	0.010	0.010	0.160	35.6	0.010	0.010	9.2	18.9	0.010	33.4
	03/02/88	56.000	0.100	0.053	0.170	0.010	59.9	0.050	0.032	1.180	42.2	0.010	0.025	7.8	20.2	0.010	35.1
	06/30/88	NA	0.100	0.010	0.140	0.010	62.9	0.010	0.010	0.480	39.6	0.022	0.010	5.6	17.0	0.010	37.2
	11/10/88	NA	0.100	0.050	0.100		60.0	0.005	0.005	0.010	31.0	0.005	0.010	6.9	8.3	0.005	38.0
	01/19/90	14.000	0.100	0.060	0.200	0.005	100.0	0.005	0.005	0.030	32.0	0.005	0.010	6.5	13.0	0.005	45.0
			0.103	0.041	0.175	0.009	68.300	0.015	0.012	0.598	37.017	0.010	0.013	7.450	15.683	0.008	37.417
BAZZA WELL	06/30/87	NA	0.100	0.050	0.840	0.010	112.0	0.010	0.010	1.070	24.8	0.058	0.010	7.2	31.2	0.010	56.2
	02/25/88	47.800	0.100	0.080	0.115	0.010	65.6	0.010	0.010	0.855	25.6	0.040	0.028	3.5	28.7	0.010	31.7
	04/25/88	40.100	0.100	0.305	1.030	0.010	81.3	0.010	0.308	9.720	28.7	0.103	0.030	23.6	32.4	0.010	76.8
	06/29/88		0.480	0.010	0.880	0.010	85.2	0.010	0.010	0.995	29.3	0.055	0.010	22.0	35.4	0.010	76.4
	11/10/88	NA	0.100	0.140	0.800		94.0	0.005	0.005	0.640	21.0	0.056	0.010	22.0	14.0	0.005	74.0
	01/12/89	50.000	0.100	0.150	0.800		100.0	0.005	0.005	0.680	24.0	0.063	0.010	28.0	32.0	0.005	84.0
	04/06/89	50.000	0.100	0.130	0.900		100.0	0.005	0.005	0.630	22.0	0.061	0.010	24.0	18.0	0.005	81.0
	07/14/89	47.000	0.100	0.150	0.900		100.0	0.005	0.005	0.720	23.0	0.056	0.010	25.0	16.0	0.005	78.0
			0.148	0.127	0.783	0.010	92.263	0.008	0.045	1.914	24.800	0.062	0.015	19.413	25.963	0.008	69.763

BARRICK GOLDSTRIKE MINES
WATER QUALITY DATABASE
(All data are total values)

WELL NUMBER	SAMPLE DATE	Zn (mg/L)	Au (mg/L)	ALKALINITY as CaCO3	CO3 (mg/L)	HARDNESS as CaCO3	HCO3 (mg/L)	OH (mg/L)	pH (s.u.)	E.C. (umhos)	TURBIDITY (mg/L)	As (mg/L)	Hg (mg/L)	Pb (mg/L)	Se (mg/L)	Tl (mg/L)	NH4 as N (mg/L)
BW-5	11/29/90	0.005	0.005	450.000	0.000	300.0	540.000	0.000	7.10	930.000	1.6	0.010	0.000	0.005	0.005	0.005	1.50
	12/20/90	0.005	0.005	360.000	0.000	320.0	430.000	0.000	7.80	870.000	1.7	0.005	0.000	0.005	0.005	0.005	1.40
	01/17/91	0.014	0.005	450.000	0.000	300.0	540.000	0.000	7.20	980.000	2.5	0.010	0.000	0.005	0.005	0.005	2.00
	02/21/91	0.005	0.005	440.000	0.000	310.0	540.000	0.000	7.00	850.000	1.5	0.009	0.000	0.005	0.005	0.005	2.10
		0.007	0.005	425.000	0.000	307.500	512.500	0.000	7.275	907.500	1.825	0.009	0.000	0.005	0.005	0.005	1.750
	11/29/90	0.005	0.005	440.000	0.000	310.0	540.000	0.000	7.10	930.000	7.9	0.022	0.000	0.005	0.005	0.005	1.20
	12/20/90	0.005	0.005	340.000	0.000	310.0	410.000	0.000	7.70	810.000	1.4	0.011	0.000	0.005	0.005	0.005	0.90
	01/17/91	0.009	0.005	430.000	0.000	320.0	520.000	0.000	7.40	960.000	7.0	0.023	0.000	0.005	0.005	0.005	1.60
	02/21/91	0.016	0.005	440.000	0.000	330.0	540.000	0.000	7.00	840.000	2.5	0.015	0.000	0.005	0.005	0.005	1.60
		0.009	0.005	412.500	0.000	317.500	502.500	0.000	7.300	885.000	4.700	0.018	0.000	0.005	0.005	0.005	1.325
BW-7	01/17/91	0.005	0.005	440.000	0.000	300.0	530.000	0.000	7.30	970.000	6.0	0.013	0.000	0.005	0.005	0.005	1.90
	02/21/91	0.005	0.005	450.000	0.000		550.000	0.000	7.00	840.000	3.0	0.011	0.000	0.005	0.005	0.005	2.00
		0.005	0.005	445.000	0.000	150.000	540.000	0.000	7.150	905.000	4.500	0.012	0.000	0.005	0.005	0.005	1.950
WW #1	04/16/87	0.060	0.010	147.000	0.000	213.0	179.000	0.000	0.01	743.000	0.7	0.010	0.000	0.010	0.003	0.010	0.31
	06/30/87	0.023	0.010	145.000	0.000	309.0	177.000	0.000	3.08	737.000	0.3	0.010	0.000	0.030	0.002	0.010	0.13
	03/02/88	0.045	0.010	147.000	0.000	309.0	180.000	0.000	8.07	722.000	1.6	0.042	0.000	0.010	0.002	0.010	0.43
	06/30/88	0.010	0.010	155.000	0.000	298.0	189.000	0.000	7.72	731.000	2.1	0.043	0.000	0.010	0.002	0.010	0.10
	11/10/88	0.032	0.050	130.000	0.000	340.0	160.000	0.000	7.70	920.000	0.2	0.067	0.000	0.005	0.009	0.010	0.20
	01/19/90	0.005	0.051	160.000	0.000	380.0	190.000	0.000	7.70	980.000	0.6	0.086	0.000	0.005	0.010	0.005	0.20
		0.029	0.024	147.333	0.000	308.167	179.167	0.000	5.713	805.500	0.907	0.043	0.000	0.012	0.005	0.009	0.228
BAZZA WELL	06/30/87	0.018	0.010	471.000	0.000	382.0	575.000	0.000	6.93	795.000	16.0	0.010	0.000	0.120	0.002	0.010	2.68
	02/25/88	0.038	0.010	165.000	0.000	269.0	201.000	0.000	7.41	663.000	5.5	0.039	0.000	0.060	0.002	0.010	0.16
	04/25/88	0.485	0.010	286.000	0.000	321.0	348.000	0.000	7.76	926.000	95.0	0.095	0.000	0.010	0.003	0.010	1.07
	06/29/88	0.010	0.010	461.000	0.000	334.0	562.000	0.000	6.84	990.000	6.7	0.046	0.000	0.010	0.003	0.010	1.94
	11/10/88	0.029	0.005	480.000	0.000	360.0	580.000	0.000	7.60	1100.000	8.0	0.010	0.000	0.005	0.005	0.010	1.20
	01/12/89	0.005	0.005	520.000	0.000	340.0	630.000	0.000	7.10	1100.000	8.0	0.018	0.000	0.005	0.005	0.005	0.90
	04/06/89	0.009	0.005	480.000	0.000	350.0	590.000	0.000	7.00	970.000	6.4	0.010	0.005	0.005	0.005	0.005	0.02
	07/14/89	0.005	0.005	420.000	0.000	360.0	510.000	0.000	7.50	870.000	3.2	0.013	0.000	0.005	0.005	0.005	1.50
		0.075	0.008	410.375	0.000	339.500	499.500	0.000	7.268	926.750	18.600	0.030	0.001	0.028	0.004	0.008	1.184

BARRICK GOLDSTRIKE MINES
WATER QUALITY DATABASE
(All data are total values)

WELL NUMBER	SAMPLE DATE	NO3+NO2 (mg/L)	PO4 as P (mg/L)	SETTLEABLE SOLIDS	TDS (mg/L)	TSS (mg/L)	Cl (mg/L)	FREE CN (mg/L)	TOTAL CN (mg/L)	WAD CN (mg/L)	F (mg/L)	SO4 (mg/L)
BW-5	11/29/90	0.050	0.020	0.100	510.000	5.0	14.0	0.100	0.005	0.005	1.400	59.0
	12/20/90	0.050	0.020	3.300	490.000	74.0	14.0	0.100	0.005	0.005	1.200	70.0
	01/17/91	0.050	0.020	0.100	580.000	5.0	15.0	0.100	0.005	0.005	1.300	61.0
	02/21/91	0.050	0.020	0.100	600.000	5.0	15.0	0.100	0.005	0.005	1.500	57.0
		0.050	0.020	0.900	545.000	22.250	14.500	0.100	0.005	0.005	1.350	61.750
	11/29/90	0.050	0.020	0.100	540.000	6.0	14.0	0.100	0.005	0.005	1.300	61.0
	12/20/90	0.050	0.020	2.900	470.000	64.0	15.0	0.100	0.005	0.005	1.200	77.0
	01/17/91	0.050	0.020	0.100	570.000	5.0	16.0	0.100	0.005	0.005	1.200	72.0
	02/21/91	0.050	0.020	0.100	590.000	5.0	15.0	0.100	0.005	0.005	1.300	66.0
		0.050	0.020	0.800	542.500	20.000	15.000	0.100	0.005	0.005	1.250	69.000
BW-7	01/17/91	0.050	0.020	0.100	500.000	5.0	15.0	0.100	0.005	0.005	1.300	61.0
	02/21/91	0.050	0.020	0.100	610.000	5.0	15.0	0.100	0.005	0.005	1.400	42.0
		0.050	0.020	0.100	555.000	5.000	15.000	0.100	0.005	0.005	1.350	51.500
WW #1	04/16/87	0.897	0.030		534.000	1.0	60.0	0.020	0.016		0.430	167.0
	06/30/87	1.005	0.038		508.000	2.4	60.1	0.002	0.002		0.050	155.0
	03/02/88	0.19	0.018		528.000	5.6	63.0	0.002	0.002		0.460	146.0
	06/30/88	1.09	0.021		585.000	4.2	44.6	0.002	0.032		0.500	4.2
	11/10/88	1.70	0.020	0.100	540.000	5.0	67.0	0.100	0.086	0.007	0.500	180.0
	01/19/90	3.10	0.040	0.100	650.000	6.0	71.0	0.100	0.200	0.210	0.500	190.0
		1.329	0.028	0.100	557.500	4.033	60.950	0.038	0.056	0.109	0.407	140.367
BAZZA WELL	06/30/87	0.05	0.010		550.000	6.4	13.2	0.002	0.002		1.200	53.0
	02/25/88	0.15	0.480		475.000	1.0	44.1	0.002	0.004		0.410	130.0
	04/25/88	0.02	0.010		609.000	76.0	13.0	0.002	0.002		0.710	212.0
	06/29/88	0.04	0.010		605.000	4.2	11.0	0.002	0.005		1.540	70.4
	11/10/88	0.05	0.020	0.100	590.000	6.0	14.0	0.100	0.005	0.005	1.700	77.0
	01/12/89	0.08	0.020	0.100	580.000	5.0	13.0	0.100	0.005	0.005	1.700	75.0
	04/06/89	0.05	0.020	0.100	600.000	5.0	13.0	0.100	0.005	0.005	1.400	74.0
	07/14/89	0.05	0.020	0.100	540.000	5.0	13.0	0.100	0.005	0.005	2.300	76.0
		0.061	0.074	0.100	568.625	13.575	16.788	0.051	0.004	0.005	1.370	95.925

