# DRAFT ENVIRONMENTAL IMPACT STATEMENT
# JERRITT CANYON PROJECT
# GOLD MINE AND MILL
# ELKO COUNTY, NEVADA



**Lead Federal Agency**

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Humboldt National Forest
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**Abstract**

This Draft Environmental Impact Statement is in response to Freeport Gold Company's proposed Operating Plan filed with the Humboldt National Forest, to construct and operate an open-pit mine, a cyanidization mill, and tailings disposal pond within and adjacent to the Humboldt National Forest. Portions of this project will extend onto private and Bureau of Land Management surface lands. The proposed project is in Elko County, Nevada.

Comments regarding this Draft Environmental Impact Statement must be received by

the Forest Supervisor, Humboldt National Forest, by FEB 16 1980

# SUMMARY

## DRAFT ENVIRONMENTAL IMPACT STATEMENT
## JERRITT CANYON PROJECT
## GOLD MINE AND MILL
## ELKO COUNTY, NEVADA

## Description

In May 1978, Freeport Gold Company submitted an Operating Plan to the Humboldt National Forest for a permit to mine and mill gold ore. Because of the magnitude of the proposed action, the Forest Service would not approve the Operating Plan until the requirements of the National Environmental Policy Act of 1969 (NEPA) were satisfied. A decision was made by the Forest Supervisor to prepare an EIS on the proposed Federal action, in compliance with new Council of Environmental Quality (CEQ) regulations (November 29, 1978) of NEPA.

This Draft Environmental Impact Statement (EIS) has been prepared by the U.S. Department of Agriculture, Forest Service (FS), with a cooperative effort by the U.S. Department of the Interior, Bureau of Land Management (BLM) in response to an application by Freeport Gold Company to mine and mill gold at their Jerritt Canyon Project in Elko County, Nevada. The proposed gold mine may involve five separate open pits in the Independence Mountains. A gold processing mill and tailings disposal pond will be constructed. These components will be connected by transportation and utility corridors.

A number of issues and concerns have been raised by private and public individuals, agencies, and organizations. Similarly, Freeport Gold Company, the Forest Service, and various local agencies and organizations have identified positive opportunities which could arise because of the proposed project. In general, there has been no major opposition to the construction and operation of the project. The six priority concerns raised by the public and governmental agencies for the Jerritt Canyon Project were effects on:

- Livestock management
- Significant deer winter range
- Sage grouse strutting and brood grounds
- Threatened Lahontan cutthroat trout
- Soil erosion and increased sediment load in streams, and
- Water quality from accidental discharge of toxic materials.

Mitigation programs were designed to alleviate some of the disruption to livestock by designing cattle passes through long cut slopes paralleling corridors. Internal educational programs and company policies instituted by Freeport Gold Company should limit the loss of livestock and deer due to excess vehicle speed, etc. Sage grouse habitat will be avoided whenever possible, however, any North Fork Valley development will probably cause an irretrievable loss of some sage grouse. Strong mitigation measures will be employed on any Foreman Creek or California Creek alternatives to provide sedimentation control from the impact of new corridors, a mill complex, or a tailings disposal area. Bridge and road construction will be performed during the late summer or fall, unless otherwise authorized, and revegetation programs will be initiated on cut and fill slopes. North Fork corridors will be situated as far as possible away from Foreman and California Creeks. Special geotechnical siting and design studies have been undertaken to construct a "fail-safe" tailings embankment and a natural clay tailings pond liner.

## Alternatives Considered

### No Action Alternative

The No Action Alternative would mean approval by the Forest Service of a small mine comparable to mines already existing on the Forest. Such a mine would be capable of producing approximately 25,000 tons of ore annually, or 6,100 troy ounces of gold. Such a mine would utilize a heap leaching facility and on-site processing plant.

### Waste Rock Disposal Alternatives

- Alternative 1 - Valley Fill and Sidehill Disposal
- Alternative 2 - Modified Valley Fill
- Alternative 3 - Sidehill Disposal

### Mill - Corridor - Tailings Pond Alternatives

- Alternative 1 - Wright Ranch mill site, Jerritt Canyon corridor, Wright Ranch tailings pond.
- Alternative 2 - Ellison Ranch mill site, Northwest corridor, Ellison Ranch tailings pond.
- Alternative 3 - Mill Site B, Northwest corridor, Ellison Ranch tailings pond.

- Alternative 4 - Mill Site B, Rancho Grande-California Creek corridor, Section 33 tailings pond.
- Alternative 5 - Section 33 mill site, - Rancho Grande-Winters Creek corridor, Section 33 tailings pond. (This is the Forest Service's preferred alternative.)
- Alternative 6 - North Fork mill site, Winters Creek corridor, North Fork tailings pond.
- Alternative 7 - Winters Creek mill site, Winters Creek corridor, North Fork tailings pond.

### Power Transmission Line Alternatives

- Alternative 1 - Highway II corridor.
- Alternative 2 - Highway 51 corridor.
- Alternative 3 - Saval Ranch corridor.

## Summary of Environmental Effects

### No Action Alternative

The No Action Alternative would allow Freeport to develop a small-scale mining operation, comparable to mines already in existence on the National Forest. A mining operation on this scale would probably use a heap leaching operation in the Independence Valley to extract gold and use the existing Northwest corridor to access the mine. The No Action Alternative would have minor adverse effects on recreation and visual quality. The socioeconomic effects, including new jobs, increased population, and increased tax receipts, would be relatively small in comparison with the effects of the proposed action. The No Action Alternative would have a moderate effect on archeological resources. Approximately 150 acres of land would be disturbed, including some talus slopes, alluvial sagebrush, mixed shrub/sagebrush, aspen, and grassland. The corridor and mining activity would affect sheep and cattle grazing allotments, and road kills of wildlife would occur, but the effects would be minimal in comparison to the proposed action. The No Action Alternative would have negligible effects on surface hydrology; the soil hazard is rated moderate to high, but underlying formations are stable. The emissions of total suspended particulates could be low and the noise level would be much lower than for the proposed project. The duration of the project could be considerably greater for the No Action Alternative, due to the reduced rate of mining the ore.

### Waste Rock Disposal Alternatives

Alternative 1. This alternative would have a moderate adverse effect on the quality of grazing resources, golden eagle habitat, and visual quality. This alternative would also contribute to moderate soil erosion due to the amount of sidehill waste rock disposal. There would be minor effects on livestock management, surface water and ground water quality.

Alternative 2. The visual quality of the area would be moderately affected by this alternative, as would the golden eagle habitat in Jerritt Canyon, and grazing resources in the area. The potential for revegetation of this alternative is slightly better than for Alternatives 1 and 3. The effects on surface and ground water quality, and livestock management were evaluated as minor.

Alternative 3. The adverse effects on quality of grazing resources, livestock management, golden eagle habitat, soil erosion loss, and visual quality would be moderate. The effects of this alternative would be minor on surface and ground water quality.

### Mill - Corridor - Tailings Pond Alternatives

Alternative 1. This alternative would have major adverse effects on livestock management in the Jerritt Canyon area and the direction in the Mountain City District Multiple Use Plan. Soil erosion and sedimentation effects on Jerritt Canyon would be major, as would effects on deer winter range. Nesting success of golden eagles would be affected in a major way. Moderate effects would be created on surface hydrology, visual quality, and cultural resources.

Alternative 2. The corridor within this alternative would have moderate adverse effects on soil erosion and the potential for recovery of soil and vegetation resources. The tailings pond site would affect ground water quality and cultural resources to a moderate degree. Deer winter range would also experience moderate effects.

Alternative 3. The corridor within this alternative would contain a tailings slurry pipeline and would have moderate adverse effects on soil erosion and the potential for recovery of soil and vegetation resources. The corridor would also have moderate effects on surface water quality and deer winter range. The tailings pond site would have moderate effects on ground water quality and archeological resources.

Alternative 4. This alternative would have major adverse effects on the management of livestock grazing with moderate effects on forage resources and the Saval Ranch Study. Sage grouse and the threatened Lahontan cutthroat trout would receive moderate effects, as would soil erosion, surface water quality, visual quality resources, and cultural resources. The corridor would contain a tailings slurry pipeline. A minor socioeconomic benefit would result from access to the project from the North Fork Valley.

Alternative 5. Moderate adverse effects would be created on sage grouse, forage resources for grazing, and archeological resources. There would be minor effects on livestock management programs, the Saval Ranch Study, and the Lahontan trout. A minor socioeconomic benefit would result from access from the North Fork Valley.

Alternative 6. Sage grouse would receive major adverse effects from this alternative, while livestock management, grazing resources, and air quality would receive moderate effects. The Lahontan trout habitat would experience minor effects, and there would be a minor socioeconomic benefit from project access from the North Fork Valley.

Alternative 7. The corridor and tailings pond would both create major adverse effects on sage grouse, and the corridor with a tailings slurry pipeline could potentially have moderate effects on surface water quality. The mill site would have moderate effects on visual quality resources, and the alternative would have a minor effect on the Lahontan trout. There would be a minor socioeconomic benefit from accessing the project from the North Fork Valley.

Looking to southeast at Highway 11 passing through Taylor Canyon.

**Power Transmission Line Alternatives**

Alternative 1. The Highway 11 corridor would have a moderate adverse effect on the visual quality of the Independence Mountains due to the length of the line and the rugged terrain. The effects of this alternative on candidate threatened plant species, the potential long range recovery of natural soil and vegetation conditions, potential soil erosion loss, surface and ground water quality are all minor.

Alternative 2. The adverse effects of the Highway 51 corridor would be minor on candidate threatened plant species, surface and ground water quality, and the visual quality of the area.

Alternative 3. The Saval Ranch corridor would have a minor adverse effect on the Saval Ranch Research and Evaluation Project, sage grouse strutting and brood grounds, and surface and ground water quality. Visual quality would be moderately affected by this corridor as it would pass through an area relatively free of man-made structures. This corridor would benefit golden eagle habitat as the powerline would provide new perches for the raptors.

## Identification of Forest Service Preferred Alternative

- Waste Rock Disposal: Alternative 2 -Modified Valley Fill
- Mill - Corridor - Tailings Pond: Alternative 5 - Section 33 mill - Rancho Grande - Winters Creek corridor, Section 33 Tailings Pond
- Power Transmission Line: Alternative 3 - Saval Ranch corridor

## Date of Transmission to EPA and the Public: DEC 17 1979

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# 1. INTRODUCTION

## The Proposed Federal Action

A Draft Environmental Impact Statement (EIS) was prepared by the U.S. Department of Agriculture, Forest Service (FS), with a cooperative effort by the U.S. Department of the Interior, Bureau of Land Management (BLM) in response to an application by Freeport Gold Company to mine and mill gold at their Jerritt Canyon Project in Elko County, Nevada. The proposed gold mine could involve five separate open pits in the Independence Mountains. A gold processing mill and tailings disposal pond will be constructed. These components will be connected by access and utility corridors. Figure 1-1 shows the general location of this project. The Federal action considered in the EIS is the approval by the Forest Supervisor, Humboldt National Forest, of a mining and milling Operating Plan based on the proposed action identified in Appendix C.[1] The Supervisor's response may be approval of the Operating Plan as proposed or to defer the decision based on proper grounds.

In most Environmental Impact Statements, the No Action Alternative indicates maintenance of the status quo. This is not the case for the Jerritt Canyon Project because Freeport Gold Company has the right to mine on the National Forest under the General Mining Law of 1872. The Forest Service is charged with administering and managing the Forest lands under 36 CFR 252, and mining is approved as an acceptable use of Forest land in the Independence Mountain area of the Humboldt National Forest. Freeport Gold Company must file an Operating Plan under 36 CFR 252 for their mining project. The Forest Supervisor will then approve, modifiy, or deny the Operating Plan. In most cases, denying approval of the Operating Plan would be the No Action Alternative. In this case, the No Action Alternative means Freeport could develop a mine comparable to the size of existing mines already developed on the Forest. Existing mining on the Humboldt National Forest consists of small mines for silver, gold, gravel, barite, and other minerals. The largest of the existing mines are barite mines producing 25,000 tons annually. Therefore, this EIS defines the No Action Alternative as denial of Freeport's Operating Plan for the proposed mine, following which Freeport could develop a small scale gold mine comparable to existing mines on the Forest.

Freeport Gold Company's original Operating Plan has been revised three times since the original submission in May of 1978. This flexibility is in part due to Freeport's recognition of significant environmental barriers that have been identified throughout the analysis. Freeport currently proposes to submit a draft revised Operating Plan that will take into consideration the Forest Service preferred alternatives and the implementation requirements identified in this EIS.

The Forest Service, under the 1897 Organic Act, the Multiple Use Mining Act of 1955, and the Multiple Use Sustained Yield Act of 1960, administers the surface uses of the National Forest system, including administration of mining claims

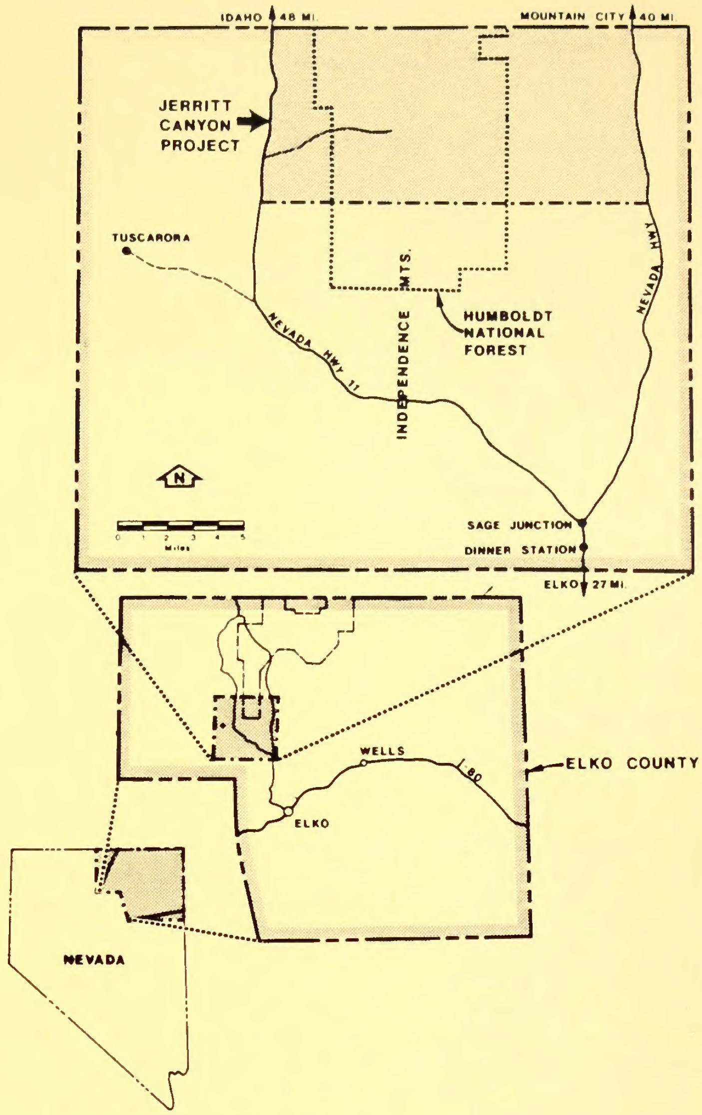



**FIGURE 1-1 Location of Jerritt Canyon Project**

located on National Forest land under the General Mining Law of 1872 (36 CFR Parts 251 and 252). All aspects of the proposed operations, as they affect National Forest surface uses, are subject to Operating Plan or special use permit approval by the Forest Service.[2]

Where the land surface is under BLM management responsibility, BLM approves the rights-of-way or requests for surface use. BLM formulates stipulations to be included in permits and licenses for the protection of surface and non-mineral resources, and for reclamation of same according to the Federal Land Policy and Management Act of 1976. Possible actions which BLM might consider include right-of-way grants for corridors (roads and powerlines) and the issuance of mill site patents on BLM land.

A joint agreement was made among representatives of the Forest Service and BLM that the Forest Service would act as the lead agency in supervising the preparation of this EIS and in conducting the environmental review required by NEPA relative to the Federal actions. BLM agreed to become a cooperating agency in this process and supplied input to this Environmental Impact Statement with regard to matters of BLM jurisdictional interest or responsibility.[3]

This Environmental Impact Statement is issued by the Forest Service in compliance with new regulations (November 29, 1978) of NEPA. In order to ensure that planning and decisions reflect environmental values, and to avoid potential conflicts, the new regulations specifically include the following requirements:

- EIS should be analytic and concise, instead of encyclopedic.
- Impacts should be presented in proportion to their significance.
- EIS should include the full range of alternatives to be considered by the responsible agency line officer.
- EIS should document the extent to which each alternative will comply with NEPA.

## Background

Freeport Exploration Company, a wholly-owned subsidiary of Freeport Minerals Company, and the FMC Corporation formed a joint venture partnership in 1976 for the purpose of mining and milling gold ore on the Humboldt National Forest. The FMC Corporation had been actively exploring the Jerritt Canyon area since 1971.

In July 1978, Freeport announced that a potential gold-bearing ore body of at least 5,000,000 tons, containing greater than 0.3 ounces of gold per ton of ore, had been discovered in the Jerritt Canyon area. The discovery is located within a 42-square mile claim block in the Mountain City District of the Humboldt National Forest.[4] Surface land ownership within and surrounding the claim block is shown in Figure 1-2.

Under an approved Forest Service exploration operating plan (dated June 21, 1977), Freeport Exploration Company is presently conducting exploration drilling in other portions of the claim block to determine gold potential. An Environmental Analysis Report was prepared by the Forest Service in March 1976 on the proposed Jerritt Canyon Project exploration program. A separate company, the Freeport Gold Company, was formed in 1978 by Freeport Minerals Company, to carry on the gold mine and mill development phase of operations.[5]

In May of 1978, Freeport submitted an Operating Plan to the Humboldt National Forest for a permit to mine and mill gold ore. Because of the magnitude of the proposed action, the Forest Service would not approve the Operating Plan until the requirements of NEPA were satisfied. A decision was made by the Forest Supervisor to prepare an EIS on the proposed Federal action.[1]

On October 6, 1978, the Humboldt National Forest and Freeport Gold Company entered into a Memorandum of Understanding (MOU) specifying the responsibilities for the preparation of this EIS. The Forest Service contracted the environmental studies and preparation of the EIS to an independent consulting firm, while retaining the ultimate responsibility for the EIS, under a third party agreement. Freeport assumed the financial responsibility for the preparation of the EIS. After reviewing the qualifications of five firms, Environmental Research & Technology, Inc. (ERT) was selected to perform a year-long environmental baseline program, completed in September 1979, and to prepare the necessary environmental reports. ERT has completed a one-year study on the Jerritt Canyon project area, and has worked with Forest Service resource personnel to prepare this EIS.[6] The names and qualifications of the Forest Service and ERT technical staff and subcontractors that developed the information used in this report are included in Appendix A of this EIS.

## General Description of Project Area

Elko County is in the northeastern corner of Nevada. Its county seat, the City of Elko, is along Interstate 80, nearly halfway between Salt Lake City, Utah, and Reno, Nevada. It is bounded by the Nevada counties of Humboldt on the west and Lander, Eureka, and White Pine on the south, the State of Utah on the east, and the State of Idaho on the north. (See Figure 1-1).

The Jerritt Canyon project area is located approximately 50 miles northwest of Elko, Nevada. The project area covers 14 full and 19 partial sections of Humboldt National Forest, Bureau of Land Management, and private land in the southern tip of the Independence Mountains. The historic mining town of Tuscarora is approximately 11 miles to the southwest, and Jacks Creek recreational area is 8 miles due north.

The proposed project area lies entirely within the Intermediate Zone of the Mountain City Ranger District Multiple Use Plan.[7] Special Multiple Use Plan Management Areas include: I-1, deer winter range, I-5, golden eagle nesting areas, and I-4, Lahontan cutthroat trout habitat. Deer winter range is located in the lower portions of the project area on the west side from Snow Canyon south to near the Forest Boundary. Golden eagle nesting sites are located in Jerritt and Burns Creeks, and Lahontan cutthroat habitat is located in Gance, Mahala, Foreman, and California Creeks. The Multiple Use Plan permits a variety of simultaneous uses in the project area. These uses include mining activities, recreation, livestock grazing, wildlife, fish, and other resource related activities. The Plan provides for varying degrees of protection for wildlife and Lahontan trout, watershed and surface water, soil, riparian and aspen areas, vegetation, and cultural and visual resources. No wilderness or wilderness further planning areas exist in or near the project area.

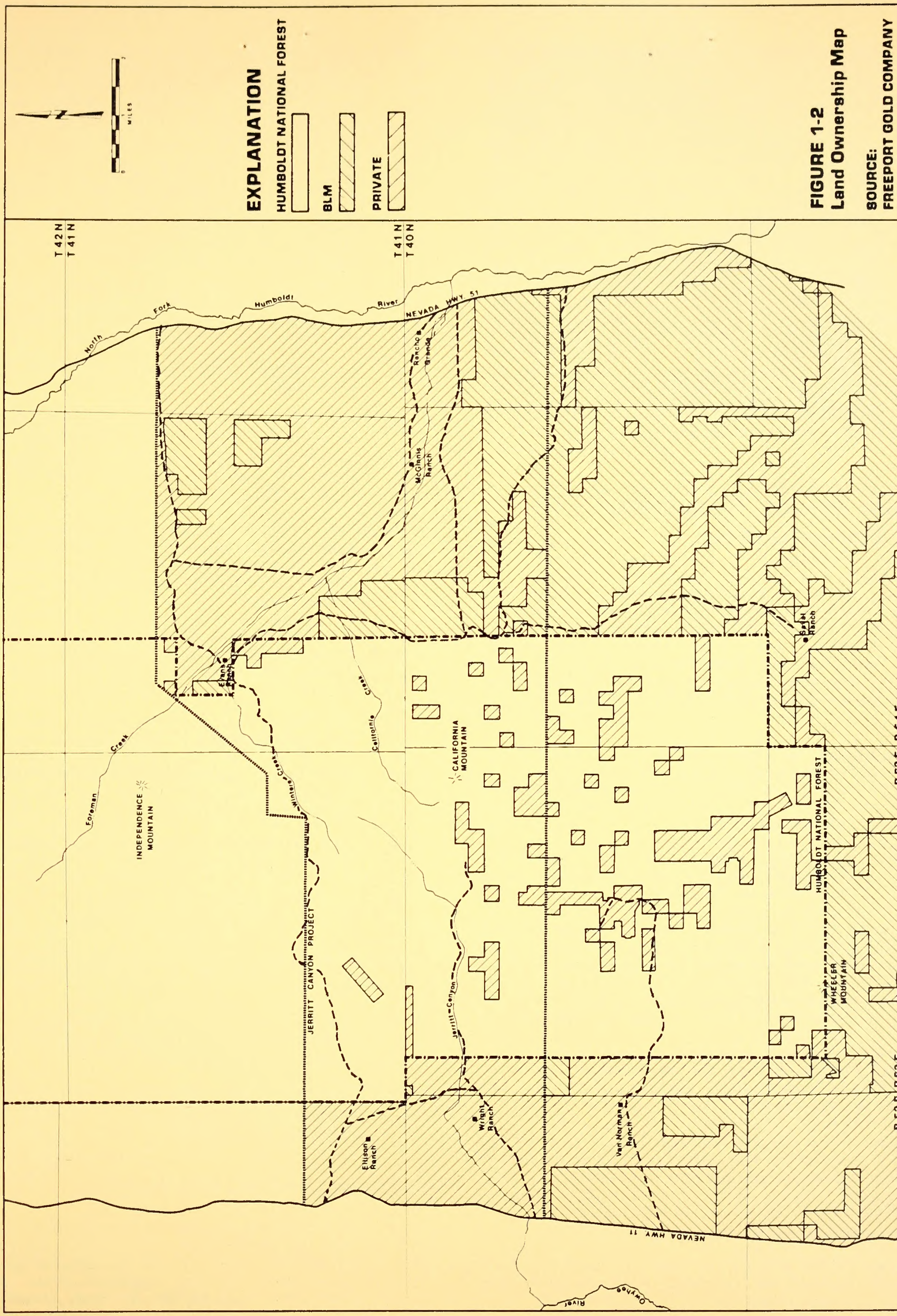


FIGURE 1-2
Land Ownership Map

SOURCE:
FREEPORT GOLD COMPANY

The Jarbidge Wilderness area is approximately 32 miles from the project area.

The project area includes both east and west slopes of the Independence Mountains with Jerritt and California Creeks being the dominant drainages. The area lies between 6,000 and 8,500 feet in elevation. The climate is typical of the Northern Great Basin with rather severe winters and mild to hot summers. Average annual precipitation over the area varies from 12 inches at the 6,000 foot level to 26 inches at the 8,000 foot level, the major part of which falls as snow during the winter. Some snow persists in the higher elevations until July. Snow precludes normal access to the project area from sometime in early December until early April each year. There is generally a period of three to five weeks in the spring during which the roads in the area are soft from melting snow and access is difficult if not impossible. The higher areas are often inaccessible because of mud and snow drifts as late as early June.[4]

## Major Issues, Concerns, and Opportunities

A number of major issues and concerns have been raised by private and public individuals, agencies, and organizations. Similarly, Freeport Gold Company, the Forest Service, and various local agencies and organizations have identified positive opportunities which could arise because of the proposed project.[7 8 9 10 11 12 13 14 15 16]

### Public Issues

- Can the Elko County school system absorb a significant increase in students?
- Will the traveling public on Nevada Highways 11 and 51 experience visual impacts from the project?
- Can a reclamation program be established to return the disturbed lands to a productive condition for future generations?
- What effects will the project have on recreation in the Independence Mountains?
- What effects will the project have on local housing, community services, and highways?
- What effects will the project have on the quantity and quality of water in Petaini Springs (at the Wright Ranch)?

### Agency Management Concerns

- What will be the aesthetic impacts of the project on existing or proposed wilderness areas?
- Will road cuts block the movement of livestock and wildlife, and reduce forage from project disturbance; will noise and project activity dislocate livestock and wildlife from entire canyons and reduce grazing resources?
- What effects will the project have on critical winter range for deer, summer range for deer, sage grouse, and chukar, and sage grouse strutting grounds; will noise and project activity negatively affect all wildlife?
- What effects will the project have on research for the Saval Ranch Research and Evaluation Project?
- Can cultural and historic resources be protected?
- Can habitat for threatened, endangered, or protected species be protected during construction and operation? (The golden eagle and Lahonton cutthroat trout occur in the area).
- Are there risks from the project of a catastrophe releasing toxic effluents to the environment, and will future generations be protected from residual effects of the project?
- Can surface and ground water resources be protected from contamination by either toxic effluents or tailings disposal?
- Will the project diminish water resources and water supply?
- What is the possibility of increased flood hazard or channel instabilities resulting from project activities?
- Can air quality standards be maintained if the project is developed?
- Will air quality be monitored during project construction and operation?
- Is energy consumption being considered in the evaluation of the project alternatives?
- What is the possibility of increased soil erosion affecting a larger area than proposed for development?
- Will this project prohibit or diminish the ability to recover other commercial minerals in the mining area?

### Opportunities Resulting from the Project

- Broaden the economic base of the City and County of Elko. The Jerritt Canyon Project will require 170 to 200 full-time employees. It is expected that all employees will reside in Elko County, with the major portion residing in the City of Elko. It is estimated that the annual salary requirements for the project will be on the order of $4,000,000. In addition, it is estimated that approximately $4,000,000 of annual operating supplies will be required. These operating supplies will be available for placement in the local market, and local vendors will be preferred, assuming quality, price, and availability are competitive.

- Substantially increase the tax revenues of Elko County on the order of $820,000 (or approximately 45 percent). Of the $820,000, $680,000 will come from proceeds taxes, $100,000 from property taxes, and $40,000 from sales tax.

- Provide approximately $100,000 to the State of Nevada from sales tax revenue.

- Assist the balance of payments deficit for the United States. In 1977, the United States produced 1,100,000 troy ounces of gold, while importing 4,250,000 troy ounces (U.S. Bureau of Mines). The Jerritt Canyon Project will produce approximately 170,000 troy ounces of gold per year.

- Possible construction of an electrical substation near the Independence Mountains which could provide an alternate source of electrical power for the City of Elko.

## Other Permits, Licenses, and Approvals

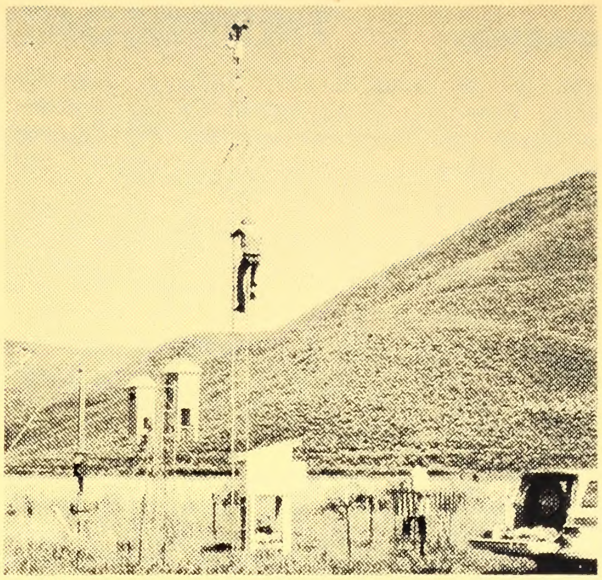
To bring this project to fruition, various permits and approvals must be obtained by Freeport Gold Company in addition to approval of their Operating Plan by the Forest Service. The following list describes the major permits and approvals necessary for the Jerritt Canyon Project.[4] Additional permits may be necessary during the life of the project.

- Prevention of Significant Deterioration (PSD) permit from the U.S. Environmental Protection Agency (EPA). Required prior to construction and must include emissions analysis and means of emissions control.

- New Source of Atmospheric Emissions permit from Nevada Division of Environmental Protection. Both a permit to construct and a permit to operate are required.

- Corridor rights-of-way approval (right-of-way grants) from BLM district and state offices.

- Approval of the archeological study by the Nevada Division of Historic Preservation and Archeology. The field study



Wright Ranch meteorological site with technician climbing to check wind instruments.

must be conducted on all potentially disturbed lands.

- Consultation with the Fish and Wildlife Service and Nevada Department of Wildlife concerning threatened, endangered, and protected species. This is a requirement of the Endangered Species Act, and the Bald and Golden Eagle Protection Act.

- Water well permit from the Nevada Division of Water Resources - State Water Engineer.

- Permit to construct a dam for a tailings pond from the Nevada Division of Water Resources.

- Approval to construct new road connecting with existing state highways, from the Nevada Department of Highways - State Highway Engineer.

- National Pollutant Discharge Elimination System (NPDES) permit to operate the facilities, from Nevada Division of Environmental Protection - Water Quality. The project is designed for no discharges, but the permit is required for accidental spills.

- Permit for transporting, storing, and using explosives, from U.S. Department of Treasury, U.S. Department of Labor, and Nevada State Inspector of Mines under the Federal Mine Safety and Health Act as amended in 1977.

- Approval of drinking water supplies and sewage treatment system, from EPA and Nevada Department of Human Resources - Health Division.

- Issuance of patents for possible 75-acre mill sites by BLM, as set forth in 43 CFR 3844.

# References


[1]Stewart, R. W. and G. A. Mealey. February 1979. Freeport Gold, Jerritt Canyon Project, Technical and Engineering Data for Environmental Report. Denver: Freeport Gold Company.

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[8]USDA, Forest Service, Humboldt National Forest. August 1978. Meeting on Study Plan for Jerritt Canyon Project Environmental Program. Elko, NV.

[9]Interagency Coordination Committee. April 1979. Meeting to Brief All Affected State and Federal Agencies on Jerritt Canyon Project. Carson City, NV.

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[11]Nevada Department of Conservation and Natural Resources. July 1978. Meetings to Brief Air, Water, Solid Waste, and Antiquities Groups about Jerritt Canyon Project. Carson City, NV.

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[15]Interagency Coordination Committee. September 1979. Meeting to Discuss Evaluation of Project Alternatives. Carson City, NV.

[16]Humboldt National Forest Interdisciplinary Team. September 1979. Evaluation of Project Alternatives and Selection of Preferred Alternative. Elko, NV.


View of Jerritt Canyon down from mill Site B to west.

# 2. AFFECTED ENVIRONMENT

## Introduction

In the summer of 1978, the Forest Service and its contractors began extensive environmental baseline studies on Freeport Gold Company's 42-square mile claim block, and on contiguous BLM and private land that may be affected by the proposed action. An interdisciplinary team was formed with expertise in the fields of recreation, visual resources, cultural resources, water resources, biology, soils, geology, socioeconomics, air resources, and noise. This team built upon the existing environmental information base on the region and collected new data to accurately describe the affected environment.

Regional and site-specific field studies were conducted during the period September 1978 through September 1979 in order to capture the seasonal variations of the existing environment. For several of the disciplines it was necessary to establish fixed monitoring stations and/or line transects to collect daily, monthly, or other seasonal data.

The results of the discipline literature surveys, field sampling and mapping, and data analyses were published in 12 technical reports which are on file with both the Humboldt National Forest and the District Office of the BLM in Elko, Nevada. Each technical report is organized in the format shown in Table 2-1. On the following pages, the significant features of the environment which might be affected by the Jerritt Canyon Project are briefly described using text, tables, graphics, and photographs. Detailed descriptions of each environmental discipline are included in the respective technical reports. The disciplines which are described in this chapter include:

- Recreation
- Visual Resources
- Cultural Resources
- Ground Water
- Surface Water
- Water Quality
- Aquatic Biology
- Wildlife
- Vegetation
- Soils
- Minerals & Geology
- Socioeconomics
- Air Resources
- Noise

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## Recreation

The topography and climate of Elko County are conducive to a wide range of recreational activities. Recreation is also encouraged by the large amount of public land managed by the Forest Service and Bureau of Land Management. However, current and projected recreational use of the project area is low, due to the isolated nature of the southern portion of the Mountain City District of the Humboldt National Forest.[1]

Hunting and fishing are the primary recreational activities in the area of the Jerritt Canyon Project. The number of annual hunter/angler days (12-hour) for the general area is estimated to be between 1,500 and 2,000.[2] Table 2-2 breaks down the recreational use days for the project area by activity.

**TABLE 2-2**
**Recreational Use Days**

| RECREATIONAL USE | DAYS (12-HOUR) |
|---|---|
| Angler Use | 419 |
| Deer Hunter Use | 1146 |
| Sage Grouse Hunter Use | 150 |
| Mountain Lion Hunter Use | 10 |
| Chukar Hunter Use | 25 |
| Miscellaneous Camping | 25 |
| **TOTAL** | **1775** |

**SOURCE: NEVADA DEPARTMENT OF WILDLIFE**

There are no developed campgrounds within the project study area. Jack Creek Campground is the nearest Forest Service recreational facility, and is approximately 11 miles north of Jerritt Canyon. Limited camping and picnicking does occur within the project area, but is minimal compared to the recreational use associated with hunting and fishing.[1]

The Nevada Department of Wildlife (formerly the Department of Fish and Game) has noted a reduction in the recreational use of the area during recent years, with a corresponding increase in the hunting and fishing success ratios. This reduction in hunter use may be due to increased energy costs, the new hunter quota system, and a possible trend away from hunting to non-consumptive recreational activities.[3 4 5]

## Visual Resources

The southern portion of the Mountain City Ranger District is isolated and is accessible via unimproved forest roads from Nevada Highway 51 to the east and Nevada Highway 11 to the west. Public use of the region is low with users falling into the following categories:[1 5]

- miners and prospectors
- ranchers
- hunters

- fishermen
- wood cutters
- campers and picnickers.

Recreational users are primarily oriented to use of the hunting and fishing resource and secondarily to enjoyment of the area's visual values. The remaining users are oriented to commercial activity and are not attracted to the area because of its visual values.[1] Nonetheless, all users have the opportunity to view and appreciate the resource.

The visual environment of the Jerritt Canyon Project was examined at two levels. First, the regional visual quality of the natural resource and compatible Federal government management activities were determined by application of the Forest Service Visual Management System.[6]

Second, within the study area the visual environment was further defined by the viewshed (area seen) of the various areas through evaluation of landscape diversity, absorption capability, presence of viewers, and viewing distance, angle, and duration.[6]

Visual quality objectives were established and mapped for each segment of the project area according to established Forest Service standards. The four visual quality objectives applicable to the study are: R - Retention, which provides for activities that are not visually evident; PR - Partial Retention, which provides for activities subordinate to the characteristic landscape of the area; M - Modification, which permits activities that visually dominate the original characteristic landscape; and MM - Maximum Modification, which allows activities that alter the vegetation and landform and dominate the original characteristic landscape with some limitations.[6,7]

The Visual Quality Objectives Pattern Map is shown in Figure 2-1 and graphically portrays the distribution and pattern of suggested visual quality objectives for the regional study area. In general, the visual environment of the regional study area varies significantly between the lowlands and upland mountains and between the eastern and western portions of the study area. Landscape compositional types throughout the area include those that are open, panoramic, enclosed, focal and feature dominated.[4,8,9]

Sensitivity levels are a measure of public concern for the scenic quality of the region. The sensitivity level evaluation is essentially based on the number of viewers an area has, their reason for being in a position to view the area, and the duration of their viewing. Sensitivity levels determine areas of primary and secondary visual importance, as portrayed in Table 2-3.[8]

The most sensitive areas from a visual standpoint are those within middleground and foreground views of Highway 51. All other roads in the area are considered of secondary importance because of the small number of travelers with major concern for visual quality or the very low level of recreation traffic. Highway 11 serves as a commuter/business route for commodity users in the agriculture and mining businesses. Some fisherman traffic occurs enroute to Wilson Reservoir and the Bull Run area. Jerritt Canyon Road, Burns Creek Road, and Gance Creek Road are used primarily by local livestock permittees and mineral exploration companies, except for fall hunter use. Summer recreation use is very limited.[1]

Viewshed mapping defines the "seen area" surrounding a given site. The practical effect is to determine the extent of the area from which the site can be seen as well and, therefore, the visibility of the site. For the proposed Jerritt Canyon Project, viewsheds for each of the alternative project components, including mine site, mill sites, access and utility corridors were mapped. The results are described in detail along with appropriate viewshed maps within the Visual Resources Technical Report.[4]

**TABLE 2-3**

**Areas of Primary and Secondary Visual Importance**

**AREAS OF PRIMARY IMPORTANCE**

- State Highway 51

**AREAS OF SECONDARY IMPORTANCE**

- State Highway 11
- Areas within foreground and middleground distance zones when viewed from Highways 11 and 51
- Jerritt Canyon Forest Road
- Burns Creek Forest Road and Burns Basin
- Gance Creek Forest Road
- California Mountain
- All remaining Forest Roads in study area
- All remaining jeep trails in study area
- Areas within background distance zones when viewed from Highways 11 and 51.
- Areas not visible from Highways 11 and 51.

**SOURCE: USDA, FOREST SERVICE — JERRY DAVIS, 1979**

# Cultural Resources

An intensive archeological survey of the Jerritt Canyon project and a sample survey of the remaining project area were conducted in order to determine the significance of all cultural resources within the study area. The surveyed lands included the areas which would fall under the direct or indirect impact of the project during construction or operation, and the areas thought to be sensitive to cultural resources, including riparian habitat, upland rangeland, and exposed rock outcrops. All areas were surveyed and recorded according to Forest Service specifications.[10]

A total of 20 aboriginal occupation sites, 1 historic dump site, 14 isolated finds, and 4 small flake scatters were recorded within the study area. The isolated finds consisted of artifacts found unassociated with any site material and are considered the result of small hunting forays. Small surface scatters consisted of a find with less than a 10-flake density and probably represent the work of single individuals. Of the 20 aboriginal occupation sites, 17 are open expression sites characterized by surface artifacts and lithic scatters of slight to moderate densities with localized heavier concentrations representing locus areas;

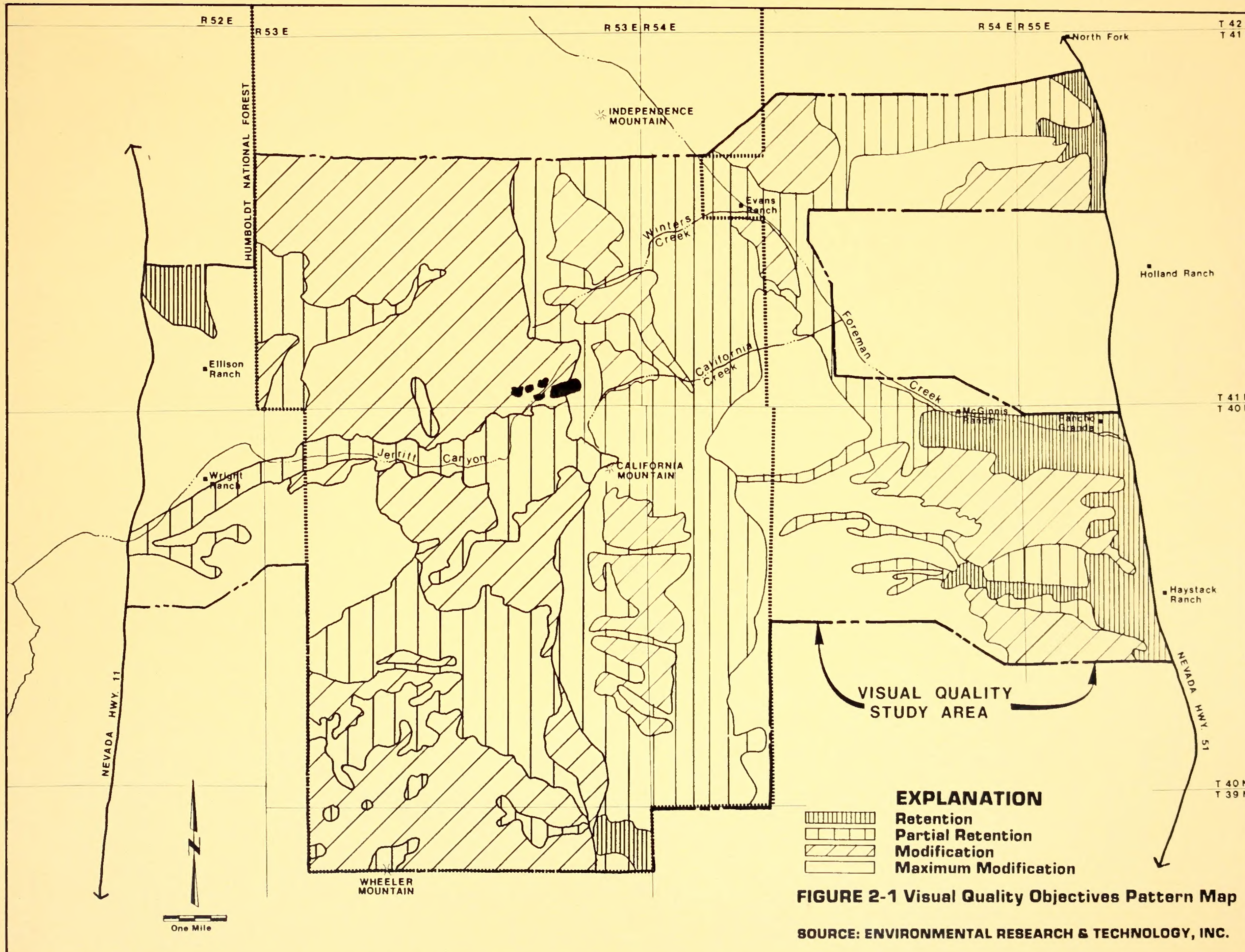



**FIGURE 2-1 Visual Quality Objectives Pattern Map**

SOURCE: ENVIRONMENTAL RESEARCH & TECHNOLOGY, INC.

three rock shelters were found. Aboriginal occupation site classifications are:[10]

8 hunting base camps

4 hunting and gathering base camps

5 temporary hunting camps

3 rock shelters

It is assumed that the study area has been utilized by humans during the last 5,000 to 6,000 years. This is based on the classification of 30 projectile points. There was a reliance on hunting as a subsistence base. The higher elevations served small seasonal temporary camps and hunting-gathering forays. Game animals included bighorn sheep, occasional deer and antelope, rabbits, and upland game birds. Great importance was placed upon seasonal runs of salmon and cutthroat trout.[10 11 12]

Base camps were predominantly at lower elevations (5,000 to 6,000 feet) near upland water sources. These headquarters served extended family groups from which individuals or small groups ventured forth on seasonal hunting and gathering expeditions.[10 11]

The importance of gathering to the aboriginal peoples of this area is speculative due to the perishable nature of materials used in gathering. It is felt that gathering played as important a role in the subsistence base as did hunting if insights into environmental reconstruction are correct. Although only six sites yielded grinding tools, gathering activities could have taken place. The harvest could have been transported to semi-permanent or permanent camps for processing and/or storage.[13 14]

Previous site disturbance is exhibited by 18 of the 20 sites. Most have been crossed by jeep access roads and fence lines, camped on by hunters and fishermen, or show signs of overgrazing by livestock. It can be assumed that the larger and better known sites and the rock shelters have been relic collected. Local ranchers talk of people having, for years, picked up relics from the surface of these sites.[10]

Nineteen sites contained projectile points, both complete and fragmented. Also found in high frequency were blades, flake scrapers, and utilized flakes. Six sites contained ground stone artifacts such as metate fragments, complete and fragmented ground manos, and a cylindrical pestle fragment. Four sites contained cores, an unexpected low number, and split cobbles were found at one site. No pottery or perishable materials (wood artifacts, cordage, basketry) were found.[10]

Moen Associates, Inc. the archeological contractor to ERT, recommended that no project area cultural resources be considered for nomination to the National Register of Historic Places. They recommended consideration of the now abandoned Evans Ranch building complex for the National Register, however, this site is at the mouth of Winters Creek Canyon which is outside of the project boundary.

# Water Resources

## Ground Water

Three distinct ground water regimes are present in the project area. These are the two alluvial ground water basins of the Independence and North Fork Valleys, separated by the bedrock ground water recharge area of the Independence Mountains. Ground water occuring within these regimes is used primarily for agricultural purposes.

The Independence Valley has about 250,000 acre-feet of usable ground water storage available with a discharge of approximately 10,000 acre-feet/year occurring as underflow and streamflow northward to the Owyhee River basins.[15 16] Recharge occurs mainly from precipitation in the Independence Mountains which migrates to the valley basin as stream and underflow, or from multiple springs.[15]

Ground water in the Independence Valley is principally contained in unconsolidated alluvial deposits of clay, sand, and gravel which obtain thicknesses of a few hundred feet. Volcanic and consolidated sedimentary rocks which underlie the alluvium are relatively impermeable.[15] Depth to water in wells ranges from about 2 to 130 feet, with perched water conditions present in the alluvial fans of the Independence Mountains.[17 18]

The North Fork Valley ground water basin receives recharge from precipitation and underflow from the eastern flank of the Independence Mountains.[19] Relationships between recharge areas of the Independence Mountains and the alluvial North Fork Valley aquifer are similar to conditions found in the Independence Valley.

Alluvial fans and terraces near the eastern flank of the Independence Mountains are comprised of semiconsolidated lenticular deposits of clay, sand, and gravel. These deposits contain ground water at depths ranging from about 2 to 120 feet.[17 18 20]

Ground water is also present in the bedrock of the Independence Mountains. Due to the complex nature of the lithology and structure of the Independence Mountains, the migration of ground water is not fully determined. All rock types contain extensive fracture systems and limestone units possess solution cavities. These secondary features act as conduits for the migration of ground waters; however, mass permeabilities are relatively low, with little water encountered during mineral and geotechnical drilling operations for the project.[17] Multiple seeps and small springs are present throughout the bedrock area. Flows from these sources are generally low and large seasonal fluctuations are common.

Possible mill site and tailings disposal areas at the Ellison and Wright Ranch properties are located in the Independence Valley. The regional ground water conditions described above are present locally at each of these sites. Geotechnical test drilling encountered ground water at a depth of about 15 feet at the Ellison Ranch site. Permeable gravel and sand deposits were encountered to a depth of 40 feet.[17]

The North Fork and Section 33 mill sites and tailings disposal areas and a proposed production water well in Section 33 are located in the North

Fork Valley. Geotechnical test drilling at the Section 33 tailings disposal area encountered perched ground water from approximately 8 to 70 feet. This water is present in overlying shallow granular alluvium and in moderately permeable lenses of semiconsolidated clayey gravels. A major portion of the subsurface materials consists of low permeability sandy and silty clays.[17] Geologic mapping indicates that similar geologic conditions underlie the North Fork area.

Mill sites B and Winters Creek are located in the Independence Mountains. Perched ground water in residual and alluvial overburden was encountered between 10 and 23 feet during test drilling at Mill Site B. Isolated saturated zones in limestone bedrock are present in both the proposed pit and waste rock disposal areas.[17] Locations of all geotechnical and ground water exploration boreholes are shown in Figure 2-2.

## Surface Water

The most significant hydrologic feature of the Jerritt Canyon project area is the drainage divide formed by the ridgeline of the Independence Mountains. Streams draining the eastern watersheds of the project area are tributary to the North Fork Humboldt River and the watercourses in the western half of the project area drain into the South Fork Owyhee River (see Figure 2-2).

The North Fork Humboldt River originates on the east side of the Independence Mountains in the vicinity of McAfee Peak and flows toward the southeast. Some of the larger creeks draining the eastern side of the claim block include Foreman Creek, Mahala Creek, and Gance Creek.[21]

The Snake River Basin originates on the western slope of the Independence Mountains draining north and west by way of the South Fork Owyhee River. This channel originates in the southern end of the Independence Valley near Tuscarora and eventually empties into the Snake River in Idaho. Jerritt Creek, Burns Creek, and Niagara Creek are some of the tributaries draining the western slopes of the Independence Mountains.[22]

Another important regional effect of the ridgeline of the Independence Mountains is its influence on the nature and distribution of precipitation within the study area. Since precipitation in the region is derived from Pacific moisture moving in from the west, the orographic barrier represented by the ridge causes differences on either side in such parameters as rainfall depth and intensity, and snowfall depth and drifting. The weighted average annual precipitation for the entire project area is 19.6 inches. In addition, differences in exposure on the east and west sides of the ridge will result in different rates of snowmelt in the spring.[23 24]

Within the study area, the surficial hydrologic features of interest may be identified as follows:

- Perennial streams which are sustained throughout the year by a base flow derived from tributary underground water.

- Intermittent streams which may flow briefly, either with spring snowmelt waters or as a result of local rainfall events.

- Perennial springs which are typically used for irrigation purposes.

- Alluvial deposits into which stream flow may disappear to become recharge to the local ground water system.

Both intermittent and perennial streams, as well as alluvial recharge areas, are present on both sides of the ridge, whereas the more significant springs (e.g., Petaini Springs (Wright Ranch) and Van Norman Springs) are present only on the west side. Within the Jerritt Canyon project area there are 32 mapped springs. Some are only small seeps whereas others contribute to or maintain the base flow of streams. Petaini Springs near the mouth of Jerritt Canyon and Van Norman Springs near the mouth of Burns Canyon, have relatively large flows ranging from 3 to 4 cfs.[24]

Drainage systems in most of the study area are well defined with sparse vegetation. When trees and brush are present, it is generally along the valley bottom.

At the lower elevations, particularly in the vicinity of the four alternative tailings disposal sites, the stream channels emerge from the canyons onto flat terraced land with little vegetation. These tailings sites are not located in flood plain areas. In this portion of the study area, flood heights would be greatly attenuated as the water spreads out laterally.[24]

Peak runoff from the Independence Mountains occurs in May and June, and is a relative measure of winter snowpack. Long-term records from the USGS gaging station at Spanish Ranch on the South Fork Owyhee River indicate that an average of 68% of the annual flow occurs between March and June.

In the summer of 1978, 17 sites for stream gaging stations were selected. Nine continuous water stage recording stations were installed on key watercourses on or near the 42-square mile claim block. Eight crest stage gaging stations were also constructed on smaller ephemeral creeks draining the study area. The characteristics of these stations are summarized in Table 2-4 and the stations are located on a map in Figure 2-2.[24]

During the period September 1978 through September 1979, the continuous recording stations were in operation. Both the minimum and peak discharges, in cubic feet per second, are shown in Table 2-5.[24]

## Water Quality

In the late summer of 1978, 18 water quality sampling stations were established within the project area. One station is an observation well in the North Fork Valley, while another 17 stations monitor surface water quality on major project area watercourses. Locations of sampling sites are presented in Figure 2-2. Twelve sampling sites were located in the Owyhee River drainage and six sampling stations were located in the North Fork Humboldt River drainage. Whenever possible, the water quality stations were selected to coincide

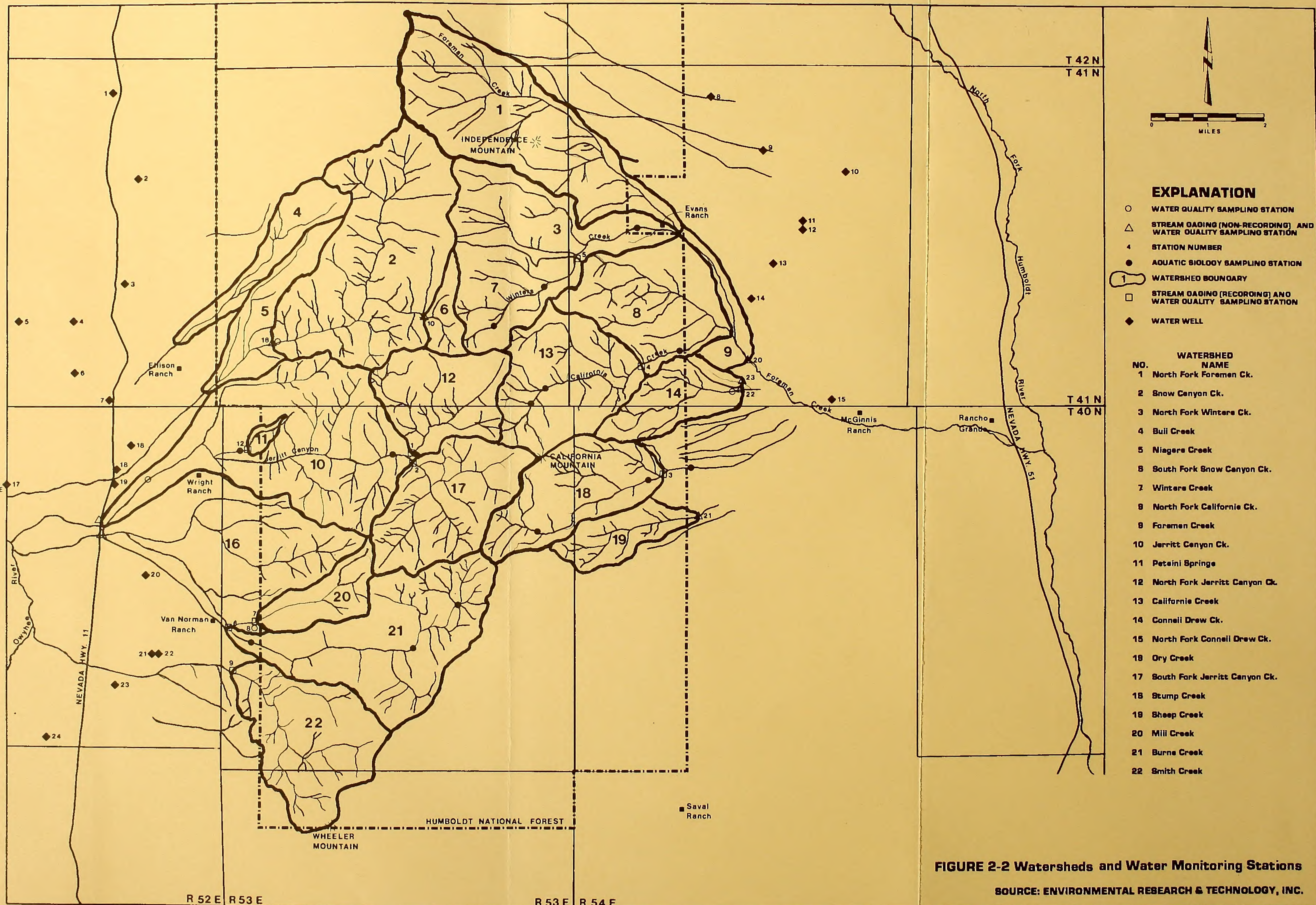



**FIGURE 2-2 Watersheds and Water Monitoring Stations**

**SOURCE: ENVIRONMENTAL RESEARCH & TECHNOLOGY, INC.**

## TABLE 2-4

### Surface Water Gaging Stations

| GAGING STATION NUMBER | LOCATION WATERCOURSE | STATION DESCRIPTION CREST STAGE GAGE | WEIR OR PARSHALL FLUME | STEVENS WATER STAGE RECORDER | WATERSHED DRAINAGE AREA (SQUARE MILES) |
|---|---|---|---|---|---|
| 1 | Jerritt Creek | | 4 Ft. Flume | Type F | 3.3 |
| 2 | S. Fork Jerritt Creek | | | Type F | 4.4 |
| 3 | Stump Creek | | | Type A | 3.8 |
| 4 | California Creek | | | Type A | 4.5 |
| 5 | Winters Creek | | | Type A | 2.8 |
| 6 | Burns Creek | | | Type F | 6.6 |
| 7 | Mill Creek | | | Type F | 1.6 |
| 9 | Smith Creek | | | Type F | 4.8 |
| 10 | S. Fork Snow Canyon | x | | | 0.8 |
| 11 | State Hwy. 11, 4 Ft. Culvert | x | | | 14.9 |
| 12 | Petaini Springs | | Rectangular Weir | Type F | 0.2 |
| 13 | State Hwy. 11, 3 Ft. Culvert | x | | | 16.7 |
| 18 | Snow Canyon Creek | x | | | 9.5 |
| 20 | Foreman Creek | x | | | 23.9 |
| 21 | Sheep Creek | x | | | 1.6 |
| 22 | Sect. 33, S. Fork | x | | | 2.0 |
| 23 | Sect. 33, N. Fork | x | | | 0.2 |

SOURCE: ENVIRONMENTAL RESEARCH & TECHNOLOGY, INC.

## TABLE 2-5

### Summary of Continuous Surface Water Flow Data September 30, 1978 Through September 30, 1979

| GAGING STATION NUMBER | WATERCOURSE | WATERSHED DRAINAGE AREA, (SQUARE MILES) | MINIMUM DISCHARGE (IN CUBIC FEET PER SECOND, CFS) | DATE OF MEASUREMENT | PEAK FLOW DEPTH (FEET) | PEAK FLOW DISCHARGE (CFS) |
|---|---|---|---|---|---|---|
| 1 | Jerritt Creek | 3.3 | 0.5 | 5- 1-79 | 0.68 | 8.7 |
| 2 | S. Fork Jerritt Creek | 4.4 | 4.8 | 3-18-79 | 1.81 | 80.1 |
| 3 | Stump Creek | 3.8 | | 5-17-79 | 0.83 | 15.5 |
| 4 | California Creek | 4.5 | | 5- 5-79 | 1.07 | 45.0 |
| 5 | Winters Creek | 2.8 | 2.5 | 4-28-79 | 0.74 | 9.6 |
| 6 | Burns Creek | 6.6 | 11.5 | 5-16-79 | 1.29 | 40.0 |
| 7 | Mill Creek | 1.6 | | 5-12-79 | 0.60 | 4.9 |
| 9 | Smith Creek | 4.8 | 12.0 | 5-18-79 | 0.97 | 24.0 |
| 12 | Petaini Springs | 0.2 | | 5-22-79 | 0.95 | 4.0 |

SOURCE: ENVIRONMENTAL RESEARCH & TECHNOLOGY, INC.

with the stream gaging stations.[25] Average minimum and maximum concentrations of selected water quality parameters for the Owyhee River and North Fork River watersheds are summarized on Table 2-6.

Surface waters draining from the west side of the Independence Mountains are predominantly calcium-bicarbonate type with relatively significant amounts of magnesium sulfate. Dissolved oxygen values were all above 6.0 mg/l, and in virtually all cases were near or above 100 percent saturation levels for the respective elevations and water temperatures.[25] The highest fecal coliform sample was 940/100 ml. which occurred at Jerritt Creek adjacent to Freeport's base camp, in September, 1978.

The water quality data for streams tributary to the North Fork River indicate that the quality of these streams are similar to those on the Independence Valley side. Like the creeks on the western side, the North Fork's tributaries are predominantly a calcium-bicarbonate type.[25]

Results from the only ground water observation station, a test well in Section 33, indicate that the water is predominantly a calcium-carbonate type and is in the very hard category of the USGS water-hardness classification.[25]

### Seasonal and Geographical Trends

Seasonal trends in the data generally depicted higher concentrations for most major constituents during the fall and winter low flow periods while the lowest concentrations were generally recorded during heavy spring runoff.[25] Differences in water quality between the North Fork Humboldt River drainages and Owyhee River drainages are minimal. Concentrations of nutrients, trace elements, and other parameters are very comparable from one side of the Independence Mountains to the other (see Table 2-6).[25]

## TABLE 2-6
### Average Maximum and Minimum Concentrations of Selected Water Quality Parameters for Project Area Tributaries

| PARAMETER | LOCAL TRIBUTARIES TO OWYHEE RIVER | LOCAL TRIBUTARIES TO NORTH FORK HUMBOLT RIVER |
|---|---|---|
| pH | 6.2 to 8.6 | 6.3 to 7.9[2] |
| DO mg/1 | 2.8 to 15.8 | 6.6 to 16.0 |
| Turbidity, NTU | <0.1 to 132.0 | 0.0 to 800 |
| Alkalinity, mg/1 as $CaCo_3$ | 30.0 to 260.0 | 40[2] to 225 |
| TDS, mg/1 | 40.0 to 400.0 | 61.0 to 459.0[2] |
| Calcium, mg/1 | 7.0 to 75.3 | 10.8 to 82.5 |
| Magnesium, mg/1 | 2.7 to 43.0 | 0.5 to 45.0 |
| Sodium, mg/1 | 0.4 to 13.1 | 0.2 to 29.6 |
| Sulfate, mg/1 | 2.4 to 91.2 | <0.01[2] to 165 |
| Phosphorus, Total, mg/1 | <0.01 to 5.8 | <0.0 to 2.3 |
| Aluminum, mg/1 | <0.01 to 5.45 | <0.01 to 23.0[4] |
| Iron, mg/1[3] | <0.01 to 7.0[6] | 0.02 to 10.7[1] |
| Zinc, mg/1 | <0.02 to 15.1[5] | <0.01 to 9.8[2] |
| Fecal Coliforms #/100 ml | 0 to 940 | 0 to 3500 |
| Total Coliforms #/100 ml | 0 to 13,000 | 0 to 1300[1] |

**EXPLANATION**

1 FLOW WAS PRESENT IN MAY AND JUNE 1979 ONLY.
2 SAMPLING NOT INITIATED UNTIL MAY 1979.
3 MAXIMUM CONCENTRATIONS WERE RECORDED IN MAY FOR ALL STATIONS; HOWEVER, THIS WAS ASSUMED TO BE DUE TO CONTAMINATION AND THE NEXT HIGHEST DATA POINT USED FOR THE MAXIMUM VOLUME.
4 PROBABLY DUE TO HIGH LEVELS OF DRILLING MATERIAL REMAINING IN WELL.
5 SAMPLE CONTAMINATION SUSPECTED
6 WATER WAS COLLECTED IN APRIL AND MAY ONLY; STATION WAS DRY ON REMAINING SAMPLING DATES.

**SOURCE: ENVIRONMENTAL RESEARCH & TECHNOLOGY, INC.**

### Regulatory Framework

Results of analyses indicate that the tributaries of both the Owyhee River and North Fork Humboldt River within the study area currently have chemical concentrations lower than the criteria set forth for Nevada Class A waters.[26] The major exception to the criteria is the presence of high levels of total phosphate. The State upper limit for phosphate in Class A waters is 0.30 mg/l, a value that is exceeded more than 50 percent of the time in the Owyhee River drainage. In the North Fork drainage, nearly 40 percent of the total phosphate analyses exceeded the 0.30 mg/l level.[25] Nevada's Class A waters are intended primarily to include waters or portions thereof located in areas of little human habitation; no industrial development or intensive agriculture; and where the watershed is relatively undisturbed by man's activity.

