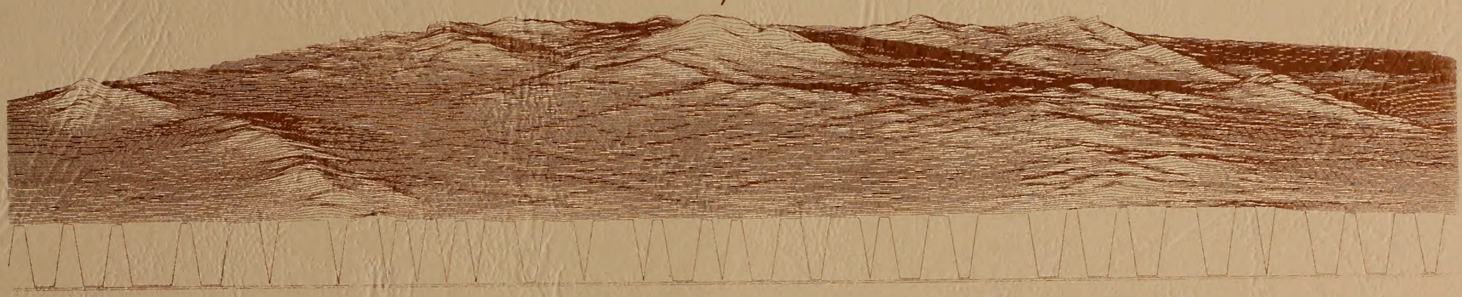
PROJECT DESCRIPTION

TECHNICAL REPORT NO.1

MT. HOPE MOLYBDENUM PROJECT



View from the south looking north

U.S. DEPARTMENT OF INTERIOR

BUREAU OF LAND MANAGEMENT

BATTLE MOUNTAIN, NEVADA

DECEMBER 1984

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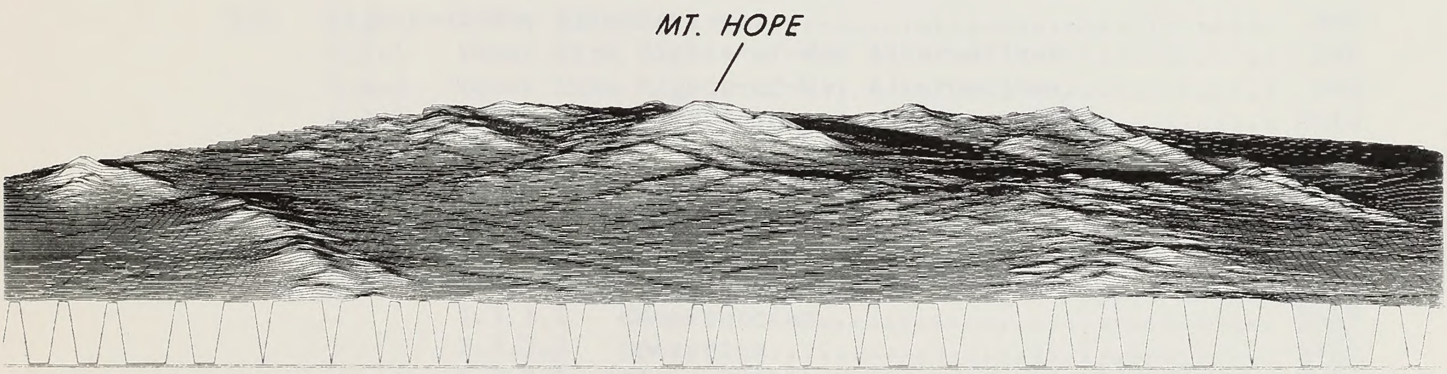

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CHAPTER 1.0

PROJECT DESCRIPTION

1.1 Introduction

Intrinsic to the Mt. Hope Molybdenum Project Environmental Impact Statement (EIS) is a project description, in the form of a proposed action, that is being considered for implementation and that in fact serves as the initiator of federal decision making.

In accordance with NEPA, the project description provided must be of sufficient detail to assure an informational basis appropriate to the analyses of environmental impacts that must be conducted. Under most cases, it is the action initiator that prepares, as the most knowledgeable party, a proposed project description for review. Such an activity was undertaken by EXXON Minerals Company (EXXON) in its source document entitled Mt. Hope Molybdenum Project Environmental Impact Report (EIR).

Under the provisions of a Memorandum of Understanding (MOU) between EXXON, the Bureau of Land Management (BLM) and a third party independent consultant (Wyatt Research and Consulting, Inc. (WRC)), EXXON prepared a detailed plan of operations summary and description. In the EIR, EXXON additionally presented discussion concerning the basis for action in a regulatory framework (e.g., permits, EIS preparation, etc.). Acting as an oversight consultant, WRC independently provided a description of the existing environment and an analysis of impacts thereof, assuming proposed action implementation. As necessary, WRC requested from EXXON clarification or supplemental information regarding the project plans in order that a complete environmental analysis would be conducted.

The information presented in this Technical Report generally represents that provided by EXXON in the Mt. Hope EIR and presented to the BLM in August, 1983. (Sequence of information presented has, however, been altered to more directly coincide with EIS Chapter 2 content and structure). In the event of discrepancies between this Technical Report and the EIS, the material presented in the EIS shall supercede Technical Report information.

CHAPTER 2.0

ALTERNATIVE INCLUDING THE PROPOSED ACTION (EIR Chapter 2)

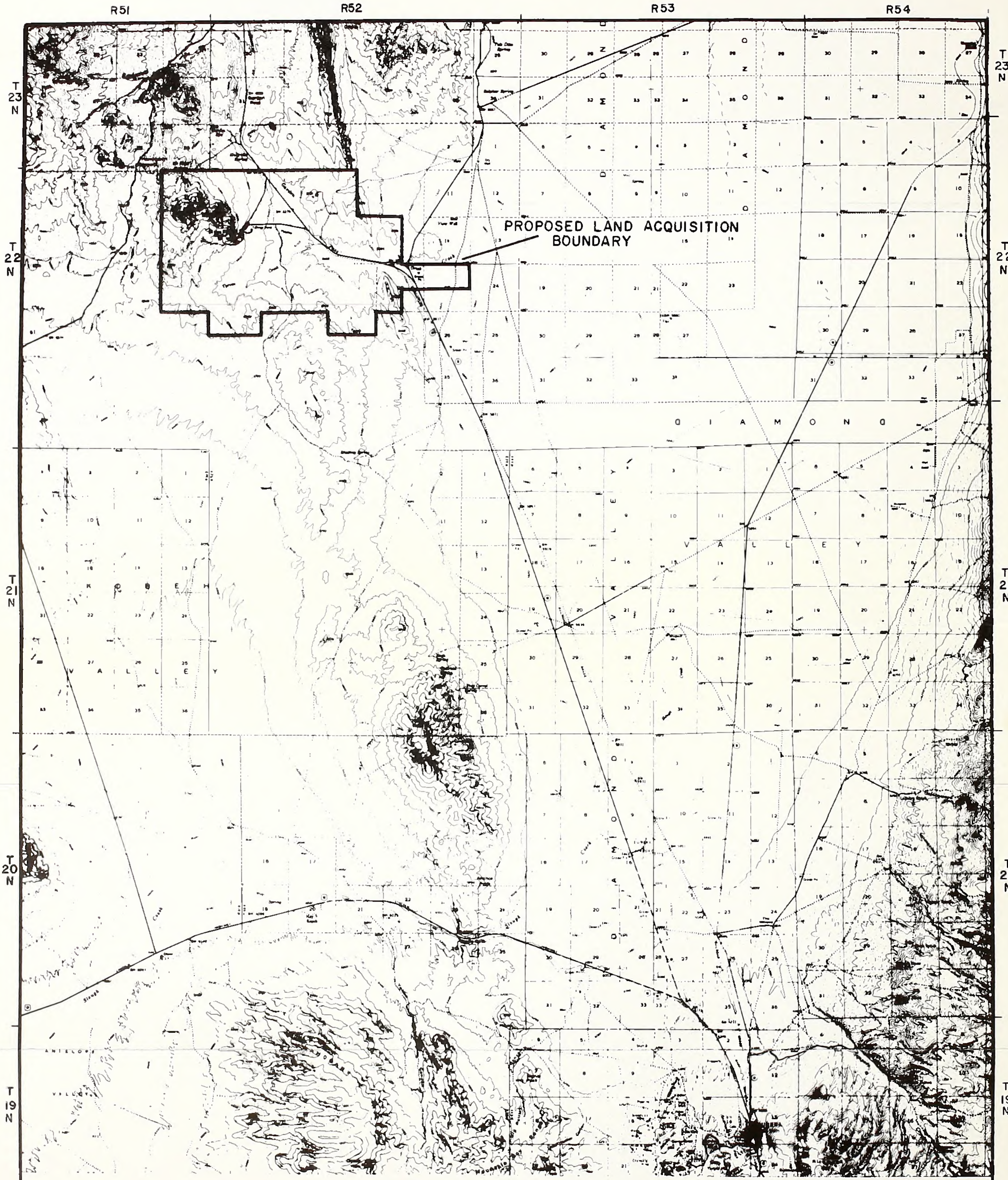
2.1 Land Acquisition Alternatives

EXXON wishes to acquire public land in the vicinity of Mt. Hope near Eureka, Nevada for the purpose of developing a molybdenum mine/process plant complex. The proposed land acquisition would not exceed 10,000 acres and would have the boundary generally represented in Figure 2-1. The area within the boundary is hereinafter referred to as the Mt. Hope site. Land acquisition alternatives are: (1) Claims, (2) Lease/Permit, (3) Purchase, and (4) Exchange.

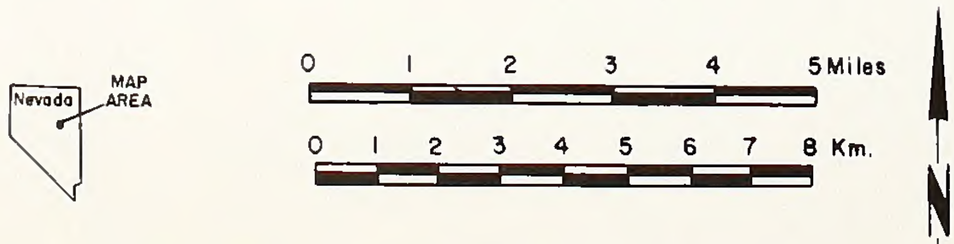
2.1.1 Claims

The General Mining Law of 1872 gives (30 USC 26) individuals the right to go upon open (unappropriated and unreserved) public lands for the purpose of mineral prospecting, exploration, development and extraction. This right is initiated by prospecting for minerals and upon discovery thereof, by locating the lands upon which such discovery has been made. A location is made by staking the corners of the claim, posting notice of location thereon, and recording the location with appropriate state authorities and the BLM. In order to hold possessory right to the claim, the filer must annually file with the BLM proof of assessment work (not less than $100 worth of labor or improvements made thereon annually) and notice of intention to hold the claim.

Claims, as described in 43 CFR 3800-3870, are of three types: mining, tunnel site, and millsite. Locators of mining claims have the exclusive right of possession of the surface of such claims for mining, processing and related activities. Tunnel site claims give the claimant "possessory right to 1500 feet of any blind lodes cut, discovered, or intersected by such tunnel which were not previously known to exist within 3000 feet from the face or point of commencement of the tunnel." Millsite claims may be filed for the purpose of occupying nonmineral lands for mining, milling, processing, beneficiation or other operations in connection with mineral extraction. Surface fee ownership may be conveyed in patents to either mining or millsite claims.



PROPOSED LAND ACQUISITION BOUNDARY



BASE: USGS TOPO QUADRANGLES, GARDEN VALLEY, WHISTLER MTN., DIAMOND SPRINGS & EUREKA, NEVADA.

MT. HOPE MOLYBDENUM PROJECT

PROPOSED LAND ACQUISITION BOUNDARY

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

FIGURE 2-1

The need to prepare an EIS was not triggered by EXXON's previous filing of mining and millsite claims as such action is considered nondiscretionary/nonenabling and is thus exempt from NEPA compliance (South Dakota vs. Andrus, 1980). Were EXXON to propose a granting of mineral leases, land use permits, or land exchange, compliance with NEPA would be required (leases/permits - 43 CFR 2920.5-2, land exchange - NEPA compliance addressed in National Forest Preservation Group vs. Butz (1973) (U.S. Court of Appeals, Ninth Circuit)).

2.1.2 Lease/Permit

A land use lease/permit may be issued under the authority of FLPMA (43 USC 1713). A permit conveys no possessory interest, but is merely an authorization for use of public lands not to exceed three years where either little or no land improvement, construction or investment is planned, or where investment can be amortized within the term of the permit. A lease conveys a possessory interest for use of public lands involving substantial construction, development or land improvement and is issued for a term having no regulatory restriction other than that it be consistent with the time required to amortize the capital investment.

2.1.3 Land Purchase

FLPMA (43 USCS 1713) provides for the sale of public lands, as a result of land use planning, if the tract is difficult, uneconomic or unsuitable for federal management; is no longer required for the purpose for which it was acquired; or its disposal will serve important public objectives. Sales of tracts in excess of 2,500 acres are subject to Congressional review. Sales may be conducted through competitive bidding, modified competitive bidding or by negotiation. On July 1, 1980, regulations promulgated by the BLM implementing this provision became effective (43 CFR 2700).

2.1.4 Land Exchange

FLPMA (43 USCS 1716) also provides for the exchange of public lands for private lands within the same state. In making the exchange decision, the Secre-

tary of the Interior must consider federal land management goals and the needs of state and local residents. Regulations delineating exchange procedures were promulgated by the BLM on January 6, 1981 (43 CFR 2200).

2.2 RIGHT-OF-WAY ALTERNATIVES

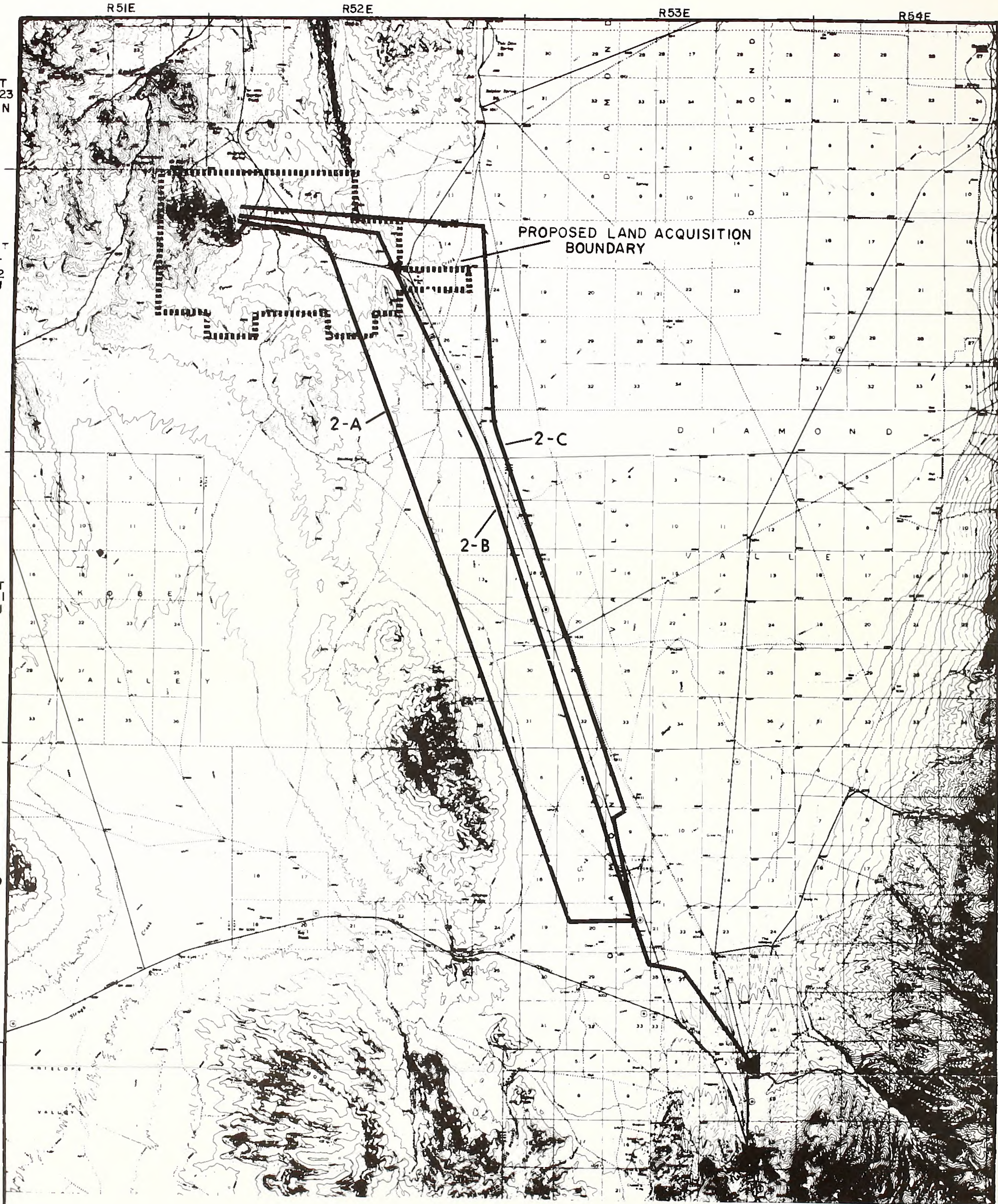
In order to pursue development of the molybdenum mine/process plant, three types of right-of-way must be granted. These are addressed in the following sections and include power line, water line, and state highway relocation right-of-way. Such right-of-way may be granted by BLM through provisions of FLPMA.

2.2.1 Power Line Right-of-Way Alternatives

Power to the Mt. Hope site would be provided by Mount Wheeler Power, Inc. (MWP) located in Ely, Nevada, and formal application to the BLM for the right-of-way would be made by that company. Information contained in this section was supplied directly by MWP, or derived therefrom. Power would be provided in two phases. Construction requirements of approximately three to five megawatts would be supplied by a 69-kilovolt (kV) line. Operational requirements of 50 megawatts would be provided by a 230-kilovolt (kV) line. Both of these lines would originate at the Machacek power substation located near Eureka. Alternative routings are shown in Figure 2-2. Construction of the project transmission line is dependent upon upgrading the Machacek power substation. However, this upgrading would occur with or without the Mt. Hope Project. If the upgrading occurs prior to EXXON requiring power for construction needs, the 230-kV line would be constructed initially and the need for the 69-kV line would be eliminated.

The following assumptions are equally applicable to constructing all of the right-of-way and form the basis for determining environmental loading factors:

1. The right-of-way would be 125 feet (ft) 38 meters (m) in width, and for the purposes of impact assessment it has been assumed that the entire width would be disturbed during construction.



PROPOSED LAND ACQUISITION BOUNDARY

ALTERNATIVE ROUTE FOR POWER LINE RIGHT-OF-WAY

0 1 2 3 4 5 Miles

0 1 2 3 4 5 6 7 8 Km.

Nevada MAP AREA

N

BASE: USGS TOPO QUADRANGLES, GARDEN VALLEY, WHISTLER MTN., DIAMOND SPRINGS & EUREKA, NEVADA.

MT. HOPE MOLYBDENUM PROJECT

ALTERNATIVE ROUTINGS FOR POWER LINE RIGHT-OF-WAY

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

FIGURE 2-2

2. Construction would proceed at the rate of two miles (mi)/week.

3. The labor force would be composed of 60 people working one ten-hour shift, five days per week.

4. Schematics of the transmission structures are shown in Figures 2-3, 2-4 and 2-5. Because the right-of-way are similar in length, the number of towers that would be needed do not vary; they include 175 tangent structures, two medium angle structures and two dead-end structures. Each structure would have two poles as support.

5. Typical equipment that would be used during construction is listed in Table 2-1. On the average, 20 pieces of equipment would be in operation at any one time.

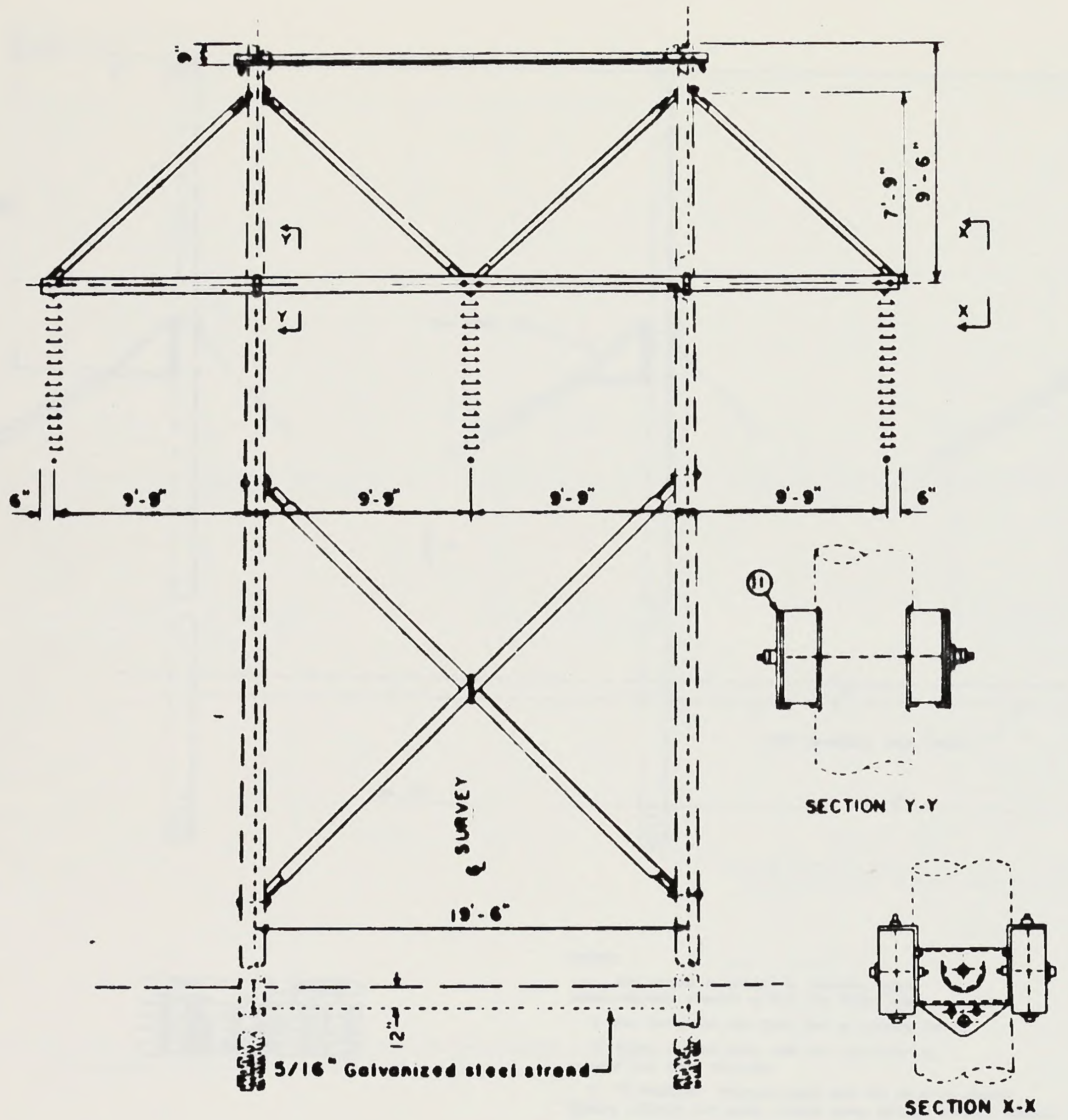
6. A 15-ft wide access road would be maintained and utilized for maintenance and emergency repair. These roads would be used for routine patrol by a lineman and groundman.

Environmental loadings occurring during construction are itemized in Table 2-2. Environmental loadings associated with operation amount to a permanent land disturbance of 41, 38 and 40 acres for Alternatives 2-A, 2-B and 2-C, respectively. Air emissions and manpower expended during operation would be negligible.

2.2.2 Water Line Right-of-Way Alternatives

During operation phases, the Mt. Hope Project would require fresh water in the amount of approximately 5400 gallons/minute (gpm) (0.34 cubic meter/sec (m^3/s)) [4730 gpm (0.30 m^3/s) actual use, 670 gpm (0.04 m^3/s) unpumped reserve]. (For a discussion of specific water uses within the mine/process plant complex, see Section 2.3.2).