BARRICK GOLDSTRIKE MINES
WATER QUALITY DATABASE
(All data are total values)

WELL NUMBER	SAMPLE DATE	TEMP. (C)	Al (mg/L)	Ba (mg/L)	B (mg/L)	Cd (mg/L)	Ca (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Mg (mg/L)	Mn (mg/L)	Ni (mg/L)	K (mg/L)	Si (mg/L)	Ag (mg/L)	Na (mg/L)
BW-1	11/02/88	NA	0.100	0.140	0.800		87.0	0.005	0.005	1.300	22.0	0.028	0.010	23.0	18.0	0.005	72.0
	11/10/88	NA	0.100	0.120	0.800		89.0	0.005	0.005	0.820	21.0	0.020	0.010	21.0	17.0	0.005	73.0
	11/21/88	47.200	3.200	0.110	0.500		61.0	0.005	0.016	1.500	21.0	0.120	0.010	15.0	17.0	0.005	62.0
	11/30/88	48.900	0.100	0.170	0.900		94.0	0.005	0.005	0.830	22.0	0.024	0.010	24.0	19.0	0.005	76.0
			0.875	0.135	0.750		82.750	0.005	0.008	1.113	21.500	0.048	0.010	20.750	17.750	0.005	70.750
BW-2	06/14/90		0.100	0.140	0.800	0.005	90.0	0.005	0.006	1.500	22.0	0.027	0.010	20.0	18.0	0.005	82.0
	07/19/90		0.100	0.150	0.800	0.005	88.0	0.005	0.005	0.470	22.0	0.015	0.010	25.0	19.0	0.005	84.0
	08/17/90		0.100	0.150	0.800	0.005	98.0	0.005	0.005	0.300	25.0	0.016	0.010	25.0	18.0	0.006	76.0
	09/20/90		0.100	0.150	0.800	0.005	93.0	0.005	0.007	0.220	22.0	0.017	0.010	20.0	16.0	0.005	63.0
	10/04/90		0.100	0.160	0.700	0.005	83.0	0.005	0.005	0.280	21.0	0.014	0.010	22.0	17.0	0.005	69.0
	11/29/90		0.100	0.180	0.800	0.005	93.0	0.005	0.005	0.150	22.0	0.014	0.010	21.0	18.0	0.005	77.0
	12/20/90		0.100	0.100	0.700	0.005	87.0	0.005	0.005	0.010	22.0	0.013	0.010	22.0	19.0	0.005	77.0
	01/17/91		0.100	0.140	0.800	0.005	87.0	0.005	0.005	0.120	22.0	0.012	0.010	20.0	19.0	0.005	71.0
	02/21/91		0.100	0.150	0.800	0.005	91.0	0.005	0.005	0.120	21.0	0.014	0.010	20.0	18.0	0.005	75.0
			0.100	0.147	0.778	0.005	90.000	0.005	0.005	0.352	22.111	0.016	0.010	21.667	18.000	0.005	74.889
P-181	09/04/87	29.400	0.100	0.020	0.093	0.010	26.6	0.010	0.010	0.348	16.7	0.018	0.010	2.5	30.5	0.010	29.8
	09/08/87	29.400	0.100	0.022	0.091	0.010	24.5	0.010	0.010	0.618	17.1	0.010	0.010	2.4	30.5	0.010	25.8
	09/10/87	NA	0.100	0.030	0.093	0.010	38.5	0.010	0.010	0.600	17.1	0.010	0.010	2.7	32.1	0.010	26.3
	09/11/87	NA	0.100	0.033	0.095	0.010	38.2	0.010	0.010	0.610	17.3	0.010	0.010	2.6	30.2	0.010	25.8
	05/02/88		0.100	0.110	0.160	0.010	29.6	0.040	0.013	0.890	23.4	0.010	0.025	2.8	29.4	0.010	28.3
	03/09/88		0.100	0.120	0.160	0.010	41.8	0.010	0.068	0.420	23.2	0.013	0.060	2.9	30.6	0.060	28.8
	03/16/88		0.100	0.120	0.180	0.010	49.8	0.010	0.010	0.522	22.4	0.010	0.015	2.9	30.2	0.080	29.1
	03/24/88		0.100	0.178	0.200	0.010	82.5	0.010	0.010	0.420	23.4	0.010	0.010	2.7	23.8	0.010	29.7
			0.100	0.079	0.134	0.010	41.435	0.014	0.018	0.554	20.075	0.011	0.019	2.688	29.663	0.025	27.950

BARRICK GOLDSTRIKE MINES
WATER QUALITY DATABASE
(All data are total values)

WELL NUMBER	SAMPLE DATE	Zn (mg/L)	Au (mg/L)	ALKALINITY as CaCO3	CO3 (mg/L)	HARDNESS as CaCO3	HCO3 (mg/L)	OH (mg/L)	pH (s.u.)	E.C. (umhos)	TURBIDITY (mg/L)	As (mg/L)	Hg (mg/L)	Pb (mg/L)	Se (mg/L)	Tl (mg/L)	NH4 as N (mg/L)
BW-1	11/02/88	0.005	0.005	430.000	0.000	310.0	520.000	0.000	6.80	990.000	0.5	0.900	0.000	0.005	0.010	0.005	0.80
	11/10/88	0.005	0.050	300.000	0.000	350.0	3770.000	0.000	6.70	1100.000	2.0	0.730	0.000	0.005	0.005	0.010	1.10
	11/21/88	0.040	0.009	340.000	0.000	260.0	410.000	0.000	7.80	720.000	5.0	0.300	0.000	0.005	0.005	0.005	0.20
	11/30/88	0.005	0.005	480.000	0.000	330.0	580.000	0.000	7.20	700.000	2.2	0.580	0.000	0.005	0.005	0.010	1.40
		0.014	0.017	387.500	0.000	312.500	1320.000	0.000	7.125	877.500	2.425	0.628	0.000	0.005	0.006	0.008	0.875
BW-2	06/14/90	0.011	0.005	430.000	0.000	310.000	310.000	0.000	7.200	1100.000	12.0	0.016	0.000	0.069	0.005	0.005	1.6
	07/19/90	0.005	0.005	440.000	0.000	310.000	530.000	0.000	7.400	620.000	2.6	0.010	0.000	0.009	0.005	0.005	2.0
	08/17/90	0.005	0.005	470.000	0.000	350.000	560.000	0.000	7.500	680.000	1.6	0.010	0.000	0.005	0.005	0.005	1.4
	09/20/90	0.006	0.022	450.000	0.000	320.000	540.000	0.000	7.800	790.000	1.3	0.010	0.000	0.019	0.005	0.005	1.4
	10/04/90	0.018	0.005	440.000	0.000	290.000	540.000	0.000	7.300	950.000	3.0	0.011	0.000	0.005	0.005	0.005	1.6
	11/29/90	0.005	0.005	430.000	0.000	320.000	520.000	0.000	7.100	910.000	0.7	0.012	0.000	0.005	0.005	0.005	1.3
	12/20/90	0.016	0.005	340.000	0.000	310.000	430.000	0.000	7.800	800.000	1.4	0.007	0.000	0.005	0.005	0.005	2.5
	01/17/91	0.006	0.005	430.000	0.000	310.000	510.000	0.000	7.300	970.000	1.5	0.014	0.000	0.005	0.005	0.005	1.8
	02/21/91	0.029	0.005	440.000	0.000	310.000	530.000	0.000	7.400	810.000	1.0	0.012	0.000	0.005	0.005	0.005	1.8
		0.011	0.007	430.000	0.000	314.444	496.667	0.000	7.422	847.778	2.789	0.011	0.000	0.014	0.005	0.005	1.711
P-181	09/04/87	0.045	0.010	141.000	0.000	135.0	172.000	0.000	8.18	483.000	2.3	0.010	0.000	0.010	0.002	0.010	0.34
	09/08/87	0.030	0.010	134.000	0.000	192.0	164.000	0.000	8.15	452.000	2.8	0.010	0.000	0.010	0.002	0.010	0.33
	09/10/87	0.060	0.010	134.000	0.000	172.0	163.000	0.000	7.70	441.000	1.0	0.010	0.000	0.010	0.002	0.010	0.17
	09/11/87	0.030	0.010	135.000	0.000	160.0	164.000	0.000	7.60	454.000	2.0	0.010	0.000	0.010	0.002	0.010	0.11
	05/02/88	0.058	0.010	151.000	0.000	170.0	184.000	0.000	7.81	464.000	0.4	0.040	0.000	0.010	0.002	0.010	0.21
	03/09/88	0.518	0.010	162.000	0.000	200.0	197.000	0.000	7.42	467.000	0.7	0.046	0.000	0.245	0.002	0.010	0.10
	03/16/88	0.010	0.010	190.000	0.000	217.0	232.000	0.000	7.47	500.000	0.4	0.040	0.000	0.010	0.002	0.010	0.10
	03/24/88	0.013	0.025	179.000	0.000	302.0	218.000	0.000	7.44	706.000	6.9	0.043	0.000	0.010	0.002	0.010	0.12
		0.096	0.012	153.250	0.000	193.500	186.750	0.000	7.721	495.875	2.071	0.026	0.000	0.039	0.002	0.010	0.185