While nitrate is not listed as a criterion in the Class A standards, some nitrate concentrations were quite high. Elevated levels of nitrate and phosphate in remote areas generally indicates pollution from livestock excrement.[25]

Except for a few anomalous values for zinc and a few elevated mercury concentrations (greater than 0.002 mg/l), all the metal concentrations for the streams fall below U.S. Environmental Protection Agency (EPA) effluent guidelines for the ore mining and dressing industry.[27]

No total suspended solids (TSS) data are available to compare with the 30 mg/l per day EPA criterion, however, most turbidity values were low indicating that regional TSS concentrations are normally at moderate levels.[25]

The EPA's National Interim Primary Drinking Water Regulations, as amended, have established quality criteria that are generally met by the 1978-79 water analyses at the 17 water quality stations.[25] [28] However, the 0.002 mg/l criterion for mercury is exceeded at several stations. The drinking water standard for chromium is 0.05 mg/l and this criterion was exceeded in 32 water quality analyses from 13 different stations. Most of the high values occurred during low winter flows which tend to concentrate values or during high runoff when more sediment is found in the streams and additional metal can be leached out due to sample preservation with acid.[25]

Except for the previously mentioned anomalous values for zinc, aluminum, iron, and some values of chromium, concentrations of trace metals considered by EPA to be safe for aquatic life were well below the proposed criteria.[29]

## Aquatic Biology

The joint Forest Service and Nevada Department of Wildlife biological and habitat stream surveys of 1978 and 1979, provided detailed information on stream fish populations within and adjacent to the 42-square mile claim block.[30]

Other aquatic biology investigations for the Jerritt Canyon project area were designed to describe the existing periphyton (attached algae) and invertebrate (insects, worms, snails, etc.) communities of the principal streams draining the project area. Aquatic sampling of principal watercourses occurred once in October 1978 and once in June 1979.[30]

Information gained from these studies provides a baseline for comparison to future monitoring programs. Certain types of algae and aquatic invertebrates are indicators of water quality, and as such, their community structure, diversity, etc. can be used to monitor the effects due to livestock grazing and mining/milling activities which could potentially stress streams.[30]

A total of 10 aquatic biology stations were sampled in October 1978. In June 1979, with more creeks flowing, 14 stations were sampled. Drainages in which three sites were sampled include Burns Creek, California Creek, Stump Creek, and Winters Creek, while only one station was sampled on Jerritt Creek and one at Petaini Springs (Wright Ranch). These sampling stations are shown on the project area map (see Figure 2-2) along with surface water and water quality monitoring stations.[30]

Known rainbow trout fisheries exist in Burns Creek and Snow Creek, while known populations of the threatened Lahontan cutthroat trout (Salmo clarki henshawi) exist in Gance Creek, California Creek, Foreman Creek, and Mahala Creek. Streams in the area not containing fish are Jerritt Creek, Winters Creek, and Stump Creek. All the above-mentioned streams were studied for populations of algae and invertebrates during the 1978-79 periods.[31 32]

The periphyton community was composed largely of diatoms, bluegreen, and green algal species. Diatoms represented the greatest number of species and frequently composed a large percentage of the total density. The species present were largely indicative of clean, cool, well oxygenated water. Organic enrichment resulting from cattle usage was indicated by the periphyton community by a change in the diatom species present and an increase in the relative abundance of green and bluegreen species.[30]

The benthic macroinvertebrate fauna of the sampled creeks was composed largely of aquatic insects of four major orders: Plecoptera (stoneflies), Trichoptera (caddisflies) Ephemeroptera (mayflies), and Diptera (trueflies). The species assemblages identified were largely indicative of well oxygenated clean water environments, although the influence of organic enrichment resulting from cattle use was noted on some locations on California and Winters Creek.[30]

## Wildlife

Terrestrial wildlife investigations were designed to characterize the mammal, bird, reptile, and amphibian populations that inhabit the project region. Specific field studies included big game pellet group transects, small mammal trapping, predator scent station sampling, helicopter surveys for sage grouse, avian strip transects, and general observations. Qualitative surveys and habitat evaluations were concentrated on the various alternative development areas, and included searches for raptor nests in likely locations, and observation of other special wildlife habitat features.[33]

The terrestrial wildlife communities inhabiting the claim block and contiguous areas result primarily from vegetative patterns and other habitat features, but are often altered, to some extent, by man's activities. The vegetative communities are relatively fixed, changing only slowly over time; however, wildlife associated with these communities are somewhat more dynamic, changing in number, distribution, and composition. Because of this, the numbers of any particular species in a certain area are, at best, very difficult to determine. As a result, field efforts during the 1978-79 season were concentrated in determining species presence and relative abundance. Habitat preferences and use patterns were also studied for certain key species.[33]

The mule deer is the most important game species in the project region. Within the project area, mule deer are migratory. Summer range is predominantly high altitude aspen and mixed shrub/sagebrush stands. Mule deer winter range on the project area is confined predominantly to the south-facing exposures in the mixed shrub/sagebrush habitat located along the lower drainages on the west side of the Independence Mountains, especially adjacent to Snow Canyon and Jerritt Canyon. These winter ranges are presently in good condition and support a large population of deer. For the lower Jerritt Canyon area, the average deer density was 12 per square mile, with a range of 0 to 49, during the 1978-79 winter. Mule deer winter range is illustrated on Figure 2-3 which also presents other important wildlife features in the area.[33 34 35]

Mountain lions are known to inhabit the project region. The animals are wide ranging and make use of all mountainous habitats, with concentration of activity in the areas where mule deer occur. The southern part of California Mountain to the headwaters of Stump Creek and into upper Burns Basin appear to be prime lion summer habitat. An estimated two lions inhabit the project region during the summer with as many as six occurring there during the winter when mule deer are concentrated.[33 36]

There is at least one active golden eagle nest in the project region, located in Jerritt Canyon (Figure 2-3). This nest fledged two young in 1979. Nesting was unsuccessful in 1978 but the nest had been active in 1977. There is another known eagle nest in the study area in upper Jerritt Canyon; it has not been active since 1977 and may be an alternate nest for the pair in lower Jerritt Canyon. Observations of a pair of immature golden eagles indicate that at least four

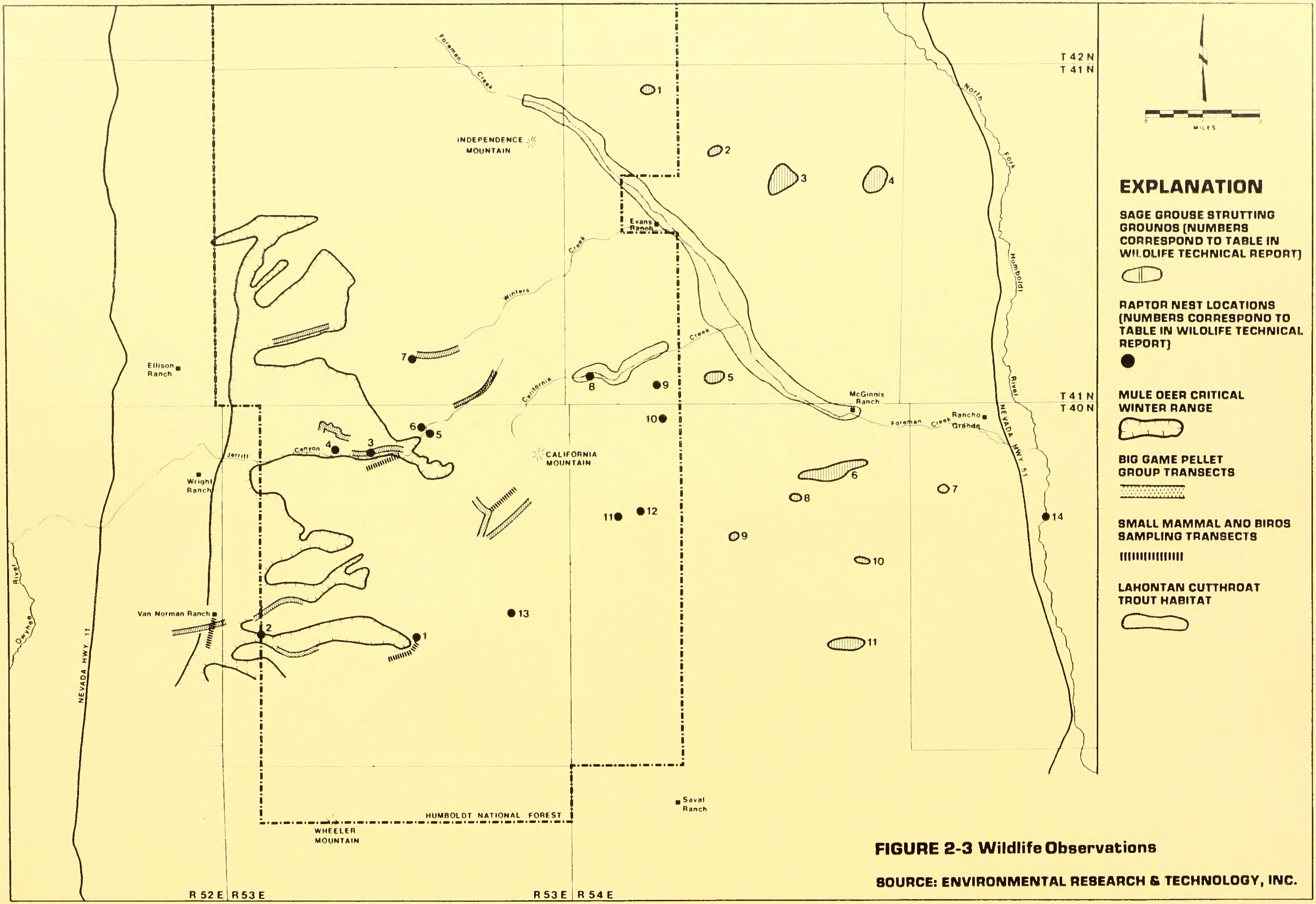



**FIGURE 2-3 Wildlife Observations**

**SOURCE: ENVIRONMENTAL RESEARCH & TECHNOLOGY, INC.**

individuals use the project area as hunting territory. Eleven other raptor species have been documented, the most important of which are red-tailed hawk, (nesting in Burns Creek Canyon), and the prairie falcon (nesting in Jerritt Canyon). Other species known to nest in the project region are the great-horned owl, marsh hawk, goshawk, Cooper's hawk, and turkey vulture. All known nest locations are also depicted on Figure 2-3.[33]

The sage grouse is the most important game bird; it occurs in high numbers in the alluvial sagebrush habitat east of the mountains. Eleven sage grouse strutting grounds have been documented for the project region, eight of which were determined to be active in 1979. The 1979 average number of males observed on the active strutting grounds was 36, with a range from 4 to 100. Alluvial sagebrush habitat near the strutting grounds is important sage grouse nesting and brood raising habitat.[33 34 37 38]

Another important game bird is the chukar, which occurs in substantial numbers in the south-facing mixed shrub/sagebrush habitat, especially along the west-side drainages. Blue grouse also inhabit the project area but in much smaller numbers, and mourning doves are summer residents.[33]

Waterfowl use of the project region is limited by the sparseness of surface water. Beaver ponds, especially along Foreman Creek, and one stock pond near the Rancho Grande-California Creek corridor provide suitable summer nesting habitat for cinnamon teal, green-winged teal, pintail, and mallard. Canadian geese were observed in the Foreman Creek meadows. Several other species of waterfowl are likely to use these waters during migration, especially along Foreman Creek. Approximately 30 sandhill cranes nest in the Foreman Creek meadows. Overall bird composition species and populations appear to be typical for the region.[33 38 39 40]

## Vegetation

A comprehensive vegetation field sampling and mapping program was accomplished during the summer of 1979. Because of the large study area involved, sampling areas were selected to represent the dominant land types and exposure angles on which particular vegetation types occurred. A total of 50 line intercept transects and associated plots were sampled among 7 vegetation types. A voucher collection was made of flowering plants encountered in the project area. All plants were collected in late June 1979, and were pressed, labeled, and stored in newspapers.[41]

Special efforts were made to locate any population of Antennaria arcuata and Cryptantha interrupta, two candidate threatened or endangered species, that may occur in the study area. Candidate species were determined from rare species distribution maps provided by the Nevada State Museum. Appropriate habitats for these species were examined during field sampling. Plant specimens suspected to represent listed species were submitted to outside specialists for positive identification.[41]

The vegetation of northeastern Nevada consists primarily of the Great Basin Sagebrush Community. Project area vegetation communities occur primarily on the Foothill Piedmont and Valley Bottomland land types on the valley basin portion of the study area, and the Fluvial Mountain Slope, and Bench and Basin Structural land types at higher elevations. Categories defined for this study approximate existing Forest Service mapping categories. A discussion of association or habitat types within the broader mapping categories is provided where appropriate.[41 42 43]

The vegetation communities of the project area occupy several major land-type associations that compose the Independence Mountains and adjacent Independence and North Fork Valleys. Within the project area, vegetation type boundaries are defined by local edaphic and topographic factors rather than large scale physiographic differences. The major land type boundaries that affect vegetation classification are between the valley bottoms and slopes and the adjacent foothill and mountain slopes.[41 42 43]

The Independence Mountains are occupied by seven major vegetation types and two major pasture types. These communities are completely described in the Vegetation Technical Report, with accompanying analyses of acreages potentially affected by various project alternatives and productivity losses. A brief synopsis of the existing vegetation types is described in the sections below. These descriptions include the extent and distribution of the type, composition, average cover, productivity, and community dynamics within the project area. The vegetation map presented in Figure 2-4 shows the distribution and extent of vegetation types over the Jerritt Canyon project area.[41]

- Aspen. The Aspen type occupies approximately 3,800 acres or 5 percent of the study area. Aspen stands occur primarily on north-facing slopes at higher elevations. The type also occurs in sites with high soil moisture availability in the vicinity of springs and along drainage bottoms.

- Mountain Shrub. The Mountain Shrub type occupies approximately 6,900 acres or 9 percent of the study area. The Mountain Shrub type occurs primarily on steep north-facing slopes at intermediate to high elevations, and on rocky slopes on various slope aspects.

- Alluvial Sagebrush. The Alluvial Sagebrush-Grass type occupies approximately 33,600 acres or 44 percent of the study area. This type is dominated by sagebrush (Artemisia) species, and occurs on the Foothill Piedmont, Valley Bottomlands, and Basin Valley Piedmont Fans landtype associations.

- Upland Sagebrush-Grass. The Upland Sagebrush-Grass type occupies approximately 22,000 acres or 29 percent of the study area. The type is dominated by sagebrush, and occurs on the Valley Foothill and Mountain Slope landtypes.

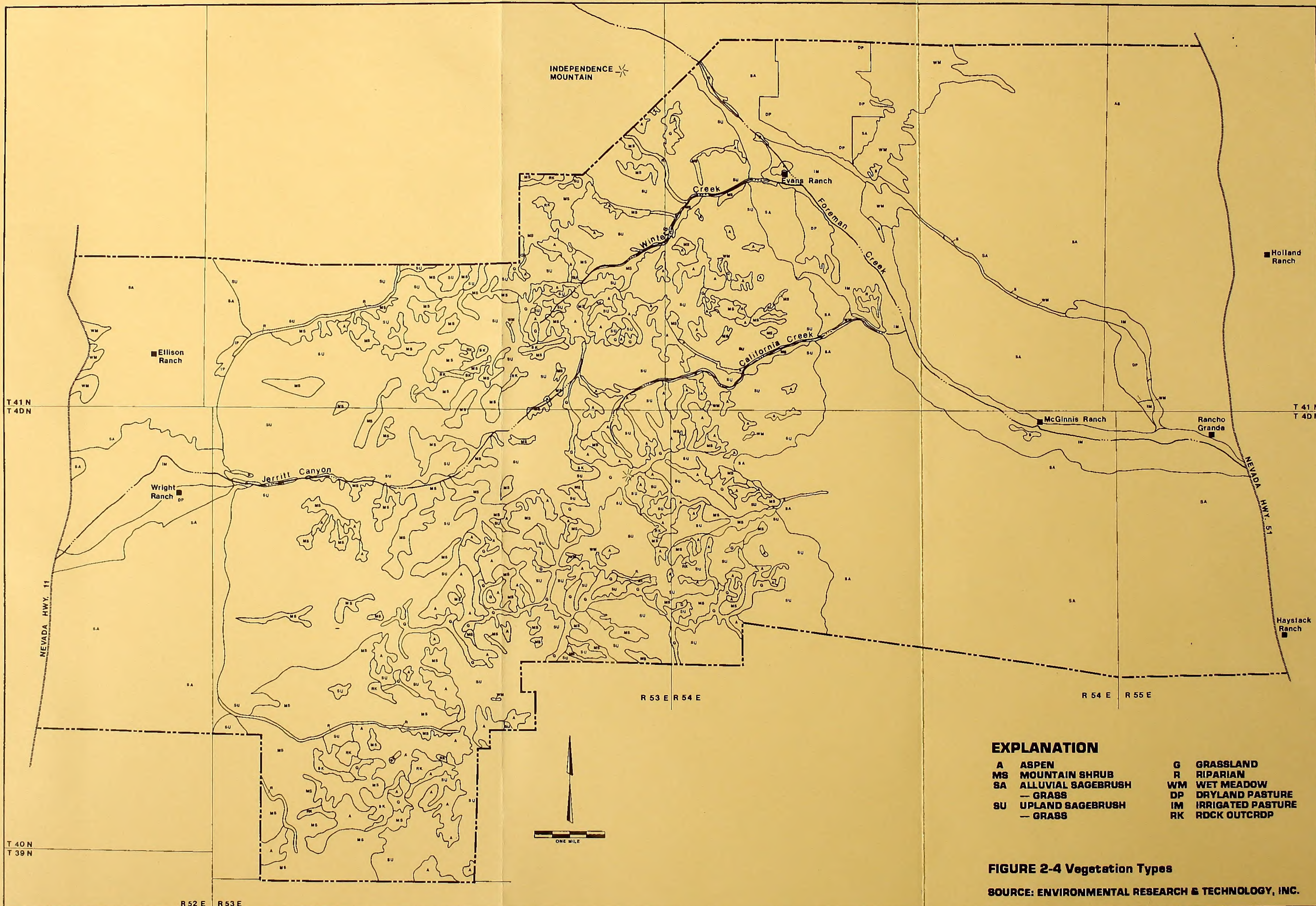



**FIGURE 2-4 Vegetation Types**

**SOURCE: ENVIRONMENTAL RESEARCH & TECHNOLOGY, INC.**

- Grassland. The Grassland type occupies approximately 1,400 acres or 2 percent of the study area. This type occurs primarily along the summit of ridges where wind velocities are high and soils are shallow and rocky.

- Riparian. The Riparian type occupies approximately 650 acres or 1 percent of the study area. This type occurs along the drainageways of permanent and intermittent streams, and below springs in the project area. It is defined by the presence of taller phraeatophytic (water loving) shrub and tree species which line streambanks in a narrow band.

- Wet Meadow. The Wet Meadow type occupies approximately 1,300 acres or 2 percent of the study area. This type occurs primarily along drainage bottoms and below hillside springs.

- Dryland Pasture. Some sagebrush-grass stands near the Wright Ranch on Jerritt Creek and the Evans Ranch on Foreman Creek have been sprayed, turned, and planted to a variety of exotic bunch grasses including crested wheatgrass (Agropyron cristatum), intermediate wheatgrass (Agropyron intermedium), and tall wheatgrass (Agropyron elongatum). Annual production in these sites was estimated to be 300 to 800 lbs./acre.

- Irrigated Pasture. Surface water from several of the major streams in the study area have been diverted to irrigate pastures for year-round livestock grazing or for winter hay. Composition of these pastures, at least in the Foreman Creek drainage, appears to be similar to natural wet meadows. Timothy (Phleum pratense) appears to be the most important exotic grass introduced into these pastures.

The Joint FS/NDW survey conducted July 11, 1978 revealed the presence of a previously undiscovered population of the Lahontan cutthroat trout in California Creek. Fish were found from the Humboldt Forest boundary at the eastern end of Section 32 up to the middle of Section 31. No other species of fish was collected.[31]

California Creek is a high mountain stream fed by springs and snowmelt and drains approximately 4.5 square miles. The stream has good water quality. Cattle grazing in the drainage is extensive. The occupied habitat for Lahontan trout consists of a series of old beaver ponds and some natural pools in a single reach of stream approximately one and one-half miles in length. In late summer California Creek dries up and the beaver ponds and connecting pools are the only habitat available to the trout. Overall habitat quality of California Creek was in the "low to fair" range with only 51 percent of optimum.[45]

The upper reaches of Foreman Creek are similar in character to California Creek. Below the Humboldt National Forest boundary, Foreman Creek is so extensively diverted for agriculture, that it is difficult to define a main channel. These diversions are for flood irrigating of hay meadows contiguous to Foreman Creek. In the areas of diversions, the stream has low flow and is subject to heavy siltation. Lahontan trout have been observed in much of the length of Foreman Creek, very consistently in the upper reaches, randomly in the diversion areas, and again more consistently in some beaver ponds in the lower reaches above its confluence with the North Fork Humboldt River.[31]

One candidate threatened plant species was found during the 1979 field survey. Cryptantha interrupta, a northeastern Nevada endemic, was recorded at scattered locations along the highways near the junction of Highways 11 and 51. Positive determination for collected specimens was performed by Dr. Larry Higgins, West Texas State University. Dr. Higgins is the recognized authority on Cryptantha.[45] The Cryptantha was included in the biological assessment performed for the Fish and Wildlife Service.

## Threatened or Endangered Species

An assessment of threatened or endangered wildlife species was performed to comply with the Endangered Species Act as amended in 1978.[34] After study of existing records and data, the Forest Service identified the need for a biological assessment of the Lahontan cutthroat trout for the Jerritt Canyon project area.[44 45] This trout is, in general, well established in the North Fork River basin and the Nevada Department of Wildlife has petitioned for the removal of the species from the Threatened Species list.[31]

In the vicinity of the Jerritt Canyon Project, only California Creek and Foreman Creek are known to contain a population of Lahontan cutthroat trout. One stream outside the claim block area which contains Lahontan trout and which may be indirectly affected by the project due to mining and/or corridors is Mahala Creek.[31]

## Rangeland and Livestock Management

Much of the Jerritt Canyon project area land is currently used for seasonal livestock grazing. Permittees are nearby ranchers who are allowed to graze their livestock on public land for a specific number of animal unit months (AUM). The project area is utilized primarily by cattle, although there is some sheep utilization in the vicinity of California Mountain and Upper Jerritt Canyon. The last extensive survey of Forest Service land within the project area was done in 1958. At this time Beitia rated range conditions in general as being poor in creek bottoms and fair in upland areas. At the same time Jerritt Creek and its related south slopes were rated as poor. Since 1958 this area has been exposed to progressively more intense livestock management and a younger class of cattle, in many cases. Land managers indicate that these two factors have combined to improve range conditions in the last 21 years. No extensive surveys of the study area have been done since 1958. Smaller studies, however, such as the Gruell Historic Photo Study, reflect improved conditions. From these studies, it appears that overall range conditions have improved to the point that "poor" condition range is limited to very small areas. Valley bottomlands are generally in fair to good condition, while side slopes are generally in good and excellent condition. Some side-slopes remain in fair condition, which is generally the result of cheatgrass being in the understory.[46]

The last extensive survey of BLM land within the project area was done in the early 1960's; the range condition was rated as poor to fair. Since that survey, the area has been grazed in the same basic manner and land managers indicate that range conditions have not changed significantly. BLM is currently conducting extensive surveys of the project area in order to reevaluate the range conditions.[8]

The Saval Ranch Research and Evaluation Study Area is located in the southeastern portion of the project area. The objective of this study is to conduct research on and evaluate the overall effectiveness of rangeland management on livestock production, vegetation, fish and wildlife and their habitats, soils, water quality, socioeconomic factors, and other resource values. The study is a cooperative effort of the USDA, Science and Education Administration, Forest Service, and Soil Conservation Service; the USDI, Bureau of Land Management; and the Saval Ranch.[47]

Estimated annual production for landtypes on the study area ranges from 300 to 400 pounds per acre of air dried forage on sagebrush sites on shallow soil, to 1,800 pounds per acre on deep organic soils on mountain slopes at high (7,000 to 8,000 feet) elevations.[41]

Overall productivity appears normal for the communities as a whole. A somewhat disproportionately high ratio of undesirable species exists, possibly due to a history of excessive livestock use in the past. A weighted mean of the 1978-79 field data, based upon community type ratios, gives an approximate average annual productivity of 705 lbs/acre for the Independence Mountains. Of this, desirable species comprise 42 percent, or 296 lbs/acre. Thus, potential usable forage for livestock is 148 lbs/acre, provided 50 percent of the annual desirable forage is cropped. Average livestock carrying capacity is five acres per AUM.[41 48]

The Independence Mountains have traditionally been used for sheep and cattle range. Ranches in the valleys on both sides of the mountains provide spring and fall grazing, and National Forest lands are utilized for late spring and summer grazing. The drainage divide along the crest of the Independence Range is a major allotment boundary within the project area. Ranches on the east side of the mountains are permitted on east slope allotments; west side ranches are permitted on the west slope. The Warm Creek allotment is an exception to this generalization.[41 48]

National Forest allotments are organized into seasonal rest pasture systems. These systems consist of two or more pastures. One pasture is grazed early one year, and late (after seed ripe) the next. In some pastures, one pasture is grazed early two years in a row, and then late in the succeeding two years. Figure 2-5 presents the pasture system and associated range improvements (stock ponds, watering troughs).[48] The stocking rates, and animal types for allotments within the project area are also summarized in Figure 2-5.

## Soils

Two levels of investigations were conducted in preparing the soil survey for the proposed project: 1) detailed site specific investigations including sampling, describing, and classifying representative soils and delineating their boundaries on aerial photographs were conducted for each proposed mill site, tailings dam, and mine site alternative; 2) existing reconnaissance soil survey information,[49 50 51] provided by the Soil Conservation Service and Forest Service, was supplemented by a field reconnaissance, interpretation of aerial photography, and geologic and topographic maps of the alternative mine access corridors. The soils were classified to the sub-group level using soil taxonomy as the key.[52 53] In addition to soil family criteria, consideration was also given to soil depth, coarse fragment content, geologic parent material, and landform in the design of soil map units, to enable interpretation of some engineering properties of the soils. The Forest Service landtype association and landtype mapping units were applied to the Jerritt Canyon project area. Three major geomorphic landscapes and four lithology groups are present in the project area. The major landtypes with their landscape characteristics and associated soils are shown on Figure 2-6 and described in the following paragraphs.

The rugged mountain topography is the product of block faulting of the various layers of sedimentary and weakly metamorphic rock. Fluvial or stream cutting erosion along with weathering of rocks of varying hardness and resistence are responsible for the present relief and soil differentiation. Areas such as Jerritt Canyon have a narrow canyon flow with steep fluvial slopes.[52 54] In this area, the soils on the ridgetops consist of stony and cobbly loams about 5 to 25 inches to hard bedrock. Areas underlain by quartzite and chert tend to have exposures of rock outcrops comprising 10 to 50 percent of the landscape and the soils are underlain by hard massive bedrock. Soils underlain by siltstone, shale, and silicious argillite tend to weather to very stony loams and stony clay loams 10 to 40 inches deep above fractured, weathered bedrock. There are few rock outcrops in the landscape in these areas.[54]

Most sideslope soils in the Independence Mountain area are very deep and stony and are the products of sheet wash and soil creep with only minor earthflow and talus deposits. The parent rock source of these colluvial deposits is also largely responsible for the resultant soil characteristics. Soils developed from limestone colluviums consist predominantly of very stony loams with a conspicuous zone of lime accumulation between 20 and 40 inches. Colluvial soils devel-

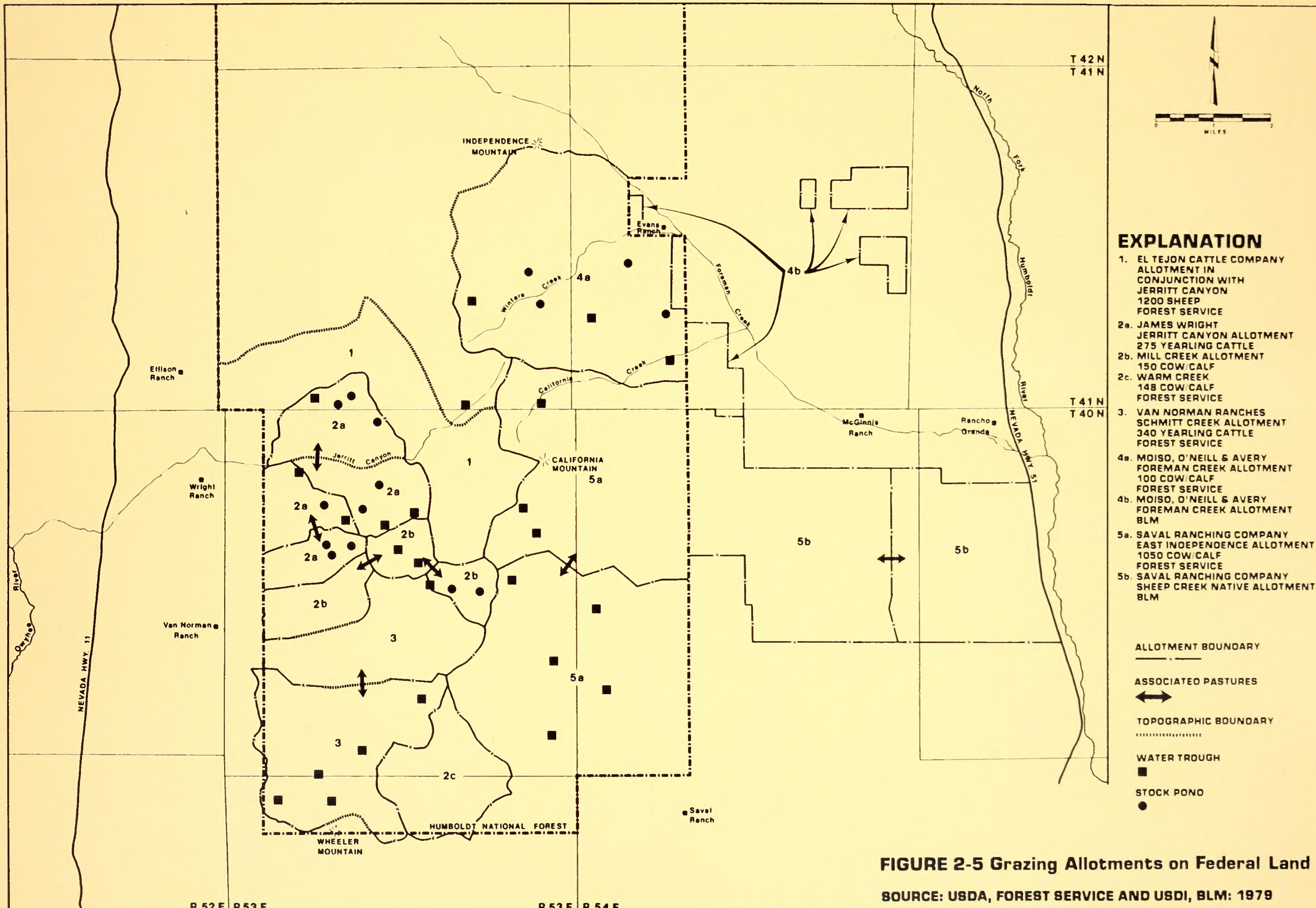



FIGURE 2-5 Grazing Allotments on Federal Land

SOURCE: USDA, FOREST SERVICE AND USDI, BLM: 1979

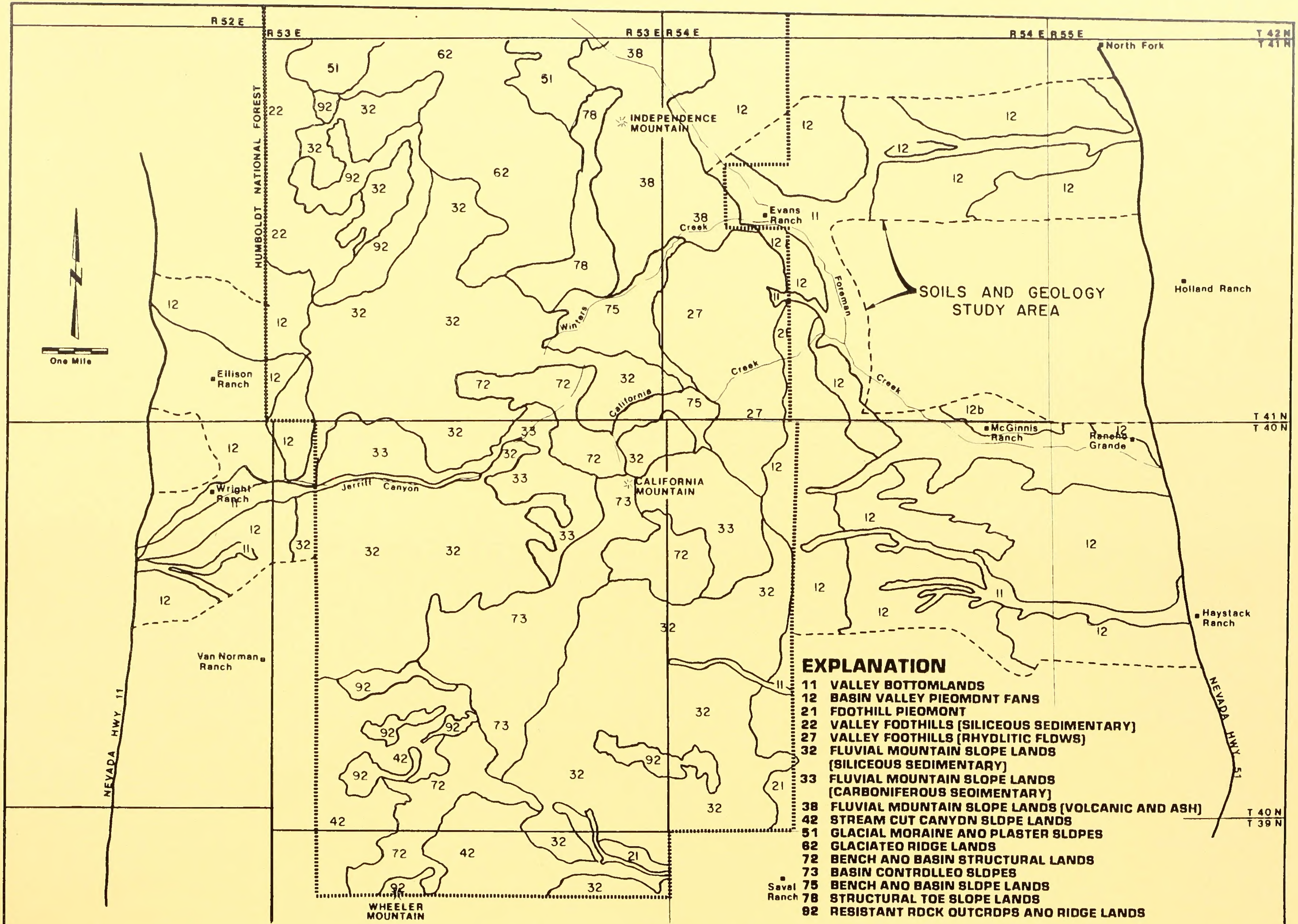



FIGURE 2-6 Landtype Associations

SOURCE: ENVIRONMENTAL RESEARCH & TECHNOLOGY, INC. AND USDA, FOREST SERVICE oped from argillite, slate, shale, quartzite and chert are also very stony, but have clay loam and clayey subsoils.[54]

Although the soils vary from 5 to 60 inches over very fractured bedrock and they have low to high productivity, the rock content and permeability make them fairly stable. Soil on the concave slopes and small basins are moderately deep to deep, have loam to clay loam textures, and have 10 to 60 percent gravel. These soils have 10 to 30 inches of organic surface soil; they produce mountain sagebrush and Aspen plant communities, depending on exposure. Resistant rock formations or rocklands are designated as landtype 92 in Figure 2-6.

The second landtype association consists of valley piedmonts or deep alluvial fans and lake terraces formed at the base of the Independence Mountains and extending into the wide basin valleys.[51 52 54]

The soils of the Independence Valley area can be divided into three main groups for discussion purposes. The soils near the mountain front consist of deep, fine textured alluvial fan materials. In places, the fan sediments are stony. Dissected lake terrace remnants occur as elongated bodies trending westward from the mountain front. These older terraces are about 5 to 10 feet higher than the more recent soils of the interfluves or valley bottoms. The terrace soils have clayey subsoils overlying silica cemented hardpans at depths ranging from 20 to 40 inches. Poorly drained recent alluvial soils occur in the low lying areas between the terrace remnants. The soils in these positions consist of deep loams and clay loams with a perched water table within 3 to 4 feet of the land surface during some part of the year.[50 51 54]

The soils of North Fork Valley can be similarly characterized according to the three soil groups previously discussed. However, the soils occur in vastly different proportions. Soils on lake terrace remnants are the predominant types in the North Fork Valley, while they are of relatively limited extent in the Independence Valley. In addition, the lake sediments have been uplifted and more extensively dissected in the North Fork Valley.

A third significant landtype in the Jerritt Canyon project area is designated as landtype 11 in Figure 2-6. This landtype consists of recent alluvium making up canyon bottoms or where confining reworking of sediment has formed deep, weakly developed soils and the canyon streams provide a fluctuating shallow water table. The soils along the canyon streams have been dissected by recent downcutting forming three to six-foot banks of highly erodable soils.[51] The poorly drained alluvial soils of the valley bottoms are of limited extent in the North Fork Valley, but similar soils are more extensive in the Independence Valley. Stony alluvial fan soils are of moderate extent in the North Fork Valley, but these fan deposits are generally finer textured and less extensive in the Independence Valley.[54]

The frigid and shallow clay pan soils of the Independence Valley are suitable for production of rangeland vegetation. In the dissected mountain slopes, grazing is often limited to the valley bottoms by deep sideslopes. Soils on the dissected lake terraces have shallow clay pans that restrict rooting and produce a low sagebrush-grass community that provides only a poor to fair productive range, depending on the local condition.[51] The soils of the stream bottoms are naturally subirrigated and are used for native hay. Some of the finer textured soils of the alluvial fans are flood irrigated and mowed for hay.[54]

## Minerals and Geology

Topography in the Independence Mountains is steep, with slopes of 35 to 60 percent in deeply dissected canyons. Maximum elevations in the project region exceed 8,000 feet above sea level. The terrain varies from rounded mountains underlain by relatively easily-eroded bedrock to prominant cliffs composed of resistant rock strata. Foothills and piedmont depositional features along the east and west margins of the range slope down to the nearby North Fork Valley and Independence Valley basins.[55]

The stratigraphic sequence in the Independence Mountains within the project region is dominated by sedimentary rocks of Paleozoic age. These rocks are divided into broad units:

- Western facies-eugeosynclinal, siliceous rocks which comprise the upper plate of the Roberts Thrust;
- Eastern facies-miogeosynclinal carbonate rocks which comprise the lower plate of the Roberts Thrust.

View of Foreman Creek looking upstream just east of Section 33.

The generalized stratigraphic sequence of geologic formations in the claim block area is shown on Figure 2-7. Basin and range normal faulting, and ensuing erosion, have created windows in the upper plate of the Roberts Thrust through which lower plate eastern facies rocks are exposed. These exposed areas of lower plate rocks contain the primary zones of gold mineralization.[56]

Figure 2-8 shows an idealized cross section looking north through the Independence Mountain area. The Tuscarora Range west of the project area is comprised of granitic rocks. The Independence Valley basin separates the Tuscarora and Independence Mountains and consists of thick alluvial deposits overlying down-dropped blocks. The North Fork Valley east of the Independence Mountains is comprised of quarternary and recent age alluvium and tertiary age volcanic ash and alluvium.[56]

Figure 4-3, which is presented in Chapter 4, shows the known gold anomalies within 42-square mile claim block area, where analysis of surficial materials has indicated the possible presence of ore-grade gold deposits. With the exception of the proposed mine area, the reserves in each area of interest are not well delineated.[57]

In November 1979, Freeport estimated that over 6,100,000 tons of ore containing an average of 0.3 ounces of gold per ton of rock have been delineated in the first five gold anomalies within the proposed mining area. Gold values within the known ore bodies occur both as oxide ores and as unoxidized carbonaceous ores.[56]

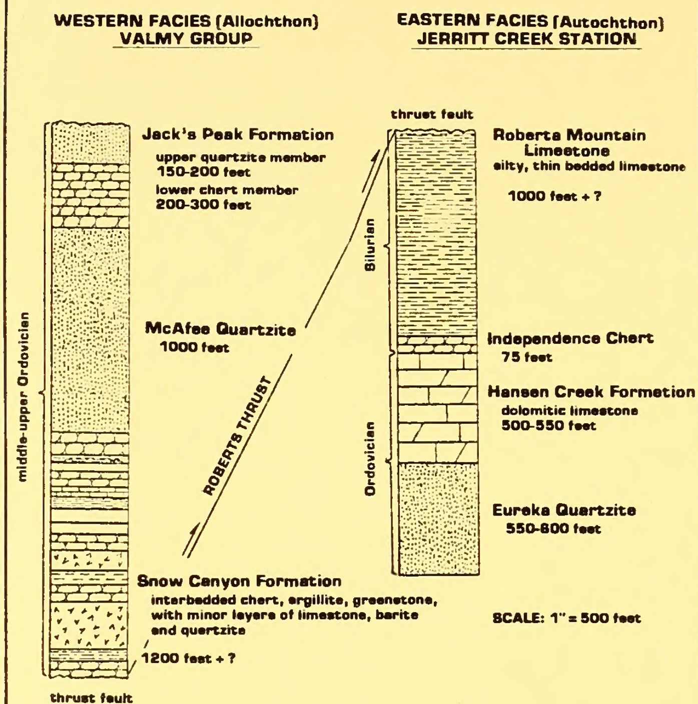



**FIGURE 2-7 Stratigraphic Section for the Jerritt Canyon Area**

SOURCE: R.B. HAWKINS, 1973

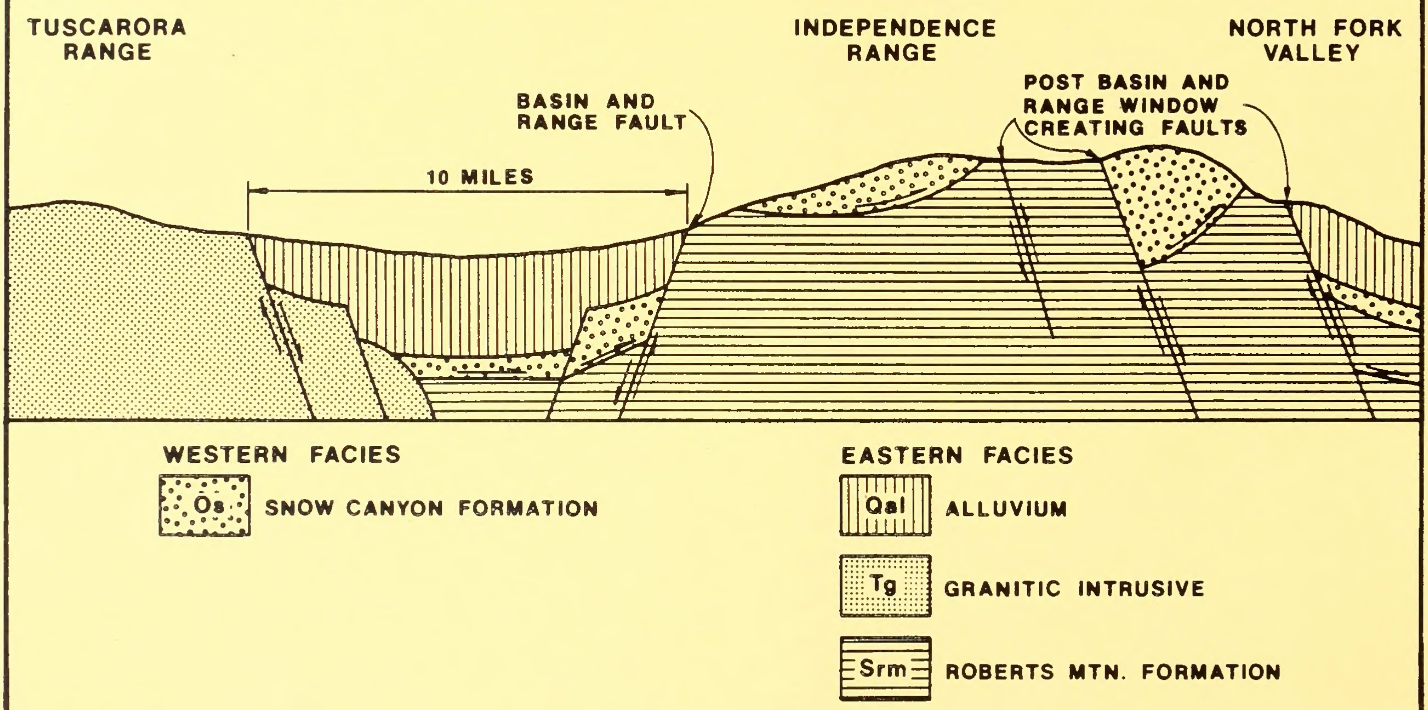



**FIGURE 2-8 Idealized Cross Section of Typical Physiography (Looking North)**

SOURCE: FREEPORT EXPLORATION COMPANY, 1979

Non-gold resources known to exist within the Jerritt Canyon project area include antimony, barium, and mercury. Available geologic evidence, and accessory data derived from gold exploration, indicate that none of these resources represent an economically viable ore in the claim block area.[56,57]

The Jerritt Canyon project area is within the seismically active Basin and Range Province but near the boundary of the weakly tectonic Snake River and Columbia Plateaus. On the basis of interpretations of site-specific and regional geology and seismologic data, an earthquake of magnitude 7.0 to 7.25 is believed possible on any of the three regional fault systems. Additionally, regional interpretations of seismicity suggest that a major earthquake could occur within a few tens of miles of almost any point in the Nevada region.[58,59]

## Socioeconomics

The socioeconomic studies for the Jerritt Canyon Project emphasized the communities which could be significantly affected by the proposed action. The study area included the City of Elko and Elko County (particularly the Independence Valley portion), Mountain City, and the Duck Valley Indian Reservation. The existing socioeconomic base and identified problem areas of the City and County of Elko are displayed in tabular form in Table 2-7.

### Elko County

The Elko County population currently is estimated to be 15,740. Between 1970 and 1978 the county's population grew by approximately 14 percent. This population growth was primarily due to high birth rates; natural growth accounted for 83 percent of the total growth between 1970 and 1977.[60]

As a reflection of its rural character and geographic location, agriculture and tourism are the base industries that employ the greatest numbers of people. (Base industries are those sectors that produce goods or services which are exported outside the local economy. They provide the basic employment and income on which the balance of the local economy depends.) The economic base is expanding, however, due to the rapid growth of several sectors, both in numbers employed and amount of income generated. Although mining represented only 7.3 percent of base employment in 1977, it has shown the most rapid growth, with a 167 percent increase in employment between 1973 and 1977, and 616 percent growth in total income generated between 1972 and 1976. Trade, services, and government sectors, which are currently large employers in the county, have also shown employment and income growth in recent years. The agricultural sector, while remaining one of the largest employers in the county, experienced a decline from nearly 19 percent to 4.6 percent of total income generated between 1972 and 1976, This decline was largely due to the generally depressed state of agriculture nationwide during that period. The total number of unemployed (4.6 percent of work force) increased by 100 individuals over the 1970-1977 period, reflecting the larger size of the total labor force.[60]

The Elko County government is financially sound. With the exception of 1975, when it experienced a slight decline, due to the recession in agriculture, assessed valuation has increased steadily since 1965. In 1977 county revenues exceeded expenditures giving the county a slight surplus. Property taxes have remained the dominant revenue source (approximately 72 percent); Federal grants have risen from 0.5 percent to nearly 13 percent of the total.[60]

Much of the land in Elko County is managed by the Federal government. The Bureau of Land Management manages about 62 percent of the county's total 17,182 square miles, the Forest Service another 10 percent. Over 60 percent of the land in the county is used for ranching and grazing. This includes land held by private ranches and Federally controlled land used for grazing. About 36 percent of the land in the county is used for recreation. County land use controls include the county zoning ordinance, mobile home regulations, and state subdivision regulations. The 1971 Elko County General Plan is the primary planning document.

County facilities and services are summarized in Table 2-7. There are an estimated 7,200 housing units in the county, of which 4,100 are in the City of Elko. Approximately 78 percent of the housing units in the county are single and multifamily dwellings, the rest being mobile homes.[60]

### City of Elko

The City of Elko had an estimated 8,970 residents in 1978. Its population grew by about 18 percent between 1970 and 1978, a rate slightly higher than the 14 percent growth exhibited by the county. Elko is the trade center of Elko County, serving as the hub of retail, wholesale, and service industry activities. The city has within its borders 169 of the 262 retail firms and 25 of the 35 wholesale establishments in the county.[60]

The City of Elko has a solid financial base. Assessed valuation has risen steadily since 1965. In 1977 the city budget showed a surplus. As of June 1978, the city's total bonded debt was $95,000, leaving a residual borrowing capacity of $6,877,634 of the allowable limit, which is equivalent to 15 percent of the city's assessed valuation.[60]

There were an estimated 4,188 housing units in Elko in 1978, which represents a 54 percent increase from 1970. The number of mobile housing units tripled between 1970 and 1979, accounting for 77 percent of the increase. Although the current vacancy rate is unknown, all indications are that it is quite low. The housing market is especially tight for rental housing.[60]

School enrollment for the Elko County School District was 2,413 in 1978-79, approximately 82% of capacity.[60] School enrollment increased significantly for the 1979-80 school year to 2,754. This increase was the result of in-migration into the county. The school district's projected enrollment for 1979-80 was 2,329 students, a decline from

**TABLE 2-7**
**Infrastructure Summary — City of Elko and Elko County, 1979**

| | | |
|---|---|---|
| **TRANSPORTATION** | 7,170 miles of county road; all roads in good shape. | No Problems |
| **RECREATION** | Numerous opportunities for hiking, camping, fishing, hunting, and sightseeing; bottle and rock hunting, and boating. | No Problems |
| | Elko has 265 acres of park space, new convention center, 18-hole golf course, four parks, and four school/recreation areas. Bike path and riverfront park development project are planned. | Park space "set aside" policy will adequately provide requirements of population growth. |
| **HOUSING** | Total housing stock in 1978 estimated to be 7,192. Single and multiple family units totaled 4,922; 2,268 were mobile homes. Current vacancy rate estimated to be very low (less than 3 percent). | Increasing population will require more housing. Special need for more rental units and mobile home space. |
| **WATER SUPPLY** | Eleven deep wells constitute principal source. 1978 pumping capacity 9.43 MGD; average daily demand 3.3 MGD; peak day demand 8.5 MGD. Storage capacity 6.4 MGD; but on peak days supplies are tight. Some mains are 18" but several are still 12" and need expansion. Water quality meets EPA requirements. | System being expanded. 1985 system will have an average daily capacity of 4.4 MGD; a peak day capacity of 11.2 MGD. The delivery system will be upgraded. |
| **WASTEWATER TREATMENT AND OISPOSAL** | Built in 1972. Plant designed to treat 2.2 MGD; daily. In 1978, average daily flow was 1.6 MGD with peak flows of 2.2 MGD. Plant has been unable to consistently meet EPA effluent discharge (to Humboldt River) requirements. Collection system needs upgrading. | City is planning new treatment plant. New plant will have capacity of 3.8 MGD. Will no longer discharge effluent into Humboldt River. Instead, will use to irrigate alfalfa crops. |
| **SOLIO WASTE OISPOSAL** | City owns 120-acre landfill site. Private rubbish collecting firm picks up garbage twice weekly. | System adequate; 86 percent of capacity remaining as of 1979. |
| **UTILITIES** | GAS — Southwest Gas Company, 2,605 hookups.<br>ELECTRIC — California Pacific Electrical Company, 5,125 hookups.<br>TELEPHDNE — California Pacific National, 4,729 hookups. | City has used up current allotment of power from California Pacific. Must look to new sources of electricity by early 1980's. |
| **HEALTH CARE** | ELKD GENERAL. Dnly hospital in County, 58-bed capacity, 14 full-time physicians, hospital equipped with emergency room, intensive care unit, and a cardiac care unit. Occupany rate 53 percent.<br>ELKD CLINIC. Private out-patient facility. Equipped with X-ray, ultra-sound, a laboratory, and therapy facilities. Twelve full-time physicians.<br>RUBY MDUNTAIN MANDR. Dnly rest home in county, 92-bed capacity. Average occupancy rate 80 percent.<br>ELKD MENTAL HEALTH CENTER. Primarily out-patient facility. Two beds availalbe if needed. Seven full-time staff.<br>ALCDHOLISM & DRUG ABUSE CENTER. Non-profit, only center of its kind in Elko County. Six full-time counselors. 15-bed treatment facility opened in September 1979. | All facilities are adequate for existing population. |
| **SCHOOLS** | Elko City enrollment area includes three elementary schools, and junior/senior high school. The 1978-79 enrollment was 2,413; approximately 70 percent of district enrollment. | No major problem; facilities at 82 percent of capacity. |
| **LAW ENFORCEMENT** | Elko Police Department has 22 full-time officers and two detectives. County Sheriff has ten full-time and five part-time officers with four full-time officers stationed in Elko. Sheriff is responsible for operating jail. | The jail is adequate and city jail has been recommended separate from existing city/county jail. |
| **FIRE** | Elko Fire Department has two fire stations, one is manned and located north of railroad tracks. The other is garage and is located south of railroad tracks. Staffing includes 15 full-time and eight volunteer firefighters. The fireflow is 3,200 GPM, and city has "class six" fire rating. | Additional staffing may be required to maintain standard level. |

**SOURCE: ABT ASSOCIATES INC., JULY 1979**

1978-79. School enrollment is still within the present capacity of the school district.[61]

The current land use plan for the city was adopted in 1974, with specific land use controls enacted by city ordiance in 1978. Land use patterns are unique in that nearly 54 percent of city land is vacant or in agricultural use. Residential use comprises less than 10 percent of the total land area. The city owns most of the vacant and agricultural land, which gives the City Planning Commission and Board of Supervisors control over any type of land use proposed in undeveloped areas.[60]

Two major projects are underway that will have major effects on local land use patterns. Construction of the I-80 bypass on the north side of town will separate existing land use from new development on the other side of the interstate. Relocation and consolidation of the existing railroad right-of-ways to the south side of the Humboldt River will eliminate a major barrier in the downtown area, but will displace some existing residential and commercial uses.[60]

Community facilities and services for Elko are summarized in Table 2-7. The existing infrastructure is generally adequate for the current population, with three exceptions. The water and wastewater systems are at capacity, but the city is moving ahead with plans for expanding both systems. The combined county/city jail is overcrowded, and a new facility is under consideration.[60]

### Other Communities

The proposed action could potentially affect three other areas of the county. The project site borders the Independence Valley, 50 miles north of Elko. Tuscarora, the only community in the valley, consists of a tavern, a small pottery school, a small mineral extraction operation, and several residences. The remainder of the valley is composed of large ranches. Public facilities and services are minimal, with the exception of one public school at the junction of Nevada Highway 11 and Nevada Highway 18 and a small bar and trailer camp at Taylor Canyon.

Mountain City is an unincorporated community of 75 persons approximately 80 miles north of Elko on Nevada Highway 51. Available public and private services are limited, but are adequate for the current population. An undeveloped mobile home park has been platted with space for 40 units. Students attend school in Owyhee on the Duck Valley Indian Reservation.[60]

The Duck Valley Indian Reservation overlaps the Idaho and Nevada border and is traversed by Nevada Highway 51. The town of Owyhee on the Nevada side is the central community on the reservation. The reservation is under the direction of the Shoshone-Paiute Tribal Council, which works in conjunction with the Bureau of Indian Affairs to provide facilities and services.

As of April 1979, the population of the reservation was 1,047. Local economic activity includes ranching, alfalfa hay production, commercial establishments and tribal services. Economic development is encouraged to reduce the high unemployment rate, which exceeds 30 percent or higher, given seasonal variations.[60]

Other major communities in Elko County include Wells, Wendover, Carlin, and Jackpot. These communities are not addressed in detail because their distance from the mine site indicates that they will not be significantly affected by the proposed action.

## Air Resources

### General Climatology

The climate of Nevada can be classified as continental and is influenced by the Sierra Nevada Mountain Range, which stretches along the western border. The general wind pattern for northern Nevada is westerly winds in the winter with a shift to south-westerly winds in the summer. The climate in the Jerritt Canyon project area follows these general trends but is also strongly affected by local topographic features, specifically, the Independence Mountains. This high elevation affects precipitation and average temperature patterns.[62]

Average annual precipitation for Jerritt Canyon is interpolated to be about 12 inches. The storm track follows westerly winds over the northern part of the state during the winter months, so most of the precipitation falls in the winter. The storm track moves further north during the summer months which results in predominantly south-westerly winds and less rain. The amount of precipitation that falls as snow depends on the elevation of the site. In Elko, which is over 2,000 feet lower and 50 miles to the south of Jerritt Canyon, approximately 40 percent of the annual precipitation falls as snow. A higher percentage of snow precipitation occurs at the mine site due to the higher elevation. During the summer, a large portion of the precipitation will occur during thunderstorms.[62 63]

On the local level, the surface wind pattern is highly dependent on the local variation in topography. Several components of mountain-valley wind systems dominate the local flows in the Jerritt Canyon area. The land feature of the north-south oriented Independence Mountains causes a weak diurnal surface wind pattern. Due to heating of both sides of this range during the daytime, shallow slope winds result. The western slopes experience a westerly upslope flow originating from the Independence Valley. Easterly slope winds flow up the east side of the range from the North Fork Valley.[63]

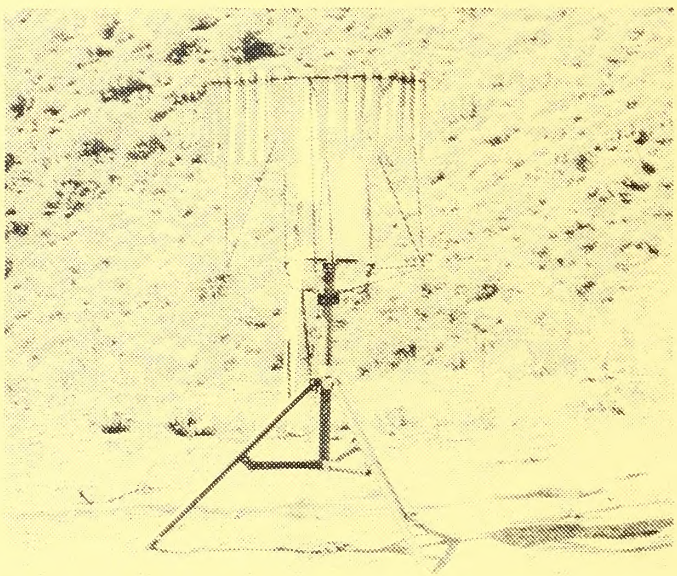
In the immediate area of Jerritt Canyon, the westerly slope winds are enhanced by a local valley wind blowing up Jerritt Canyon during the daytime. The valley wind, driven by the temperature difference between the mouth and upper end of the canyon, fills the canyon with westerly directed winds during the day.[64]

On the eastern slope of the Independence Mountains, the easterly daytime slope winds are weaker and more shallow because they are flowing against the prevailing westerly flow. During strong prevailing westerly wind conditions, the easterly upslope winds may disappear.

During nighttime, the direction of the flow pattern is reversed. Weak, shallow, gravity-driven drainage winds flow down both sides of the Independence Mountains. Any large canyons in the range, such as Jerritt Canyon, will channel and enhance the drainage or mountain winds.[64]

Seasonally, the diurnally-varying mountain-valley and slope wind patterns are most well-developed during clear-sky, sunny summer and fall days and nights. They are weakest, or non-existent, during cloudy, stormy conditions or when strong prevailing winds dominate.[64]

Due to their topography, both the Independence Valley and the North Fork Valley experience their own mountain-valley flow regimes. However, being much broader topographic features, the wind circulation in these valleys will be weakly developed and is not expected to significantly influence the surface winds in or near the Independence Mountains. The main effect of the Independence and North Fork Valleys is to channel strong prevailing winds in a north-south directions.[64]



Precipitation gauge with surrounding wind deflectors.

## Air Quality

The quality of air in the Jerritt Canyon area is excellent because of the limited activities of man in the region. Only two air quality parameters are of concern for this project: total suspended particulates (TSP) and sulfur dioxide ($SO_2$). These are the only significant air quality pollutants that will be generated in significant quantities by the site-specific project activities.[65]

There are two sources of available TSP data: on-site air quality measurement stations and State of Nevada stations in Elko. There has been weekly on-site monitoring of particulate concentrations since September 1978 at two stations: 1) adjacent to the Marlboro Canyon mine site, and 2) in the Independence Valley, near the mouth of Jerritt Canyon. The geometric mean for the particulate values recorded at the mine site is approximately 7 $\mu g/m^3$. The geometric mean of the TSP concentration recorded for this period at the Independence Valley site is 10 $\mu g/m^3$. These TSP values are in contrast to much higher values measured in the City of Elko. The annual average 1972 and 1973 Elko values, measured at the Elko County Hospital, are just below 60 $\mu g/m^3$.[65] However, these values do not represent the background concentration for the Jerritt Canyon Project region; they reflect the particulate matter generated by human activity in an urban environment.[64 65]

There is no source of $SO_2$ measurements in Elko County, Nevada. $SO_2$ data from monitoring stations in other non-industrial areas of Nevada show annual averages ranging from 0 to 9 $\mu g/m^3$ with no recorded violations of the 24-hour standard. These measurements were taken mainly in Clark County, Nevada. Much higher $SO_2$ readings have been recorded near Kennecott Copper Company's smelter operation at McGill, Nevada; however, these levels are not indicative of air quality in Elko County. Given the absence of other $SO_2$ sources around the Jerritt Canyon project area, it can be safely assumed that current $SO_2$ levels at the site are minimal.[64 65]

## Noise

The only sources of manmade noise now affecting the project area are: 1) exploratory drilling operations; 2) occasional off-road vehicles; 3) occasional light aircraft overflights; and 4) occasional discharge of firearms during hunting season. For practical purposes, the Jerritt Canyon project area does not presently contain any significant sources of manmade noise. Other than manmade sources of noise, natural noise sources consist of wind, rain, thunder, insects, birds, and other wildlife.[64]

Due to the remoteness of the project from manmade sources of noise, and the existance of measured noise data for similar remote areas, a field monitoring program to measure existing noise was not necessary. The noise data show that in natural environments, noise levels can be extremely low, on the order of 15 decibels (dBA) and vary over a considerable range up to levels of approximately 45 dBA, depending upon what natural sources are present.[66 67 68]

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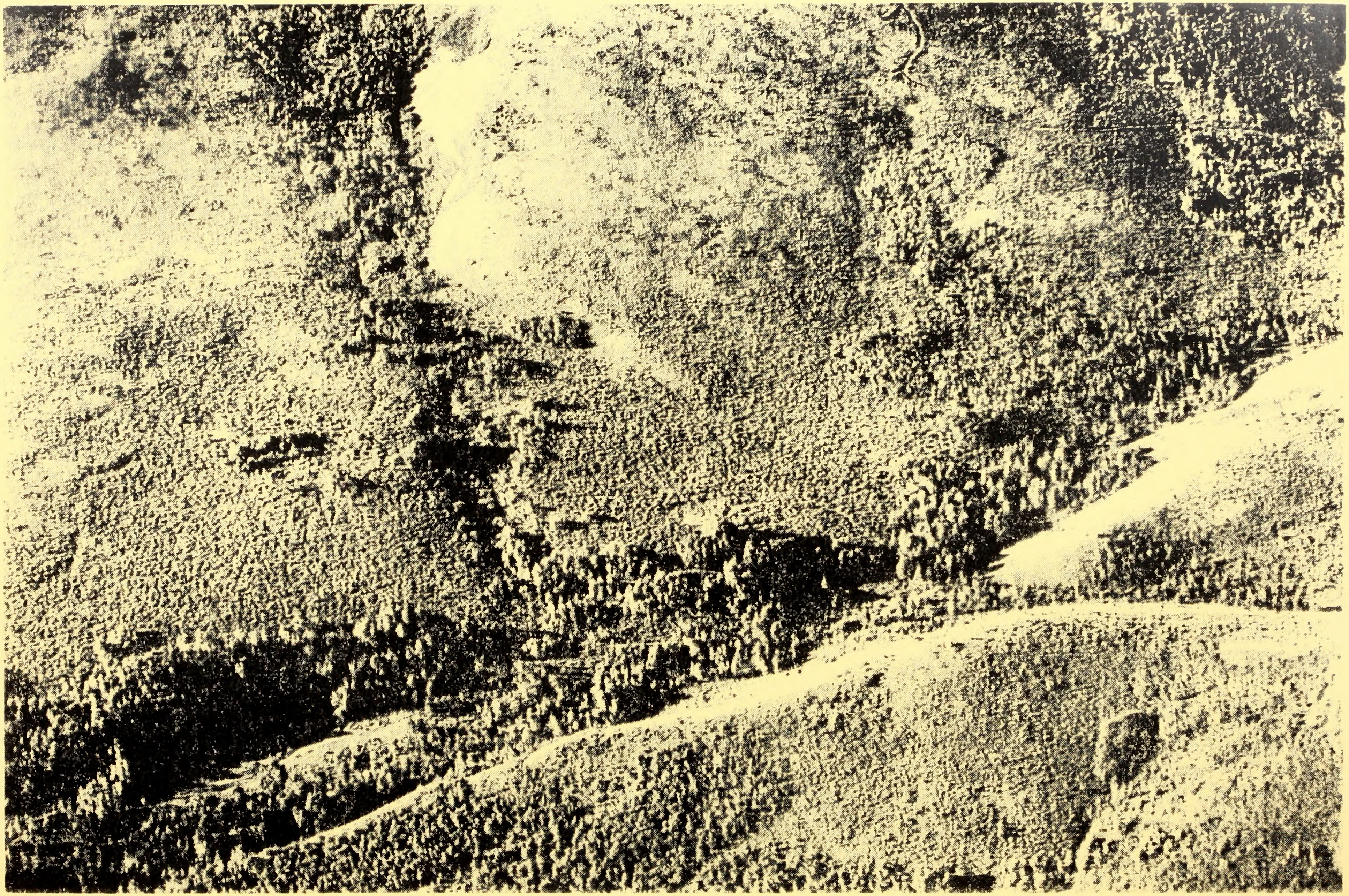


View of California Creek looking south at the boundary of Sections 31 and 32.