EXXON initially identified nine sites as potential water supply sources; three sites in each of the following valleys: Diamond, Pine/Garden and Kobeh. Of these nine, six (two sites per valley) were chosen for further



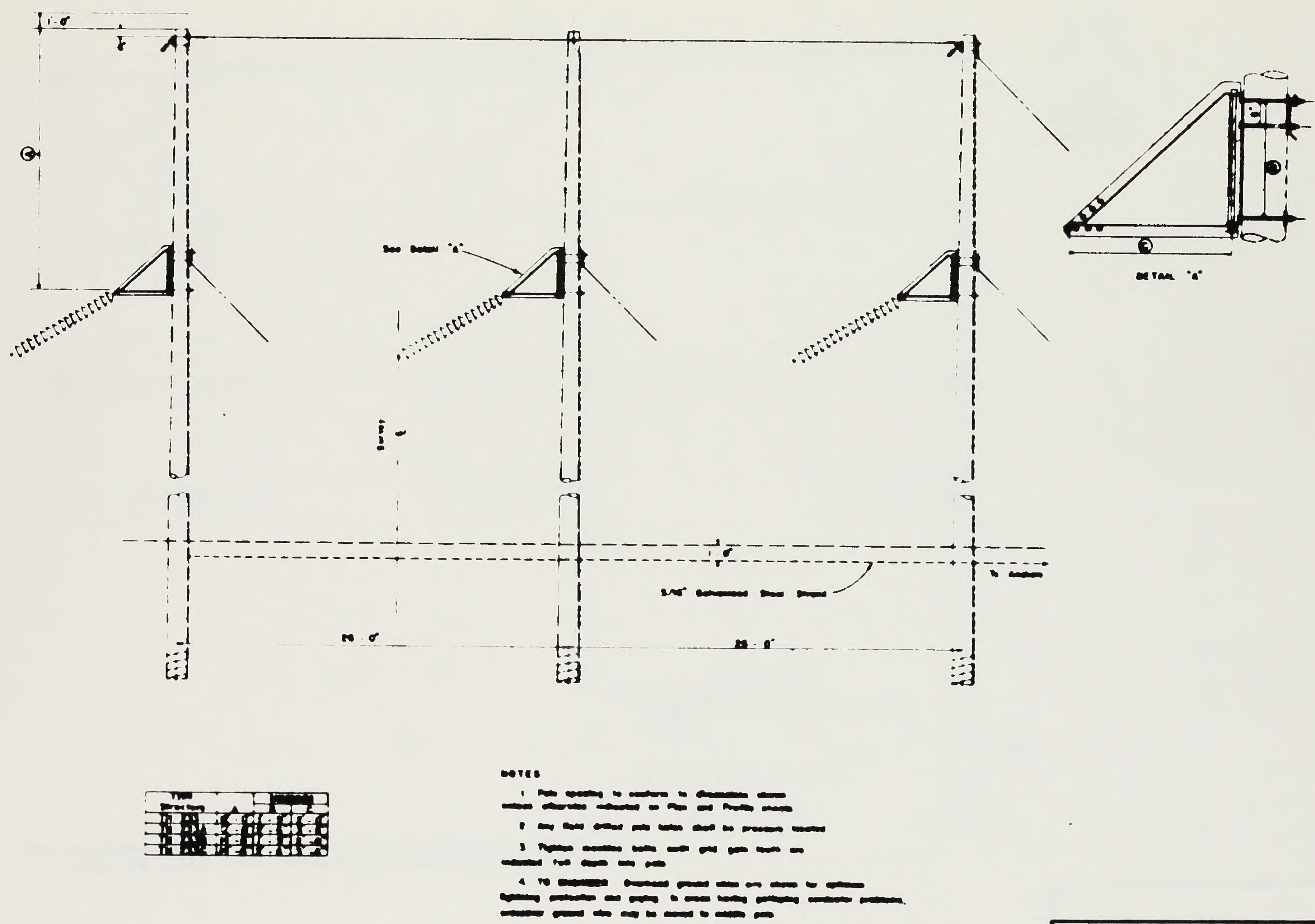
SOURCE: U.S. DEPARTMENT OF AGRICULTURE, 1976.
ELECTRIC TRANSMISSION SPECIFICATIONS AND DRAWINGS.

MT. HOPE MOLYBDENUM PROJECT

TRANSMISSION LINE TANGENT STRUCTURE
230 KV H-FRAME SUSPENSION -TWO POLE

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

FIGURE 2-3



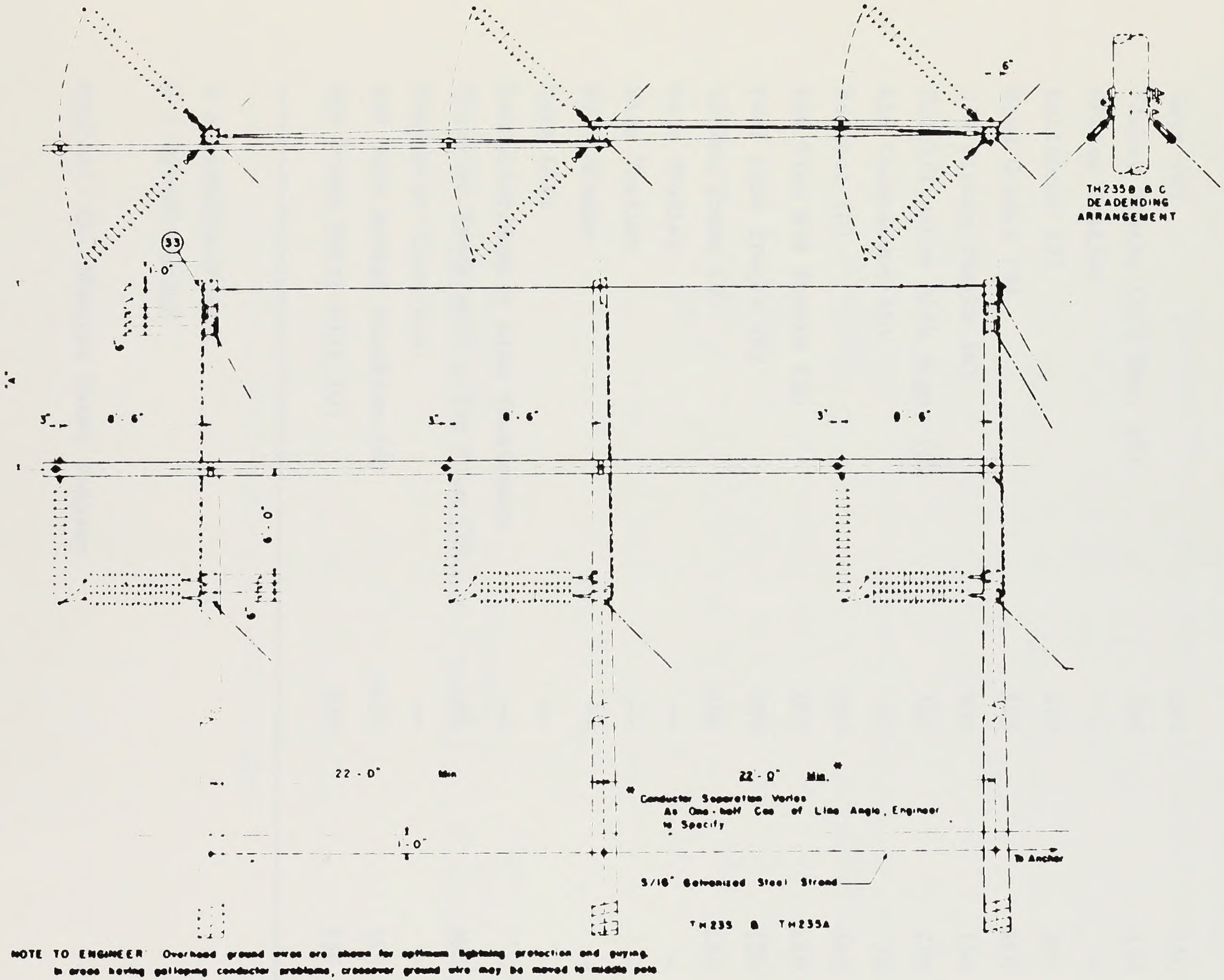
SOURCE: U.S. DEPARTMENT OF AGRICULTURE, 1976.
ELECTRIC TRANSMISSION SPECIFICATIONS AND DRAWINGS.

MT. HOPE MOLYBDENUM PROJECT

TRANSMISSION LINE
MEDIUM ANGLE STRUCTURE
H-FRAME SUSPENSION-THREE POLE
(230 KV MAXIMUM)

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

FIGURE 2-4



SOURCE: U.S. DEPARTMENT OF AGRICULTURE, 1976.
ELECTRIC TRANSMISSION SPECIFICATIONS AND DRAWINGS.

MT. HOPE MOLYBDENUM PROJECT

TRANSMISSION LINE
DOUBLE DEADEND STRUCTURE-THREE POLE
(230 KV MAXIMUM)

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

FIGURE 2-5

Table 2-1 Equipment Utilized During Construction Of Power Line And Access Road

Type	Horsepower (hp)	Kilowatt (kw)	No.
Cars (G)	200	150	3
Pickup Trucks (1/2 Ton) (G)	200	150	6
Office Trailer	--	-	1
Bulldozer (D)	270	200	2
Road Grader (D)	325	240	1
4/4 Pickup Trucks (G)	200	150	6
Truck/Tractor with Auger (D)	300	225	2
Air Compressor (D)	97	73	4
Backhoe (D)	195	145	2
6x6 Flat Bed Trucks (D)	185	140	2
Fuel Lube Trucks (D)	200	150	2
25-Ton Crane (D)	210	155	1
Pole Trailer	--	-	3
Wire Trailer	--	-	3
Reel Stands	--	-	15
Fork Lift	--	-	1
Conductor/Static Line Tensioners	--	-	2
Traveler Truck with 6-Ton Boom (D)	493	365	1
Conductor Travelers	--	-	300
6x6 with Aerial Platform (G)	220	165	3
4x4 6-man Carry-Alls (G)	200	150	6

G = gasoline-fueled

D = diesel-fueled

Source: Mt. Wheeler Power Company

Table 2-2 Environmental Loadings Associated With Construction Of Power Line Alternatives

Alternative	Length (mi)	Length (km)	Area Disturbed (ac)	Area Disturbed (million m^2)
A	23	(37)	345	(1.4)
B	21	(34)	315	(1.3)
C	22	(35)	330	(1.3)

Man-Months Expended	Duration of Disturbance (weeks)
215	11.5
197	10.5
206	11.0

SO_x Emissions (lbs/day)	SO_x Emissions (kg/day)	NO_x Emissions (lbs/day)	NO_x Emissions (kg/day)	Total Suspended Particulates (lbs/day)	Total Suspended Particulates (kg/day)
14.5	6.6	195.5	88.7	14.1	6.4

Source: Mt. Wheeler Power Company and WRC EIS Team

examination and EXXON made application to the Nevada State Engineer for water rights from each of these sites. In March, 1983, the State Engineer agreed to grant EXXON the water rights at two sites (Kobeh A at Section 26, Township 22 North, Range 50 East and Kobeh C at Section 24, Township 21 North, Range 51 East) in Kobeh Valley on the condition that EXXON install flow meters and monitoring wells to measure drawdown. EXXON agreed to drop its water rights applications in Pine/Garden and Diamond Valleys. Consequently, although the Pine/Garden and Diamond Valley sites were identified in the scoping document as alternatives, they are no longer so considered based on the State Engineer's decision.

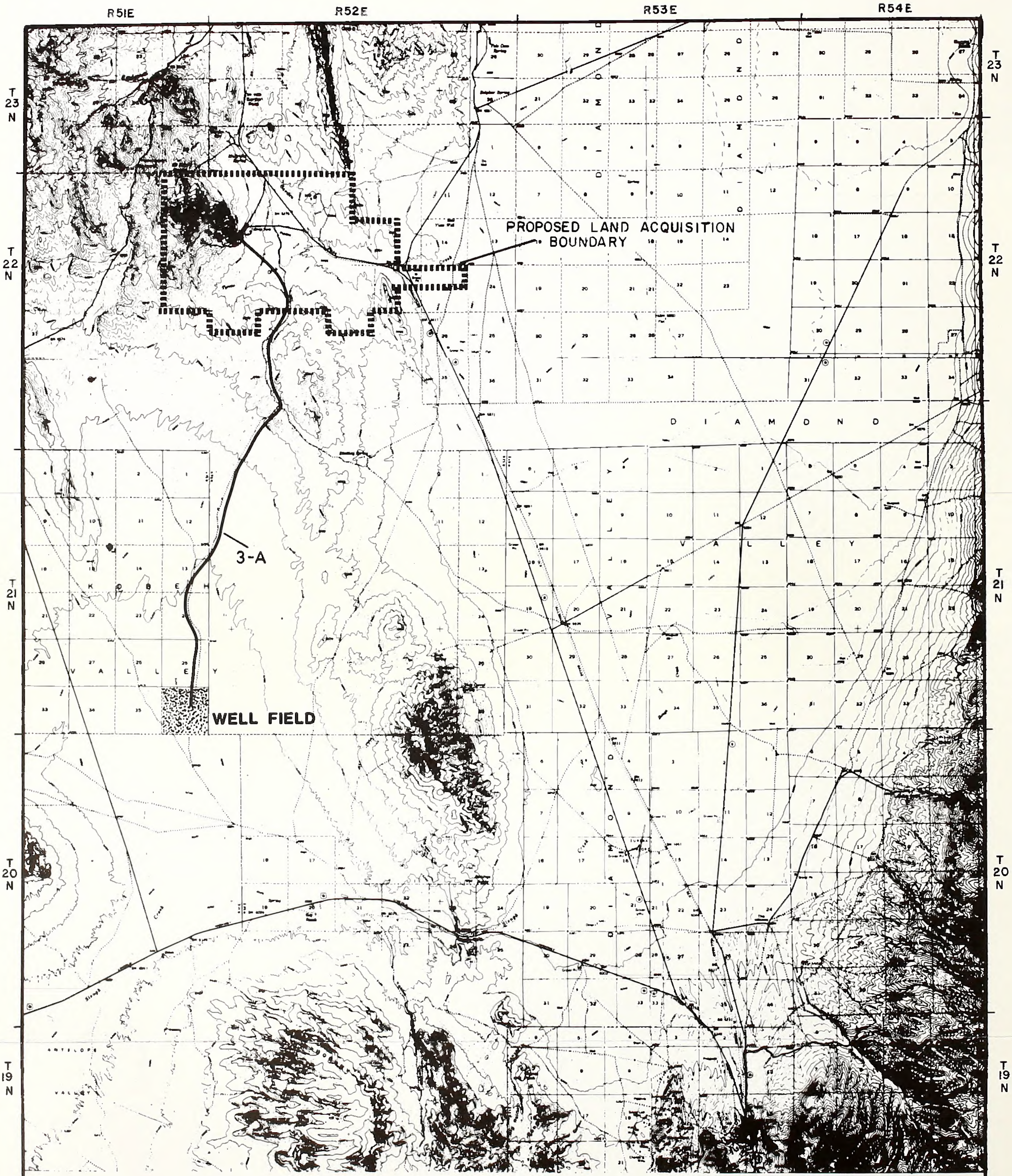
It is anticipated that pump tests at the Kobeh test site will reveal that the full 5400 gpm (0.34 m^3/s) may be obtained from that site alone. If so, application will be made to the State Engineer to transfer the diversion for Kobeh A and C to the Kobeh test site. Proposed location of the well field at the Kobeh test site and approximate routing of the 11-mi (18-km) associated pipeline are shown on Figure 2-6. Assumptions used to estimate the environmental loadings associated with the pipeline right-of-way are presented in the following.

1. A 24-in (61-cm) diameter welded steel pipe buried 24 in (61 cm) below the ground surface would convey the water from the well field to the site facilities.

2. A 15-ft (4.6-m) wide graveled service road would be constructed and maintained parallel to the pipeline.

3. At the well field, four wells on a one-mile spacing would be constructed. Each well would be capable of producing 2700 gpm (0.17 m^3/s); two wells would be pumped continuously and two would be maintained as back-up.

4. At a maximum, a 100-ft (31-m) wide corridor would be disturbed during construction. A 25-ft (7.6-m) wide corridor including the 15-ft (4.6-m) wide service road would be permanently maintained.



PROPOSED LAND ACQUISITION BOUNDARY
PROPOSED ROUTE FOR WATER LINE RIGHT-OF-WAY

Nevada MAP AREA

0 1 2 3 4 5 Miles
0 1 2 3 4 5 6 7 8 Km.

N

BASE: USGS TOPO QUADRANGLES, GARDEN VALLEY, WHISTLER MTN., DIAMOND SPRINGS & EUREKA, NEVADA.

MT. HOPE MOLYBDENUM PROJECT

PROPOSED ROUTING FOR KOBEH VALLEY WATER LINE RIGHT-OF-WAY

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

FIGURE 2-6

5. At each well site, 0.25 ac (1012 m^2) would be disturbed during construction. The same area (drill pad and pump station) would be permanently graveled and maintained.

6. Construction would proceed at an average rate of 500 ft/day (152 m/day). A construction crew of approximately 30 individuals would be required.

7. Equipment required on-site is listed in Table 2-3. On the average, ten pieces of equipment would be in operation ten hours per day, five days per week.

8. To provide power to the well site, a 34 kV line would be constructed from the substation at the project site to the well site. Poles would be placed at intervals of approximately 350 feet. They would be approximately 40 feet high with a ten-foot cross arm existing three feet from the top. Area around the poles would only be maintained free of vegetation in excess of fifteen feet in height. Disturbance resulting from construction of this power line is included in Item 4. There would be no permanent disturbance. (Power detail added for EIS text, not in original EIR).

Based on these assumptions, the environmental loading factors during construction are itemized in Table 2-4. Environmental loadings during operation are negligible with the exception of a permanent land disturbance of 42 ac (170,000 m^2).

2.2.3 State Route 278 Relocation Right-of-Way

One of the tailings pond sites under consideration (see Section 2.3.5) would require an approximate 6 mi (10 km) relocation of State Route 278 as shown in Figure 2-7. Formal application for the right-of-way and actual construction would be made by the Nevada Department of Transportation, and the following assumptions are based on information provided by that agency.

Table 2-3 Equipment Required For Construction Of Water Supply Pipeline And Access Roads

Type	Horsepower (hp)	Kilowatt (kw)	No.
Motor Grader (D)	195	145	1
Dump Trucks (D)	250	185	5
Bulldozer (D)	410	305	1
Scraper	--	--	1
Sheepsfoot Compacter	--	--	1
Backhoe (D)	195	145	1
Backhoe (D)	62	46	1
Water Truck (3000-gal) (D)	200	150	1
Pick-up Trucks (G)	200	150	2

G = gasoline-fueled

D = diesel-fueled

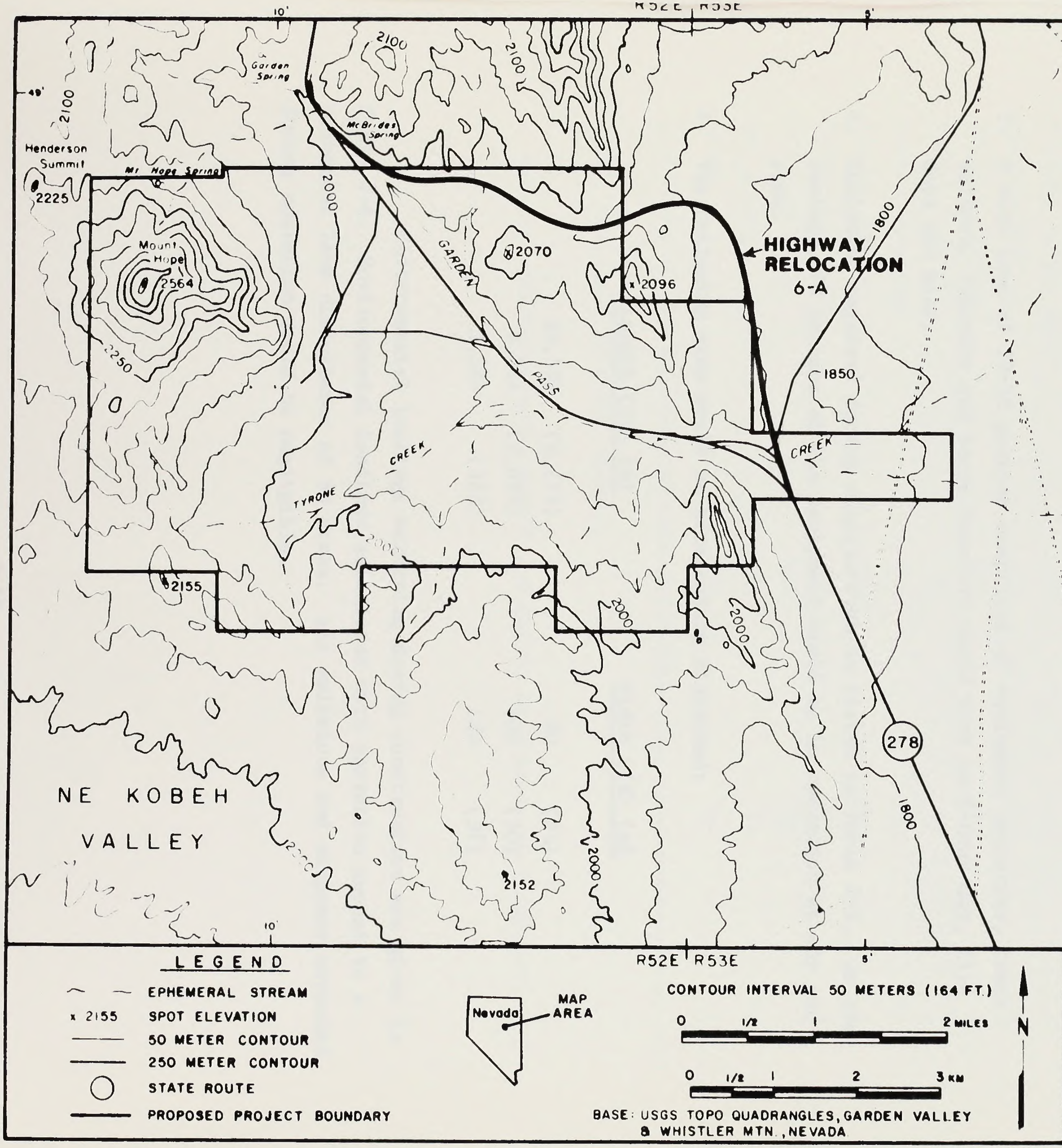
Source: EXXON Minerals Company

Table 2-4 Environmental Loadings Associated With Construction Of Water Supply Pipeline From Kobeh Valley

Total Length of Road & Pipeline (mi)	(km)	Area Disturbed (ac)	(m^2)	Duration of Disturbance (Days)
11	(18)	132	(534,200)	116

Man-hours Expended	SO_x Emissions (lbs/day)	(kg/day)	NO_x Emissions (lbs/day)	(kg/day)	Total Suspended Particulates (lbs/day)	(kg/day)
3480	9.9	4.5	134.0	60.8	5.7	2.6

Source: EXXON Minerals Company and WRC EIS Team



MT. HOPE MOLYBDENUM PROJECT

STATE HIGHWAY 278
RELOCATION RIGHT-OF-WAY

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

FIGURE 2-7

1. The following area would be disturbed during construction:

Length (ft)	(m)	Width (ft)	(m)
20,592	(6,276)	84	(26)
9,504	(2,897)	105	(32)
1,584	(483)	126	(38)

2. Construction would require approximately eight months.

3. A work crew of 30-50 persons comprised of equipment operators, truck drivers, laborers and fence erectors would work an 8-hour day, five days per week.

4. Equipment required during construction is listed in Table 2-5. On the average, 70 percent of the equipment would be in operation at any one time.

5. The following area would be permanently disturbed:

Length (ft)	(m)	Width (ft)	(m)
20,592	(6,276)	80	(24)
9,504	(2,897)	100	(30)
1,584	(483)	120	(37)

Environmental loadings occurring during construction are given in Table 2-6. Environmental loadings associated with operation amount to a permanent land disturbance of 63 acres. Air emissions and manpower expended during operation would be negligible.

Table 2-5 Equipment Utilized During State Route Relocation Construction Phase

Type[1/]	Horsepower (hp)	Kilowatt (kW)	Number
Dozers D-8	300	225	2
Scrapers 631	450	335	5
Backhoe (1 Cu. Yd.)	55	40	1
Loaders 966	200	150	2
Rollers (Pneum.)	100	75	2
Rollers (Steel)	87	65	2
Trucks (Hauling)	200	150	10
Trucks (Water)	150	110	2
Motor Grader 135	180	135	2
Crushing Plant	300	225	1
Hot Plant	100	75	1
Paver	122	90	1

1/ All equipment is diesel fueled.

Source: EXXON Minerals Company and Nevada Department of Transportation

Table 2-6 Environmental Loadings Associated With Construction Of State Route Relocation

Total Length (mi)	(km)	Area Disturbed (ac)	(m^2)	Duration of Disturbance (months)	Man-hours Expended 1/
6	(10)	67	(271,000)	8	64,000

Total Suspended Particulates (lbs/day)	(kg/day)	SO_x Emissions (lbs/day)	(kg/day)	NO_x Emissions (lbs/day)	(kg/day)
11.9	5.4	21.8	9.8	283.2	128.5

1/ Based on a work crew of 50 persons.

Source: EXXON Minerals Company and WRC EIS Team

2.3 Facility Alternatives Associated With Permitting

2.3.1 Permitting Requirements

EXXON would have to obtain several state and federal permits as listed in Table 2-7 before most aspects of construction and all aspects of operation at Mt. Hope could commence. The CEQ regulations identify federal permitting as an action that is generically subject to NEPA. The CEQ regulations also advocate that when states have NEPA-like laws in force, the federal government and the state authorities cooperate in the preparation of a single EIS. Because the State of Nevada has no NEPA-like requirements that would affect the Mt. Hope Project, none of the state permits listed in Table 2-7 would provoke the EIS process. The potential of the federal permits to trigger the process is discussed following.

The U.S. Environmental Protection Agency's Consolidated Regulations 1/ on Procedures for Decision-making (40 CFR 124.9) state the following:

> "NPDES permits other than permits to new sources as well as all RCRA, UIC and PSD permits are not subject to the environmental impact statement provisions of section 102(2)(C) of the National Environmental Policy Act, 42 U.S.C. 4321."

The BLM regulations addressing Surface Management of Public Lands under U.S. Mining Laws (43 CFR 3800) require that an applicant file a Plan of Operations prior to commencing construction. The following is required by Section 3809.2-1:

> "When an operator files a plan of operations or a significant modification which encompasses land not previously covered by an approved plan, the authorized officer shall make an environmental assessment or a supplement thereto to identify the impacts of the proposed operations on the lands and to determine whether an environmental impact statement is required."

1/ These regulations were unconsolidated on April 1, 1983 (48 FR 14146).