BARRICK GOLDSTRIKE MINES
WATER QUALITY DATABASE
(All data are total values)

WELL NUMBER	SAMPLE DATE	NO3+NO2 (mg/L)	PO4 as P (mg/L)	SETTLEABLE SOLIDS	TDS (mg/L)	TSS (mg/L)	Cl (mg/L)	FREE CN (mg/L)	TOTAL CN (mg/L)	WAD CN (mg/L)	F (mg/L)	SO4 (mg/L)
BW-1	11/02/88	0.05	0.050		630.000	5.0	13.0	0.100	0.005	0.005	1.400	91.0
	11/10/88	0.05	0.020	0.100	580.000	5.0	16.0	0.100	0.005	0.005	1.600	92.0
	11/21/88	0.28	0.130	0.100	460.000	26.0	15.0	0.100	0.005	0.005	1.100	82.0
	11/30/88	0.05	0.030	0.100	650.000	5.0	18.0	0.100	0.005	0.005	1.700	86.0
		0.108	0.058	0.100	580.000	10.250	15.500	0.100	0.005	0.005	1.450	87.750
BW-2	06/14/90	0.050	0.020	0.100	610.000	5.0	14.0	0.100	0.005	0.005	1.300	66.0
	07/19/90	0.050	0.030	0.100	610.000	5.0	15.0	0.100	0.005	0.005	0.700	58.0
	08/17/90	0.050	0.020	0.100	600.000	5.0	14.0	0.100	0.005	0.005	1.300	73.0
	09/20/90	0.050	0.020	0.100	580.000	5.0	14.0	0.100	0.005	0.005	1.400	58.0
	10/04/90	0.050	0.020	0.100	570.000	5.0	16.0	0.100	0.005	0.005	1.700	50.0
	11/29/90	0.050	0.020	0.100	540.000	8.0	13.0	0.100	0.005	0.005	1.400	56.0
	12/20/90	0.050	0.020	2.900	470.000	92.0	15.0	0.100	0.005	0.005	1.300	72.0
	01/17/91	0.050	0.020	0.100	560.000	5.0	15.0	0.100	0.005	0.005	1.200	59.0
	02/21/91	0.050	0.020	0.100	580.000	5.0	15.0	0.100	0.005	0.005	1.500	56.0
		0.050	0.021	0.411	568.889	15.000	14.556	0.100	0.005	0.005	1.311	60.889
P-181	09/04/87	0.70	0.580		359.000	1.6	32.4	0.002	0.002		0.960	18.0
	09/08/87	0.80	0.430		319.000	2.0	32.7	0.002	0.004		0.550	19.0
	09/10/87	0.94	0.181		344.000	1.0	30.5	0.002	0.002		0.600	49.0
	09/11/87	0.92	0.188		339.000	1.0	30.0	0.002	0.002		0.610	51.0
	05/02/88	0.14	0.061		362.000	1.0	28.0	0.002	0.002		0.890	63.2
	03/09/88	0.09	0.055		346.000	2.4	27.6	0.002	0.002		0.420	75.3
	03/16/88	0.07	0.029		362.000	4.8	26.8	0.002	0.006		0.522	72.0
	03/24/88	0.09	0.393		488.000	1.2	43.4	0.002	0.009		0.420	118.0
		0.468	0.240		364.875	1.875	31.425	0.002	0.004		0.622	58.188

BARRICK GOLDSTRIKE MINES
WATER QUALITY DATABASE
(All data are total values)

WELL NUMBER	SAMPLE DATE	TEMP. (C)	Al (mg/L)	Ba (mg/L)	B (mg/L)	Cd (mg/L)	Ca (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Mg (mg/L)	Mn (mg/L)	Ni (mg/L)	K (mg/L)	Si (mg/L)	Ag (mg/L)	Na (mg/L)
PPW #2	05/23/89	22.000	0.100	0.070	0.260		78.0	0.005	0.005	0.130	23.0	0.049	0.010	7.9	15.0	0.005	40.0
	02/27/90	40.000	0.100	0.140	0.800	0.005	85.0	0.005	0.010	0.280	26.0	0.058	0.020	17.0	20.0	0.005	68.0
	03/28/90	38.000	0.100	0.120	0.700	0.005	91.0	0.005	0.005	0.090	26.0	0.050	0.020	15.0	18.0	0.005	64.0
	04/26/90	40.000	0.100	0.140	0.800	0.005	89.0	0.005	0.005	0.130	25.0	0.040	0.010	18.0	20.0	0.005	71.0
	05/04/90	40.000	0.100	0.180	0.900	0.005	95.0	0.005	0.005	0.120	26.0	0.043	0.020	18.0	21.0	0.005	69.0
	07/19/90	41.000	0.100	0.140	0.800	0.008	88.0	0.005	0.005	0.180	25.0	0.033	0.010	20.0	18.0	0.005	76.0
	09/20/90	40.000	0.100	0.130	0.800	0.006	91.0	0.005	0.005	0.130	25.0	0.036	0.010	17.0	17.0	0.005	63.0
	08/31/90	40.000	0.100	0.140	0.900	0.005	90.0	0.005	0.005	0.200	24.0	0.033	0.010	20.0	17.0	0.005	76.0
	10/04/90	42.000	0.100	0.140	0.700	0.006	81.0	0.005	0.005	0.160	24.0	0.034	0.010	19.0	17.0	0.005	69.0
	11/29/90	42.500	0.100	0.160	0.800	0.009	89.0	0.005	0.005	0.150	24.0	0.049	0.020	18.0	18.0	0.005	75.0
	12/20/90	42.500	0.100	0.120	0.800	0.005	91.0	0.005	0.005	0.110	25.0	0.050	0.010	18.0	18.0	0.005	75.0
			0.100	0.135	0.751	0.006	88.000	0.005	0.005	0.153	24.818	0.043	0.014	17.082	18.091	0.005	67.818
PPW-3R	05/08/90	32.000	0.100	0.140	0.900	0.005	93.0	0.005	0.005	0.060	23.0	0.005	0.004	22.0	18.0	0.005	80.0
	06/16/90	32.000	0.100	0.100	0.300	0.005	71.0	0.005	0.014	0.140	24.0	0.055	0.010	4.6	9.0	0.005	43.0
	08/23/90	31.000	0.036	0.150	0.360	0.005	77.0	0.005	0.005	0.190	27.0	0.062	0.020	5.9	13.0	0.005	47.0
	10/04/90	32.000	0.100	0.160	0.500	0.005	75.0	0.005	0.008	0.470	29.0	0.120	0.010	8.7	11.0	0.005	57.0
			0.084	0.138	0.515	0.005	79.000	0.005	0.008	0.215	25.750	0.061	0.011	10.300	12.750	0.005	56.750
PPW-4	12/20/89	NA	0.700	0.150	0.700	0.005	100.0	0.005	0.005	0.120	25.0	0.007	0.002	0.0	19.0	0.005	59.0
	01/19/90	NA	0.100	0.150	0.800	0.005	90.0	0.005	0.052	0.640	23.0	0.013	0.030	19.0	20.0	0.005	74.0
	02/27/90	38.000	0.100	0.150	0.800	0.005	83.0	0.005	0.013	0.080	22.0	0.005	0.006	0.0	20.0	0.005	67.0
	03/28/90	35.000	0.100	0.120	0.800	0.005	84.0	0.005	0.005	0.140	21.0	0.005	0.010	20.0	17.0	0.005	69.0
	04/26/90	38.000	0.100	0.150	0.900	0.005	90.0	0.005	0.100	0.100	22.0	0.005	0.030	22.0	18.0	0.005	77.0
	05/08/90	36.000	0.100	0.140	0.300	0.005	77.0	0.005	0.005	0.250	26.0	0.140	0.030	5.3	18.0	0.005	43.0
	06/15/90	40.000	0.100	0.110	0.700	0.005	84.0	0.005	0.005	0.040	22.0	0.005	0.010	20.0	15.0	0.005	70.0
	07/19/90	38.000	0.100	0.130	0.900	0.005	86.0	0.005	0.005	0.040	22.0	0.005	0.010	24.0	21.0	0.005	81.0
	08/16/90	39.000	0.100	0.130	0.800	0.005	89.0	0.005	0.005	0.040	21.0	0.005	0.020	21.0	15.0	0.005	73.0
	09/20/90	38.500	0.100	0.130	0.800	0.005	88.0	0.005	0.005	0.030	22.0	0.005	0.010	22.0	17.0	0.005	67.0
	10/04/90	40.000	0.100	0.140	0.700	0.005	77.0	0.005	0.005	0.040	21.0	0.005	0.010	23.0	16.0	0.005	70.0
			0.155	0.136	0.745	0.005	86.182	0.005	0.019	0.138	22.455	0.018	0.015	16.029	17.818	0.005	68.182

BARRICK GOLDSTRIKE MINES
WATER QUALITY DATABASE
(All data are total values)