# 3. EVALUATION CRITERIA

## Introduction

Criteria are statements on which a judgement or decision can be based. This chapter of the EIS presents the criteria developed in order to evaluate each of the project alternatives and to select the preferred alternative.

The evaluation criteria developed for this analysis of environmental impacts were derived from several general sources including:

- Public and Other Agency Recommendations
- Laws, Executive Orders, and Regulations, including the National Environmental Policy Act (NEPA)
- Goals and Objectives of Forest Service Plans and Policy Statements
- Test of Legal, Technical, Financial, Economic, Social, and Political Feasibility.

The specific sources for the evaluation criteria are cited at the end of this chapter.

The initial step in the development of the evaluation criteria was the identification of public issues, management concerns, and opportunities regarding the implementation of the project (see Chapter 1). Once issues, concerns, and opportunities had been identified, an extensive list of criteria was developed to analyze the relative effect of implementation of each of the project alternatives on the elements of concern. During the evaluation process, certain criteria were eliminated because their application did not enable evaluation of the project options and alternatives. The complete list of criteria developed for the evaluation of the project options and alternatives is included in Appendix B.

The evaluation criteria, once selected, were designated as key criteria, unique concerns, and general criteria. The key criteria (1 to 6) are those representing the most significant issues and concerns. They were determined to be the criteria which would be most affected by implementation of an alternative. Unique concerns (4, 7, and 8) are those criteria which have unique constraints on the project and/or which are subject to legal standards. The general criteria (9 through 19) were applied to the alternatives in order to evaluate relative differences in beneficial and adverse effects of implementation. The general criteria were not weighted as heavily in the evaluation process as the key criteria and unique concerns, but are important in understanding the consequences of implementation, and in selecting the best alternative.

Most of the criteria can best be met by selection of an alternative that provides the least effect to that criteria. Only in a few cases (i.e., air quality) are there quantifiable legal standards or limits which cannot be exceeded. Chapter 6 is devoted to measuring the positive or negative effects that each of these alternatives has on the various criteria. This evaluation is then displayed so the consequences of selecting each of the alternatives can be seen.

These criteria have been developed so as not to exclude any reasonable project alternative from consideration. The criteria should, however, eliminate from consideration alternatives which are not feasible for implementation.

## Criteria

The following decision criteria have been developed to evaluate the various alternatives being considered for the Jerritt Canyon Project.

1. Effect on livestock management (from noise, human activities, and corridor barriers)
2. Effect on deer winter range
3. Effect on sage grouse strutting grounds and brood grounds
4. Effect on Lahontan trout
5. Potential soil erosion loss
6. Effect on surface water quality (due to sedimentation)
7. Effect on research values for the Saval Ranch Research and Evaluation Project
8. Effect on golden eagle
9. Effect on quality of grazing resources (AUMs)
10. Effect on Federal candidate threatened plant species
11. Long range recovery of natural soil and vegetation conditions
12. Effect on surface hydrology (channel stability and potential flood hazard)
13. Effect on ground water quality
14. Effect on air quality (particulates)
15. Maintenance of visual quality of the Independence Mountains
16. Effect on archeological and historical resources
17. Consistent with requirements of Mountain City Ranger District Multiple Use Plan
18. Potential for socioeconomic opportunities
19. Potential land disturbance (applied only to evaluation of waste rock disposal and transmission line alternatives)

## Sources of Information

National Environmental Policy Act - 101 (b) (1-6), 101 (c), and 102 (2) (c)

Forest and Rangeland Renewable Resources Planning Act (as amended)

National Forest Management Act of 1976 (PL94-588)

Federal Land Policy and Management Act of 1976 (PL94-579)

Endangered Species Act (as amended)

Endangered American Wilderness Act of 1978

Multiple Use Sustained Yield Act of 1960

Resources Planning Act of 1974

National Historic Preservation Act of 1974

National Historic Preservation Act of 1966

Antiquities Act of 1906

Executive Order 11593, (Protection and Enhancement of the Cultural Environment), 1971

Bald Eagle and Golden Eagle Protection Act

Wild and Free-Roaming Horse and Burro Act of 1972

Resource Conservation and Recovery Act of 1976

Clean Water Act of 1977

Federal Water Pollution Control Act of 1972

Effluent Guidelines and Standards for Ore Mining and Dressing

Federal Safe Drinking Water Act

Nevada Water Pollution Control Act of 1974

Forest Service Regulations, 36 CFR 251 and 252

Multiple Use Mining Act of 1955

Clean Air Act (as amended), 1977

Forest Service Roadless Area Reinventory and Evaluation II (RARE II)

Department of Agriculture, Forest Service, the NEPA Decision Process; Federal Register, Vol. 44, No. 79, Monday, April 23, 1979

EIS Scoping Document for Freeport Gold Company's Jerritt Canyon Project on the Humboldt National Forest in Elko County, Nevada

Executive Order 11990 (Protection of Wetlands), Executive Order 11988 (Floodplain Management)

Mountain City Ranger District Multiple Use Management Plan

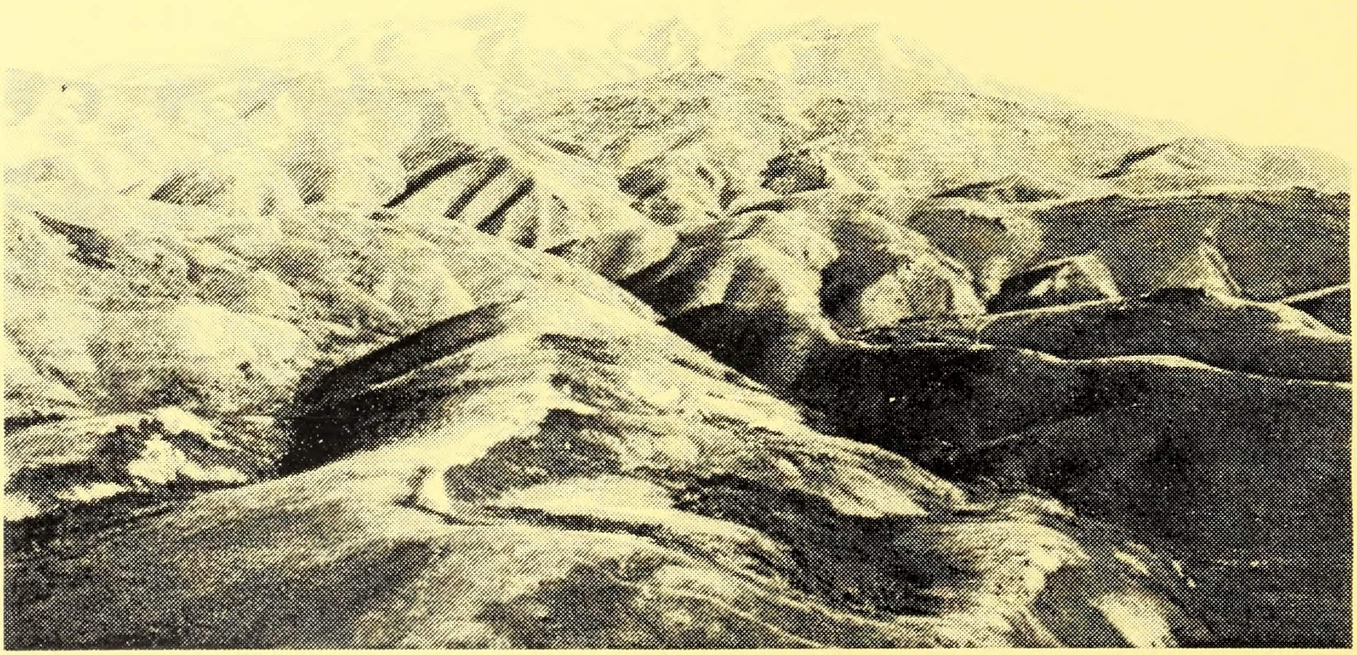
Forest Service Manual Regulations

BLM Manual Regulations

General Mining Law of 1872, as amended

Minerals Policy Act of 1970

Nevada Air Quality Control Act



Aerial view of 42-square mile claim block looking northward, with Marlboro Canyon mine site centered in upper ridges.

# 4. ALTERNATIVES CONSIDERED

## Introduction

An overview of Chapter 4 can best be presented by outlining the objectives which will be satisfied in the various sections of this chapter:

- Describe the applicant's proposed action.
- Document the planning process used to formulate component options and alternatives for the Jerritt Canyon Project.
- Document the logic for eliminating some component options and alternatives because of major technical or economic restraints.
- Describe all of the proposed component options, including the current Freeport Gold Company preferred option for each project component.
- Select and display all reasonable alternatives that utilize all of the viable component options.
- Based upon probable effects of the Jerritt Canyon Project on the environment and on other multiple use activities within the Forest, present a list of management constraints and guidelines and corresponding mitigation measures, for each alternative, which could be implemented by Freeport and which will allow Freeport to produce gold with minimal effects on the land resources.
- Develop and describe a monitoring program which will provide timely feedback on the implementation of the management constraints and guidelines.

Three important definitions are included at the beginning of this chapter.

Project Components - These are the five major functions which, when linked together, form the Jerritt Canyon Project. The project components for this EIS are.

- Mine and related waste rock disposal areas
- Gold mill
- Support facilities
- Corridors
- Tailings disposal system

Options - The word options has been used in this EIS for the component analysis to avoid confusion with the word alternative. In reality, each option is an alternative way of accomplishing some component action. For many of the project components, there are optional ways of performing the required function. For example, there are four different transportation methods which could be used to move gold ore from the mine to the mill. These transportation modes are referred to as methodology options in this EIS. Another example of component options is the variety of different locations for mill sites or tailings disposal sites.

Alternatives - With the exception of the open-pit mine, all of the project components have geographical location options. These components include:

- Waste rock disposal areas
- Transportation corridors
- Mill sites
- Tailings disposal sites
- Power transmission line corridors

By definition for this EIS, the project alternatives are derived from this list of location options. Since the mill, tailings disposal system, and the connecting transportation corridor are an integral system, they are coupled together to form various alternatives. The groups of alternatives which will be considered in this EIS are 1) waste rock disposal area alternatives, 2) mill-corridor-tailings pond alternatives, and 3) power transmission line corridors.

## Overview of Proposed Action

Freeport Gold Company has a 42-square mile claim block on the Humboldt National Forest, 50 miles north of Elko, Nevada. The proposed Jerritt Canyon Project gold mine is located within the northern one-third of this claim block. Other project components will be located on adjacent Forest Service, BLM, and private land. Freeport's gold activities can be divided into two stages: 1) 1981 to 1991 - proposed action, and 2) 25-year plan - possible future activities. Since only the first stage is based upon proven gold ore reserves, the Forest Service will treat this action in the EIS. The 25-year plan is formulated on minimal geologic information and hence is discussed in very general terms in Appendix C. The 25-year program cannot be specifically treated in this EIS because of the total lack of proven ore information.[1]

The location of the proposed Jerritt Canyon Project is shown in Figure 4-1. The proposed open-pit gold mine is situated in the Independence

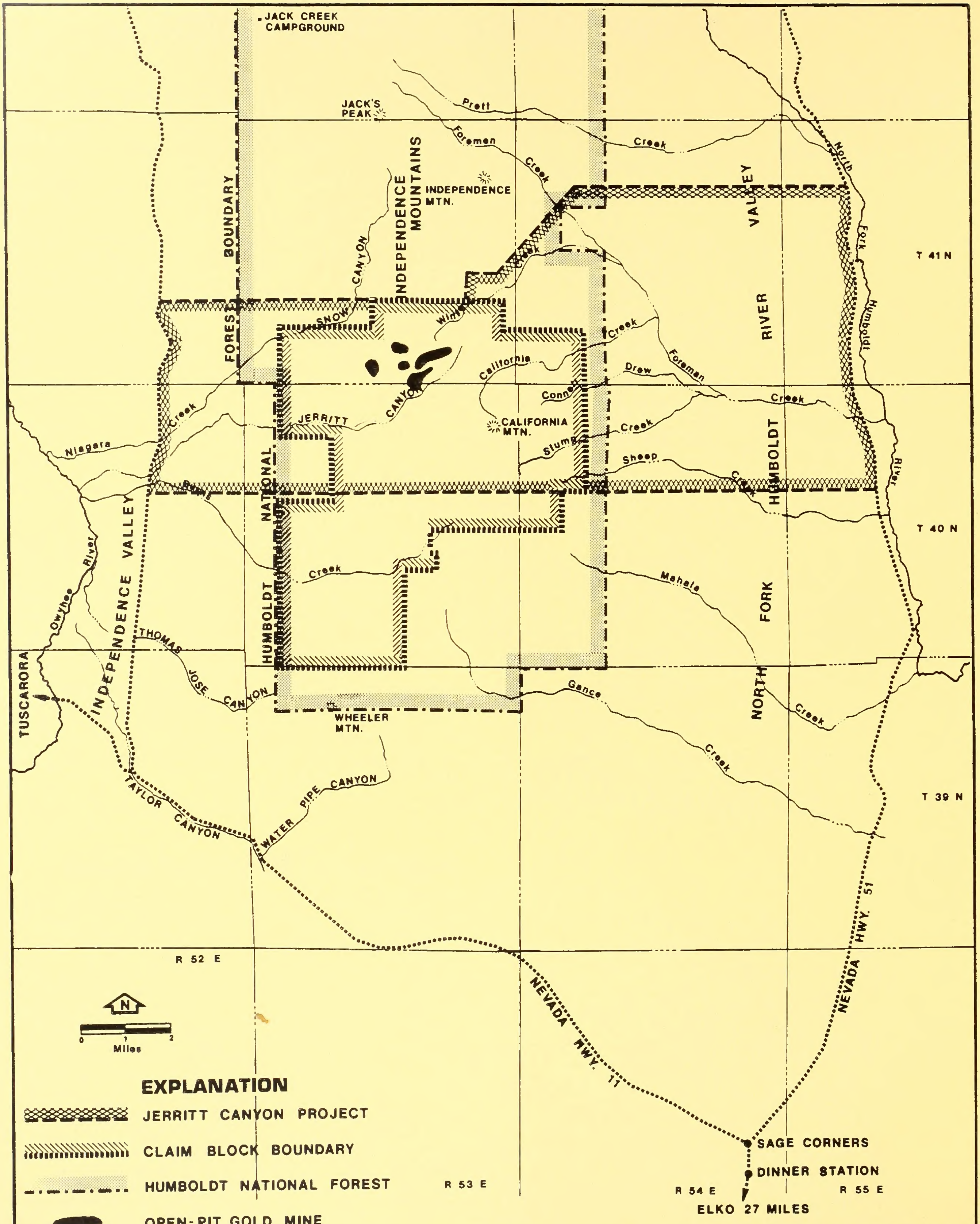



**FIGURE 4-1 Location of Proposed Jerritt Canyon Project**

**SOURCE: FREEPORT GOLD COMPANY AND FOREST SERVICE**

Mountains at elevation 7,800 feet, which is about 1,500 to 2,000 feet above the flanking Independence Valley and the North Fork Humboldt River Valley.

Freeport Gold Company proposes to mine gold ore by conventional drill-blast-load-haul open-pit benching methods. Some selected mineralized areas may lend themselves to mining by underground methods from the walls of the completed open pits.[2]

Freeport estimated during Fall 1979 that over 6,100,000 tons of potential ore containing an average of 0.3 ounces of gold per ton of rock have been delineated in the vicinity of Marlboro Canyon, as shown in detail in Figure 4-2. Based upon the development drilling program, Freeport has proven ore-grade reserves to support a mill which can handle 700,000 tons per year of ore. There are sufficient reserves in this area to sustain a mine/mill operation for approximately 10 years. During each day's mining operation, an average of 16,800 tons of overburden and 2,800 tons of gold ore will be mined. Freeport's mining operation will be conducted for two 8-hour shifts per day for 250 days each year. Mining at this level will produce enough gold ore to feed the 2,000 ton-per-day gold mill which Freeport proposes to build in the vicinity of the mine. At the present time there are four other areas near Marlboro Canyon that are known to contain gold mineralization. These are Alchem, North Generator Hill, Generator Hill, and West Generator Hill. These areas have not been fully drilled, and no estimate is known of the amount of ore reserve at the present time.[2]

The mining operation will consist of drilling, blasting, and placement of overburden or gold ore by 10 cubic yard capacity front-end loaders and/or 5 to 7 cubic yard shovels into 75-ton rear dump trucks. Overburden rock will be hauled to nearby waste disposal areas, while the ore will be hauled to the mill. Two mineralogically different types of gold ore have been encountered at the Jerritt Canyon mine: oxide and carbonaceous gold ore. Each type of ore must be segregated and stockpiled in separate areas near the mill.[2]

The Marlboro Canyon ore-body, by far the largest of the five proposed open pits, is 4,000 feet long and 400 feet wide. Mining of this ore-body will occur through a vertical range of about 350 feet. The other four ore-bodies may range from 700 to 2,500 feet long and 200 to 400 feet wide. About 36 million tons of overburden will be stripped from the Marlboro Canyon area in the process of ore extraction. This waste rock or very low grade gold ore cannot be economically processed through the mill. The overall overburden removal ratio for the open-pit mines is estimated to be 6 tons of overburden per ton of ore.[2]

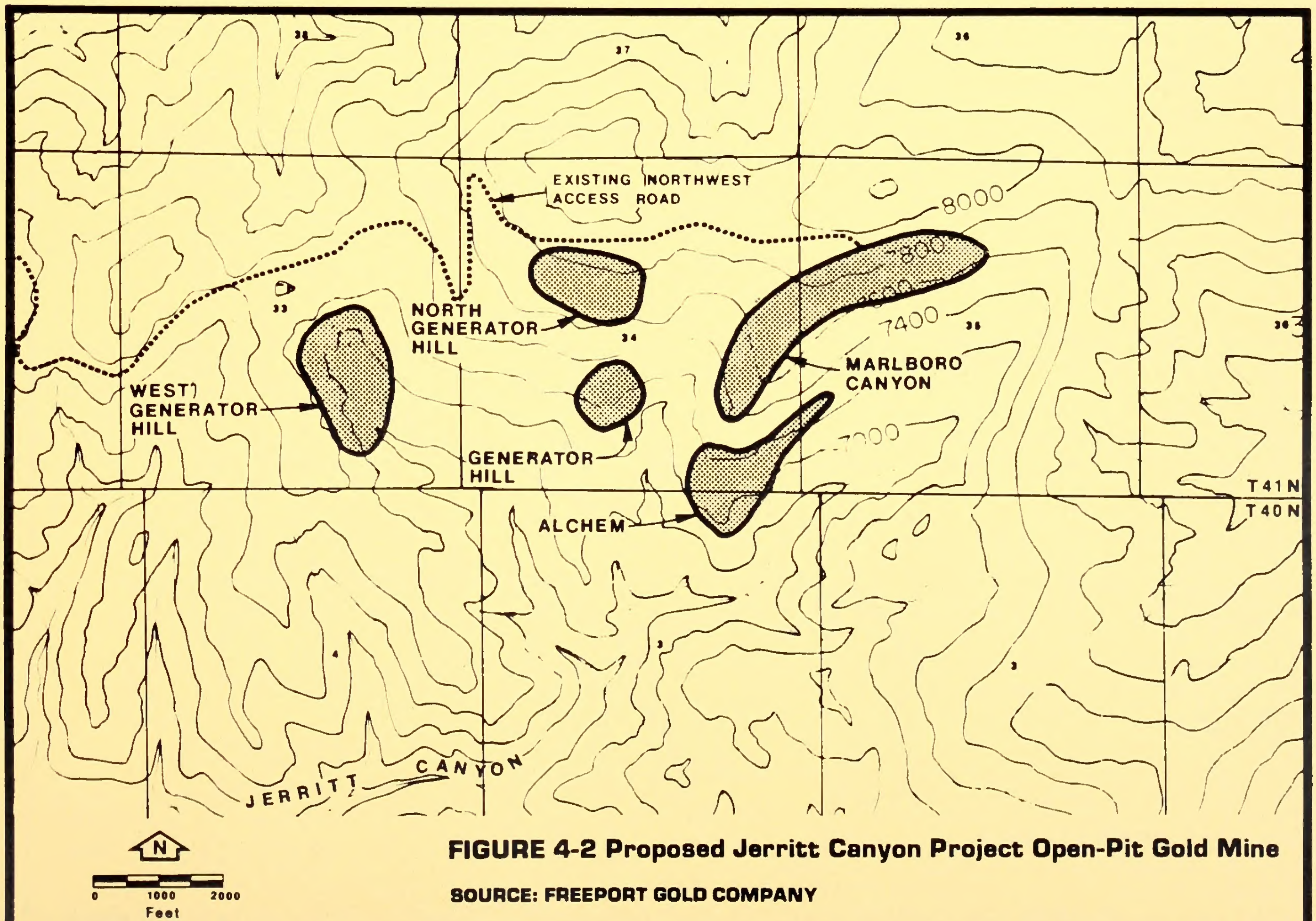



**FIGURE 4-2 Proposed Jerritt Canyon Project Open-Pit Gold Mine**

SOURCE: FREEPORT GOLD COMPANY

On the following map (see Figure 4-3), there are 20 geologic anomalies[1/] which have been given an identification name by Freeport Gold Company. These anomalies may contain ore-grade material based upon surface evidence or upon limited reconnaissance drilling activity. These 20 anomalies have been grouped into three areas. Freeport refers to these areas as Mining Area 1, Mining Area 2, and Mining Area 3. Mining Area 1 is made up of the ore-grade reserves of the anomalies Alchem, Marlboro Canyon, Generator Hill, West Generator Hill, and North Generator Hill. Over the next quarter century, there are a number of development scenarios which could take place in Mining Areas 2 and 3. Freeport's geologists and engineers have prepared one optimistic scenario which might represent the greatest possible gold mine development (and impact) on the entire claim block. This optimistic development scenario, described in Appendix C, is based upon very limited drilling data.[1 3]

If Freeport decides to open other gold mines, mills, tailings disposal areas on or adjacent to the 42-square mile claim block, additional environmental actions must be conducted by the Forest Service. The Forest Service will prepare an Environmental Assessment on the proposed operations, or will prepare a supplement to this EIS.

1/ Anomaly - an area that may contain ore-grade material based upon certain above ground geological conditions.

## Formulation of Options

Under the Council on Environmental Quality's (CEQ) revised regulations governing the National Environmental Policy Act (November 29, 1978), the "heart of the environmental impact statement" is to be focused on the alternatives chapter. The Forest Service officials at the Humboldt National Forest have emphasized the development of reasonable options and alternatives for virtually all components of Freeport Gold Company's proposed action. Personnel from the Forest Service, consultants to the Forest Service, Freeport Gold Company and its consultants have conducted 12 months' of special studies to formulate a comprehensive set of project options and alternatives for virtually every major action involving the construction, operation, and abandonment of this gold mine/mill operation. During this 12-month period, personnel from the Forest Service and its consultants also visited other operating hard-rock mining/milling operations in Nevada and Idaho. These visits provided more insight into the variety of component options that are available to Freeport Gold Company.[4]

Freeport Gold Company presented a proposed Operating Plan to the Forest Service early in 1978. The Forest Service and its consultant asked Freeport to consider all feasible options for executing each of the project components. Freeport's mining engineers, geologists, and process

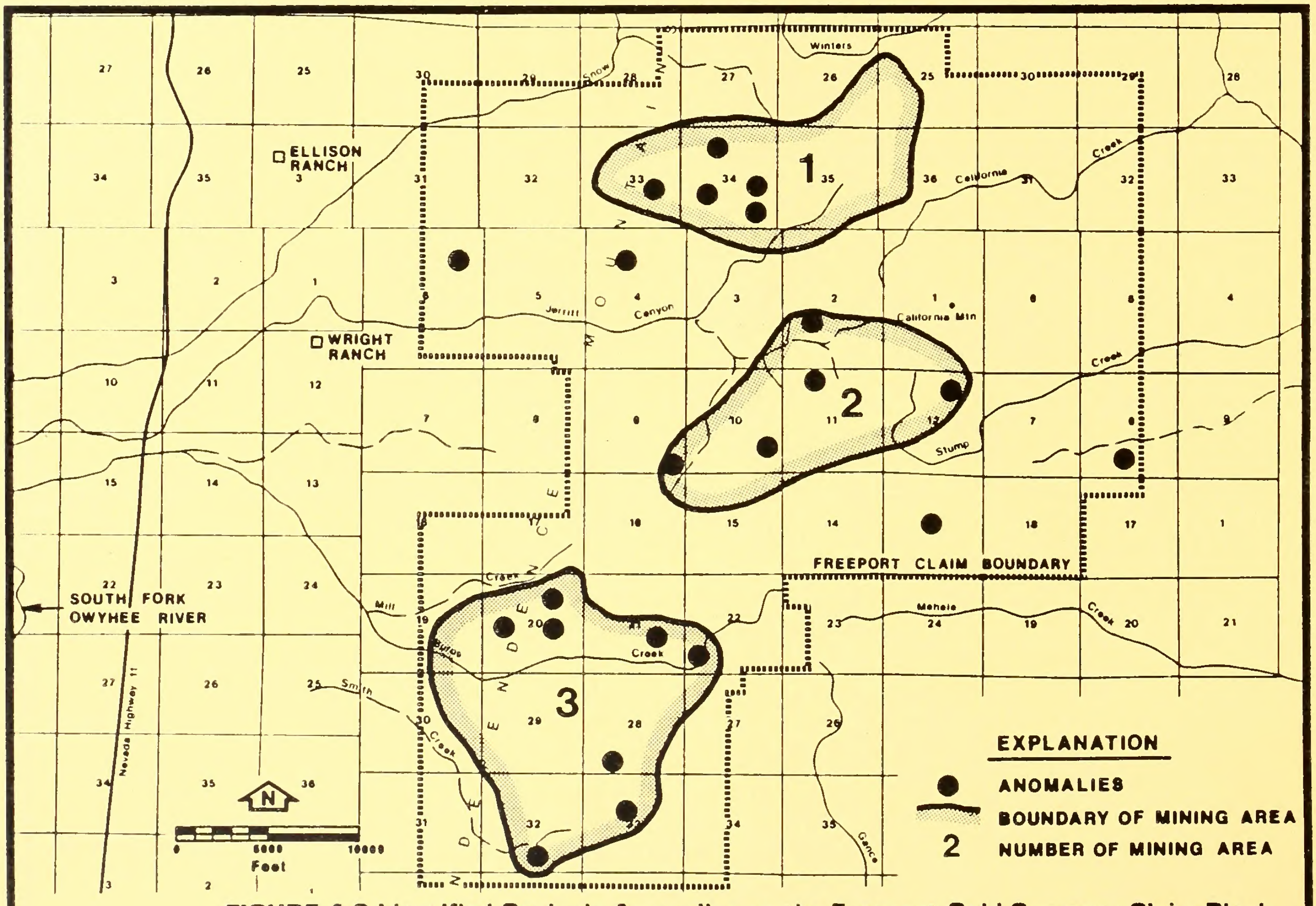



**FIGURE 4-3 Identified Geologic Anomalies on the Freeport Gold Company Claim Block**

SOURCE: FREEPORT GOLD COMPANY

engineers prepared detailed engineering studies which presented the physical and economic data plus a description of each viable option for the five project components. Upon receiving this information, the Forest Service developed additional options which the applicant had not considered. These new options were then submitted to Freeport for detailed engineering and economic analyses. Those options which were deemed totally non-viable from an engineering, geotechnical, or economic standpoint are described in this section, along with the feasible options.[2 5]

## Options Eliminated From Detailed Study

Throughout the entire period during which the proposed action plan was formulated, optional possibilities were formulated and evaluated by the Forest Service and Freeport Gold Company. Technically feasible project options available to Freeport can be broken down into two categories: operational methodologies and geographic locations. The significant project options which are classifiable as methodology options include mining techniques, waste rock disposal techniques, and ore hauling techniques. The options which are directly related to location are mill sites, corridor routes, and tailings disposal sites.

### Mining Options

There are a number of proven mineral extraction techniques which have been used in hard-rock and other mining operations. For hard-rock gold mining, there are four methods which were considered and rejected by the Freeport Gold Company for the Jerritt Canyon Project.

#### Auger Mining

In soft-bedded deposits of uniform thickness and grade, such as coal, various mechanized mining methods such as augering have been used successfully as a surface mining technique:

- This method is not applicable to erratic mineralization in hard rock.
- There are no homogeneous deposits of gold ore at Jerritt Canyon
- The cost of auger operations in hard rock is prohibitive, because of bit replacements.

#### In-Situ Leaching

In this mining method, solutions capable of dissolving the metal content of the ore are allowed to percolate through the ore-body. The solution is then collected in openings drilled below the ore zone and pumped to a recovery plant where the dissolved metals are extracted. There are three main reasons why this method will not work at the Jerritt Canyon Project:

- The highly faulted and fractured nature of the parent rock in Marlboro Canyon would result in a poor recovery of the solutions after passing through the ore-body.
- Approximately 50% of the ore in the Marlboro Canyon deposit is carbonaceous. This ore, unless pretreated in surface facilities, has an affinity for gold in solution. This means that gold leached from the oxide portions of the ore-body would be, to a great extent, reabsorbed into the carbonaceous material. The overall effect would be a very low recovery of the gold metal values.
- The third adverse condition affecting in-situ leaching is the impermeability of the ore. The hard jasperiod ore would not allow the solutions to penetrate the rock and dissolve the gold. Leaching would be limited to a narrow zone surrounding fractures in the rock.[2 6]

#### Heap Leaching

Heap leaching is a modification of in-situ leaching, whereby the gold ore is mined, crushed, and stacked on impermeable asphalt pads. A sodium cyanide solution capable of dissolving the gold in the ore is applied to the top of the ore heap and allowed to percolate through to the asphalt pad. The solution is then collected off the pad and pumped to a recovery plant where the gold is extracted. There are four reasons why this option will not be used to process all the ore from the Jerritt Canyon Project:[2 6]

- Gold recoveries from the oxide ore would only be on the order of 50% to 60%.
- Gold recoveries from the carbonaceous ore would be considerably less without expensive pre-treatment of the ore in a mill.
- Spent ore, after the sodium cyanide treatment, would have to be trucked to a tailings pond to prevent cyanide from reaching water supplies.
- The current price of gold will not justify the use of heap leaching on the type and low grade of the Jerritt Canyon Project ore.

For the particular ore deposit at Jerritt Canyon, Freeport has decided that this alternative is impractical and economically unfeasible. Freeport may use this technique on minor amounts of low grade ore, if present day economics should radically change.[6]

### Underground Mining

Underground mining methods were considered by Freeport as a primary method of mining but they were rejected for the following reasons:

- Methods are not selective enough to permit a high recovery of the natural resource.
- Underground methods would encounter extreme difficulty in following the erratic distribution of the mineralization without incurring high dilution and high losses of ore.
- Underground methods are a high cost method of mining.

A few selected areas may be mined by underground methods from the walls of the completed open pit. Freeport engineers will continue to examine the occurrence of mineralization and the possibilities of utilizing some underground mining techniques to maximize gold ore extraction.[2 6]

## Transportation Methods

Several methods of transporting ore from the Jerritt Canyon mine were explored in detail by Freeport Gold Company. The alternative methods were analyzed because of the possibility that ore might have to be transported to a mill in the Independence Valley or in the North Fork Valley. The final method selected by Freeport was truck hauling using 75-ton rear dump trucks. Discussion of the different transportation methods and the reasons for rejection of other options are presented below. A cost comparison chart for the various transportation methods is presented in Table 4-1.[7 8]

**TABLE 4-1**

**Costs of Alternative Transportation Systems For Various Mill Options**

| Optional Mill Site | Conveyor | Tramway | Slurry Pipeline | Truck Haulage |
|---|---|---|---|---|
| | Millions of Dollars | | | |
| **SITE "B"** | | | | |
| Initial Capital Cost | $10.4 | $10.2 | $ 9.3 | $ 8.9 |
| Annual Operating Cost | .1 | .3 | .3 | .1 |
| **WINTERS CREEK** | | | | |
| Initial Capital Cost | 10.6 | 10.0 | 9.1 | 8.8 |
| Annual Operating Cost | .1 | .4 | .4 | .2 |
| **WRIGHT RANCH** | | | | |
| Initial Capital Cost | 19.5 | 16.9 | 11.8 | 10.5 |
| Annual Operating Cost | .3 | 1.8 | .9 | .8 |
| **ELLISON RANCH** | | | | |
| Initial Capital Cost | 19.5 | 16.9 | 11.8 | 10.5 |
| Annual Operating Cost | .3 | 1.8 | .9 | .8 |
| **SECTION 33** | | | | |
| Initial Capital Cost | 16.5 | 14.5 | 10.7 | 10.1 |
| Annual Operating Cost | .3 | 1.5 | .8 | .6 |
| **NORTH FORK MILL** | | | | |
| Initial Capital Cost | 22.0 | 19.4 | 11.3 | 10.8 |
| Annual Operating Cost | .4 | 2.3 | .8 | .7 |

SOURCE: FREEPORT GOLD COMPANY

### Belt Conveyor

A rubber belt conveyor carried on a series of elevated platforms was considered for transporting gold ore down the mountain to a valley mill site. Construction of such a system would involve an access road to each platform site, construction of the platform, erecting supporting framework between platforms, installing the guides, idlers, and belt.[7 8] This transportation method was eliminated for the following reasons:

- Belts are noisy and create spillage and dust problems
- Failure at any point shuts down system
- All capital costs are front-ended
- High initial cost of $300 per foot
- Conveyor system is not very flexible to changes in load-out location, etc.
- Operational problems in sub-zero weather due to inability of belt material to stay flexible.

### Tramway

An aerial tramway of multiple ore hoppers suspended on cables was considered as a system with adequate capacity and very low environmental impact. A tramway system would be quite similar to a conveyor system in operational advantages and disadvantages. Numerous support towers would be erected and cables suspended between them. Ore hoppers would be attached to the cables. An access road would be needed to each tower site for construction and maintenance.[7 8] The following are the reasons why this transportation method was not selected:

- Haul trucks are still necessary to feed hoppers from working pit
- High initial cost of nearly $300 per foot
- High winds can stop operation
- Failure at any point stops system
- High rate of maintenance incidents.

### Slurry Pipeline

A slurry pipeline system was considered in which crushed ore would be mixed with water (50% ore and 50% water) and then injected into a pipeline for gravity flow to the mill site. Construction would involve an access road along the entire pipeline corridor. The pipeline would be either constructed underground or supported on above ground piers. A buried line would require a 6-foot deep trench over the entire corridor. Construction costs would approach $65 per foot.

The ore would have to be crushed and ground at the mine to allow it to be slurried, thus requiring the construction of a crusher, semi-autogenous mill, and support facilities at the mine site. A large pond with mechanical agitation would also be required at the mine site to handle surges of ore and provide a continuous slurry supply to the pipeline. Some pumping of the slurry would still be required to handle the slurry at both ends of the pipeline, even though gravity would greatly reduce energy costs for the system. A pipeline would have to be emptied and flushed whenever changing from oxide ores to carbonaceous ores.[2 7 8] There are several reasons for the elimination of this method of transporting gold ore:

- Trucks are still required to feed crusher
- System failure cuts off ore supply to mill
- Dewatering system needed at mill
- Water consumption for slurrying and line flushing is significant
- Construction costs and operational requirements are considerable
- High possibility of line leaks or breaks.

### Milling Processes and Mill Sites

To assist in the selection and rejection of mill sites, a consulting engineering firm, Bechtel Corporation, was contracted by Freeport to evaluate technical and economic factors with respect to these general areas. As a part of Bechtel's scope of work, they were directed to recommend additional mill sites. Alternative milling processes which might be considered in this decision process were also evaluated by Bechtel. As a result of the studies by Freeport and their engineering consultant, the following conclusions were made:[9 10]

- There are no reasonable milling processes available other then the cyanidation technique for the Jerritt Canyon ore body.
- There are no viable mill sites available in the mountain areas adjacent to the mine other than the Winters Creek sites and Mill Site B.
- All mill sites in the valley areas beyond a 12-mile haul distance were economically non-feasible locations.

Virtually all valley areas within the 12-mile haul distance were considered to be feasible mill site options. The selected mill site options are discussed in the next major section, Options Considered.[8]

## Options Considered for Detailed Study

A similar analysis was performed on the selected mining method and ore transportation technique as was performed on the eliminated options. The formulation of these selected options is presented in the next two paragraphs. Subsequent paragraphs describe the options dependent on geographical location (corridor routes, mill sites, and tailings disposal sites). These options were evaluated using criteria developed specifically for each component.

### Open-pit Mining

There are a number of important reasons why open-pit mining methods were selected by Freeport for the development of the gold ore:[2 5 6]

- Deposit is close to the surface (50 to 300 feet).
- Highly selective mining method in which the material mined can be designated ore or waste in relatively small lots (50 to 75 tons). This is important not only in differentiation of ore from waste, but because there are two types of ore present: carbonaceous and oxide. Each type of ore has different metallurgical properties and must be treated in separate circuits within the gold mill.
- Most economical mining technique.
- Best overall recovery of the mineral resources in this deposit.

### Ore Transportation by Truck

A battery of large capacity rear dump trucks used in tandum with front-end loaders or shovels is the most prevalent method of ore transportation in worldwide open-pit mining operations. There are several reasons for the selection of truck haulage for transporting the gold ore:[7 8]

- Capital costs can be incrementally expended during growth of project
- Ultimate flexibility - can haul to and from innumerable stations
- Predictable operational efficiency
- Cost and operational flexibility
- Will disturb less land than other techniques.

The flexibility and cost of trucks outweighed other cost and energy considerations and led Freeport to their choice for ore transportation for the Jerritt Canyon Project.

### Waste Rock Disposal Options

There are two technically feasible methods of disposing of waste rock and overburden materials associated with the Jerritt Canyon Project open-pit mines: 1) sidehill disposal and 2) valley fill.[11 12]

Sidehill disposal consists of dumping of waste rock material directly downslope of the open pits. The sidehill disposal areas are formed by casting the waste rock downslope along the entire low wall of each pit. The quantity of material which can be cast over the side at any specific location is dependent upon the natural slope and the geo technical properties of the soils and sub-soils covering the natural slope.[11 12]

Valley fill waste rock disposal consists of dumping waste materials into nearby valley sites. Advantage is taken of the sides of the valley to contain larger volumes of rock in areas with smaller surface coverage than sidehill dumping. The fills will be built in lifts (layers) starting at the highest elevation fill and moving downslope along with the general sequence of mining. After the waste rock is hauled from the mine pit, it is dumped into lifts until the designated disposal area is filled to design capacity. Each fill has a flat top surface and a steeply sloped face down to the next lowest fill area.[11 12]

### Corridor Routes

Major corridor systems were developed by Freeport Gold Company and the Forest Service based upon specific criteria. These criteria are as follows:[7 8 13]

- Property Rights and Land Ownership - corridor right-of-way for roads (100 to 150 feet wide) and power distribution lines (40 feet wide) must be on Federal land or on private land which could be leased or purchased.

- Engineering - Average centerline grades should average 8% or less. Soils and subsoil material should be relatively stable with respect to landslides and localized sloughing.

- Geography - Candidate routes should, wherever possible, connect existing mine-mill-tailings pond options in a fairly direct manner. Each major corridor system must have access to Nevada Highway 11 or to Highway 51.

The rationale developed for the EIS dictated that an array of candidate routes be chosen to allow a reasonable range of geographic and topographic choices. At least two access corridors should be available to link Highway 11 in the Independence Valley, and two or more access routes to connect Highway 51 to the east.

Five potential corridors were selected that satisfied the grade and length restrictions.[13] Each of the five corridors has existing road segments that make up part of its length. The five feasible primary east-west corridors are: Jerritt Canyon, Northwest, Winters Creek, Rancho Grande-California Creek, and Sheep Creek. In association with the primary corridors are a number of secondary north-south corridors which connect the several optional mill sites and tailings disposal sites. These corridors are shown in Figure 4-4.

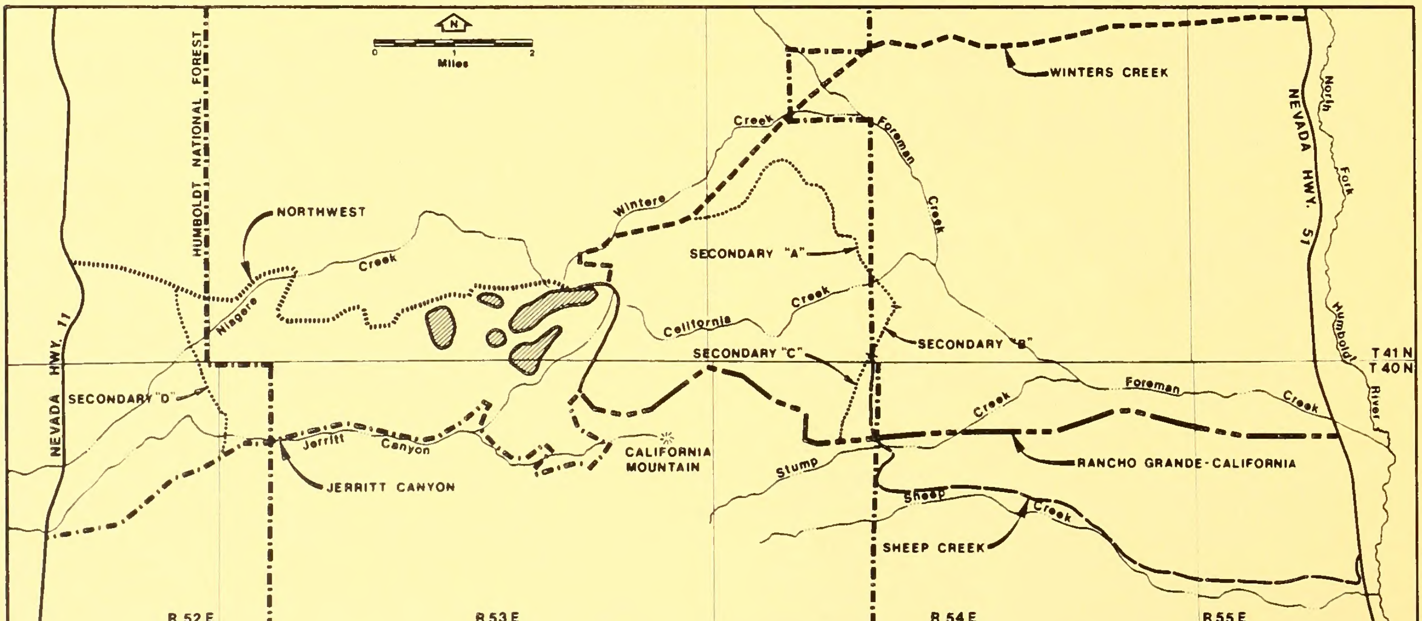



**FIGURE 4-4 Location of Transportation Corridor Options**

SOURCE: FREEPORT GOLD COMPANY AND FOREST SERVICE

### Mill Sites

Feasible mill site locations were formulated by the Forest Service and Freeport Gold Company based upon seven specific criteria. These criteria are:[10 13]

- Land Ownership - 75 acres of land must be available for Freeport to lease, purchase, or patent.
- Geography - Mill site should have geographic proximity to mine.
- Mineral Reserves - Mill complex should not be underlain by commercial quantities of mineable ore.
- Hydrology - Mill site should be outside of major flood plain or drainage subject to major flood events.
- Elevation - Mill should be at higher elevation than tailings disposal area.
- Topography - Mill complex should be in area of minimum relief with general ground slope of 2 to 5%. About 70 to 80 acres of contiguous, relatively flat land is required.
- Geotechnical - Subsurface conditions should be competent to allow adequate foundation support.

The rationale developed for this EIS also dictates that an array of candidate sites be found that allows a wide range of geographic and topographic choices. Accordingly, optional mill sites which satisfy the criteria and yet give the government and the public some geographic choices, are likely candidates.

There are six mill site options which satisfy most of the criteria discussed under Milling Processes and Mill Sites in the Options Eliminated From Detailed Study section. These candidate sites are: Winters Creek, Wright Ranch, Ellison Ranch, Section 33, North Fork, and Site B.[8 13] These candidate mill site options are shown on Figure 4-5.

### Tailings Disposal Techniques and Sites

Bechtel was asked to assist Freeport in the engineering and geotechnical study to select tailings disposal techniques and candidate sites for tailings. Bechtel identified and documented three non-feasible tailings disposal methodologies from an economic and engineering standpoint:[9 10]

1) Return tailings to abandoned areas in mine pit.

2) Bury tailings below ground surface.

3) Transport tailings to a remote disposal area outside of the Jerritt Canyon area.

Selection of tailing disposal site options was made by Freeport Gold Company on the basis of extensive geotechnical and water resource investigations. The following criteria influenced selection of the four tailings disposal site options:[9 10 13]

- Land Ownership - Sufficient land must be available either through purchase, patent, lease, or Federal land whereby a 200-acre pond can be built with tailings capacity for 7,000,000 tons of solids.

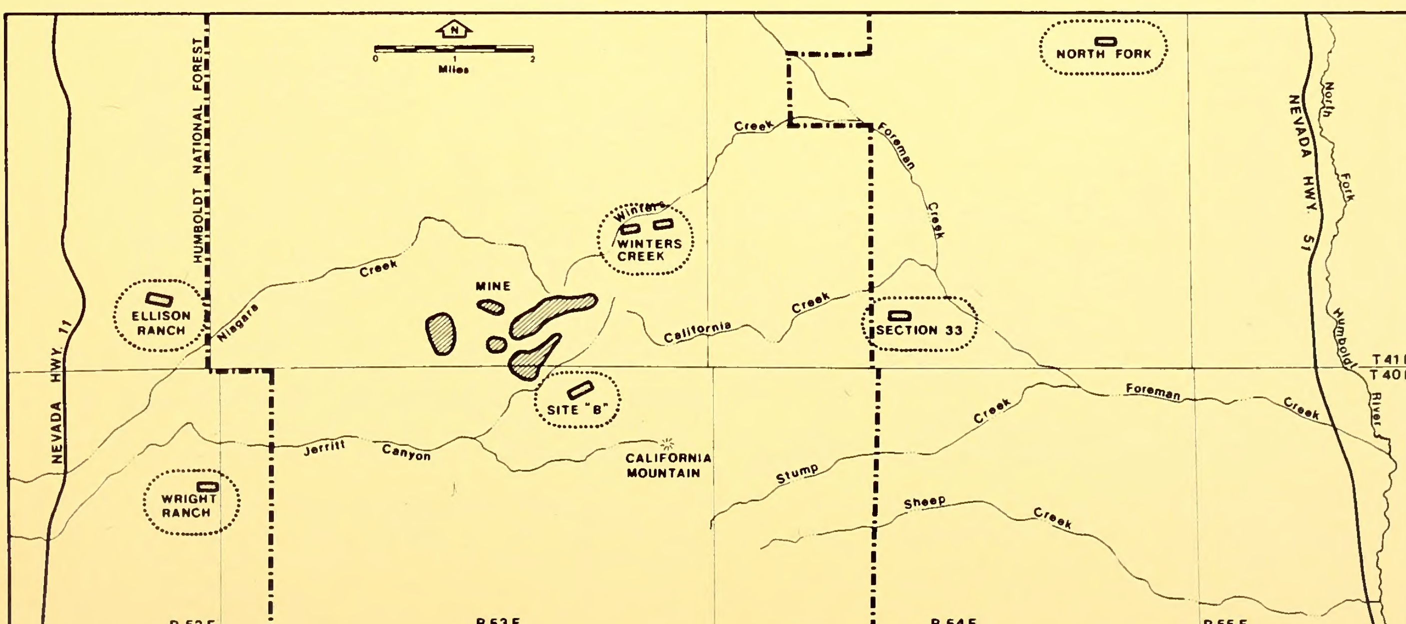



**FIGURE 4-5 Location of Mill Site Options**

**SOURCE: FREEPORT GOLD COMPANY AND FOREST SERVICE**

- Geography - Tailings disposal area should have geographic proximity to mill complex.

- Mineral Reserves - Tailings disposal site should not be underlain by commercial quantities of mineable ore.

- Hydrology - Size of watershed or drainage upstream of tailings pond should be as small as possible.

- Topography - Candidate sites should provide for a maximum storage volume with a minimum embankment material. Also, site should provide large tailings pond surface area per unit of volume (to maximize evaporation).

- Geotechnical - Pond site should be underlain with thick, continuous layers of clay or other impermeable natural strata. Foundation and structures should be stable to support ultimate tailings pond and maximum precipitation events.

- Elevation - Tailings storage area should be lower than mill complex.

- Borrow Material - Suitable quantities of rock, sand, gravel and clays should be available near the candidate area.

No mountain sites were located that had geotechnical properties acceptable to safe disposal of cyanide mill tailings. All candidate mountain sites were underlain with porous limestone.[14]

A large number of candidate sites in the Independence Valley and the North Fork Valley were also eliminated because of the lack of suitable topographic barriers, or from the standpoint of flood prone areas.[10]

An array of candidate tailings storage sites were identified on both valley floors flanking the Jerritt Canyon Project. Two sites were selected in the Independence Valley and two sites chosen in the North Fork Valley.[2 8 13] The tailings disposal site options which will be evaluated in Chapter 6 of this EIS are: Wright Ranch, Ellison Ranch, Section 33, and North Fork. These sites are shown on Figure 4-6.

## Formulation of Alternatives

### Waste Rock Disposal Alternatives

Based upon soils and geotechnical surveys of the slopes and valley near the Marlboro mine site, Freeport formulated three basic waste rock disposal plans. The plans or alternatives utilize one or more techniques of waste rock disposal in different geographic locations near the Marlboro pit. All three alternatives are feasible from a stability standpoint, whether sidehill disposal or valley fill techniques are employed.[11 15 16]

The Mines Project Group at the University of Arizona was retained to construct a topographic relief model of the Marlboro Canyon area. A 1 inch = 200 feet scale model was used to illustrate possible dump locations. This large scale three-dimensional model greatly facilitated the evaluation of the visual impacts and the selection of candidate waste rock disposal areas.[17]

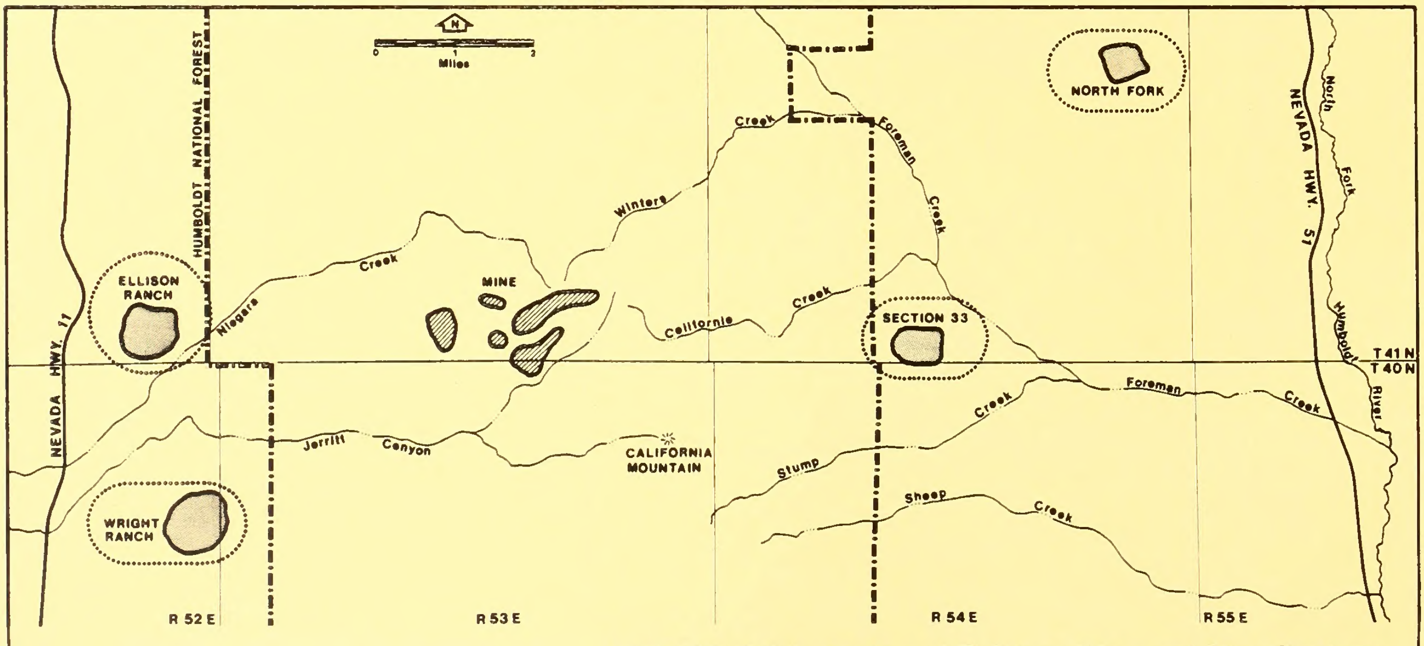



**FIGURE 4-6 Location of Tailings Disposal Site Options**

**SOURCE: FREEPORT GOLD COMPANY AND FOREST SERVICE**

### Mill-Corridor-Tailings Pond Alternatives

Within this section of the Alternatives Considered chapter, the individual component options described earlier are logically assembled into complete systems. These systems constitute the geographic project alternatives being evaluated within this Environmental Impact Statement. The Forest Service EIS team evaluated six viable mill site options, four tailings disposal areas, and five major corridor routes for final analysis. The process for developing the most feasible alternatives is described below:

- Each mill site option was coupled with the geographically closest tailings disposal area option.
- Because of its central location, the mill site option closest to the mining area was paired with other tailings disposal areas in both east and west directions because of equal proximity to these tailings disposal locations.
- At this stage, seven logical mill site/ tailings disposal area alternatives were identified.
- A major corridor route was then selected for each of the seven alternatives. The criteria for corridor selection was primarily the shortest viable corridor that linked the mining area with each mill/ tailings area alternative. Four separate corridor options were required to tie the seven alternatives back to the mining area.
- An engineering-economic feasibility analysis was performed on each of the seven mill/corridor/tailings area alternatives.
- A review was made of the seven alternatives to test for geographic variety. One objective of the formulation of alternatives was to give the decision makers information on project components that could be located in the Independence Valley, the North Fork Valley, and in the Independence Mountains. This was accomplished by selecting two mill/ tailings options in each valley and two mill options in the Independence Mountains. From a geotechnical and ground water pollution standpoint, there were no satisfactory tailings pond sites available in the Independence Mountains.
- One major previously identified corridor option was not needed to link any of the seven alternatives. This major corridor, the Sheep Creek corridor, will be used as a backup option in the event that major environmental barriers are discovered that discourage the selection of the other four corridor options.

Mathematically, there are many permutations which could utilize all combinations of the three major components: mills, corridors, and tailings disposal areas. The number of alternatives has been reduced to seven using economic and minimum land disturbance criteria, primarily in isolating the shortest transportation corridors.

Three of the selected alternatives involve a mountain mill site location and various combinations of valley tailings disposal sites in the Independence Valley and North Fork Valley. The remaining four alternatives are sets of valley mill/tailings disposal alternatives: two alternatives in the Independence Valley and two in the North Fork Valley. Thus the physical-cost evaluation will compare short ore truck hauls coupled with slurry pipeline systems against long ore truck haul routes paired with a very short (less than 1,500 feet) tailings pipeline system.[7 8]

Table 4-2 summarizes the physical characteristics of the seven mill-corridor-tailings pond alternatives which will be evaluated within this EIS.

**TABLE 4-2**

**Mill-Corridor-Tailings Disposal Alternatives**

| Alternative Number | Mill Site Option | Corridor Option | Tailings Disposal Site Option |
|---|---|---|---|
| 1 | Wright Ranch | Jerritt Canyon | Wright Ranch |
| 2 | Ellison Ranch | Northwest | Ellison Ranch |
| 3 | Site B | Northwest | Ellison Ranch |
| 4 | Site B | Rancho Grande-California Creek | Section 33 |
| 5 | Section 33 | Rancho Grande-Winters Creek- | Section 33 |
| 6 | North Fork | Winters Creek | North Fork |
| 7 | Winters Creek | Winters Creek | North Fork |

SOURCE: FREEPORT GOLD COMPANY

### Power Transmission Line Alternatives

Sierra Pacific Power Company formulated three logical alternatives to bring commercial power into the Jerritt Canyon Project. Criteria governing the development of alternatives was essentially limited to two considerations:[18]

- Utilize existing power distribution line or utility corridors, if possible, and
- Select routes which require the shortest transmission line.

Using these criteria, Sierra Pacific chose two corridor alternatives paralleling the two north-south state highways, and a third alternative which represented a direct overland route to the Jerritt Canyon Project.[18]

# Description of Project Alternatives

This section of Chapter 4 describes the project alternatives in detail. These individual alternatives will be evaluated in Chapter 6 and the impacts that these project alternatives will have on the environment will be documented in Chapter 5, Effects of Implementation. The options and alternatives described here are:

- No action alternative
- Waste rock disposal alternatives
- Mill site-corridor-tailings disposal site alternatives
- Power transmission line corridor alternatives

### No Action Alternative

The No Action Alternative would allow the applicant to develop a gold mine roughly equivalent in size to existing mining operations on the Humboldt National Forest. Such a mine would produce about 25,000 tons per year in contrast to the proposed mining of 850,000 tons per year. Such a small scale gold mine would likely use a heap leaching process to extract gold, since it would not be economical to construct a mill for such small tonnages. The existing Northwest corridor would probably be used to access the mine, and the heap leaching pad would be built in the Independence Valley. The life of the project might be considerably lengthened by mining at such a reduced rate, so that the mine might operate for up to 100 years.

### Waste Rock Disposal Alternatives

The evaluation of the various waste rock disposal alternatives was studied during the summer of 1979 by the consulting firm of Pincock-Robertson Company, and the University of Arizona--Mines Project Group. Based upon soil analysis, observation trenches, and rock mechanics studies, it was concluded that both sidehill disposal and valley fill options would result in stable fills. Waste rock disposal alternatives were formulated by considering these criteria:[11 16 17]

- Stability of waste rock pile
- Economics of hauling
- Visual impact

Three alternatives were formulated for the Jerritt Canyon Project. Physical considerations for the three alternatives are described in terms of area versus slope. Ultimate reclamation and revegetation success can be strongly correlated to slope. Table 4-3 presents the approximate acreages falling into various slope categories. The waste rock disposal alternatives are displayed graphically in Figures 4-7 through 4-9.[11 12 19]

### Mill-Corridor-Tailings Pond Alternatives

On the next seven pages, the mill site-corridor-tailings pond alternatives are described and characterized by the use of text, tables, figures, and photographs. In the last sections of Chapter 4, there is a more detailed discussion of management constraints, management guidelines, monitoring programs, and mitigation measures which are common to all project alternatives. In Appendix C, there is a very detailed discussion of generic mitigation measures which Freeport will initiate on the Jerritt Canyon Project.