Table 2-7 Mt. Hope Project Permitting Requirements

Permit/Approval	Statutory Authority	Permitting Authority
1. Plan of Operation	43 CFR 3809	U.S. Bureau of Land Management
2. Prevention of Significant Deterioration (PSD) Permit 1/	NRS 445	Nevada Division of Environmental Protection
3. Explosives Transport Permit 2/	18 USC Chapter 4	U.S. Department of Treasury
4. Notification of Commencement of Operations and Closing of Mines 3/	30 CFR 57.26	U.S. Mine Safety and Health Administration
5. Camp Site Permit	Regulations Governing Individual Sewage Disposal Systems (10/19/72) Regulations Governing Mobile Homes and Mobil Home Parks (9/21/70)	Nevada Division of Health, Nevada Division of Manufactured Housing
6. Modification of Habitat Permit	NRS 501.105	Nevada Department of Wildlife
7. Permit to Construct Tailings Dam	NRS 535.010	Nevada State Engineer, Nevada Department of Wildlife
8. Solid Waste Permit	NRS 444	Nevada Division of Environmental Protection
9. Notification of Commencement or Closing of Mine Operation 3/	NRS 512.160	Nevada Inspector of Mines
10. Historic Preservation Notification 3/	---	Nevada Division of Historic Preservation and Archaeology
11. Zero Discharge or Subsurface Injection/Infiltration Permit 4/	NRS 445	Nevada Division of Environmental Protection
12. Permit to Appropriate Public Waters 5/	NRS 553, 534	Nevada State Engineer

1/ PSD permitting authority was delegated to Nevada in June, 1983. State requirements are found in NRS 445 and include acquiring an Air Quality Permit to construct/operate.

2/ This permit will be required only if EXXON Minerals Company will be transporting explosives across state lines. EXXON Company, U.S.A. already holds such a permit (TX 33-10) and it could be made equally applicable to EXXON Minerals Company in approximately two months.

3/ This is not a permit per se, but a notification to responsible agency.

4/ According to the State of Nevada which administers the National Pollutant Discharge Elimination System (NPDES), the Mt. Hope Project would not require an NPDES permit because there are no surface waters in the vicinity of Mt. Hope to which an intermittent, accidental, or continuous discharge could flow. However, the project would be required to obtain a zero discharge or subsurface injection/infiltration permit relative to tailings pond infiltration.

5/ This permit has been conditionally granted to EXXON for water rights in Kobeh Valley.

NOTE: The above is based upon regulations in place at the time of writing. It is possible that other requirements may be promulgated between the time of EIS completion and permit acquisition. This is especially true of Resource Conservation and Recovery Act (RCRA) related regulations.

Based on these regulations, only new source NPDES permitting and Plan of Operations approval require NEPA compliance activities. Because, for the reasons cited in Table 2-7, the Mt. Hope Project will not require an NPDES permit; only approval of the Plan of Operations would involve preparation of a NEPA-compliance document. The following sections describe construction and operation activities and reasonably available alternatives at Mt. Hope that would be addressed by the Plan of Operations.

2.3.2 Overview

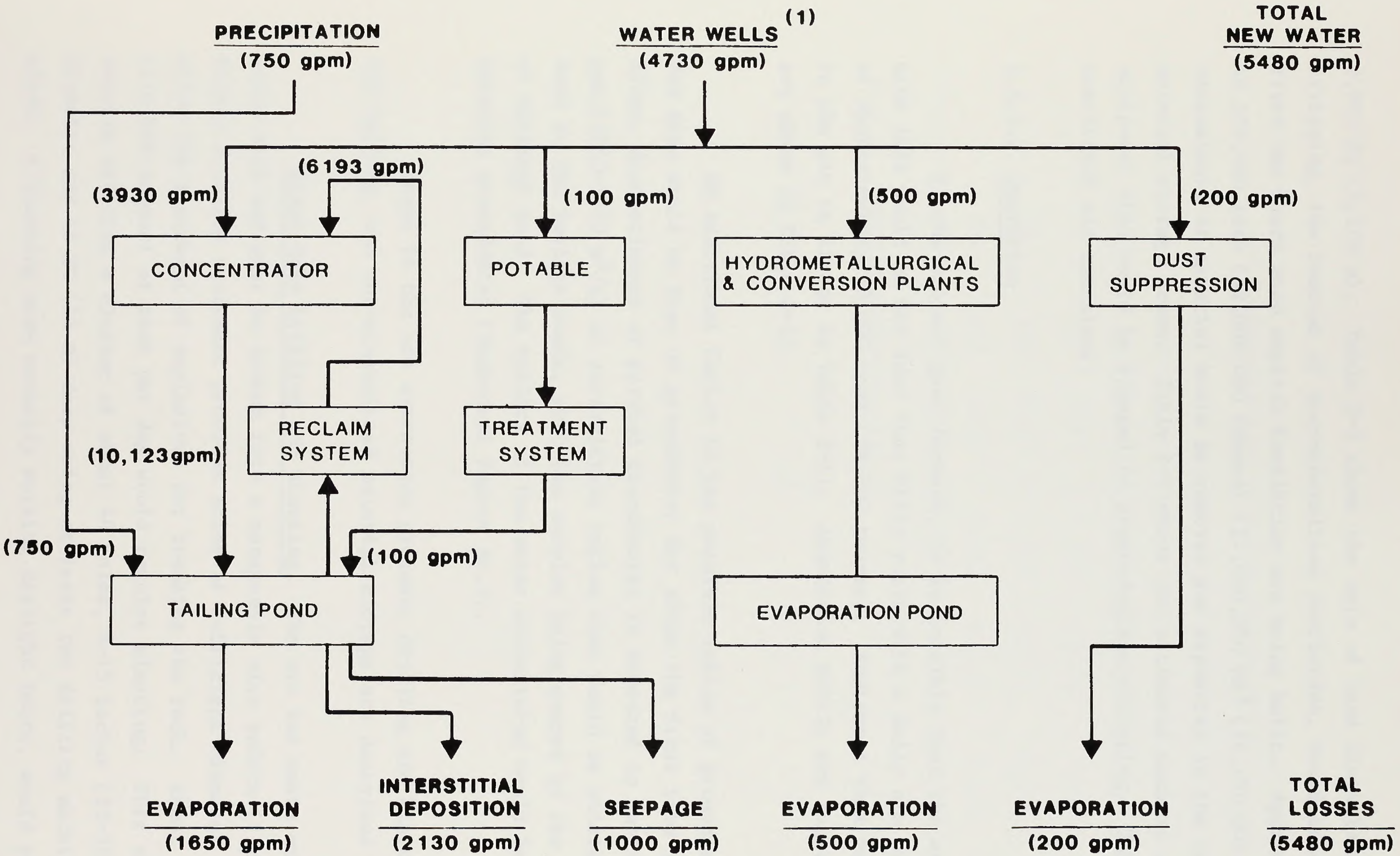
The project components that would be developed can be divided into five parts: mine pit/non-mineralized material storage, process plant, auxiliary components, tailing pond and subdivision. Each of these segments will be described in turn in the following sections. Figure 2-8 shows an overall water balance for the operation. Environmental loadings in terms of area disturbed, air emissions, effluents and solid waste, etc., that would be generated are identified for construction and operational phases of each segment. Post-operation or reclamation phases are addressed in Section 2.7, Mitigating Measures/ Monitoring Programs.

In general, workers would be on-site 250 to 300 10-hour days/year (1 shift/day) during construction. During operations, the mine and process plant would operate 350 and 360 24-hour days/year (3 shifts/day), respectively. A discussion of socioeconomic factors including number of employees and potential distribution of these employees occurs in the Section 2.3 addressing subdivision alternatives.

2.3.3 Mine/Non-mineralized Material Storage

2.3.3.1 Construction

Mining would be by open pit methods. Development of the mine would occur over a multi-year period with the final pit configuration being attained after approximately fifty years of production. Ultimately, the high and low walls of the pit would be approximately 3,600 and 2,300 ft (1,100 and 700 m) high, respectively. The greatest distance across the pit would be approximately



(1) EXXON HAS A WATER APPROPRIATION OF 5400 gpm IN KOBEH VALLEY. THIS BALANCE SHOWS AN UNPUMPED RESERVE OF 670 gpm.

SOURCE: EXXON MINERALS COMPANY

MT. HOPE MOLYBDENUM PROJECT

PROVISIONAL WATER BALANCE AT YEAR 20

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

FIGURE 2-8

6,900 ft (2,100 m). Table 2-8 shows the rate of land disturbance. Preproduction stripping, the removal of non-mineralized overburden, would occur during the first two years when capital facilities are being built. Approximately 46,000,000 tons (42,000,000 tonnes) (21,000,000 yd^3 (16,100,000 m^3, assuming no expansion)) of material would be removed and deposited in the non-mineralized material storage areas. Table 2-9 shows the estimated numbers and types of equipment that would be engaged in preproduction stripping. Table 2-10 shows associated air emissions.

2.3.3.2 Operation

If the project goes forward, it is possible that the anticipated mine life would be not less than fifty years with a daily ore production rate of approximately 30,000 tons (28,000 tonnes). Equipment that would be used in the pit is listed in Table 2-11. Associated mobile and fugitive emissions are shown in Table 2-12.

An additional factor is the possible inflow of groundwater into the pit. The mine would be free of groundwater for about the first five years. Thereafter, discontinuous or perched groundwater is expected to contribute 200-600 gpm (1260-3780 m^3/s) of intermittent inflow that would be utilized to suppress dust on the haulage roads, with the surplus being pumped to the process plant or tailings pond. The quality of the water encountered would be the same as existing groundwater (Technical Report No.5).

Steps in the ore extraction process, drilling and blasting, loading and hauling, and non-mineralized material storage are described below.

Blast Hole Drilling and Blasting. The ore and waste material occurs as solid rock and must be broken into a manageable size before it can be removed. Rotary drilling equipment provides holes of sufficient diameter and depth to allow the placement of explosives for breaking the rock. About 121,000 tons (110,000 tonnes) of rock per day would require blasting. This would normally require drilling a cluster of about 40 holes, 9-15 inches (23-38 cm) in diameter and 45 ft (14 m) deep using at least two drilling machines round the clock. A blasting crew normally working daylight hours, would place about

Table 2-8 Rate Of Areal Disturbance During Pit Development And Non-Mineralized Material Storage Area

acres (km_2)

Year	Pit		Storage Area		Total	
5	173	(0.7)	857	(3.5)	1,030	(4.2)
10	193	(0.8)	1,598	(5.7)	1,791	(6.5)
50+	695	(2.8)	2,745	(11.2)	3,440	(14.0)

Source: EXXON Minerals Company

Table 2-9 Representative Equipment In Operation During Pre-Production Stripping (Construction)

Item	Horsepower (hp)	(Kilowatt) (kW)	Available Units	Units Used During a Work Period
DRILLING				
12-in. Drill	500	(370)	2	1
Secondary Drill	300	(225)	2	1
BLASTING				
Explosive Truck	200	(150)	2	1
Blast Hole Stemmer	125	(95)	2	1
LOADING				
15-yd Shovel (E)	--	--	3	2
10-1/2-yd Hydraulic Shovel	400	(300)	2	1
8-yd Front End Loader	375	(280)	2	1
HAULING				
120-ton truck	1,200	(895)	19	15
50-ton truck	650	(485)	2	1
AUXILIARY				
Track Dozer (D-9)	400	(300)	4	2
Rubber Tired Dozer	400	(300)	4	3
Motor Grader	250	(185)	3	2
Water Truck	450	(335)	2	1
Lube Truck (G)	200	(150)	2	1
Fuel Truck (G)	200	(150)	2	1
Welding Truck (G)	200	(150)	2	1
Repair Truck (G)	200	(150)	2	1
Cable Reel Truck (G)	200	(150)	2	1
Backhoe	200	(150)	2	1
60-ton Crane	500	(370)	2	1
20-ton Crane	250	(185)	2	1
Tractor Truck	650	(485)	1	1
Bus (G)	125	(95)	5	4
Pickup 4x2 (G)	125	(95)	15	11
Pickup 4x4 (G)	125	(95)	7	5
Utility Truck (G)	200	(150)	2	1
Mobile Light Plant (G)	10	(7)	7	6

G - Gasoline powered
E - Electric powered
All other equipment diesel-fueled.

Source: EXXON Minerals Company

Table 2-10 Air Emissions (Mobile & Total Suspended Particulates) Associated With Pre-Production Stripping (Construction) 1/

SO_x Emissions		NO_x Emissions		Total Suspended Particulates	
(lbs/day)	(kg/day)	(lbs/day)	(kg/day)	(lbs/day)	(kg/day)
21.8	9.9	291.0	132.0	16.3	7.4

1/ Assumes 70% of the equipment identified in Table 2-9 is in operation at any one time.

Source: WRC EIS Team

Mt. Hope Molybdenum Project

Table 2-11 Representative Equipment Required During Pit Operation

Item	Horsepower (hp)	(Kilowatt) (kW)	Available Units	Units Used During a Work Period
DRILLING				
12-in. Drill	500	(370)	3	2
Secondary Drill	300	(225)	2	1
BLASTING				
Explosive Truck	200	(150)	3	2
Blast Hole Stemmer	125	(95)	2	1
LOADING				
15-yd^3 Shovel (E)	--	--	4	3
10-1/2-yd^3 Hydraulic Shovel	400	(300)	2	1
8-yd Front End Loader	375	(280)	2	1
HAULING				
120-ton Truck	1,200	(895)	25	20
50-ton Truck	650	(485)	2	1
AUXILIARY				
Track Dozer (D-9)	400	(300)	5	3
Rubber Tired Dozer	400	(300)	5	4
Motor Grader	250	(185)	4	3
Water Truck	450	(335)	3	2
Lube Truck (G)	200	(150)	3	2
Fuel Truck (G)	200	(150)	3	2
Welding Truck (G)	200	(150)	3	2
Repair Truck (G)	200	(150)	3	2
Cable Reel Truck (G)	200	(150)	2	2
Backhoe	200	(150)	2	1
60-ton Crane	500	(150)	2	1
20-ton Crane	250	(150)	2	1
Tractor Truck	650	(485)	1	1
Bus (G)	125	(95)	6	5
Pickup 4x2 (G)	125	(95)	20	15
Pickup 4x4 (G)	125	(95)	10	7
Utility Truck (G)	200	(150)	2	1
Mobile Light Plant (G)	10	(7)	10	8

E - Electric-powered
G - Gas-fueled
All other pieces of equipment are diesel-fueled.

Source: EXXON Minerals Company

Table 2-12 Air Emissions Associated With Operation Of Mine 1/

SO_x Emissions		NO_x Emissions		Total Suspended Particulates	
(lbs/day)	(kg/day)	(lbs/day)	(kg/day)	(lbs/day)	(kg/day)
29.1	13.2	389.1	176.5	22.5	10.2

1/ Assumes 70% of the equipment identified in Table 2-11 is in operation at any one time.

Source: WRC EIS Team

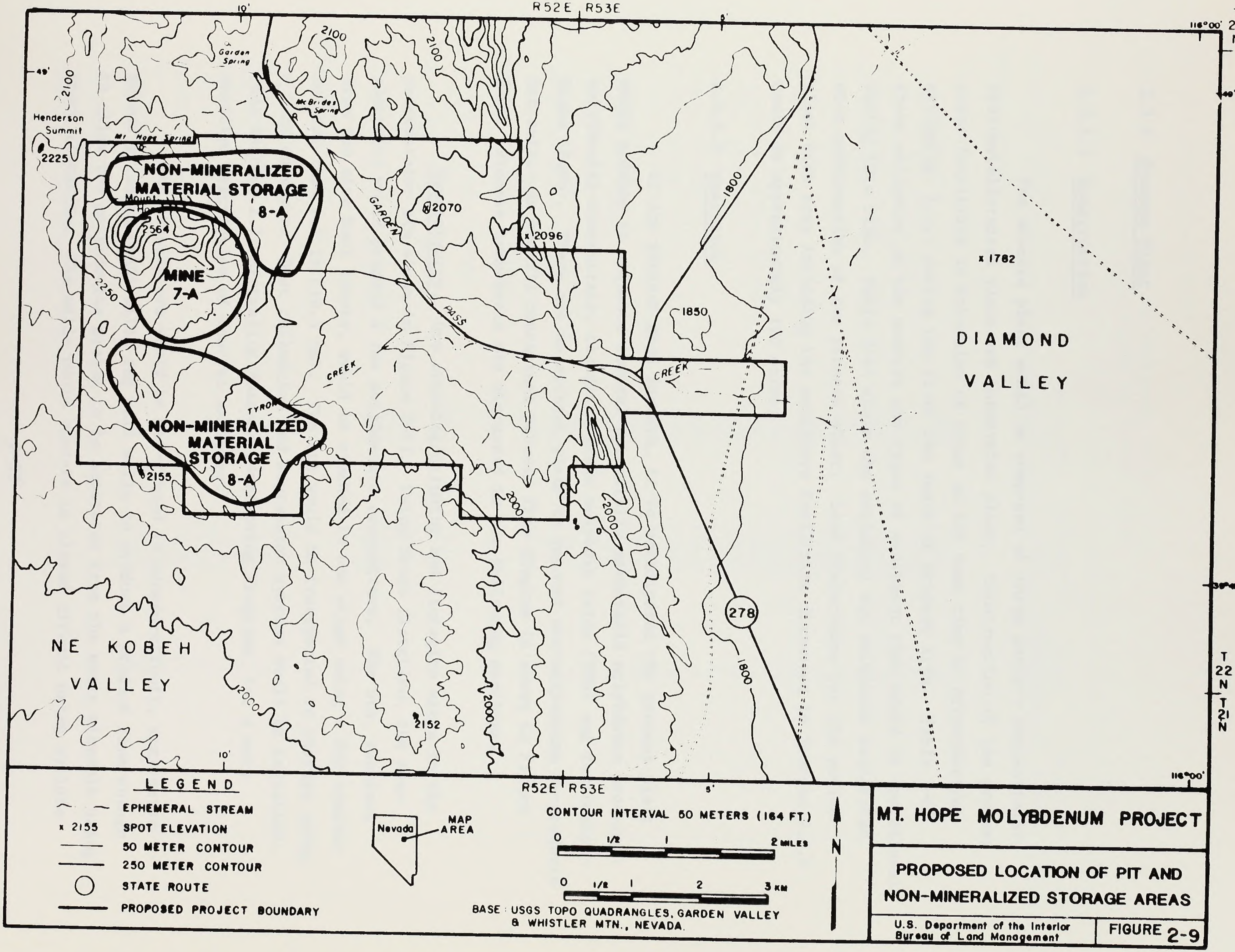
1,000 pounds (454 kg) of explosives in each hole and blast the 40 holes simultaneously. The explosive would normally consist of an ammonium nitrate (fertilizer grade)/fuel oil mixture.

Loading and Hauling. Once the rock is broken by blasting, large electric-powered shovels capable of scooping 15 yd^3 (11 m^3) at once would load the broken rock into diesel-powered haul trucks with a carrying capacity of 120-170 tons (109-155 tonnes) per load. During a normal 24-hour work day these machines would load and haul 120,000 tons (110,000 tonnes). On the average, 3-4 shovels working round-the-clock would load 20-25 trucks also working round-the-clock. Trucks would haul the material out of the pit a distance of over one mile to the storage area if it is non-mineralized material or less than one mile to a primary crusher if it is ore. Roads would be wetted down as needed to suppress dust. (See Section 2.7, Mitigating Measures/Monitoring Programs, for a more detailed description of dust suppression techniques.)

Non-mineralized Material Storage. The waste to ore production weight ratio would be approximately 3:1. Approximately 90,000 tons (80,000 tonnes) (42,000 yd^3 (32,000 m^3) assuming no expansion) of non-mineralized material would be removed each day. This material would be hauled to areas adjacent to the mine and placed in layered piles. Each pile would be 300-900 ft (100-300 m) in height. The horizontal surfaces of these areas would be kept smooth by bulldozers that would push material over the edge as haulage trucks dump their loads. Runoff from these storage areas would be channelled to the tailings pond for water conservation purposes and collection of any dissolved constituents. (See Section 2.7, Mitigating Measures/Monitoring Programs, for a more detailed description of runoff collection and control systems.)

2.3.3.3 Alternatives

The location of the mine/non-mineralized material storage sites are shown in Figure 2-9. The location of the pit is dependent upon mineralization and consequently, no siting alternatives exist.



MT. HOPE MOLYBDENUM PROJECT

PROPOSED LOCATION OF PIT AND NON-MINERALIZED STORAGE AREAS

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

FIGURE 2-9

2.3.4 Process Plant

2.3.4.1 Construction

The process plant would be composed of three parts - concentrator, hydrometallurgical plant and conversion plant. Construction of the process plant facilities is scheduled to occur at the same time as preproduction stripping, i.e., during the first two years of project life. Table 2-13 shows estimates of the numbers and types of equipment that would be operational during this time. Table 2-14 shows the estimated air emissions associated with construction of the process plant. Land disturbance for the entire plant site area including the auxiliary facilities discussed in Section 2.3.6 would be approximately 100 acres.

2.3.4.2 Operation

If the project goes forward, it is anticipated the process plant would produce in sequence several potentially marketable molybdenum products: molybdenite concentrate, technical grade molybdic oxide (TMO) and ferromolybdenum (FeMo). There are no current plans to recover non-molybdenum by-products for sale. An overall conceptual process flow diagram is shown in Figure 2-10. Process components are discussed in the following sections.

Concentrator. Ore crushing/grinding and flotation steps in the concentrator are shown in Figure 2-11. Using froth flotation, the concentrator would produce a raw molybdenite concentrate. The ore, received from the mine haul trucks, would be crushed in one stage using a dry crusher to less than 6.5 in (16.5 cm). The ore would be transported to storage using a belt conveyor. Dust collection and supression systems would be installed. (See Section 2.7, Mitigating Measures/Monitoring Programs, for a more detailed description of control measures.)

The crushed ore would be wet-ground in closed-circuit, semi-autogenous grinding (SAG) mills and ball mills to produce a product fine enough to allow the molybdenite grains to be separated from the waste minerals using froth flotation. The mills would operate in closed circuit using cyclone

Table 2-13 Representative Equipment In Operation During Construction Of Process Plant

Item	Horsepower (hp)	(Kilowatt) (kW)	Total Quantity	Units Used During A Work Period
DIESEL-POWERED				
Track drills w/600 CFM compressors	250	(185)	6	4
Dump truck, 19-23 yd^3	450	(335)	4	4
Dump truck, 10-12 yd^3	450	(335)	16	12
Dump truck, 21 yd^3	500	(375)	2	2
Motor grader	250	(185)	4	2
Scraper, 21-31 yd^3	450	(335)	4	3
Dozer	300	(225)	4	2
Dozer	410	(305)	4	2
Front-end loader, 5 yd^3	400	(300)	3	3
Front-end loader, 12 yd^3	800	(600)	1	1
Crane, 150-ton	500	(370)	1	1
Crane, 35-ton	250	(185)	6	4
Crane, 50-ton	250	(185)	4	2
Crane, 30-ton	250	(185)	2	2
Crane, 18-ton	250	(185)	5	4
Crane, 8-ton	250	(185)	3	3
Compactor, 15-ton	250	(185)	2	1
Sheepfoot, Cat 815	250	(185)	2	1
Compactor, 20-ton vibration	250	(185)	1	1
Water truck, 3,000 gal	350	(260)	5	3
Concrete pump, 90 yd^3/hr	150	(110)	2	1
Lowboy trailer, 150-ton w/tractor	400	(300)	1	1
Lowboy trailer, 60-ton w/tractor	300	(225)	3	1
Concrete transit mixer, 8 yd^3	250	(185)	8	6
Aggregate plant, 175 ton/hr	250	(185)	1	1
Concrete plant, 100-m^3/hr	250	(185)	1	1
GASOLINE-POWERED				
Forklift, 1.5-10 ton	150	(110)	6	4
Loader/backhoe	150	(110)	2	1
Backhoe, 1 yd^3	150	(110)	6	4
Sedan	150	(110)	8	8
Pickup	150	(110)	22	22
4-wheel drive	150	(110)	15	10
Van	150	(110)	16	16
Carryall	150	(110)	10	10
Bus	150	(110)	5	5

Source: EXXON Minerals Company

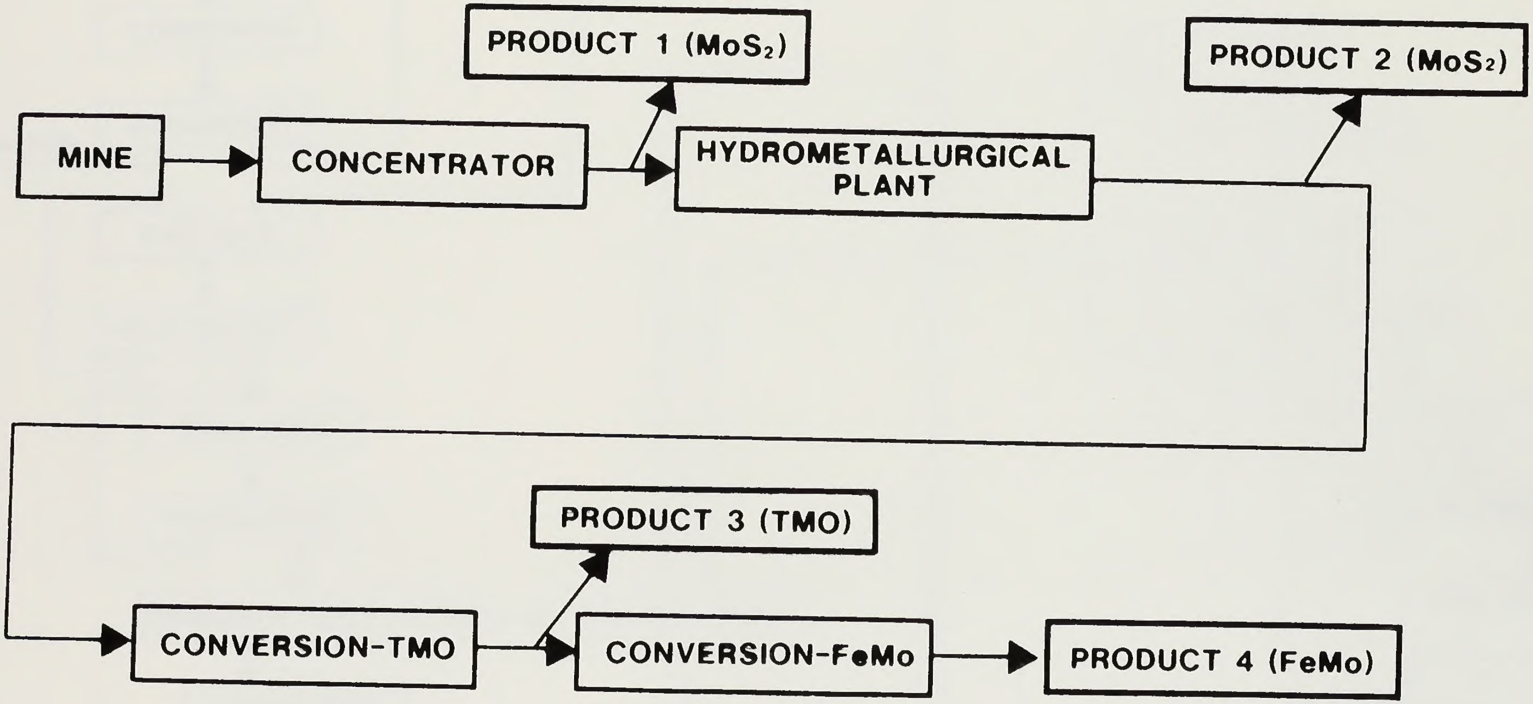
Mt. Hope Molybdenum Project

Table 2-14 Air Emissions Associated With Construction Of Process Plant 1/

SO_x Emissions (lbs/day)	SO_x Emissions (kg/day)	NO_x Emissions (lbs/day)	NO_x Emissions (kg/day)	Total Suspended Particulates (lbs/day)	Total Suspended Particulates (kg/day)
44.1	20.0	573.2	260.0	35.7	16.2

1/ Assumes 70% of equipment in use during a work period (Table 2-13) is in operation at any one time.