WELL NUMBER	SAMPLE DATE	Zn (mg/L)	Au (mg/L)	ALKALINITY as CaCO3	CO3 (mg/L)	HARDNESS as CaCO3	HCO3 (mg/L)	OH (mg/L)	pH (s.u.)	E.C. (umhos)	TURBIDITY (mg/L)	As (mg/L)	Hg (mg/L)	Pb (mg/L)	Se (mg/L)	Tl (mg/L)	NH4 as N (mg/L)
PPW #2	05/23/89	0.024	0.005	210.000	0.000	300.0	250.000	0.000	7.40	670.000	0.7	0.330	0.002	0.010	0.007	0.005	0.20
	02/27/90	0.028	0.005	410.000	0.000	320.0	500.000	0.000	7.20	840.000	2.3	0.390	0.001	0.005	0.007	0.005	0.30
	03/28/90	0.040	0.005	400.000	0.000	330.0	490.000	0.000	7.80	870.000	0.3	0.340	0.001	0.005	0.010	0.005	0.30
	04/26/90	0.030	0.005	410.000	0.000	320.0	500.000	0.000	7.70	760.000	0.3	0.300	0.000	0.005	0.008	0.005	0.70
	05/04/90	0.038	0.005	400.000	0.000	340.0	490.000	0.000	8.00	940.000	3.0	0.350	0.001	0.005	0.008	0.005	0.50
	07/19/90	0.036	0.005	420.000	0.000	320.0	510.000	0.000	7.20	700.000	7.6	0.350	0.002	0.005	0.006	0.005	1.00
	09/20/90	0.046	0.006	420.000	0.000	330.0	510.000	0.000	7.20	780.000	1.3	0.350	0.002	0.005	0.006	0.005	0.80
	08/31/90	0.050	0.005	410.000	0.000	320.0	500.000	0.000	8.10	960.000	0.4	0.400	0.001	0.005	0.007	0.005	0.80
	10/04/90	0.060	0.005	430.000	0.000	300.0	520.000	0.000	7.10	940.000	1.9	0.370	0.001	0.005	0.006	0.007	0.90
	11/29/90	0.032	0.005	400.000	0.000	320.0	490.000	0.000	7.00	910.000	2.9	0.420	0.001	0.011	0.005	0.005	0.80
	12/20/90	0.037	0.005	370.000	0.000	330.0	450.000	0.000	7.60	760.000	2.2	0.370	0.003	0.005	0.005	0.005	0.90
		0.038	0.005	389.091	0.000	320.909	473.636	0.000	7.482	830.000	2.082	0.361	0.001	0.006	0.007	0.005	0.655
PPW-3R	05/08/90	0.180	0.005	390.000	0.000	330.0	470.000	0.000	7.00	880.000	0.6	0.110	0.004	0.005	0.005	0.005	0.20
	06/16/90	0.062	0.005	250.000	0.000	280.0	300.000	0.000	8.00	500.000	0.6	0.140	0.002	0.005	0.005	0.005	0.20
	08/23/90	0.075	0.005	300.000	0.000	110.0	370.000	0.000	7.80	610.000	1.3	0.170	0.001	0.006	0.007	0.005	0.20
	10/04/90	0.110	0.006	290.000	0.000	310.0	350.000	0.000	7.40	790.000	0.5	0.270	0.000	0.005	0.005	0.005	0.20
		0.107	0.005	307.500	0.000	257.500	372.500	0.000	7.550	695.000	0.738	0.173	0.002	0.005	0.006	0.005	0.200
PPW-4	12/20/89	0.029	0.005	370.000	0.000	350.0	440.000	0.000	6.60	860.000	0.5	0.110	0.002	0.007	0.005	0.005	0.20
	01/19/90	0.130	0.005	380.000	0.000	320.0	460.000	0.000	6.70	930.000	0.4	0.110	0.007	0.045	0.005	0.005	0.20
	02/27/90	0.035	0.005	390.000	0.000	300.0	470.000	0.000	7.10	800.000	0.5	0.130	0.006	0.005	0.005	0.005	0.20
	03/28/90	0.037	0.005	400.000	0.000	300.0	490.000	0.000	7.20	840.000	0.3	0.110	0.006	0.005	0.005	0.005	0.20
	04/26/90	0.160	0.005	410.000	0.000	320.0	490.000	0.000	6.80	730.000	0.6	0.110	0.001	0.005	0.005	0.005	0.20
	05/08/90	0.043	0.005	270.000	0.000	300.0	330.000	0.000	7.80	680.000	1.5	0.130	0.000	0.005	0.005	0.005	0.20
	06/15/90	0.046	0.005	400.000	0.000	300.0	480.000	0.000	7.20	1100.000	0.3	0.110	0.004	0.005	0.005	0.005	0.30
	07/19/90	0.047	0.005	420.000	0.000	310.0	510.000	0.000	7.00	610.000	0.5	0.094	0.003	0.005	0.005	0.005	0.30
	08/16/90	0.045	0.010	460.000	0.000	310.0	560.000	0.000	7.10	570.000	0.2	0.100	0.003	0.005	0.005	0.005	0.20
	09/20/90	0.054	0.006	430.000	0.000	310.0	520.000	0.000	7.60	770.000	0.3	0.110	0.002	0.005	0.005	0.005	0.02
	10/04/90	0.061	0.005	420.000	0.000	280.0	510.000	0.000	7.10	930.000	30.0	0.120	0.001	0.005	0.005	0.005	0.20
		0.062	0.006	395.455	0.000	309.091	478.182	0.000	7.109	801.818	3.190	0.112	0.003	0.009	0.005	0.005	0.202

BARRICK GOLDSTRIKE MINES
WATER QUALITY DATABASE
(All data are total values)

WELL NUMBER	SAMPLE DATE	NO3+NO2 (mg/L)	PO4 as P (mg/L)	SETTLEABLE SOLIDS	TDS (mg/L)	TSS (mg/L)	Cl (mg/L)	FREE CN (mg/L)	TOTAL CN (mg/L)	WAD CN (mg/L)	F (mg/L)	SO4 (mg/L)
PPW #2	05/23/89	0.51	0.060	0.100	430.000	5.0	35.0	0.100	0.005	0.005	0.600	
	02/27/90	0.05	0.060	0.100	570.000	5.0	17.0	0.100	0.005	0.005	0.900	76.0
	03/28/90	0.10	0.440	0.100	590.000	7.0	18.0	0.100	0.005	0.005	0.900	70.0
	04/26/90	0.07	0.060	0.100	590.000	5.0	17.0	0.100	0.005	0.005	0.900	82.0
	05/04/90	0.05	0.130	0.100	590.000	5.0	17.0	0.100	0.005	0.005	0.900	67.0
	07/19/90	0.05	0.160	0.100	600.000	5.0	15.0	0.100	0.005	0.005	0.600	66.0
	09/20/90	0.05	0.130	0.100	560.000	5.0	14.0	0.100	0.005	0.005	1.200	64.0
	08/31/90	0.05	0.160	0.100	570.000	5.0	14.0	0.100	0.005	0.005	1.200	60.0
	10/04/90	0.05	0.080	0.100	560.000	10.0	16.0	0.100	0.005	0.005	1.300	56.0
	11/29/90	0.05	0.120	0.100	540.000	5.0	14.0	0.100	0.005	0.005	1.200	58.0
	12/20/90	0.05	0.070	5.700	500.000	49.0	15.0	0.100	0.005	0.005	1.100	83.0
		0.098	0.134	0.609	554.545	9.636	17.455	0.100	0.005	0.005	0.982	68.200
PPW-3R	05/08/90	0.30	0.030	0.100	560.000	5.0	16.0	0.100	0.005	0.005	1.0	70.0
	06/16/90	2.50	0.050	0.100	440.000	10.0	22.0	0.100	0.005	0.005	0.5	75.0
	08/23/90	1.70	0.020	0.100	480.000	5.0	22.0	0.100	0.005	0.005	0.5	66.0
	10/04/90	5.50	0.030	0.100	460.000	8.0	23.0	0.100	0.005	0.005	0.6	68.0
		2.500	0.033	0.100	485.000	7.000	20.750	0.100	0.005	0.005	0.650	69.750
PPW-4	12/20/89	0.66	0.050	0.100	530.000	5.0	16.0	0.100	0.005	0.005	0.9	74.0
	01/19/90	0.64	0.040	0.100	540.000	5.0	15.0	0.100	0.005	0.005	0.8	75.0
	02/27/90	0.73	0.030	0.100	540.000	5.0	17.0	0.100	0.005	0.005	0.9	51.0
	03/28/90	0.57	0.350	0.100	560.000	6.0	17.0	0.100	0.005	0.005	1.0	56.0
	04/26/90	0.34	0.030	0.100	530.000	5.0	16.0	0.100	0.005	0.005	0.9	72.0
	05/08/90	0.97	0.070	0.100	450.000	5.0	20.0	0.100	0.005	0.005	0.5	74.0
	06/15/90	0.22	0.050	0.100	580.000	6.0	25.0	0.100	0.005	0.005	1.0	73.0
	07/19/90	0.18	0.070	0.100	580.000	5.0	16.0	0.100	0.005	0.005	0.6	65.0
	08/16/90	0.17	0.030	0.100	590.000	5.0	14.0	0.100	0.005	0.005	1.1	67.0
	09/20/90	0.20	0.050	0.100	570.000	5.0	14.0	0.100	0.005	0.005	1.2	59.0
	10/04/90	0.23	0.050	0.100	560.000	5.0	15.0	0.100	0.005	0.005	1.4	52.0
		0.446	0.075	0.100	548.182	5.182	16.818	0.100	0.005	0.005	0.936	65.273

BARRICK GOLDSTRIKE MINES
WATER QUALITY DATABASE
(All data are total values)