**TABLE 4-3**

**Characteristics of Waste Rock Disposal Alternatives**

| ALTERNATIVES | EQUIPMENT REQUIRED | PRESENT VALUE OF CAPITAL AND OPERATING HAUL COSTS | ACRES COVERED | AREAS BY SLOPE CLASSES AFTER ABANDONMENT OF DISPOSAL AREA | |
|---|---|---|---|---|---|
| | | | | FINAL GRADE GREATER THAN 50% | FINAL GRADE LESS THAN 33% |
| 1 Valley Fill and Sidehill Disposal | 12 Trucks<br>1 Shovel<br>2 Loaders | $10,785,790 | 157 | 86 | 71 |
| 2 Modified Valley Fill Near Pit | 12 Trucks<br>1 Shovel<br>2 Loaders | $10,643,100 | 141 | 55 | 86 |
| 3 Sidehill Disposal | 18 Trucks<br>1 Shovel<br>2 Loaders | $13,615,960 | 138 | 95 | 43 |

SOURCE: FREEPORT GOLD COMPANY

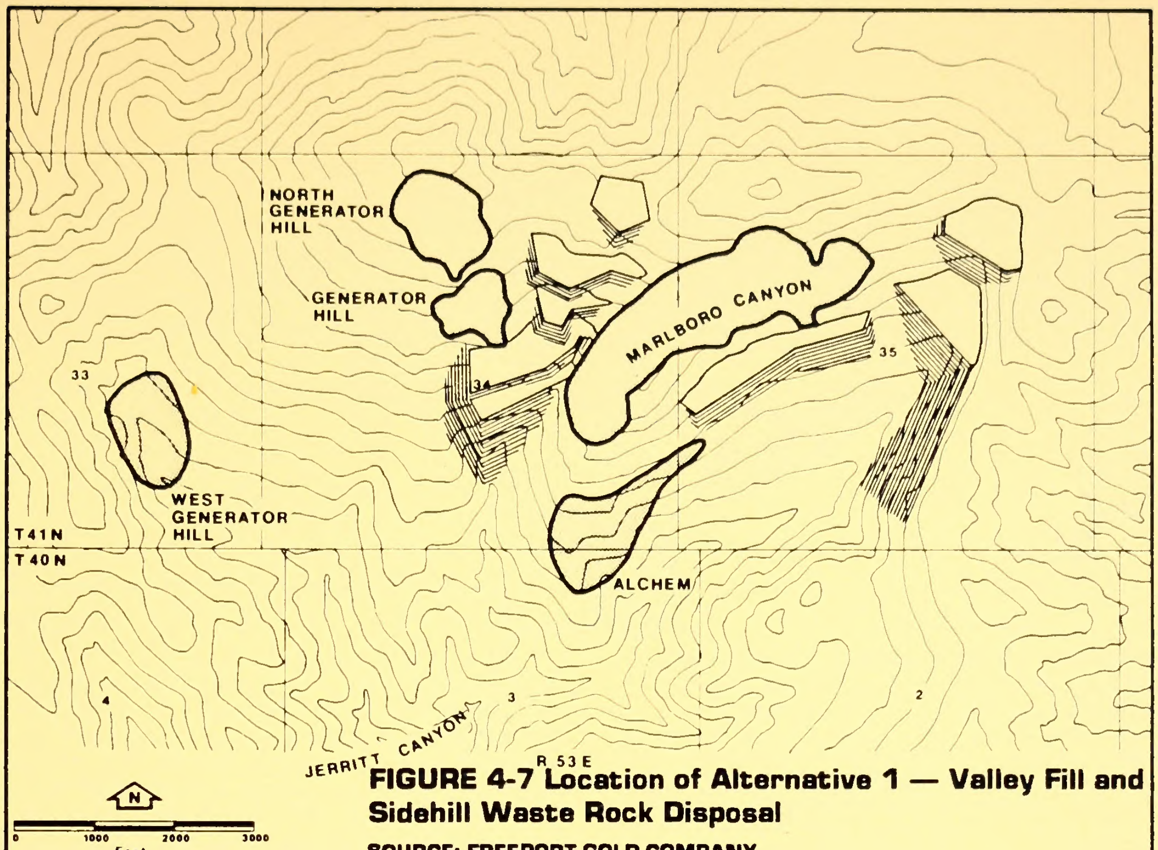



**FIGURE 4-7 Location of Alternative 1 — Valley Fill and Sidehill Waste Rock Disposal**

**SOURCE: FREEPORT GOLD COMPANY**

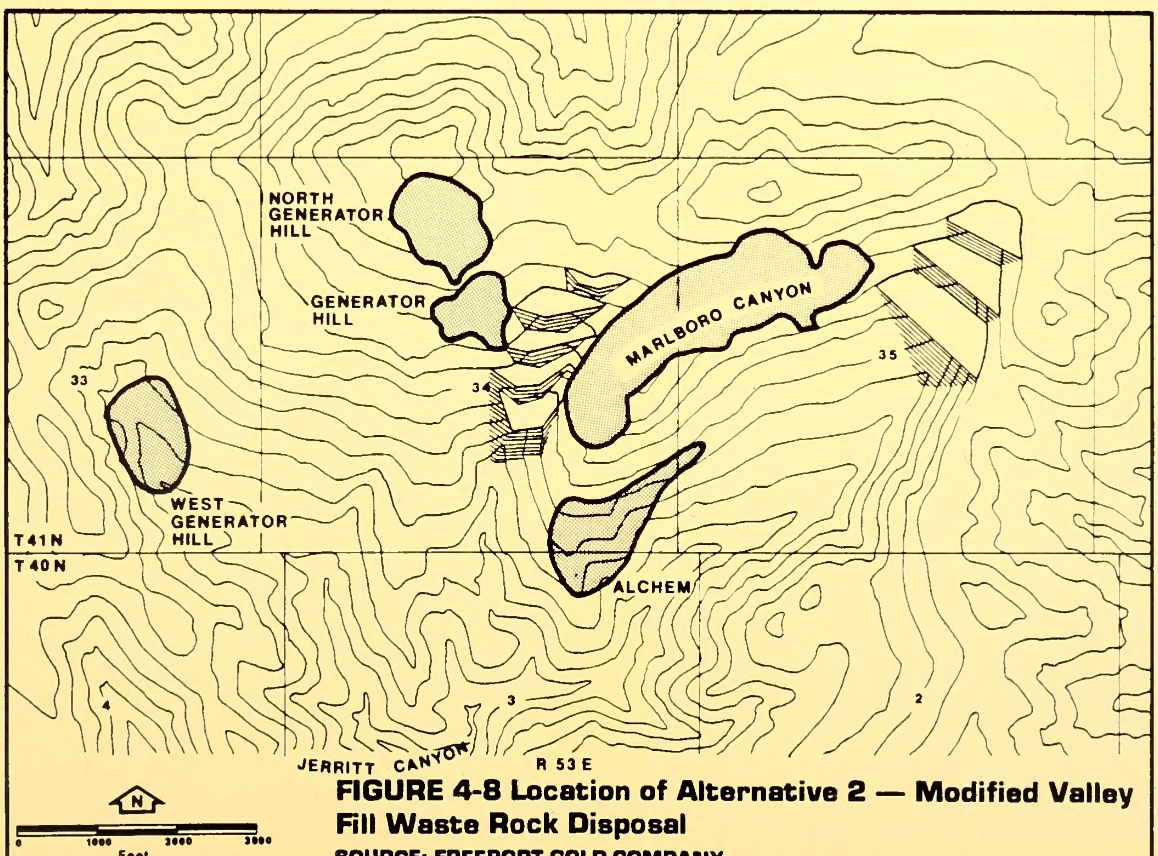



**FIGURE 4-8 Location of Alternative 2 — Modified Valley Fill Waste Rock Disposal**

**SOURCE: FREEPORT GOLD COMPANY**

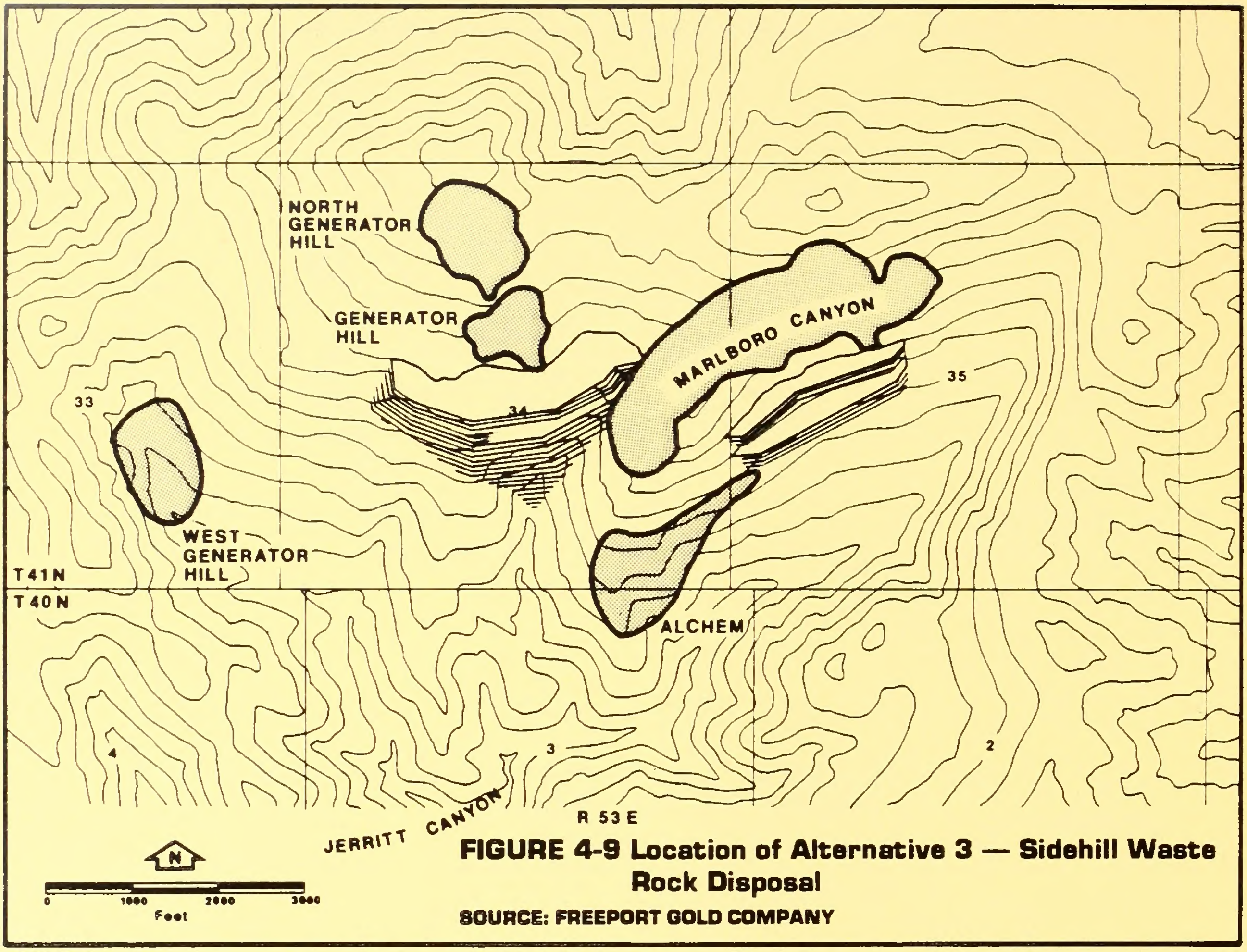
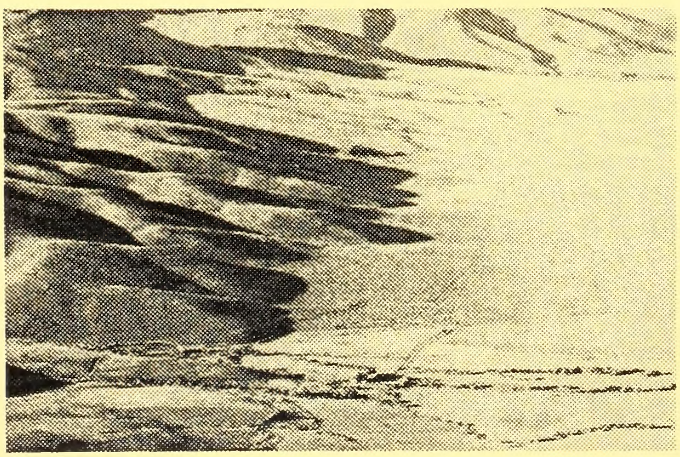


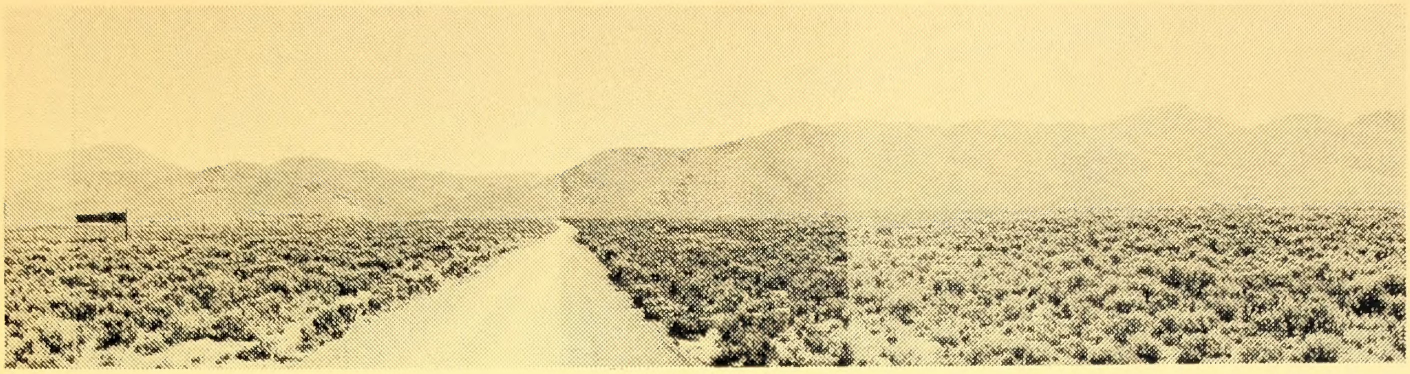

**FIGURE 4-9 Location of Alternative 3 — Sidehill Waste Rock Disposal**

SOURCE: FREEPORT GOLD COMPANY



Looking south from mouth of Jerritt Canyon. Wright Ranch mill site is in right center of photo.

Looking east at mouth of Jerritt Canyon. Wright Ranch is in lower left.



Proposed Wright Ranch Mill Site. Panorama from the intersection at Jerritt Canyon Road and Highway 11.

**Alternative 1**

Alternative 1 represents a mill site and tailings disposal area located just west of the Wright Ranch compound in the Independence Valley near the mouth of Jerritt Canyon. An existing access road to Highway 11 would be used to reach the mill complex. Much of the existing Jerritt Canyon road would be incorporated into a haul road leading to the Marlboro Canyon mine site. This alternative is characterized by a long steep haul road coupled with a very short tailings pipeline.[2 3]

Table 4-4 summarizes the major physical considerations associated with this alternative and Figure 4-10 shows the geographic aspect of the project components.[7 8]

**TABLE 4-4**
**Physical Considerations For Alternative 1**
**Wright Ranch Mill Site, Jerritt Canyon Corridor, Wright Ranch Tailings Disposal Area**

| Physical Consideration | Quantity |
|---|---|
| • Mine Site to Mill Site Distance | 9.8 miles |
| • Mill Site to Tailings Disposal Area Distance | 0.1 miles |
| • Miles of Access Road | 1.7 miles |
| • Mine to Mill — Haulage Profile | 7400' down to 5820' |
| • Mine to Mill — Average Grade | 3% |
| • Truck Haulage Cycle Time | 91 minutes |
| • Total Number of Haul and Water Trucks | 8 haul & 4 water |
| • Ease of Public Access To | High |
| • Land Ownership Status | Mill Site — Private<br>Tailings Area — Private<br>Corridor — Private & Federal |

**SOURCE: ADAPTED FROM FREEPORT GOLD COMPANY**

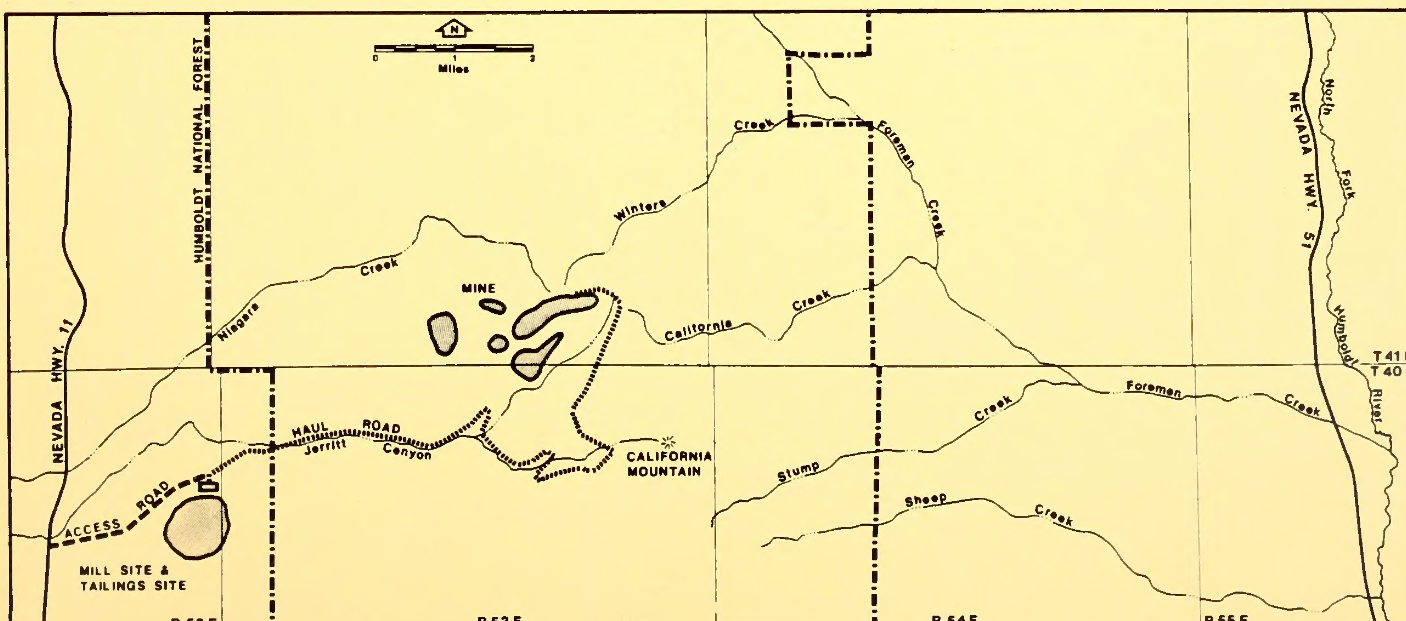
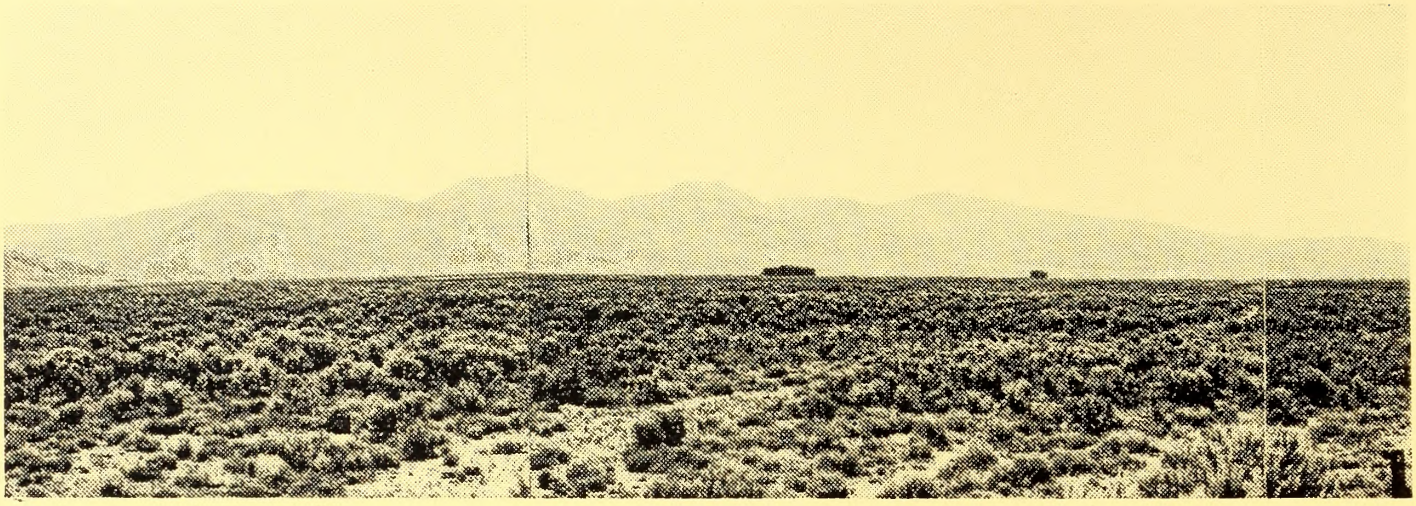



**FIGURE 4-10 Location of Alternative 1 — Wright Ranch Mill — Jerritt Canyon Corridor — Wright Ranch Tailings Pond**

**SOURCE: FREEPORT GOLD COMPANY**



Proposed Ellison Ranch Mill Site. Panorama from Highway 11.

**Alternative 2**

Alternative 2 represents a slight modification to Alternative 1. Again both the mill and tailings disposal site are contiguous to one another and are situated on the alluvium of the Independence Valley. The mill-tailings area is close to the mouth of Snow Canyon. An existing access road would connect the mill to Highway 11 to the west. Some of the existing Snow Canyon road would be incorporated into the proposed Northwest Corridor. This alternative is characterized by a long, fairly steep haul road coupled with a very short tailings pipeline.[2 3]

Table 4-5 summarizes the major physical considerations associated with this alternative and Figure 4-11 shows the geographic aspect of the project components.[7 8]

**TABLE 4-5**

**Physical Considerations For Alternative 2**

**Ellison Ranch Mill Site, Northwest Corridor, Ellison Ranch Tailings Disposal Area**

| Physical Consideration | Quantity |
|---|---|
| • Mine Site to Mill Site Distance | 10.9 miles |
| • Mill Site to Tailings Disposal Area Distance | 0.1 miles |
| • Miles of Access Road | 1.2 miles |
| • Mine to Mill — Haulage Profile | 7400' down to 5880' |
| • Mine to Mill — Average Grade | 2.6% |
| • Truck Haulage Cycle Time | 107 minutes |
| • Total Number of Haul and Water Trucks | 10 haul & 4 water |
| • Ease of Public Access To | High |
| • Land Ownership Status | Mill Site — Private<br>Tailings Area — Private<br>Corridor — Private & Federal |

**SOURCE: ADAPTED FROM FREEPORT GOLD COMPANY**

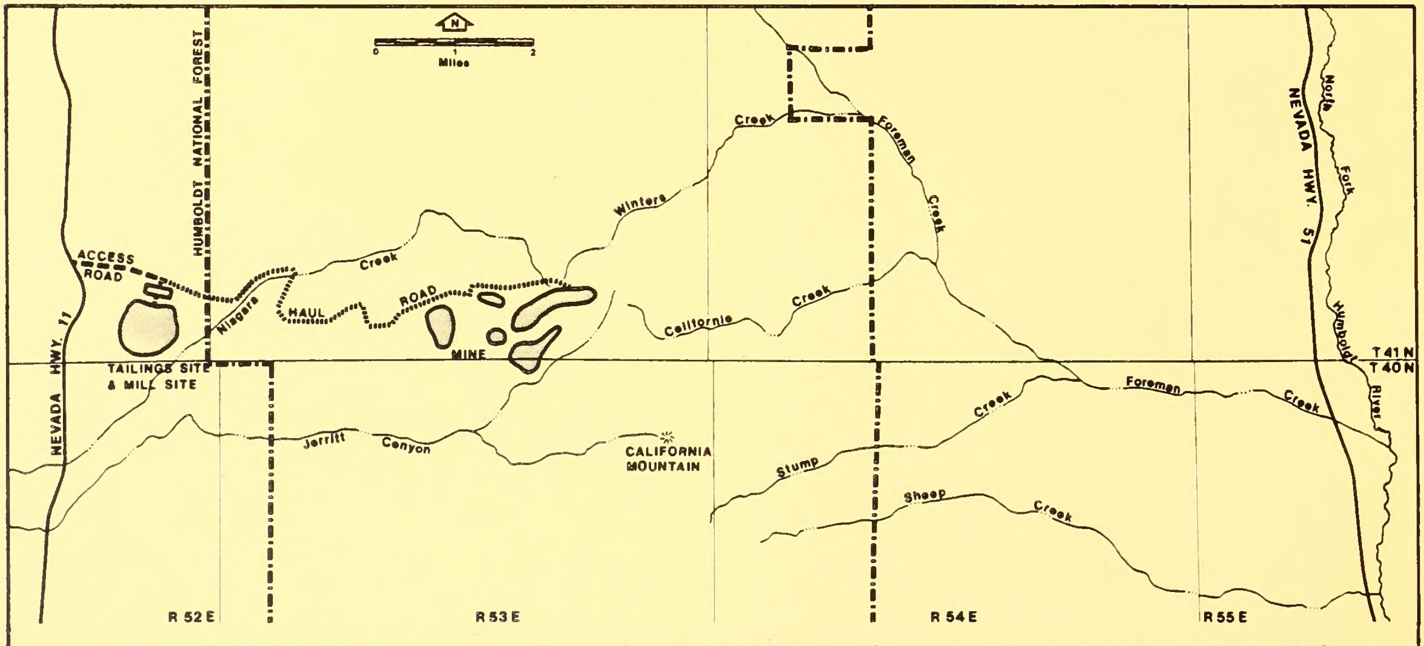



**FIGURE 4-11 Location of Alternative 2 — Ellison Ranch Mill — Northwest Corridor — Ellison Ranch Tailings Pond**

**SOURCE: FREEPORT GOLD COMPANY**

Mill Site B in center with Marlboro Mine Site in upper right.

**Alternative 4**

Alternative 4 parlays the mountain mill Site B with a tailings disposal area in Section 33 in the North Fork Valley. A corridor connecting the mill and tailings area would parallel California Creek along the side of California Mountain. An access road would be constructed parallel to the Rancho Grande access road to connect with Highway 51. This alternative would be characterized by a short flat haul road from mine to mill, and a long tailings pipeline connecting the mill to the valley floor on the east.[2 3]

Table 4-7 summarizes the major physical considerations associated with this alternative and Figure 4-13 shows the geographic aspect of the project components.[7 8]

**TABLE 4-7**

**Physical Considerations For Alternative 4**
**Site B Mill Site, Rancho Grande-Calif. Creek Corridor, Section 33 Tailings Disposal Area**

| Physical Consideration | Quantity |
|---|---|
| • Mine Site to Mill Site Distance | 1.2 miles |
| • Mill Site to Tailings Disposal Area Distance | 6.7 miles |
| • Miles of Access Road | 11.5 miles |
| • Mine to Mill — Haulage Profile | 7400' down to 7270' |
| • Mine to Mill — Average Grade | 2% |
| • Truck Haulage Cycle Time | 23 minutes |
| • Total Number of Haul and Water Trucks | 2 haul & 2 water |
| • Ease of Public Access To | Low |
| • Land Ownership Status | Mill Site — Federal<br>Tailings Area — Federal<br>Corridor — Federal |

**SOURCE: FREEPORT GOLD COMPANY**

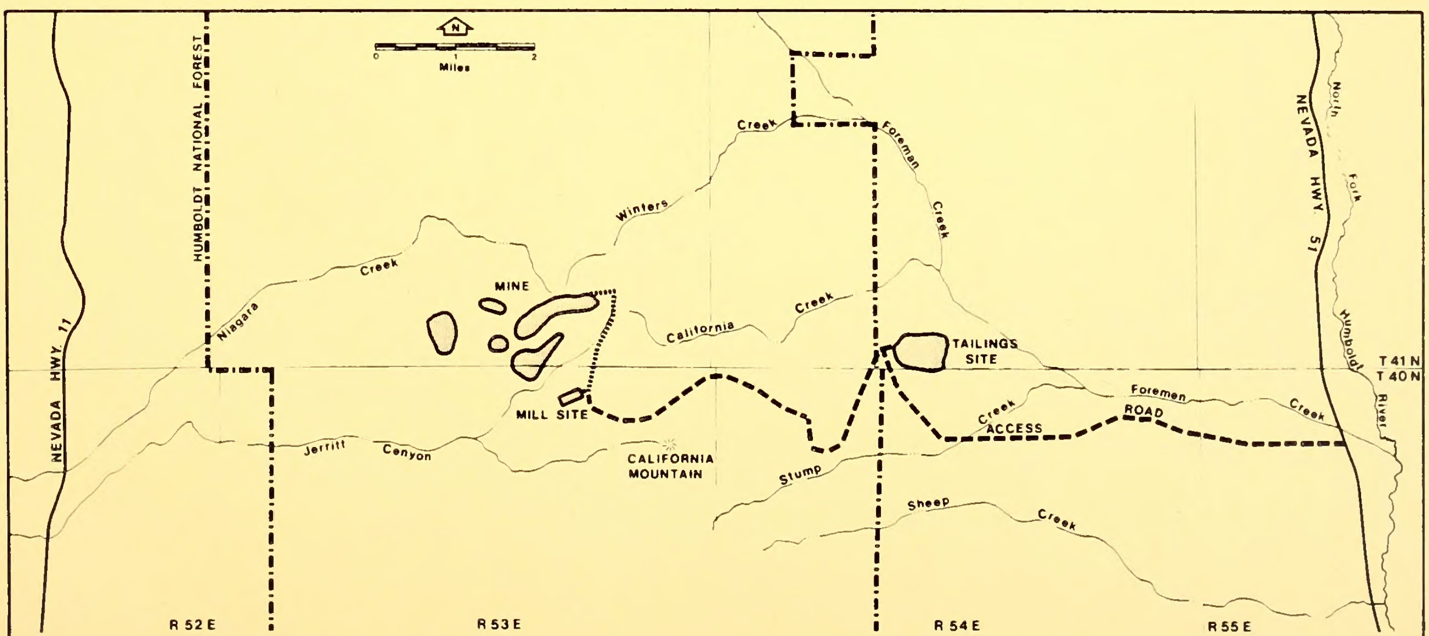
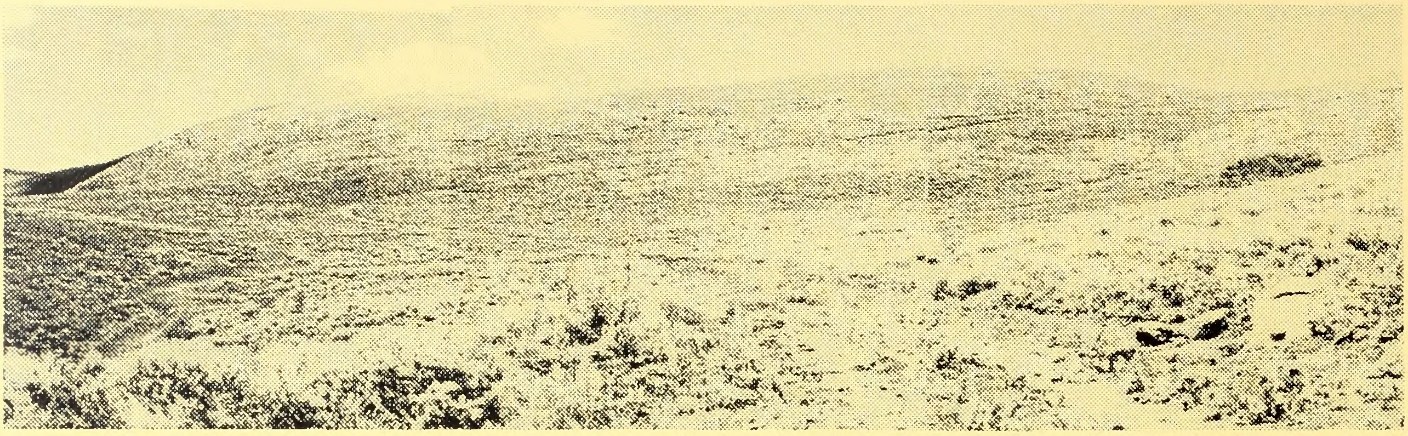



**FIGURE 4-13 Location of Alternative 4 — Mill Site B — Rancho Grande-California Creek Corridor — Section 33 Tailings Pond**

**SOURCE: FREEPORT GOLD COMPANY**



A panoramic view of Mill Site B looking east.

**Alternative 3**

Alternative 3 is a configuration which matches a mountain mill site with an Independence Valley tailings disposal site. The Site B mill is located as close as possible to the mining operation to minimize truck haul turnaround time. The tailings disposal area is again located on the Ellison Ranch, and is tied to the Site B mill via the Northwest Corridor. An existing access road connects the tailings area to Highway 11. This alternative is characterized by a short haul road from the mine to mill site with essentially no grade. This is coupled with a very long tailings pipeline which is routed almost 10 miles to the valley disposal site. This alternative is just another variation of a system which could use Mill Site B, Jerritt Canyon corridor and the Wright Ranch tailings site.[2 3]

Table 4-6 summarizes the major physical considerations associated with this alternative and Figure 4-12 shows the geographic aspect of the project components.[7 8]

## TABLE 4-6

**PHYSICAL CONSIDERATIONS FOR ALTERNATIVE 3**

**Mill Site B, Northwest Corridor, Ellison Ranch Tailings Disposal Area**

| Physical Conditions | Quantity |
|---|---|
| • Mine Site to Mill Site Distance | 1.2 miles |
| • Mill Site to Tailings Disposal Area Distance | 9.8 miles |
| • Miles of Access Road | 11.4 miles |
| • Mine to Mill — Haulage Profile | 7400' down to 7270' |
| • Mine to Mill — Average Grade | 2% |
| • Truck Haulage Cycle Time | 23 minutes |
| • Total Number of Haul and Water Trucks | 2 haul & 2 water |
| • Ease of Public Access To | Medium |
| • Land Ownership Status | Mill Site — Federal<br>Tailings Area — Private<br>Corridor — Private & Federal |

SOURCE: AOAPTED FROM FREEPORT GOLD COMPANY

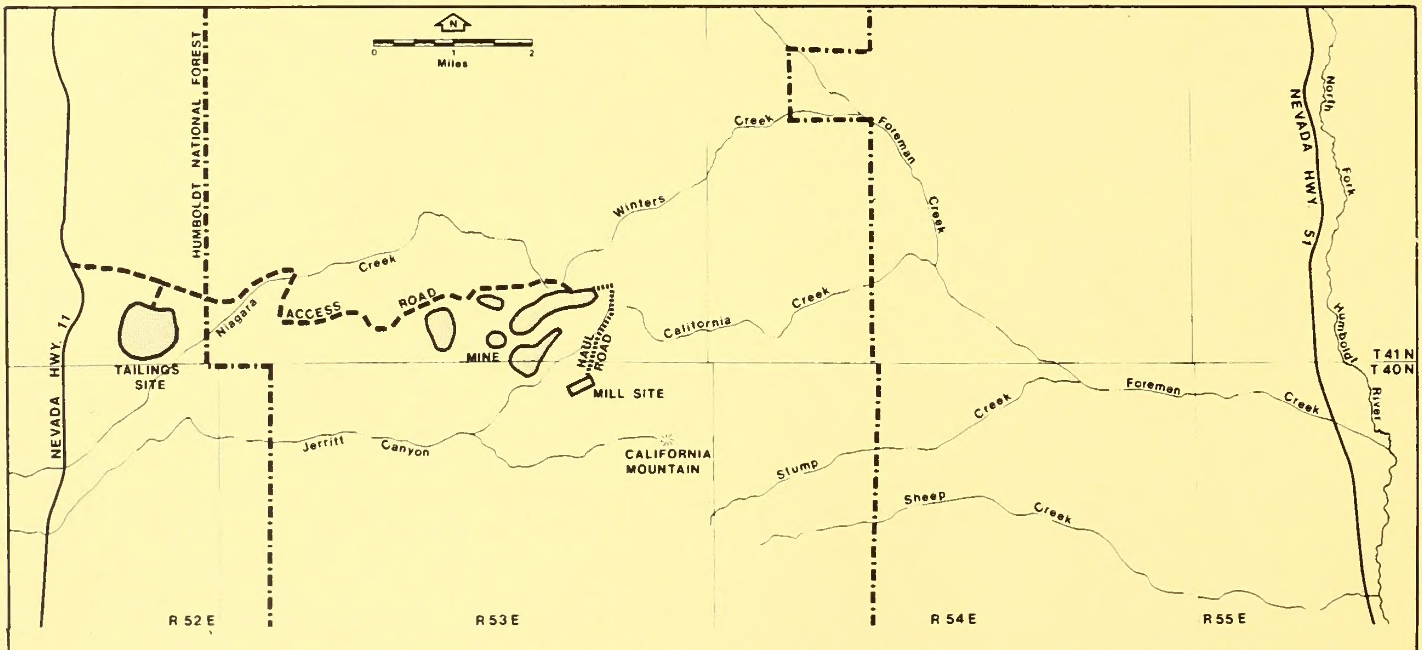
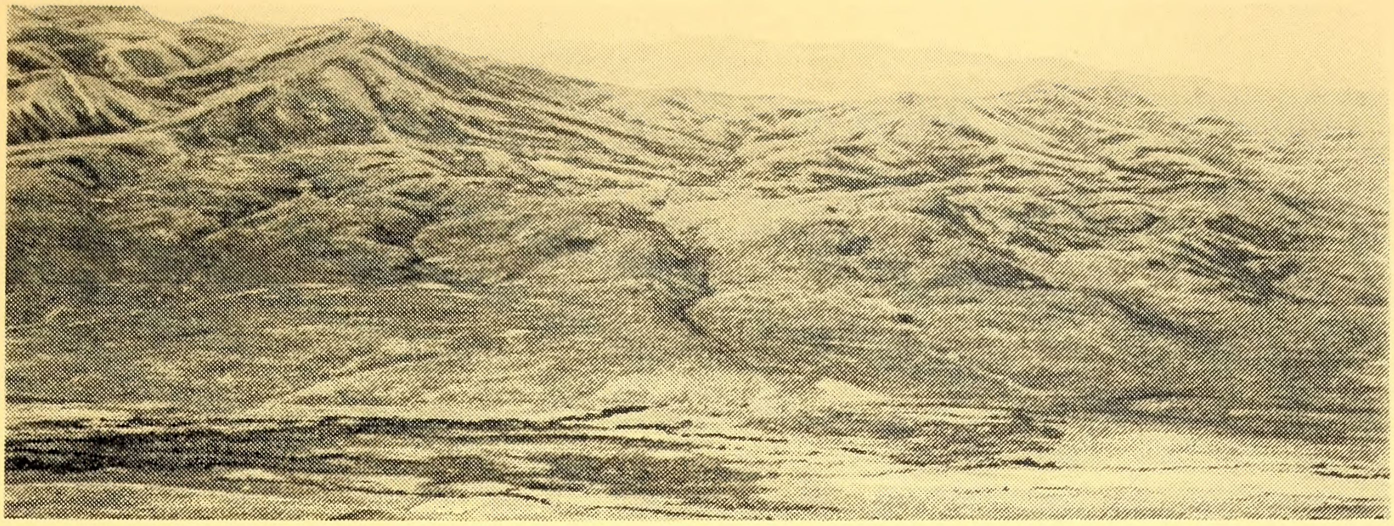



**FIGURE 4-12 Location of Alternative 3 — Mill Site B — Northwest Corridor — Ellison Ranch Tailings Pond**

SOURCE: FREEPORT GOLD COMPANY



View of Foreman Creek (foreground) and California Creek (center) and California Mountain (left) looking west.

### Alternative 5

Alternative 5 is a parallel to Alternatives 1 and 2. Both the mill and tailings disposal area would be located next to one another on the valley floor. Instead of the Independence Valley, Alternative 5 positions mill/tailings disposal area in the North Fork Humboldt River Valley on Section 33 southwest of Rancho Grande. Access to Highway 51 would be via a new road parallel to the Rancho Grande road. Ore would be hauled on a new road along Secondary Corridor A and the Winters Creek Corridor. This alternative is characterized by a fairly long haul road with moderate grades, and a very short tailings pipeline.[2 3]

Table 4-8 summarizes the major physical considerations associated with this alternative and Figure 4-14 shows the geographic aspect of the project components.[7 8]

## TABLE 4-8

### Physical Considerations For Alternative 5

**Section 33 Mill Site, Rancho Grande-Winters Creek Corridor, Section 33 Tailings Disposal Area**

| Physical Consideration | Quantity |
|---|---|
| • Mine Site to Mill Site Distance | 8.0 miles |
| • Mill Site to Tailings Disposal Area Distance | 0.1 miles |
| • Miles of Access Road | 8.2 miles |
| • Mine to Mill — Haulage Profile | 7400" down to 6280' |
| • Mine to Mill — Average Grade | 2.7% |
| • Truck Haulage Cycle Time | 82 minutes |
| • Total Number of Haul and Water Trucks | 8 haul & 4 water |
| • Ease of Public Access To | Medium |
| • Land Ownership Status | Mill Site — Federal<br>Tailings Area — Federal<br>Corridor — Private & Federal |

**SOURCE: ADAPTED FROM FREEPORT GOLD COMPANY**

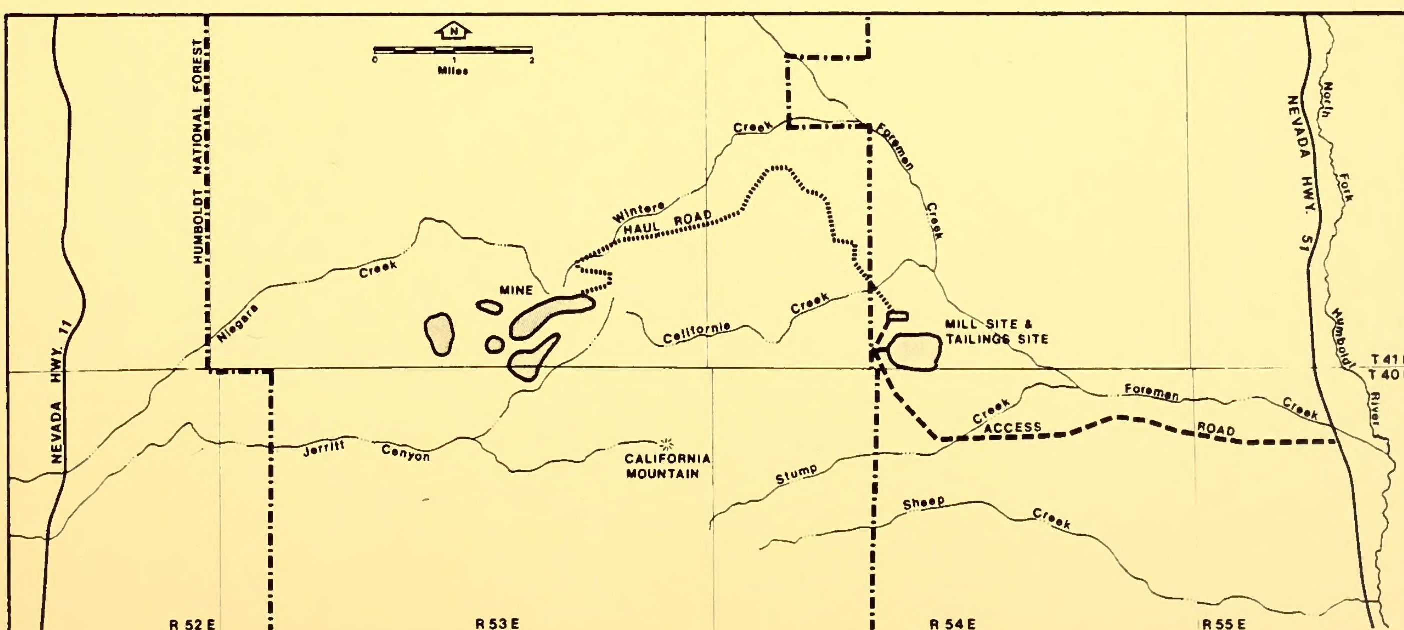
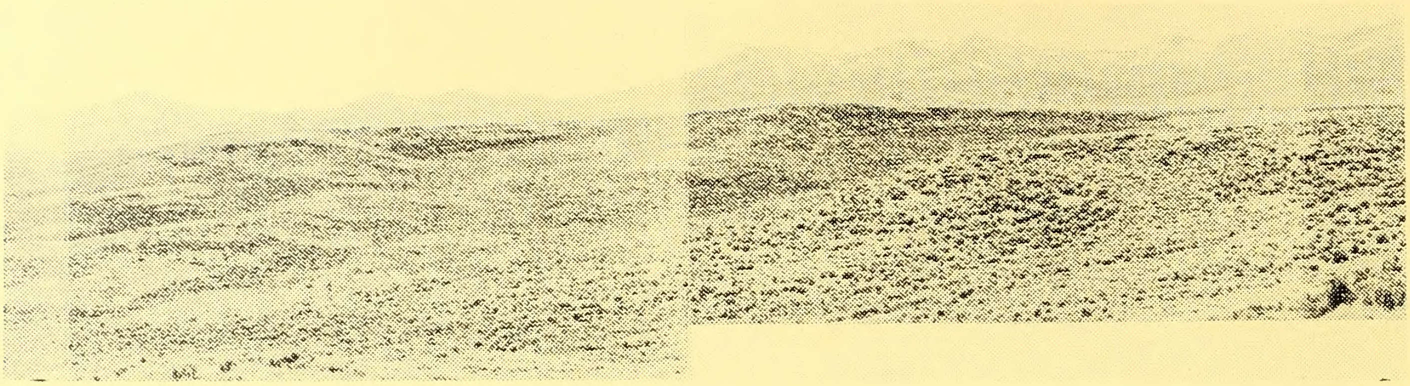



**FIGURE 4-14 Location of Alternative 5 — Section 33 Mill — Rancho Grande-Winters Creek Corridor — Section 33 Tailings Pond**

**SOURCE: FREEPORT GOLD COMPANY**



Looking west at North Fork Tailings Pond Site. Panorama view looking south from low ridge adjacent to proposed pond.

**Alternative 6**

Alternative 6 is designed to give the decision makers another choice in the North Fork Valley. Again, both the mill/tailings disposal areas are contiguous to one another on the valley floor. A new haul road would connect the mill complex to the mine via the Winters Creek corridor. This alternative would be characterized by a long haul road with moderate grades and a very short tailings pipeline. Access to Highway 51 would be along an existing ranch road.[2 3]

Table 4-9 summarizes the major physical considerations associated with this alternative and Figure 4-15 shows the geographic aspect of the project components.[7 8]

**TABLE 4-9**

**Physical Considerations For Alternative 6**

**North Fork Mill Site, Winters Creek Corridor, North Fork Tailings Disposal Area**

| Physical Consideration | Quantity |
|---|---|
| • Mine Site to Mill Site Distance | 9.6 miles |
| • Mill Site to Tailings Disposal Area Distance | 0.1 miles |
| • Miles of Access Road | 2.7 miles |
| • Mine to Mill — Haulage Profile | 7400' down to 6340' |
| • Mine to Mill — Average Grade | 2.1% |
| • Truck Haulage Cycle Time | 93 minutes |
| • Total Number of Haul and Water Trucks | 8 haul & 4 water |
| • Ease of Public Access To | High |
| • Land Ownership Status | Mill Site — Private<br>Tailings Area — Private<br>Corridor — Private & Federal |

**SOURCE: ADAPTED FROM FREEPORT GOLD COMPANY**

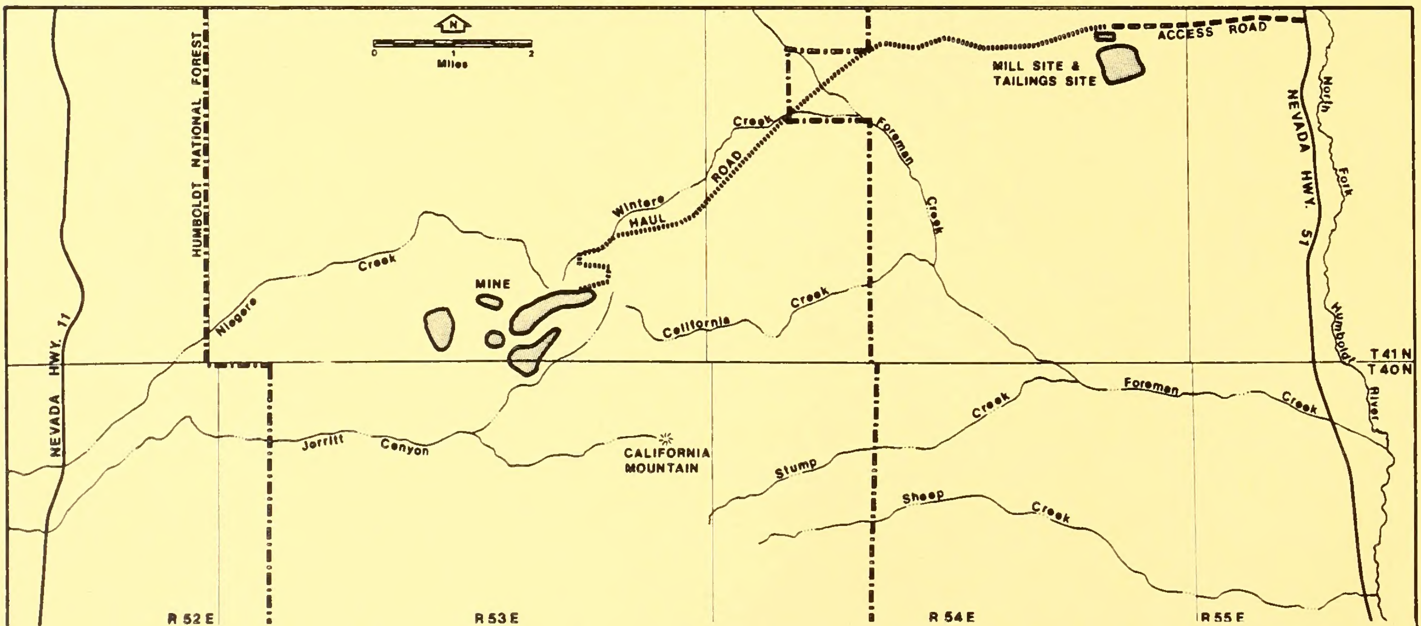
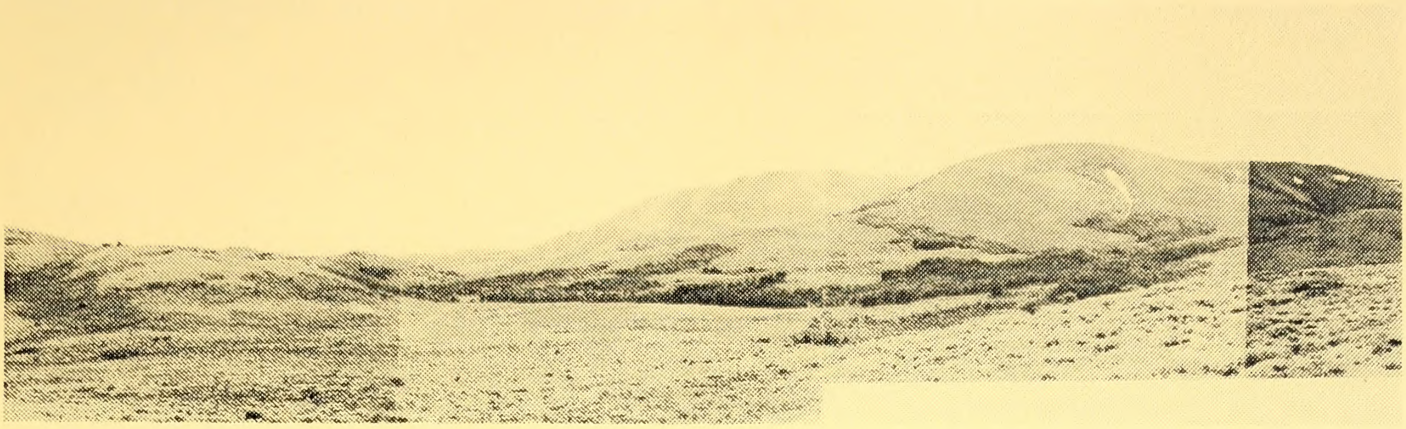



**FIGURE 4-15 Location of Alternative 6 — North Fork Mill — Winters Creek Corridor — North Fork Tailings Pond**

**SOURCE: FREEPORT GOLD COMPANY**



Winters Creek Mill and Service Building Site, looking south.

**Alternative 7**

Alternative 7 is similar to Alternatives 3 and 4. A mountain mill site would be located high in the Winters Creek watershed. A separate shop-warehouse complex would be located at a different site 0.8 miles from the mill but still high in the watershed. A tailings disposal pond would be built at the North Fork site in the North Fork Humboldt River Valley. Access to Highway 51 would be along an existing ranch road and up a new road paralleling Winters Creek. A new haul road would be built in the Winters Creek watershed to tie the mine to the mill complex and the shop complex. [2]

Table 4-10 summarizes the major physical considerations associated with this alternative and Figure 4-16 shows the geographic aspect of the project components. [7 8]

**TABLE 4-10**

**Physical Considerations For Alternative 7**
**Winters Creek Mill Site, Winters Creek Corridor, North Fork Tailings Disposal Area**

| Phsycial Consideration | Quantity |
|---|---|
| • Mine Site to Mill Site Distance | 2.3 miles |
| • Mill Site to Tailings Disposal Area Distance | 7.2 miles |
| • Miles of Access Road | 9.9 miles |
| • Mine to Mill — Haulage Profile | 7400' down to 7240' |
| • Mine to Mill — Average Grade | 1.3% |
| • Truck Haulage Cycle Time | 36 minutes |
| • Total Number of Haul and Water Trucks | 4 haul & 2 water |
| • Ease of Public Access To | Medium |
| • Land Ownership Status | Mill Site — Federal<br>Tailings Area — Private<br>Corridor — Private & Federal |

**SOURCE: AOAPTEO FROM FREEPORT GOLO COMPANY**

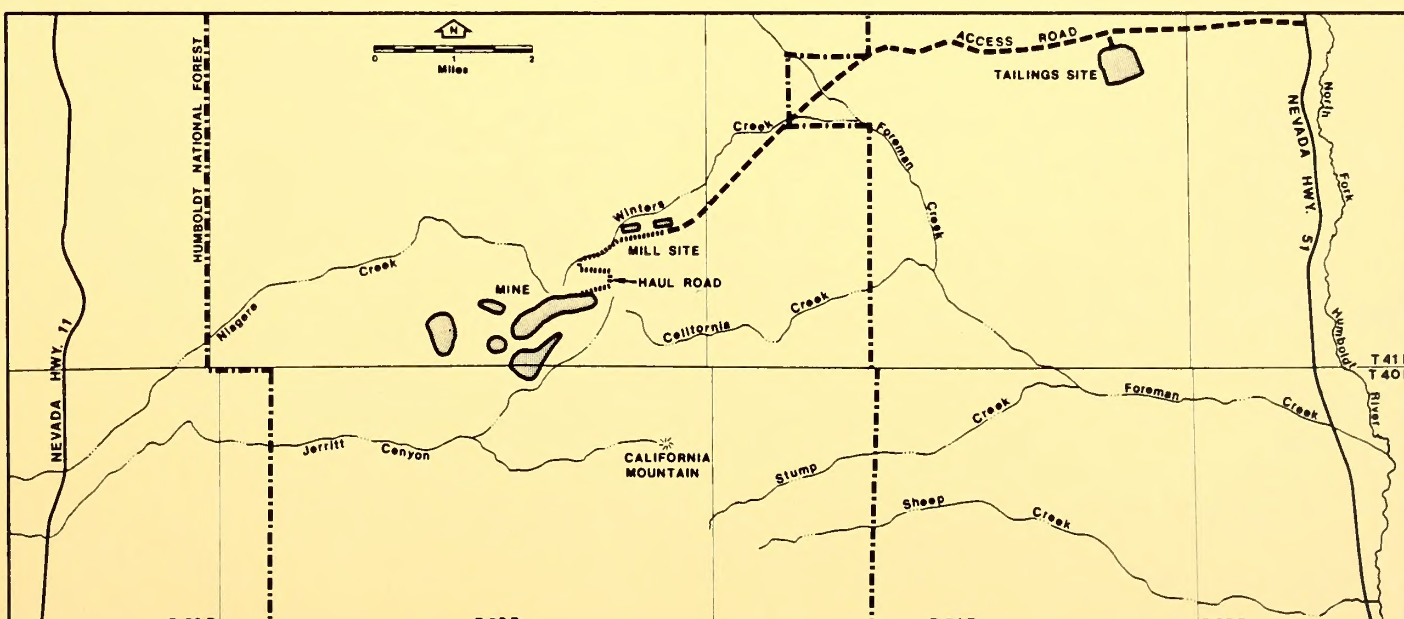



**FIGURE 4-16 Location of Alternative 7 — Winters Creek Mill — Winters Creek Corridor — North Fork Tailings Pond**

**SOURCE: FREEPORT GOLO COMPANY**

### Power Transmission Line Alternatives

Sierra Pacific Power Company and Idaho Power Company have begun construction of a 345 kv transmission line between the North Valmy power plant and the Midpoint substation near Twin Falls, Idaho. This east-west oriented transmission line will intersect Nevada Highway 11 and Highway 51 at points located about 6 miles north of Sage Corners (see Figure 4-17). A 345 kv tap substation could be constructed on BLM land at Highway 11 or at Highway 51 to drop the power to 120 kv.[18]

The 120 kv power transmission line will be constructed on wood H-frame structures consisting of 2 wooden poles, one wooden cross-brace, and either wood or steel crossarm. Porcelain insulator strings and aluminum clamps supporting the conductor will be installed on the crossarm. A detailed description of the power transmission line construction techniques is included within Appendix C of this report.[18]

Sierra Pacific has suggested three logical alternatives for bringing power north to the Jerritt Canyon Project from the Valmy-Midpoint transmission line to the intersection of the proposed east-west project corridors. Table 4-11 summarizes the physical characteristics of the three power transmission line alternatives.

**TABLE 4-11**
**Physical Considerations for Power Transmission Line Alternatives**

| ALTERNATIVE | LENGTH OF PRIMARY LINE (MILES) | EXISTING CORRIDOR | CAPITAL COST ($) |
|---|---|---|---|
| 1 Highway 11 Corridor | 22 | YES | 4,070,000 |
| 2 Highway 51 Corridor | 16 | YES | 3,860,000 |
| 3 Saval Ranch Corridor | 13 | NO | 3,600,000 |

SOURCE: SIERRA PACIFIC POWER COMPANY

#### Alternative 1 — Highway 11 Corridor

Sierra Pacific could construct a substation near the junction of the Valmy-Midpoint transmission line and Highway 11. The line voltage will be dropped from 345 kv to 120 kv at the substation. A new 120 kv transmission line will be constructed north along the existing power line corridor adjacent to Highway 11 to the Jerritt Canyon access corridor. From this point, an east-west line will be built along existing corridors from Highway 11 to the proposed mill site. Upon reaching the mill site, another substation will be constructed to further drop the voltage from 120 kv to 4.16 kv. The distance from the substation to the Jerritt Canyon access road is approximately 22 miles.[18]

#### Alternative 2 — Highway 51 Corridor

As another alternative, Sierra Pacific has suggested that a similar substation could be fabricated near the junction of Highway 51 and the Valmy-Midpoint transmission line. Again, a new north-south 120 kv transmission line will be built from the substation to the Freeport mill complex along an existing utility corridor paralleling Highway 51 for most of the alignment. The distance from this substation to the Rancho Grande corridor turnoff is about 16 miles.[18]

#### Alternative 3 — Saval Ranch Corridor

The third alternative line uses the Highway 11 substation as the southern terminus. A 120 kv line will be constructed directly north across country paralleling the eastern foothills of the Independence Mountains and cutting across the western portion of the Saval Ranch. The distance from this substation to the lines intersection with the Rancho Grande corridor is approximately 13 miles.[18]

## Management Constraints and Guidelines

The intent of these constraints and guidelines is to ensure that the project areas and corridors are reclaimed as much as possible to their original level of productivity, and that environmental disturbances are minimized during the construction and operation of the project. This section describes mitigation measures and techniques that lessen or eliminate impacts. It includes discussion of surface management requirements that would be employed by Freeport and monitored by the BLM and Forest Service regardless of the alternative selected. Procedures for implementation of the following constraints and guidelines will be included in the Freeport's Operating Plan which will be filed by Freeport.[20 21]

There are a number of general plans, programs and actions which Freeport must accomplish prior to the initiation of major construction activities. These are items which affect broad discipline areas. These plans and programs will also be appendices to Freeport's Operating Plan.

Freeport will develop a corridor plan for agency approval for the roads, pipelines, and utilities. The plan will include major design features to facilitate prevention of pollution, minimization of erosion, and rehabilitation of all disturbed areas not required in operation of the transportation system or utilities system. Included within this corridor plan will be general stipulations which will minimize Freeport's impact on the Saval Ranch Research and Evaluation Project by restricting activities that would affect the study to only those essential to the mining and exploration program.

Freeport will develop a reclamation plan for agency approval for construction and abandonment of the mill site, the tailings pond, and other project buildings and structures, waste rock disposal areas, and other disturbed areas.

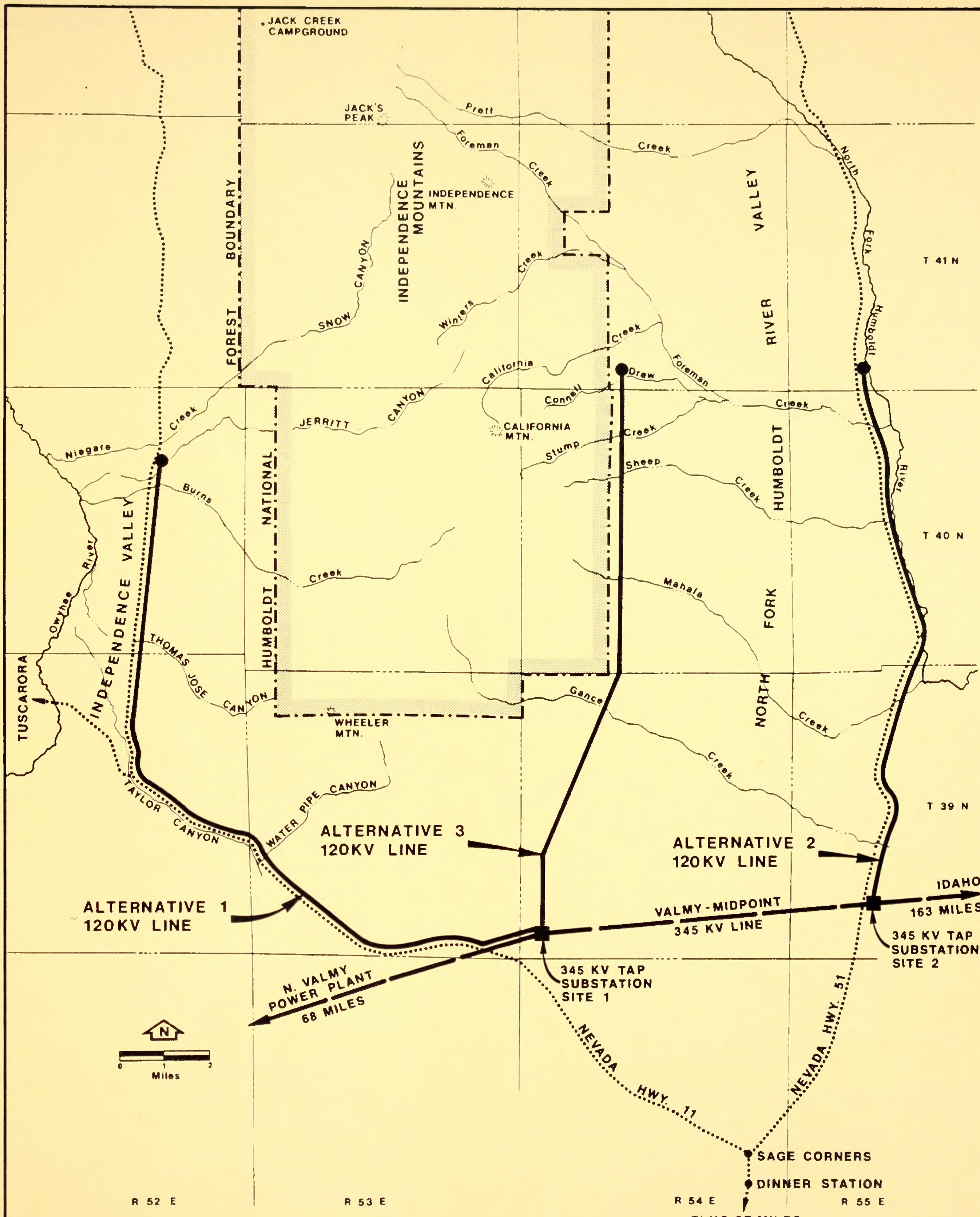



**FIGURE 4-17 Location of Power Transmission Line Alternatives**

**SOURCE: FREEPORT GOLD COMPANY**

A third plan will be prepared by Freeport for inclusion within the Operating Plan. Freeport will provide a detailed plan to describe snow management, including removal techniques, transportation methods, and disposal sites. Procedures will be incorporated within the plan to describe the techniques to alleviate the snow pack problem on waste rock disposal areas.

Prior to the commencement of project construction, the Forest Service and BLM have responsibilities which must be implemented. All construction sites and new corridor centerlines will be field inspected by the District Ranger and/or BLM personnel prior to commencement of construction activity. Prior to construction of the power distribution line, BLM and the Forest Service will identify pertinent environmental issues, and explain the mitigation procedures and stipulations to Sierra Pacific Power Company, their construction contractors, and Freeport.

In the following pages, there are a number of management constraints and guidelines which Freeport and its contractors will be responsible for implementing. These items have been assembled by environmental discipline areas for ease in presentation.

## Recreation and Public Access

- Ensure that corridor construction or use does not prevent or unreasonably disrupt the use of existing public roads.
- Protect existing recreation access, especially for hunters, where access will not endanger or impede the public or mining operations.
- Require closures and rehabilitation of mining roads not needed for access or use after activities are completed.
- Maintain and rehabilitate existing access roads damaged by Freeport vehicles.
- Regulate public access and public vehicular traffic as required to facilitate operations and protect the public, livestock, and to the extent possible, wildlife from hazards associated with the Jerritt Canyon Project operation.

## Visual Resources and Archeology

- Minimize impacts to visual resources in visually sensitive areas such as roads and trails, by prudent design of power poles, buildings, and other structures. For example avoid "skylining" power poles against the horizon in critical viewsheds.
- Utilize earth tone colors for painting of facilities installed on BLM or Forest Service lands.
- Conduct intensive archeological field surveys (BLM Class III) on all unsurveyed portions of the corridor right-of-way. Cultural properties subject to unavoidable loss or disturbance will be salvaged by a qualified archeologist. If previously undiscovered cultural resources are discovered during construction, construction will be temporarily halted in that area until the resources can be inspected by a qualified professional.
- Bring to attention of the responsible officer any objects of historic or archeological interest discovered as a result of Jerritt Canyon Project construction.