Source: WRC EIS Team



SOURCE: EXXON MINERALS COMPANY

MT. HOPE MOLYBDENUM PROJECT

PROCESS FLOWSHEET

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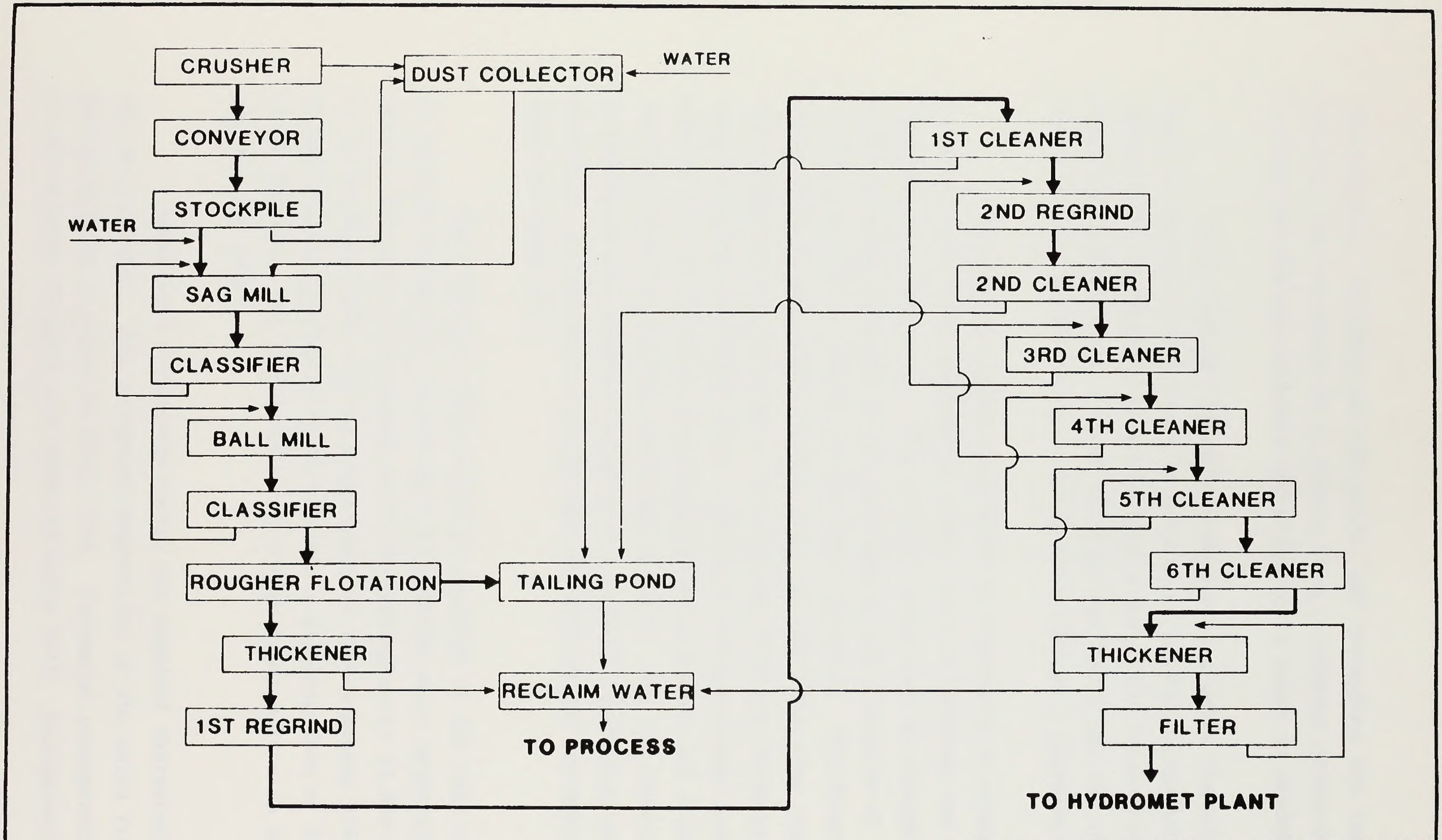
Bureau of Land Management

FIGURE 2-10



MT. HOPE MOLYBDENUM PROJECT

CONCENTRATOR FLOWSHEET

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

FIGURE 2-11

classifiers. Entering the SAG mills, and throughout the remainder of the process, the ore would be in slurry form (ore/water mixture) and would be transported through launders and pipes using pumps as needed.

After conditioning with reagents to promote the recovery of molybdenite, the ore slurry would be treated in rougher flotation machines to separate the molybdenum minerals into a low grade concentrate. This concentrate would be further treated as described below and the reject, or tailing, would be transported to the tailing pond through a pipeline.

The rougher concentrate would be thickened to reject a portion of the contained water and reground in a ball mill to liberate the molybdenum minerals from the waste material. This product would then be cleaned in flotation machines using reagents to further promote the flotation of the molybdenite and suppress the flotation of the waste material. The first cleaner concentrate would be reground a second time and refloated five times to produce the raw molybdenite concentrate. The tailings from the first and second cleaning steps would be scavenged, i.e., refloated using stronger reagent dosages to enhance the flotation of the remaining molybdenite, and discarded with the tailings from the rougher scavenger circuit. The raw concentrate would then be thickened and filtered to produce a product containing approximately 15% moisture. An estimate of materials consumed by the concentrating process is shown in Table 2-15.

The tailings, which would be produced at the rate of 10 million tons/yr (9 million tonnes/yr), is the most voluminous waste associated with the process plant. The rate of discharge would be approximately 12,350 gpm (0.78 m^3/sec). It is estimated that the tailings would be approximately 35% solids with a dry solid specific gravity of 2.65 and have a settling rate of 6 to 7 in/sec (15 to 18 cm/sec). The solids would be a fine sandy silt with about 60% passing the No. 200 sieve.

Based upon laboratory tests, the chemical characteristics of the tailing can be projected. The estimated composition of the solid fraction of the composite tailing is shown in Table 2-16. Estimated concentrations of components of the aqueous fraction are shown in Table 2-17. Estimated seepage rate is

Table 2-15 Materials Typically Consumed By Concentrator

Material	Amount (lbs/day)	Amount (kg/day)
Fuel Oil No. 2	19,800	8,970
Syntex VB	1,200	540
Sodium Silicate Type 'N'	16,200	7,340
Pine Oil	1,500	680
Aerofroth 65	600	270
Nokes Reagent	1,800	820
Sodium Cyanide	900	410
Sodium Hexametaphosphate	1,500	680
Sodium Hydroxide	3,300	1,490

Source: EXXON Minerals Company

Mt. Hope Molybdenum Project

Table 2-16 Estimated Composition Of Solid Fraction Of Tailings

Element Determined	Weight % as Mineral	
Cu	0.04	($CuFeS_2$)
Fe	0.39	(FeS_2)
Fe	1.03	(Fe_2O_3)
Zn	0.06	(ZnS)
Pb	0.01	(PbS)
As	0.02	($FeAsS$)
Cd	not detected	
Bi	not detected	
Mn	0.06	(Mn_2O_3)
Na	0.46	(Na_2O)
K	6.52	(K_2O)
Si	79.10	(SiO_2)
Al	10.16	(Al_2O_3)
Sn	not detected	
W	0.04	($(FeMn)WO_4$)
Ba	0.05	($BaSO_4$)
P	0.04	(P_2O_5)
	98.45	

Source: EXXON Minerals Company

Table 2-17 Estimated Composition Of Aqueous Fraction Of Tailing

Element	Concentration After Eight Cycles (ppm)	Estimated Equilibrium Concentration (ppm) 1/
Ag	0.01	
Al	0.16	
As	<0.063	
B	0.012	
Ba	0.058	
Be	**	
Ca	40.0	
Cd	0.0091	
Co	**	
Cr	0.0068	
Cu	0.0041	<1.0
Fe	0.21	1.0
K	58.1	
Li	0.058	
Mg	11.04	
Mn	0.278	5.0
Mo	1.083	
Na	48.54	
Ni	0.0068	
P	1.611	
Pb	**	
Pt	**	
Sb	**	
Se	**	
Si	3.58	
Sn	1.26	
Sr	0.08	
Ti	**	
Tl	**	
U	**	
V	**	
W	**	
Zn	0.035	<1.0
Cn-	1.858	1.0
Total Sulfur	94.5	
$SO_4^{=}$	86.9	500
$CO_3^{=}$	0.65	
HCO_3^{-}	159.7	
TOC	17.24	
TDS	621.0	1000

** Below detectable limit.

1/ First column represents laboratory results of metallurgical testing using Kobeh Valley water recycled eight times. For most constituents these estimates approximate equilibrium concentrations. Those constituents which may further build up are shown in the second column with the extent of build-up having been estimated based on operating experiences at other similar molybdenum processing facilities.

Source: EXXON Minerals Company

from 500 to 1,000 gpm (2,725 to 5,450 m^3/s).

Hydrometallurgical Plant. The purpose of the hydrometallurgical (leach) plant is to upgrade the raw, impure concentrate. The plant would consist of facilities to dissolve (leach) the impurities, filter the leached concentrate from the solubilized impurities, and dry the leached concentrate. A conceptual process flowsheet is shown in Figure 2-12. Materials consumed by the process are listed in Table 2-18.

(1) Leaching Operation

A ferric chloride/calcium chloride chemical leach process would be used. Conveyors would first move the concentrate from the concentrator filters to a storage bin at the leach plant. Leaching would be done in batches (approximately 15/day) in three steam-jacketed, agitated autoclaves. The leaching solution would be a brine containing calcium chloride, ferric chloride, cupric chloride and hydrochloric acid.

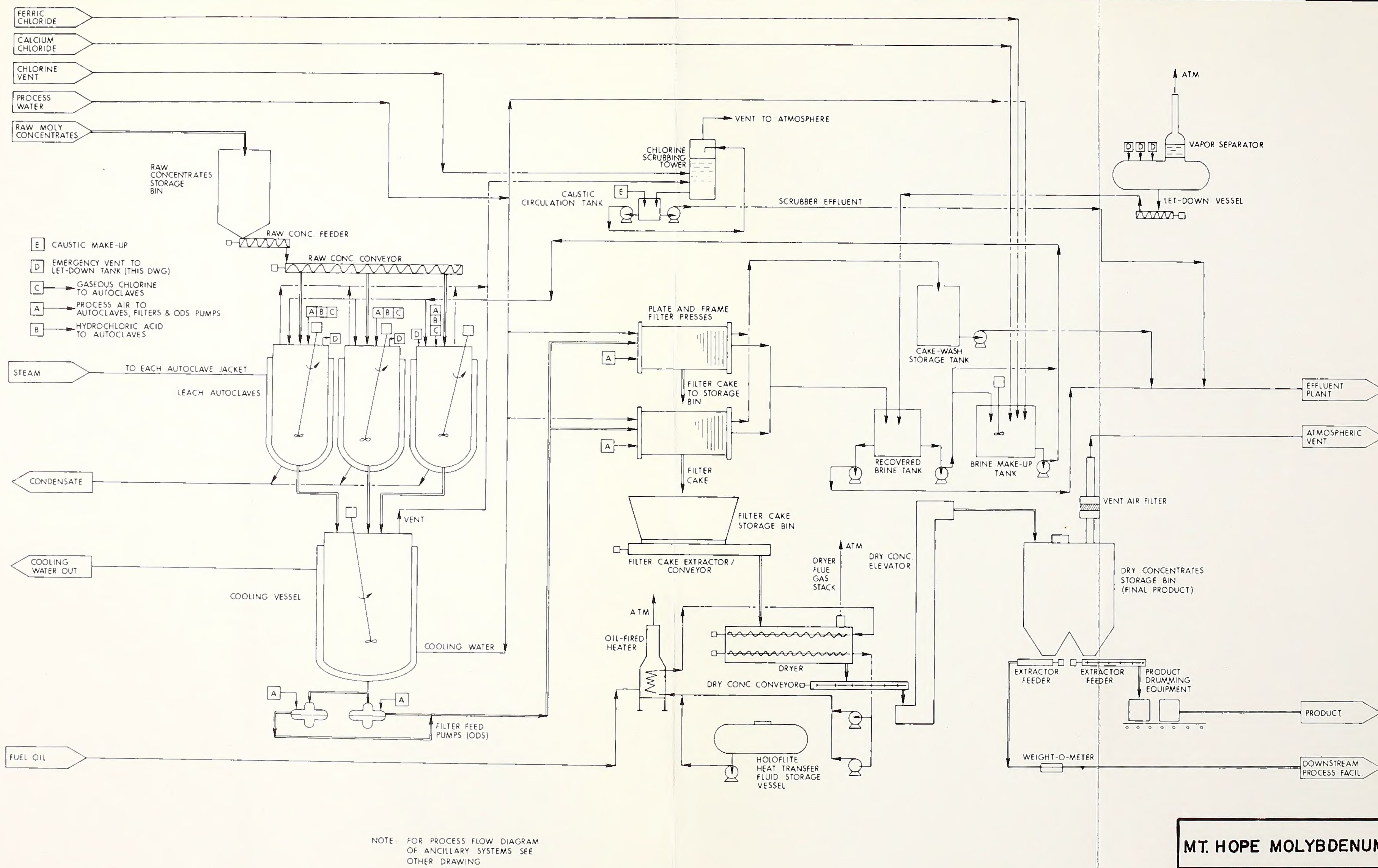
The assumed sequence of the leach operation for each batch, which would require approximately three hours, is outlined below:

1. Brine would be pumped from the brine make-up tank to a selected empty autoclave.

2. The autoclave would be sealed and gaseous chlorine added to produce the required ferric iron concentration.

3. Excess chlorine gas would be vented to the chlorine scrubbing tower when the chlorination is completed. (See Section 2.7 Mitigating Measures/Monitoring Programs for a more detailed description of this system.)

4. A batch of raw molybdenite concentrate would be added to the chlorinated leach solution.



MT. HOPE MOLYBDENUM PROJECT

HYDROMETALLURGICAL PLANT FLOWSHEET

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

FIGURE 2-12

Table 2-18 Representative Materials Consumed By Hydrometallurgical Plant

Material	lb/day	kg/day
Chlorine (99.5% liquid)	2,400	1,100
Ferric Chloride (aqueous, 38.9% $FeCl_3$ by weight)	2,800	1,266 (anhydrous)
Calcium Chloride (anhydrous, superflake, 94-97%)	7,800	3,524
Caustic Soda (flake, 98% NaOH)	145	65
Hydrated Lime (air classified, 98% $Ca(OH)_2$)	2,300	1,050
Hydrochloric Acid (aqueous, 35.2% HCl by weight)	480	218
Water	320,000 (38,000 gal)	145,000 (172 m^3)
Electric Power	2,000 kwh	2,000 kwh
Fuel Oil (No. 2)	2,363	1,074

Source: EXXON Minerals Company

5. The autoclave would be sealed and steam would be introduced to the autoclave heating jacket. The temperature of the reactants would be brought to 230°F (110°C) and maintained at that temperature and a pressure of 31 pounds per in^2 (psi) (21375 pascal (Pa)) (Abs) for two hours.

6. Steam heating would be stopped and the reactants would be discharged to a cooling vessel using compressed air.

7. Reactants would be cooled to 120°F (50°C) in an agitated cooling vessel by circulating water through the cooling vessel jacket.

(2) Filtration

The contents of the cooling vessel would be pumped to one of two fully automated plate and frame filter presses. Filtration would proceed in two stages. After the first stage, a filter cake containing 14% leachate would be produced and retained in the filter press. The resulting leachate would be stored in the recovered brine tank.

In the second stage, the filter cake would be washed with water to remove the remaining leachate from the cake. On completion of this stage of filtration, the filter cake would contain 14% (wt) water. The filter cake would be automatically discharged to the filter cake storage bin in preparation for final drying.

The solution from this operation would be stored in the cake-wash storage tank. Impurities extracted by the leaching process would accumulate in the solution and eventually inhibit the efficiency of leach extraction. In order to control this accumulation, a portion of the leachate from first stage filtration would be rejected and pumped from the recovered brine tank to the effluent plant. Including that part of the leachate rejected during the second washing stage of the process, a total of 30% of the volume of initial leach solution for each batch is assumed to be rejected from the system and treated in the effluent plant.

(3) Drying

The filter cake storage bin would have a capacity of about 14 tons (13 tonnes) of wet cake. Filter cake would be removed continuously from the filter cake storage bin and fed to the inlet of a jacketed dryer. This dryer would be a screw type, indirect heat exchanger using a hot thermal oil to transfer heat to the dryer feed. Heat would be supplied to the thermal oil by an oil-fired heater burning No. 2 fuel oil. Dried concentrate would be discharged from the dryer at a moisture content of approximately five percent by weight and conveyed by an "en-masse" conveyor to the dry concentrate storage bin.

(4) Ancillary Systems

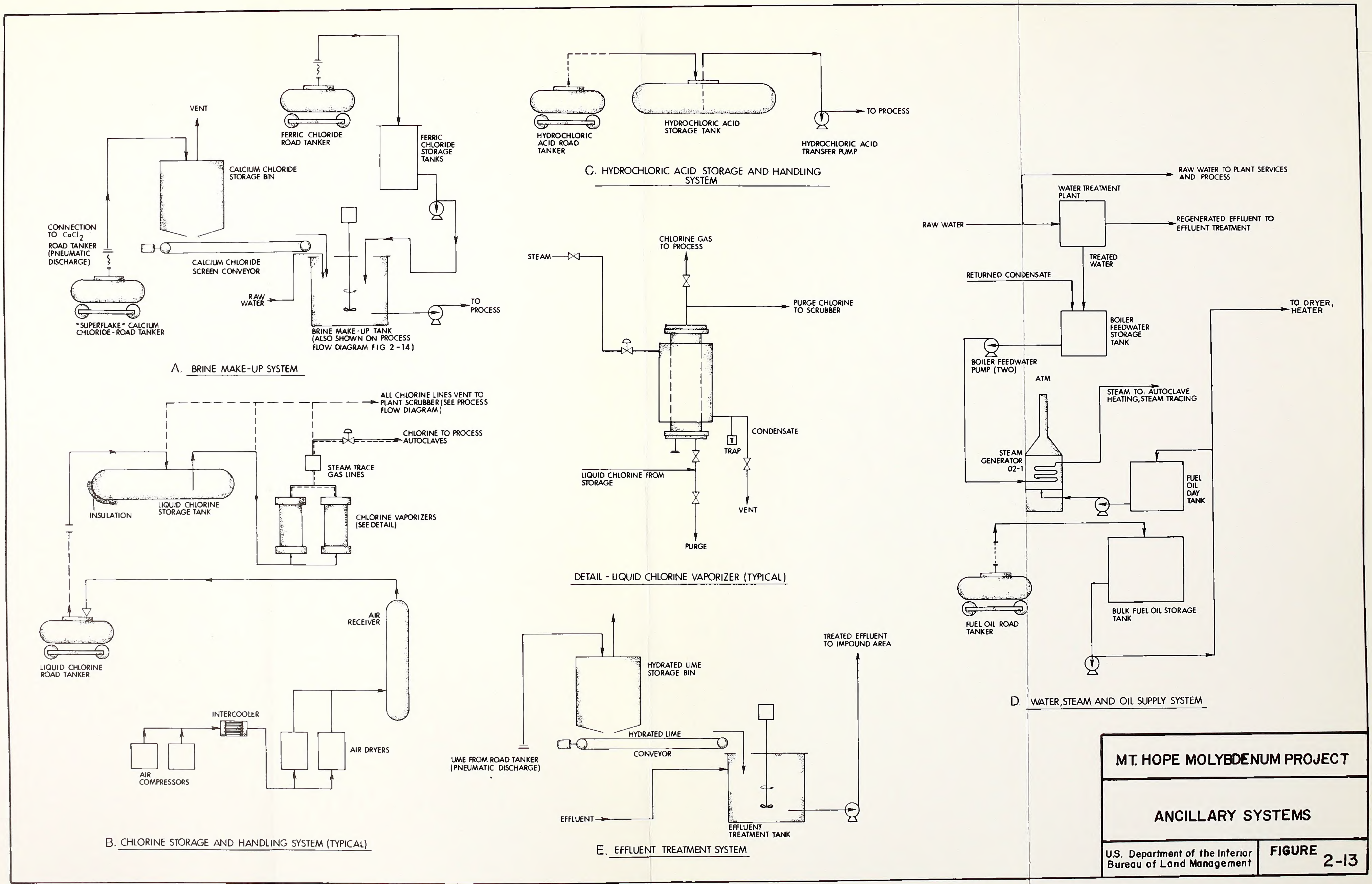
In addition to the main process stream described above, there would be several other ancillary, support systems. These are discussed below and shown conceptually in Figure 2-13.

(a) Brine Make-Up System

The brine make-up system would allow for the daily make-up of the brine required to replace that rejected due to impurity build-up. Brine would be made up in an agitated tank using raw water to which is added calcium chloride and ferric chloride. Calcium chloride would be delivered as 98% "super flake" and transferred pneumatically to the calcium chloride storage bin which has a capacity equivalent to approximately two weeks of consumption at the assumed 30 percent rejection rate required for impurity control. Ferric chloride solution would be delivered by road tanker and stored on site. Ten days storage capacity is anticipated.

(b) Chlorine Storage and Handling System

Liquid chlorine, received by road tanker, would be transferred by compressed air to a 20-ton storage tank. Although liquid chlorine consumption would be small, 1.2 ton/day (1.1 tonne/day), the instantaneous process requirement would be large and consequently, steam vaporizers



MT. HOPE MOLYBDENUM PROJECT

ANCILLARY SYSTEMS

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FIGURE 2-13

would be provided. Chlorine vents from road tanker transfers and all chlorine liquid and gas lines would be piped to the gas scrubber which would also service the leach autoclave vents.

(c) Hydrochloric Acid

Hydrochloric acid would be delivered by road tanker and stored in a 7,500-gal (28-m^3) rubber-lined tank. It would be pumped to the leach autoclaves as required.

(d) Water, Steam and Oil Supply System

It is assumed that water from Kobeh Valley would be of sufficient quality for direct use as plant service water and for process cooling duties. Water for steam generation purposes would be demineralized and water for potable uses would be chlorinated. The water storage tank would be at an elevation of 6,960 ft (2120 m).

Bulk fuel oil would be received by road tanker and stored onsite in a 50-ton (45-tonne) capacity tank. Fuel oil would be consumed in steam generation and in the drying process. A small quantity of fuel oil may be used for domestic services.

(e) Effluent Treatment System

Process effluent would be lime treated and the resulting sludge would be pumped to a lined evaporation pond of approximately 165 acres located inside the plant boundary. (See Section 2.7, Mitigating Measures/Monitoring Plan, for detailed description of this system.)

Conversion Plant. Further processing of the concentrate from the hydrometallurgical plant would occur in the conversion plant which consists of two parts, Technical Molybdic Oxide (TMO) and Ferromolydenum (FeMo) production.