WELL NUMBER	SAMPLE DATE	TEMP. (C)	Al (mg/L)	Ba (mg/L)	B (mg/L)	Cd (mg/L)	Ca (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Mg (mg/L)	Mn (mg/L)	Ni (mg/L)	K (mg/L)	Si (mg/L)	Ag (mg/L)	Na (mg/L)
PPW-6	07/20/89		0.100	0.080	0.800		0.005	0.005	0.010	21.00	0.02	0.000	0.010	20.0	14.0	0.005	64.0
	10/09/89		0.100	0.210	0.800		97.000	0.005	0.005	0.26	23.00	0.030	0.010	21.0	18.0	0.050	84.0
	01/18/90		0.100	0.180	0.900	0.005	100.000	0.005	0.027	0.10	23.00	0.025	0.010	23.0	21.0	0.005	74.0
			0.100	0.157	0.833	0.005	65.668	0.005	0.014	7.120	15.341	0.018	0.010	21.333	17.667	0.020	74.000
PPW-8	06/22/90	30.000	0.100	0.180	0.700	0.005	98.0	0.005	0.005	0.080	25.0	0.005	0.010	17.0	15.0	0.005	68.0
	07/19/90	30.500	0.100	0.160	0.700	0.005	85.0	0.005	0.005	0.510	24.0	0.009	0.010	18.0	16.0	0.005	76.0
	09/20/90	31.000	0.100	0.160	0.700	0.005	89.0	0.005	0.006	0.080	23.0	0.008	0.020	14.0	17.0	0.005	57.0
	10/04/90	32.000	0.100	0.160	0.700	0.005	77.0	0.005	0.006	0.130	22.0	0.005	0.010	16.0	16.0	0.005	65.0
	11/29/90	28.000	0.100	0.180	0.800	0.006	84.0	0.005	0.005	0.040	21.0	0.005	0.010	16.0	17.0	0.005	69.0
	12/20/90	31.000	0.100	0.130	0.800	0.005	88.0	0.006	0.005	0.040	22.0	0.005	0.010	16.0	18.0	0.005	73.0
	01/17/91	30.000	0.100	0.150	0.800	0.005	84.0	0.005	0.005	0.010	22.0	0.005	0.010	17.0	19.0	0.005	69.0
			0.100	0.160	0.743	0.005	86.429	0.005	0.005	0.127	22.714	0.006	0.011	16.286	16.857	0.005	68.143
PPW-9	09/20/90		0.100	0.050	0.100	0.005	65.0	0.005	0.006	0.090	33.0	0.018	0.010	5.900	10.0	0.005	31.0
	10/04/90		0.100	0.050	0.100	0.005	58.0	0.005	0.005	0.100	34.0	0.012	0.010	6.300	9.0	0.005	31.0
	11/29/90		0.100	0.050	0.100	0.005	62.0	0.005	0.005	0.150	37.0	0.013	0.010	5.900	10.0	0.005	33.0
			0.100	0.050	0.100	0.005	61.667	0.005	0.005	0.113	34.667	0.014	0.010	6.033	9.667	0.005	31.667
PPW-10	05/08/90	28.000	0.100	0.100	0.600	0.006	92.0	0.005	0.005	0.160	25.0	0.013	0.020	12.0	17.0	0.005	59.0
	06/15/90	30.000	0.100	0.090	0.500	0.005	93.0	0.005	0.005	0.320	26.0	0.019	0.010	15.0	16.0	0.005	62.0
	08/14/90	28.000	0.100	0.090	0.600	0.006	96.0	0.005	0.005	0.230	26.0	0.017	0.030	15.0	18.0	0.005	58.0
	10/04/90	27.000	0.100	0.110	0.400	0.005	75.0	0.005	0.005	0.190	23.0	0.012	0.010	11.0	14.0	0.005	54.0
			0.100	0.098	0.525	0.006	89.000	0.005	0.005	0.225	25.000	0.015	0.018	13.250	16.250	0.005	58.250
PPW-12	05/17/90	53.000	0.100	0.180	0.800	0.005	98.0	0.005	0.005	0.620	24.0	0.023	0.010	24.0	14.0	0.005	80.0
	06/15/90	51.000	0.100	0.140	0.700	0.005	91.0	0.005	0.005	0.820	22.0	0.021	0.010	24.0	14.0	0.005	78.0
	07/19/90	46.000	0.100	0.140	0.800	0.005	88.0	0.005	0.005	0.870	22.0	0.021	0.010	25.0	17.0	0.005	84.0
	08/16/90	45.000	0.100	0.160	0.700	0.005	96.0	0.006	0.005	0.860	22.0	0.022	0.010	21.0	15.0	0.005	75.0
	09/20/90	49.000	0.100	0.160	0.800	0.005	94.0	0.005	0.005	0.550	22.0	0.022	0.010	20.0	16.0	0.005	65.0
	10/04/90	48.000	0.100	0.160	0.700	0.005	82.0	0.005	0.005	0.790	21.0	0.019	0.010	22.0	15.0	0.005	70.0
	02/18/91	46.000	0.100	0.140	0.800	0.005	87.0	0.005	0.005	0.320	21.0	0.015	0.010	20.0	17.0	0.005	75.0
			0.100	0.154	0.757	0.005	90.857	0.005	0.005	0.690	22.000	0.020	0.010	22.286	15.429	0.005	75.286

BARRICK GOLDSTRIKE MINES
WATER QUALITY DATABASE
(All data are total values)

WELL NUMBER	SAMPLE DATE	Zn (mg/L)	Au (mg/L)	ALKALINITY as CaCO3	CO3 (mg/L)	HARDNESS as CaCO3	HCO3 (mg/L)	OH (mg/L)	pH (s.u.)	E.C. (umhos)	TURBIDITY (mg/L)	As (mg/L)	Hg (mg/L)	Pb (mg/L)	Se (mg/L)	Tl (mg/L)	NH4 as N (mg/L)
PPW-6	07/20/89	0.005	0.005	350.000	0.000	260.000	420.000	0.000	7.8	770.000	8.5	0.010	0.000	0.005	0.005	0.005	0.800
	10/09/89	0.009	0.005	440.000	0.000	340.000	540.000	0.000	8.0	1000.000	0.4	0.250	0.000	0.005	0.005	0.005	2.200
	01/18/90	0.005	0.005	420.000	0.000	340.000	510.000	0.000	7.5	1100.000	1.0	0.150	0.000	0.005	0.005	0.005	1.700
		0.006	0.005	403.333	0.000	313.333	490.000	0.000	7.767	956.667	3.300	0.137	0.000	0.005	0.005	0.005	1.567
PPW-8	06/22/90	0.031	0.005	390.000	0.000	350.0	470.000	0.000	7.60	900.000	3.4	0.180	0.002	0.005	0.025	0.005	0.20
	07/19/90	0.031	0.005	390.000	0.000	310.0	470.000	0.000	7.20	640.000	2.5	0.180	0.002	0.005	0.005	0.005	0.20
	09/20/90	0.030	0.006	400.000	0.000	320.0	490.000	0.000	7.30	750.000	0.5	0.190	0.003	0.005	0.005	0.005	0.20
	10/04/90	0.072	0.005	400.000	0.000	280.0	480.000	0.000	7.20	900.000	0.3	0.200	0.004	0.005	0.005	0.005	0.20
	11/29/90	0.023	0.005	410.000	0.000	300.0	500.000	0.000	7.10	880.000	0.4	0.220	0.003	0.000	0.005	0.005	0.20
	12/20/90	0.028	0.005	360.000	0.000	310.0	430.000	0.000	7.90	740.000	1.8	0.210	0.004	0.005	0.005	0.005	0.20
	01/17/91	0.029	0.005	390.000	0.000	300.0	470.000	0.000	7.90	910.000	0.3	0.240	0.001	0.005	0.005	0.005	0.20
		0.035	0.005	391.429	0.000	310.000	472.857	0.000	7.457	817.143	1.314	0.203	0.003	0.004	0.008	0.005	0.200
PPW-9	09/20/90	0.130	0.005	120.000	0.000	300.000	140.000	0.000	8.0	660.000	0.8	0.210	0.000	0.005	0.008	0.005	0.200
	10/04/90	0.160	0.005	120.000	0.000	280.000	140.000	0.000	7.6	790.000	1.0	0.160	0.000	0.005	0.009	0.005	0.200
	11/29/90	0.220	0.005	120.000	0.000	310.000	140.000	0.000	7.9	770.000	1.2	0.140	0.000	0.005	0.005	0.005	0.200
		0.170	0.005	120.000	0.000	296.667	140.000	0.000	7.833	740.000	1.000	0.170	0.000	0.005	0.007	0.005	0.200
PPW-10	05/08/90	0.028	0.005	330.000	0.000	330.0	390.000	0.000	7.30	810.000	1.2	0.340	0.008	0.005	0.005	0.005	0.20
	06/15/90	0.021	0.021	300.000	0.000	340.0	360.000	0.000	7.40	1100.000	2.0	0.018	0.010	0.005	0.015	0.006	6.50
	08/14/90	0.190	0.010	360.000	0.000	350.0	430.000	0.000	7.40	870.000	1.4	0.360	0.000	0.005	0.015	0.005	0.20
	10/04/90	0.074	0.005	340.000	0.000	280.0	410.000	0.000	7.30	850.000	5.5	0.370	0.005	0.005	0.005	0.005	0.20
		0.078	0.010	332.500	0.000	325.000	397.500	0.000	7.350	907.500	2.525	0.272	0.006	0.005	0.010	0.005	1.775
PPW-12	05/17/90	0.005	0.005	410.000	0.000	300.0	500.000	0.000	7.60	940.000	2.6	0.022	0.000	0.005	0.005	0.005	1.40
	06/15/90	0.005	0.005	420.000	0.000	320.0	510.000	0.000	7.80	1100.000	3.0	0.018	0.000	0.005	0.005	0.005	1.90
	07/19/90	0.005	0.005	440.000	0.000	310.0	530.000	0.000	7.50	670.000	4.1	0.015	0.000	0.005	0.005	0.005	2.00
	08/16/90	0.005	0.010	440.000	0.000	330.0	530.000	0.000	7.30	590.000	2.0	0.017	0.000	0.005	0.005	0.005	1.40
	09/20/90	0.005	0.006	440.000	0.000	330.0	540.000	0.000	7.60	750.000	5.7	0.016	0.000	0.005	0.005	0.005	1.90
	10/04/90	0.034	0.005	450.000	0.000	290.0	540.000	0.000	7.40	960.000	9.4	0.016	0.000	0.005	0.005	0.005	1.60
	02/18/91	0.005	0.005	450.000	0.000	300.0	550.000	0.000	7.80	980.000	0.9	0.016	0.000	0.005	0.005	0.005	1.90
		0.009	0.006	435.714	0.000	311.429	528.571	0.000	7.571	855.714	3.957	0.017	0.000	0.005	0.005	0.005	1.729

BARRICK GOLDSTRIKE MINES
WATER QUALITY DATABASE
(All data are total values)