## Fish and Wildlife

- Post in conspicuous places notices informing employees and contractors of all applicable laws and regulations governing hunting, fishing, and trapping.
- Powerline construction will be limited to non-sensitive seasons when crossing critical wildlife habitat.
- Upon completion of the construction, new powerline access roads will be closed and reclaimed, if necessary, in those sensitive habitat areas affecting sage grouse strutting/brooding grounds.
- Evaluate raptor nesting sites to provide protective measures if construction is proposed to occur during the nesting period.
- Minimize activity in Jerritt Canyon adjacent to golden eagle nesting areas during the period March through June on an annual basis.
- Protect humans, livestock, and large mammals by erecting an 8-foot high fence around the tailings disposal pond.
- Protect habitat of the threatened Lahontan cutthroat trout and the sensitive plant species, Cryptantha interrupta.
- Avoid corridor areas containing identified threatened or endangered specimens. Areas containing threatened or endangered plants which are anticipated to be disturbed must be inspected by a qualified field botanist.

### Livestock Management

- Freeport will assist in alleviating impacts of proposed action on permitted livestock operations on BLM and Forest Service administered lands if it can be demonstrated that the mining operation directly caused the problem.

- Where a corridor or exploration road cuts a natural barrier used for livestock control, Freeport will close the opening by use of a fence or cattleguard.

- Reimburse ranch owners for livestock losses due to collisions with Freeport vehicles on roads.

### Reclamation and Revegetation

- Stockpiles will be removed from corridor construction areas and stablized for use during post-construction rehabilitation, where practical.

- Reduce surface disturbance, where possible, by backfilling overburden and other waste rock into mined out pit areas. Mined out pits will not normally be backfilled, but where possible some backfilling may be applicable.

- Ensure the affected project areas are returned to as natural a condition as possible by requiring a performance bond to be held by the Forest Service until satisfactory completion of reclamation requirements as specified in 36 CFR 252 and the Federal Land Policy Management Act. The reclamation requirements will be addressed in the reclamation plan, as part of the Operating Plan.

- Use of blades on bulldozers is restricted to brush blades only if necessary to clear heavy sagebrush, except as approved by the authorized officer.

### Water Quality and Hazardous Substances

- Store petroleum products, chemicals, toxic or volatile materials in durable containers or impermeable containment structures. This storage will be such that any accidental spillage will not drain into any watercourse. If, during operations, any hazardous substance should be spilled, the control, removal, disposal, and cleanup of the substance will be the responsibility of Freeport.

- Apply pesticides or herbicides only with the prior approval of the District Ranger or BLM Area Manager.

- Install a chlorine emergency and pump back system directly below tailings dam to neutralize cyanide compounds in case of tailings seepage or leakage.

- Locate equipment service areas away from streams to prevent potential water contamination.

- Locate roads out of stream bottoms, if possible, to minimize sediment entering stream channels.

- Protect resource values by maintaining waste rock disposal areas and water and sediment control structures, during and after the Jerritt Canyon Project operation. If sediment movement problems occur during the operation, construct appropriate sedimentation basins.

- Following corridor construction, all disturbed areas such as storage areas for materials and short access road spurs will be cleaned up, rehabilitated, and revegetated.

- Avoid channeling water into drainages not capable of handling the added flow.

### Solid Waste

- Remove all waste oil and petroleum products to an authorized sanitary land fill after corridor construction is completed. Use of portable chemical toilets is required for construction personnel. No wastes of any kind can be disposed of into watercourses or on the ground.

- Garbage will be disposed of in approved sanitary landfills. Other demolition wastes generated during the construction and operations will be buried in permitted landfills according to Nevada regulations.

- Adhere to the following siting and design criteria for tailings disposal:

  1) The watershed above the tailings disposal area is to be as small as possible to minimize flood potential.

  2) Diversion ditches will be installed to divert surface runoff away from the tailings pond and/or the tailings dam, and reservoir will be designed to handle a 100-year runoff event.

  3) Topographic features should be used to provide protection from wind to control and minimize fugitive dust.

4) Embankment slopes should be relatively flat after abandonment in order to minimize erosion potential. In general, final slopes should not be steeper than 3 to 1.

5) A self-sustaining vegetation cover should be established or rip rap employed to retard wind and water erosion.

## Air Quality

- Dust abatement will be required on unpaved access, construction, and haul roads.
- Conduct construction and operation activities in accordance with applicable air quality regulations and standards.

## Fire, Safety, and Housing

- Install warning signs on all access or haul roads in compliance with the Federal Mine Safety and Health Act as amended in 1977.
- Fire protection will be required at major project buildings.
- Use approved spark suppression device on all equipment and make operators aware of the "hot emissions control device" problem on new vehicles.
- Construct fire lines or perform clearing when determined by the government to be neccessary for fire prevention.
- Comply with the National Fire Codes on handling, transportation, storage, use and disposal of flammable materials.
- Restrict company employees from living on Forest Service or BLM lands to only those few personnel needed to provide security and maintain building operations at the mill site. During construction phase, occupancy may be permitted at designated sites by the District Ranger or BLM representative.

# Mitigation Measures

In Appendix C (Proposed Action), a detailed discussion is presented on the various mitigation programs that Freeport proposes to initiate during the construction, operation, and abandonment phases of the project. Other details concerning Freeport's mitigation program will be presented in three documents; 1) Corridor Plan, 2) Reclamation Plan, and 3) Snow Management Plan. Where relevant, these mitigation programs will be designed to conform to MSHA and/or OSHA regulations. Mitigation programs which are discussed in this appendix are listed below by project component.

## Mining Operation

### Drainage Control

Diversion ditches will be constructed to divert runoff around the mine pit and back into natural drainages below the mine area. Ground water flow into the pits will be collected and used for dust control on haul and access roads.[14, 22]

### Snow Management

Proper equipment will minimize buildup of packed snow in the pits. Snow will be removed from the mine pit and waste disposal areas prior to disposal of waste rock.[22] There will be no layering of snow and waste rock.

### Mine Reclamation and Revegetation

Adverse environmental effects will be minimized by use of 10-foot, 15-foot, and 20-foot bench heights and by the proposed $35^{o}$ to $45^{o}$ overall pit wall slope angles.[2]

### Waste Rock Reclamation and Revegetation

All mine waste disposal areas will be shaped to conform to the natural landforms in the area. Stockpiled topsoil and growth media will be placed on the upper portions of the disposal areas prior to re-seeding. Following post-mining earthwork, vegetation species will be seeded to re-establish the natural ground cover on portions of the waste disposal areas.[23]

## Corridors

### Protection of Antiquities

Prior to commencement of construction, an archeologist will perform the necessary walk through on corridor centerlines. Either line relocation or salvage operations will be performed to mitigate any impacted archeological sites.

### Runoff and Erosion Control

Runoff and erosion from roads will be controlled by berms and ditches to prevent uncontrolled erosion. Culverts and drains will be installed as necessary to redirect water into the natural watercourses.[22, 24]

### Dust Control

Appropriate methods will be used to control dust from project roads.[25]

#### Vegetation Control

All cut and fill slopes will be reseeded to control erosion.[2]

#### Reclamation and Revegetation

Reclamation of abandoned haul roads and access roads (if required by the Forest Service) will involve the smoothing of sharp grade breaks and ripping of hard surfaces to prepare areas for reseeding. Lands along pipeline and power transmission line corridors will be revegetated and all refuse, debris, and work facilities will be removed.[2 23]

Reseed power transmission line disturbed areas designated by the BLM. Those areas will be scarified and seeded promptly following construction. Inspection and evaluation of seeded areas will be performed by BLM for three growing seasons following revegetation.

### Mill Operation

#### Gaseous Effluent Control

Off-gases from the chlorination tanks will be scrubbed in a tower through which a solution of sodium carbonate will be pumped. Recovered chlorine will be recycled back to the mill circuit.[2]

#### Solid Effluent Control

The primary crusher building will be equipped with a dust collection system. Dust collected in this system will be gathered into a wet scrubber. Off-gases from the smelting furnaces will be treated in an electrostatic precipitator to meet air quality standards. The tailings will be kept in a wet or moist condition so that minimal dust will escape into the atmosphere.[2 25]

#### Liquid Effluent Control

Other constituents in the gold ore will be dissolved and put into solution. These elements will be carried in the liquid portion of the tailings and deposited into the tailings pond. There will be no liquid discharged from the mill or tailings system into the natural waters of Elko County.[2]

#### Mill Decommissioning

All buildings will be dismantled and removed upon termination of the Jerritt Canyon Project. Foundations will be covered with fill and soil. Any areas that might be contaminated with cyanide will be de-activated prior to abandonment.[2 23]

### Tailings Disposal System

#### Surface Water and Ground Water Drainage Control

The tailings disposal pond area will be lined to provide an impervious barrier to vertical movement. Horizontal seepage of liquids will be controlled by appropriate dam embankment design supported by rigorous monitoring networks.[2 24]

#### Tailings Line Spill Management

On short distance tailings lines (0.1 mile), the tailings pipe will be located in a ditch which will drain to the tailings disposal area. If a spill or leak does occur, the tailings material will be immediately treated with chlorine compounds to deactivate the cyanide.[2]

A complex spill prevention program is described in Appendix C for long tailings disposal lines.

#### Spray System Control

An optional spray system will be installed if necessary to accelerate evaporation rates. Chlorine could be used to deactivate the cyanide prior to spraying, should it be required.[2 25]

#### Reclamation and Revegetation

After abandonment and final drying of the tailings pond, the dry tailings will be shaped and contoured to blend into the natural landscape. A topsoil cover will be placed over the tailings area, and reseeded to achieve vegetative cover.[2 23]

### Support Facilities Mitigation

#### Public Safety and Security

The Jerritt Canyon Project office-shop-mill complex will be protected and monitored for public safety and security. Signs will be used to warn the public about dangerous and hazardous areas.[2]

#### Fire Protection

Water tanks, fire hydrants, hose houses, and other fire protection equipment will be strategically located throughout the mill complex.[2]

#### Drainage Control

Surface runoff from the watershed upstream from the mill will be diverted around the complex via ditches and introduced back into natural watercourses. Storm runoff occurring within the boundaries of the mill complex will be collected, stored, and evaporated in an emergency storage pond.[2 22]

#### Wastewater Management

An aerated digestion treatment plant or an equivalent secondary treatment system will be built to handle the domestic wastewater collection system around the mill complex. Portable toilet facilities will be provided at the mine and other remote facilities around the Jerritt Canyon Project area.[2]

#### Solid Waste Management

A landfill site will be constructed for disposal of construction and solid waste material. All solid wastes will be covered and compacted with inert waste rock and subsoil to a minimum thickness of 6 inches once a week. Total reclamation will be achieved upon abandonment.[2]

#### Support Facilities Abandonment

At the completion of mining and milling at the Jerritt Canyon Project, all man-made structures will be removed from the area. The mill complex area will be reseeded. A mixture of native species will be planted to revegetate the disturbed area.[2 23]

## Monitoring Programs

A generic discussion of the recommended monitoring programs is given here. The number and placement of monitoring stations will vary for the various alternatives. The specific details of the monitoring program for the selected alternatives should be developed jointly by the District Ranger and Freeport and incorporated into the approved operating plan. This plan will also include time limitations for corrective action.

Details of the recommended ground water monitoring program are included in the Ground Water Technical Report. Freeport should submit an annual monitoring report which summarizes the data collection program to the Forest Service, the BLM and the Nevada Department of Environmental Protection.

The recommended monitoring plan is tabulated below by discipline area:

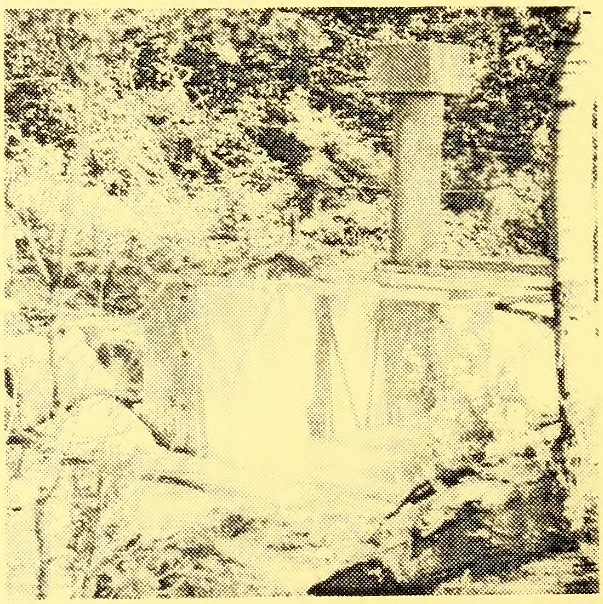
- Surface Water Flow - Maintain the existing stream flow gaging stations in Jerritt Canyon and on Petaini Springs to collect continuous streamflow records.[22]

- Surface Water Quality - Collect periodic water samples for selected inorganic and organic chemical constituents. Sampling stations should be located at the water gaging stations in Jerritt Canyon, Petaini Springs, and in the watercourses directly downstream of the tailings disposal area, and the waste rock disposal area.[26 27]

- Ground water - Install two observation wells down gradient and one well up gradient from the tailings disposal area. Wells should be developed in the shallow aquifers underlying the tailings pond (see Appendix C for monitoring well construction details). Grab samples should be taken periodically from these three wells, and from Freeport's Section 33 water supply well, for analysis of selected heavy metals and compounds which are present in the tailings. After the initial installation, Freeport should collect water samples from the four wells every three months or at other intervals at the discretion of the responsible officer.[14 26]

- Wildlife - The Forest Service and BLM will monitor the Nevada Department of Wildlife's annual surveys of mule deer herds and sage grouse strutting grounds.

A technician checking the wind vane and anemometer.



View looking upstream of water flow monitoring station on Jerritt Creek.

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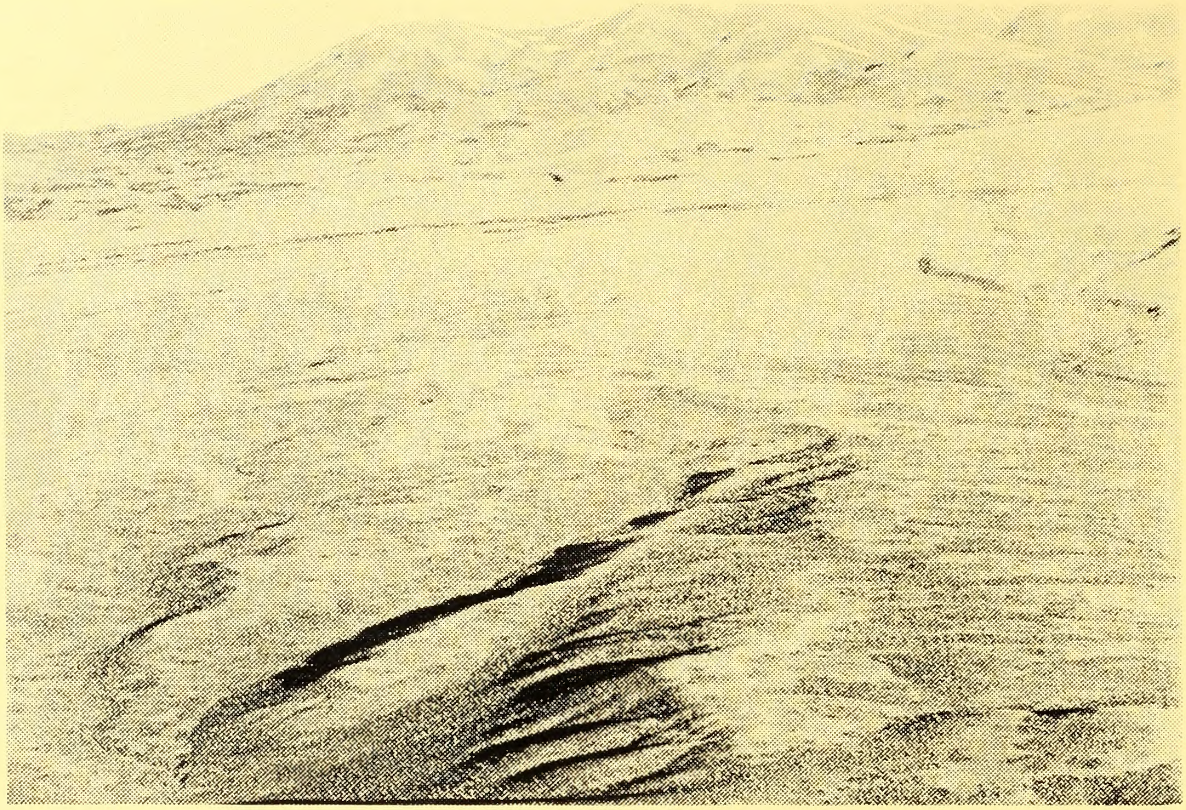
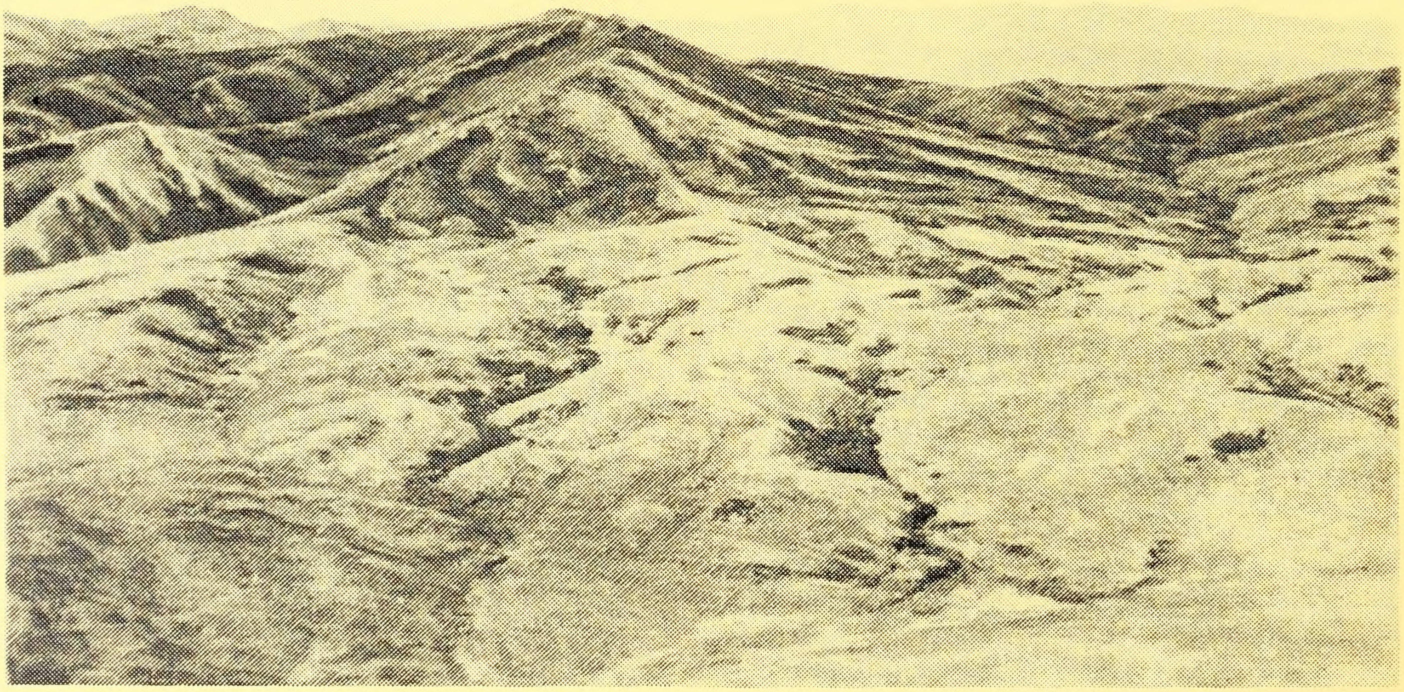


Looking to southwest with North Fork Mill Site in foreground.



East side of California Mountain with two unnamed drainages in foreground.

# 5. EFFECTS OF IMPLEMENTATION

## Introduction

This chapter of the EIS describes the consequences to the environment that will result should each of the alternatives be implemented. The descriptions will be presented to show differences in the expected output from each alternative, the costs, and the kinds and amounts of environmental changes resulting from each alternative.

Anticipated environmental effects from implementing the various alternatives have been quantified as much as possible. Certain elements lend themselves to quantification better than others, and for those elements which are difficult to quantify, special effort has been made to provide qualitative statements with sufficient detail to adequately describe differences in significance, or magnitude, or duration of the environmental effects. Description is also provided to distinguish which effects are direct, indirect, cumulative, and/or unavoidable. Also included are brief discussions on long and short-term relationships of effects, and any resource commitments which are irreversible or irretrievable. Certain cost/benefit analyses have been made and these are presented as additional background for the record of decision.

The no action alternative is also discussed and compared with the other alternatives in this chapter. It is the intent of this chapter to identify and discuss all major points of view raised by concerned individuals, organizations, and agencies.

### Assumptions

A variety of assumptions has to be made in preparing this chapter. The assumptions were necessary to allow quantification of impacts wherever possible in individual discipline areas. Among these assumptions are the following: a finite number of acres was assumed for each of the physical facilities: mine site, mill site, waste rock disposal area, and tailings pond. A separate but fixed corridor width was assumed for both access and haul roads. The construction period for roads was assumed to be six months, one year for the mill and tailings pond, and one year for preproduction opening of the mine. The life of the project was assumed to be 25 years. It was assumed the mill would operate 24 hours per day and the mine 16 hours per day. Alternative locations for specific facilities were selected using several geological and topographic criteria plus design criteria from Freeport. These criteria are described in Chapter 4.

Atmospheric emissions from the mill and vehicles were estimated by using standard emission factors. The numbers and kinds of vehicles used on the project were estimated by Freeport engineering staff. The Freeport staff also provided the basic assumptions for liquid effluent disposal, the potential for pipeline leaks and accidents, and safety requirements for reagents and explosives. The actual size of the mine was determined by the amount of ore reserves and the expected prices of gold anticipated by Freeport. Costs for the various alternatives were developed by Freeport and by outside consultants for Freeport.

### Expected Outputs

A summary of expected, quantifiable outputs from the various alternatives described is presented below:

- 170,000 troy ounces of gold annually or approximately 68 million dollars (at $400 per troy ounce).
- 170 to 200 jobs with an annual payroll of approximately $4,000,000.
- $920,000 in taxes paid to City and County of Elko and State of Nevada annually.

These expected outputs will not vary depending on which alternative is chosen, rather, the various alternatives will have different costs incurred to produce these outputs. The differences in cost are discussed in the Cost/Beneft Analysis. These outputs will begin to accrue during the one year of construction, will peak during the first year of production, and will remain relatively constant during the life of the project.

### Cost/Benefit Analysis

Any cost/benefit analysis for the Jerritt Canyon Project is essentially a cost only comparison of alternatives, because all alternatives are designed to achieve the same goal of gold production from the mine. All three of the waste rock disposal alternatives would also achieve the same objective but with different costs. The No Action Alternative would have different benefits than the other seven alternatives.

Some of the unit costs used to develop the cost/benefit analysis for waste rock include costs per foot of haul road, costs per vehicle unit for waste hauling, costs per haul cycle, and acres consumed per waste rock disposal alternative. All the waste disposal alternatives will achieve the same output, or same benefit, e.g., allow construction of the pits to permit the production of ore. A cost/benefit analysis, therefore, only treats the differences in costs among those options.

### Location Alternatives

The development of location alternatives involved evaluating mill sites, tailings pond sites, and connecting corridors to arrive at a feasible combination of these elements. Some of the unit costs for evaluating location alternatives for facilities include costs per foot of haul road, costs per foot of access road, costs per foot of other service roads, costs per foot of fresh water pipeline, costs per foot of tailings pipeline, costs per mile of powerlines, costs per site for mill site preparation, costs per site for tailings pond construction, costs per vehicle unit for ore hauling, costs per haul cycle, and costs for earthmoving associated with any special construction per site or corridor. Table 5-1 presents the cost comparisons of the waste rock disposal alternatives, and the seven project alternatives.

The No Action Alternative would mean approval by the Forest Service of a small mine comparable to mines already existing on the Forest. Such a mine would be capable of producing only approximately 25,000 tons of ore annually, or 6,100 troy ounces of gold. Such a mine would ulitize a heap leaching facility and on-site processing plant. A small scale mine for the No Action Alternative was judged by Freeport to be uneconomic, therefore capital development costs were not prepared.

### Federal Management Costs

Expenses incurred by the Forest Service and BLM in managing the natural resources of the area after the project is in place, are assumed to be essentially the same for all alternatives. The Forest Service and BLM might experience minor variations in management expenses in areas such as grazing allotment coordination, and monitoring of the project operations, depending on which alternative was finally chosen, but such variations would be very minor. The Forest Service and BLM anticipate management expenses of approximately $7,000 annually as a result of having the project in place.

The No Action Alternative would likely cause the Forest Service less management expense than one of the seven project alternatives. The reason is that the smaller scale operation under the No Action Alternative would create less disturbance and less operational monitoring over the life of the project. The Forest Service estimates management costs of approximately $1,000 annually if the No Action Alternative is chosen.

## Environmental Changes

### Recreation

Recreational visitor days may be reduced or not affected by the project. Access roads into the Independence Mountains may increase visitor days for casual activities such as sight-seeing or berry picking. If the access road is built on private land, it will be closed to public travel and have no effect on visitor use of the area. Certain of the facilities may impact wildlife resources and, since the majority of visitor days are for hunting and fishing, the long-term and cumulative effects may be reduced visitor days. Fishing use is distributed over three streams on the east side, Gance, Mahala, and California Creeks, of which only California Creek would be impacted, and two streams on the west side, Smith and Niagara Creeks, neither of which would be impacted.

Effects on recreational use would be direct in the case of access roads open to the public, or traditional access roads being blocked by mining or other related development. An indirect effect

**TABLE 5-1**
**Summary of Freeport Costs For Project Options and Alternatives**

| | | | | INITIAL CAPITAL COST (IN THOUSANDS $) | ANNUAL OPERATING COST (IN THOUSANDS $) |
|---|---|---|---|---|---|
| **Waste Rock Disposal Alternatives** | | | | | |
| 1. Valley Fill & Sidehill Disposal | | | | 4,620 | 1,524 |
| 2. Modified Valley Fill | | | | 4,620 | 1,486 |
| 3. Sidehill Disposal | | | | 6,102 | 1,833 |
| **Location Alternatives** | | | | | |
| | Mill Site | Corridor | Tailings Pond | | |
| 1. | Wright Ranch | Jerritt Canyon | Wright Ranch | 71,339 | |
| 2. | Ellison Ranch | Northwest | Ellison Ranch | 87,825 | |
| 3. | Site B | Northwest | Ellison Ranch | 90,858 | |
| 4. | Site B | R.G. - Calif. Creek | Section 33 | 72,584 | |
| 5. | Section 33 | R.G. - Winters Ck. | Section 33 | 70,147 | |
| 6. | North Fork | Winters Creek | North Fork | 71,858 | |
| 7. | Winters Creek | Winters Creek | North Fork | 71,012 | |
| **Power Distribution Line Alternatives** | | | | | |
| 1. Highway 11 Corridor | | | | 4,070 | |
| 2. Highway 51 Corridor | | | | 3,860 | |
| 3. Saval Ranch Corridor | | | | 3,600 | |

**SOURCE: FREEPORT GOLD COMPANY**

would occur if the project creates a long term change in the grazing and migration patterns of deer herds, thus affecting deer hunters. A corridor passing through a sage grouse strutting ground would have an indirect effect on grouse hunters by causing a long-term change in grouse populations. Such sage grouse strutting grounds would be affected to various degrees by Alternatives 4, 5, 6 and 7.

Those alternatives affecting deer hunting (1, 2 and 3) will have only short-term effects, as the deer will adapt to the project facilities and so, presumably, will the deer hunters. The alternatives affecting grouse will have both short and long-term effects because the grouse will not adapt to the project and their populations may be permanently diminished.

Fishing on California Creek could be affected indirectly by road construction increasing erosion and sedimentation and degrading the trout habitat as in Alternative 4. Fishing in California Creek could also be affected directly by building a bridge over it for haul trucks and thus degrading the fishing in the area, which could occur in Alternative 5.

If the Forest Service determines that conditions around the mine and mill area are dangerous to recreationists, then various closure restrictions could be imposed. The mine and other facilities will decrease the sense of remoteness in the area and create a visual intrusion for some of the visitors to the areas. Recreational visits are normally less than 2000 person-days annually for the region of the southern Independence Mountains.

The No Action alternative would have minimal effects on recreation on the forest. The corridor would affect deer winter range, but traffic volumes on the road should be light. The road would be closed to the public and should not stimulate any increased fishing pressure in Snow Canyon.

### Visual Resources

The evaluation of effects to visual quality objectives was somewhat easier to document than was recreation effects, but equally difficult to quantify. Since all of the study area was classified into visual quality objective areas, each alternative was evaluated as compatible, not compatible, or compatible with mitigation measures. Figure 5-1 shows areas within the study area which fall into these classifications. The capacity of each landscape to absorb alteration without losing its visual character also contributed to the effects evaluation. The visual absorbtion capability is a function of landform, and vegetation screening and variety.

Alternatives 1 and 2 would place large scale facilities in close proximity to Highway 11. A mill and tailings pond would be highly visible in the flat terrain of the Independence Valley. The Jerritt Canyon corridor would create substantial changes in an area rated distinctive. The cut and fill slopes of the Northwest corridor where it climbs from the valley floor to the ridgeline would be moderately to highly visible. Additionally, the Northwest corridor is visible from other National Forest areas further north. Low sensitivity in these areas would permit construction of facilities with mitigation.

Visibility impacts of Alternative 3 are very similar to those of Alternative 2, except mill site B affects an area with a visual objective of partial retention. Visibility of the mill is dependent on its color and a viewing location several miles west across the Independence Valley. Alternative 4 has the same mill site but an eastern corridor and tailings pond location. The tailings pond in Section 33 is visually compatible with area objectives, but the Rancho Grande-California Creek corridor crosses a sensitive and distinctive visual area on California Mountain. A road cut up California Mountain would be very visible to Highway 51 travelers. Visual quality effects of Alternative 5 are much lower than Alternative 4 because the Winters Creek corridor is rated compatible with a modification objective with overall low visual character. Even though a mill would be placed in Section 33, it is in scale with the site with a mountain background, plus visibility is minimal beyond the immediate valley area. Alternatives 6 and 7 have very compatible corridor and tailings pond sites. The corridor crosses modification zones and with mitigation, can cross the partial retention zone. Essentially, it would be visible only where it intersects Highway 51. The North Fork mill site is highly visible to the east, but for limited duration by travelers. The Winters Creek mill site has higher impacts because the location is in more vulnerable landscapes, plus the service building site can be seen from Highway 51.

All three of the waste rock disposal options will be within 1,000 feet of each other in Jerritt Canyon. All of them are in a zone classified for modification of visual quality objectives. The length of the face of the various disposal areas was evaluated for visual effect. The final angle of repose varied among alternatives and it was felt that lower angles of repose had greater potential for reclamation.

Visual quality intrusion was considered to be one of the most significant direct effects of new power transmission line construction. Alternatives 1 and 3 were judged to constitute moderate new visual intrusions, in Alternative 1 because of the rugged and varied topography the new line must cross, and in Alternative 3 because the line would be a new installation in foothill areas presently having only minimal man-made structures. Alternative 2 would experience minor visual intrusions with a new line being placed in an existing power distribution line corridor.

The heap leaching operation of the No Action Alternative would also be visible on the flat terrain of the Independence Valley, and the Northwest corridor would also be visible from Highway 11.

All of the above described visual effects will be direct effects and represent the total cumulative effects of the project. In most cases the major visual effects will be unavoidable and will last for the life of the project or beyond, as in the case of road cuts on mountain flanks. Many of the visual impacts are reversible following removal of the structures and reestablishment of vegetation. Only major road construction would cause the irretrievable loss of some visual resources.

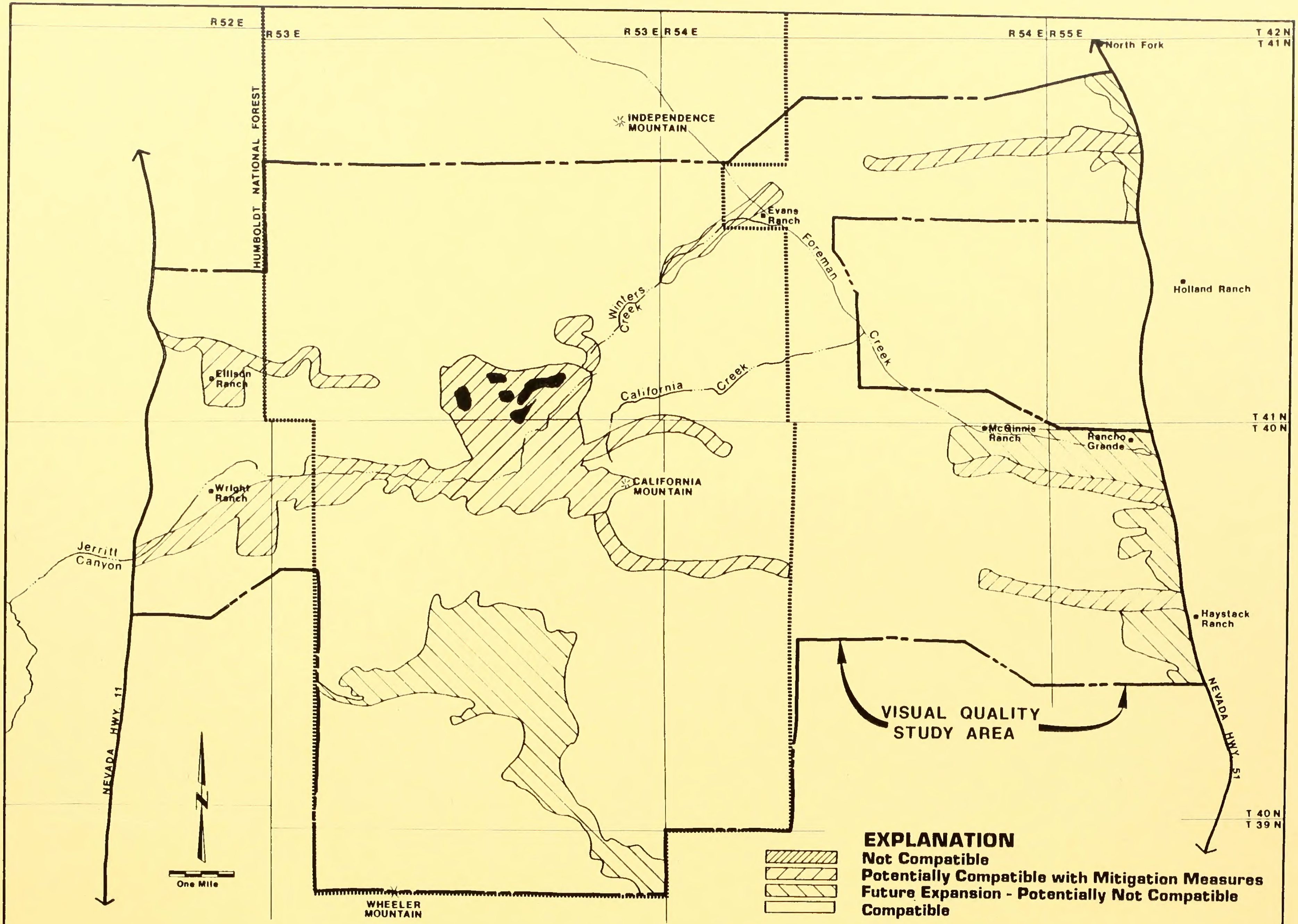



**FIGURE 5-1 Visual Quality Objectives Compatibility Map**

SOURCE: ENVIRONMENTAL RESEARCH & TECHNOLOGY, INC.

## Cultural Resources

Various archeological sites would be adversely affected by the various alternatives, some directly and some indirectly. Alternatives 2 and 3 would affect different sites because of corridor and tailings pond location. A historic hunting base camp would be affected by the Northwest corridor in the area near the Forest Service boundary, and a hunting and gathering base camp would be affected by the Ellison Ranch tailings pond location.

Alternative 1 would affect three sites by locating the transportation corridor in Jerritt Canyon. These sites are not in Jerritt Canyon proper, but are in Steer Canyon where the corridor leaves Jerritt Canyon to start climbing east-northeast to the mine site. Two of the sites are short distances up Steer Canyon from Jerritt Canyon. Both sites are temporary hunting camps containing stone features and a midden deposit. The third site affected by the Jerritt Canyon corridor is an historic dump located a short distance east of Highway 11 on private property. The dump contains relics which preceded mechanized agriculture in the area.

If the Sheep Creek corridor alignment were to be used in either Alternative 4 or 5, up to four sites could be affected by corridor location. The Sheep Creek corridor would pass through a hunting base camp with a lithic workshop component located on BLM land. The area is a few miles west of Highway 51. Associated with the Sheep Creek corridor is Secondary Corridor "C", running north-south to join the corridor with Section 33. Secondary Corridor "C" would pass through a hunting base camp located on private land.

Alternatives 4 and 5 would also impact other archeological sites through construction of Secondary Corridor "B" and the mill site at Section 33. Secondary Corridor "B" would pass through a hunting base camp with a possible lithic workshop on Forest Service land between Stump Creek and California Creek. The proposed mill site at Section 33 could affect a hunting base camp which is located between the mill site and Secondary Corridor "A".

Three additional sites could be affected by the corridor and mill sites in Alternatives 6 and 7. The Winters Creek access road could affect two sites located on private property west of Highway 51. One site is a hunting-gathering base camp three miles west of the highway. The third site would be affected by Alternative 7 only, and then only indirectly. The site is a temporary hunting camp located on Forest Service land and within a tenth of a mile of both the Winters Creek mill site and corridor. The site would likely be affected by increased traffic, construction, and human presence.

The No Action Alternative would also affect archeological resources where the Northwest corridor passes near a hunting base camp site. If the Ellison Ranch site were used for tailings disposal, a hunting and gathering base camp site could be affected.

In the evaluation of the alternatives, the assignment of impact levels depended on several criteria including size of the site, uniqueness of the materials found there, and whether the site has been previously disturbed by trails, roads, fences, or grazing. As indicated above, some alternatives have features which will directly affect archeological sites, while others will affect identified sites only indirectly. Additionally, all sites will have cumulative impacts from increased human presence and travel as a result of the project, even though most impacts can be mitigated by relocating the facilities to avoid the site. Mitigation by avoidance will be a primary objective of project development, and can be easily accomplished in most cases. These effects will occur in the long term, rather than the short term, because of the cumulative effects over the life of the project rather than any immediate effects. If, over time, the sites experience increased travel and artifact collection, these resources plus any information to be derived from the location of the artifacts will be irretrievably lost.

## Surface Water

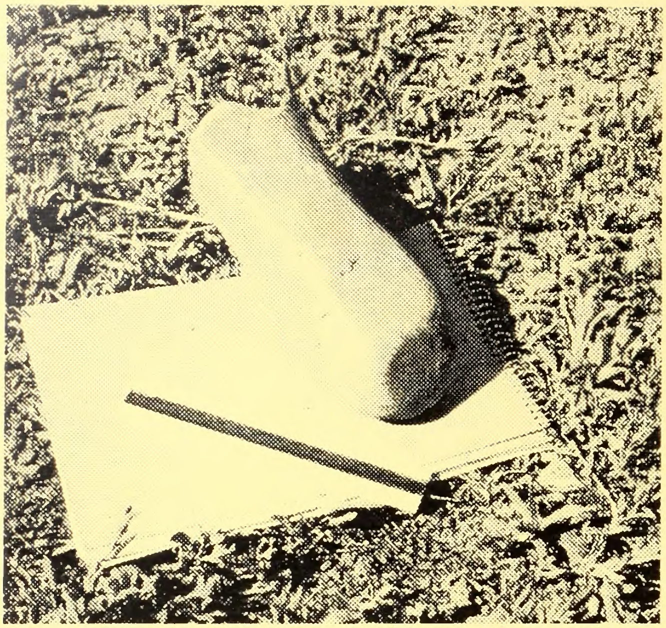
Effects of project alternatives on surface hydrology will be of one or two basic processes. One, the project structures and facilities will serve to increase surface runoff in localized areas, or two, the structures or facilities may obstruct existing channels either by physical structures or by channel filling through increased sedimentation. In both cases, normal drainage patterns would be changed as would flood water levels, and runoff rates.

Surface hydrology could be affected by all project facilities. The net influence on total storm runoff quantities due to the effect of roads on watershed slopes and precipitation-retention characteristics should be small. Increased depth of flooding in stream channels would be the principal consequence of access and haul roads, and could result from either a narrowing of the stream channel where fill may be required to construct roads parallel to the stream axis, or to inadequate capacity of culverts or bridges at points where roads cross stream channels.

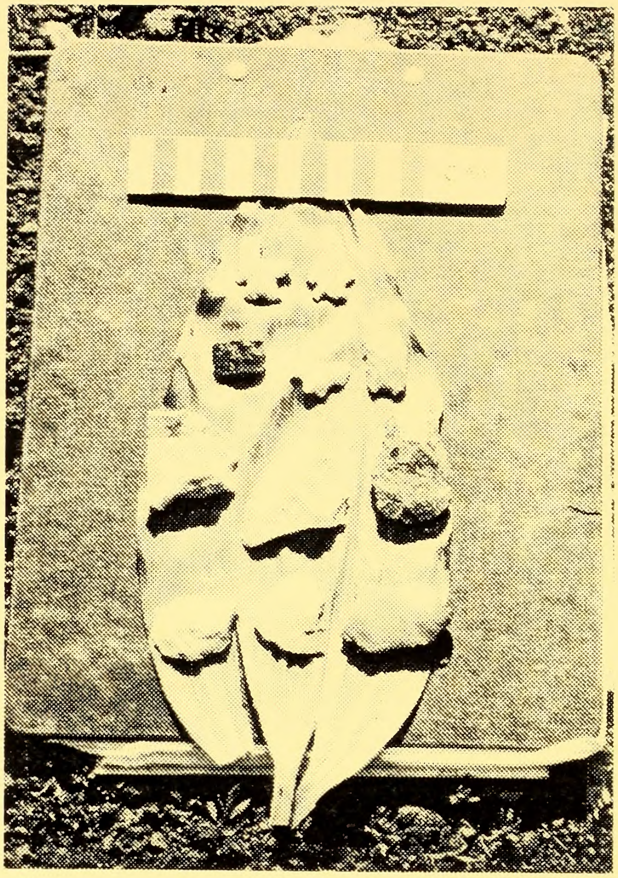
The various mill sites would generally have a small effect on overall storm runoff since the area is small relative to the watershed. The principal consequence of the mill sites is a modification of the local drainage pattern in the vicinity of the site.

Effects from the tailings ponds should be minimal because one of the prime locational criteria was to have minimal watershed area above the tailings pond. The tailings ponds are located off-channel from the major stream systems so their impact on storm runoff would be minor. In the event any tailings pond does intercept significant storm flow, the only hydrological effect would be a reduction in net runoff from that watershed.

The effect of tailings pipelines on the hydrology of the project area would be governed by their location with respect to flood zones of the watersheds which they traverse. When well away from possible flood waters, the pipeline's effect on the hydrologic regime will be similar to those of roadways. When within the flood plain, however, there are two possible consequences; one would be to increase the flood-crest stage due to obstruction of the channel, and the other could be actual structural damage, including possible failure of the pipeline. This could result from the force of

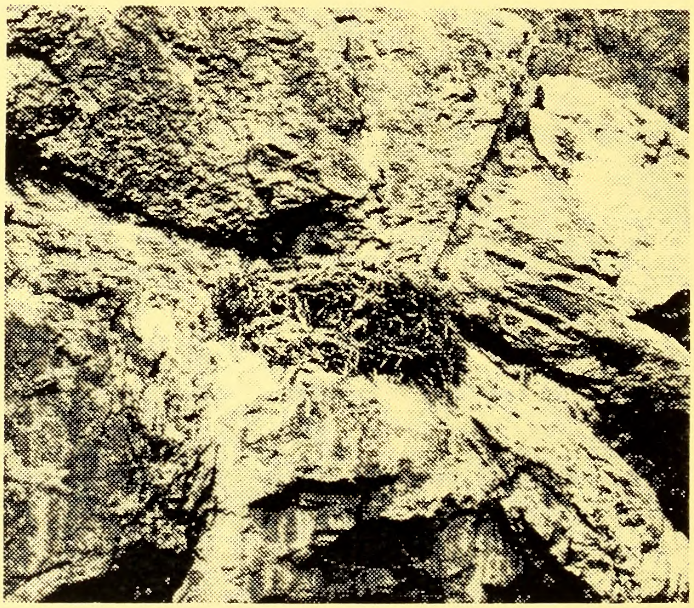


Hand-shaped working stone from archeological site.



Surface artifacts from hunting and gathering base camp on Jerritt Canyon Project area.

Landscape architect D. Gillespie making panoramic photographs of project site.



Golden Eagle nest with young in Jerritt Canyon.

incident floodwater, the impact of boulders and debris, or the undermining of supporting piers. The effect of structural damage could be extremely severe since it could release the tailings directly into the adjacent watercourse.

Alternative 1 could cause major effects on surface hydrology because corridor construction in the narrow Jerritt Canyon would require extensive work in the channel itself. The corridor would require many stream crossings and extensive cut and fill slopes to accommodate a roadway.

Alternative 2 would have very minor impact on surface hydrology as the mill and tailings site are not in any major drainage, and the Northwest corridor is at the northern perimeter of the Jerritt Creek watershed. The corridor would contribute sediment to Niagara Creek where the stream exits Snow Canyon.

The use of mill Site B in Alternative 3 would have little effect on surface hydrology in Jerritt Canyon because the site is small relative to the entire watershed.

Alternative 4 also uses mill Site B as discussed for Alternative 3. The Rancho Grande-California Creek corridor would parallel Foreman Creek for some distance and would cross Stump Creek with a culvert crossing. The corridor from Section 33 via California Mountain to Site B would contain a tailings pipeline, so construction could generate larger areas of cut and fill than would a corridor without a pipeline. Large cut and fill areas could contribute more sediment to the California Creek drainage.

If the Sheep Creek corridor were chosen for this alternative, then several possible effects could occur to surface hydrology and water quality. The Sheep Creek corridor would have to cross both Sheep and Stump Creeks with culvert crossings, construction of which could increase sedimentation in both streams and ultimately Foreman Creek.

Effects of the Rancho Grande-Winters Creek corridor would be similar to those in Alternative 4 for the lower reaches of Foreman Creek and for Stump Creek. The upper portion of the corridor however, would cross lower California Creek with a bridge or culvert, construction of which could increase the total suspended solids in lower California Creek and Foreman Creek.

Alternative 6 locates both the mill and tailings pond at the North Fork site which is at the headwaters of a very small watershed and will have negligible effects on both surface hydrology and water quality. The corridor may have effects on the hydrology and water quality of Foreman Creek however, because the corridor would require a raised roadbed to be constructed across the flood irrigated meadows which are east of Foreman Creek. The roadbed would have numerous culverts under it to avoid any ponding of flood irrigation waters, but the time distribution of runoff from the meadows may be affected. Construction of the roadbed and the bridge over Foreman Creek will contribute to the sediment load of the stream.

Alternative 7 uses the same corridor as Alternative 6, with the same expected effects on surface hydrology. Again, the tailings pond at the North Fork site should have negligible effects on surface hydrology water quality or ground water.

Effects on surface hydrology from the waste rock disposal alternatives were not significantly different for any of the alternatives. There is a potential for leaching of some heavy metals and other toxic substances from the waste rock into surface and ground water. It was felt that positive drainage from the tops of the disposal areas would mitigate any potential leaching to a large extent.

None of the power transmission line alternatives would affect surface water resources. The smaller scale No Action Alternative with facilities located at the Ellison Ranch site would not have any significant effect on surface hydrology.

### Ground Water

Effects upon the ground water regime will result from the withdrawal of approximately 1600 acre-feet per year of water from the North Fork Valley aquifer, the use of the water in the processing of ore, and the subsequent disposal of water of diminished quality into a tailings pond. The use of these ground waters will result in the loss of 1600 acre-feet/year from the basin's water budget due to the proposed evaporation of wastewaters from an essentially seepage-free impoundment; however, no other users should be adversely affected. The incorporation of these waters into the processing and disposal of ore will result in the introduction of heavy metal ions, reagents, and other constitutents. The disposal of these waters into a waste impoundment creates the potential of effluent seepage into the underlying aquifers.

In all discussions of effects on ground water, the tailings pond was considered the most important element because of the long-term possibility of tailings effluent being spilled or leaked and finding their way into the ground water system. Chapter 4 and Appendix C of the EIS discuss the design criteria and tailings dam mitigation program in more detail. Impermeable soils or man-made liners must be adequate to prevent downward seepage into the ground water. In this respect, the Ellison and Wright Ranch sites have higher risks than do the North Fork sites since there is a lack of near surface clay at those sites. Artificial pond liners were considered at the Ellison Ranch site, but excluded due to their extraordinary expense, and lack of long-term reliability.

Some minor effects in water supply were also evaluated. It is possible that production wells in the North Fork Valley will have minor effects on ground water because they will be located in deeper aquifers than those serving existing wells and may thus increase the downward transport of shallower ground water. The loss of ground water that seeps into the open-pit mine from small lenses or aquifers at the mine site will represent a minor loss of ground water. The seepage is not expected to be large enough to affect downstream springs. The extensive drilling program in the ore body did not encounter any significant aquifers.

In Alternative 1 the mill and tailings pond site at Wright Ranch would not create any effects on surface hydrology, but the permeable subsoils and shallow ground water create a potential for aquifer contamination if accidental spills were to occur.

For Alternatives 2, and 3 the lack of impermeable clay layers coupled with shallow ground water at the Ellison site increase the potential for ground water contamination when compared with other tailings pond sites. The mill site directly overlays a fractured bedrock foundation which makes the local ground water somewhat vulnerable to accidental spills. The effects on water resources from the Jerritt Canyon corridor and Ellison Ranch tailings pond are the same as discussed for Alternatives 1 and 2.

Location of the tailings pond in Alternative 4 is in section 33 which has a thick sequence of clay layers; therefore, seepage of tailings water should not have any effect on ground water.

Effects on water resources by Alternative 5 mill and tailings site would be quite similar to those of Alternative 4, except that a mill site at section 33 would have negligible effects on ground water, unlike mill Site B. In Alternative 6, the North Fork site is underlain by thick beds of clay, so effects on ground water should be minimal.

In Alternative 7, the mill site and the tailings pipeline in Winters Creek, have the potential to affect ground water because it is in an area of fractured bedrock, which could allow any spilled materials to enter the local ground water system. However, the tailings pond at the North Fork site should have negligible effects on ground water.

There is some potential for leaching of heavy metals and other toxic substances into the ground water from the waste rock disposal area. Leaching tests on waste rock samples show only minimum potential for leaching of materials out of the waste rock. This effect would be the same for all three of the waste rock disposal areas because their locations are so close to one another. The power transmission lines should not have any effect on ground water hydrology regardless of which alternative is chosen.

The No Action Alternative would involve a heap leaching operation at the Ellison Ranch site. Total containment of the leaching solutions is a design criteria and an economic necessity, however, any accidental spill of leaching solutions could easily enter ground waters through the permeable soils at the Ellison Ranch site.

### Water Quality

An expected effect on the water quality of the streams in the project area is increased suspended solids in affected stream drainages due to increased erosion. There is a potential for other effects, including 1) possible discharge of toxic water from leachates seeping from waste rock storage piles, 2) possibility of accidental spills of hazardous materials enroute to the mill site, and 3) potential for tailings pipeline breakage and spill of materials into streams. Spillage of process water, tailings slurry, and reagents along corridors, at the mill site or along slurry pipelines could degrade the quality of local ground water, especially water in shallow perched zones.

In Alternative 1, the large amount of cut and fill construction for the corridor would increase erosion and sedimentation and degrade water quality. The access road from Highway 11 is an area which could experience an accidental spill of toxic material which could degrade water quality in both Jerritt Canyon creek and the adjacent Burns Creek drainage.

In Alternative 2, the mill and tailings pond site near Bull Creek could cause some increase in sedimentation to that stream. Toxic material spills on the access road from Highway 11 could enter Bull Creek.

Effects on water quality from Alternative 3 would be essentially similar to those for Alternatives 1 and 2.

An accidental spill along the corridor in Alternative 4, or a break in the tailings pipeline would affect California Creek. The Section 33 tailings pond could contribute an increase in sedimentation to Foreman Creek during construction. Vehicular accidents spilling toxic materials into streams along the corridor would have higher probabilities than other corridors because of slightly greater length, and an additional stream crossing.

In Alternative 5 the upper portion of the corridor would cross lower California Creek with a bridge, construction of which could increase sedimentation in lower California Creek and Foreman Creek.

In Alternative 6 the corridor location in the Winters Creek area could contribute to erosion in the Winters Creek drainage, and thus degrade water quality to some degree. The location of the mill and tailings pond is in the headwater of a very small watershed and should have negligible effects on water quality.

The corridor in Alternative 7 will have a tailings pipeline associated with it, plus it is an access road over much of its length. Both of these factors increase the potential for spills of toxic materials into Winters or Foreman Creek.

Since all three of the waste rock disposal alternatives are located in the same watershed, no distinction could be made on water quality effects from waste rock disposal. The three power transmission line alternatives should not have any long-term effects on water quality in area streams. The No Action Alternative would be designed to contain all leaching solutions from the heap leaching operation. If any accidental spill did occur, water quality in Bull Creek and ultimately the Owyhee River could be degraded.

If construction of the project facilities causes erosion that directly enters a stream, there will be several direct effects. Any filling of the channel will increase flood water stages, and change the time distribution of downstream runoff. Any accidental spills of toxic materials that enter a stream will have direct effects on water quality and indirect effects on ground water because many area streambeds are primary ground water recharge areas. Seepage from the tailings pond could directly affect surface or ground waters depending on whether seepage was horizontal or vertical. Cumulative effects on water quality must also include suspended sediment from irrigation operations which will continue during the life of the project, as will cattle grazing along all affected streams.

The increased sediment load to streams is an unavoidable effect of this project. The above described effects on water resources will not occur immediately, but will start during the one year construction period and continue for the life of the project. Ongoing revegetation and normal soil stabilization may mitigate some of the effects over the long term. Once soils erode into streams, the resource is irretrievable. In most cases however, the process of erosion is a reversible one. Physical alterations of stream channels are reversible when considering man-made structures. Should a spill of toxic materials occur into a stream, there would be an immediate resource loss, but the restoration of water quality could occur over time. The same is true of contaminated ground water, but the time interval would be significantly longer.

### Aquatic Biology

Effects on aquatic environments associated with this project are 1) potentially increased siltation in the streams and its associated detrimental impacts on instream flora and fauna, and 2) improved access with subsequent increased pressure on fishery resources. There is a potential for other effects including potential release to streams of toxic waste water from project processes, toxic ground water or leachates from waste rock piles, and potential for accidental spills of toxic materials being delivered to the mill site. Of the above, the one which would create the most detrimental effects is increased siltation to the streams.

Activities which will create siltation problems are mining, waste dumps, access/haul roads, and site preparation for mill and tailings pond. Overburden or waste rock storage piles will remain largely unvegetated for a long period of time and will be highly susceptible to erosion. In addition, elevated arsenic concentrations of at least 190 parts per million (ppm) have been found in some of the overburden waste rock which could potentially be leached into streams. ERT sampled drill cores from the Marlboro pit and found elevated arsenic levels throughout many core samples, but typically at depths greater than 60 feet.

Construction and use of any of the proposed access and/or haul roads will create the greatest amount of erosion and resultant siltation. Long haul roads will have the potential to create a greater amount of silt, while access roads will probably produce less. Pipeline construction associated with alternative corridors will also be a source of increased siltation. Siltation impacts due to construction of the mill site and tailings pond are expected to be minimal for those options located on the valley floors.

California Creek and Foreman Creek contain the threatened Lahontan cutthroat trout and could be affected by certain corridor options. Effects could be in the form of an accidental spill of toxic materials or increased siltation from construction and operations.

Effects associated with abandonment would include increased erosion if revegetation efforts are minimal or unsuccessful. Haul roads may deteriorate and result in increased erosion and siltation of streams. Unsuccessful tailings pond revegetation efforts could result in erosion of the pond's solid waste material which may contain toxic metal compounds. Runoff from the mine pit areas and waste rock piles may contain toxic substances and silt which would be detrimental to the aquatic biota in Jerritt Creek.

Increased siltation is viewed as a very serious effect because it decreases suitable habitat for invertebrate organisms on which fish feed, and it can physically injure fish gills if concentrations are very high. Increased siltation also degrades the habitat for aquatic plants which oxygenate the water and provide cover. The end result is reduced fish populations.

Alternative 1 will affect only Jerritt Creek Canyon which does not have any fisheries because it is an intermittant stream. All project facilities in this alternative would be located in the Jerritt Canyon watershed thereby magnifying erosion and siltation effects. The cumulative effects of this alternative would be to degrade Jerritt Creek as a source of water for cattle and wildlife.

Similarly, Alternative 2 would have very few effects on aquatic biota. The Northwest corridor could increase erosion in the Jerritt Canyon watershed, but the corridor is from a mile to a mile and a half distant from Jerritt Canyon. The Ellison Ranch mill site and tailings pond site are in the Niagara Creek drainage plus the Bull Creek drainage to the south of the sites, neither of which has a fishery at that location.

Alternative 3 again concentrates the facilities in the Jerritt Canyon drainage except for the Ellison Ranch tailings pond. This alternative would require a tailings pipeline down the Northwest corridor, and an accidental tailings spill would ultimately affect Jerritt Canyon Creek. The same is true of any vehicular accident which might spill toxic materials; they would ultimately reach Jerritt Canyon, which has no fisheries.

Effects on aquatic biota from Alternative 4 will be potentially much greater than any of the first three alternatives. The mill would be located at Site B and thereby contribute to erosion in the Jerritt Canyon drainage. The corridor down from the mill around California Mountain and across Rancho Grande will be an access road with a tailings pipeline. The corridor would have several possible effects, including increasing erosion in the California and Foreman Creek drainages, having the potential of a tailings pipeline spill in the California Creek drainage and having the potential of a vehicular accidental spill of toxic materials in both the California and Foreman Creek drainages. The overland distances from the corridor to the various streams is highly variable, which makes any evaluation of risk from accidental spills very difficult. An accidental spill or leakage of tailings liquid from the tailings pond in section 33 could possibly enter Foreman Creek which would be approximately three quarters of a mile away. The Rancho Grande corridor is on private land and would be closed for access by recreational fishermen.

Alternative 5 would have few effects on aquatic biota, but they would be almost exclusively confined to Foreman Creek. The mill and tailings pond, both in Section 33, could cause erosion and have the potential for accidental spills which could possibly enter Foreman Creek. The corridor parallels the lower reaches of Foreman Creek and the corridor would cross California Creek (below the Lahontan trout habitat) and follow the Winters Creek drainage which has no fishery. Corridor construction could increase erosion in Foreman Creek, both above and below the confluence of California Creek. Accidental vehicle spills of toxic materials could affect lower Foreman Creek.

The fewest effects to aquatic life in streams in the North Fork Valley would likely result from Alternative 6. A mill and tailings pond located at the North Fork site would not affect any well defined drainage, rather the area is on the gently rolling valley floor that drains into the North Fork Humboldt, approximately two to three miles to the east. The corridor has to cross Foreman Creek on its way up the Winters Creek drainage. Construction of that stream crossing could increase sedimentation in the stream reach that contains the threatened Lahontan trout.

Alternative 7 has the corridor and tailings pond location in common with Alternative 6. However, the corridor has a tailings pipeline associated with it, which has the potential for a leak or break at or near the stream crossing of Foreman Creek. The mill and tailings pipeline and corridor above Foreman Creek would affect Winters Creek which has no fishery. The corridor would again be an access road to the Winters Creek mill site. Vehicular accidents involving reagent supply trucks could spill toxic chemicals into Winters Creek. The corridor would be on private land, as in Alternative 6, and would not provide additional access to fishermen.

Effects on aquatic biology would be negligible from the waste rock disposal options because Jerritt Canyon has no permanent aquatic habitat. None of the three power transmission line corridors are expected to affect aquatic biology in the area. The No Action Alternative would not have any effects beyond those discussed for Alternative 2, and likely fewer effects because of the smaller scale of operations in the No Action Alternative.

Most of the above described effects on aquatic biota are indirect effects in that erosion and small spills of toxic wastes would degrade the aquatic environment and reduce the potential for aquatic biota to reproduce and survive. If a spill of toxic materials were to occur, it would have direct effects on the fishery and could possibly sterilize a reach of the stream. Any increased fishing pressure resulting from increased access would also be a direct effect on the fisheries. Cumulative effects on aquatic environment must also include cattle grazing which is a current and future use of the project area. The physical degradation of stream banks and the pressure on vegetation by cattle will continue to contribute to soil erosion in project area streams. Although some level of increased sedimentation into streams will be unavoidable when implementing this project, much of the potential for erosion will be mitigated (see Chapter 4). Most of the effects of erosion will occur during the short term, the construction period, and the first few years of operation. Over the long-term life of the project, soil stabilization and revegetation will serve to reduce erosion. The potential for accidental spills from vehicles and from the plant or tailings pond will exist over the life of the project. The loss of soil resources through erosion and sedimentation is irretrievable. If eroded soils do not travel all the way into streams, then reclamation and revegetation can make some erosion losses reversible. If a spill of toxic materials directly affected a stream, the losses of biota would be irretrievable, but the loss of habitat would be reversible over a period of time.

### Threatened or Endangered Species

California Creek and Foreman Creek contain the threatened Lahontan cutthroat trout and could be affected by certain corridor options. Impacts could be in the form of an accidental spill of toxic materials or increased siltation from construction and operations.

The corridor in Alternative 4 will be an access road with a tailings pipeline. The corridor would have several possible effects, including increasing erosion in the California and Foreman Creek drainages, having the potential of a tailings pipeline spill in the California Creek drainage and having the potential of a vehicular accidental spill of toxic materials in both the California and Foreman Creek drainages. Much of the upper portion of the corridor is in the California Creek drainage above the habitat occupied by Lahontan trout. Occupied habitat in Foreman Creek is largely above the area which could be affected by the corridor.

Alternative 5 would have few effects on Lahontan trout, but they would be almost exclusively confined to Foreman Creek. The corridor parallels the lower reaches of Foreman Creek and the corridor would cross California Creek (below the year-round Lahontan trout habitat but in the area occupied by Lahontan trout during high flow periods) and follow the Winters Creek drainage which has no fishery. Corridor construction could increase erosion in Foreman Creek, both above and below the confluence of California Creek. Accidental vehicle spills of toxic materials could affect lower Foreman Creek.

In Alternative 6 the corridor has to cross Foreman Creek on its way up the Winters Creek drainage. Construction of that stream crossing could increase sedimentation in the stream reach that contains the threatened Lahontan trout.

Alternative 7 is very similar in effects to Alternative 6 except the corridor has a tailings pipeline associated with it, which has the potential for a leak or break at or near the Lahontan trout habitat in Foreman Creek.

Effects on the threatened Lahontan cutthroat trout would be indirect through habitat degradation. Corridor construction in the California and Foreman Creek drainage in Alternative 4, and crossings of California and Foreman Creeks in Alternatives 5, 6 and 7 could all contribute to increased sedimentation and potentially lowered water quality in the short-term construction period.

The three waste rock disposal alternatives will not have any effects on threatened or endangered species. Two of the three power transmission line corridors do have the potential to effect populations of the candidate threatened plant Cryptantha interrupta. Corridor alternatives 1 and 2 along Highways 11 and 51 respectively, could cross areas with known populations of Cryptantha. None of the seven mill-tailings-corridor alternatives would affect any known populations of C. interrupta, nor would the No Action Alternative. The candidate threatened plant Antennaria arcuata may also occur in the area but has not been identified on site.

## Wildlife

Several aspects of development and operation of the Jerritt Canyon Project will adversely impact wildlife populations within the study area. The primary impact categories which will affect wildlife populations are: direct habitat removal or alteration, human presence, noise, changes in surface water quality, dust and mill emissions ($SO_2$ and particulates).

The most severe impact to all resident wildlife populations will be the removal or destruction of habitat and associated disturbance of adjacent areas. Mining, and the construction of a mill site, tailings pond, and transportation corridor will result in the eventual loss of from 750 to 1,170 acres of wildlife habitat, depending on the alternative selected. Most habitat losses will occur within the mixed shrub/sagebrush and alluvial sagebrush habitats.