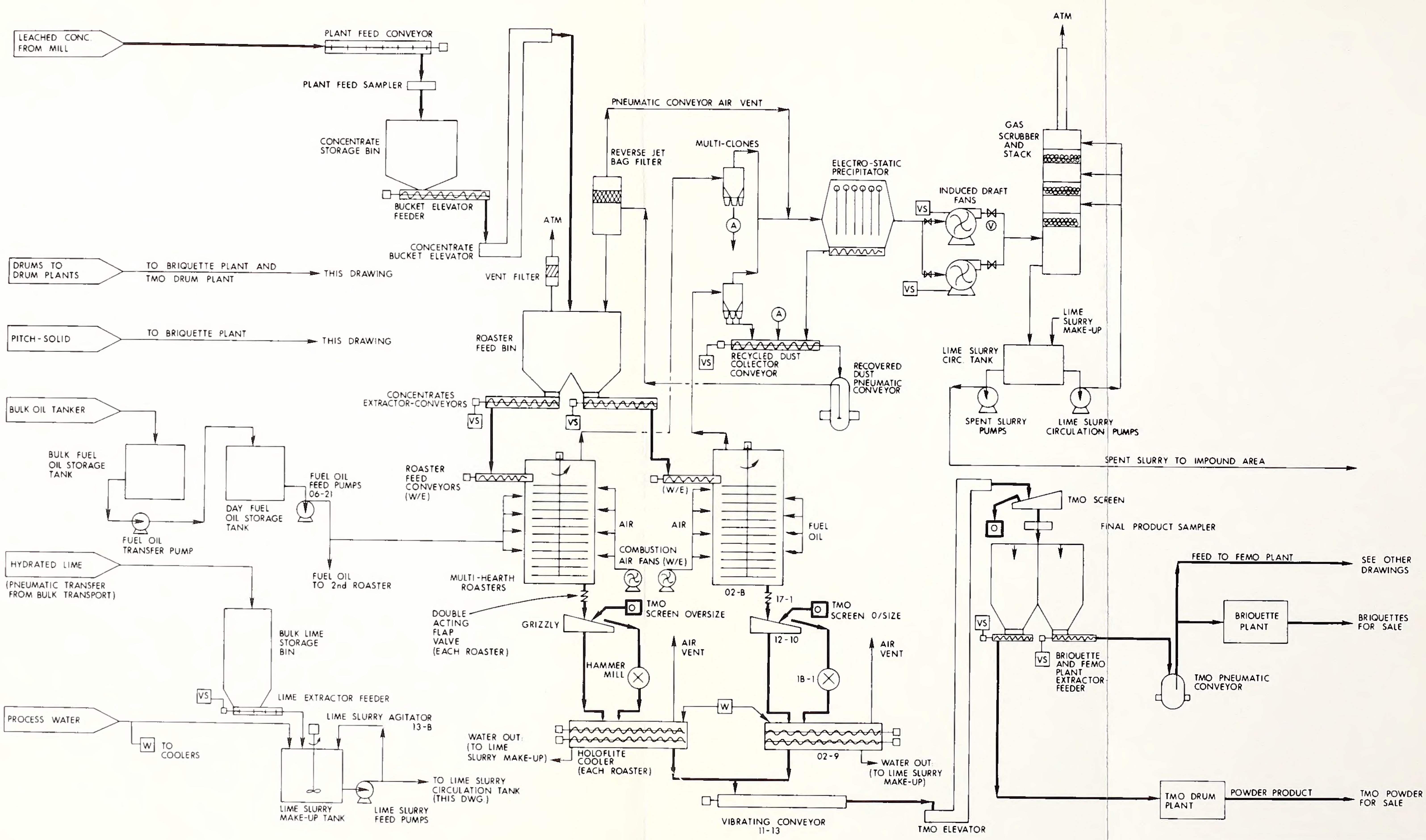
(1) TMO Production

A typical conceptual schematic of the TMO process is shown in Figure 2-14. The materials that would be consumed by TMO production are listed in Table 2-19. Dried concentrate would be conveyed from the leach plant to the concentrate storage bin which would have a capacity of 350 tons. Concentrates would be withdrawn as required from the storage bin and transported by bucket elevator to one of two roaster feedbins.

There would be two multiple-hearth roasters generally operating at hearth temperatures not in excess of 1,300°F (700°C). Heat for the roaster operation would be provided partly from fuel oil, partly from the combustion of residual mineral oils contained in the flotation concentrate and mostly (70% of total heat) from the oxidation of the sulfur in the molybdenite concentrates.

Roaster gas, typically containing from 0.5 to 1.5% (volume) SO_2 and entrained solids, would be collected in a flue gas manifold. Roaster gas would pass through cyclones and dry-plate-type electrostatic precipitators. Solids eliminated in this way would be collected, conveyed to a pneumatic conveyor and pneumatically transported to the roaster feed bin for recycle to the roasters. Although the composition of the entrained material would vary depending on such factors as particle size, moisture content of initial roaster feed, gas velocity, etc., it is expected to consist of approximately equal parts of unroasted concentrate and TMO. Cleaned gas from the electrostatic precipitator would be transported through induced draft fans which discharge the gas to a gas scrubber.

In the gas scrubber, the sulfur dioxide bearing gas would be contacted with calcium hydroxide slurry and the sulfur oxides would be converted to calcium sulfite and calcium sulfate. Clean gas would be vented to the atmosphere. An aqueous slurry, containing calcium sulfite, calcium sulfate and some residual calcium hydroxide, would be pumped from the plant to an impoundment area for storage. (A more detailed description of the treatment of air emissions may be found in Section 2.7, Mitigating



NOTES:

VS - VARI-SPEED GEARS

V - BUTTERFLY VALVES FOR I.D. FAN ISOLATION

EQP. 01-13: ROTARY (AIR SEAL) VALVES ON CYCLONES AND ELECTROSTATIC PRECIPITATOR NOT SHOWN ON FLOWSHEET.

W WATER SUPPLY

MT. HOPE MOLYBDENUM PROJECT

PROCESS FLOW DIAGRAM: TMO PLANT

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FIGURE 2-14

Table 2-19 Materials Typically Consumed During TMO Production

Material	lb/day	kg/day
Lime (Hydrated, Air Classified 98% $Ca(OH)_2$)	105,000 lb/day	46,900 kg/d
Water (untreated)	4,141,000 lb/day (500,000 gal)	1,878,000 kg/d (1,900 m^3)
Electrical Power	7,200 kwh	7,200 kwh
Fuel Oil (No. 2)	900 lb/day	1,977 kg/d

Source: EXXON Minerals Company

Measures/Monitoring Programs.)

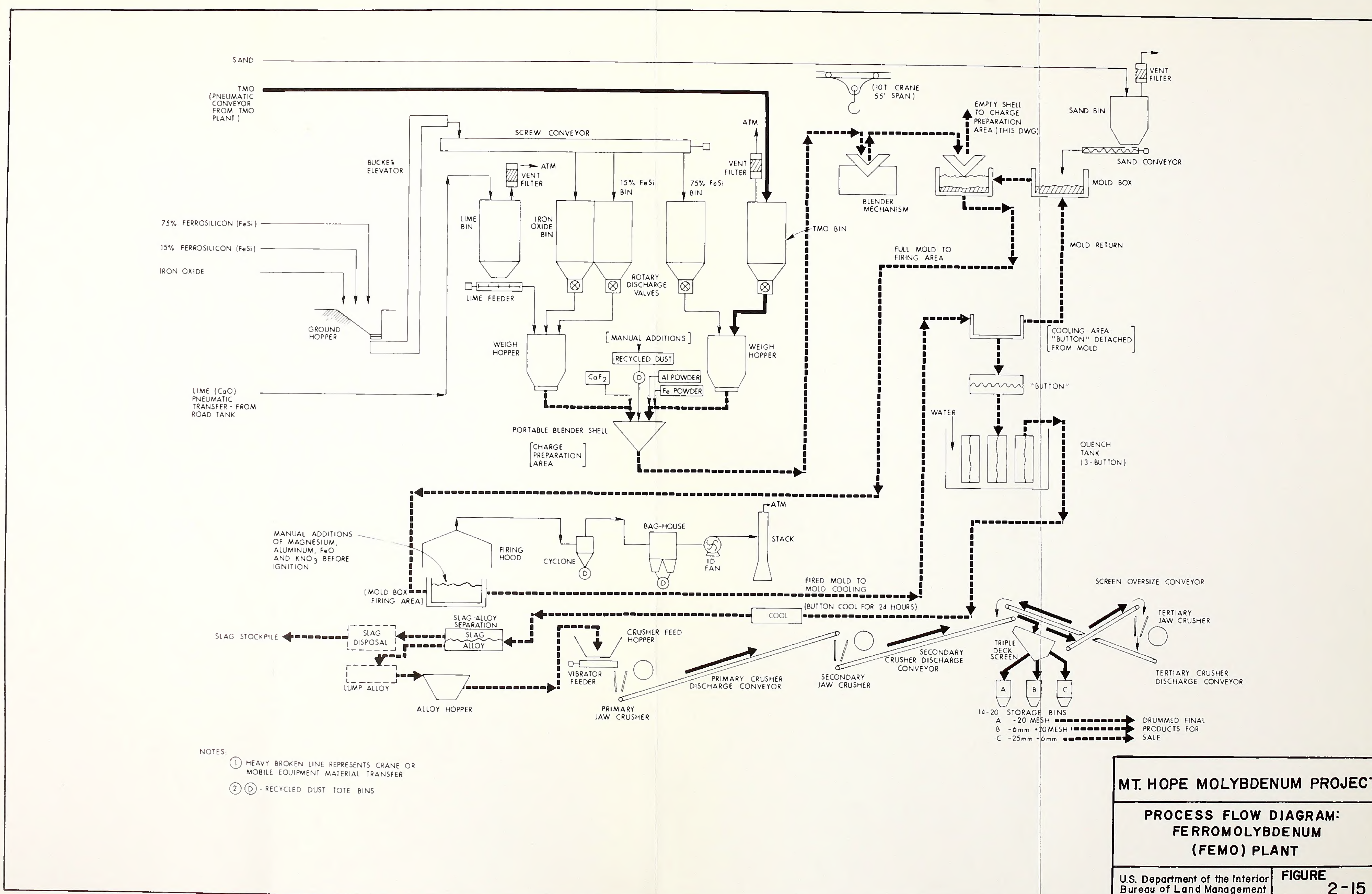
Roaster products would fall from the lowest hearth of the roasters by gravity to a double-acting flap valve which would regulate ingress of ambient air to the roaster and discharge the product to a grizzly. Grizzly undersize would fall by gravity to an indirect cooler and oversize would pass to a hammermill. The hammermill product would be recycled back to the cooler. Using water, the roaster product would be cooled from 1,000° to 210°F (550° to 100°C). Water consumption for cooling would be approximately 8 gpm (0.0005 m^3/s) per cooler and warm water leaving the coolers would be used in lime slurry make-up.

Cooled product would be transported by vibrating conveyor to a bucket elevator which would move the TMO to a vibrating screen located above the storage bin. TMO screen oversize would fall by gravity to either of the two grizzly screens at the roasters. The storage bin would have a nominal capacity of approximately 45 tons (41 tonnes).

From storage, the product would be 1) conveyed to the FeMo plant for further purification, 2) conveyed to the briquette plant, or 3) drummed and stored for shipment. Briquettes would be formed by compressing TMO with pitch in a hydraulic press. The briquettes would be 4 in (10 cm) long and weigh 4.6 lbs (2.1 kg). Briquettes would then be drummed and stored for shipment.

(2) FeMo Production

A conceptual process flow diagram for FeMo production is shown in Figure 2-15. Ferromolybdenum would be produced in batches by the "thermit" process which uses the exothermic heat of reaction developed when aluminum and silicon reduce molybdenum trioxides to molybdenum metal. When iron is present in the initial charge, the final product is a ferro-molybdenum alloy. A normal batch "burn" would consume the quantities of material shown in Table 2-20. Up to seven batches/day would be burned at temperatures as high as 3,500°F (1925°C). Slagging agents would also be added to the charge to produce a fluid, low-melting slag composed of the acid



MT. HOPE MOLYBDENUM PROJECT

PROCESS FLOW DIAGRAM: FERROMOLYBDENUM (FEMO) PLANT

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FIGURE 2-15

Table 2-20 Materials Typically Consumed Per Day - FeMo Production

Material	Weight (lb)	Weight (kg)
TMO	23,000	10,500
FeSi (75%)	7,000	3,200
FeSi (15%)	5,400	2,400
Fe_2O_3	4,600	2,100
CaO	3,500	1,600
Al (Metal)	1,100	500
Fe (Metal)	770	350
CaF_2	700	320

Source: EXXON Minerals Company

insoluble portion of the TMO and the silicon dioxide and aluminum oxides formed during the reaction.

TMO would be conveyed pneumatically from the storage bin at the TMO plant to the ferromolybdenum plant. Lime, iron oxide, 15% ferro silicon, recycled dust, calcium fluoride, aluminum, iron powder, 75% ferrosilicon and TMO would be combined and blended. This mixture or charge would be added to reusable firing molds which would consist of an eight-foot square steel box with two-foot high walls. For each burn, the box floor would be covered with refractory bricks and the entire box would be lined with sand.

Charged molds would be transported by overhead crane to the firing area and a starter or "ignition" mix of magnesium powder, aluminum powder, potassium nitrate and iron oxide would be manually sprinkled over the charge. Reaction or "burn" time would vary from one minute to 1/2 hour. A three to five minute burn is considered to be optimum. Upon completion of the burn, the mold and its reacted contents would be allowed to cool for 16 hours.

Very little gas would develop during a normal burn. However, if limestone or hydrated lime is present in the lime charged to the reaction, the water present in the hydrated lime and the CO_2 in the limestone would produce a gas. Typically, however, there would be no visible emissions from the baghouse exhaust stack. Dust collected in the cyclones or baghouse would be recycled to subsequent charges. (See Section 2.7, Mitigating Measures/Monitoring Programs, for a more detailed description of this control technology.)

The cooled reaction product would consist of a cohesive button-shaped mass about 6 ft (1.8 m) in diameter and 16 in (0.4 m) thick. The "button" would be pulled from the mold box and placed in an empty quench tank. At this time, the temperature in the interior of the button would be greater than 1,500°F (800°C). Water would be introduced into the quench tank, and the button would cool in the tank for about 45 minutes until the temperature at the button interior is about 1,000°F (550°C) and the button has cracked along the alloy/slag interface. The button would then be withdrawn

from the quench tank, laid on the floor and allowed to cool for 24 hours.

After cooling is complete, the button would be broken with sledge hammers and the alloy manually separated from the slag and transported to the alloy crusher. The slag would be transported to a slag bin with a 10 ton (9 tonne) capacity crane.

The alloy crushing plant circuit would consist of three jaw crushers which would produce alloy in the three size fractions - furnace size: -25 mm to +6 mm; ladle size: -6mm to +841 micron; and small ladle size: less than -841 micron. The crushed fractions of ferromolybdenum alloy would be stored in three separate bins and packaged in steel drums for shipment.

Slag would be taken daily by truck to the slag storage area. The slag, at an assumed -8 in (-200 mm) size, would have a bulk density of about 1.3 ton/yd^3 (1.5 ton/m^3). At this bulk density and assuming a 5.0 ft (1.5 m) high pile and production of slag over a period of 50+ years, approximately 14 acres of land would be required to stockpile the slag. Slag piles would be trimmed occasionally using either a rubber-tired front-end loader or a small bulldozer.

2.3.4.3 Summary of Environmental Loadings

Tables 2-21, 2-22 and 2-23 summarize air, solid and liquid wastes that would be generated by the process plant. In-process and end-of-pipe control technologies are mentioned briefly in these tables as they were in preceding sections, but the reader is referred to Section 2.7, Mitigating Measures/Monitoring Plans, for a more detailed description. A summary of areal disturbance is given in Table 2-24.

2.3.4.4 Alternatives

Siting of the process plant is driven by the location of the mine which is fixed by the ore deposit and the location of the tailing pond (see Section 2.3.5). The process plant would be located so as to minimize

Table 2-21 Summary Of Air Emissions From Process Plant

Concentrator

Crusher/Stockpile Reclaim – Release of scrubbed suspended particulates at the rate of 450 lb/day. (225 lb/day (102 kg/day) from the crusher and 222 lb/day (100 kg/day) from stockpile reclaim)).

The crusher would be located at an elevation of 6774 ft (2066 m) and the stack would be 33 ft (10 m) high. The stockpile would be located at 6705 ft (2045 m) and the stack would be 33 ft (10 m) high.

Hydrometallurgical Plant

Dryer flue gas – Release of water vapor from dryer at the rate of 8.1 lb/min (3.7 kg/min), entrained air, and a possible oil fume derived from burning an oily concentrate.

Oil-fired heater – Residual gas from burning 1350 lbs (613 kg) No. 2 fuel oil/day. Oil of typical composition.

Chlorine scrubbing tower – Intermittent release of chlorine gas not to exceed regulatory limits. Before release, stream would be scrubbed using sodium hydroxide solution.

Vent air filter – Possible intermittent release of displaced air containing TMO particles.

Vapor separator – Release occurring only in event of excursion from normal operation. Vapor separator to accept contents of leach autoclaves and condense vapor.

The hydrometallurgical plant would be at an elevation of 6682 ft (2038 m) and each stack would be 77 ft (24 m) high with the exception of the vent filters which would be 25 ft (7.5 m) high.

TMO Production

Scrubber – Roaster flue gas entering scrubber would have passed through an electrostatic precipitator assumed to achieve 98% removal of solids. Scrubber assumed to achieve 97% removal efficiencies. Final emission rate is assumed to be approximately 3.17 tons/day SO_2 and 0.002 tons/day of particulates.

Vent filters (2) – These emissions would be routed to electrostatic precipitators mentioned above and become part of the above stream.

Vent air filters (2) – Intermittent release of ambient air.

The TMO plant would be at an elevation of 6682 ft (2038 m) and the scrubber stack would be 120 ft (37 m) high.

FeMo Production

Vent filters – Intermittent release of ambient air.

Stack gas – Release of approximately 5000 scf/min (141 m^3/min) composed mostly of air and small quantities of water vapor and CO_2 at slightly elevated temperatures.

The FeMo plant would be at an elevation of 6682 ft (2038 m) and the stack would be 79 ft (24 m) high.

Note: All stack heights include height of structures.

Source: EXXON Minerals Company

Table 2-22 Summary Of Effluents From Process Plant

Concentrator	
Dewatering and Grinder -	Tailings with aqueous fraction characteristics described in Table 2-17.
Hydrometallurgical Plant	
Wastewater Treatment Plant -	Collects flows from leaching operation, blow-down from boilers, regeneration effluents from water treatment plant and scrubber, and effluent from chlorine scrubbing. Expected flow is (154 ton/day (140 tonne/day) or 23 gpm (0.001 m^3/s)). Assuming 95% treatment efficiencies, effluent will contain 0.52 ton/day (0.47 tonne/day) CaO_2, 0.06 ton/day (0.05 tonne/day) Fe, 0.02 ton/day (0.02 tonne/day) Cu and 0.0006 ton/day (0.0005 tonne/day) Pb. Effluent would be discharged to a lined evaporation pond.
TMO Plant	
Scrubber -	Scrubber will use $Ca(OH)_2$ slurry to eliminate SO_x. Effluent stream would be $CaSO_3$ and $CaSO_4$ with some TMO solids and some unreacted $Ca(OH)_2$. Approximate stream flow of 1985 ton/day (1800 tonne/day) would be discharged to a lined evaporation pond.
FeMo Plant	No liquid effluent would be generated.

Source: EXXON Minerals Company

Table 2-23 Summary Of Solid Wastes From Process Plant

Concentrator	
Dewatering of Concentrate -	Tailings with solid fraction characteristics shown in Table 2-16.
Hydrometallurgical Plant	There would be no solid wastes from this plant other than the neutralization product described under effluents.
TMO Production	
Gas scrubber slurry -	Approximately the same amount of slurry would be generated as lime is used or 44 ton/day (40 tonnes/day). Slurry would contain $CaSO_4$, $CaSO_3$, $CaCO_3$, SiO_2, MoS_2 and MoO_3 and would go to a lined evaporation pond.
FeMo Production	
Slag -	10.2 ton/day (9.3 tonne/day) containing approximately 1.7% Mo, 9.6% FeO, 59% SiO_2, 14.9% CaO, 2.9% CaF_2 and 8.5% Al_2O_3.

Source: EXXON Minerals Company

Table 2-24 Areal Extent Of Major Mt. Hope Project Components 1/

Components	Acres	Million m^2
Tailing Pond 2/	2,200-5,700 (3,460)	8.9-23
Pit	700	2.8
Non-Mineralized Material Storage Areas	2,400	9.7
Evaporation Pond	165	0.7
Plant Site and Auxiliaries	100	0.4
Subdivision Site	200	0.8
Site Access Road 3/	30	0.1
(Spacing Acreage)	(1,845)	
	5,795-9,295 (8,900)	24-38

1/ Parameters in parentheses added during EIS preparation.

2/ Site dependent, see Section 2.3.5.

3/ Exclusive of access roads paralleling rights-of-way.

cost of ore and tailing transport. Based on these constraints, the optimum location of the process plant, with the exception of the crusher which would be located on the pit edge, is shown in Figure 2-16.

The entire process may be located in a single L-shaped structure or, alternatively, the concentrator and leach plant in one structure and the TMO and FeMo production in a second structure connected by overhangs.

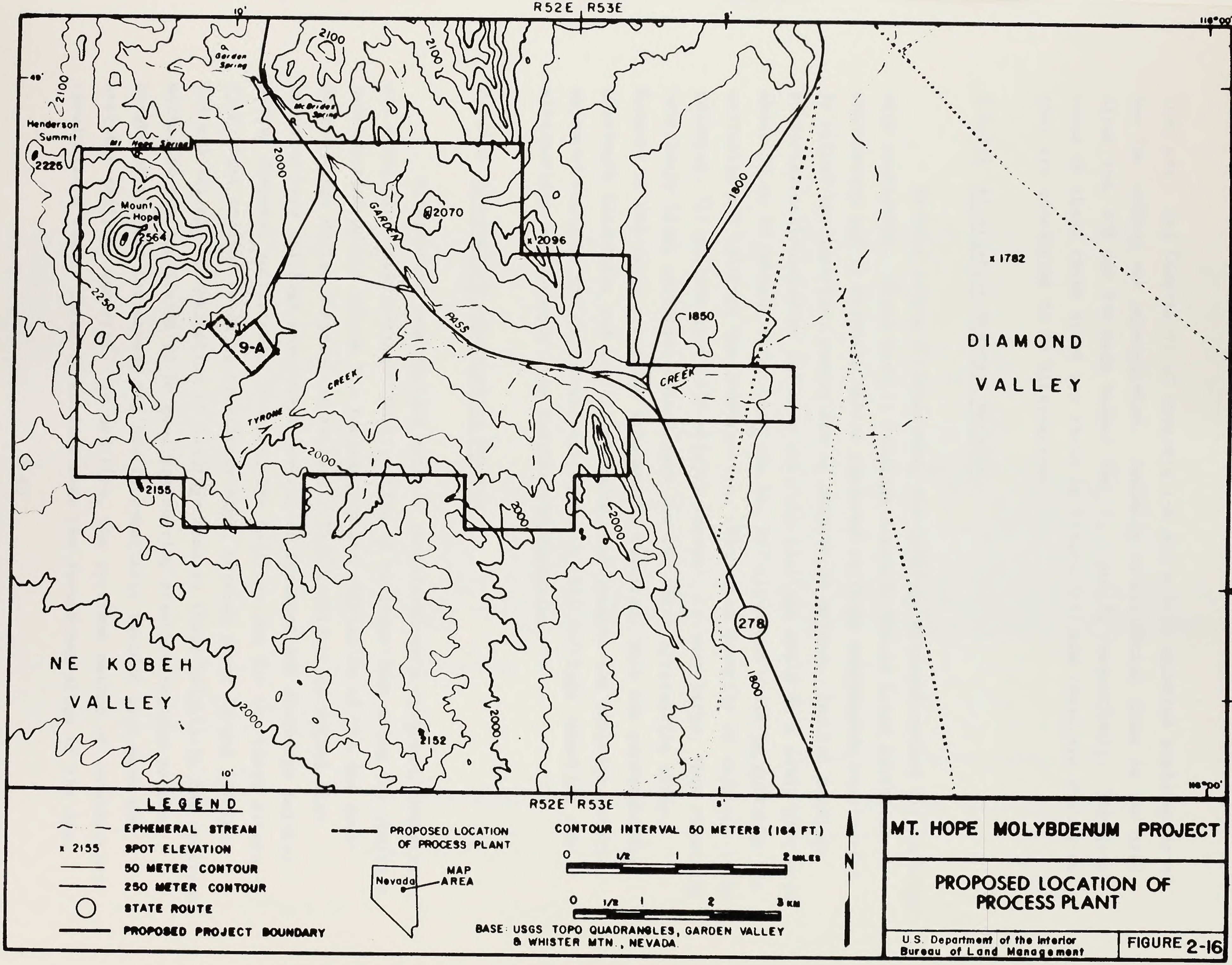
Because each process step produces a marketable product, alternatives also exist in the form of varying the relative amounts of each product.

2.3.5 Tailings Pond

Unlike its predecessors, this section does not differentiate between construction and operation phases. This difference exists because although building the starter dam is distinctly a construction activity occurring during the designated two-year construction period, building the rockfill toe and drainage interruption dam and the gradual, strategic segregation and placement of tailings to form a self-liner is a continual process extending far into the years of operation. Instead this section is organized to discuss criteria for selection of sites, alternative disposal techniques and alternative dam construction techniques. Finally, this section addresses the specifics of the three alternative sites selected.