WELL NUMBER	SAMPLE DATE	NO3+NO2 (mg/L)	PO4 as P (mg/L)	SETTLEABLE SOLIDS	TDS (mg/L)	TSS (mg/L)	Cl (mg/L)	FREE CN (mg/L)	TOTAL CN (mg/L)	WAD CN (mg/L)	F (mg/L)	SO4 (mg/L)
PPW-6	07/20/89	0.100	0.040	0.100	500.000	6.00	15.0	0.100	0.005	0.005	1.400	68.0
	10/09/89	0.050	0.080	0.100	620.000	5.00	13.0	0.100	0.005	0.005	1.300	96.0
	01/18/90	0.050	0.030	0.100	610.000	5.00	13.0	0.100	0.005	0.005	1.300	84.0
		0.067	0.050	0.100	576.667	5.333	13.667	0.100	0.005	0.005	1.333	82.667
PPW-8	06/22/90	0.34	0.090	0.100	550.000	5.0	18.0	0.100	0.005	0.005	0.7	63.0
	07/19/90	0.32	0.100	0.100	570.000	5.0	18.0	0.100	0.005	0.005	0.5	73.0
	09/20/90	0.29	0.070	0.100	550.000	5.0	16.0	0.100	0.005	0.005	0.8	64.0
	10/04/90	0.42	0.070	0.100	540.000	8.0	17.0	0.100	0.005	0.005	0.9	56.0
	11/29/90	0.10	0.070	0.100	530.000	5.0	15.0	0.100	0.005	0.005	0.9	63.0
	12/20/90	0.05	0.050	5.700	470.000	42.0	15.0	0.100	0.005	0.005	0.8	78.0
	01/17/91	0.05	0.070	0.010	560.000	5.0	16.0	0.100	0.005	0.005	0.8	64.0
		0.224	0.074	0.887	538.571	10.714	16.429	0.100	0.005	0.005	0.771	65.857
PPW-9	09/20/90	0.050	0.060	0.100	480.000	6.0	53.0	0.100	0.005	0.005	0.500	150.000
	10/04/90	0.050	0.020	0.100	480.000	5.0	55.0	0.100	0.005	0.005	0.500	130.000
	11/29/90	0.060	0.030	0.100	480.000	5.0	55.0	0.100	0.005	0.005	0.500	220.000
		0.053	0.037	0.100	480.000	5.333	54.333	0.100	0.005	0.005	0.500	166.667
PPW-10	05/08/90	0.83	0.110	0.100	530.000	5.0	24.0	0.100	0.005	0.005	0.6	72.0
	06/15/90	10.00	0.110	0.100	620.000	6.0	23.0	0.100	0.020	0.020	0.6	86.0
	08/14/90	5.40	0.130	0.100	600.000	5.0	25.0	0.100	0.054	0.052	0.7	95.0
	10/04/90	0.87	0.110	0.100	510.000	6.0	26.0	0.100	0.005	0.005	0.7	76.0
		4.275	0.115	0.100	565.000	5.500	24.500	0.100	0.021	0.021	0.650	82.250
PPW-12	05/17/90	0.05	0.020	0.100	600.000	5.0	14.0	0.100	0.005	0.005	1.5	67.0
	06/15/90	0.05	0.020	0.100	300.000	5.0	14.0	0.100	0.005	0.005	1.2	54.0
	07/19/90	0.05	0.030	0.100	600.000	5.0	15.0	0.100	0.005	0.005	0.7	70.0
	08/16/90	0.05	0.020	0.100	580.000	5.0	13.0	0.100	0.005	0.005	1.6	48.0
	09/20/90	0.05	0.020	0.100	570.000	5.0	13.0	0.100	0.005	0.005	1.5	65.0
	10/04/90	0.05	0.020	0.100	560.000	5.0	14.0	0.100	0.005	0.005	1.7	57.0
	02/18/91	0.05	0.020	0.100	580.000	5.0	14.0	0.100	0.005	0.005	1.3	52.0
		0.050	0.021	0.100	541.429	5.000	13.857	0.100	0.005	0.005	1.357	59.000

BARRICK GOLDSTRIKE MINES
WATER QUALITY DATABASE
(All data are total values)

WELL NUMBER	SAMPLE DATE	TEMP. (C)	Al (mg/L)	Ba (mg/L)	B (mg/L)	Cd (mg/L)	Ca (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Mg (mg/L)	Mn (mg/L)	Ni (mg/L)	K (mg/L)	Si (mg/L)	Ag (mg/L)	Na (mg/L)
PPW-13	01/17/91	45.000	0.100	0.130	0.800	0.005	87.0	0.005	0.005	0.970	22.0	0.031	0.010	20.0	18.0	0.005	71.0
	02/21/91	47.000	0.100	0.130	0.800	0.005	88.0	0.005	0.005	0.560	21.0	0.024	0.010	19.0	17.0	0.005	74.0
			0.100	0.130	0.800	0.005	87.500	0.005	0.005	0.765	21.500	0.028	0.010	19.500	17.500	0.005	72.500
PUPW-2	02/11/88	NA	0.100	0.025	0.129	0.010	33.4	0.010	0.010	1.140	29.8	0.050	0.012	4.6	24.0	0.010	40.2
	02/18/88	22.800	0.100	0.080	0.098	0.010	64.5	0.010	0.010	0.925	26.4	0.043	0.020	3.6	23.1	0.028	32.4
	02/25/88	23.300	0.100	0.220	0.811	0.010	84.6	0.010	0.050	0.031	19.9	0.048	0.035	19.7	18.7	0.013	76.8
	03/02/88	23.300	0.100	0.068	0.190	0.010	46.8	0.240	0.010	2.090	39.1	0.043	0.025	5.4	24.3	0.010	33.4
	03/09/88	24.400	0.100	0.105	0.190	0.010	50.1	0.025	0.010	1.730	36.2	0.040	0.033	4.8	24.8	0.088	32.8
	03/16/88	24.400	0.100	0.150	0.190	0.010	49.2	0.010	0.010	1.640	36.3	0.040	0.030	4.1	23.4	0.010	33.4
	03/24/88	22.800	0.100	0.235	0.200	0.010	51.7	0.013	0.010	0.805	34.6	0.033	0.015	5.0	30.1	0.010	32.8
			0.100	0.126	0.258	0.010	54.329	0.045	0.016	1.194	31.757	0.042	0.024	6.743	24.057	0.024	40.257

BARRICK GOLDSTRIKE MINES
WATER QUALITY DATABASE
(All data are total values)

WELL NUMBER	SAMPLE DATE	Zn (mg/L)	Au (mg/L)	ALKALINITY as CaCO3	CO3 (mg/L)	HARDNESS as CaCO3	HCO3 (mg/L)	OH (mg/L)	pH (s.u.)	E.C. (umhos)	TURBIDITY (mg/L)	As (mg/L)	Hg (mg/L)	Pb (mg/L)	Se (mg/L)	Tl (mg/L)	NH4 as N (mg/L)
PPW-13	01/17/91	0.005	0.005	400.000	0.000	310.0	480.000	0.000	7.90	900.000	3.2	0.073	0.000	0.005	0.005	0.005	1.70
	02/21/91	0.005	0.005	430.000	0.000	310.0	520.000	0.000	7.60	800.000	3.5	0.067	0.000	0.005	0.005	0.005	1.80
		0.005	0.005	415.000	0.000	310.000	500.000	0.000	7.750	850.000	3.350	0.070	0.000	0.005	0.005	0.005	1.750
PUPW-2	02/11/88	0.048	0.010	162.000	0.000	206.0	198.000	0.000	7.57	660.000	8.9	0.033	0.000	0.035	0.002	0.010	0.11
	02/18/88	0.105	0.010	163.000	0.000	270.0	198.000	0.000	7.70	688.000	7.3	0.044	0.000	0.055	0.003	0.010	0.24
	02/25/88	0.233	0.010	420.000	0.000	293.0	512.000	0.000	7.57	921.000	20.0	0.069	0.000	0.057	0.002	0.010	1.56
	03/02/88	0.023	0.010	168.000	0.000	278.0	206.000	0.000	7.74	644.000	6.8	0.057	0.002	0.023	0.002	0.010	0.28
	03/09/88	0.045	0.010	173.000	0.000	274.0	211.000	0.000	7.44	658.000	7.2	0.033	0.000	0.010	0.002	0.010	0.10
	03/16/88	0.010	0.010	174.000	0.000	272.0	212.000	0.000	7.88	660.000	5.0	0.055	0.000	0.010	0.002	0.010	0.10
	03/24/88	0.010	0.010	200.000	0.000	272.0	244.000	0.000	7.38	571.000	0.3	0.045	0.000	0.010	0.002	0.010	0.10
		0.068	0.010	208.571	0.000	266.429	254.429	0.000	7.611	686.000	7.931	0.048	0.000	0.029	0.002	0.010	0.356

BARRICK GOLDSTRIKE MINES
WATER QUALITY DATABASE
(All data are total values)

WELL NUMBER	SAMPLE DATE	NO3+NO2 (mg/L)	PO4 as P (mg/L)	SETTLEABLE SOLIDS	TDS (mg/L)	TSS (mg/L)	Cl (mg/L)	FREE CN (mg/L)	TOTAL CN (mg/L)	WAD CN (mg/L)	F (mg/L)	SO4 (mg/L)
PPW-13	01/17/91	0.05	0.020	0.100	520.000	5.0	14.0	0.100	0.005	0.005	1.3	61.0
	02/21/91	0.05	0.020	0.100	590.000	5.0	14.0	0.100	0.005	0.005	1.4	57.0
		0.050	0.020	0.100	555.000	5.000	14.000	0.100	0.005	0.005	1.350	59.000
PUPW-2	02/11/88	0.08	1.340		442.000	1.9	80.0	0.002	0.002		1.5	44.0
	02/18/88	0.05	0.667		490.000	2.8	92.0	0.002	0.002		0.3	56.0
	02/25/88	0.69	0.010		561.000	16.0	14.1	0.002	0.002		1.4	58.0
	03/02/88	0.10	0.380		470.000	7.2	44.3	0.002	0.002		0.4	121.0
	03/09/88	0.13	0.260		460.000	4.0	43.1	0.002	0.005		0.6	130.0
	03/16/88	0.13	0.655		463.000	2.4	44.0	0.002	0.006		0.4	110.0
	03/24/88	0.24	0.025		394.000	1.2	26.3	0.002	0.003		0.5	32.8
		0.202	0.477		468.571	5.071	49.114	0.002	0.003		0.729	78.829

BARRICK GOLDSTRIKE MINES
WATER QUALITY DATABASE
(All data are total values)