Removal of habitat will result in the direct destruction of less mobile species such as small mammals, bird nestlings, reptiles, and amphibians, and the displacement of more mobile species such as adult birds, predatory mammals, and mule deer. These species and their relative abundances have been identified in the description of the affected environment.

Where mule deer, domestic livestock, and other herbivores are displaced, increased grazing and browsing pressure on adjacent habitat may cause deterioration of range and browse condition. Disturbance in the canyons on the west side of the Independence Mountains (key deer winter range) would be far more critical than any disturbance to deer summer range at high elevations or on the east side.

Raptors and mammalian predators will have their available hunting territory reduced by the amount of the disturbed area. Because most predators are wide-ranging, it is difficult to assess how removal of a portion of their hunting range may affect them. If predators are food limited, however, a reduction in predator numbers proportionate to the reduction in their food supply could be reasonably expected.

The greatest impact of habitat removal and disturbance to other wildlife species will be loss of nesting or breeding habitat and a reduction in habitat carrying capacity. Displaced species may not be able to establish themselves elsewhere since available breeding territory is assumed to be already occupied or utilized to capacity. Loss or alteration of locally unique or restricted vegetation types, especially the riparian type has a disproportionate impact, since any loss of this vegetation type represents a significant proportion of that available in the project region.

After habitat removal, increased human presence and associated activities may have the most significant impact on resident wildlife populations. Increased human presence increases the potential for wildlife-human interactions ranging from harassment of wildlife to increased poaching and legal harvest.

Mule deer and golden eagles are two of the most visible wildlife residents in the project region and are thus more prone to harassment. Mountain lion, other predators, mule deer and upland game species such as rabbits, chukar, and sage grouse could face additional legal as well as illegal hunting pressure.

Mountain lion will probably be the species most affected by the proposed Jerritt Canyon Project, especially as related to human disturbance. Human presence will increase avoidance reactions of mountain lion and cause their emigration from much of the project area. Elimination of the mountain lion would reduce deer mortality from predators by some number per lion per year.

With increased human activity, the potential for vehicle-wildlife collisions will also increase. Many other smaller wildlife species, such as rabbits, ground squirrels, and reptiles will be prone to road-kill, but populations of these animals are not likely to be seriously affected by these losses. Increased human presence will also likely increase off-road vehicle use which will increase the potential for wildlife harassment, wildlife-vehicle collisions, and habitat damage.

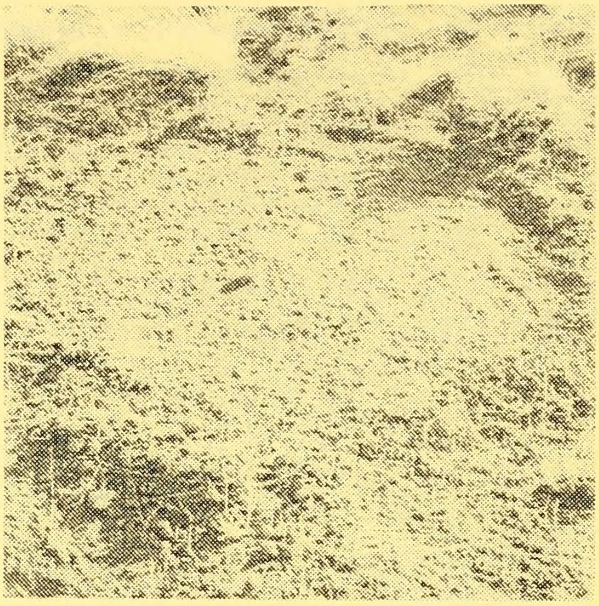
Noise generated during project construction and mining and milling operation will impact wildlife. The most common responses of animals to noise are avoidance or accommodation. Except at extreme levels, most of the more secretive and smaller animals would coexist with the noise source treating it as background noise. Other animals, expecially those which rely most on auditory cues for orientation and those using vocal communication (e.g., songbirds) will avoid the vicinity of a noise source, moving away until the noise level drops to an acceptable background level for that species. After initial avoidance of human activity and noise producing areas, some wildlife species may become acclimated to the activity and noise and begin to reinvade adjacent areas formerly avoided. Abrupt and intermittent noises (e.g., blasting) are less likely to be accommodated than are more steady, continuous noises.

Any increased sediment loads in surface waters could have an indirect effect on wildlife by reducing aquatic plants or other organisms that are utilized for food by terrestrial wildlife. Contamination of surface water may occur through leaching of toxic elements from exposed ore and waste rock. Related to contamination of surface water supply will be the presence of potentially toxic water in the tailings pond. This water will be highly alkaline and will contain toxic elements such as cyanide, arsenic, mercury, and lead. Fencing will prevent most livestock and larger terrestrial wildlife species from gaining access to the pond, but access by waterfowl, other water birds, and small mammals cannot be prevented and some losses will result.

Dust may impact local fauna since ingestion of dust-covered leaves could increase tooth wear in herbivores. Since tooth deterioration is an important contribution to death and disease in ungulate populations, the increased level of dust on range plants could be potentially detrimental to mule deer.

Evaluations of alternatives considered the full range of effects previously discussed. Loss of habitat was the prime consideration, and the mill site, tailings pond, and corridor for Alternative 1 would disturb 283 acres of alluvial sagebrush, 38 acres of mixed shrub/sagebrush, 4 acres of aspen, and 4 acres of grassland. Some mule deer winter

Nevada Department of Wildlife electro-fishing stream on the project area



Photograph of scent-visitation site which records animal tracks.

ERT botanist performing vegetation transects.

Two ERT wildlife biologists identifying small rodent trapped on project area.

range would be disturbed, and the Jerritt Canyon corridor would have a high potential for deer road kills. The corridor could also reduce mountain lion hunting territory, disturb an active Golden Eagle nest, reduce numbers of chukar through road kills and habitat loss, and degrade the Jerritt Creek canyon as a wildlife water source.

Alternative 2 would disturb 282 acres of alluvial sagebrush, 29 acres of mixed shrub/sagebrush, 2 acres of meadow, and 1 acre of rock outcrop (rocky headlands). Mule deer transitional or winter range would be disturbed and road kills could be quite high as the Northwest corridor passes through a winter concentration area. Habitat loss and road kills could also reduce numbers of chukar. These same effects would apply to Alternative 3 except that different amounts of habitat types would be disturbed. Alternative 3 would affect 206 acres of alluvial sagebrush, 94 acres of mixed shrub/sagebrush, 1 acre of meadow, 1 acre of rocky headlands, and 3 acres of grassland.

Alternative 4, located on the east side of the mountains, would affect 222 acres of alluvial sagebrush, 84 acres of mixed shrub/sagebrush, 4 acres of aspen, and 4 acres of grassland. The Rancho Grande corridor and Section 33 tailings pond will have effects on sage grouse strutting grounds since three of these areas are within a half mile of the corridor, and one historic strutting ground (not active the past two years) is in the area proposed for the tailings pond. Additionally, the corridor and tailings pond would affect a larger habitat area used by grouse for nesting and brooding. The proximity of this alternative to Foreman Creek may have minor effects on Sandhill cranes, Canada geese, other waterfowl, hunting raptors, and other wildlife associated with the riparian area of Foreman Creek. The alternative would have little or no effect on area mule deer.

The Rancho Grande corridor and Section 33 tailings pond also occur in Alternative 5, but a different corridor is used to climb into the mountains from Section 33, i.e., up the Winter's Creek drainage. This alternative would disturb 307 acres of alluvial sagebrush, 15 acres of mixed shrub/sagebrush, 6 acres of aspen, and 4 acres of grassland. The different corridor has few other effects beside the different amounts of habitat disturbed. The placement of both the mill and tailings pond in Section 33 could increase the magnitude of the effects on sage grouse that were described for Alternative 4.

Alternative 6 utilizes the North Fork Valley for site facilities and uses the Winters Creek corridor exclusively. Three hundred twenty-four acres of alluvial sagebrush would be disturbed, as would 12 acres of mixed shrub/sagebrush, 7 acres of aspen, 6 acres of dryland pasture, 3 acres of meadow, 1 acre of riparian area, and 1 acre of grassland. The mill and tailings pond would affect sage grouse nesting and brooding habitat, and the tailings pond would also cover an active strutting ground used in 1979. Disturbing a strutting ground would have direct effects on breeding success. The corridor west from Highway 51 would also disturb a strutting ground used in 1979. Sage grouse mortalities from road kills would also occur with this corridor choice. The corridor crossing of Foreman Creek would disturb wildlife that utilize the riparian areas. As the corridor climbs into the Winter's Creek drainage, it would affect mule deer summer range, and pass through an area of many diverse habitats which result from good ecotonal variations. The area has high diversity of wildlife species.

The last alternative evaluated is very similar to Alternative 6 except the mill would be located up in the mountains in the Winters Creek drainage. Alternative 7 would disturb 214 acres of alluvial sagebrush, 69 acres of mixed shrub/sagebrush, 21 acres of aspen, 4 acres of dryland pasture, 2 acres of meadow, and 1 acre of grassland. The tailings pond and corridor would disturb sage grouse strutting grounds (two) as well as nesting and brooding habitat. Sage grouse would also be subject to road kills on the corridor. The corridor crossing of Foreman Creek would disturb riparian habitat, and then higher in the Winters Creek drainage, the corridor and mill sites would disturb mule deer summer range and the very diverse wildlife habitat at the Winters Creek mill site. The mill site and support facilities site alone would disturb 60 acres of mixed shrub/sagebrush and 15 acres of aspen.

The waste rock disposal alternatives would remove areas of forage from use by wildlife, but the effect would be similar for all three alternatives, as would the effect on predators from loss of hunting area available to them. The power transmission line alternatives would have negligible effects on deer winter range, while corridor Alternative 3 passes within a half mile of three sage grouse strutting grounds. The new power poles could provide benefits to Golden eagles and other raptors and at the same time have negative effects on the sage grouse from both disturbance during construction and from raptors. The No Action Alternative would effect deer winter range, and subject both deer and chukar to increased road kills.

The construction of the project facilities would create direct effects on wildlife through direct loss of habitat, displacement of animals, and direct mortalities of smaller, less mobile forms, plus road kills. The presence of the facilities and increased human presence would have indirect effects on wildlife such as noise, dust, and activity reducing the use of adjacent habitat by sage grouse, or abandonment of nests by raptors, or reduction in the use of summer range by mule deer. The same would occur for those forms of wildlife using riparian habitat in the area of a corridor crossing. Other indirect effects of the project include increased potential for harassment and legal hunting as a result of increased numbers of people/wildlife contact.

Most of the described effects would occur over the life of the project. Short-term productivity of the wildlife resources will not suddenly be affected, rather the described effects will build and develop over time. In the case of direct loss of habitat, the situation can be largely reversed at the end of the project. Most forms of wildlife will reinvade habitat after the avoidance-causing mechanism is removed. Only in the case of sage grouse is there concern for the return of the grouse to former habitat. Some biologists feel that following disturbance of a strutting ground and adjacent brooding habitat, those specific birds are irretrievably lost because they do not migrate and they no longer reproduce, they simply live out their lives in adjacent areas.

## Vegetation

The resource value (productivity) of vegetation communities is influenced by edaphic, topographic, and climatic factors. Resource values are also influenced by biotic factors such as grazing animals and disease. Since plants are not mobile, impacts will be centered primarily on the areas that are actually disturbed.

The loss of rangeland and wildlife habitat will occur, regardless of the alternative chosen. Current vegetation resources will be removed, and will not become available again until abandonment and reclamation efforts are completed. There will be more extensive utilization of vegetation communities adjacent to the project development due to displacement of grazing and browsing animals. Displacement of livestock can be ameliorated somewhat by grazing management. Movements of big game cannot be directly managed. The degree of impacts associated with displacement will depend upon how critical the development area is to the animal group involved.

The removal of vegetation cover will increase the risk of soil erosion. Unchecked erosion can damage vegetation communities downslope and down drainage due to siltation, mechanical injury, and bank caving. Erosion of streambanks can also occur rapidly during spring runoff. Off-road traffic may damage or kill plants, and initiate erosion, especially on steep slopes. As the human population increases in the project area, there is an increased risk of indiscriminate off-road traffic.

Increased human activity in the project area increases the risk of accidental fires. Fires can spread effectively in sagebrush-grass communities, especially if there is a dense cheatgrass understory. Fires can eliminate desirable species like bitterbrush, and permit the invasion of undesirable species of annual weeds and rubber rabbitbrush. Project components may also affect populations of proposed threatened or endangered plant species. The extent of these impacts will depend on the distribution of the plant species as a whole, and the number of populations occurring throughout the project area.

There is a risk of local damage to vegetation due to accidental spills of chlorine and sodium cyanide used in the milling process. These spills could occur along access roads to the mill, or accidental discharges of tailings material from a pipeline between the mill and tailings pond, or from the tailings pond itself. Some sulfur dioxide will also be released during the milling process. This emission is expected to be very low, and will meet state and federal standards for this substance, but over the life of the project may have some low-grade effects on vegetation near the mill. Deposition of dust along haul and access roads may result in a loss of vigor of roadside plants because photosynthesis is reduced as a result of lessened light availability.

Losses of vegetation from disturbance during construction and operation are restricted solely to facility sites and corridors. Table 5-2 presents number of acres and amount of vegetation production that would be affected by the seven project alternatives. Table 5-3 presents a relative evaluation of the more general effects that could occur to vegetation but which are difficult to quantify. The table only ranks effects as low, moderate or high.

The loss of vegetation is a direct and unavoidable effect of implementing this project. The increased potentials for fire, weed invasion, off-road vehicles, and dust are indirect effects of the project, but they would have direct effects on the vegetation if they occurred. Cumulative effects of the project will also include the current grazing allotments on the forest because grazing will continue as a use of the lands during the life of the project. The bulk of the direct effects on vegetation will occur in the short term, essentially the construction period. The indirect effects plus grazing will continue over the life of the project. The loss of existing vegetation and its productivity is an irretrievable loss, but all effects on vegetation are reversible to a great extent following abandonment and reclamation.

## Rangeland and Livestock Management

The magnitude of effects on grazing resources is dominated by the choice of a tailings pond location, while the corridor chosen will have the greatest effect on management of livestock grazing. To determine the number of AUMs lost by a particular alternative, the quantity and quality of forage lost must be evaluated together. The results of this evaluation are shown in Table 5-3. The effect that corridors have on managing livestock grazing results from the situation where a corridor may split up an allotment and serve as a barrier keeping cattle from utilizing the entire allotment. A corridor through an allotment would also subject the cattle to increased road kills because fencing the corridor is not feasible because it would create a barrier to movement. Additionally, some of the project area has adjacent cattle and sheep allotments, thus requiring different management procedures.

Alternative 1 has a corridor through Jerritt Canyon that is in the middle of a cattle allotment. The Northwest corridor in Alternatives 2 and 3 will affect both cattle and sheep allotments. The Rancho Grande-California Creek corridor in Alternative 4 splits a cattle allotment, plus the Section 33 tailings site is one of the more productive sites on the project area. Alternative 5 also uses the Section 33 site, plus the corridor goes through the Winters Creek drainage which is also very productive. Alternatives 6 and 7 also utilize areas of the Winters Creek drainage, but the rest of the corridors and facility sites are in less productive areas. If the Sheep Creek corridor were to be used in either Alternative 4 or 5, it would split a cattle allotment used by the Saval Ranch.

Alternatives 1 and 4 would restrict access by livestock to established water sources. Alternative 1 locates the corridor in the steep,

## TABLE 5-2
**Effects on Vegetation by Jerritt Canyon Project Alternatives**

| EFFECTS | ALTERNATIVES 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Total Area Disturbed (acres) | 272 | 257 | 247 | 257 | 275 | 267 | 255 |
| Acres Disturbed of: | | | | | | | |
| Alluvial sagebrush | 226 | 225 | 206 | 222 | 250 | 237 | 214 |
| Upland sagebrush | 29 | 22 | 33 | 27 | 15 | 8 | 26 |
| Mixed shrub | 9 | 7 | 4 | 0 | 0 | 4 | 2 |
| Aspen | 4 | 0 | | 4 | 6 | 7 | 5 |
| Grassland | 4 | 0 | 2 | 4 | 4 | 1 | 1 |
| Meadow | 0 | 2 | 1 | 0 | 0 | 3 | 2 |
| Rock outcrop | 0 | 1 | 1 | 0 | 0 | | |
| Dryland pasture | 0 | 0 | 0 | 0 | 0 | 6 | 4 |
| Riparian | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Estimated Total Production of Affected Area (1000 pounds) | 272.7 | 198.7 | 183.0 | 112.8 | 116.1 | 117.3 | 111.0 |
| Estimated Production of Desirable Species on Affected Area (1000 pounds) | 113.2 | 16.7 | 19.8 | 63.0 | 60.7 | 50.0 | 43.9 |
| Average Productivity (Pounds/Acre) | 1002 | 773 | 741 | 439 | 422 | 439 | 435 |
| Estimated AUMs Lost By Level of Productivity | 100 | 23 | 28 | 89 | 84 | 70 | 61 |

**SOURCE: ENVIRONMENTAL RESEARCH & TECHNOLOGY, INC.**

## TABLE 5-3
**Effects Evaluation on Vegetation**

| | | FIRE | WEED INVASION | OFF ROAD DISTURBANCE | WILDLIFE, LIVESTOCK DISPLACEMENT |
|---|---|---|---|---|---|
| **Alternative 1** | **Mill** | L | M | L | M |
| | **Corridor** | M | H | H | H |
| | **Tailings** | L | M | L | M |
| **Alternative 2** | **Mill** | L | H | L | L |
| | **Corridor** | M | H | H | M |
| | **Tailings** | L | H | L | L |
| **Alternative 3** | **Mill** | L | H | M | M |
| | **Corridor** | M | H | H | M |
| | **Tailings** | L | H | L | L |
| **Alternative 4** | **Mill** | L | L | M | M |
| | **Corridor** | L | H | H | M |
| | **Tailings** | L | L | L | L |
| **Alternative 5** | **Mill** | L | L | L | L |
| | **Corridor** | L | H | H | M |
| | **Tailings** | L | L | L | L |
| **Alternative 6** | **Mill** | L | M | L | L |
| | **Corridor** | M | M | M | M |
| | **Tailings** | L | L | L | L |
| **Alternative 7** | **Mill** | M | M | L | M |
| | **Corridor** | M | M | H | M |
| | **Tailings** | L | M | L | L |

**EXPLANATION:** L = low, M = moderate, H = high

| **Fire** | **Weed Invasion** | **Off Road Disturbance** | **Displacement** |
|---|---|---|---|
| High: Ground Cover >60% | High: Least Desirable Species >40% of Dry Weight Composition | High: Adjacent slopes >25% | High: Area Critical Winter Range or Utilized Year Round |
| Moderate: Ground Cover 30-59% | Moderate: Least Desirable Species 20-39% by Weight Composition | Moderate: Adjacent slopes 10-25% | Moderate: Primarily Spring or Summer Range, Moderate to High Quality Forage |
| Low: Ground Cover 0-29% | Low: Least Desirable Species 0-19% of Composition | Low: Adjacent slopes <10% | Low: Lightly Utilized, Inaccessible or Low Quality |

**SOURCE: ENVIRONMENTAL RESEARCH & TECHNOLOGY, INC.**

confined canyons of Jerritt Canyon where cattle could be easily disturbed by the corridor. Alternative 4 has the corridor crossing the side of California Mountain where it could serve as a barrier to cattle movement. The corridor in Winters Creek in Alternative 6 also splits an allotment in a very productive area.

All of the waste rock disposal alternatives would affect a combination cattle/sheep allotment and remove some grazing areas from production. All three alternatives would essentially have the same effects on grazing resources. The power transmission line corridors are not expected to have any effect on grazing resources. The No Action Alternative would affect both cattle and sheep allotments with the corridor and mining activity. Some livestock displacement could still occur under this alternative and from three to six AUMs might be lost.

## Soils

The majority of the effects of the project on the soil resources will occur during project construction. With the exception of development of the open-pit mine and waste rock disposal, some 500 to 600 acres of land will be disturbed during a one to three year period.

A total of approximately 400 acres of open-pit would be excavated during a 10 year period with waste rock overburden occupying about 150 acres adjacent to the pits. These are considered operational effects on the soil resources. Site reclamation activities, with the exception of road stabilization and revegetating soil stockpiles, would not be undertaken until after closure of the mine.

About 200 to 250 acres of land will be disturbed in construction of access and haul roads and utility line placement. The major effects on the soil resources from abandonment of the project relate to the curtailment of road maintenance and drainage culvert maintenance. Inadequate or suspended maintenance could cause increases in soil erosion and sedimentation as the road banks slough and culverts become clogged with debris.

The effects on soils are relatively equivalent among alternatives with only minor variations. Variation will occur depending on steepness of slopes, and amounts of soil that are available for stockpiling in a specific construction site. All the soils in the study area are considered to be well drained. Surface soil textures vary somewhat, but most are gravelly loams. Area soils are also quite similar in percentage of coarse fragments. Depths of soils are highly variable from 20 to 60 inches.

Alternative 1 would affect soils significantly by the extensive amount of cut and fill construction necessary for the Jerritt Canyon corridor. The steepness of slopes in the Jerritt Canyon drainage serves to classify the soils as non-agricultural and with limited rangeland capacity. Even though the slopes are steep, the erosion hazard is only moderate to high because of well aggregated soil structure and the abundance of surface protective coarse fragments. The mill site and tailings pond site at Wright Ranch have deep gravelly loam soils that are considered good for irrigated agriculture and would experience significant impacts if facilities were constructed there. The erosion hazard of Wright Ranch soils is moderate to low.

The mill and tailings pond site at Ellison Ranch in Alternative 2, have similar soils properties as the Wright Ranch but have better drainage capabilities. The Northwest corridor however, would require longer corridor length than Alternative 1, and is located in steep upland topography. The corridor is located in areas underlain by stable land forms and competent bedrock. Slope stability is better than the Jerritt Canyon corridor, and the soil erosion hazard is rated moderate to high. Effects on soils would be less than Alternative 1 because less cut and fill construction would be required.

Corridor effects on soils in Alternative 3 would be only slightly greater than Alternative 2 because a tailings pipeline would be included in the corridor. Soil effects would be the same for the Ellison Ranch tailings pond. Effects on soils at mill site B would be major because the soil stability is very good. The area has slopes of 0 to 10 percent, over 60 inches of gravelly loam soils, and an erosion hazard of moderate to moderately low. These same characteristics however, would create an environment that would be very favorable for reclamation.

Alternative 4 also locates the mill at site B. The Rancho Grande-California Creek corridor would have major effects on soils because the upper portion of the corridor traverses areas of potentially erosive and unstable colluvium and bedrock slopes derived from fractured, thinly bedded, carbonaceous limestone. The lower portion of the corridor crosses stable, terrace rangeland soils with a slight to moderate soil erosion hazard. The same conditions are found at the Section 33 tailings pond site as along the Rancho Grande corridor. These soils are rated as fair to poor for range capability. Secondary Corridor "B" would be included in this alternative and it crosses stable fans and terraces which have slight to moderate soil erosion hazards.

Alternative 5 would have the same minor effects on soils as described above for the Rancho Grande portion of the corridor and Section 33. Where the upper portion of the corridor enters the Winters Creek drainage, the soil erosion hazard is considered moderate, largely because slopes range from 0 to 20 percent so the effects on soils would be minor. If the Sheep Creek corridor were chosen for either Alternative 4 or 5, effects on soils would be major. The upper portions of the Sheep Creek corridor have steep slopes and would require extensive cut and fill construction causing significant erosion even though the soil erosion hazard is moderate. The lower portion of the Sheep Creek corridor has soils with fair to poor forage productivity and a moderate to moderately low erosion hazard.

Soil effects from Alternative 6 would be minor. The North Fork mill and tailings pond site have gravelly clay loam soils with fair to poor range productivity with an erosion hazard of moderate to low, largely because coarse fragments in the soils range from 20 to 60 percent. Some soils in the North Fork site are considered to be excessively drained. The Winters Creek corridor in its upper portion has a moderate soil erosion hazard but should have only minor effects on soils because much of the route is on fairly level, stable terraces, with a short portion of the corridor on stable upland formations.

Alternative 7 has effects on soils most similar to Alternative 6. The Winters Creek mill site has gravelly clay soils which are of somewhat higher quality because of their higher organic matter content. The Winters Creek corridor will disturb a larger amount of soils because of the tailings pipeline than the same corridor in Alternative 6.

Soil erosion from the various waste rock disposal alternatives will be determined by the size and the amount of fine particles present. Since the same material sizing will be present for all sites, the alternative with the smallest surface area offers more protection from erosion. The final topography might affect stability of the disposal area, but good engineering practice requires that a safety factor be included in all designs. The potential for reclamation of the surface of the site was felt to be important, and the acreages ranged from 43 to 86. Other effects on soil resources from waste rock were considered similar for all alternatives.

Power transmission line Alternative 1 was considered to have significant effects on soils because of steeper topography to be traversed with more difficult construction than Alternatives 2 or 3. The No Action Alternative would disturb approximately 150 acres of soils, and most soil erosion hazards are rated moderate to high.

Construction of any of these alternatives would cause direct effects on the soil resources by moving them, as in cut and fill road construction, or by stockpiling soils. Any increased erosion through the life of the project would also be a direct effect. Cumulative effects on soils must also include off-road vehicle use on BLM and National Forest lands, and continued cattle grazing. The disturbance of soils is an unavoidable consequence of this project. The stockpiling of portions of the disturbed soils will mean the effects are generally reversible. Some soil disturbance however, will irretrievably alter the soil resources in certain areas.

**Minerals and Geology**

The project will generate geology-related impacts in that existing in-place materials will be excavated, modified and relocated. The gold content of the ore bodies will be extracted and tailings will be permanently relocated. Additionally, topography along access and haul roads will be altered. The majority of disturbed areas will not be returned to their precise original condition following mining activities.

The total area to be cut or filled represents a very small percentage of the total claim block area, even assuming the optimistic future mining plans described in Appendix C, Proposed Action. Moreover, project related topographic alterations are not anticipated to result in post-mining configurations incongruous with the canyon and ridge topography of the range.

Access and/or haul roads between existing paved roads and proposed and possible future mining areas would cross active seismic zones. Direct displacement of foundation material by faulting would be of major concern in the case of tailings pond or mill structures; and of relatively minor importance to roadways. Site-specific geotechnical investigations indicate that active faults are not present below proposed mill/tailings sites. Embankment design with respect to seismic loading will be subject to regulations of the Nevada Division of Water Resources and anticipated regulations of the U.S. Department of Labor, Mine Safety and Health Administration.

Long term slope stabilities in the immediate vicinity of roads and other excavations may be affected by the project in the form of localized change in the rate of natural physical weathering processes. Disturbed talus slopes and cuts will eventually stablize at a slightly flatter slope angle than when constructed. Large-scale blasting operations associated with removal of overburden and ore will induce local ground disturbance, but not to the degree of causing risk to structures currently in-place. Some accelerated talus slope movement in slopes with threshold stability may be expected in the immediate vicinity of the mine due to blasting vibrations. Such slopes should reach a "blast stable" condition after several detonations and undergo no further movement of significance. Field reconnaissance did not indicate the presence of slopes where extensive slope failure from this cause would endanger existing or planned structures.

Alternative 1 will have moderate geological effects. The Jerritt Canyon corridor will disturb the toes of some talus slopes and perhaps accelerate natural slippage rates in the area of disturbance. Greater amounts of earth materials would be moved than in other corridors. The Wright Ranch tailings disposal site would require relatively small volumes of earthwork, unless natural clay lining materials have to be brought in to assure an impermeable lining.

The Northwest corridor, in Alternative 2, will also disturb some talus slopes, but less than in Alternative 1. The Ellison Ranch tailings disposal site may require the largest amount of earthwork of all tailings sites because of the flat topography and permeable nature of the sub-soils.

Alternative 3 would have no other geological effects beyond those described for the Northwest corridor and Ellison Ranch tailings site.

In Alternative 4, the Rancho Grande-California Creek corridor would cross zones on the north side of California Mountain that show evidence of past landslides. This could necessitate greater care in roadbed design and drainage structures. This corridor will also require the greatest length of new road construction. If the Sheep Creek corridor is chosen for this alternative or Alternative 5, it may cross perennial wet areas which are fed by springs. Road construction in these areas would require more extensive drainage and subgrade preparation to ensure long term stability. The construction of Secondary Corridor "B" will encounter heavy cobble-boulder colluvium, thus requiring somewhat more construction effort than other corridors. The Section 33 tailings pond site would not require any lining materials to be brought in.

Alternative 5 will not have any geological effects significantly different from those described for Alternative 4. Alternative 5 avoids crossing the north face of California Mountain, but effects from constructing secondary corridor "B" will be the same. Construction of the higher portion of the Winters Creek haul road will experience slightly more difficult conditions because of jasperoid bedrock and more variable topography.

Alternative 6 will require the Winters Creek corridor to cross wet bottomlands near Foreman Creek, thus requiring additional fill and drainage preparations during road construction. The North Fork tailings pond site would require only small volumes of earth work.

Alternative 7 has the most difficult location for a mill. The Winters Creek mill site would require significantly greater blasting and earthmoving than other options due to the presence of very hard jasperoid bedrock and rough topography.

Geological effects from waste rock disposal were considered negligible for all three alternatives. The stability of the waste rock areas will be insured by prudent engineering which must include safety factors for such construction of disposal areas. The power transmission line corridors would not have any effects on geology. The No Action Alternative would still remove gold ore from the open pit mine, although recovery of the gold would be at a lower rate because of the lower efficiency of heap leaching rather than a processing mill. Some talus slopes would be disturbed by the corridor for the No Action Alternative.

Geological effects would be both direct and indirect. Removal and disturbance of volumes of earth will directly affect geological materials. If disturbing talus slopes serves to increase natural slippage rates over time, this would be an indirect effect. The construction earth-moving and development of the open pits is unavoidable. Most of the effects will occur in the short-term of construction. Development of the open pits will occur over the long term, as will blasting and the potential for blast-induced earth movements. The major effects described are irreversible. Some of the earthmoving will cause irretrievable losses of some earth materials.

The project will extract gold from the mined rock. Several other minerals occur in the same ore, including antimony, barium, and mercury. Exploratory analyses indicate none of these resources represent an economically viable ore worth developing. Mercury exists in marginal concentrations and could possibly be recovered in the future depending on the economics of the mercury market.

## Socioeconomics

Evaluation of socioeconomic effects of the project centered on the City of Elko, then on the rest of Elko County, particularly the Independence Valley, Mountain City, and the Duck Valley Indian Reservation. Effects of the project will occur in population, employment, housing, and community facilities.

By 1990, the proposed action is expected to create 391 permanent job opportunities in the county, approximately a 5 percent increase in jobs. Of these, 170 will be directly related to the proposed action; another 221 service-sector jobs will be created in order to provide goods and services to the applicant, its employees, and their families. In addition, between April 1980 and July 1981, there will be an average of 165 short-term construction related employment opportunities in the county, with a peak of 380 workers for a short period in 1981.

It is estimated that approximately 40 percent of the 391 employment opportunities that will be created by the proposed action will be filled through in-migration. Using a multiplier of 3.3 to determine the total population increase that will be associated with immigration, it is estimated that approximately 500 persons will enter the county as a result of the proposed action by 1990, approximately a 3 percent increase in population.

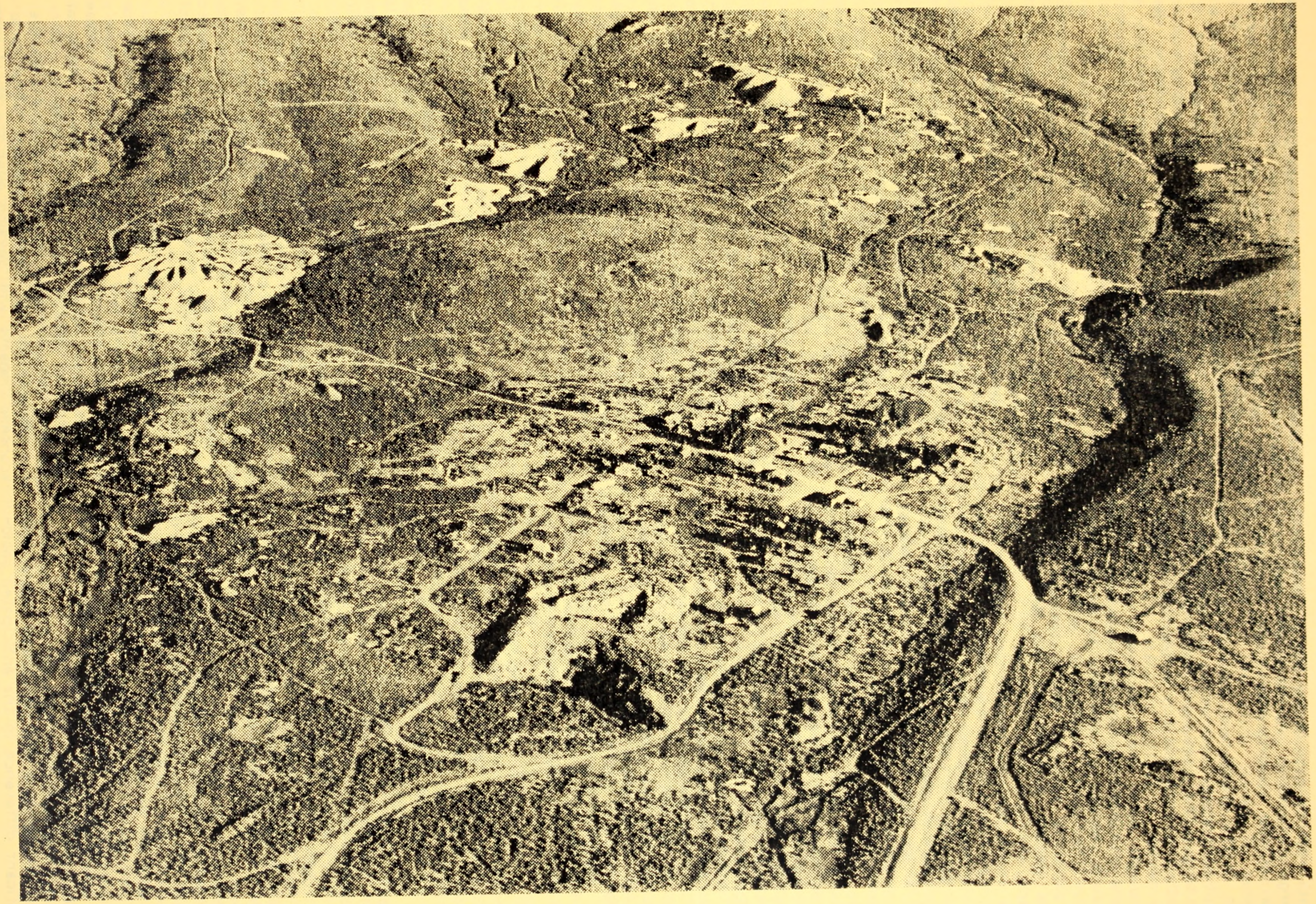
The proposed action will accelerate diversification of the economy making the mining industrial sector the county's third most important sector in terms of employment and income generation. The proposed action will strengthen the county trade and service industries, because of increased demand for goods and services by people migrating into the county to fill newly created jobs. In addition, approximately $920,000 in tax proceeds will be available to the state and county. Elko County will receive a total of $820,000: $680,000 from proceeds tax, $100,000 property tax, and $40,000 from sales tax, approximately a 45 percent increase in these tax revenues.

The proposed action will result in a need for additional housing in Elko County. The demand for housing will peak in 1981 when the construction work force reaches its maximum size. Forty-one new housing units are estimated to be needed at that time. Because the construction force is short-term and temporary, rental units and mobile homes are expected to be the types of housing most in demand. The permanent work force is estimated to create a demand for approximately 41 additional units by 1990 in Elko County and 152 additional units in the City of Elko. This is approximately a 2½ percent increase in housing units. Single family and mobile homes are the types of housing that will be in greatest demand for permanent workers.

The vast majority of the people associated with the population increase are expected to reside cent of the construction work force and 85 percent of the permanent workers will reside in the city. This represents a permanent population increase of 440 persons by 1990.

The population increase alone will not significantly alter the city's economic base; however, the proposed action will give impetus to the city's economic growth. The applicant has stated that about $4 million in annual purchases will be directed towards local businesses provided quality, price, and availability are competitive. In addition, the growth in the city's population will stimulate retail sales and services. Finally, more mining-related employment in the city will help to broaden the local economic base.

The most serious of existing infrastructure problems will be the continued housing shortage. At the present time, there is a very low (less than



Aerial view of historic mining community of Tuscarora on west side of Independence Valley.

3 percent) vacancy rate in the city. Consequently, a large increase in population will require an expansion of the housing stock. An increase in the number of rental units will be particularly important in the short term because of the large number of temporary construction workers who will need housing. The permanent workers, however, are expected to prefer to buy single family houses or mobile homes.

Although both the water and wastewater system are at capacity, plans have been developed and funding secured by the city to expand both systems. The fire department will probably require additional staffing, and a planned station near the airport will add to the department's capabilities.

The city's schools, health care services and facilities, and solid waste collection and disposal system will have adequate capacity to meet the projected demands for population levels associated with both normal growth plus the effects of the proposed action (see Table 2-9). Some increases in noise levels and dust may occur as a result of a larger population.

While some alienation may occur between construction workers and long-time residents during the construction phase, these effects will be temporary. It is anticipated that the permanent project-related population will be absorbed into the existing community with little effect on traditional social value systems.

The effects of population growth are generally not expected to be significant in rural Elko County. Only 15 percent of the permanent work force and 30 percent of the construction workers are projected to live outside the City of Elko. Provision of an adequate housing supply, especially rental units, will probably be the largest problem. Many of the construction workers are expected to commute to the work site on a weekly basis, living in their own mobile homes, or campers.

The county areas most directly affected by the proposed action include the Independence Valley, Mountain City, and the Duck Valley Indian Reservation. Most of the demand for new housing units outside of Elko will occur in Independence Valley and Mountain City, primarily for mobile homes. Any large-scale development in the Independence Valley would cause problems in the supply of facilities and services; however, only minimal development, if any, is expected. In Mountain City, rental housing is available in the form of motels, in addition to sites which are available for mobile homes. Other facilities and services are adequate, assuming a minimal level of development. Development of the existing platted mobile home park could help meet the projected housing demand, particularly during construction, and provide a significant stimulus to the local economy as well. The Duck Valley Indian Reservation has a wide range of public facilities and services, and the proposed action is not expected to affect the reservation's infrastructure capacity. The proposed action may, however, have some beneficial effect on the current high unemployment rate on the reservation.

Because socioeconomic impacts are primarily based upon employment and population levels, the only significant difference in the anticipated socioeconomic impacts associated with the various alternatives is related to the use of western access versus eastern access to the site. Alternatives 1, 2 and 3 would require access from Highway 11 in the Independence Valley. Alternatives 4, 5, 6 and 7 would require access from Highway 51 in the North Fork Valley. Selection of a western access route from Highway 11 via the Independence Valley would result in a greater concentration of employees and related population in Elko, with corresponding reductions in impacts on Mountain City, the Duck Valley Indian Reservation, and other unincorporated areas of Elko County. The western route would stimulate some population increase in Tuscarora and the remainder of the Independence Valley, but this increase would be slight because of the limited facilities and services available.

The eastern route provides more direct access to Mountain City, the Indian reservation, and other points along Highway 51, which essentially lie beyond normal driving range from the Independence Valley area. Although Highway 11 does extend north from the project area and eventually joins Highway 51 at Owyhee, the road is unpaved over part of its length and is not an all-weather road.

Energy costs to the applicant and employees are also affected by the choice of an eastern or western access route. Access to the mine and mill from Highway 51 would be approximately ten miles closer to Elko than would access in the Independence Valley. Over the life of the project, that represents significant savings in fuel used by employees, by the company, and by suppliers who will freight supplies to the mine and mill.

The economic criteria was considered the most significant in evaluating waste rock disposal alternatives. Costs varied depending on hauling distances and storage volumes in close proximity to the open pit. Construction costs were also significant for the power distribution line corridor. Corridor Alternatives 1 and 2 were quite similar in costs, while Alternative 3 had a cost advantage because of its shorter length. A "no action" sized gold mine could be expected to create approximately 12 new jobs and create a total population increase of perhaps 40 people in Elko County. Tax receipts to the county and City of Elko would be approximately $30,000 annually. The city infrastructure and current housing supply could accommodate the population increase with only minor effects.

The employment and population increases will be direct effects of the project, as are the tax payments that will be paid to various authorities. Increases in the trade and service industries, effects on schools, law enforcement and community facilities will be indirect effects. Increased demand for housing is also an indirect effect of the project.

The impacts described represent the cumulative impacts because they will build over a time period of one to two years, then remain relatively stable. The direct effects of population increase and tax base increase are unavoidable. Many of the indirect effects can be mitigated by prior planning of both agencies and individuals so that the impacts do not become serious. The socioeconomic impacts will develop over the short term and remain as a constant over the life of the project. Following the life of the project, some of the effects (such as population increase, housing demand and expanded tax base) will be reversible to some degree. Conditions will not revert to those of 1980 because of other non-project-related growth during the same period. This project will cause an irretrievable commitment of resources to expand city and county facilities to meet housing and community infrastructure expansions.

### Air Resources

The mine site is located in Air Quality Control Region (AQCR) 147, Basin 36, Independence Valley. The project site is described as remote, and the surrounding area is devoid of other industrial development. As a result, the air quality modeling study considered only emissions from the Jerritt Canyon Project sources. Any effects on air resources would result from operation of the mine, mill, corridors and tailings pond. These effects are considered to be of a similar magnitude for all alternatives.

Emissions of sulfur dioxide ($SO_2$) from the mill point sources were estimated to be 230 tons per year (52.7 pounds per hour maximum short-term emission rate), and emissions of total suspended particulates (TSP) from the industrial process sources were estimated to be 28.9 tons per year (8.2 pounds per hour maximum 24-hour rate). Meteorological characterization for the modeling study was taken from on-site measurements in as far as data were available, but for long-term annual average concentrations, meteorological records from the National Weather Service station at Elko were used. Annual-average and maximum 24-hour concentrations of $SO_2$ and TSP were calculated as well as maximum 3-hour concentrations of $SO_2$. These were compared to the applicable National and State Ambient Air Quality Standards.

Modeling was performed for a representative mill site in the North Fork Valley. The predicted results indicate that the $SO_2$ effects for the mine emissions are minimal. The highest annual concentration is 0.0006 ppm. All receptors beyond 2,190 yards are expected to experience annual concentrations of less than 0.0002 ppm.

The highest 24-hour average concentrations calculated for $SO_2$ resulted from worst-case meteorological assumptions of 12 hours of persistence of east winds under neutral conditions with winds averaging 5.75 miles/hour, followed by winds from other directions. A discussion of meteorological conditions considered is presented in the Air Resources Technical Report. The maximum calculated value was 0.0077 ppm. This represents 6% of the Federal 24-hour standard and 8% of the Nevada standard. The maximum value calculated for 3-hour concentrations resulted from conditions of east-northeasterly winds with a speed of 5.75 miles/hour and stable conditions. Under these conditions, a concentration of 0.055 ppm was calculated at a point 1,100 yards east of the mill site. This prediction represents 12% of the state and Federal 3-hour standards. These predicted results are considerably below the appropriate standards. The maximum predicted concentrations also occur close to the proposed mill. This indicates that the effects of $SO_2$ emissions on local ambient air quality will be extremely localized and small.

Annual modeling was also done for TSP. The highest value calculated at any receptor was 0.9 $\mu g/m^3$ at a point 550 yards east-northeast of the mill site. This predicted concentration is 1% of the Federal secondary standard and 2% of the Nevada standard. The impacts are very localized, affecting a small area to the north and east of the mill site. The concentration predicted at each receptor decreases to below 0.1 $\mu g/m^3$ beyond 2,190 yards downwind of the mill.

The highest 24-hour average concentration calculated for TSP resulted from the same worst-case meteorological assumptions of the $SO_2$ modeling. The largest calculated value was 13 $\mu g/m^3$ occurring 550 yards east of the mill site. The predicted impact represents 9% of the standard. It is an extremely localized impact, occurring within 550 yards of the mill and decreasing further downwind. The main emission source which contributes to the predicted TSP concentrations is the coal stockpile.

One detrimental impact of increased amounts of suspended particulate matter, depending on particle size, may be visibility degradation. Visibility can be defined in terms of the distance in which a certain amount of contrast is discernible, usually with respect to a dark object against the horizon. Visibility degradation is caused by airborne particles absorbing and scattering light, usually by particles which range between 0.1 µm to 1 µm in diameter. Mining does not produce significant amounts of particles in this size range. The size distribution of particles generated by mining was described in Appendix D of the report "Survey of Fugitive Dust from Coal Mines", EPA document 908/I-78-003, February 1978. The particles in this size range are generally secondary aerosols such as sulfates and nitrates, and constitute a very small portion of the mass of TSP. The size distribution of the particles based upon other mining studies indicates that very little visibility degradation will occur. The area of maximum TSP impact is close to the crusher (550 yards) and will be the area of the greatest visibility degradation.

It can be concluded, that within the accuracy of the model calculations, the Jerritt Canyon Project will not cause ambient pollutant levels in excess of Federal and state ambient air quality standards. The operation of the mine and mill is not expected to degrade visibility beyond a very short distance from the mill, and will not have any effect when viewed from the Jarbidge Wilderness Area east of the project.

The only variation in effects on air resources that could occur from the different alternatives would be different amounts of TSP generated by different lengths of haul roads. Since haul roads are to be watered to mitigate the generation of TSP, evaluations of this effect by each alternative were not made. Evaluations of the Jerritt Creek corridor and the Winters Creek corridor rated them slightly more conducive to TSP generation than the other three corridors, primarily because of their length and the amount of cut and fill construction required.

Secondary effects of the proposed action on air resources will be confined to emissions from increased vehicular traffic. An estimated increase in vehicular traffic within Elko County for 2,500,000 miles per year will result in approximately 70 tons per year of carbon monoxide emissions, 11 tons per year of nitrogen oxides emissions and 13 tons per year of hydrocarbon emissions. These emissions, distributed over the 7190 miles of county road will not result in measureable increases in the ambient concentration of these pollutants. Calculated concentration from these emissions are considerably less than $0.1 \mu g/m^3$.

If Freeport Gold Company decides to generate their own electrical power on-site with diesel generators, then the immediate area would experience emissions of sulfur dioxide, oxides of nitrogen, unburned hydrocarbons and other products from the diesel engines. It is estimated these emissions would not violate the National Ambient Air Quality Standards.

The waste rock disposal alternatives would affect air resources with emissions from the diesel powered haul trucks, but all three alternatives would be essentially similar. The power transmission line alternatives would not have any effect on air resources following the construction period. The No Action Alternative would generate TSP emissions from the corridor and mill site, but at a lower level than would the proposed mill and mine. The levels of TSP generated during construction would be in compliance with a Nevada Air Quality permit.

**Noise**

There are no specific quantitative governmental regulations applying to community noise levels due to this project. Noise sensitive receptors (ranch houses) are generally located at considerable distances from the mine and mill construction sites, which represent the major construction activity points. For some of the alternatives, the corridor-ranch separation distances are on the order of several thousand feet. Corridor construction at any given point along the road is anticipated to be of relatively short duration. The noise impacts associated with corridor construction for Alternatives 1, 4 and 5 would be limited to brief periods during several days, in which people outside such ranches may experience some degree of annoyance. Construction at the mill sites for Alternatives 1 and 5 would not produce appreciable outdoor annoyance, but might cause some degree of annoyance associated with the change from a very quiet environment to moderately quiet conditions. Wildlife will also be affected by construction activities, including noise.

Long-term operational centers of noise emission will exist at three general locations: 1) mine, 2) haul roads, and 3) mill. An additional source of noise will be rock blasting twice a day at the mine. Large off-road diesel electric haul trucks will constitute a major noise source. The mining locations are in steep mountainous areas with few, if any, direct line-of-sight paths to human receptor areas. At distances beyond 7000 feet, noise measured at existing mines was below the 30 dBA background noise level. On this basis of distance and no direct lines-of-sight it is concluded that blasting and truck noise at the mine sites will produce little or no impact on sensitive land uses.

Noise levels at those ranches located closest to the haul road corridors (Alternatives 1, 4, and 5) will be exposed to periodic changes in noise levels associated with the passage of haulage trucks. Noise levels will be similar to those of the road construction (about 50 dBA). The annoyance effect on the residents is potentially greater, however, due to the long term nature of haul road traffic.

Mill noise levels due to the ore grinding and other operations will occur on a continuous 24-hour per day basis. For the nearest identified receptor, the mill noise level is estimated to be 52 dBA. This estimate also assumes direct line of sight propagation which would not be the case for this project, therefore, actual noise levels should be lower. Mill related noise would potentially have some effect on ranch residents for Alternatives 1 and 5. The noise exposure would consist of a relatively steady low frequency noise at approximately 50 dBA. The change in noise level with respect to the existing background levels of 20 to 30 dBA will be noticeable for some distance.

There will not be any noise effects from the power transmission line alternatives following construction. All activities at the waste rock disposal alternative sites will contribute to the general noise level of activity at the mine but there are essentially no differences among alternatives. Noise levels would be much lower for the No Action Alternative than the proposed mine/mill, however the mining, haul trucks and ore blasting would still be sources of noise.

The above described noise effects will be direct effects from the project, and also represent the cumulative noise effects for the area because no other noise sources are expected in the area. The effects of noise are also unavoidable if the project is implemented. The noise effects will begin when construction begins, and will continue for the life of the project.

## Sources of Information

Information used in developing the environmental effects described in this chapter derived from numerous sources including the following:

USDA, Forest Service, published and unpublished data.

Nevada Department of Wildlife, published and unpublished data.

BLM, published and unpublished data.

City and County agency data and interviews with individuals of Elko, Nevada.

Nevada Department of State Planning data.

On-site studies in recreation, visual quality, cultural resources, ground water, aquatic biology, wildlife, vegetation, soils and overburden, geology, mineral resources and noise, and socioeconomics.

On-site monitoring programs for surface hydrology, water quality, meteorology and air quality.

Freeport Gold Company technical and engineering designs and plans.

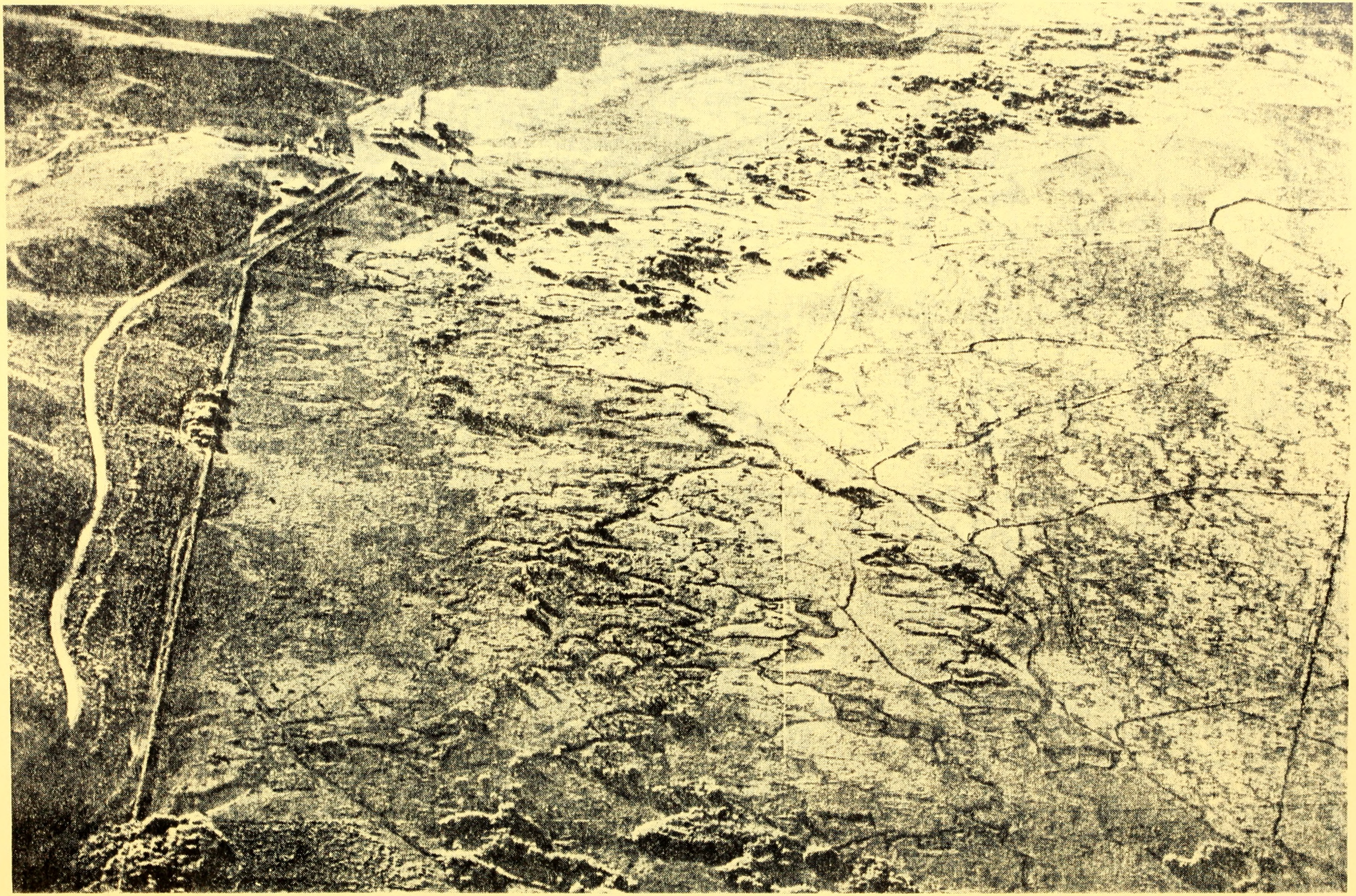
Freeport Exploration and FMC Corporation exploration data on geology.

Technical reports prepared by ERT for each discipline area covering the 1978-79 baseline period.

Interdisciplinary environmental project team meeting in Elko, Nevada on September 19 to 22, 1979.

Cumulative years of experience in impact assessment by ERT scientists.

View of Winters Creek drainage looking west up into Independence Mountains



View of Foreman Creek looking east at the Rancho Grande complex. Nevada Highway 51 is at the extreme upper portion of the photograph.

# 6. EVALUATION OF ALTERNATIVES

## Introduction

Following the definition of the effects of implementation in the previous chapter, the interdisciplinary team compared each alternative against all the other alternatives according to the evaluation criteria. The objectives were to identify the most significant consequences (adverse and beneficial) of each alternative, if that alternative were implemented. By questioning "what if the alternative were implemented," then the mass of environmental, socioeconomic, and cost data could be distilled down to identify major, moderate, and minor effects, unique concerns, and project costs. This process identified features or effects that should be defined as fatal flaws, i.e., any element that made the alternative infeasible when compared to the other alternatives. Table 6-1 presents the evaluation of alternatives and the evaluation criteria. By reading the table vertically one can see the significance of the effects of each criteria. By reading the table horizontally one can compare the effects of each alternative against other alternatives.

## Evaluation of Mill-Corridor-Tailings Disposal Alternatives

Of the numerous evaluation criteria, six were considered to be key, in that major adverse effects in these criteria areas were weighted much heavier than other criteria. The key criteria were those representing the most significant issues and concerns raised by the public and governmental agencies. These six criteria were: 1) effects on the management of livestock grazing on the area, 2) effects on deer winter range, 3) effects on sage grouse, 4) effects on Lahontan cutthroat trout, 5) effects on soil erosion, and 6) effects on surface water quality, primarily because of sedimentation. These criteria were the ones in which major fatal flaws could determine an entire option or alternative to be infeasible. After an alternative was judged acceptable in the key criteria, the evaluation then proceeded on to remaining criteria. Threatened and endangered plants were not considered a key criteria because of their current proposed status. In addition to key criteria, three additional criteria were identified as having unique values or constraints for the project, i.e. the Saval Ranch Research Project, the threatened Lahontan trout, and the protected golden eagles. Special notice was then placed on these criteria following the initial evaluation by key criteria. Whenever a unique concern was found to be free of effects from the project, this was considered a minor benefit, and evaluated in the same manner as an identified benefit from other criteria.

Alternative 1: Wright Ranch mill and tailings pond site, and a Jerritt Canyon corridor. Alternative 1 would have major adverse effects on six of the 18 criteria, moderate effects on four criteria, minor effects on three, and no effects on five of the criteria. Four of the six key criteria would have major effects, and one of the unique concerns also would have major effects. This alternative would have major adverse effects on deer winter range because of the corridor location. The large amount of cut and fill construction for the road plus the numerous stream crossings were considered major effects on soil erosion and water quality. The corridor was also considered a major barrier to the movement of livestock and wildlife, in effect preventing cattle from utilizing all areas on both sides of the roadway and creating barriers to livestock water sources. This effect was considered major both to the individual livestock allotment permittee, but also to the established direction in the Mountain City District Multiple Use Plan. Alternative 1 would also have a unique concern requiring special evaluation regardless of impact. The unique concern was the golden eagles nesting in Jerritt Canyon. It was reasoned that the corridor would have a major effect on those protected birds which could not be mitigated. There are some benefits to be derived from Alternative 1 in that there would be no adverse effects on two of the unique concerns, the Saval Ranch Study and Lahontan trout. Alternative 1 would be the third most inexpensive option to construct, at a cost of $71,339,000.

Alternative 2: Ellison Ranch mill and tailings site, and Northwest corridor. Alternative 2 would not have any major adverse effects, but would have moderate effects on four of the 18 criteria, minor effects on 10 criteria, and no effect on four of the criteria. Four of the six key criteria would be affected as would one of the unique concerns. This alternative would have moderate effects on deer winter range and potential for soil erosion, both because of construction of the Northwest corridor. The alternative would yield benefits in not having any adverse effects on the Saval Ranch or Lahontan trout. Alternative 2 would be the second most expensive alternative to build, at a cost of $87,825,000.

Alternative 3: Mill Site B, Northwest corridor, and tailings pond at the Ellison Ranch site. This alternative would not have major effects on any of the evaluation criteria, but would have moderate effects on three criteria, minor effects on 11, and no effects on four of the criteria. Four of the six key criteria would be affected, as would one of the unique concerns. As in Alternative 2, there would be moderate effects on deer winter range and potential for soil erosion from the construction and operation of the corridor, which includes a tailings pipeline in this alternative. Benefits from the alternative would include no effects on the Saval Ranch or Lahontan trout. A minor benefit was anticipated at mill Site B because the good quality soils were expected to be able to recover and revegetate easily following abandonment. In the summary evaluation though, this minor benefit was outweighed by the moderate effects on soil erosion from the corridor. Alternative 2 would be the most expensive alternative to construct, costing $90,858,000.

# TABLE 6-1

## AN EVALUATION OF THE MILL-CORRIDOR-TAILINGS POND ALTERNATIVES

M - MILL SITE
C - CORRIDOR
T - TAILINGS POND

| | ALTERNATIVE #1 | | | | ALTERNATIVE #2 | | | | ALTERNATIVE #3 | | | | ALTERNATIVE #4 | | | | ALTERNATIVE #5 | | | | ALTERNATIVE #6 | | | | ALTERNATIVE #7 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | WRIGHT RANCH | JERRITT CYN | WRIGHT RANCH | SUMMARY | ELLISON RANCH | NORTHWEST | ELLISON RANCH | SUMMARY | SITE B | NORTHWEST | ELLISON RANCH | SUMMARY | SITE B | R.G.-CALIF. CK | SECTION 33 | SUMMARY | SECTION 33 | R.G.-WINTERS CK | SECTION 33 | SUMMARY | NORTH FORK | WINTERS CK. | NORTH FORK | SUMMARY | WINTERS CK | WINTERS CK | NORTH FORK | SUMMARY |
| EVALUATION CRITERIA | M | C | T | | M | C | T | | M | C | T | | M | C | T | | M | C | T | | M | C | T | | M | C | T | |
| 1. Impact on Livestock Management (from Noise, Human Activities, and Corridor Barriers) • | 0 | ≡ | 0 | ≡ | 0 | - | 0 | - | 0 | - | 0 | - | 0 | ≡ | 0 | ≡ | 0 | - | 0 | - | 0 | = | 0 | = | 0 | - | 0 | - |
| 2. Impact on Deer Winter Range • | - | ≡ | - | ≡ | - | = | - | = | 0 | = | - | = | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3. Impact on Sage Grouse Strutting Grounds and Brood Grounds • | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | = | = | = | = | = | = | = | = | ≡ | ≡ | ≡ | 0 | ≡ | ≡ | ≡ |
| 4. Impact on Lahontan Trout • •• | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | = | 0 | = | 0 | - | 0 | - | 0 | - | 0 | - | - | - | 0 | - |
| 5. Potential Soil Erosion Loss • | - | ≡ | - | ≡ | - | = | - | = | - | = | - | = | - | = | - | = | - | - | - | - | - | - | - | - | - | - | - | - |
| 6. Impact on Surface Water Quality Due to Sedimentation • | - | ≡ | - | ≡ | - | - | - | - | - | - | - | - | - | = | - | = | - | - | - | - | 0 | - | 0 | - | - | = | 0 | = |
| 7. Impact on Research Values for the Savel Ranch Research and Evaluation Project •• | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ≡ | 0 | = | 0 | - | 0 | - | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8. Impact on Golden Eagle •• | - | ≡ | - | ≡ | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 9. Impact on Quality of Grazing Resources (AUM's) | = | - | = | = | - | - | - | - | - | - | - | - | - | - | = | = | - | = | = | = | - | = | - | = | - | - | - | - |

**EXPLANATION**

+ MINOR BENEFIT
0 NO EFFECT
- MINOR EFFECT
= MODERATE EFFECT
≡ MAJOR EFFECT
• KEY EVALUATION CRITERIA
•• UNIQUE CONCERNS

# TABLE 6-1 (CONTINUED)

M - MILL SITE
C - CORRIDOR
T - TAILINGS POND

| EVALUATION CRITERIA | ALTERNATIVE #1 M (WRIGHT RANCH) | ALTERNATIVE #1 C (JERRITT CYN) | ALTERNATIVE #1 T (WRIGHT RANCH) | ALTERNATIVE #1 (SUMMARY) | ALTERNATIVE #2 M (ELLISON RANCH) | ALTERNATIVE #2 C (NORTHWEST) | ALTERNATIVE #2 T (ELLISON RANCH) | ALTERNATIVE #2 (SUMMARY) | ALTERNATIVE #3 M (SITE B) | ALTERNATIVE #3 C (NORTHWEST) | ALTERNATIVE #3 T (ELLISON RANCH) | ALTERNATIVE #3 (SUMMARY) | ALTERNATIVE #4 M (SITE B) | ALTERNATIVE #4 C (R G -CALIF. CK) | ALTERNATIVE #4 T (SECTION 33) | ALTERNATIVE #4 (SUMMARY) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10. Impact on Federal Candidate Threatened or Endangered Plant Species | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11. Long Range Recovery of Natural Soil and Vegetation Conditions | 0 | – – | 0 | – – | 0 | – – | 0 | – – | + | – – | 0 | – | + | – – | – | – – |
| 12. Impact on Surface Hydrology (Channel Stability and Potential Flood Hazard) | – | – – | – | – – | – | – | – | – | 0 | – | – | – | 0 | 0 | – | – |
| 13. Impact on Ground Water Quality | – | – | – | – | – | 0 | – – | – – | – | – | – – | – – | – | – | 0 | – |
| 14 Impact on Air Quality (Particulates) | – | – – | – | – – | – | – | – | – | – | – | – | – | – | – | – | – |
| 15. Maintenance of Visual Quality of the Independence Mountains | – | – | – | – | – | | 0 | – | – | | – | – | – | – – | 0 | – – |
| 16. Impact on Archaeological and Historical Resources | 0 | – | 0 | 0 | 0 | – | – | – | 0 | – | – | – | 0 | – – | – | – – |
| 17. Consistent with Requirements of Mountain City Multiple Use Plan | 0 | – – – | 0 | – – – | 0 | – | 0 | – | 0 | – | 0 | – | 0 | – | 0 | – |
| 18. Potential for Socioeconomic Opportunities | 0 | – | 0 | – | 0 | – | 0 | – | 0 | – | 0 | – | 0 | + | 0 | + |

| EVALUATION CRITERIA | ALTERNATIVE #5 M (SECTION 33) | ALTERNATIVE #5 C (R G -WINTERS CK) | ALTERNATIVE #5 T (SECTION 33) | ALTERNATIVE #5 (SUMMARY) | ALTERNATIVE #6 M (NORTH FORK) | ALTERNATIVE #6 C (WINTERS CK) | ALTERNATIVE #6 T (NORTH FORK) | ALTERNATIVE #6 (SUMMARY) | ALTERNATIVE #7 M (WINTERS CK) | ALTERNATIVE #7 C (WINTERS CK) | ALTERNATIVE #7 T (NORTH FORK) | ALTERNATIVE #7 (SUMMARY) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10. Impact on Federal Candidate Threatened or Endangered Plant Species | 0 | 0 | 0 | 0 | 0 | 0 | – | – | 0 | 0 | – | – |
| 11. Long Range Recovery of Natural Soil and Vegetation Conditions | – | – | – | – | – | – | – | – | 0 | – | – | – |
| 12. Impact on Surface Hydrology (Channel Stability and Potential Flood Hazard) | – | – | – | – | 0 | – | 0 | – | 0 | – | 0 | – |
| 13. Impact on Ground Water Quality | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | – | 0 | 0 |
| 14 Impact on Air Quality (Particulates) | – | – | – | – | – | – – | – | – – | – | – | – | – |
| 15. Maintenance of Visual Quality of the Independence Mountains | 0 | – | 0 | – | – | – | 0 | – | – – | – | 0 | – |
| 16. Impact on Archaeological and Historical Resources | – – | – – | – | – – | 0 | – – | 0 | – – | – | – | 0 | – – |
| 17. Consistent with Requirements of Mountain City Multiple Use Plan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | – | 0 | 0 | – |
| 18. Potential for Socioeconomic Opportunities | 0 | + | 0 | + | 0 | + | 0 | + | 0 | + | 0 | + |

Alternative 4: Mill Site B, Rancho Grande-California Creek corridor and Section 33 tailings pond site. Alternative 4 would have major effects on one of the evaluation criteria, moderate effects on nine criteria, minor effects on five, no effect on two, and a benefit on one of the 18 criteria. Five of the six key criteria would be affected, and all three of the unique concerns would be affected. The Rancho Grande-California Creek corridor is the element of this alternative that would create a major effect on livestock management concerns. The corridor, especially the upper portion, would split a grazing allotment, plus the cut and fill construction of the road on the flanks of California Mountain would form an impassable barrier for cattle between the north and south portions of the allotment. The upper portion of the corridor would also be constructed in the California Creek drainage and could therefore affect the habitat of the Lahontan trout through erosion and the use of a tailings pipeline. The lower portion of the corridor and the tailings pond would affect sage grouse strutting grounds.