2.3.5.1 Site Selection

Selection of a tailings disposal site is extremely important, not only from an environmental point of view, but also from cost, operational and technical standpoints. In 1982, EXXON commissioned a study to identify potential tailing disposal sites. The identification criteria were site storage capacity and site proximity to Mt. Hope, major drainages and perennial springs and streams, and antiquities or environmentally-sensitive areas. Using these criteria, the contractor identified ten candidate sites, the locations of which may be found in Figure III-1 in Appendix 1-A of this Technical Report. These ten sites were then ranked on the basis of capital costs, operating costs, technical factors, environmental considerations and



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PROPOSED LOCATION OF PROCESS PLANT

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FIGURE 2-16

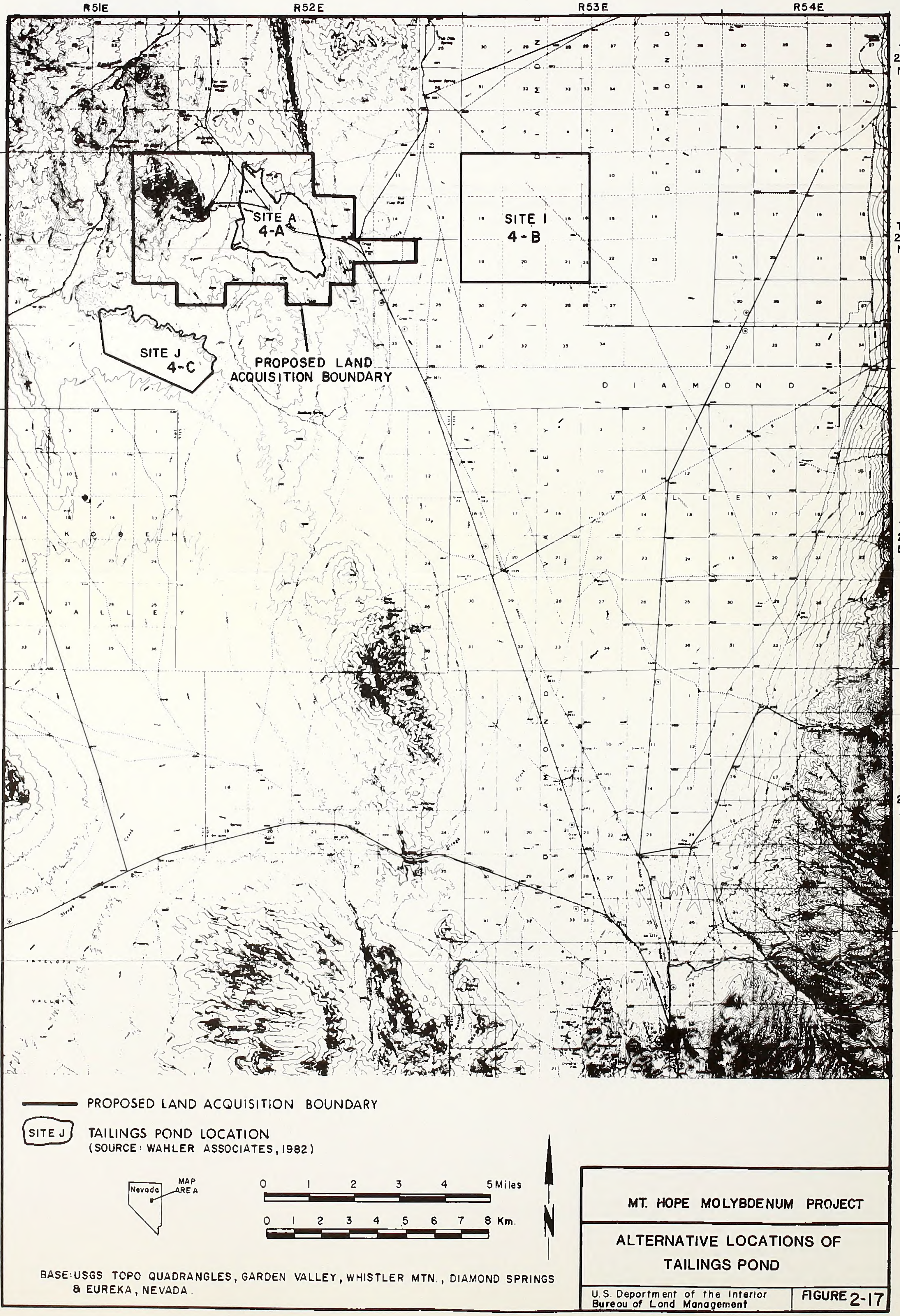
land use. See Chapter VI of Appendix 1-A for a more detailed explanation of how the ranking was accomplished. Assuming an artificial liner is not used, Sites 4-A, 4-B and 4-C were ranked Nos. 1, 2 and 3, respectively. The locations of these three sites are shown in Figure 2-17 and these are the sites that are considered to be alternatives.

2.3.5.2 Alternative Disposal Methods

Besides siting alternatives, two tailings disposal method alternatives were considered. These were 1) tailings disposal behind zoned earthfill embankments and 2) disposal behind cycloned tailings embankments constructed by either the upstream, centerline or downstream method. Initial tailings characterization studies indicate that the tailings would be a sandy silt with about 50 to 60 percent finer than the No. 200 sieve and would be suitable for cycloning and tailings dam construction. The total quantity of tailings to be produced, 715 million tons (650 million tonnes), is very large, thus requiring relatively large retention embankments for the three alternative sites. Because of the large retention embankments required, with the corresponding earthwork quantities and associated costs, and because the tailings material appeared suitable for dam construction, earth fill tailings retention dam alternatives were dropped from further consideration.

2.3.5.3 Alternative Construction Methods

Alternative construction methods considered were upstream, downstream and centerline construction. Construction of tailings dams using the upstream construction method allows for reclamation and vegetation of the dam downstream slope during disposal operations. This construction method also requires less tailings management (moving of cyclones and discharge points) during disposal operations. However, the tailings dam for the three alternative sites studied would be relatively high, between about 78 and 397 feet (24 and 121 m). Construction of tailings dams to these heights by the upstream method is not considered to be good engineering practice because as the height of the dam increases, the dam is eventually founded over weak and unstable tailings material. In addition, the upstream method of construction results in a higher phreatic surface near the downstream slope of the dam,



R51E
R52E
R53E
R54E
T 23 N
T 22 N
T 21 N
T 20 N
T 19 N
SITE A 4-A
SITE I 4-B
SITE J 4-C
PROPOSED LAND ACQUISITION BOUNDARY
D I A M O N D
V A L L E Y
K O B E H
V A L L E Y
PROPOSED LAND ACQUISITION BOUNDARY
SITE J TAILINGS POND LOCATION (SOURCE: WAHLER ASSOCIATES, 1982)
Nevada
MAP AREA
0 1 2 3 4 5 Miles
0 1 2 3 4 5 6 7 8 Km.
N
BASE: USGS TOPO QUADRANGLES, GARDEN VALLEY, WHISTLER MTN., DIAMOND SPRINGS & EUREKA, NEVADA.
MT. HOPE MOLYBDENUM PROJECT
ALTERNATIVE LOCATIONS OF TAILINGS POND
U.S. Department of the Interior
Bureau of Land Management
FIGURE 2-17

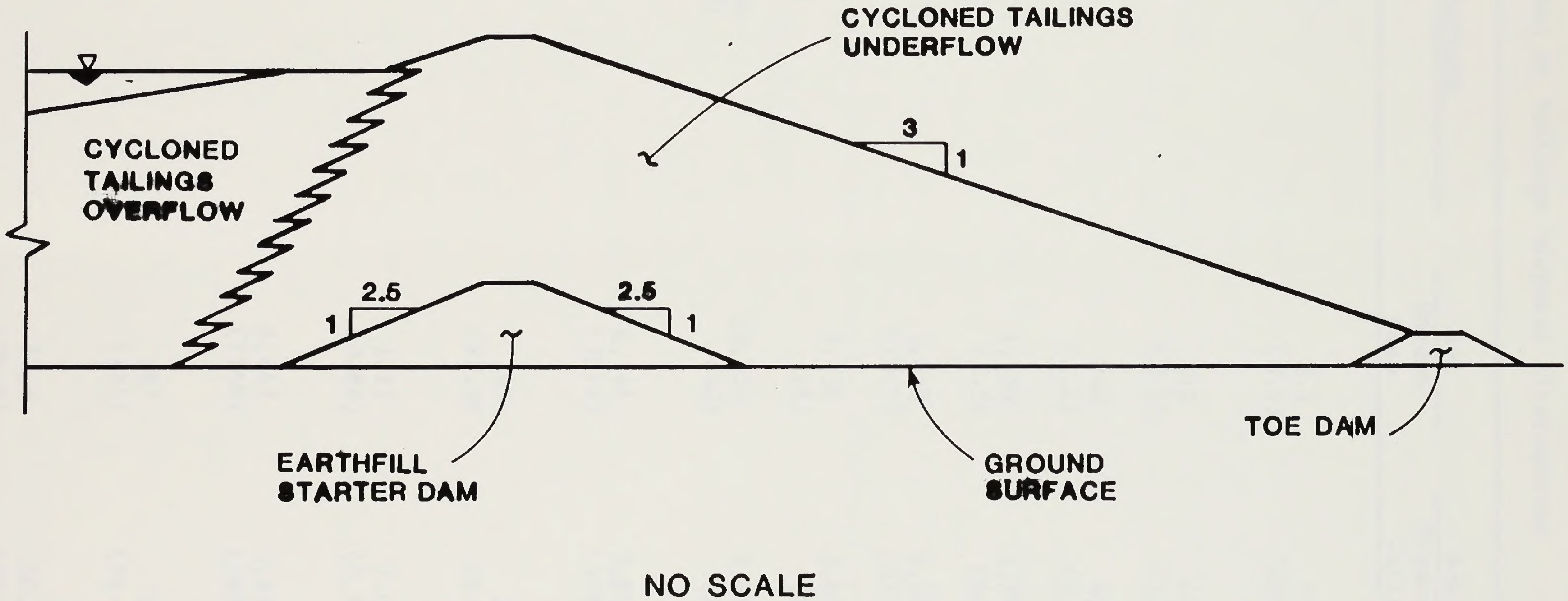
and this condition can be detrimental to static stability. It also increases the liquefaction potential of the embankment if subjected to earthquake loadings. Therefore, the upstream method of construction was dropped from further consideration.

Both centerline and downstream methods of tailings dam construction, when the dams are properly designed and constructed, are suitable methods of tailings disposal using high embankments. However, the downstream method of construction requires a larger quantity of tailing sand for embankment construction and more intensive tailings management for dam construction. Because of this, and since using a downstream construction method would have no significant advantages for the Mt. Hope Project, the centerline method of tailings dam construction was selected as the basis for alternatives comparison. A typical section of centerline tailings embankment is shown in Figure 2-18.

2.3.5.4 Comparison of Alternative Sites

Approximately 390,000 acre-feet (480 million m^3) of storage would be required for the 715 million tons (650 million tonnes) of tailings produced during the project life. For the comparison of alternatives, it was assumed that the starter dams would be sized to provide 6,650 acre-feet (8.2 million m^3) of storage. This would be equivalent to one year of tailings production.

The tailings transport facilities for the three alternatives were sized based upon daily tonnage of 33,000 tons (30,000 tonnes), 2.65 solids specific gravity, tailings pulp at 35 percent solids and tailings grind with 60 percent minus No. 200 mesh. For the conceptual design of the selected alternatives, the production rate was assumed to be 30,000 tons (28,000 tonnes) of ore per day. The tailings discharge would be 12,350 gpm (0.78 m^3/s) at a density of 35 percent solids. To allow for surges and give the plant the capability of compensating for unscheduled shutdown days, this number was increased by 25 percent. The tailings disposal system was, therefore, sized for a slurry volume of 12,350 x 1.25 = 15,440 gpm (0.97 m^3/s). The three alternatives are compared in Table 2-25 and described in more detail in the following sections.



MT. HOPE MOLYBDENUM PROJECT

TYPICAL TAILINGS EMBANKMENT SECTIONS

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FIGURE 2-18

Table 2-25 Comparison Of Tailings Disposal Alternatives

POND SPECIFICATIONS	4-A Garden Pass	4-B Diamond Valley	4-C Upper Kobeh Valley
Lineal Distance from Mill Site - mi	2.1	6.3	3.6
- (km)	(3.4)	(10.1)	(5.8)
Areal Extent - 5 yr - ac	519	425	667
- (km^2)	(2.1)	(1.7)	(2.7)
10 yr - ac	840	850	988
- (km^2)	(3.4)	(3.4)	(4.0)
20 yr - ac	1,358	1,700	1,358
- (km^2)	(5.5)	(6.9)	(5.5)
40 yr - ac	2,643	4,250	2,099
- (km^2)	(10.7)	(17.2)	(8.5)
Ultimate - ac	3,458	5,650	2,173
- (km^2)	(14)	(23)	(8.8)
Drainage Area - acres	12,352	5,650	3,930
- (km^2)	(50)	(23)	(16)
Starter Dam Crest Elevation - ft	6,144	5,864	6,426
- (m)	(1874)	(1789)	(1960)
Starter Dam Height - ft	95	21	56
- (m)	(22.9)	(6.4)	(17.1)
Starter Dam Volume - million yd^3	1.12	1.00	2.43
- million (m^3)	(0.86)	(0.76)	(1.86)
Ultimate Dam Crest Elevation - ft	6,447	5,922	6,619
- (m)	(1166)	(1806)	(2018)
Ultimate Dam Height - ft	397	78	249
- (m)	(121)	(24.1)	(75.9)
Ultimate Dam Volume - million yd^3	32.3	30.6	66.5
- million (m^3)	(24.6)	(23.4)	(50.9)

Table 2-25 Comparison Of Tailings Disposal Alternatives (continued)

POND SPECIFICATIONS	4-A Garden Pass	4-B Diamond Valley	4-C Upper Kobeh Valley
Tailing Conveyance			
Type of Flow	Gravity	Gravity	Pumped
Length of Tailings Line			
- mi	4.4	15.0	7.5
- (km)	(7.1)	(24.2)	(12.1)
Reclaim Water Pump-Back			
- gpm	3,500	1,500	3,000
- (lps)	(221)	(95)	(189)
Reclaim Water Return			
Line Length - mi	3.7	8.0	5.3
- (km)	(6.0)	(12.9)	(8.5)
Access Road Length			
- mi	3.2	7.0	3.6
- (km)	(5.2)	(11.3)	(5.8)

Source: EXXON Minerals Company

Alternative 4-A. This alternative would utilize a cycloned sand tailings embankment located about 2,000 ft (610 m) upstream of the narrow gap in the Sulphur Spring Range. The location of this site is shown in Figure 2-17. This alternative site is located adjacent to, and downstream of the process plant.

Initially, an earthfill starter dam would be constructed to an elevation of 6,144 ft (1874 m). The starter dam would be 95 ft (22.9 m) high and would contain 1.12 million yd^3 (0.86 million m^3) of material. The starter dam would have a 30-ft (9.1-m) crest width and 2.5H:1V slopes. The ultimate tailings dam would have a crest elevation of 6,447 ft (1166 m).

This alternative would have a relatively large drainage area, 12,352 ac (50 km^2). However, diversion facilities could be provided to direct runoff around the impoundment. Since this site is located lower than the preferred mill site, tailings transport could be by gravity flow.

Utilization of this site would require abandoning approximately two miles (3.2 km) of paved state highway. About six miles (9.7 km) of new highway would be required to bypass the impoundment. (See Section 2.2.3.)

Alternative 4-B. This alternative is located in the alluvial flats in the western part of Diamond Valley about seven miles (11.3 km) east of the Mt. Hope site (Figure 2-17). The disposal facility for this alternative would consist of a large ring dike impoundment, ultimately having an impoundment area of 5,658 ac (23 km^2). The initial earthfill starter dike for this alternative would be 21 ft (6.4 m) high, three miles (4.8 km) long, and require about 1.0 million yd^3 (0.76 million m^3) of material. The ultimate tailings dam would have a crest elevation of 5,922 ft (1806 m). Since this alternative is a ring dike scheme, the impoundment would have essentially no contributory drainage area. This site is located down-gradient from the preferred mill site. Tailings transport for this alternative would be by gravity flow with reclaim water return requiring pumping.

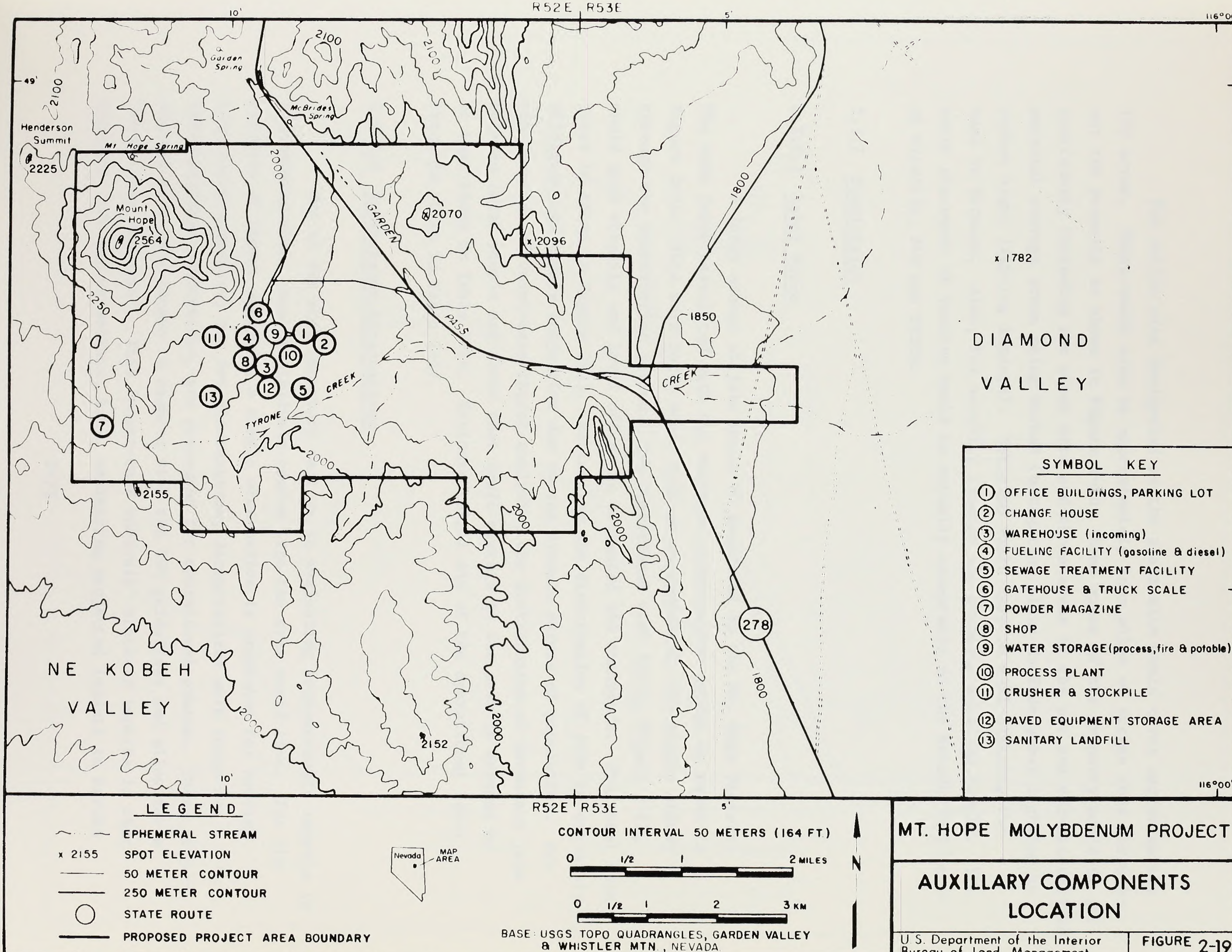
Alternative 4-C. This alternative is located in Upper Kobeh Valley, about four miles (6.4 km) south of the Mt. Hope site (Figure 2-17). The initial starter

dam for this alternative would be constructed to an elevation of 6,426 ft (1960 m). The starter dam would be 56 ft (17.1 m) high and contain about 2.43 million yd^3 (1.86 million m^3) of material. The ultimate tailings dam would have a crest elevation of 6,619 ft (2018 m). Site 4-C would have a relatively small drainage area, 3930 ac (16 km^2). Diversion channels can be utilized to direct storm runoff around the impoundment. Because of the location of this site, with respect to the preferred mill site, both tailings transport and reclaim water return would require pumping.

2.3.6 Auxiliary Components

In addition to the ancillary systems which are shown in Figure 2-13 and are considered a part of the hydrometallurgical plant, there would be several other support facilities present as listed below and shown on Figure 2-19. Numbers on the listing are keyed to the figure.

1. Office buildings, parking lot
2. Change house
3. Warehouse (incoming)
4. Fueling facility (gasoline, diesel)
5. Sewage treatment facility (see Section 2.7, Mitigating Measures/ Monitoring Programs, for a detailed description of this facility)
6. Gatehouse and truck scale
7. Powder magazine
8. Shop
9. Water storage
   - Process water (3.5 million gal)
   - Fire water (0.5 million gal)
   - Potable water
10. Process plant - all facilities discussed in Section 2.3.4.2 including those shown in Figure 2-13 and the ore storage pile and product shipment warehouses.
11. Crusher and stockpile
12. Paved equipment storage area
13. Sanitary landfill (see Section 2.7, Mitigating Measures/Monitoring Programs, for a more detailed description of this facility)



MT. HOPE MOLYBDENUM PROJECT

AUXILLARY COMPONENTS LOCATION

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FIGURE 2-19

The entire area designated as the plant site would cover approximately 100 acres. There would also be approximately four miles of access road throughout the property as shown in Figure 2-20. Some areas of the property would be lit continously including the plant site and those areas of the pit and non-mineralized material storage areas being worked (mitigation plans include amber lighting to reduce night lighting impacts). Vehicles would rely on self-lighting for runs in between. Also, for security reasons the property would be fenced. The exact placement of fencing would be mutually acceptable to the Nevada Department of Wildlife, BLM and EXXON.

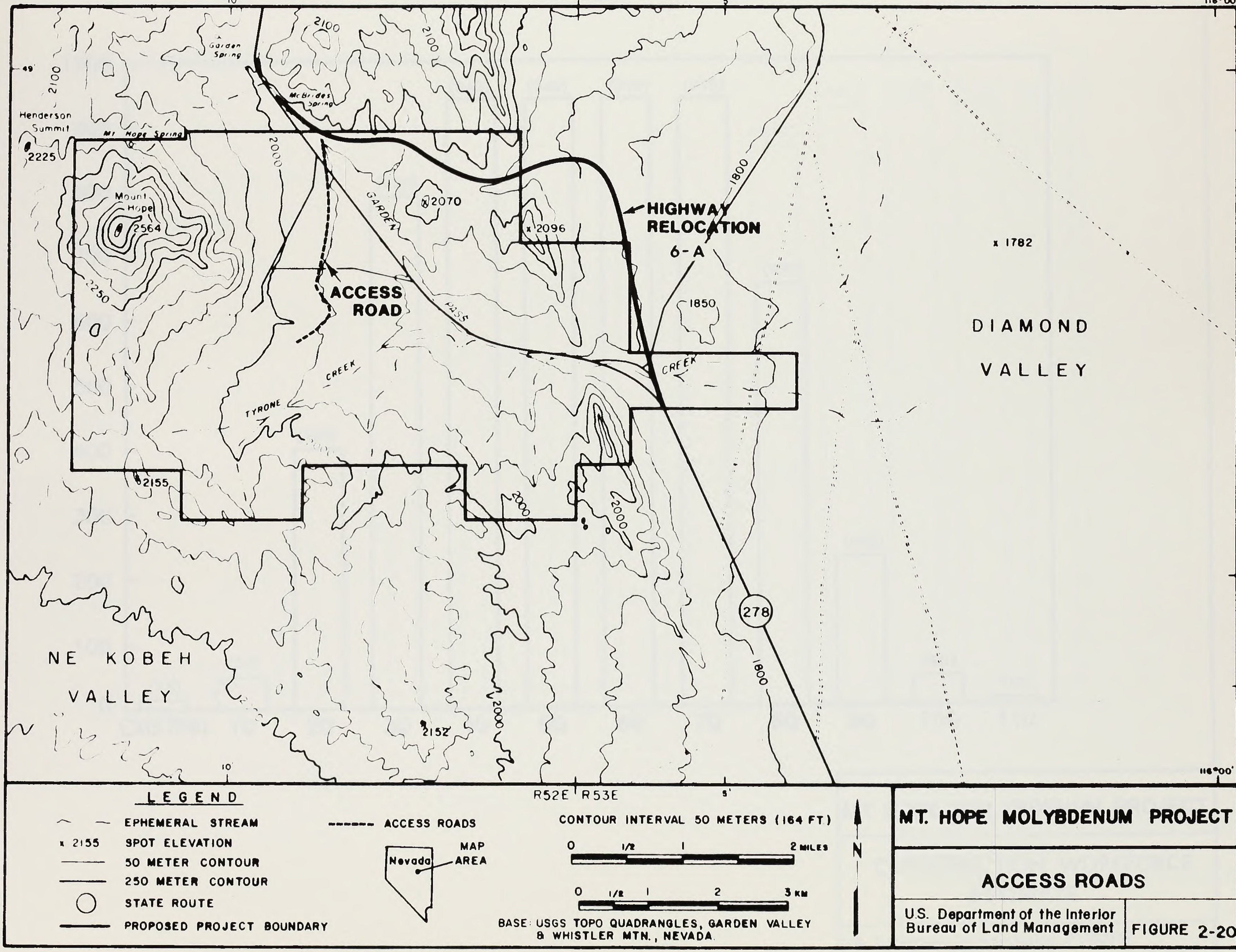
2.3.7 Subdivision

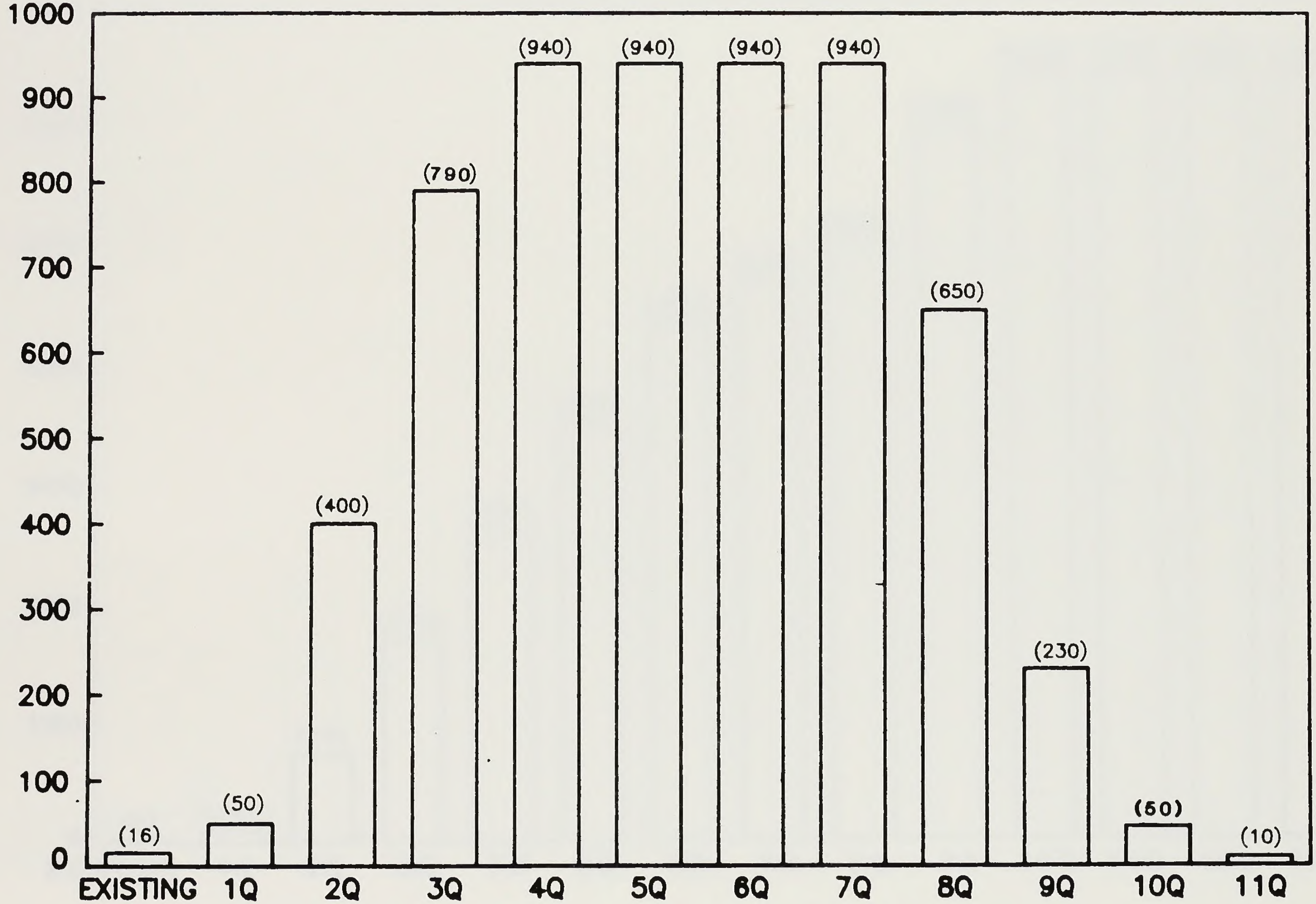
2.3.7.1 Labor Force

A large number of jobs would be generated by the Mt. Hope Project. The work force associated with the two-year construction period is shown in Figure 2-21. This work force would peak at approximately 940 people midway through the construction period. The operational work force, Figure 2-22, would grow steadily and level off at an estimated 640 employees. The total work force is shown in Figure 2-23. Estimating the distribution of jobs is extremely difficult and highly subjective due to the dynamic nature of population. For the purposes of worst-case impact analysis, the distribution of permanent jobs between local people and those that would migrate to the area is assumed to be that shown in Table 2-26. Estimated skill mix of the operational labor force is shown in Table 2-27.