WELL NUMBER	TEMP. (C)	Al (mg/L)	Ba (mg/L)	B (mg/L)	Cd (mg/L)	Ca (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Mg (mg/L)	Mn (mg/L)	Ni (mg/L)	K (mg/L)	Si (mg/L)	Ag (mg/L)	Na (mg/L)
GEOCHEMICAL WEIGHTING																
SET 1 (85.7%)																
AA WELL		0.094	0.052	0.134	0.008	30.588	0.007	0.014	0.573	15.425	0.053	0.011	6.294	32.731	0.007	28.613
BAZZA WELL		0.148	0.127	0.783	0.010	92.263	0.008	0.045	1.914	24.800	0.062	0.015	19.413	25.963	0.008	69.763
WW-1		0.103	0.041	0.175	0.009	68.300	0.015	0.012	0.598	37.017	0.010	0.013	7.450	15.683	0.008	37.417
BW-3		0.100	0.143	0.780	0.010	89.300	0.005	0.006	0.650	21.900	0.064	0.011	21.600	16.000	0.005	75.200
BW-4		0.100	0.153	0.833	0.005	92.000	0.005	0.005	0.673	22.333	0.026	0.010	21.667	19.000	0.005	73.000
BW-5		0.100	0.170	0.800	0.005	88.500	0.005	0.007	0.210	21.000	0.016	0.013	20.500	18.750	0.005	76.250
BW-6		0.100	0.120	0.775	0.005	89.500	0.005	0.005	0.465	22.750	0.090	0.010	19.500	14.500	0.005	72.500
BW-7		0.100	0.170	0.800	0.005	89.500	0.005	0.005	0.425	21.000	0.015	0.010	20.000	19.000	0.005	74.500
MEAN VALUES		0.106	0.122	0.635	0.007	79.994	0.007	0.012	0.688	23.278	0.042	0.011	17.053	20.203	0.006	63.405
SET 2 (14.3%)																
BW-1		0.875	0.135	0.750		79.994	0.007	0.012	0.688	23.278	0.042	0.011	17.053	20.203	0.006	63.405
BW-2		0.100	0.147	0.778	0.005	90.000	0.005	0.005	0.352	22.111	0.016	0.010	21.667	18.000	0.005	74.889
P-181		0.100	0.079	0.134	0.010	41.435	0.014	0.018	0.554	20.075	0.011	0.019	2.688	29.663	0.025	27.950
PPW-2		0.100	0.135	0.751	0.006	88.000	0.005	0.005	0.153	24.818	0.043	0.014	17.082	18.091	0.005	67.818
PPW-3R		0.084	0.138	0.515	0.005	79.000	0.005	0.008	0.215	25.750	0.061	0.011	10.300	12.750	0.005	56.750
PPW-4		0.155	0.136	0.745	0.005	86.182	0.005	0.019	0.138	22.455	0.018	0.015	16.029	17.818	0.005	68.182
PPW-6		0.100	0.157	0.833	0.005	65.668	0.005	0.014	7.120	15.341	0.018	0.010	21.333	17.667	0.020	74.000
FPW-8		0.100	0.160	0.743	0.005	86.429	0.005	0.005	0.127	22.714	0.006	0.011	16.286	16.857	0.005	68.143
PPW-9		0.100	0.050	0.100	0.005	61.667	0.005	0.005	0.113	34.667	0.014	0.010	6.033	9.667	0.005	31.667
PPW-10		0.100	0.098	0.525	0.006	89.000	0.005	0.005	0.225	25.000	0.015	0.018	13.250	16.250	0.005	58.250
PPW-12		0.100	0.154	0.757	0.005	90.857	0.005	0.005	0.690	22.000	0.020	0.010	22.286	15.429	0.005	75.286
PPW-13		0.100	0.130	0.800	0.005	87.500	0.005	0.005	0.765	21.500	0.028	0.010	19.500	17.500	0.005	72.500
PUPW-2		0.100	0.126	0.258	0.010	54.329	0.045	0.016	1.194	31.757	0.042	0.024	6.743	24.057	0.024	40.257
MEAN VALUES		0.163	0.126	0.592	0.006	76.928	0.009	0.009	0.949	23.959	0.026	0.013	14.635	17.996	0.009	59.930
		Al (mg/L)	Ba (mg/L)	B (mg/L)	Cd (mg/L)	Ca (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Mg (mg/L)	Mn (mg/L)	Ni (mg/L)	K (mg/L)	Si (mg/L)	Ag (mg/L)	Na (mg/L)
WEIGHTED VALUES		0.114	0.123	0.629	0.007	79.555	0.007	0.012	0.726	23.375	0.040	0.012	16.707	19.888	0.006	62.908

BARRICK GOLDSTRIKE MINES
WATER QUALITY DATABASE
(All data are total values)

WELL NUMBER	Zn (mg/L)	Au (mg/L)	ALKALINITY as CaCO3	CO3 (mg/L)	HARDNESS as CaCO3	HCO3 (mg/L)	OH (mg/L)	pH (s.u.)	E.C. (umhos)	TURBIDITY (mg/L)	As (mg/L)	Hg (mg/L)	Pb (mg/L)	Se (mg/L)	Tl (mg/L)	NH4 as N (mg/L)
GEOCHEMICAL WEIGHTING																
SET 1 (85.7%)																
AA WELL	0.071	0.007	143.500	0.000	157.563	175.063	0.000	7.484	391.813	3.117	0.085	0.000	0.051	0.004	0.008	0.333
BAZZA WELL	0.075	0.008	410.375	0.000	339.500	499.500	0.000	7.268	926.750	18.600	0.030	0.001	0.028	0.004	0.008	1.184
WW-1	0.029	0.024	147.333	0.000	308.167	179.167	0.000	5.713	805.500	0.907	0.043	0.000	0.012	0.005	0.009	0.228
BW-3	0.009	0.005	413.000	0.000	282.000	500.000	0.000	7.420	855.000	6.830	0.031	0.000	0.005	0.005	0.005	1.590
BW-4	0.015	0.005	450.000	0.000	323.333	543.333	0.000	7.200	880.000	8.533	0.180	0.000	0.005	0.005	0.005	1.567
BW-5	0.007	0.005	425.000	0.000	307.500	512.500	0.000	7.275	907.500	1.825	0.009	0.000	0.005	0.005	0.005	1.750
BW-6	0.009	0.005	412.500	0.000	317.500	502.500	0.000	7.300	885.000	4.700	0.018	0.000	0.005	0.005	0.005	1.325
BW-7	0.005	0.005	445.000	0.000	150.000	540.000	0.000	7.150	905.000	4.500	0.012	0.000	0.005	0.005	0.005	1.950
MEAN VALUES	0.027	0.008	355.839	0.000	273.195	431.508	0.000	7.101	819.570	6.126	0.051	0.000	0.014	0.005	0.006	1.241
SET 2 (14.3%)																
BW-1	0.027	0.008	355.839	0.000	273.195	431.508	0.000	7.101	819.570	6.126	0.051	0.000	0.014	0.005	0.006	1.241
BW-2	0.011	0.007	430.000	0.000	314.444	496.667	0.000	7.422	847.778	2.789	0.011	0.000	0.014	0.005	0.005	1.711
P-181	0.096	0.012	153.250	0.000	193.500	186.750	0.000	7.721	495.875	2.071	0.026	0.000	0.039	0.002	0.010	0.185
PPW-2	0.038	0.005	389.091	0.000	320.909	473.636	0.000	7.482	830.000	2.082	0.361	0.001	0.006	0.007	0.005	0.655
PPW-3R	0.107	0.005	307.500	0.000	257.500	372.500	0.000	7.550	695.000	0.738	0.173	0.002	0.005	0.006	0.005	0.200
PPW-4	0.062	0.006	395.455	0.000	309.091	478.182	0.000	7.109	801.818	3.190	0.112	0.003	0.009	0.005	0.005	0.202
PPW-6	0.006	0.005	403.333	0.000	313.333	490.000	0.000	7.767	956.667	3.300	0.137	0.000	0.005	0.005	0.005	1.567
PPW-8	0.035	0.005	391.429	0.000	310.000	472.857	0.000	7.457	817.143	1.314	0.203	0.003	0.004	0.008	0.005	0.200
PPW-9	0.170	0.005	120.000	0.000	296.667	140.000	0.000	7.833	740.000	1.000	0.170	0.000	0.005	0.007	0.005	0.200
PPW-10	0.078	0.010	332.500	0.000	325.000	397.500	0.000	7.350	907.500	2.525	0.272	0.006	0.005	0.010	0.005	1.775
PPW-12	0.009	0.006	435.714	0.000	311.429	528.571	0.000	7.571	855.714	3.957	0.017	0.000	0.005	0.005	0.005	1.729
PPW-13	0.005	0.005	415.000	0.000	310.000	500.000	0.000	7.750	850.000	3.350	0.070	0.000	0.005	0.005	0.005	1.750
PUPW-2	0.068	0.010	208.571	0.000	266.429	254.429	0.000	7.611	686.000	7.931	0.048	0.000	0.029	0.002	0.010	0.356
MEAN VALUES	0.055	0.007	333.668	0.000	292.423	401.738	0.000	7.517	792.543	3.106	0.127	0.001	0.011	0.005	0.006	0.905

	Zn (mg/L)	Au (mg/L)	ALKALINITY as CaCO3	CO3 (mg/L)	HARDNESS as CaCO3	HCO3 (mg/L)	OH (mg/L)	pH (s.u.)	E.C. (umhos)	TURBIDITY (mg/L)	As (mg/L)	Hg (mg/L)	Pb (mg/L)	Se (mg/L)	Tl (mg/L)	NH4 as N (mg/L)
WEIGHTED VALUES	0.031	0.008	352.668	0.000	275.945	427.251	0.000	7.161	815.705	5.695	0.062	0.000	0.014	0.005	0.006	1.193

BARRICK GOLDSTRIKE MINES
WATER QUALITY DATABASE
(All data are total values)

WELL NUMBER	NO3+NO2 (mg/L)	PO4 as P (mg/L)	SETTLEABLE SOLIDS	TDS (mg/L)	TSS (mg/L)	Cl (mg/L)	FREE CN (mg/L)	TOTAL CN (mg/L)	WAD CN (mg/L)	F (mg/L)	SO4 (mg/L)
GEOCHEMICAL WEIGHTING											
SET 1 (85.7%)											
AA WELL	0.464	0.171	0.110	289.750	9.925	18.231	0.063	0.004	0.005	0.451	47.863
BAZZA WELL	0.061	0.074	0.100	568.625	13.575	16.788	0.051	0.004	0.005	1.370	95.925
WW-1	1.329	0.028	0.100	557.500	4.033	60.950	0.038	0.056	0.109	0.407	140.367
BW-3	0.050	0.042	56.361	566.000	16.900	14.900	0.100	0.005	0.005	1.370	69.600
BW-4	0.050	0.020	0.100	573.333	9.667	15.333	0.100	0.005	0.005	1.333	58.667
BW-5	0.050	0.020	0.900	545.000	22.250	14.500	0.100	0.005	0.005	1.350	61.750
BW-6	0.050	0.020	0.800	542.500	20.000	15.000	0.100	0.005	0.005	1.250	69.000
BW-7	0.050	0.020	0.100	555.000	5.000	15.000	0.100	0.005	0.005	1.350	51.500
MEAN VALUES	0.263	0.049	7.321	524.714	12.669	21.338	0.081	0.011	0.018	1.110	74.334
SET 2 (14.3%)											
BW-1	0.263	0.049	1.830	524.714	12.669	21.338	0.081	0.011	0.018	1.110	74.334
BW-2	0.050	0.021	0.411	568.889	15.000	14.556	0.100	0.005	0.005	1.311	60.889
P-181	0.468	0.240		534.809	10.113	19.225	0.088	0.009		1.190	66.723
PPW-2	0.098	0.134	0.609	554.545	9.636	17.455	0.100	0.005	0.005	0.982	68.200
PPW-3R	2.500	0.033	0.100	485.000	7.000	20.750	0.100	0.005	0.005	0.650	69.750
PPW-4	0.446	0.075	0.100	548.182	5.182	16.818	0.100	0.005	0.005	0.936	65.273
PPW-6	0.067	0.050	0.100	576.667	5.333	13.667	0.100	0.005	0.005	1.333	82.667
PPW-8	0.224	0.074	0.887	538.571	10.714	16.429	0.100	0.005	0.005	0.771	65.857
PPW-9	0.053	0.037	0.100	480.000	5.333	54.333	0.100	0.005	0.005	0.500	166.667
PPW-10	4.275	0.115	0.100	565.000	5.500	24.500	0.100	0.021	0.021	0.650	82.250
PPW-12	0.050	0.021	0.100	541.429	5.000	13.857	0.100	0.005	0.005	1.357	59.000
PPW-13	0.050	0.020	0.100	555.000	5.000	14.000	0.100	0.005	0.005	1.350	59.000
PUPW-2	0.202	0.477		533.550	6.295	22.908	0.100	0.007		0.885	84.495
MEAN VALUES	0.673	0.103	0.403	538.950	7.906	20.757	0.098	0.007	0.008	1.002	77.316