All three elements of the alternative would create moderate effects on erosion and surface water quality. There was also a unique concern for this alternative in that the area south of California Creek and east of California Mountain is a grazing allotment for the Saval Ranch Research and Evaluation Project. The effects of the corridor would also be effects on the Saval Ranch Study by introducing new variables in the midst of that research project.

A minor benefit was noted for the recovery of soils and vegetation at mill Site B, but it was outweighed by erosion effects from the corridor. Another minor benefit was noted for socioeconomic conditions resulting from having access to the project in the North Fork Valley instead of the Independence Valley. Alternative 4 was also noted for not affecting deer winter range. This alternative would be the fifth most expensive to construct, at a cost of $72,584,000.

Alternative 5: Mill and tailings at Section 33, and a Rancho Grande-Winters Creek corridor. Alternative 5 would have no major effects on any of the evaluation criteria, but would have moderate effects on three criteria, minor effects on 10 criteria, no effects on four of the criteria, and one minor benefit. Moderate effects from all three elements were noted for sage grouse, with only the lower portion of the corridor contributing to those effects. The haul road corridor from Section 33 up Winters Creek would have to bridge over California Creek and could thereby have potential effects on Lahontan trout in Foreman Creek. The Lahontan trout was also a unique concern that required additional review.

One of the positive aspects of Alternative 5 is lack of effect on deer winter range. There would be minor benefits on socioeconomic conditions resulting from North Fork Valley access instead of Independence Valley access. It was also felt this alternative was without significant effects on ground water hydrology and quality. Alternative 5 would be the most economical project to construct at a cost of $70,147,000.

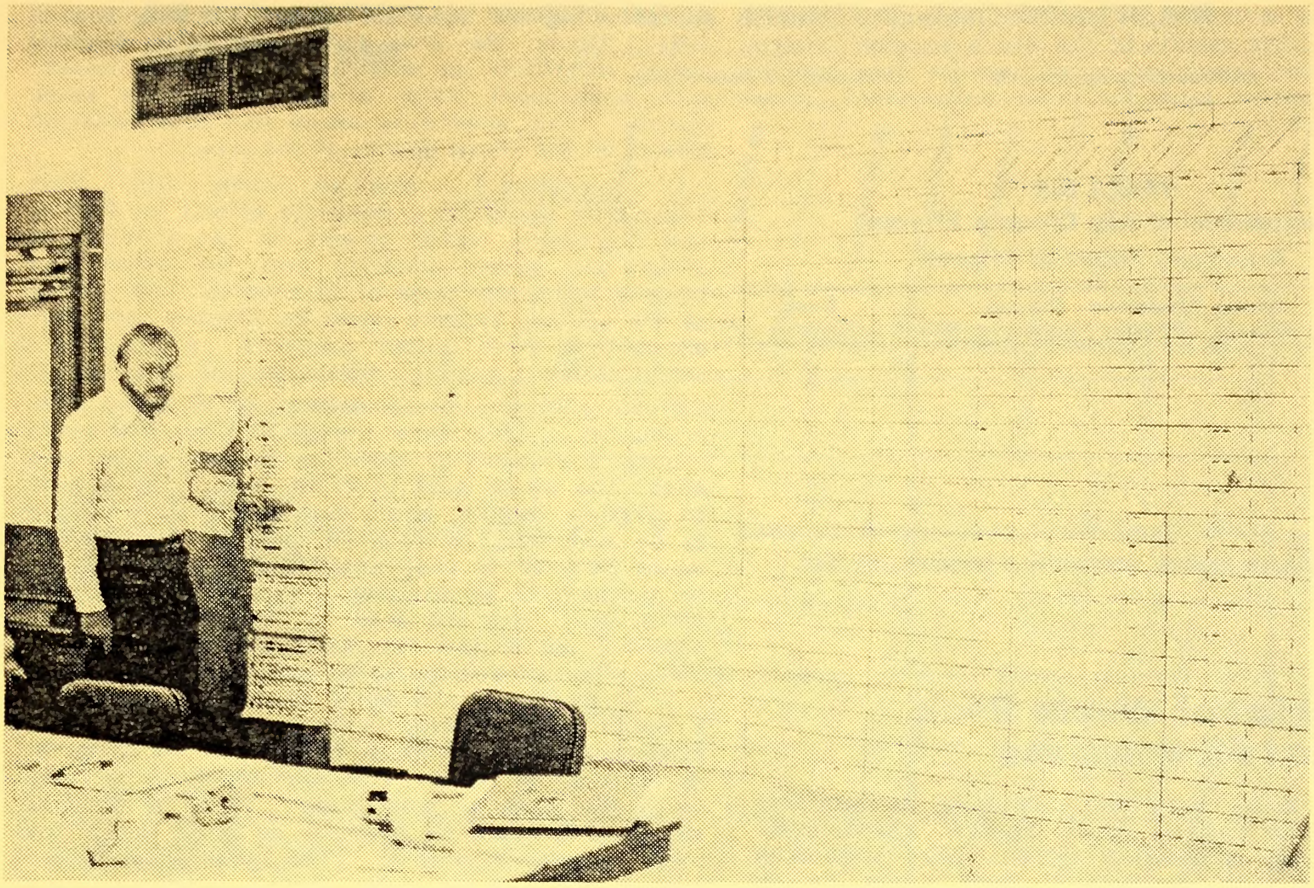
Alternative 6: Mill and tailings pond at the North Fork site, and a corridor up Winters Creek. Alternative 6 would have major effects on only one of the evaluation criteria, moderate effects on four of the criteria, minor effects on eight, no effect on four, and a minor benefit on one of the evaluation criteria. Five of the six key criteria would be affected as would two of the three unique concerns. Major effects on sage grouse would result from construction of both the corridor and the tailings pond. Moderate effects on livestock management were expected from the corridor acting as a barrier to cattle movements. Additionally, the length of the corridor suggested this alternative could have moderate effects on air quality from the generation of particulates. The Lahontan trout habitat in Foreman Creek could possibly be affected by bridging the stream and this was a unique concern in evaluating the alternative. Minor effects could be created on proposed endangered plants. Benefits from Alternative 6 were lack of effect on the Saval Ranch and minor socioeconomic effects from the east side access. This alternative would cost $71,858,000 to construct, making it the fourth most expensive alternative.

Alternative 7: Mill site in Winters Creek drainage, tailings pond at the North Fork site, and the Winters Creek corridor. This alternative would have major effects on one evaluation criteria, moderate effects on two criteria, minor effects on 11 criteria, no effects on three, and a minor benefit on one of the criteria. Five of the six key criteria would be affected, as would two of the three unique concerns. Both the corridor and tailings pond site of this alternative would have major effects on sage grouse strutting grounds. The corridor, because it contains a tailings pipeline, would cause moderate effects on surface water quality. The corridor would also bridge Foreman Creek and could affect the Lahontan trout habitat which was a unique concern. Alternative 7 would yield benefits in not affecting the Saval Ranch and by having access from the east side of the mountains. The cost to construct Alternative 7 would be $71,012,000, or the second most economical of all alternatives.

Freeport Gold Company intends to buy commercial electrical power from the Sierra Pacific Power Company. The primary source of this power would be the Valmy coal-fired generating station northwest of Battle Mountain. If, in the event the commercial power is not available, or a power distribution line corridor could not be approved, then Freeport would use diesel-powered generators for on-site generation of their power. On-site generation would require the installation of three diesel generators, storage tanks for supplies of fuel, and periodic shipments of diesel fuel to the site. The diesels would create atmospheric emissions on site.

The Valmy generating station would also create atmospheric emissions from burning coal, and the power distribution line would have its own environmental effects as discussed elsewhere in this report. Freeport would bear the costs of constructing the power distribution line to the site. The purchase of commercial power would exceed the costs for on site power generation by approximately $1 million in initial costs.

The preceding discussion was summarized from the data presented in Table 6-1. The table graphically presents the evaluation of each alternative against the evaluation criteria. Since there



Interdisciplinary team filled out this large wall matrix of criteria and effects.

Interdisciplinary evaluation team from left to right: D. Keefe, R. Sanz (hidden), S. Long, R. Weeks and S. Ellis. G. Rahm and D. Kimpton, Forest Service advisors, are on the extreme right.

was some difficulty in treating the entire table as a whole, the results of the key evaluation criteria, unique concerns, and noted benefits were compiled into a smaller table for initial comparisons, shown in Table 6-2.

**TABLE 6-2**
**Comparison of Key Criteria Effects**
**Summary Totals of Effects**

| Alternative | Major Effects | Moderate Effects | Unique Concerns | Benefits | Cost Ranking |
|---|---|---|---|---|---|
| 1 | 4 | 0 | 1 | 2 | 3 |
| 2 | 0 | 2 | 0 | 2 | 6 |
| 3 | 0 | 2 | 0 | 2 | 7 |
| 4 | 1 | 4 | 1 | 1 | 5 |
| 5 | 0 | 2 | 1 | 2 | 1 |
| 6 | 1 | 1 | 1 | 2 | 4 |
| 7 | 1 | 1 | 1 | 2 | 2 |

SOURCE: ENVIRONMENTAL RESEARCH & TECHNOLOGY, INC.

## Evaluation of Waste Rock Disposal Alternatives

The above described evaluation process was repeated for waste rock disposal alternatives. Four of the evaluation criteria were eliminated because it was determined there would be no effects from the disposal of waste rock on those criteria or the effects would be similar for all alternatives. Accordingly, effects on air quality were discounted, effects on cultural resources were discounted, effects on the Mountain City Multiple Use Plan would be similar for all alternatives, and socioeconomic effects of the waste rock disposal were also discounted. The amount of surface land disturbed by each alternative was then added to help quantify the environmental effects. Alternative 1 would effect 156.7 acres, Alternative 2 - 140.5 acres and Alternative 3-138.4 acres.

Gold mineralization has been found under one of the sites originally proposed for waste rock disposal in Alternative 4 - Valley Fill Southwest of Generator Hill. Evaluation of the alternative was performed but had to be eliminated when the gold ore was located, in order to prevent making that body of ore irretrievable. Evaluations of the other three waste disposal alternatives are presented in Table 6-3.

Alternative 1. Valley Fill and sidehill disposal. Alternative 1 would have moderate effects on four of the 18 evaluation criteria, minor effects on two criteria, no effects on seven criteria, and the remaining five criteria were all similar or discounted. Three of the six key criteria would be affected, as would one of the three unique concerns. This alternative would have moderate effects on grazing resources on the Jerritt Canyon allotment as it would remove 156.7 acres from forage production. Approximately 71 of those acres would be revegetated following the end of the project and reclamation of the disposal area. The same loss of area would affect golden eagles by removing the area as habitat for prey organisms. Using the area for waste rock disposal would contribute to moderate soil erosion losses, with subsequent minor effects on surface water quality. This alternative would also have moderate effects on the visual quality of the area.

Alternative 2. Modified valley fill. This alternative would have moderate effects on four of the 18 criteria, minor effects on two criteria, no effects on seven criteria, and the other five criteria being the same or discounted. Only three of the six key criteria would be affected, and only one of the three unique concerns. Alternative 2 would affect grazing resources on the Jerritt Canyon allotment by removing 140.5 acres from production. This same change in land use would reduce the hunting area for golden eagles and affect the visual quality of the area. The effects on grazing, eagles, and visual quality were judged to be moderate. Effects on livestock management would be minor in that human and vehicular activity at the site would likely keep cattle some distance away from the area. A moderate effect on potential soil erosion loss would have a subsequent minor effect on surface water quality.

Alternative 3. Sidehill disposal. Alternative 3 would have moderate effects on five of the 18 evaluation criteria, minor effects on one criteria, no effects on seven criteria, with five criteria being the same or discounted. Three of the six key criteria would be affected, as would one of the three unique concerns. The alternative would remove 138.4 acres from forage production and habitat for wildlife, and would therefore have moderate effects on livestock grazing, golden eagles, and soil erosion potential. This alternative would distribute activity and noise over a wider geographical area and would therefore have moderate effects on livestock management. There would be minor effects on surface water quality and moderate effects on visual quality resources. Benefits would be derived from not affecting the Saval Ranch or sage grouse with this alternative.

## Evaluation of Power Transmission Line Alternatives

Table 6-3 shows the relative ranking of effects of the three proposed power transmission corridors. The same process was used by the interdisciplinary team to evaluate each of the 18 criteria plus construction costs. Alternatives 1 and 2 involved existing corridors but would still require the setting of a new line of poles. Alternative 3 was a corridor across areas essentially without man-made influences. Alternative 1 would be 22 miles long, Alternative 2 - 16 miles, and Alternative 3 - 13 miles.

Alternative 1. Highway 11 corridor. This alternative would have no major effects on any of the evaluation criteria, a moderate effect on one criteria, minor effects on four of the criteria, no effects on nine criteria, with four of the criteria not evaluated or discounted. Only two of the six key criteria were affected, and none of the unique concerns. Visual effects along the Highway 11 corridor would be moderate because the terrain is

# TABLE 6-3

## AN EVALUATION OF WASTE ROCK DISPOSAL AND POWERLINE ALTERNATIVES

| | WASTE ROCK ALTERNATIVES | | | POWERLINE ALTERNATIVES | | |
|---|---|---|---|---|---|---|
| | ALTERNATIVE #1 | ALTERNATIVE #2 | ALTERNATIVE #3 | ALTERNATIVE #1 | ALTERNATIVE #2 | ALTERNATIVE #3 |
| | VALLEY FILL & SIDE HILL DISPOSAL | MODIFIED VALLEY FILL | SIDE HILL DISPOSAL | HIGHWAY 11 CORRIDOR | HIGHWAY 51 CORRIDOR | SAVAL RANCH CORRIDOR |
| 1. Impact on Livestock Management (from Noise, Human Activities, and Corridor Barriers) • | 0 | 0 | 0 | 0 | 0 | - |
| 2. Impact on Deer Winter Range • • | - - | - - | - - | 0 | 0 | + |
| 3. Impact on Sage Grouse Strutting Grounds and Brood Grounds • • | 0 | 0 | 0 | 0 | 0 | - |
| 4. Impact on Lahontan Trout • | - - | - - | - - | - | 0 | 0 |
| 5. Potential Soil Erosion | 0 | 0 | 0 | 0 | 0 | 0 |
| 6. Impact on Surface Water Quality Due to Sedimentation | - - | - - | - - | 0 | 0 | 0 |
| 7. Impact on Research Values for the Saval Ranch Research and Evaluation Project • | - | - | - - | 0 | 0 | 0 |
| 8. Impact on Golden Eagle | 0 | 0 | 0 | - | - | 0 |
| 9. Impact on Quality of Grazing Resources (AUM's) • • • | 0 | 0 | 0 | 0 | 0 | 0 |
| 10. Impact on Federal Candidate Threatened or Endangered Plant Species | 71 ACRES | 86 ACRES | 43 ACRES | - | 0 | 0 |
| 11. Potential Long Range Recovery of Natural Soil and Vegetation Conditions • | 0 | 0 | 0 | 0 | 0 | 0 |
| 12. Impact on Surface Water Quality Due to Sedimentation • | 0 | 0 | 0 | 0 | 0 | 0 |
| 13. Impact on Ground Water Quality | 0 | 0 | 0 | 0 | 0 | 0 |
| 14. Impact on Air Quality (Particulates) | Similar for all | | | | | |
| 15. Maintenance of Visual Quality of the Independence Mountains | - - | - - | - - | - - | - | - - |
| 16. Impact on Archeological and Historical Resources | Similar for all | | | | | |
| 17. Consistent with Requirements of Mountain City Multiple Use Plan | Similar for all | | | | | |
| 18. Potential for Socio-economic Opportunities | Similar for all | | | | | |
| 19. Potential Land Disturbance | 156.7 ACRES | 140.5 ACRES | 138.4 ACRES | 22 MI. | 16 MI. | 13 MI. |

**EXPLANATION**

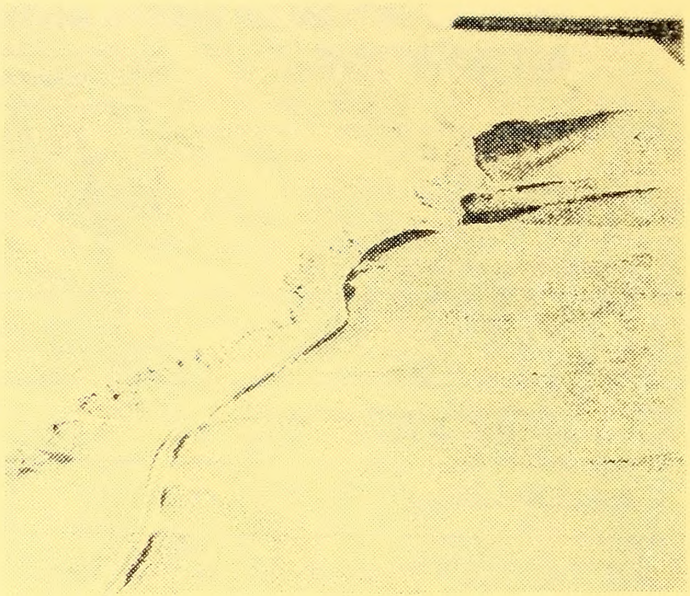
- \+ MINOR BENEFIT
- 0 NO EFFECT
- \- MINOR EFFECT
- = MODERATE EFFECT
- ≡ MAJOR EFFECT
- • KEY EVALUATION CRITERIA
- • • UNIQUE CONCERNS

rugged and visually interesting. Construction through that rough terrain would cause minor effects on soil erosion and lower potential for recovery of soil and vegetation conditions. Known populations of the sensitive plant Cryptantha would also be affected, as would certain streams from erosion induced sedimentation. Benefits were noted for the alternative in that none of the three unique concerns would be affected.

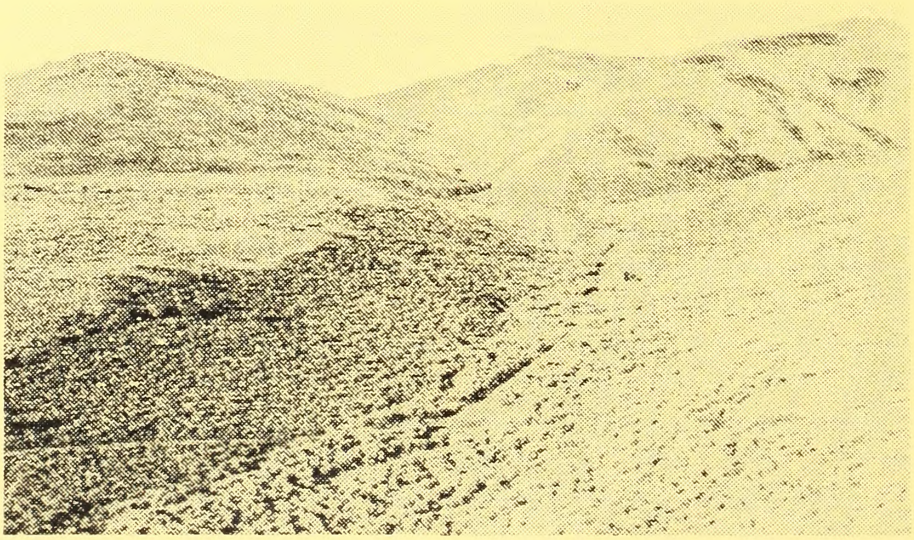
Alternative 2. Highway 51 corridor. This alternative would not have any major or moderate effects on the evaluation criteria. Minor effects would occur on three criteria, no effects on 11 criteria, and the other four criteria were not evaluated.

Only one of the key criteria would be affected and none of the unique concerns. Minor effects on surface water quality from sedimentation would occur from construction activities at stream crossings. An additional series of poles would also have minor effects on visual quality. This corridor would traverse areas with known populations of the sensitive plant Cryptantha. Benefits from not affecting any of the unique concerns was noted for this alternative.

Alternative 3. Saval Ranch corridor. Alternative 3 would have moderate effects on one of the evaluation criteria, minor effects on three criteria, no effects on nine criteria, and a minor benefit to golden eagles by providing hunting perches in an area almost without any high perches. Two of the six key criteria would be affected, as would two of the unique concerns, one negatively, one positively. This corridor would be a new corridor and would thus have moderate effects on visual quality. Construction at stream crossings could have minor effects on erosion induced sedimentation. The line would cross within one half mile of two sage grouse strutting grounds, and construction and eagles perching on the poles could have minor effects on the grouse. The corridor directly crosses the Saval Ranch and could have minor effects on the research study being conducted in the area. Benefits from not affecting one unique concern (Lahontan trout) and postively affecting another unique concern (golden eagles) were noted for this alternative.



Looking southeast at Highway 11 as it passes through Taylor Canyon.



Looking west at typical viewshed traversed by Saval Ranch power distribution line. Line will pass left to right along flanks of hills.

# 7. IDENTIFICATION OF FOREST SERVICE PREFERRED ALTERNATIVE

For the initiation of the Jerritt Canyon Project, the Forest Service had selected a set of feasible alternatives. From an environmental standpoint some of the candidate project options and alternatives were essentially equal when rated against the evaluation criteria. In September 1978, Freeport identified a preferred alternative as Mill Site B, Jerritt Canyon corridor, and a tailings pond high in Jerritt Canyon. Geotechnical data determined the Jerritt Canyon tailings pond infeasible. In March 1979 Freeport identified Section 33 as the preferred tailings pond site with a corridor across Rancho Grande-California Creek to reach Mill Site B. Concern over the tailings pipeline in the California Creek drainage and its cost, led Freeport to change their preferred alternative again. In September 1979, Freeport chose a preferred corridor from a mill site and tailings pond site in Section 33 to the mine via the Winters Creek drainage. During this process, the Forest Service was evaluating all alternatives including the changes made by Freeport.

Obviously, no alternative would create zero effects on the regional environment. However, in terms of comparison against one another, two or three mill-corridor-tailings pond alternatives stood out as the better candidates. These "best" alternatives have been selected by the Forest Supervisor for presentation in this chapter. Much of the rationale for the elimination of the marginal alternatives was documented in Chapters 5 and 6 in this EIS. In all cases, the Forest Supervisor evaluated the alternatives against the primary evaluation criteria covering the environmental effects and values which are covered under the natural sciences, social sciences, and environmental design arts (visual resources). These environmental effects and values were then weighed against equally important evaluation criteria falling into the areas of economics, engineering and geotechnical considerations.

The following alternatives have been recommended by the Forest Supervisor for resolving some of the conflicts concerning multiple uses of available resources. Implementation of the preferred alternative will include the Management Constraints and Guidelines identified in Chapter 4 of this EIS.

## Waste Rock Disposal Alternatives

Effects from the project on the first evaluation criteria, the Saval Ranch Study, were considered negligible for all three alternatives because of their location on the west side of the Independence Mountains. Effects on livestock grazing were determined to be simply a result of the number of acres removed from grazing which favored Alternative 3 - Sidehill Disposal, by a very slight margin over the other alternatives. The management of grazing was also considered to be equally affected by each of the disposal options because all three options fall within the same sheep and goat allotment. None of the three disposal alternatives would have any effect on proposed threatened or endangered plants.

Evaluation of the potential for recovery of soil and vegetative resources involved discussion of the amount of final surface that would be level, and the amount of area in each alternative that could be revegetated. The various alternatives had different acreages of level surface which could be topsoiled and revegetated. The acreages of slopes were also calculated and evaluated based on the potential for reestablishing vegetation. The evaluation team finally determined acreage to be the best indication of recovery since all disposal sites would be reclaimed in the same manner; this decision favored Alternative 2 by a small margin.

None of the three alternatives are in a location within deer winter range, or near sage grouse strutting grounds or brood habitat, or in watersheds containing Lahontan trout, thereby assuring no effects on these evaluation criteria. All the waste rock alternatives, however, are located in the hunting area of the golden eagles which nest in Jerritt Canyon. Any reduction in eagle hunting success would likely be proportional to the acreage of habitat of prey organisms that would be lost to waste rock disposal. The loss of hunting area was judged equivalent for all three options.

The potential for soil erosion from the waste rock disposal areas is a result of the size of the cobble placed in the disposal area, the amount of fine-grained material placed there, and the overall size of the disposal area. Alternatives 1 and 3 have significant amounts of sidehill dumping which should have a larger potential for causing erosion, plus be slower to revegetate over time. This evaluation ranked Alternative 2 marginally better than Alternatives 1 and 3.

Effects from waste rock disposal on surface hydrology were judged minimal for all alternatives because the disposal sites are high in the watershed with little or no watershed above them, particularly the valley fill alternatives. The primary effect would be minor changes in runoff patterns from the watershed, regardless of the chosen alternative. Concern over surface water quality was, however, not as easily evaluated. The overburden to be disposed of contains several heavy metals in various concentrations. As the ore is broken up and exposed to air and water, the metal ions may oxidize and enter surface waters. This process is a slow one, and the overburden will not be finely broken up, so that the rate of oxidation of heavy metals is expected to be very long-term. The evaluation team felt that all alternatives will have similar effects on surface water quality.

Much the same situation occurred in evaluating the effects of waste rock disposal on ground water quality. Much of the Independence Mountains contains faulted bedrock and areas of highly permeable limestone. Possible effects of runoff from waste rock disposal areas could degrade ground water quality. Since the major geological structures are consistent over an area much larger than the areas of waste rock disposal, it was felt all disposal alternatives would have similar effects on ground water quality.

Visual quality evaluations of the three waste rock disposal alternatives indicated only minor differences in the size of viewsheds. The major criterion for evaluation was felt to be the length or magnitude of the face of the disposal sites. Valley fills had much smaller faces compared to sidehill disposal areas. This evaluation gave a slight preference to Alternative 2.

There were more expressed preferences for Alternative 2 for reasons of visual quality and largest area to be reclaimed. The final criterion of cost slightly favored Alternative 2 over Alternative 1 ($10,700,000 and $10,600,000 respectively), and did indicate a cost disadvantage to Alternative 3 ($13,600,000).

From the arguments and preferences presented by the interdisciplinary team, the Humboldt National Forest has identified Alternative 2, Modified Valley Fill, as the preferred alternative, providing that an adequate reclamation and revegetation plan can be demonstrated. This reclamation and revegetation plan will become a part of the approved Forest Service Operating Plan for Freeport Gold Company.

## Mill-Corridor-Tailings Disposal Alternatives

An initial decision was made to eliminate Alternative 1 because of the large number of major environmental effects demonstrated. Then because there were three alternatives without any major environmental effects, it was decided that alternatives without major effects were preferable to alternatives with major effects, thus eliminating Alternatives 4, 6 and 7.

Discussion of the potential adverse effects of tailings slurry pipelines determined them to have a high potential for leaks and breaks caused by the severe weather, rough terrain construction and erosive tailings. The evaluation team felt any alternative with a tailings pipeline should be discounted. This eliminated Alternatives 3, 4, and 7.

Discussion of the safety of tailings ponds, and how critical were the subsurface materials focused on the permeable nature of the unconsolidated materials beneath the Ellison Ranch tailings site. It was felt that the potential for ground water contamination was great and the tailings site should be discounted unless lined with man-made liners, which would then discount the tailings pond because of the extreme high cost. Thus, with Alternative 2 discounted, Alternative 5 became the preferred alternative.

Some members of the evaluation team suggested a modified alternative to try and salvage another option. The proposed alternative placed the mill and tailings pond at the Wright Ranch site and utiltized the Northwest corridor plus Secondary Corridor "D" to go from the mouth of Snow Canyon south to the Wright Ranch site.

Evaluation of this alternative then determined that effects on deer winter range would be moderate. The longer corridor would have moderate effects on soils, vegetation and geological materials, while the longer pipeline would have major effects on both surface and ground water because of the additional stream crossings of Bull Creek and the very permeable substrata. For these reasons the newly proposed alternative was discounted.

In order to "double check" the evaluations, Alternative 6 was reinstated and a minute evaluation conducted of Alternatives 5 and 6. Alternative 5 would have no major effects, while Alternative 6 would have such effects on sage grouse. Alternative 5 would have moderate effects on sage grouse, and cultural resources, while Alternative 6 would have moderate effects on grazing resources, air quality (particulates) and was moderately more expensive to construct. Alternative 5 would have minor effects on the Saval Ranch Project and air quality while Alternative 6 would have minor effects on visual quality and cultural resources.

Alternative 5 was considered the preferred alternative because it was felt that the effect on sage grouse from Alternative 6 was the most severe impact. The effects from Alternative 6 on livestock management and grazing were of second greatest significance. Finally, the minor effects from Alternative 5 on the Saval Ranch Study could be planned for and mitigated by the Saval Ranch Study Steering Committee.

The Forest Supervisor has selected Alternative 5 as a prime candidate for implementation. Alternative 5 has a mill site and tailings disposal site on the flanks of the Independence Mountains in the North Fork Valley within Section 33, just north of the Saval Ranch. Section 33 is administered by the BLM and is immediately adjacent to the boundary of the Humboldt National Forest (see Figure 7-1).

Both the interdisciplinary team members and the Forest Supervisor agreed on the selection of Alternative 5 over all other candidates for several reasons:

- One of the two best natural sites for a tailings pond (both from embankment and clay lining)
- The best North Fork Valley site for avoidance of active sage grouse strutting grounds
- One of the four best alternatives for protecting deer winter range habitat
- One of the four optimum locations from a socioeconomic and energy conservation standpoint
- From cost/benefit considerations, Alternative 5 is the most economical candidate

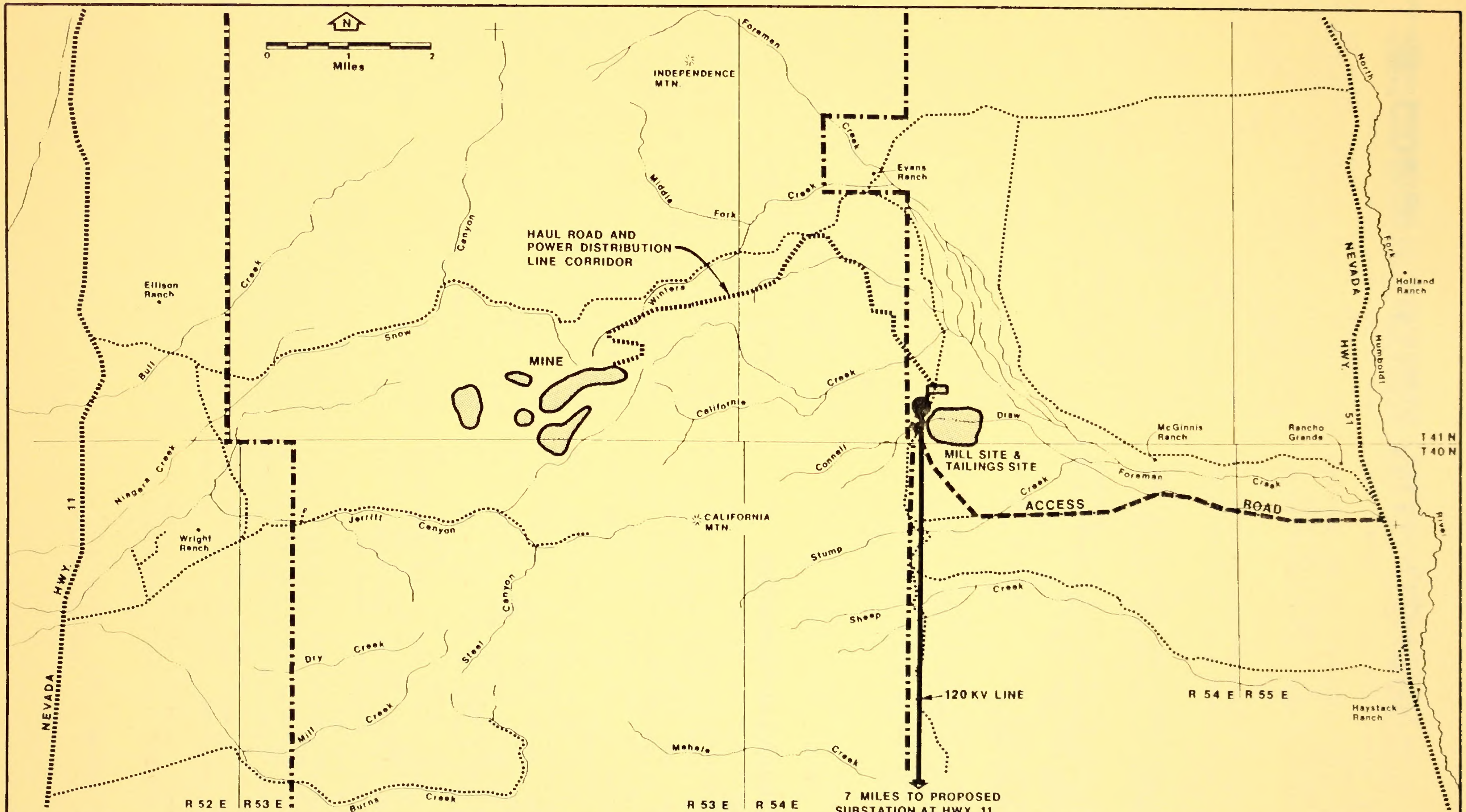



FIGURE 7-1 The Forest Service Preferred Alternative

Almost all of the above criteria ranking also holds true for Alternative 6, North Fork, mill site - Winters Creek Corridor - North Fork Tailings Disposal area.

There are minor environmental and economic benefits of Alternative 5 versus Alternative 6. Some of the differences which are evident between 5 and 6 are:

1) Alternative 6 creates more disruption to range management practices in the North Fork Valley

2) Alternative 6 directly impacts one large active sage grouse strutting ground

3) Alternative 6 has slightly more potential of affecting the habitat of the threatened Lahontan cutthroat trout

4) Alternative 6 will have high annual operating costs.

These shortcomings for Alternative 6 are not of such a significant nature to eliminate this mill and tailings pond location from consideration because many of the ecological effects can be mitigated.

## Power Transmission Line Alternatives

Alternatives 1 and 2 would not have any effect on the Saval Ranch Study, while Alternative 3 would directly cross the Saval Ranch and impose the construction disturbance on those lands. A powerline and its corridor would have no effects on livestock grazing following the construction period, nor would it have any effect on management of grazing programs.

Alternatives 1 and 2 would both cross areas known to contain populations of the candidate threatened plant species Cryptantha. Construction of the corridor could affect those plants, while Alternative 3 would not affect any populations of Cryptantha. Other effects on soils and vegetation would occur during construction. The potential to recover from these effects was judged to be excellent for Alternatives 2 and 3, but Alternative 1 crosses more rugged terrain and is the longest corridor and so was judged to have minor effects on recovery of soil and vegetation resources.

Wildlife is subject to few effects from a medium-sized powerline such as the proposed line. It was felt there would not be any effects on deer winter range or Lahontan trout from any of the alternatives. The powerline in Alternative 3 would pass within a half mile of sage grouse strutting grounds, and it was felt the power poles could provide new perches for raptors and thus have minor effects on sage grouse populations. The same reasoning considered this a benefit for area raptors, including golden eagles.

Effects on soil erosion could be minor for Alternative 1, but negligible for Alternatives 2 and 3. This was judged to be the case because Alternative 1 is the longest corridor and will cross the most rugged terrain of the three routes, particularly in the Taylor Canyon area. Effects of powerline construction were considered negligible on surface hydrology, and surface and ground water quality. Effects of the powerline on visual quality were judged moderate for Alternative 1 because of the rugged and more scenic terrain that was crossed, and also for Alternative 3 because the corridor passes through an area relatively unmarred by man-made structures. Alternative 2 would create minor visual effects along the existing corridor because of the addition of new poles and lines.

The costs to construct the various powerline alternative are: Alternative 1 - $4,070,00, Alternative 2 - $3,860,000, and Alternative 3 - $3,600,00. The evaluation of these alternatives also included the basic assumption that it would not be feasible to run a powerline from either existing highway corridor over the mountains to serve a mill site in the opposite valley. The end result of the evaluation of alternatives was to identify Alternative 2 as the preferred alternative based on the significance of identified effects plus the stated BLM policy of preference for existing corridors over new corridors.

Since the Forest Supervisor has selected the two prime candidate mill sites in the North Fork Valley, power transmission line Alternative 1, paralleling Highway 11 to the Wright Ranch is infeasible from a distance (and cost) consideration. The principal differences between Alternatives 2 and 3 are essentially in the area of economics and visual resources. Both the Forest Service and BLM would prefer to keep all new utility construction within existing corridors. Alternative 2 will follow the existing utility corridor paralleling Nevada Highway 51. However, Alternative 3 is less expensive than Alternative 2 because it is 3 miles shorter. Neither alternative has adverse social or natural environmental handicaps. Alternative 3 would cause some problems with the Saval Ranch Study because of short-term disruption across the study area. The powerline would cause new visual disruption to a natural foothills area where there is little evidence of man (see Figure 4-17).

The Forest Service and BLM have identified Alternative 3 as the preferred alternative from arguments and recommendations from the interdisciplinary team. The corridor is the shortest of the three corridors and thus will have fewer effects related to distance, plus offer a significant cost savings. Finally, most of the ecological effects will be restricted to the construction period, or will be wholly mitigated.

# 8. CONSULTATION WITH OTHERS

The Environmental Impact Statement for the Jerritt Canyon Project was prepared by the U.S. Department of Agriculture, Forest Service, Humboldt National Forest with a cooperative effort by the U.S. Department of Interior, Bureau of Land Management, Elko District. The Humboldt National Forest, as the lead agency, has implemented public and interagency consultation and coordination throughout the development of this EIS. The consultation and coordination has included meetings with other Federal and state agencies and local government groups, public meetings, and correspondence with concerned interest groups and individuals. The following specific activities have taken place as part of this coordination program.

| **Date** | **Activity** |
|---|---|
| 7/6/78 | Distribution of baseline study plans and meetings with Nevada Department of Conservation and Natural Resources, Carson City, Nevada<br>■ Division of Solid Waste Management<br>■ Division of Water Quality Control<br>■ Division of Air Quality Control<br>■ Division of Historic Preservation and Archeology<br>■ Division of Water Resources<br>■ Division of Mineral Resources |
| 8/3/78 | Meeting with Nevada Department of Wildlife, Reno, Nevada |
| 8/4/78 | Distribution of baseline study plans and meeting with U.S. Department of Interior, Bureau of Land Management, Elko District, Elko, Nevada |
| 8/8/78 | Meeting with Nevada State Planning Office, Carson City, Nevada |
| 8/9/78 | Meeting with Elko County Commissioners, Elko, Nevada |
| 10/16/78 | Meeting with Nevada Department of Wildlife, Elko, Nevada |
| 10/20/78 | Discussion with Nevada Division of Air Quality Control, Carson City, Nevada |
| 12/8/78 | Meeting with Nevada Division of Air Quality Control, Carson City, Nevada |
| 1/23/79 | Meeting with City Manager and City Council, Elko, Nevada |
| 1/24/79 | Meeting with Assistant City Manager, City Engineer, and Superintendent of Schools, Elko, Nevada |
| 2/6/79 | Meeting with Planning and Zoning Board, City of Elko |
| 3/5-3/6/79 | Meetings and field trips with Caribou National Forest and various phosphate mining companies, Soda Springs, Idaho |
| 3/15/79 | Notice of Intent to File Environmental Impact Statement published in Federal Register |
| 3/26/79 | Distribution of Scoping Document to Federal and state agencies, and concerned individuals (approximately 50 copies distributed) |
| 3/26/79 | Announcement of project, by Humboldt National Forest, sent to the following newspapers and radio station: Elko Daily Free Press; Elko Independent; Wells Progress; Nevada State Journal, Reno; Radio Station KELK, Elko |
| 4/2/79 | Meeting with Nevada Division of Environmental Protection, (Solid Waste Management), and Division of Historic Preservation and Archeology, Carson, City, Nevada |
| 4/3/79 | Nevada State Agency Coordination Meeting, Carson, City, Nevada<br>■ Nevada Division of Environmental Protection<br>■ Nevada Department of Wildlife<br>■ Nevada Department of Highways<br>■ Nevada State Engineer<br>■ Bureau of Mines<br>■ BLM State Office |
| 4/4/79 | Meeting with U.S. Environmental Protection Agency, Office of External Relations, and Hazardous Materials Section, San Francisco, California |
| 4/19/79 | Letters sent to representatives of Sierra Club and Wilderness Society describing the scope of the Jerritt Canyon Project |
| 5/10/79 | Meeting with U.S. Department of Interior, Fish and Wildlife Service, Endangered Species Office, Sacramento, California |
| 6/20/79 | Meeting with Saval Ranch Research and Evaluation Project Steering Committee, Elko, Nevada |
| 9/13/79 | Briefing on socioeconomic studies for Jerritt Canyon Project for the City Manager, City Council, City Planning Group, County Manager, County Commissioners, County Planning Group, Elko, Nevada |
| 9/18/79 | Public Meeting, Elko, Nevada (23 individuals registered) |

| | |
|---|---|
| 9/19/79-<br>9/22/79 | Humboldt National Forest Interdisciplinary Team Meeting to evaluate the project alternatives, Elko, Nevada |
| 9/28/79 | Nevada State Agency Coordination Meeting, Carson City, Nevada |

- State Planning Coordinator's Office
- Department of Wildlife
- Department of Transportation
- Department of Agriculture
- Department of Conservation and Natural Resources
- Division of Air Quality Control

Many Federal, state, and local government agencies were contacted and have contributed to the preparation of this Environmental Impact Statement during the coordination process. The agencies contacted for consultation include:

### Federal Government

U.S. Department of Agriculture
    Forest Service
        Humboldt National Forest
        Toiyabe National Forest
    Soil Conservation Service
U.S. Department of Interior
    Bureau of Land Management
    Fish and Wildlife Service
    Geological Survey
    Bureau of Mines

### State of Nevada

Department of Conservation and Natural Resources
    Division of Environmental Protection
    Division of Historical Preservation & Archeology
    Division of Parks
    Division of Forestry
    Division of Water Planning
    Division of State Lands
    Division of Water Resources
    Division of Mineral Resources
    Division of Conservation Districts
Department of Wildlife
Department of Highways
Department of Human Resources
    Health Division
Department of Transportation
Department of Agriculture
Department of Economic Development
Department of Energy
State Museum
State Engineer
Archeological Survey
Bureau of Mines

### Local Government

City of Elko
    City Manager's Office
    City Council
County of Elko
    County Manager's Office
    County Commissioners
    Superintendent of Schools
Mountain City Community Council
Saval Ranch Research and Evaluation Project

Private groups and individuals who have participated in the consultation and coordination process for this Environmental Impact Statement are listed below.

### Private Groups

The Sierra Club, Toiyabe Chapter
The Wilderness Society, Nevada Region
Nevada Cattlemen's Association
Nevada Wildlife Federation
Elko Chamber of Commerce
Elko County Farm Bureau
Nevada Mining Association
Owyhee Tribal Council

### Individuals

| | |
|---|---|
| Alice O'Neill Avery | Elko, NV |
| Mack Barrington | Elko, NV |
| Melvin Basanez | Mountain City, NV |
| John Bidart | Bakersfield, CA |
| Dan Bilbao | Elko, NV |
| John Carpenter | Elko, NV |
| Charlene Chambers | Mountain City, NV |
| Riley & Rosella Chambers | Mountain City, NV |
| G.E. Chapin | Elko, NV |
| James Connelly | Mountain City, NV |
| Joseph Couch | Mountain City, NV |
| Dan Dilay | Elko, NV |
| Jeanne Edwards | Elko, NV |
| Wade Ellett | Elko, NV |
| Stanley Ellison | Tuscarora, NV |
| J.C. & Barbara Farrell | Elko, NV |
| Joe Ferrara | Elko, NV |
| Virlis Fisher | Las Vegas, NV |
| Norman Glazer | Halleck, NV |
| Elmer & Margaret Hall | Mountain City, NV |
| Bob Hawkins | Elko, NV |
| Len Hoskins | Elko, NV |
| Paul Lucas | Elko, NV |
| Quayle Lusty | Elko, NV |
| Dick Mecham | Mountain City, NV |
| John C. Miller | Elko, NV |
| James J. Moiso | Elko, NV |
| Richard J. O'Neill | Elko, NV |
| Doug Plocher | Elko, NV |
| Dale Porter | Elko, NV |
| Karl Ratliff | Mountain City, NV |
| Chuck & Maxine Read | Mountain City, NV |
| Dean Rhoades | Elko, NV |
| Don & Norma Rizzi | Mountain City, NV |
| Deloyd Satterthwaite | Tuscarora, NV |
| Dave Secrist | Elko, NV |
| Marjorie Sill | Reno, NV |
| Gene Smalley | Ely, NV |
| Mel Steninger | Elko, NV |
| Norm Thompson | Mountain City, NV |
| Don Tompkins | Mountain City, NV |
| Oliver & Anna Tremewan | Mountain City, NV |
| Charles Van Norman | Tuscarora, NV |
| Robert & Dottie Vidano | Tuscarora, NV |
| Gus Vitale | Mountain City, NV |
| H.R. Williams | Elko, NV |
| C. Woodbury | Elko, NV |
| James J. & Joann Wright | Tuscarora, NV |
| Fred R. Zaga | Jiggs, NV |

# INDEX

# APPENDIX A
# LIST OF PREPARERS

The following individuals had primary responsibility for conducting the environmental studies, preparation of the technical reports, and development of this Environmental Impact Statement. Their education, project responsibilities, qualifications, and experience are summarized below.

### Environmental Research & Technology, Inc.

DOUGLAS M. ROSS, P.E., Project Manager

B.S. in Geological Engineering, Colorado School of Mines; Advanced studies in water resource and sanitary engineering, Loyola University of Los Angeles

Jerritt Canyon Project: Responsible for supervision of all discipline studies, liaison and coordination with applicant and government agencies, and regulatory compliance. Co-author of EIS.

Manager of large, multidisciplinary energy development and transportation projects. Project management experience includes environmental impact studies for two railroad branch lines, four coal mines, and three oil shale projects.

DEHN E. SOLOMON, Assistant Project Manager

B.A. in Biology, Kalamazoo College; M.S. in Biology, Texas Christian University

Jerritt Canyon Project: Responsible for interdisciplinary coordination of environmental studies, budgetary control, and co-author of EIS. Senior author of Threatened and Endangered Species Biological Assessment for submittal to USDI, Fish and Wildlife Service.

Designs and manages multidisciplinary environmental studies for energy development projects. Experience includes preparation of environmental impact assessments for proposed copper smelter, crude oil pipeline, fossil-fuel power plant, and transmission lines.

VALERIE J. RANDALL, Project Coordinator

B.A. in Urban Studies, Briarcliff College; Minor in Geography-Cartography

Jerritt Canyon Project: Responsibilities include coordination of cultural resources survey and report, and major role in coordination and preparation of EIS. Author of Recreation Technical Report.

Experience includes participation in cultural resources studies for pipelines, and mine/mill projects and responsibility for coordination and preparation of elements of environmental reports.

DANIEL F. KEEFE, Aquatic Biologist

B.S. in Biology, Regis College; M.S. in Zoology, Colorado State University

Jerritt Canyon Project: Responsible for environmental studies of water quality, aquatic biology, and threatened or endangered fish. Senior author of Water Quality and Aquatic Biology Technical Reports.

Experience includes water quality and aquatic biology studies for proposed mining/milling projects, power plants, and pipelines.

SCOTT L. ELLIS, Plant/Range Ecologist

B.A. in Biology and English, Cornell University

Jerritt Canyon Project: Responsible for environmental studies of vegetation, threatened or endangered plant species, and range management. Senior author of Vegetation Technical Report.

Experience includes design and management of vegetation surveys and reclamation plans for proposed surface and underground mining projects and pipelines; development of publication describing threatened or endangered plant species in Colorado for the USDI, Fish and Wildlife Service; design and performance of surveys for threatened or endangered plant species at proposed industrial sites and along proposed transmission/pipeline corridors.

STEPHEN G. LONG, Reclamation Specialist

B.S. in Wildlife Biology and M.S. in Regional Resource Planning with emphasis in Soil Science/Reclamation, Colorado State University.

Jerritt Canyon Project: Responsible for preparation of plan for reclamation and revegetation of disturbed land.

Experience includes preparation of reclamation plans for surface mines, pipelines, and power plants; soil characterization and analysis studies.

JEFFREY H. PETERS, Soil Scientist

B.S. in Renewable Natural Resources and M.S. in Soil Science, University of California-Davis; Graduate studies in Geology

Jerritt Canyon Project: Responsible for classification and mapping of soils and evaluation of soil and overburden data for incorporation into reclamation plans.

Experience includes soil inventories and development of mine reclamation plans for surface mines in the western United States.

ROBERT C. SANZ, Wildlife Biologist

B.S. in Zoology, Colorado State University.
Jerritt Canyon Project: Design and implementation of small mammal, big game, sage grouse, songbird, and raptor surveys. Senior author of Wildlife Technical Report.
Experience includes developing sampling methodologies and conducting field studies and literature reviews involving small mammal, lagomorph, mammalian predator, and big game populations.

STEVEN R. VIERT, Wildlife/Range Biologist

B.S. in Wildlife Management, University of Michigan; M.S. in Range Ecology, Colorado State University
Jerritt Canyon Project: Responsible for design and implementation of big game survey; assisted in vegetation field survey.
Experience includes biological inventories, impact analyses, and recommendation of mitigative measures for surface mines and other energy development projects.

T. MICHAEL PHELAN, Avian Biologist

B.A. in Zoology, University of California at Los Angeles; Advanced studies in Biology, San Diego State University
Jerritt Canyon Project: Responsible for sampling, analysis, and interpretation of avian population.
Experience includes small mammal trapping inventories, songbird, raptor, and big game surveys; participation in study to analyze the impacts of surface mining on fish and wildlife resources in the western United States.

ROBERT A. MC DONALD, Technical Consultant

B.S. in Fisheries Science and M.S. in Natural Resource Administration, Colorado State University
Jerritt Canyon Project: Provided technical assistance on government regulations, permitting strategies, and EIS procedures.
Experience includes management of large, multidisciplinary environmental impact assessments for transportation, mine/mill, and power plant/ reservoir studies.

RICHARD SPOTTS, Surface Water Hydrologist

B.S. in Civil Engineering, Colorado State University; Graduate studies in Hydrology
Jerritt Canyon Project: Performed flood hydrology studies in all project watersheds.
Experience includes design and installation of surface and ground water monitoring networks and evaluation of data from surface gaging, aquifer tests, and water quality sampling.

WILLIAM S. KRUPKE, Hydrologist

Courses in General Conservation, Soil and Water, Forestry, Fish and Wildlife, Range Management, Parks and Recreation; National School of Conservation
Jerritt Canyon Project: Responsible for hydrologic data collection, analysis, and interpretation.
Experience includes field supervision of well drilling and installation, performance of pump tests, and installation and maintenance of stream gaging and surface water sampling facilities.

THOMAS F. LAVERY, Air Resources Manager

A.B. in Mathematics, Providence College; M.S. in Meteorology, Massachusetts Institute of Technology
Jerritt Canyon Project: Preparation of air permit applications and interface with government agencies on air quality.
Experience includes management of large air quality impact studies involving development and application of atmospheric diffusion models, including the assessment of stationary and mobile sources of pollutants.

KIRK D. WINGES, Air Quality Engineer

B.S. in Earth and Planetary Science, Massachusetts Institute of Technology; M.S. in Chemical Engineering, University of California at Berkeley
Jerritt Canyon Project: Responsible for emissions inventory and development of air quality model. Senior author of Air Resources Technical Report.
Experience includes modeling of emissions from mining operations, electric power generation, and wind erosion.

DENNIS F. GILLESPIE, Landscape Architect

B.S. in Forest Resources, College of Forest Resources, University of Washington; M.L.A. (Landscape Architecture), Graduate School of Design, Harvard University; graduate work in environmental law/ urban studies
Jerritt Canyon Project: Responsible for visual quality field survey and analysis. Senior author of Visual Resources Technical Report.
Experience includes visual quality evaluations, industrial facility site selection studies, land use and natural resource management studies, and environmental assessments.

ROBERT M. EARSY, Noise Analyst

B.S. in Electrical Engineering, University of Connecticut; M.S. in Electrical Engineering, Northeastern University; MCP (City Planning), Harvard University

Jerritt Canyon Project: Responsible for prediction of noise levels and recommendation of noise abatement measures. Author of Noise Technical Report.
Experience includes noise assessment studies for mining operations, power plants, and residential development projects throughout the nation.

RICHARD J. DEFIEUX, Geologist

B.A. and M.A. in Geology, Boston University
Jerritt Canyon Project: Responsible for geological field investigations, data collection and analysis. Co-author of Minerals and Geology Technical Report.
Experience includes preparation of geological and hydrological input to environmental impact assessments, including consideration of physical resource planning issues.

JAMES H. WAGNER, Air Instrumentation Manager

B.S. in Electrical Engineering, Wichita State University; M.S. in Electrical Engineering, University of Colorado
Jerritt Canyon Project: Responsible for design, installation, and maintenance of air quality monitoring program.
Experience includes development of specialized instrumentation and data acquisition systems for use in meteorology and air quality monitoring programs.

**Water and Environment Consultants, Inc.**

CHARLES M. BOSLEY, Surface Water Hydrologist

B.S. in Civil Engineering, Colorado State University; Graduate studies in Hydraulic Engineering
Jerritt Canyon Project: Analysis of surface hydrology data and senior author of Surface Hydrology Technical Report.
Experience includes collection, organization, and analysis of surface hydrology data.

**Sergent, Hauskins & Beckwith, Consulting Soil and Foundation Engineers**

GEORGE H. BECKWITH, P.E., Geotechnical Engineer

B.S. in Civil Engineering, Gonzaga University
Jerritt Canyon Project: Manager of geotechnical studies for analysis of alternative mill sites and tailings disposal areas. Senior author of Geotechnical Report.
Experience includes management of geotechnical investigations to develop design criteria for power generation and transmission facilities, earth dams, evaporation ponds, mining and industrial complexes, bridges and buildings.

RALPH WEEKS, Ground Water Hydrologist

B.S. in Geology, Northern Arizona University
Jerritt Canyon Project: Investigation of ground water conditions and impact analysis. Author of Ground Water Technical Report.
Experience includes design, implementation, and analysis of ground water programs for sites proposed for development, including mines, railroads, dams, and powerlines.

**Abt Associates Inc., Socioeconomic and Planning Consultants**

JANET J. SKINNER, Sociologist

B.A. in History, California State College, Fullerton; M.A. in Social Sciences, California State University, Fullerton
Jerritt Canyon Project: Design and implementation of socioeconomic study, including liaison and coordination with local government agencies and planning officials. Senior author of Socioeconomics Technical Report.
Experience includes planning and implementation of numerous socioeconomic studies related to energy development projects.

RONALD A. DUTTON, Economist

B.S. and M.S. in Economics, University of Wyoming
Jerritt Canyon Project: Design and implementation of economic impact forecasting methodology and collection of socioeconomic data. Co-author of Socioeconomics Technical Report.
Experience includes direction of and participation in socioeconomic studies for environmental impact assessments; design and implementation of community attitude surveys and land-use analyses.

**Moen Associates Inc., Cultural Resources Consultants**

MICHAEL E. MOEN, Archeologist

B.A. in Anthropology, Minor in Biology, California State University, Haywood; Graduate studies in Anthropology
Jerritt Canyon Project: Responsible for design, implementation, and analysis of cultural resources survey of project area. Senior author of Cultural Resources Technical Report.
Experience includes performance of archeological surveys for government agencies and educational institutions and excavation and cataloguing of artifacts.

ROBERT R. ELLIS, Archeologist

B.A. in Anthropology, California State University, Fullerton
Jerritt Canyon Project: Served as Project Leader responsible for collecting, reporting, and analysis of archeological and historical data.
Experience includes management and participation in numerous archeology studies, including the excavation and curation of artifacts.

## USDA, Forest Service

GARY N. RAHM, Forest Planner, Humboldt National Forest

B.S. in Watershed Management, School of Forestry, Colorado State University.
Jerritt Canyon Project: Responsible for overall coordination of preparation of EIS and Forest Service liaison with Freeport Gold Company.
Experience includes diverse background in preparation of environmental assessment and interdisciplinary team work; assignments in specialist studies and resources administration for the Forest Service.

DAVID KIMPTON, Forest Ranger, Mountain City District

B.S. in Forestry, University of Idaho; Minor in Range, Soils, and Botany
Jerritt Canyon Project: Responsible for resource and multiple use coordination, and management of Forest Service portion of the 42-square mile claim block.
Experience includes assignments as Zone Manager, Sawtooth National Recreation Area; Resource Assistant, Stanley Ranger District, Challis National Forest; Resource Assistant and Range Conservationist, Ely Ranger District, Humboldt National Forest; and Range Conservationist, Powell Ranger District, Dixie National Forest.

## Freeport Gold Company

RICHARD W. STEWART, Environmental Coordinator

B.S. in Chemical Engineering, Louisiana State University
Jerritt Canyon Project. Responsible for providing technical and engineering data on project to Forest Service.
Experience in design and operation of mining projects.

GEORGE MEALEY, Manager Mine Development

B.S. in Mining Engineering, Montana College of Mineral Science and Technology
Jerritt Canyon Project: Developed technical and engineering data on project.
Experience in design and construction of mining projects.

Two ERT scientists awaiting early morning reconnaissance flight over project area to survey powerline alternatives.

# APPENDIX B
# ORIGINAL EVALUATION CRITERIA

The complete list of criteria developed in order to evaluate the project options and alternatives is included in this appendix. As discussed in Chapter 3, certain criteria were eliminated from the evaluation because it was not possible to compare the relative effects of implementation of the various alternatives based on these criteria. In addition, there was some repetition of criteria content. The specific sources of the evaluation criteria are cited in Chapter 3.

## Laws, Executive Orders, and Regulations

### Protect the Environment for Future Generations

- Effect on research values for Saval Ranch Research and Evaluation Project
- Effect on deer winter range
- Effect on key deer migration routes
- Effect on sage grouse strutting grounds and brood grounds
- Meets legal obligations for protection of Lahontan cutthroat trout habitat
- Effect on proposed threatened or endangered plant species
- Effect on golden eagle habitat
- Effect on visual quality standards of the Independence Mountain area
- Background visual effect on the region's existing or potential wilderness areas
- Effect on future recovery of other commercial minerals in the mining area
- Effect on energy consumption

### Attain the Widest Range of Beneficial Uses Without Risk to Health or Safety

Water quality and quantity

- Effect on streams from sediment production
- Risk of contamination of surface or ground water from tailings disposal
- Effect on channel stability and potential flood hazard
- Effect on water supply

Air quality

- Degradation of air quality within legal standards
- Effect on air quality from vehicular emissions

Other

- Risk to the public from dangerous materials or explosives
- Transportation routes suitable for the uses proposed

### Assure Diverse and Productive Surroundings for the Existing and Potential Users of the Area

Vegetation

- Amount of vegetative cover lost due to project components
- Potential for best long range recovery of natural conditions

Soils

- Amount of soil disturbance and erosion loss
- Amount of disturbed area
- Potential for maximum feasible rehabilitation within economic and legal limits

Wildlife and Livestock

- Loss of habitat by restricting movement
- Displacement of animals (wildlife and livestock) by noise or human activities

Other

- Loss of dispersed recreation
- Loss of grazing resources (AUMs) or permitted livestock

### Attain the Widest Range of Beneficial Uses of the Environment Without Degradation or Unintended Consequences

- Effect on existing uses and activities
- Long term risk of contamination
- Probability of design failure

### Assure a Balance between Population and Resource Use which will Permit High Standards of Social, Economic, and Cultural Surroundings

- Potential for disruptive socioeconomic effects and/or the best mitigation opportunities
- Potential for socioeconomic mixing with local area values
- Effect or archeological sites or opportunity for recovery prior to development

## Goals and Objectives from Higher Order Laws, Regulations, Plans or Policy Statements

### Consistent with Higher Order Plans

- Within guidelines of and best coordinates the project with requirements of the Mountain City Multiple Use Plan
- Consistent with established Forest Service regulations
- Within the guidelines set forth by the 1872 Mining Law and subsequent amendments

## Test of Legal, Technical, Financial, Economic and Political Feasibility

### Alternative Must be Technically Possible

- Effectiveness of engineering options
- Alternative which Freeport Gold Company is most financially willing to pursue
- Assurances from private landowners for rights-of-way or leases

### Alternative Should be Acceptable to Concerned Public

- General acceptance of the project alternative by the concerned public
- Potential for political repercussions

### Alternative Should be Economically Efficient

- Relative capital investment cost effectiveness
- Economic feasibility for mining operations

### Alternative Must Meet All Legal Requirements

- Violation of any Federal, state, or local requirements

View of the Marlboro Canyon mine site taken from peak of California Mountain.

# APPENDIX C
# PROPOSED ACTION

This appendix describes the elements and facilities comprising the various components of the proposed Jerritt Canyon Project: the activities and schedules associated with the construction, operation, and abandonment of each component, and the detailed mitigation measures proposed in order to minimize the environmental effects of the project activities.

This appendix also provides a more detailed description of Freeport's 25-year program for possible development of Mining Areas 2 and 3 in the southern two-thirds of the Jerritt Canyon claim block (see Figure 4-3).

## Project Components

### The Mine

#### Mine Construction and Operation

##### Mining and Reclamation Equipment

Freeport will conduct the development and reclamation of the mines with its own personnel and equipment, although a general contractor may be employed in the initial mine prestripping operation. Freeport's proposed equipment is listed in Table C-1.