2.3.7.2 Subdivision Alternatives

One of the most important factors in evaluating socioeconomic impacts is determining where those individuals coming into the area would live. For the purposes of impact analysis, a single alternative is presented for housing construction workers; but two alternatives, decentralized work force and EXXON-assisted subdivision, are presented for operational phases. These alternatives have been chosen in keeping with the CEQ guidelines and allow for a "worst-case analysis". This "worst-case analysis" brackets impacts in that opposite, extreme situations, i.e., maximizing projected impacts to Eureka


R52E R53E
Garden Spring
McBrides Spring
Henderson Summit
2225
Mt Hope Spring
Mount Hope
2564
2250
2100
2000
2070
x 2096
GARDEN
PASS
CREEK
TYRONE
ACCESS ROAD
HIGHWAY RELOCATION 6-A
1850
1800
x 1782
DIAMOND VALLEY
NE KOBEH VALLEY
2155
2152
278
T 23 N
T 22 N
T 21 N
116°00'
49'
39°45'
10'
5'
LEGEND
EPHEMERAL STREAM
x 2155 SPOT ELEVATION
50 METER CONTOUR
250 METER CONTOUR
STATE ROUTE
PROPOSED PROJECT BOUNDARY
ACCESS ROADS
Nevada
MAP AREA
CONTOUR INTERVAL 50 METERS (164 FT)
0 1/2 1 2 MILES
0 1/2 1 2 3 KM
BASE: USGS TOPO QUADRANGLES, GARDEN VALLEY & WHISTLER MTN., NEVADA
N
MT. HOPE MOLYBDENUM PROJECT
ACCESS ROADS
U.S. Department of the Interior
Bureau of Land Management
FIGURE 2-20

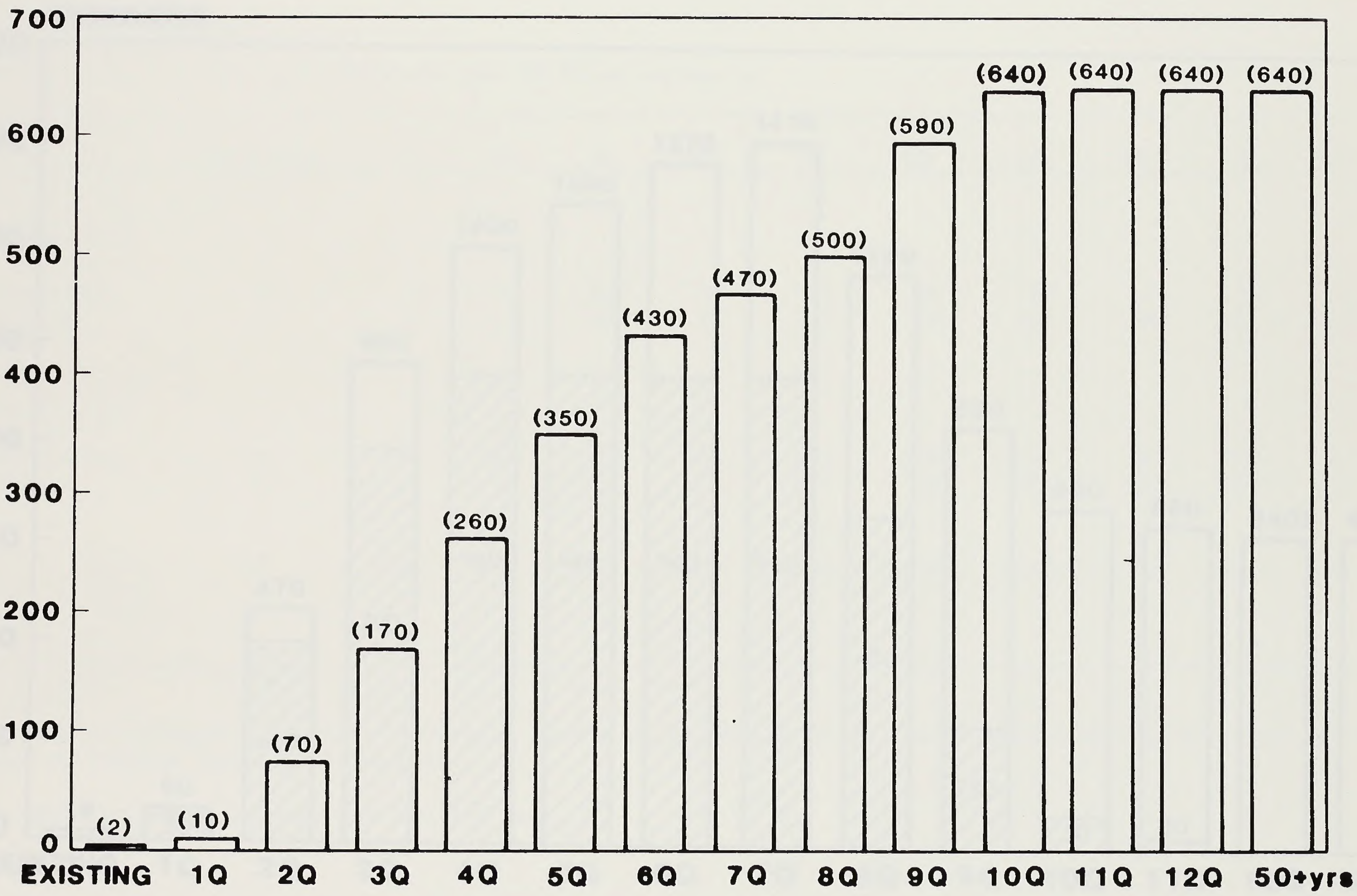


MT. HOPE MOLYBDENUM PROJECT

CONSTRUCTION WORKFORCE ESTIMATE

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

FIGURE 2-21



MT. HOPE MOLYBDENUM PROJECT

OPERATION WORKFORCE ESTIMATE

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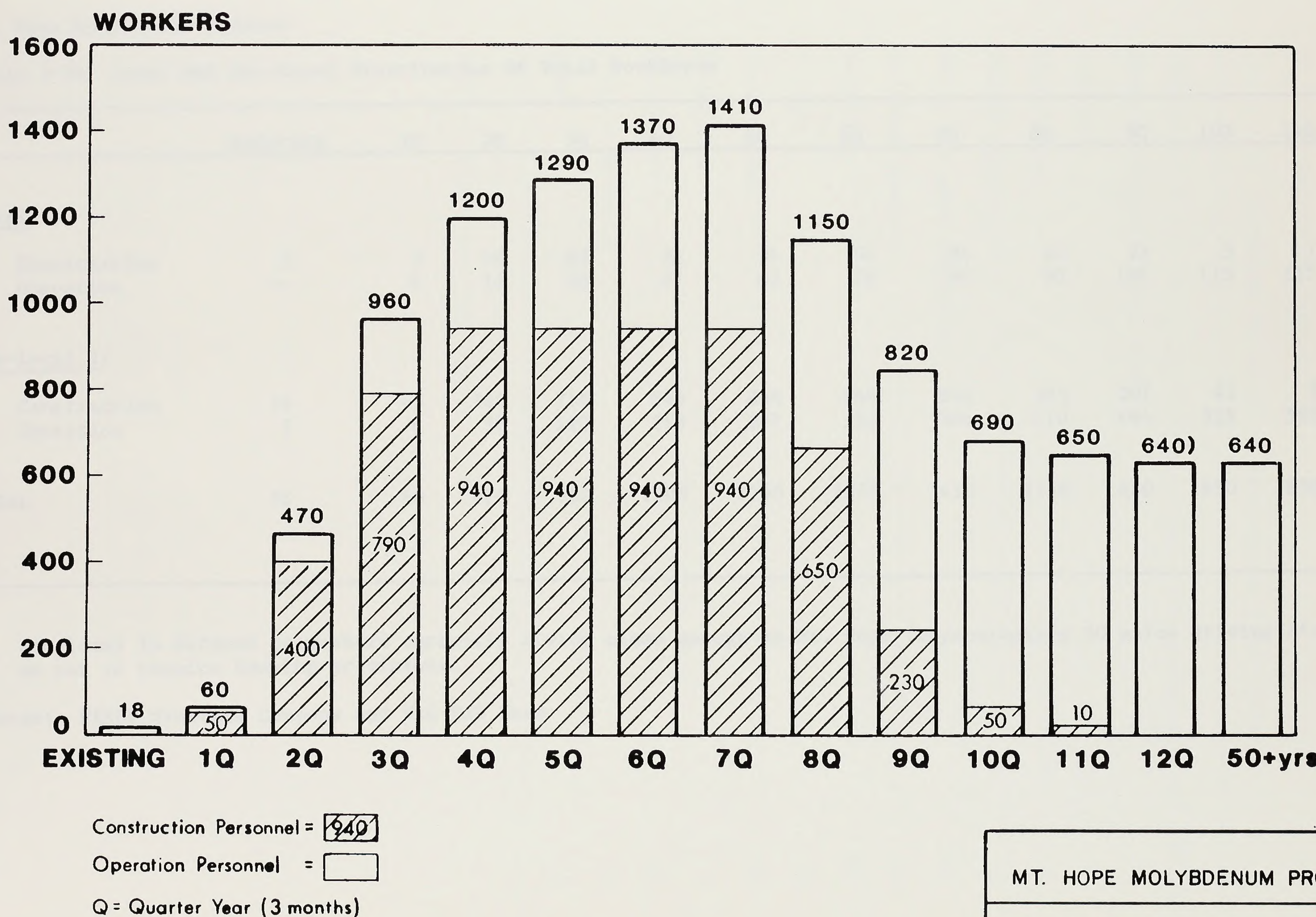
Bureau of Land Management

FIGURE 2-22



SOURCE: EXXON MINERALS COMPANY

MT. HOPE MOLYBDENUM PROJECT

TOTAL WORKFORCE ESTIMATE

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

FIGURE 2-23

Table 2-26 Local And Non-Local Distribution Of Total Workforce

	Existing	1Q	2Q	3Q	4Q	5Q	6Q	7Q	8Q	9Q	10Q	11Q	12Q
Local													
Construction	2	5	40	80	94	94	94	94	65	23	5	1	0
Operation	--	4	12	30	47	63	78	84	90	106	115	115	115
Non-Local 1/													
Construction	14	45	360	710	846	846	846	846	585	207	45	9	0
Operation	2	6	58	140	213	287	352	386	410	484	525	525	525
TOTAL	18	60	470	960	1200	1290	1370	1410	1150	820	690	650	640

1/ Non-local is defined as workers currently living close enough to Mt. Hope (approximately 90 miles driving distance) so as not to require housing provisions.

Source: EXXON Minerals Company and WRC EIS Team

Mt. Hope Molybdenum Project

Table 2-27 Estimated Skill Mix Of Operational Labor Force

Skill	Number
Management/Professional Staff	130
Clerical	34
Technicians	39
Shovel Operators	16
Heavy Equipment Operators	127
Drillers/Blasters	14
Mechanics	104
Welders	18
Electricians	20
Machinists	4
Millwrights	28
Process Operators	53
Other	53

Source: EXXON Minerals Company

versus maximizing projected impacts to other communities, are evaluated.

EXXON believes that housing the 525 non-local permanent employees and their families is an extremely important aspect of project development and is committed to working with local communities to ameliorate impacts in a fashion acceptable to the community and compatible with sound business practices. Much depends on detailed planning and an accurate assessment of impacted individuals' desires and expectations from their communities. However, this level of community planning cannot properly and effectively be initiated at this early state of decision-making and project planning.

For this reason, the above "worst-case analysis" approach has been adopted. The actual development scenario would lie somewhere between the two alternatives identified.

In order to avoid undesirable speculative purchase of real estate and disruption of existing communities in the Mt. Hope area, care has been taken to avoid showing potential locations of subdivision sites. This omission does not affect the ability to perform an accurate socioeconomic impact analyses.

Construction Housing. Several factors were considered in developing the proposed scenario including 1) vacancy rates, 2) overlap of operating and construction jobs is such that permanent housing cannot be prematurely built to temporarily house construction workers, 3) short duration and remote location is likely to attract a large number of single workers, and 4) EXXON desires to minimize disruption to existing communities. These factors lead to the following proposed alternative:

- A 450-unit man camp would be built near the mine to house single and single-status workers. It would be constructed of modular units for rooms, mess hall/kitchen and other buildings. The workers would be housed one man to a room and would be provided three meals/day, maid service and a recreational program. EXXON would provide for water supply, sanitary facilities, road access and electric power.

- A 415-space, 50-acre recreational vehicle park would be developed near Eureka or near the mine/process plant to house married or single workers who own mobile homes or campers. The park would include a sanitary system, water supply, streets and off-street parking. At the end of construction, if located near Eureka, it may be converted to a permanent 210-lot mobile home subdivision to house operational workers.

- Limited number of hotel/motel rooms in Elko or Eureka may be retained to supplement housing provisions.

Permanent Housing

(1) Decentralized Work Force

Under this alternative it is assumed that non-local workers would distribute themselves among the existing communities of Eureka, Carlin and Elko as fits their individual desires. Distribution is assumed to be that shown in Table 2-28.

(2) Subdivision

Under this alternative, a subdivision which would be available on a free choice basis to employees would be developed. The subdivision may be located near the mine/process plant or adjacent and/or integrated into the Town of Eureka.

This subdivision would require approximately 150 acres of land (200 acres if the 400 unit RV park previously discussed is included). Single family dwellings, multifamily dwellings and mobile home lots would be provided in proportion to anticipated demand from non-local workers. It is estimated that the mix of unit types would be approximately equal to the mix of net housing additions in Eureka and Elko counties over the period 1970-1980. During that period, single family dwellings accounted for 24% of net housing additions and multifamily dwellings accounted for 32%. Mobile homes represented the balance, or 44%, of net housing additions.

Mt. Hope Molybdenum

Table 2-28 Estimated Natural Distribution Of Non-Local Permanent Workforce

Community	No. of Workers
Eureka	356
Elko	128
Carlin	41
Ely	0

Source: EXXON Minerals Company and WRC EIS Team

A variety of single family housing sizes, types and styles would be expected to be built. Multifamily units would likely be garden style apartments of modular construction, including studio, 1, 2 and 3 bedroom units. Consistent with county requirements, the new subdivision would include adequate parkland dedication and improvements. If sufficient retail services have not been conveniently provided by others, the new subdivision would also include land for 10,000 to 20,000 square feet of retail construction to meet residents' needs. This would provide space for such uses as a small grocery store, laundromat, hair stylist, dry cleaner, variety store, auto service, etc.

2.4 Proposed Action

Among the alternatives presented in the preceding sections, Table 2-29 and Figure 2-24 designates the proposed action. This designation has been made in keeping with the CEQ regulations for the purpose of the impact analysis and represents the best engineering judgment at this stage of preliminary project planning but is not a commitment on the part of EXXON.

2.5 No Action Alternative (as presented in the EXXON EIR)

Under this alternative, BLM would not permit EXXON to acquire the necessary land nor would it grant the right-of-way under the provisions of FLPMA. If this were to occur, EXXON would not terminate the Mt. Hope Project but would seek to acquire the necessary acreage under the non-discretionary provisions of the 1872 mining laws. The construction and operation of the mine/process plant complex would be the same as described under the Proposed Action.

If the water line right-of-way were refused, EXXON would seek to transfer its water rights in Kobeh Valley to Pine/Garden and/or Diamond valleys or purchase existing water rights from those areas such that a right-of-way across federal land would not be required (determined not feasible). If the power line right-of-way were refused EXXON would proceed with evaluating the feasibility of on-site generation facilities (determined not reasonably possible). If the highway relocation right-of-way were rejected EXXON would construct the tailings pond at Alternative Site 4-C rather than 4-A.

Table 2-29 Proposed Alternative

I. Land Acquisition - The proposed action is to transfer land in such a way that it most benefits the public and EXXON receives secure title to the land and maintains surface and mineral rights. At this time, these goals appear to be best met by a combination of mineral claim and land sale.

II. Rights-of-Way - The proposed action includes power line right-of-way routing 2-A (C in EIR), a below ground water line right-of-way routing from Kobeh Valley, and the single highway right-of-way routing previously discussed. These routings are shown in Figures 2-2, 2-6 and 2-8, respectively.

III. Mine/Process Plant - The proposed siting alternative is shown in Figure 2-24.

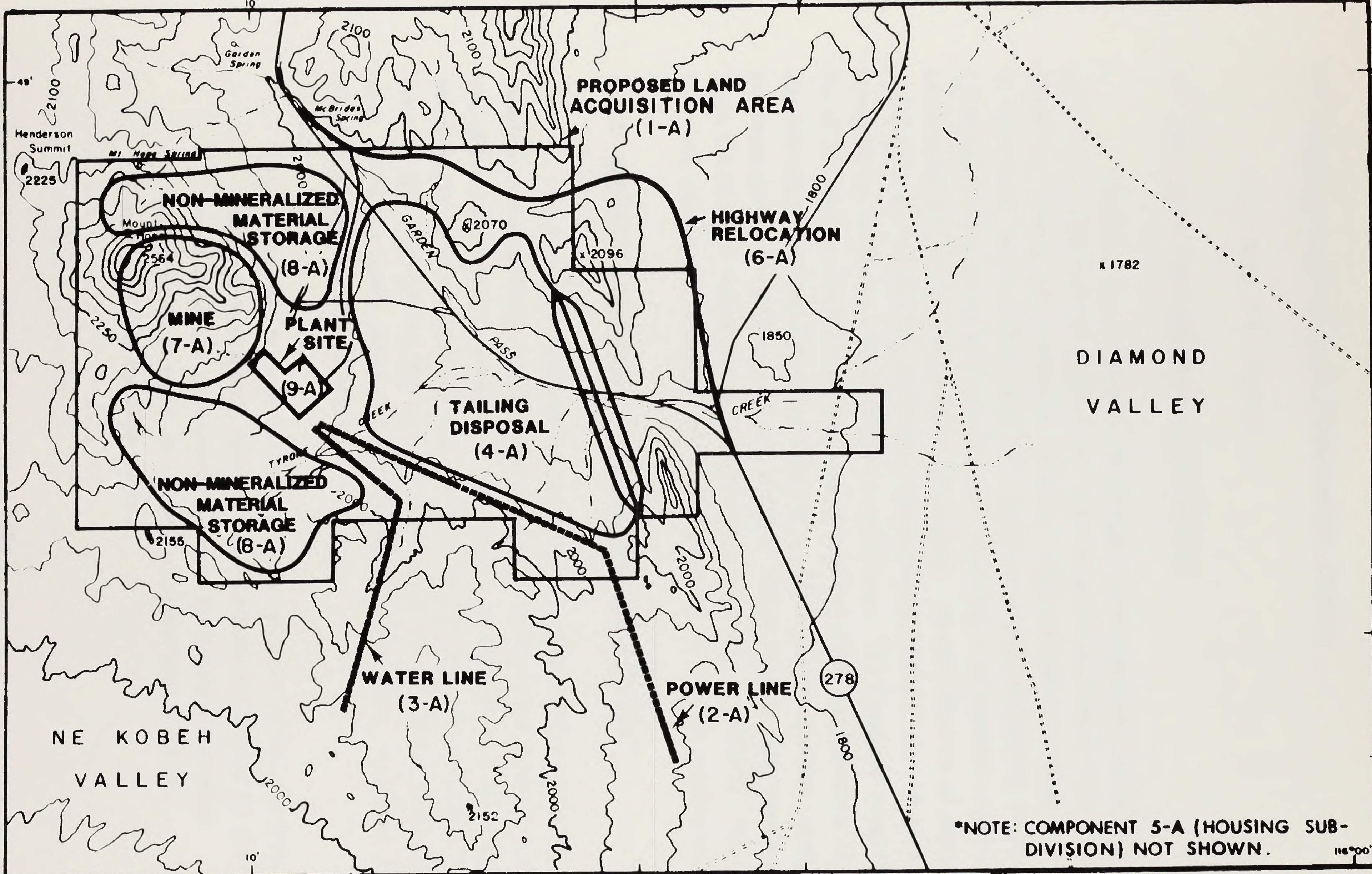
a. Mine/Overburden Storage - The proposed action is the single alternative presented.

b. Process Plant - The proposed action is to produce FeMo. All components presented would be constructed and operated.

c. Tailings Pond - The proposed action is to construct a tailings pond behind a cycloned embankment at site 4-A using centerline construction methods.

IV. Subdivision - The proposed action is the subdivision.

Source: EXXON Minerals Company



MT. HOPE MOLYBDENUM PROJECT

PROPOSED ACTION

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

FIGURE 2-24

2.6 Comparative Analyses of Environmental Effects

(See Draft EIS Summary).

2.7 Mitigating Measures/Monitoring Programs

This section describes technology, practices and procedures that could be implemented at EXXON's Mt. Hope mine/process plant site to lessen or eliminate adverse environmental effects. This section has been developed to be consistent with current federal, state and local regulatory requirements, including installation and operation of federally designated technology and implementation of best management practices. In the absence of definitive regulatory or permitting authority requirements, description of mitigating measures is based on common industry practices. The measures described are based on current information and, to the extent that requirements change between date of publication and time of project implementation, mitigating measures actually implemented may differ. (This Section has been incorporated into the EIS and supplemented as agreed upon by BLM and EXXON. The following has been abstracted directly from the EXXON EIR as it was presented.)

2.7.1 Mitigation of Impacts to Land Surface (Reclamation)

Reclamation regulations currently in force which could be used to develop a land surface reclamation plan for the Mt. Hope Project are brief and offer only generic guidance. They exist in the context of requiring preparation of a reclamation plan as part of the Plan of Operation which must be approved by the BLM in accordance with 40 CFR 3800, "Surface Management of Public Lands under U.S. Mining Laws". Pertinent sections of this regulation are excerpted below:

"(3) At the earliest feasible time, the operator shall reclaim the area disturbed, except to the extent necessary to preserve evidence of mineralization, by taking reasonable measures to prevent or control on-site and off-site damage of the federal lands.

(4) Reclamation shall include, but shall not be limited to:

(i) Saving of topsoil for final application after reshaping of disturbed areas have been completed;

(ii) Measures to control erosion, landslides, and water runoff;

(iii) Measures to isolate, remove, or control toxic materials;

(iv) Reshaping the area disturbed, application of the topsoil and revegetation of disturbed areas, where reasonably practicable; and

(v) Rehabilitation of fisheries and wildlife habitat."