	NO3+NO2 (mg/L)	PO4 as P (mg/L)	SETTLEABLE SOLIDS	TDS (mg/L)	TSS (mg/L)	Cl (mg/L)	FREE CN (mg/L)	TOTAL CN (mg/L)	WAD CN (mg/L)	F (mg/L)	SO4 (mg/L)
WEIGHTED VALUES	0.322	0.057	6.332	526.749	11.988	21.255	0.084	0.011	0.016	1.095	74.760

APPENDIX F

RECLAMATION COST ESTIMATE

BARRICK GOLDSTRIKE MINES INC.
RECLAMATION PLAN COST ESTIMATE

ITEM	ACTIVITY	ACRES	COST PER ACRE	TOTAL
1.	DRILL HOLE ABANDONMENT	See Section 19		
2.0	ROADS			
2.1	HAUL ROADS			
	EARTH MOVING/DEMOLITON			
	Regrading	118	$436	$51,448
	Culvert Removal and Drainage Restoration			$29,120
	Ripping	118	$130	$15,340
	Top Soil Hauling/Placement	118	$1,752	$206,736
	Top Soil Spreading			$0
	REVEGETATION			
	Seeds	118	$75	$8,850
	Fertilizer/Mulch	118	$17	$2,006
	Seed Bed Prep	118	$84	$9,912
	Planting	118	$46	$5,428
	Sub-total			$328,840
2.2	EXPLORATION ROADS AND DRILL PADS			
	EARTH MOVING/DEMOLITON			
	Regrading	26	$320	$8,320
	Ripping	26	$130	$3,380
	Top Soil Hauling/Placement			0
	Top Soil Spreading	26	$130	$3,380
	REVEGETATION			
	Seeds	26	$75	$1,950
	Fertilizer/Mulch	26	$17	$442
	Seed Bed Prep	26	$84	$2,184
	Planting	26	$46	$1,196
	Sub-total			$20,852
	Roads - sub-total			$349,692

3. TAILINGS IMPOUNDMENT RECLAMATION:

Impoundment Decommissioning			$864,300
Mobilization/Demobilization			$75,000
EARTH MOVING/DEMOLITION			
Ripping	510	$130	$66,300
Top Soil Hauling/Placement	510	$1,752	$893,520
Top Soil Spreading			$0
REVEGETATION			
Seeds	510	$75	$38,250
Fertilizer/Mulch	510	$17	$8,670
Seed Bed Prep	510	$84	$42,840
Planting	510	$46	$23,460
Sub-total			$2,012,340

4. WASTE ROCK DISPOSAL AREA RECLAMATION:

Mobilization/Demobilization			$75,000
EARTH MOVING/DEMOLITION - Flat Surfaces			
Regrading	885	$82	$72,570
Top Soil Hauling/Placement	885	$1,752	$1,550,520
Top Soil Spreading	885	$0	$0
Ripping	885	$130	$115,050
EARTH MOVING/DEMOLITION - Sloped Surfaces			
Regrading	928	$2,514	$2,332,992
Top Soil Hauling/Placement	928	$1,892	$1,755,776
Top Soil Spreading	928	$453	$420,384
REVEGETATION - Flat surfaces			
Seeds	885	$75	$66,375
Fertilizer/Mulch	885	$17	$15,045
Seed Bed Prep	885	$84	$74,340
Planting	885	$46	$40,710
REVEGETATION - Sloped Surfaces			
Seeds	928	$75	$69,600
Fertilizer/Mulch	928	$121	$112,288
Seed Bed Prep	928	$182	$168,896
Planting	928	$384	$356,352
Sub-total			$7,225,898

5.0 TAILINGS POND DAM RECLAMATION

Mobilization/Demobilization			$0

5.1 TAILINGS POND DAM RECLAMATION

EARTH MOVING/DEMOLITION			
Regrading	175	$663	$116,025
Top Soil Hauling/Placement	175	$1,892	$331,100
Top Soil Spreading	175	$453	$79,275
REVEGETATION			
Seeds	175	$75	$13,125
Fertilizer/Mulch	175	$121	$21,175
Seed Bed Prep	175	$182	$31,850
Planting	175	$384	$67,200
Sub-total			$659,750

6. TRENCH RECLAMATION: Not Applicable (1)

7. HEAP LEACH RECLAMATION:

Heap Leach Decommissioning			$1,877,500
Mobilization/Demobilization			$0
EARTH MOVING/DEMOLITION - Flat Surfaces			
Top Soil Hauling/Placement	114	$1,752	$199,728
Top Soil Spreading	114	$0	$0
Ripping	114	$130	$14,820
EARTH MOVING/DEMOLITION - Sloped Surfaces			
Breach Liners	220	$39	$8,580
Regrading	220	$663	$145,860
Top Soil Hauling/Placement	220	$1,892	$416,240
Top Soil Spreading	220	$453	$99,660
REVEGETATION - Flat surfaces			
Seeds	114	$75	$8,550
Fertilizer/Mulch	114	$17	$1,938
Seed Bed Prep	114	$84	$9,576
Planting	114	$46	$5,244
REVEGETATION - Sloped Surfaces			
Seeds	220	$75	$16,500
Fertilizer/Mulch	220	$121	$26,620
Seed Bed Prep	220	$182	$40,040
Planting	220	$384	$84,480
Sub-total			$2,955,336

8. SOLUTION/SETTLING PONDS RECLAMATION:

Mobilization/Demobilization			$25,000
EARTH MOVING/DEMOLITION			
Fold Liners	23	$165	$3,795
Regrade Ponds	23	$3,701	$85,123
Top Soil Hauling/Placement	23	$1,752	$40,296
Top Soil Spreading			$0
REVEGETATION			
Seeds	23	$75	$1,725
Fertilizer/Mulch	23	$17	$391
Seed Bed Prep	23	$84	$1,932
Planting	23	$46	$1,058
Sub-total			$159,320

9. OPEN PITS RECLAMATION: Not Applicable (2)

10. UNDERGROUND MINES ABANDONMENT: Not Applicable (3)

11. INSTREAM MINING RECLAMATION: Not Applicable (4)

12. RECLAMATION MONITORING $248,480

13.0 FACILITIES AND FACILITES ACCESS, YARDS AND STOCKPILES

13.1 FACILITIES

EARTH MOVING/DEMOLITION			
Foundations and Slab Burial	48	$3,601	$172,848
Ripping	102	$130	$13,260
Top Soil Hauling/Placement	102	$1,752	$178,704
Top Soil Spreading			$0
REVEGETATION			
Seeds	102	$75	$7,650
Fertilizer/Mulch	102	$17	$7,650
Seed Bed Prep	102	$84	$1,734
Planting	102	$46	$8,568
Sub-total			$390,414

13.2 FACILITIES ACCESS, YARDS AND STOCKPILES

EARTH MOVING/DEMOLITION			
Ripping	553	$130	$71,890
Top Soil Hauling/Placement	553	$1,752	$968,856
Top Soil Spreading			$0
REVEGETATION			
Seeds	553	$75	$41,475
Fertilizer/Mulch	553	$17	$9,401
Seed Bed Prep	553	$84	$46,452
Planting	553	$46	$25,438
Sub-total			$1,163,512
Facilities, facilities access, yards, and stockpiles sub-total			$1,553,926

14. BUILDING DEMOLITION: Not Applicable (5)

15. BUILDING REMOVAL: Not Applicable (6)

16. UTILITY RECLAMATION: Not Applicable (7)

17. BENEFICATION RECLAMATION: Not Applicable (8)

18. UNDERGROUND STORAGE TANKS: Not Applicable (9)

19. DRILL HOLE, AND WELL RECLAMATION:

	Number	$/Well	Total
Exploration holes	100	$4,026	$402,600
Environmental Monitoring Ports	21	$885	$18,585
Potable Water Wells	2	$5,193	$10,386
Dewatering Wells	30	$53,343	$1,600,290
Sub-total			$2,031,861

20. FENCING/SIGNS $135,000

21. OTHER EQUIPMENT: Not Applicable (10)

22. LANDFILL CLOSURE

EARTH MOVING/DEMOLITION			
Backfill	4	$4,160	$16,640
Ripping	4	$130	$520
Top Soil Hauling/Placement	4	$1,752	$7,008
Top Soil Spreading	4	$0	$0
REVEGETATION			
Seeds	4	$75	$300
Fertilizer/Mulch	4	$17	$68
Seed Bed Prep	4	$84	$336
Planting	4	$46	$184
Sub-total			$25,056

RECLAMATION COSTS $17,356,659

PROJECT (DIRECT) ("ADMINISTRATIVE COSTS") OVERHEAD AND OFFICE (INDIRECT COSTS) OVERHEAD:

$17,356,659 * 18 percent = $3,124,199	$3,124,199
TOTAL:	$20,480,858

ESTIMATE PREPARED BY: Valerie Sawyer, Barrick, 7 May 91
DATE PREPARED: Don S. Smith III, Barrick 5/7/91

FOOTNOTES

(1) Any trenches to be reclaimed have been included in the cost estimate for facilities reclamation.

(2) The Post/Betze Pit will not be reclaimed.

(3) Barrick does not anticipate that any of its underground operations will exist at the time of mine closure.

(4) Barrick is not conducting instream mining operations.

(5) Building demolition and equipment removal is not included in the cost estimate. The salvage value of the equipment and buildings will exceed the cost of building demolition. The cost of foundation removal and burial is included in the cost estimate for facilities reclamation.

(6) See Footnote (5).

(7) See Footnote (5).

(8) See Footnote (5).

(9) There are no underground storage tanks at the Goldstrike Mine.

(10) All facilities have been accounted for in the cost estimate.