**TABLE C-1**

**Heavy Equipment Roster For the Proposed Jerritt Canyon Project**

| | Capacity/Model Each | Number of Units | Horsepower of Each Unit | Long-term Usage Factor* |
|---|---|---|---|---|
| Front-end Loader | 10 cu. yard | 3 | 550 | 2.0 |
| Blast Hole Drills | 6-3/4" holes, truck-mounted | 3 | 230 | 1.8 |
| Rear Dump Trucks | 75-Ton | 10 | 600 | 7.5 |
| Road Graders | 14 G Type | 2 | 180 | 1.0 |
| Water Trucks | 3600 Gallon | 2 | 600 | 1.1 |
| ANFO Powder Truck | | 1 | 200 | 0.7 |
| Maintenance Trucks | 5-Ton | 3 | 175 | 1.5 |
| Pick-up Trucks | 3/4-Ton | 7 | 125 | 4.5 |
| Bulldozers, Tracked | D-8 Type | 2 | 250 | 1.5 |

*The long term usage factor indicates the number of equipment units which are expected to be operating simultaneously.

**SOURCE: FREEPORT GOLD COMPANY**

##### Overburden Removal and Mining Operation

The mining cycle will begin by drilling vertical blast holes along the edge of each bench. A powder truck will load the closely spaced grid of shallow blast holes with the ANFO slurry. Upon detonation, the in-place rock will be broken into fragments ranging in size from pea gravel up to 30 inches in diameter. For the Jerritt Canyon Project, an estimated consumption rate of 0.5 pounds of ANFO per ton of overburden or ore moved is considered adequate. For an average year, the company will use about 1,272 tons of ANFO or equivalent explosive.

Following about one year of overburden stripping, sufficient gold ore will have been exposed to allow production mining to begin. Beginning at the upper elevations of each mine, the mining process will progress by sequential benching downward, using 20-foot high benches. After detonation, two 10-cubic yard front-end loaders will scoop up the fractured ore and load the 75-ton rear dump trucks. Several of these dump trucks will shuttle back and forth between the mine and the primary crusher stockpile at the mill until the broken ore is exhausted.

During the blast hole-drilling operation, samples will be collected from the bore hole cuttings. These cuttings will be labeled and taken to the assay laboratory. Within this assay lab, the cuttings will be analyzed for gold content and for type of gold ore (oxide or carbonaceous). Using the assay analysis information, mine personnel will then stake the new blast hole area for future ore stockpile segregation or for waste rock disposal.

The excavated gold ore will be loaded at the mine pit into off-highway 75-ton rear dump trucks. These trucks will then traverse the interconnecting ramp system along the pit walls and proceed to the appropriate primary crusher stockpiles at the mill.

#### Mine Mitigation Program

##### Drainage Control

Diversion ditches will be constructed to divert natural surface runoff around the mine pits back into natural watercourses downstream from the mining area. Corrugated metal pipe culverts will be installed where needed to carry water below roads and surface utilities. Along critical reaches of the diversion ditch system, the channel sides and bottom will be lined with suitable rock (riprapped) to maintain stable channel sides and prevent erosion.

While Freeport does not anticipate that any significant ground water seepage will be encountered during the mining operation, a few small springs and ground water pockets may be intercepted during the excavation of the mines.

Within the ore zone, a series of collection channels will be maintained to feed a mine sump with ground water seepage and precipitation which falls into the pit. [1/] The sump will be located in the lowest elevation of the pit floor and will be equipped with a submersible pump. Water entering the sump will be transferred via the submersible pump and a stand pipe to the water trucks for haul road dust control. Any water which flows into the sump in excess of that quantity which could be used for dust control will be diverted to natural stream channels.

#### Snow Management

Light falls of snow will not create any obstruction or problem for mining at the Jerritt Canyon Project. Snowfalls of 6 inches or less will require no unusual operating procedure. Motor graders will be used on haul roads to minimize buildup of packed snow in a continuation of their normal duties of road maintenance.

Very heavy snowfalls, or reopening of an area which has not been worked for an extended period of time, will require the physical removal of snow. This will be accomplished by a bulldozer-loader-truck activity: bulldozers piling the snow accumulation, and front-end loaders placing the snow into rear dump trucks. Snow will be transported and dumped out of the mining area into a location which will not be overdumped by mine waste at a later time during the winter; this will avoid the problem of waste rock dump failure due to entrapped snow masses during the spring thaw.

#### Mine Reclamation And Revegetation

Reclamation of the mine area will be a continuing process throughout the life of the mine. Adverse environmental effects due to high, precipitous rock walls will be minimized by use of the 10-foot, 15-foot, and 20-foot bench heights and by the proposed $35^{o}$ to $45^{o}$ overall pit wall slope angle. Backfilling of mined out pit areas with waste rock will be practiced as feasible. Backfilling of the entire pit is not desirable, since changes in technology and gold prices may combine to allow extraction of additional lower grade ore from the mineralized deposit in the future. Never-the-less, some local backfilling using waste rock production is a possibility.

#### Waste Rock Reclamation and Revegetation

The average slopes of all mine waste disposal areas will be shaped to the natural angle of repose. Using a team of bulldozers, the surface and edges will be graded in a manner to accomplish two objectives:

- Restructure the shape of the disposal areas to conform to the natural landforms in the Independence Mountains, thus minimizing visual instrusion, and
- Reshape the disposal areas when necessary to allow natural runoff to spread out and prevent erosion of the dump surface.

Following completion of post-mining reclamation, native and non-native vegetation species will be seeded to re-establish the natural ground cover in portions of the mine pit and on waste disposal areas. Final topography will include a depression in areas where mining occurred and hills where waste disposal areas were constructed. Aesthetically, the post-mining landscape will feature the ridge and valley topography which characterizes the area and, although an observer will be able to detect former pit and disposal area locations, the revegetated disposal sites should present no sharp grade breaks which may be visually offensive.

### Corridors

Specific elements of the corridor options for this project include access roads built for conventional vehicles, haul roads built for large off-highway ore trucks, pipelines carrying both tailings and fresh water, and finally, powerlines to serve the mill and other components. The ultimate corridor network is estimated to disturb on the order of 200 acres.

#### Corridor Construction

Road construction will be done primarily by bulldozers and road graders, although some drilling and blasting may be required in difficult mountainous sections. Development of the access road on government lands will begin as soon as possible after completion of the permitting process. Road construction will proceed simultaneously from both the mill site end of the corridor and from the appropriate paved state highway to allow rapid completion of road building. Simultaneously with initial mill complex work, construction will begin on a haul road from the mill to the mine, from the mine to waste rock disposal areas, and across the ore-body area to allow access for preproduction overburden stripping. Construction of the access road will require approximately six months. Construction and abandonment of haul roads will be a continuous process throughout the life of the project.

Construction of water supply and/or tailings pipelines will involve the clearing of a right-of-way and the digging of a trench along side the roads. Trucks carrying pipeline sections and bulldozer-mounted cranes will then travel the right-of-way placing pipeline sections into the trench. The pipeline construction schedule will depend upon the final length of the line, but will probably require fewer than six months.

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[1/] At 8,000 feet of elevation in the Independence Mountains, the annual average precipitation is about 26 inches of water.

### Corridor Operation

#### Access Roads

An access road, by definition, is a road which connect the public highways to the project area. For the Jerritt Canyon Project, the primary access road will connect either Nevada Highway 11 or Nevada Highway 51 with the mill complex. This access road will be used by project personnel, vendors, contractors, and the public for egress or ingress to the project area. Public access will be controlled at the gate into the mill complex or at the paved state highway. Heavy off-highway vehicles will not be used on the access road.

The road base will be formed of local rock and gravel materials produced during ditching and grading of the road alignment. Aggregate for the road surface will be produced at a gravel pit near the road route. Typical cross sections of the major types of road construction are presented in Figures C-1, C-2, and C-3.

The access road surface will be paved with asphalt prior to beginning the mill operation to provide a good traveling surface and to minimize dust. The access road will be used for daily transportation of workers to and from the mine by bus, small truck, or automobile, in addition to transport of equipment and supplies to and from the mill site.

#### Haul Roads

Mine haul roads, which will not be utilized for public access, will be constructed for passage of off-highway haul trucks, other heavy mine equipment, and mine service vehicles in the following areas: (1) from the crusher and maintenance shop area to the mine, (2) within the mine pit, and (3) between the pit and adjacent waste dumps and ore stockpiles. Some of the mine haul roads are of a temporary nature, serving a sector of the mine for a limited period; thus, the placement of some haul roads changes as the mine operation demands.

#### Pipelines

In those alternatives featuring long tailings pipelines, both water and tailings pipelines will be constructed parallel with the road alignments in most cases. Occasionally, the pipeline routes may diverge from the roads somewhat to save construction costs, because the pipelines do not have to maintain the same gentle gradients and sharp curves as do the roads. Details for the construction and operation of the tailings line are presented in the Tailings Disposal System section and for the water supply pipelines in the Support Facilities section.

#### Power Transmission Lines

Conventional, above-ground power transmission lines will be installed to the mill, and from the mill site to the water pumps, to the tailings pond, and to the communications tower. Freeport may use diesel generators to produce their own power on-site, or commercial power may be purchased and brought into the site via transmission lines from a new substation near the junction of Highway 11 and Highway 51. The details of powerline construction and operation are presented in the section on Support Facilities.

### Corridor Mitigation Program

#### Runoff and Erosion Control

All runoff from access and haul roads will be directed along the roads by berms and ditches to prevent uncontrolled erosion of road surfaces. In most areas, culverts and drains will be installed as necessary to redirect the water into the natural drainages.

Techniques for control of waterborne erosion will be used to limit erosion at its source and to trap or filter sediment as may occur immediately adjacent to the road right-of-way. The goals for erosion control for the Jerritt Canyon Project corridor construction and operation are:

- To maintain water quality in the principal streams to a level that will be acceptable to existing fish and wildlife needs; and
- To prevent erosion's deteriorating effect on the integrity of the road structures.

Specific design criteria which will help to achieve these goals relate to the corridor construction techniques and a variety of simple mitigation measures. For example, cut slopes should be no steeper than 1½:1 (1½ horizontal units for every vertical unit of measurement) in areas where a slope intercept can be achieved at a distance not exceeding 50 feet. Fill slopes should be 1½:1 or flatter.

In an overall scheme of erosion control, a number of control measures will be integrated together to establish a system. For the new corridors at the Jerritt Canyon Project, the system will include:

- Berms - to contain roadway surface runoff from uncontrolled spill over an unprotected fill slope.
- Silt barriers - to trap silt carried from sheet runoff rivulets.

Erosion from haul and access roads will be controlled by installing vegetation on all cut and fill slopes. Water that runs off the roads will be diverted to ditches on the cut side of the road and then diverted by underground culverts to the downstream side of the road. At the point where the culvert discharges, silt barriers (composed of rip-rap) will be installed to collect silt and also to drastically decrease the velocity of the water and spread the flow out over a large area so that natural vegetation can effectively filter out silt.

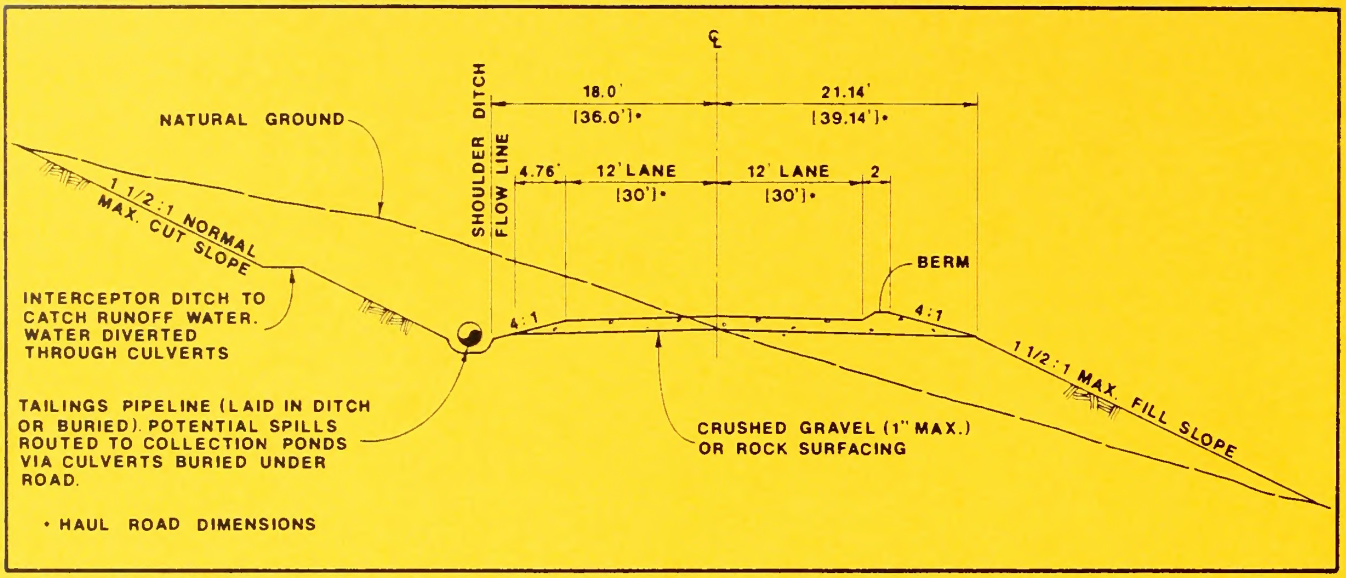



**FIGURE C-1 Typical Section of Road Construction Along California Mountain**
**SOURCE: FREEPORT GOLD COMPANY AND INTERNATIONAL ENGINEERING COMPANY, INC.**

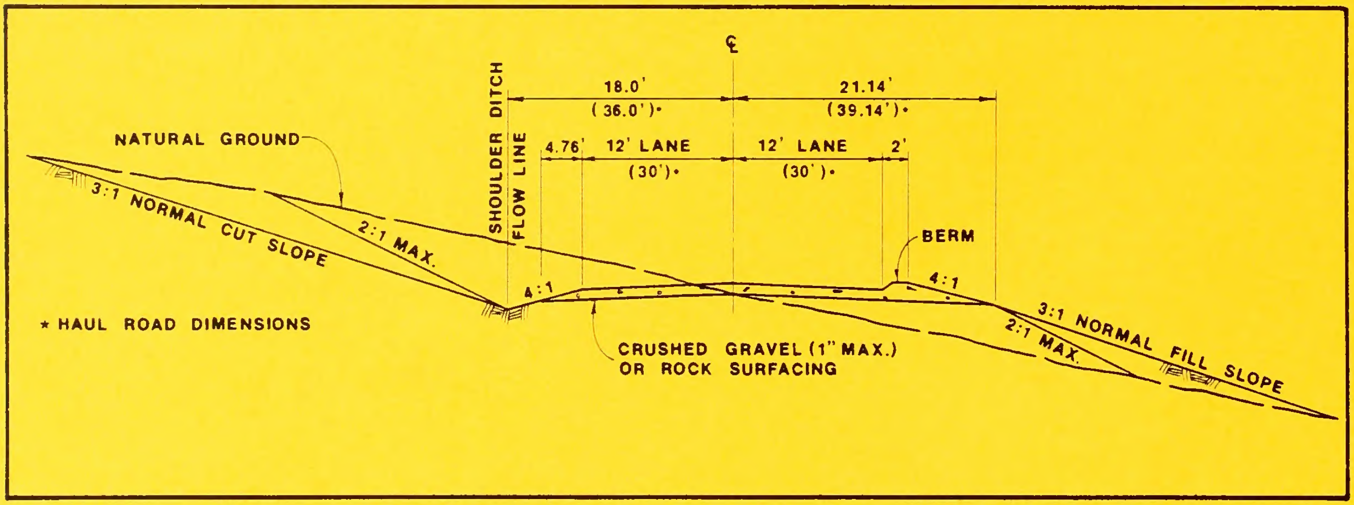



**FIGURE C-2 Typical Section of Road Where Natural Ground Slopes are 4:1 or Flatter**
**SOURCE: FREEPORT GOLD COMPANY AND INTERNATIONAL ENGINEERING COMPANY, INC.**

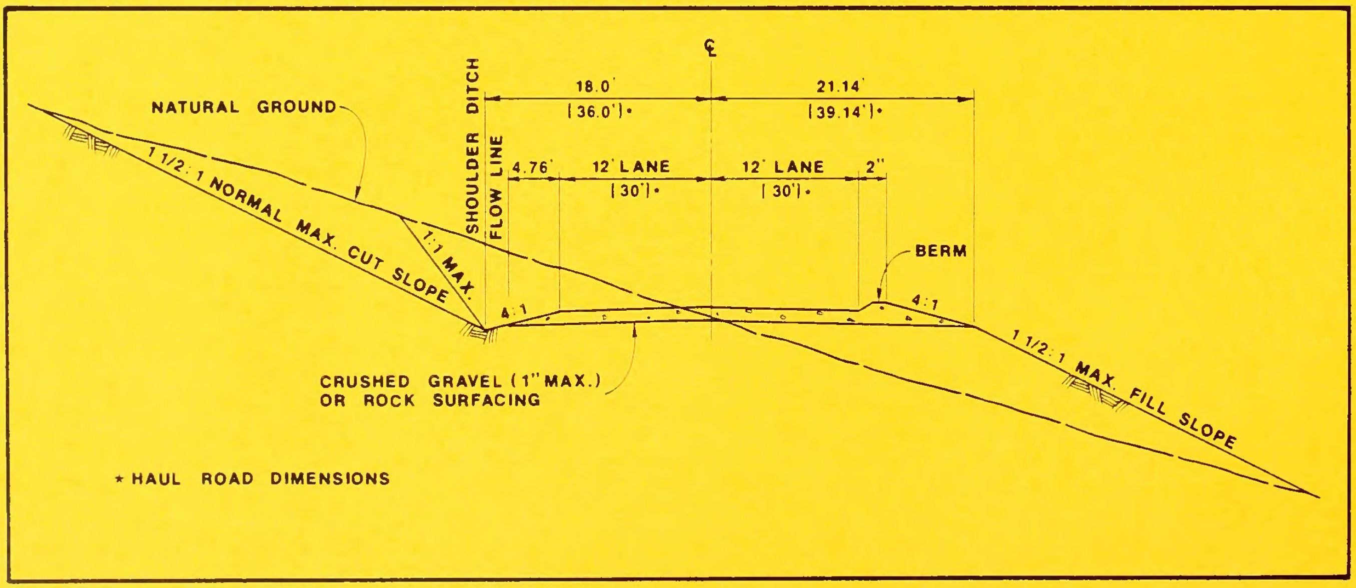



**FIGURE C-3 Typical Section of Road Where Natural Ground Slopes are Steeper Than 4:1**
**SOURCE: FREEPORT GOLD COMPANY AND INTERNATIONAL ENGINEERING COMPANY, INC.**

#### Dust Control

Roads will be maintained by motor graders, with dust control on haul roads provided by water trucks. The sprinkler trucks will utilize mine drainage water as much as possible.

#### Vegetation Control

All cut and fill slopes will be seeded to control erosion.

#### Snow Management

Snow will be removed from all haul and access roads, and will be dumped on land away from waste rock disposal areas.

#### Reclamation and Revegetation

Reclamation of abandoned haul roads will involve the smoothing of sharp grade breaks and ripping of hard surfaces to prepare the areas for reseeding. At abandonment, the same will be true of the access road if the Forest Service or BLM does not wish to retain it for future recreational access.

Grading efforts will not be necessary to reclaim the pipeline and utility rights-of-way. Removal of the power poles will be sufficient to allow these corridors to return to a natural state.

Following completion of post-mining reclamation, seeding of native and non-native vegetation species will re-establish the natural ground cover. The roadway surfaces will be ripped to allow natural water infiltration and a rough surface for seed entrapment.

The pipeline and utility corridors will not experience regular traffic so that during the project operation the corridors should re-establish any low-growing vegetation lost during construction. Reclamation of the utility corridors will involve no more than removal of the man-made facilities, unless BLM requests specific reseeding on local areas.

### The Mill

Two separate and distinct types of gold ore occur in Freeport Gold Company's mineral deposit. The two ore types are classified, from a mineralogical standpoint, as oxide and carbonaceous. Oxide ore can be processed using conventional cyanidation techniques. Carbonaceous ore requires a more complex and proprietary treatment involving a preoxidation and a chlorination treatment prior to using conventional cyanidation techniques. The mill will initially be designed to treat 2,000 tons of ore per day, with provision for possible expansion to 3,000 tons of ore per day built into the facility. The mill circuit will feature a common ore crushing section and two separate circuits to grind and treat both oxide and carbonaceous ore, respectively.

#### Mill Construction

Freeport's gold mill will be erected on a 75-acre mill complex along with a number of support service buildings and facilities. Details for the mill complex construction are described in the Support Facilities section.

#### Mill Operation

##### Water Balance

Total mill water requirements will be approximately 580 gallons per minute. It is not possible to recirculate wastewater from the carbonaceous ore circuit due to the high chloride content of the effluent. However, wastewater from the oxide circuit can be recycled and Freeport may elect to construct a tailings dam with a midpoint barrier to allow recycling of the oxide circuit wastewater. However, it is more likely that the oxide circuit tailings and the carbonaceous circuit tailings will be mixed and pumped to a combined tailings disposal area. It is expected that the tailings mixture will consist of 50% solids and 50% water. Once the tailings reach the disposal pond, the water will be allowed to evaporate.

##### Reagents

Freeport Gold Company has prepared an estimate of the chemical reagents that will be used in the proposed 2,000 tons per day mill process. The major reagents and expected consumption on a daily and yearly basis are shown in Table C-2.

In addition, it is expected that small quantities of sodium hydroxide and sodium sulfide will be used.

**TABLE C-2**
**Estimated Consumption of Chemical Reagents**

| | Estimated Consumption Rate | |
|---|---|---|
| Chemical Reagent | Pounds Per Day | Pounds Per Year |
| Sodium Carbonate (soda ash) | 50,000 | 18,250,000 |
| Liquid Chlorine | 50,000 | 18,250,000 |
| Sodium Cyanide | 4,000 | 1,460,000 |
| Activated Charcoal | 100 | 36,500 |
| Burnt Lime | 10,000 | 765,000 |
| Various Fluxes | 115 | 42,000 |

SOURCE: FREEPORT GOLD COMPANY

##### Ore Crushing and Grinding

Ore from the ore stockpiles will be fed into the primary crusher by front-end loaders. The resulting crushed ore will be routed via conveyor belts to the appropriate carbonaceous or oxide ore surge stockpiles directly adjacent to the mill building. Two separate 1,000 tons per day semi-autogenous mill grinding circuits will be provided for individual processing of carbonaceous ores or oxide ores. The purpose of the grinding circuit is to convert the crushed ore (½ to 6-inches in diameter) to finely pulverized particles about 0.012-inches in diameter. (See Figure C-4 for a schematic diagram of the crushing, grinding, and milling circuits.)

### Carbonaceous Ore Processing

From the grinding circuit, the segregated carbonaceous ore will pass through a series of proprietary steps to convert the carbonaceous ore into an oxide-type gold ore. The heart of the process is the use of chlorine gas as an oxidant to break down the carbonaceous nature of the ore. Following preoxidation the carbonaceous ore will be processed in a circuit similar to that used for oxide ore.

### Oxide Ore Processing

After the oxide ore is ground, the slurry is agitated in a series of tanks with about 0.1% sodium cyanide and about 0.2% lime. After dissolution, the gold is recovered by the carbon-in-pulp process. In this process, activated charcoal is added to adsorb the gold in solution. A series of six to eight tanks are used to agitate the slurry. Activated charcoal is added to the last tank and is advanced from tank to tank by screening the coarser charcoal. In this manner, the charcoal is moved countercurrently to the flow of slurry which results in the highest loaded carbon being in contact with the highest grade solution and fresh unloaded carbon being contacted with lean solutions. The loaded carbon that is removed from the circuit is then treated in the stripping circuit.

### Activated Carbon Stripping

The purpose of the carbon stripping circuit is to remove the gold from the carbon and electro-deposit it onto steel wool covered sheets (cathodes). From the oxide and carbonaceous circuits, the gold-loaded carbon will be fed into steel tanks. Desorption (stripping) of the gold will be accomplished by passing a hot solution of sodium hydroxide and sodium cyanide through the carbon-gold slurry. This process will break the gold from the carbon and put the gold into solution. This gold-bearing solution will then pass through a zinc precipitation unit. The residual carbon (charcoal) from the process will be regenerated into activated carbon by heating it in a kiln. The finished reactivated carbon will then be recycled to the oxide and carbonaceous ore circuits.

### Gold Refining

The gold precipitate obtained from the zinc precipitation unit will be smelted in a small furnace and then poured into 1,000-ounce bars. (The small smelting furnace will only operate 2 to 3 hours per week.) The gold bullion bars will then be cleaned, weighed, and stored in a vault to await shipment to market.

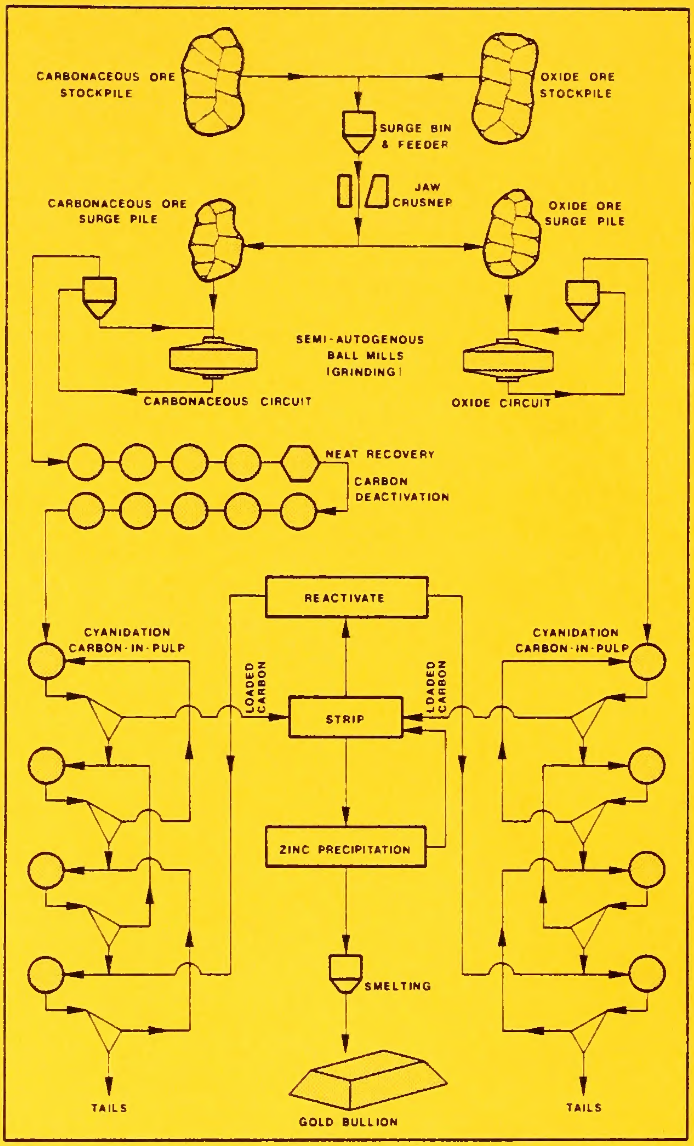



**FIGURE C-4 Proposed Gold Mill Circuit**

**SOURCE: FREEPORT GOLD COMPANY**

## Mill Mitigation Program

### Gaseous Effluent Control

Sources of gaseous effluents from the mill processing area will be: (a) exhaust gases from a small coal-fired industrial boiler (The boiler will produce less than 25,000 pounds per hour of 150 psig steam), (b) off-gases from the chlorination tanks, (c) exhaust gases from the smelting furnaces, and (d) exhaust gases from the diesel generator. At present, it is anticipated that total sulfur dioxide ($SO_2$) emissions will amount to about 230 tons per year or about 1,300 pounds of $SO_2$ per day. The amount of $SO_2$ that is emitted meets all Federal and state criteria for ambient air standards.

Off-gases from the chlorination tanks will be scrubbed in a tower through which a solution of sodium carbonate will be pumped. Any chlorine present in the off-gases will be absorbed in the solution. A small solution bleedoff will recycle the chlorine back to the mill circuit. Off-gases from the scrubbing system will consist mainly of carbon dioxide and water vapor.

Exhaust gases from the smelting furnaces will contain $SO_2$ and particulates. $SO_2$ emissions are expected to total about 2.5 tons per year or about 13.5 pounds of $SO_2$ per day. The particulate control program for these furnaces is described in the next section.

### Solid Effluent Control

Excluding the mill tailings, solid effluents from the mill area will consist of airborne particulates from various sources: (a) road traffic, (b) dust generated from the crushing plant and mill stockpiles, (c) particulates present in the smelting furnace off-gases, (d) particulates from the diesel generators (if used), and (e) particulates from the coal-fired steam boiler.

A water tanker will be provided which is equipped with spray bars. This tanker will be used to spray water on the haul road to control fugitive dust emissions, as required.

The primary crusher building will be equipped with a dust collection system above the feeder, crusher, and conveyor transfer points. Dust collected in this system will be gathered in a wet scrubber. The dust will be mixed with water and pumped to the carbonaceous ore grinding circuit. In addition, water sprays will be provided at transfer points and on the conveyor systems to control dust emission.

Off-gases from the smelting furnaces will be treated in a 2,500 cubic feet per minute electrostatic precipitator. Particulates collected in the precipitator will be disposed of in the mill tailings or recovered and sold as a by-product (possibly mercury).

The tailings will be kept in a wet or moist condition so that no dust will escape into the atmosphere. (See a more detailed writeup under Tailings Disposal System.)

### Liquid Effluent Control

In the treatment of the ore by both chlorination and cyanidation, several constituents in the ore, other than gold, will be dissolved. Some of these elements, for example mercury, will be removed from solution and either precipitated and returned to the tailings in solid form or commercially recovered as a metal. Other elements remain in solution and will be carried in the liquid portion of the tailings. In addition, the tailings will contain some spent reagents. Based upon bench scale metallurgical studies conducted by Freeport, the expected analysis of these elements and reagents in the liquid portion of the tailings will be as follows:

| Reagent or Metal | Expected Concentration in Tailings Liquid (Milligrams per Liter) |
|---|---|
| Arsenic | 1.0 |
| Barium | <0.5 |
| Cadmium | <0.2 |
| Chromium | <0.1 |
| Lead | <0.5 |
| Mercury | 0.4 |
| Selenium | 0.01 |
| Silver | <0.3 |
| Sodium Cyanide | 0.05% |

It should be pointed out that the concentration of the various elements listed above is subject to variation depending on the mineralogy of the ore being treated. Cyanide decomposes rapidly into non-toxic elements. As the water in the pond evaporates, mercury and arsenic are precipitated and returned to the solids part of the tailings. There will be no liquid discharged from the mill or tailings system into surface or ground water.

### Mill Decommissioning

A discussion of the proposed mill abandonment operation is described in the Support Facilities section of this appendix.

## Tailings Disposal System

The milling of gold ore will result in the suspension of finely ground rock mixed with mill wastewater. This slurry is referred to as the tailings. Final disposal of the tailings will be accomplished via a pipeline to a dam and reservoir for evaporation of the liquid portion and permanent storage of the solid portion.

### Tailings Disposal System Construction

While exact construction methods are not presently known, typical dam construction techniques can be presented. These construction techniques were developed by the geotechnical firm of Sergent, Hauskins & Beckwith.

The conceptual embankment design for the tailings disposal dam is shown in Figure C-5. A full height central core zoned embankment dam will be built to minimize seepage of tailings fluids from outside the impoundment and to provide a safe design for potential earthquake effects at the site.

Major features of the conceptual design are as follows:

- A relatively thick core will be built to minimize seepage. This central clay core will extend through the more permeable surface material to the clay materials which underlie the axis at about 10 to 15 feet in depth.

- Sandy transition zones will be constructed both upstream and downstream from the core.

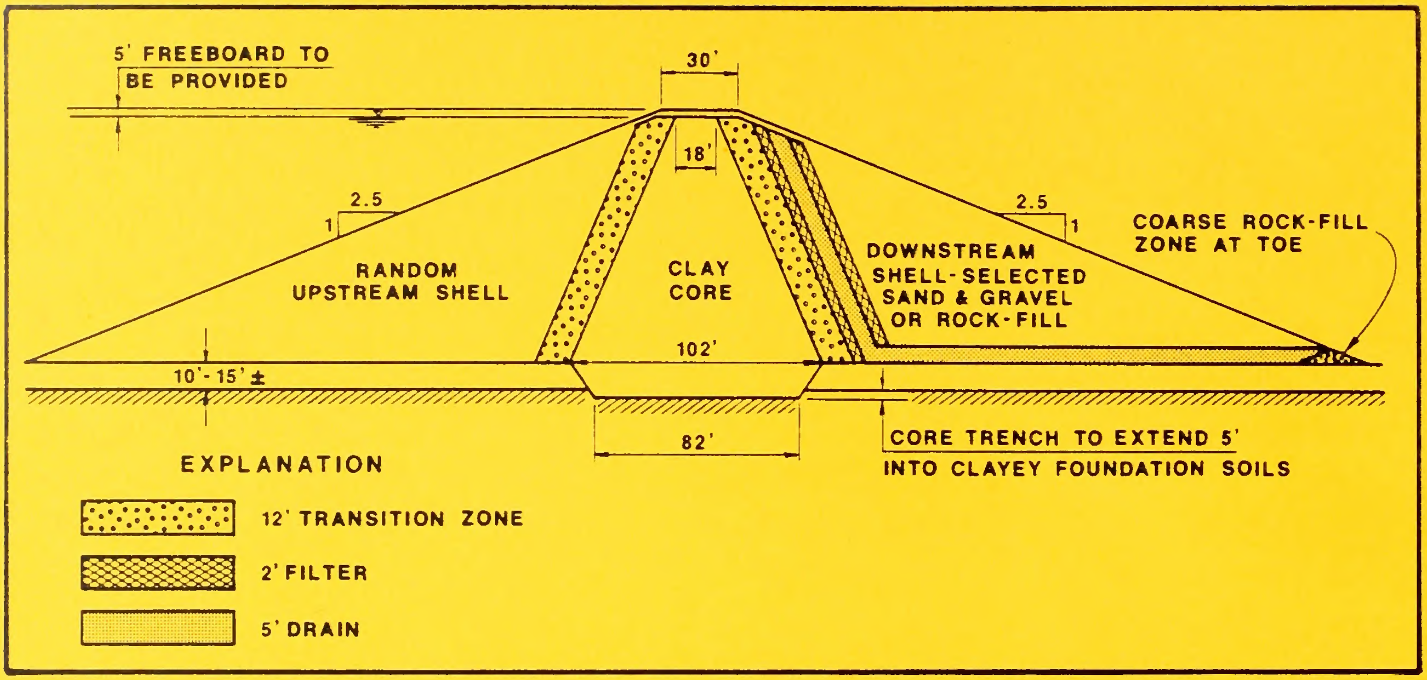



**FIGURE C-5 Schematic Cross Section of Zoned Earthfill Embankment With Central Core**
**SOURCE: SERGENT, HAUSKINS & BECKWITH, 1979**

- A thick gravel drain will be placed downstream of the transition zone extending to the toe. Two-foot granular filter zones will be built on both sides of the inclined portion of the drain.

- An upstream shell zone consisting of random granular materials will be constructed.

- A downstream shell zone consisting of selected granular soils or rock-fill will be built.

- Removal of any softer surface soils from beneath the embankment foundation where they occur will be performed to provide relatively uniform stiff support throughout. No more than 1 or 2 feet of soil removal will be necessary.

Five feet of freeboard plus 1.5 feet of camber to allow for embankment settlement was considered in the conceptual design. The potential for 2 feet of settlement in a major seismic event was also considered in analysis and design of freeboard.

In addition, the tailings pond will be located on top of areas that contain 30 to 70 feet of impervious clays which will prohibit any verticle seepage of tailing water into ground water acquifers.

**Tailings Disposal System Operation**

Carbonaceous ore tailings and oxide ore tailings will be transported by the pipeline to the tailings dam. Transmission of the tailings will be accomplished by pumping, by gravity flow, or by a combination of the two, depending upon the location of the mill and tailings pond.

After reaching the tailings pond site, the pipeline will be routed along the top of the dam. Discharge spigots will be placed at intervals to allow the tailings to enter the pond at several locations to provide for a level accumulation of tailings. Disposal of water will be accomplished by evaporation. Net evaporation rates for the area average 30 inches per year. Should additional evaporative capacity be required, a floating barge pump will be provided to pump water into a series of sprinklers which will spray water over the tailings pond.

**Tailings Disposal System Mitigation Program**

**Surface and Ground Water Drainage Control**

The following elements of the instrumentation and monitoring system will be installed:

- Hydraulic piezometers placed at about 500-foot centers in the lower part of the drain near the core.

- Open-well piezometers placed beneath the centerline of the dam in the lower part of the core at approximately 500-foot centers.

- A row of monuments located just downstream from the crest spaced at 200-foot centers to allow measurement of elevations and relative vertical movements.

- Open gravel-packed sampling wells with 4-inch casing spaced at 300-foot centers near the toe of the dam for seepage monitoring and water quality sampling.

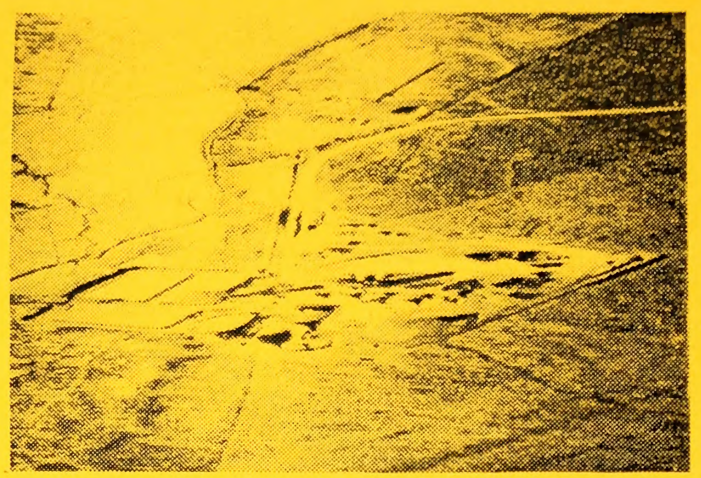
A collection system will be placed by extending the granular drain at the toe of the dam to the contact of the clayey soils at about 10 to 15 feet. A collection pipe will be installed at the bottom of the drain leading to a sump placed about 150 feet downstream from the toe of the dam at the low point in the drainage. Any liquid material caught in this manner will be pumped back into the tailings pond.

### Tailings Line Spill Management

The final choice of the location of a mill site and tailings site will greatly influence the management of potential spills from tailings lines. If the mill site and the tailings site are located within 1,000 feet of each other, monitoring and treatment of spills will be much less complicated than if the tailings line traverses a corridor of 5 to 7 miles in length.

On short distance tailings lines, the pipe will be supported on piers or laid along the ground. The line will contain flowmeter and pressure indicators that will be designed and constructed to immediately shut down the pumps (or in some cases a gravity non-pressure system would be used). The tailings line will also be monitored frequently for leaks. If a leak or spill does occur, the tailings material will be immediately treated with chlorine compounds, a sodium hypo-chlorite to deactivate the cyanide, and the spilled material will be hauled to the tailings pond. Water spilled from the tailings line will be routed into a ditch that will flow to the tailings pond or back to the emergency spill pond that is located in the mill area.

On long distance tailings pipelines, the line design will either be a rubber lined or cement lined pipe that could be buried or laid above ground, or a drop box arrangement. A drop box arrangement is a gravity flow system in which the tailings slurry flows in a pipe on a 2% downward slope and at various intervals drops into a vertical 3-foot diameter vertical concrete pipe section. The overall system is similar to a stairstep design with tailings flowing into the top of the drop box and discharging out at the bottom. If the rubber lined or concrete lined pipe design is chosen, then both pressure indicators and flow meters will be installed on the line to monitor for breaks in the line. These instruments will be tied into a control board so that if a break occurs in the tailings line, the tailings pumps will automatically stop pumping. If the drop box design is chosen, then there will be a level indicator at the top of each drop box which will stop the tailings pumps if any of the drop boxes plug up and tailings start to pour out of the top of the drop boxes. It is felt that with the gravity (non-pressure) system, there is no chance of the pipeline segments between each drop box breaking and causing spillage of tailings. In any design method, the tailings line will be so constructed that if there is a leak the material will flow into a ditch on the cut side of the road. Tailings material will be diverted under the road in a series of culverts. The culverts will discharge into a series of sedimentation ponds on the fill side of the road where the tailings material will be collected. Chlorine compounds or sodium hypochlorite will be used to deactivate the cyanide in the tailings solution so that no tailings solution will enter any streams.



Aerial view of barite processing plant in Independence Valley.

### Fencing

Freeport will install a 8-foot high fence around the tailings pond.

### Reclamation and Revegetation

Following shutdown of operations, sufficient time will be allowed for surface water to evaporate. This is expected to take between one and two years. After drying, the tailings will be shaped and contoured to blend into the natural landscape. A 4-foot thick cover of soil and sub-soil materials will be spread over the tailings area. This cover will consist of 2½ feet of inert granular fill material, topped with 18-inches of soil. Sufficient quantities of soil and inert fill material would be developed in borrow areas near the tailings disposal pond, or would be excavated from the pond area itself prior to tailings disposal operations. A reseeding program will be undertaken, using both native and non-native species of vegetation to achieve cover and stabilization of the tailings. Sprinkler irrigation may be necessary for one season to reestablish suitable vegetation on the tailings area.

## Support Facilities

Almost all of the wide variety of physical service functions, buildings, storage yards, pollution control systems, utilities systems, etc. which are used in support of the mining, milling and transportation operations are located in a 75-acre complex centered around the gold mill.

Facilities which will be provided at the proposed 75-acre complex include:

- Office and maintenance shops
- Water storage tank
- Ore stockpile areas
- Parking area
- Soda ash and burnt lime storage facilities
- Sewage treatment plant

- Primary crushing plant
- Emergency spill pond
- Warehouse
- Water treatment plant
- Grinding plant
- Reagent storage building
- Mill building
- Power generation plant (an option)
- Tailings pump house
- Power substation (an option)

The proposed building layout, stockpile and pond locations, mill complex perimeter, and exclusion boundary (fence-line) are shown in Figure C-6.

**Support Facilities Construction**

Construction work at the mill complex will consist of site preparation (roads, site grading, foundation excavation) followed by erection and equipping of offices and change room, crushing and concentrating facilities, maintenance and warehouse structures, and other related facilities. The mill complex buildings will be of structural steel and the exterior panels will be earth-tone in color. Approximately 19 months will be required for detailed engineering and plant construction; it is anticipated that actual field construction will require 12 months. A diesel-driven power plant will be installed at the mill site to provide temporary electrical power during construction.

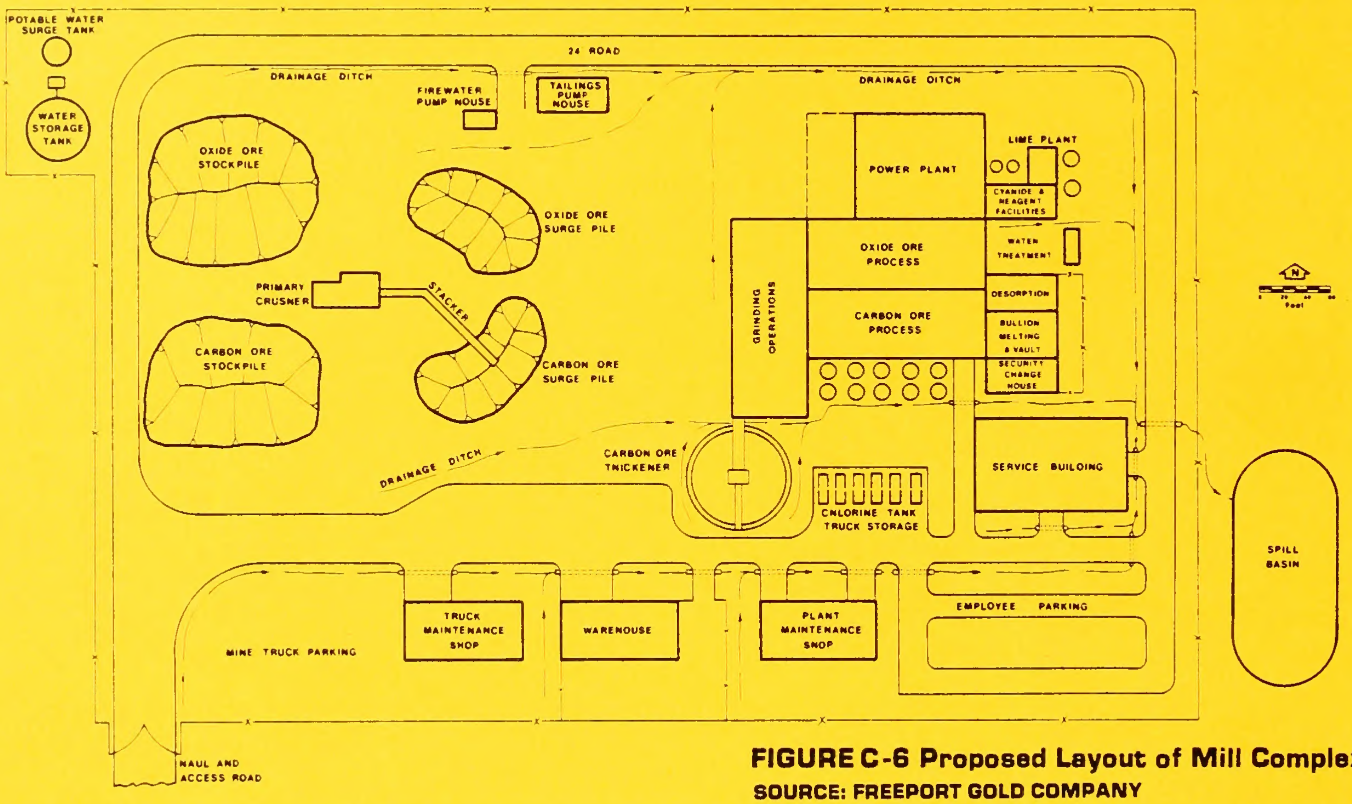
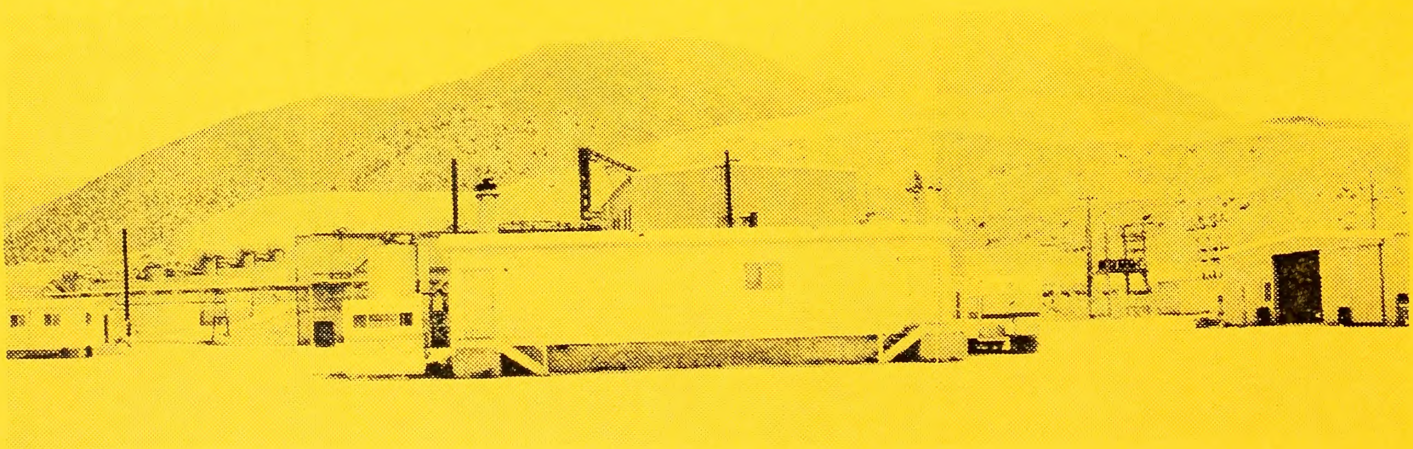



**FIGURE C-6 Proposed Layout of Mill Complex**
**SOURCE: FREEPORT GOLD COMPANY**



A panoramic view of a typical gold mill complex. This is a 1,000 TPD gold mill at Cortez, Nevada.

### Support Facilities Operation

#### Maintenance Shops and Warehouse

The principal shops, offices, and warehouse within this mill complex are listed below along with their approximate external dimensions.

Proposed Maintenance Shops, Offices, and Warehouse for the Jerritt Canyon Project

| Structure | External Dimensions |
|---|---|
| Mill service, office & labs | 80' × 130' |
| Warehouse | 100' × 100' |
| Mining service shop & office | 50' × 150' |
| Mill shop | 50' × 100' |
| Boiler & compressor building | 50' × 80' |

#### Fuel and Explosive Storage

Gasoline for use in vehicles and mine equipment will be stored in underground storage tanks. A vehicle filling station with pumps will be provided for each tank. Fuel trucks will be used to distribute fuel to other field equipment. These storage facilities will be constructed at the mill complex and the mine.

Two above-ground diesel fuel oil storage tanks (about 40,000 gallons each) will serve the mill and mine. This storage area will be diked to contain any accidental spills. If necessary, two above-ground diesel storage tanks of about 70,000 gallons each will serve the power plant generator. These tanks will also be enclosed in a separate diked area.

Two magazines for explosives will be constructed by Freeport. One for detonators, and a second for explosives, safety fuse, detonating cord, and other blasting agents. These magazines will be located in accordance with the current American Table of Distances for storage of explosives. Construction and storage design will conform to regulations promulgated by the Mine Safety and Health Administration. Sites for these explosive magazines will be inactive areas with natural topographic shielding. Explosives will be transported at times and over routes that will expose a minimum number of persons.

#### Reagent Storage

Sodium carbonate (soda ash) and lime to be used for pH control will be received in bulk quantities. Pneumatic equipped truck trailers will discharge the soda ash into a 250-ton capacity storage silo. The silo will be equipped with an exhaust fan and baghouse which will collect soda ash dust generated during unloading operations. A separate similar area within the mill complex will be dedicated to the storage of burnt lime.

Chlorine will be received and stored in either tank trailers of about 20-ton capacity or in 1-ton cylinders. Sufficient parking space will be allocated for a total of eight tank trailers. Chlorine will be drawn from one tank trailer at a time as required. If 1-ton cylinders are used instead of tank trailers, 60 cylinders will be stored on site. Liquid chlorine will be gasified in a small steam-heated evaporator and then piped to the carbonaceous ore circuit in the mill.

Sodium cyanide will be received in 55-gallon steel drums. About 30 tons of cyanide drums can be handled in the reagent storage area. A stock cyanide solution will be mixed in a tank equipped with a vent and scrubber. Water spray from the scrubber operation will be disposed of as make-up water in the carbonaceous ore circuit in the mill.

Activated charcoal, fluxes, and other miscellaneous reagents will be stored in a 30 by 60-foot area in the reagent storage facility. Isopropyl alcohol will be stored in a separate isolated area in the reagent storage area.

#### Water Supply

The anticipated water requirements for the Jerritt Canyon Project are shown below:

| Type of Water Use | Maximum Flow (Gallons Per Minute) | Water Use (Acre-feet Per Year) |
|---|---|---|
| Potable (drinking) | 50 to 75 | 80 to 120 |
| Dust suppression | 45 | 70 |
| Process water | 580 | 935 |
| Fire control | 1500 | not applicable |
| Service water | 100 | 160 |

A permit has been obtained from the Nevada Division of Water Resources to drill water wells and use up to 1,000 gallons per minute (gpm) for domestic and industrial purposes. Freeport has drilled a well in Section 33 of BLM land in the North Fork Valley. The well will be furnished with a vertical turbine pump. Water will be piped in an 8-inch diameter pipeline which will be routed alongside the nearest access or haul road. The water will be stored in an 600,000 gallon main storage tank at the mill complex.

Potable (drinking) water will be obtained from the main storage tank. This potable supply will be treated to conform to stipulations in the U.S. Safe Drinking Water Act and regulations promulgated by the Nevada State Health Division. These 4,000 gallon tanks will supply a fresh water distribution system to all buildings and labs at the mill complex. Additional fresh water coolers for the mine employees will be distributed daily throughout the active mine and other remote work areas.

Well water not diverted into the potable water system will be used at the mill complex for industrial water purposes such as for mill process water, fire protection, dust control, and service water at the shops.

A vertical pipe and spigot hooked up to a pump will be constructed at both the mill complex and at the drainage sump in the mine pit floor to serve water trucks. Water collected in the mine and 2) commercial power from a generating station outside of Elko County. Both alternatives will be discussed in the following paragraphs.

## On-Site Power Generation

Electrical power requirements for the project can be provided by three diesel generators which can be located adjacent to the mill complex. Each diesel generator will produce 2.2 megawatts at 4.16 kilovolts (kv). Two units will operate continuously and one will be available as a backup unit.

Above-ground power distribution lines will be installed from the mill site to the water pumps, to the tailings pipeline pumps, to the tailings pond, and to the communications tower.

## Valmy-Midpoint 345kv Transmission Line

As an alternative to on-site power generation, Freeport has been negotiating with the Sierra Pacific Power Company to purchase commercial power from a 345 kv tap substation located along the Valmy-Midpoint 345 kv transmission line. Sierra Pacific and Idaho Power Company have begun construction of this 345 kv line from the North Valmy Power Plant to Twin Falls, Idaho. The line will be routed through a corridor just south of the Jerritt Canyon Project 6 to 8 miles north of the junction of Nevada Highway 11 and Nevada Highway 51. A substation will be erected near Highway 11 or Highway 51 and the line voltage will be stepped down from 345 kv to 120 kv. From this substation, Sierra Pacific has three alternatives to deliver the power to the Jerritt Canyon Project:

- A new 120 kv transmission line could be constructed north along the existing power line corridor adjacent to Highway 11 to one of the Jerritt Canyon or Northwest access corridors. From that point, an east-west line could be built from Highway 11 to the proposed mill site. Upon reaching the mill site, another substation will be constructed to further drop the voltage from 120 kv to 4.16 kv.

- A similar substation could be erected at the junction of Highway 51 and the North Valmy transmission line. Again, a new north-south 120 kv transmission line could be built from the substation to the Freeport mill complex along an existing utility corridor paralleling Highway 51 for most of the alignment.

- From the Highway 11 substation a new power corridor could be established going directly north along the eastern base of the Independence Mountains for 13 miles to the intersection of the Rancho Grande access road. From that point, the line would follow one of the proposed corridors leading to the preferred mill site.

None of the engineering or survey work has been completed for either transmission line or the substations. The 120 kv line will be constructed on a wooden H-frame structure consisting of two wooden poles, a wooden crossbrace, and either a wood or steel crossarm.

Construction access will be by means of existing roads where possible. Where such roads do not exist, overland travel will be employed. Where the terrain will not allow overland travel, new access roads will be constructed. Access between towers will not require bulldozer bladed trails except over rough terrain or where heavy brush interferes with safe vehicle operation.

During the conductor stringing activity, 150-feet long by 50-feet wide leveled pads must be constructed at approximate two mile intervals for puller or tensioner equipment. During stringing a small cat or 3/4 ton truck is driven down the right-of-way pulling hard lines.

Construction site materials (including uprooted natural vegetation) will be removed, and regular sanitary disposal of garbage, refuse, and liquid waste will be maintained in accordance with State regulations. Flammable liquid areas will be designed to retain liquids in case of spill.

Cleanup and site restoration will be an ongoing process. Rehabilitation and disposal will be handled one section at a time. All roads, trails, and disturbed areas no longer needed for line operation and maintenance will be restored to original gound level wherever possible. Disturbed areas along the corridor will be revegetated; however, use of chemical aids such as fertilizers, herbicides, or insecticides is not planned.

## Communication System

Freeport proposes to install a microwave tower system between a mill site and the City of Elko. Depending on the final selection of a mill site, there will be a repeater station on California Mountain or on Adobe Summit.

The repeater station will cover an area of approximately 200 square feet. The repeater station will also consist of a steel tower having dimensions of approximately 7 ft. x 7 ft. x 15 ft. high. There will be either one or two 6 ft. parabolic dish antennas mounted on the tower. In addition there will be an underground vault having the dimensions of 8 ft. x 8 ft. x 8 ft. The communication system will be linked to a powerline and to existing four-wheel drive roads.

## Support Facilities Mitigation

### Public Safety and Security

The Jerritt Canyon Project mill complex will occupy an area of about 1,000 by 700 feet, all of which will be fenced to prevent the entrance of unauthorized people. The mill complex area will be enclosed by a 6-foot high chain-link fence with a three-strand barbed wire top. Up to six television cameras may be installed in high security areas.

Areas that could be a potential threat to human safety will be designated with appropriate warning signs in conformance with federal mine safety laws. In addition, fences will be constructed and maintained around the tailings disposal area and any other uniquely hazardous areas.

A special internal security system will be implemented for monitoring the gold bullion room, and another security program designed for the transportation of the gold bullion to outside market places.

### Fire Protection

The lower portion of the 600,000 gallon main water storage tank, representing about 120,000 gallons, will be reserved for fire protection. A 1,000 gpm diesel-driven pump will maintain 100 pounds per square inch (psi) pressure in this loop or if possible, the tank will be installed at an elevation such that gravity flow could be utilized. Fire hydrants, hose houses, and other fire protection equipment will be strategically located throughout the mill complex in accordance with standards of the National Fire Protection Association. A fire road will be constructed around the mill complex to protect the facility from wildfires.

A company firefighting organization will be established, equipped, and trained. Fire drills will be held at least twice a year. Fire extinguishers will be mounted on all mobile mine equipment with enclosed cabs.

### Drainage Control

Surface runoff from the watershed upstream from the mill will be diverted around the mill complex via ditches and introduced back into the natural drainage system below the complex. Storm runoff occurring within the boundaries of the mill complex will be collected in ditches and routed to an emergency storage basin which will have a capacity of about 100,000 cubic feet. This capacity will be adequate to handle a 10 year flood event.

Chemical or process spills that cannot be handled within the mill will be diverted to this basin. In the event of a power failure, mill tailings in the short uphill sections of the tailings pipeline will also be dumped into this pond. The emergency storage basin will be equipped with a transfer pump to enable the pumping of the pond contents back to the tailings pump house where they will then be re-pumped to the tailings pond. See Figure C-6 for a typical surface drainage system for the proposed mill complex.

### Wastewater Management

Separate restrooms for men and women will be located in the office, plant maintenance shop, warehouse, truck maintenance shop, and change areas at the mill site. Sewage will be piped to an aerated digestor treatment plant at the mill site for processing. Effluent from this secondary treatment plant will be discharged into the mill tailings disposal system. The design and construction of this sewerage system will be coordinated through and permitted by the Nevada Health Division and the Nevada Division of Environmental Protection.

Portable toilet facilities will be provided at the mine and will be serviced at frequent intervals by a contractor or mine personnel. Similar facilities will be provided at the mill site, tailings disposal area, and along corridor construction routes during the construction period.

### Solid Waste Management

In accordance with the State of Nevada regulations governing solid waste management, Freeport will prepare a detailed solid waste management plan. A landfill site will be constructed for disposal of construction materials and other solid waste generated during the life of the Jerritt Canyon Project. A fence will be utilized as a litter collector around the disposal area. Demolition materials that will be disposed of in the disposal area include wood, paper products, nonsalvageable building materials, small metal containers, and plastic materials. Hazardous material and sanitary wastes will not be disposed of at this site. All solid wastes will be covered and compacted with inert waste rock or subsoil to a minimum uniform thickness of 6 inches once a week. A final cover of soil and fill compacted to a uniform thickness of 24 inches will be placed on the final grade of landfill within 90 days of abandonment.

### Support Facilities Abandonment

A discussion of the proposed mill abandonment operation is described in the Support Facilities section of this appendix.

Following shutdown of mining and milling operations, all buildings and structures will be dismantled. Equipment will be removed and concrete foundations will be broken up where feasible. Foundations will be covered with fill and soil. The disturbed areas will then be recontoured and a final layer of soil will be placed on the mill complex area. Following the grading activities, seeding of native and non-native plant species will be accomplished. Any areas that might be contaminated with cyanide solution will be treated with a sodium hypochlorite solution to deactivate the cyanide into a harmless solid.

# The Jerritt Canyon Project — 1980 to 2006

This section of Appendix C describes possible development in Mining Area 2 and Mining Area 3. Table C-3 summarizes Freeport's most optimistic 25-year plan for their Humboldt National Forest claim block.

In Mining Area 2 (see map delineating this area in Figure 4-3), there are no known ore-grade reserves. Freeport has performed a minimal amount of drilling at the Lost Mine, Saval Canyon, Steer Canyon, and California Mountain anomalies. To date, they have not been successful in these areas. The company plans to continue exploration in Mining Area 2 for at least the next three to five years. If Freeport should be successful in locating ore-grade reserves in Mining Are 2, then the most logical means for treating the ore would be to transport the ore to the proposed mill site supporting Mining Area 1. Also, if ore-grade material is located in Mining Area 2, it is assumed that the mill size could be expanded to handle an additional 1,000 tons per day (tpd). Based on this possibility, by 1985-1986 the presently proposed mill capacity could be increased from the now proposed 2,000 tpd to 3,000 tpd. This action would require increased tailings disposal capacity which could be accommodated at any of the alternative tailings ponds. The amount of additional acreage that could be disturbed in Mining Area 2 could be on the order of 1,000 acres for additional haul roads, waste rock disposal areas, and mine pits. Freeport cannot foresee that there would be any new access roads required either from the eastern or western side of the Independence Mountains for mining in Mining Area 2. Most likely there would not be a new mill constructed to handle the additional ore from Mining Area 2, only an expansion of the mill that would be required to handle ore from Mining Area 1. In order to quantify the possible effect from Mining Area 2, one could assume that mining could begin in Mining Area 2 in 1985-1986 and continue until 1995-1996. From 1985 to 1990 the rate of mining in Mining Area 2 would be on the order of 1,000 tpd with a possible increase to 3,000 tpd during the period 1991 to 1996. (This assumes that all of Mining Area 1 will be mined out by 1990-1991.)

In Mining Area 3, Freeport has performed only a minimal amount of exploration work and to date the company has not delineated any ore-grade reserves. Freeport has indicated that they will continue to explore and drill that area over the next 7 to 10 years. What happens in Mining Area 3 will be determined by the amount and location of ore-grade reserves. If only a small amount of reserves (less than 5,000,000 tons) are delineated, then the ore could be hauled to the mill site that will be built to handle Mining Area 1. However, it is remotely possible that sufficient reserves will be proven to justify a new mill. If this should occur, it should be assumed tht a new 2,000 tpd mill would be built in a central location in Mining Area 3 and that the necessary tailings ponds would be located in the Independence Valley adjacent to Mining Area 3. In this case, a new access road would be required and would probably enter Mining Area 3 from the west side. Freeport does not currently believe that such activities would require an access road coming in from the eastern side of the mountains. Based on the assumption that adequate ore is located in Mining Area 3 to support a new mill, then one can assume that by 1990 a new mill would be built and ore would be mined until approximately the year 2006. During this period, Freeport estimates that land disturbance of around 1,500 acres could occur for mine haul roads, access roads, mill site, mine sites, and waste disposal sites in Mining Area 3 (see Table C-3).

**TABLE C-3**

**Possible Development Scenario For Freeport Gold Company's Humboldt National Forest Claim Block**

| MINING AREA | ESTIMATED MINING PERIOD | MILL REQUIRED? | MILL PRODUCTION RATE (TONS PER DAY) | TAILING POND REQUIRED? | ACCESS ROAD REQUIRED? | HAUL ROADS REQUIRED? | MAXIMUM AREA DISTURBED (ACRES) |
|---|---|---|---|---|---|---|---|
| 1 | 1981 to 1991 | Yes - at site near Jerritt Canyon | 2,000 until 1986 | Yes | Yes | Yes from mining areas to mill site | 1,500 |
| 2 | 1986 to 1996 | No - use the existing mill near Jerritt Canyon | Increase existing mill to 3,000 in 1986 | Yes - add extra tailings storage capacity at tailings disposal area | No | Yes - from mining areas to mill site in Jerritt Canyon area | 1,000 |
| 3 | 1990 to 2005 | Yes - mill in Mining Area 3 | 2,000 | Yes - tailings pond to be located in Independence Valley | Yes | Yes - from mining areas to mill in Mining Area 3 | 1,500 |

SOURCE: FREEPORT GOLD COMPANY