In general, EXXON would carry out land surface reclamation in three phases; i.e., subsequent to the two-year construction period, intermittently on an as-needed basis during operation, and finally, at end-of-mine/process plant life. The final stage would involve the largest and most extensive effort and is the phase usually identified with the concept of reclamation.

The broad nature of the current regulations, as well as the fact that the largest reclamation activity would not begin until at least fifty years subsequent to start of operations (major regulatory changes could occur in the interim), make it extremely difficult to develop a reclamation plan at this time that could be guaranteed to meet changes to existing regulations.

Consequently, the measures discussed in the following sections were developed in line with what EXXON believes will fulfill the requirements of 40 CFR 3800 and are good management practices, based upon like experiences in similar terrain and climate.

2.7.1.1 Reclamation After Construction

Reclamation after construction would involve reclaiming those areas of temporary disturbance, such as the rights-of-way corridors and areas of the process plant site between structures. Adverse effects, consisting mostly of destruction of vegetation cover and some erosion,

would be mitigated by regrading and revegetating as soon as possible after the construction activity is complete. Revegetation would consist of establishing a ground cover. The BLM recommended (USDI, 1982) cover is a mixture of crested wheatgrass, pubescent/intermediate wheatgrass and four wing saltbrush applied at the rate of six, three and one lbs/acre, respectively.

During construction, topsoil and overburden would be removed and stockpiled for use during reclamation (see Section 2.7.1.3). If the topsoil stockpiles are to exist for more than one year, they would be seeded for stabilization.

2.7.1.2 Reclamation Coterminous With Operation

Erosion/Surface Runoff. Constructing the tailings pond at site 4-A (Figure 2-17) would allow all facilities to be located within the Garden Pass drainage subbasin. Such placement of components simplifies containment and control of surface runoff and minimizes erosion.

Surface runoff from the site, including that from non-mineralized material and ore storage areas, would be collected and routed to the tailings pond. As appropriate, stone rip rap and diversion ditches would be constructed to control runoff and erosion. If necessary, small catchment basins would be included in the control plan. A larger basin would be constructed at the foot of the tailings dam to intercept and collect runoff from the dam face. The collected water would be intermittently pumped to the tailings pond.

In accordance with sound management practices, routine site inspections would be conducted throughout the years of operation. Detected erosion problems would be corrected in a timely manner as a standard operating procedure. In this respect, particular attention would be given to the tailings dam.

2.7.1.3 Final Reclamation

Final reclamation would be implemented in such a way as to comply with applicable regulations. Based on sound management practices, the following actions, as described on a component by component basis, would be undertaken during final reclamation of the site.

Mine/Non-Mineralized Material Storage Areas. The open pit mine would remain as it would exist at the end of mining. Because the non-mineralized material storage areas would be composed of large rocks, they would not be recontoured or reclaimed.

Process Plant. The process plant and other capital facilities would be salvaged as much as possible. Unsalvagable portions would be demolished and disposed of either offsite or in the landfill. The surface would be cleaned up, graded as necessary, and revegetated. Revegetation would be with the same cover as described in Section 2.7.1.1.

Tailings Pond. After the tailings pond surface has dried out, approximately two feet of rock from the non-mineralized material storage areas would be placed over the tailings. As much as possible, this rock layer would then be covered with the overburden/topsoil stockpiled during construction. The cover would then be seeded with a groundcover (see Section 2.7.1.1) and pinyon and/or juniper trees would be planted. This cover would be contoured so as to minimize seepage of precipitation into the tailings. Also, runoff from surrounding areas would be diverted around the reclaimed tailings basin to further reduce infiltration.

The slope of the final cover surface would be graded appropriately, and the downstream face of the tailings pond dam would be recontoured to the extent necessary to maintain stability and control erosion during the tailings basin dry-out period. Downgradient monitoring wells (see Section 2.7.2.2) would be appropriately plugged and abandoned.

2.7.2 Mitigation of Impacts to Hydrologic Regime

2.7.2.1 Surface Water

Mine/Process Plant Effluent. The Clean Water Act of 1977 (33 USC 1251) is the principal federal statute addressing water pollution control. In accordance with the authority this legislation provides, the U.S. Environmental Protection Agency (EPA) has promulgated effluent limitations governing discharges from industrial point source categories into navigable waters. On December 3, 1982, such limits were promulgated by the EPA for the ore mining and dressing point source category. Briefly, for the subcategory pertinent to molybdenum these standards allow for a combined discharge from the mine/ore dressing step that will not exceed the flow from the mine itself1/ nor the limits given below:

Effluent Characteristic	Effluent Limitations (mg/l)	
	Maximum for any 1 Day	Average of Daily Values for 30 Consecutive Days
Cu	0.30	0.15
Zn	1.5	0.75
Pb	0.6	0.3
Hg	0.002	0.001
Cd	0.10	0.05
pH	(+)	(+)
TSS	30.0	20.0

+ Within the range of 6.0 to 9.0

1/ Regulations allow for additional discharge in geographical areas of net precipitation and if recycling may cause contaminant build-up to the point of process interference.

On February 17, 1983, EPA proposed the first of two phases of effluent limitations guidelines for the nonferrous metals manufacturing point source category (48 FR 7032). The Phase II proposal, which will address molybdenum manufacturing, is scheduled to appear in September, 1983. It is anticipated these regulations will require that members of the molybdenum manufacturing point source category be required to attain the overall achievable concentrations identified in Proposed General Development Document for Effluent Limitations Guidelines and Standards for the Nonferrous Metals Manufacturing Point Category (EPA, 1983) and shown below (Berlow, 1983):

Effluent Characteristic	Effluent Limitation (mg/l) 1/	
	Monthly Average	Maximum
Ammonia	58.6	133.0
As	0.57	1.39
Al	1.24	3.02
Cu	0.61	1.28
CN	0.08	0.20
Fl	17.6	39.7
Ni	0.37	0.55
Pb	0.09	0.10
Se	0.37	0.82
Sb	0.86	1.93
Zn	0.42	1.02
O&G	10.0	10.0
TSS	12.0	20.8

1/ Effluent limitations are actually expressed as mass per unit mass of product and are arrived at by multiplying an expected flow per unit mass of product and the above concentrations. Such a flow limit would probably also be imposed on the molybdenum manufacturing point source subcategory. Although it cannot dictate that industry use a specific treatment technology, the EPA must be able to show that technologies that can achieve the specified levels of treatment do exist.

These regulations are imposed upon industry by requiring industrial surface water dischargers to apply for and receive a National Pollutant Discharge Elimination System (NPDES) permit (Title IV of Clean Water Act). Normally, operations such as that proposed by EXXON at Mt. Hope would be required to obtain such an NPDES permit; discharge from the mine and concentrator would be governed by the ore mining and dressing regulations and discharge from the hydrometallurgical and conversion plant (TMO and FeMo production) would be potentially subject to the proposed non-ferrous metals manufacturing regulations. Because there are no surface waters in the vicinity of EXXON's Mt. Hope site to which a discharge could flow, EXXON would not be required to obtain this permit (see Section 2.3.1). However, its process design would achieve a no discharge standard for both point source category segments by employing measures recommended by the EPA, and considered by that Agency to be best available demonstrated technology (BADT). Among these measures are recycling process water from the concentrator, employing the tailings pond and lined pond as evaporation/settling basins, and lime precipitating wastewater flow from the hydrometallurgical plant.

Sanitary Wastewater. Sanitary wastewater from both the subdivision and the mine/process plant would be treated to applicable state and federal standards. Applicable state requirements are those found in "Regulations Governing Individual Sewage Disposal Systems", adopted October 19, 1982 by the Nevada State Board of Health, and "Regulations Governing Mobile Homes and Mobile Home Parks (Trailer Courts)", adopted September 21, 1970 by the Nevada State Board of Health. In general, primary and secondary treatment would be used and levels of pollutants would not exceed those specified by EPA and shown below (40 CFR 133):

Pollutant	Limit
5-day Biochemical Oxygen Demand (BOD_5)	30 mg/l (30-day average)
	45 mg/l (7-day average)
Total Suspended Solids (TSS)	30 mg/l (30-day average)
	45 mg/l (7-day average)
pH	6.0-9.0

At this stage of planning, it is expected that the plant would have a treatment capacity of approximately 70,000 gpd (265 m^3/day). A 30,000 to 40,000 gal (115 to 150m^3) storage tank would be located ahead of the system to handle the surge at shift changes. The treated effluent would be discharged to the tailing pond and the sludge (approximately 100 lbs/day (45 kg/day)) would be disposed of on site in the solid waste disposal facility (see Section 2.7.4.1).

In the alternative of the Exxon-assisted subdivision, sanitary wastewater treatment would depend on the location of the subdivision. If it is proximal to Eureka, it would be treated by that community's existing system. Exxon would work with Eureka to provide any upgrade or alteration of facilities that might be needed as a result of the increased flow. If the subdivision is proximal to the mine/process plant, a secondary system would be sized, constructed and operated to treat the combined sanitary wastewaters from the subdivision and the mine/process plant.

2.7.2.2 <u>Groundwater</u>

Seepage from the tailings basin would be regulated through issuance of a Zero Discharge or Subsurface Injection/Infiltration permit by the State of Nevada Department of Environmental Protection under the authority of NRS 445.131 through NRS 445.354. Which of these permits is issued would depend upon the nature of the seepage and the design of the tailings pond.

EPA toxicity tests show that the tailings would not be classified as hazardous (see Technical Report No. 5). Impact analyses demonstrate that there would be no deleterious effects from seepage from the tailings basin to groundwater. Therefore, it is believed that a clay or synthetic liner would not be required.

Seepage can best be minimized by segregating the tailings such that the fine fraction tends to form a self-seal. Upon start-up, the tailings would be cycloned and the coarse-sized fraction (sands) would be deposited at a point on the south side of the basin. The fine-sized fraction (clays) would be piped to the inside of the starter dam and deposited along the bottom and sides of the basin to a minimum thickness of approximately 10 ft (3 m). This

fine-grained material would tend to seal the bottom and sides of the tailings pond, substantially reducing the rate of seepage.

To further ensure the protection of groundwater quality, monitoring wells would be installed down-gradient of the tailings basin. The groundwater quality would be routinely monitored at these wells throughout the operational life of the mill and during the dry-out period of the tailings basin. If necessary, seepage would be intercepted by a series of wells and pumped back to the tailings basin.

2.7.3 Mitigation of Impacts to Air Quality

The Clean Air Act of 1970, as amended in 1977, is the federal umbrella statute that provides for the control of air pollution from stationary and mobile sources. In 1971, the nation was geographically divided into Air Quality Control Regions (AQCR's)(Section 107 of the Act). Section 109 of the Act directed EPA to develop primary and secondary National Ambient Air Quality Standards (NAAQS), the former to protect the public health and the latter to protect public welfare. Such standards have been promulgated for sulfur dioxide, particulate matter, carbon monoxide, ozone, nitrogen dioxide and lead. These standards need not take into account the cost of compliance nor whether control technology exists.

Upon promulgation of the NAAQS, air quality in the AQCR's was examined and each AQCR was classified as an attainment or non-attainment area on a per pollutant basis, depending on whether air quality was better or worse than the NAAQS. Attainment areas were further divided into three classes as defined by Congress in the Clean Air Act for the purpose of identifying the increment of degradation that could be allowed.

Section 110 requires that each state develop an implementation plan (SIP) that provides for bringing the entire state into compliance with NAAQS. For AQCR's with air quality better than NAAQS, the SIP must show how prevention of significant deterioration (PSD) will occur. In non-attainment AQCR's, the plan must limit construction of new sources unless decreased emissions can be realized from existing sources. This additive decrease plus

the added emissions from the new source must sum to a net annual decrease before a new source may obtain a permit.

Additionally, Section 111 provides for the development of technology-based new source performance standards (NSPS) on an industry by industry basis. Lastly, under the authority of Section 112, EPA may promulgate standards for hazardous pollutants (NESHAPS). Like NAAQS, these standards need not take into account cost of compliance or whether technology is available to meet the standard. Standards have been promulgated for abestos, beryllium, mercury and vinyl chloride (40 CFR 61).

All of these aspects of the Clean Air Act and EPA's companion implementing regulations 40 CFR 50-99, combine to affect permitting an industrial facility.1/ EXXON's proposed Mt. Hope Project is located in a Class II attainment area for all of the NAAQS constituents. It is also a major source [Section 169(1)] and consequently will be required to acquire a PSD permit. However, it would emit none of the hazardous pollutants currently identified under NESHAPS.

As the above demonstrates, derivation of the emission limits that would ultimately appear in EXXON's Mt. Hope Project PSD permit is extremely complex, and the limits cannot be accurately predicted. Consequently, control technology that would be installed to achieve these limits cannot be finally identified. However, mitigating measures can be discussed in terms of legally allowable increments of degradation, technology identified by NSPS, and technology in use by other members of the industry.

The Act itself, in Section 163, establishes allowable increments for the Class I, II and III areas. The Class II allowable increase is shown following:

1/ PSD permitting is carried out by EPA as per 40 CFR 124 until a state has an approved SIP which by fiat includes delegation of permitting authority. Nevada does not yet have an approved SIP. When such approval is granted, state permitting procedures as in NRS 445 will apply.

Pollutant	Allowable Increase Microgram/Cubic Meter
Particulate matter	
Annual geometric mean	19
24-hr maximum	37
Sulfur dioxide	
Annual arithmetic mean	20
24-hr maximum	91
3-hr maximum	512

Depending on the established baseline in the area ["the ambient concentration levels which exist at the time of the first application for a permit in an area subject to this part" (Section 169(4)], air quality monitoring data collected and air quality modeling performed by EXXON relative to preparing the permit application, and projected emissions from other sources, Exxon would be awarded an increment of the increment.

Exxon would also be required to achieve applicable new source performance standards. On August 24, 1982 (48 FR 36859), EPA proposed a particulate matter stack emission NSPS for Metallic Mineral Processing Plants, including molybdenum, of 0.05 gms per dry standard cubic meter.

2.7.3.1 Process Plant Emissions

Control technology commonly used by the industry is discussed below.

Particulate Emissions. Dust collection would be provided over the primary ore crusher, at conveyor feed points, on the multi-hearth roasters of the TMO plant and on the mold box (firing area) of the FeMo plant. Dust-laden air from primary ore crushing and at concentrator conveyor feed points would be water-scrubbed to remove particulates. Wet-grinding would also be effective in particulate removal. If promulgated, this segment of the plant would have to achieve the NSPS cited above.

Dust-laden air from the TMO plant pneumatic conveyor system would pass through a reverse jet bag filter. Emissions from the multi-hearth roasters of the TMO plant would be passed through multi-cyclones to control particulates.

SO_2 Emissions. SO_2 would be contained primarily in the roaster flue gas generated during TMO production. This gas would be combined with the bag filter exhaust and passed through the multi-cyclones (mentioned above). It would then go through an electrostatic precipitator to remove sub-micron particles, followed by a scrubber using $Ca(OH)_2$ slurry to remove SO_2 prior to discharge to the atmosphere. The resultant waste stream would contain $CaSO_3$ and $CaSO_4$. Emissions from the mold box (firing area) of the FeMo plant would be passed through a cyclone and a baghouse in series.

Also, vents from various material enclosures (e.g., dry concentrate storage bin, roaster feed bin, lime bin, TMO bin, sand bin, etc.) would be equipped with passive filters to remove particulates from air vented to the atmosphere. These filters would typically be cartridge, manually-replaceable types.

Chlorine Emissions. Air vented from the chlorine storage tanks, leach autoclaves and cooling vessel associated with the hydrometallurgical plant would be collected and passed through a scrubbing tower using a sodium hydroxide solution for chlorine fume removal prior to discharge to atmosphere. A dilute sodium hypochlorite solution would be generated and routed to the wastewater treatment plant.

2.7.3.2 Fugitive Emissions

It would be standard practice to wet down disturbed land surfaces during construction activities. This practice would hold true also for roads in routine use during construction and operation phases of the project.

Fugitive emissions from the surface of the tailing pond would be minimized to the extent needed by the same management procedures that would protect groundwater quality and are described in Section 2.7.2.2. The

±100 mesh material is the size fraction most prone to dusting. The coarser fraction is too heavy to be windborne and the finer sizes tend to cake. The material prone to dusting would be separated with cyclone classifiers and confined within a small area of the tailing pond. The surface area susceptible to aeolian erosion would be much smaller than if distributed throughout the pond and segregated by natural sedimentation. This smaller area would be sprayed with cyclone overflow and would cake upon drying, thereby reducing the potential for erosion.

2.7.4. Mitigation of Impacts from Solid Wastes

The Resource Conservation and Recovery Act of 1976 (RCRA) gave EPA the authority to regulate land disposal of wastes. Solid waste is defined under Section 1004(27) of RCRA as "any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities...". Subtitle C of RCRA addresses regulation of hazardous waste, a subset of solid waste, and Subtitle D provides for the management of nonhazardous wastes through the states.

On May 19, 1980 EPA completed rule-making on a major set of regulations implementing Subtitle C and providing a cradle to grave system of control and permitting covering generators, transporters and owners and operators of hazardous waste treatment, storage and disposal facilities (40 CFR 260-267 and 270, 271). The State of Nevada's Hazardous Waste Disposal Law may be found in NRS 444.700 to 444.778. State regulations governing hazardous waste management were effective October 16, 1980.

In fulfillment of Subtitle D, EPA has promulgated some regulatory guidance to the states regarding development of solid waste management plans and classification of landfills. The State of Nevada's solid waste disposal law (exclusive of hazardous wastes) may be found in NRS 444.440 to 444.630. Nevada has also published solid waste management regulations and Article 5 classifies and provides performance standards for land disposal

sites.

Clearly, the non-process wastes (trash, refuse, garbage, etc.) that would be generated by the project and subdivision would be subject to the State of Nevada's NRS 444.440 to 444.630 statute and implementing regulation. However, although process solid wastes (solid fraction of tailing, slag, sludge from wastewater treatment plant) are clearly within the solid waste definition and subject to RCRA, controversy has arisen as to whether mining wastes should be considered hazardous or non-hazardous. When promulgated, the May 19, 1980 regulations were applicable to mining wastes, but on November 19, 1980 (Federal Register Special Supplement 63), mining wastes were excluded from regulation pending completion of a special study of the mining industry called for by Section 1008 of RCRA. The same exclusion was incorporated into Section 444.726 of Nevada's Hazardous Waste Disposal Law.

EXXON would construct and operate a land disposal facility for non-process wastes in accordance with State of Nevada solid waste management regulations. The kind of disposal facility would depend on the number of people it serviced and consequently, whether the subdivision was located near the Mt. Hope site or Eureka. If the subdivision is located near the mine-mouth, this facility would be sized to handle refuse generated by the mine/process plant and the subdivision. If the subdivision is located near Eureka, EXXON would work with the Town of Eureka to use its landfill facility for waste generated by the subdivision and the landfill at the Mt. Hope site would handle only that generated at that location.

2.7.4.1 Mt. Hope Site Wastes Only

In accordance with Nevada regulations, EXXON would construct and operate a Class III facility (improved dump). The facility would be designed to prevent scattering of lightweight materials (e.g., portable litter fences), control vehicular and livestock access, and control pooling and minimize percolation of surface waters. The facility would be operated so as not to be unsightly or create odors. The face of the working fill would be kept as narrow as is consistent with safe and efficient equipment operation.

Solid wastes would be spread and compacted in thin layers, each layer would not be thicker than two (2) feet prior to compaction. On a weekly basis, wastes would be covered with a suitable material compacted to a thickness of six (6) inches. The final cover for the facility would be applied within ninety days of closure and would be twenty-four (24) inches thick and graded to drain surface water. The top slope would have a grade of two to four percent. The surface would be vegetated.

Sewage sludge would not be disposed of in the Class III facility, but a separate site designed in accordance with Section 2.6.1.1 of the Nevada Solid Waste Management Regulations would be constructed and operated.

2.7.4.2 Mt. Hope Site/Subdivision Solid Wastes

In accordance with Nevada regulations, Exxon would construct and operate a Class II facility (modified landfill). All of the requirements discussed above for a Class III facility would be equally applicable to a Class II facility. Additionally, application of the six-inch cover would occur every four days rather than weekly and application of the final cover would occur within 30 days of closure rather than 90 days.

Sewage sludge would not be disposed of in the Class II facility, but a separate site designed in accordance with Section 2.6.1.1 of the Nevada Solid Waste Management Regulations would be constructed and operated.

2.7.5 Mitigation of Impacts to Cultural Resources

Due to the density of sites and because some of the historic and pre-historic sites are potentially eligible for National Register listing, the BLM and EXXON will begin review of the property in accordance with 36 CFR 800, Protection of Historic and Cultural Properties. This review will include a determination of eligibility for listing from the Secretary of the Interior (National Park Service) in accordance with 36 CFR 63. Such determination will be made in consultation with the Nevada State Historic Preservation Office (SHPO) as an agent of the Advisory Council on Historic Preservation. If any of the sites are found to be eligible, mitigating

measures mutually acceptable to the SHPO, Advisory Council, BLM and EXXON will be identified and would be implemented.

Mitigative measures involving the Pony Express Trail would emphasize coordinated planning and activities with the National Pony Express Association.

2.7.6 Monitoring Programs

Monitoring programs would be conducted during the pre-construction phase to further characterize the baseline environment for the purpose of permitting and during operation to ensure that permit emission limits are being adhered to. Each of the programs, air and groundwater, are discussed below.

2.7.6.1 Air Monitoring Program

One year's worth of air quality/meteorological data would be collected in conjunction with PSD permitting. The actual monitoring scheme would be jointly worked out with Region IX (San Francisco, California) of the EPA, the Nevada State Department of Environmental Protection and EXXON and would depend on the status of the SIP at the time. Based on existing regulatory framework and imminent modifications, monitoring for the parameters shown in Table 2-30 would occur. Monitoring would take place at two stations at the Mt. Hope site.

Monitoring would be required to be conducted during operation as a condition of the Mt. Hope Project's PSD permit. The parameters to be measured and frequency of analysis would depend upon the stipulations of the permit.

2.7.6.2 Groundwater Monitoring Program

The groundwater monitoring program would take place in two parts: 1) monitoring of groundwater availability in Kobeh Valley as per the State Engineer's conditions to granting EXXON water rights in Kobeh Valley and 2) monitoring of groundwater quality in the project vicinity and Kobeh Valley.

Mt. Hope Molybdenum Project

Table 2-30 Parameters To Be Analyzed For During Pre-Construction Air Quality/Meteorological Monitoring Program

Station #	Parameter
1	NO_x
	SO_2
	TSP (collocated with fine particle capture) 1/
	Visibility
	Trace Metals/Elements 2/
	Temperature
	Barometric Pressure
	Relative Humidity
	Precipitation
	Evaporation
	Wind Direction
	Wind Speed
2	TSP 1/

1/ In accordance with State of Nevada monitoring network practices, particulate filters would be collected every six (6) days.

2/ Every other particulate filter would be analyzed for the trace metals/elements of cadmium, copper, lead, mercury, nitrate and sulfate for the first three months of the monitoring period. At the end of this period a determination will be made to continue or terminate these analyses.

Source: EXXON Minerals Company

In accordance with EXXON's water rights permits three monitoring wells will be drilled at:

1. NE 1/4 Section 25, T. 22 N., R. 50 E.
2. SE 1/4 Section 35, T. 22 N., R. 50 E.
3. SE 1/4 Section 27, T. 22 N., R. 50 E.

These wells will be drilled and cased to an approximate minimum depth of 400 feet and approximately the bottom 100 feet of casing will be perforated. Groundwater depth in these wells will be monitored and reported to the State Division of Water Resources as follows:

Time Period	Monitoring Frequency	Reporting Frequency
Mine Construction (1st year)	monthly	quarterly
Remainder Mine Construction	quarterly	quarterly
Mine Production (1st 2 years)	quarterly	quarterly
Remainder Mine Production	semi-annually	semi-annually

The groundwater quality monitoring program agreed to by EXXON and the Nevada State Department of Environmental Protection in conjunction with the Zero Discharge/Groundwater Infiltration permit includes monthly analysis of samples from three wells for those parameters shown in Table 2-31. The wells would be located at Mt. Hope spring, the Kobeh Valley water supply site and in the Garden Pass drainage subbasin.

Monitoring wells would be installed at the foot of the tailing dam to regularly check for potential changes in groundwater quality related to seepage from the tailing pond. The frequency of monitoring and parameters tested for would be mutually agreed to by EXXON and the Nevada Division of Environmental Protection.

Table 2-31 Constituents To Be Analyzed For During Pre-Construction Groundwater Quality Monitoring Program 1/

Aluminum	Oil and Grease
Ammonia	pH
Antimony	Phenols
Arsenic	Phosphorus (as P)
Barium	Radioactivity
Beryllium	Alpha
Bicarbonate	Beta
Boron	Radium, Total
Bromide	Radium 226, Total
Cadmium	Selenium
Calcium	Silicon
Carbonate	Silver
Chemical Oxygen Demand (COD)	Sodium
Chromium, Total	Strontium
Cobalt	Sulfate
Conductivity	Sulfide
Copper	Sulfite
Cyanide	Surfactants
Fluoride	Thallium
Hydrogen Sulfide	Tin
Iron	Titanium
Lead	Total Dissolved Solids (TDS)
Lithium	Total Organic Carbon (TOC)
Magnesium	Total Organic Nitrogen
Manganese	Total Suspended Solids (TSS)
Mercury	Tungsten
Molybdenum	Vanadium
Nickel	Zinc
Inorganic Nitrogen (NO_3-N)	Chloride

1/ The entire suite of parameters would be analyzed during the first three months. Those parameters that are consistently below detection limits would be dropped from the remainder of the program.

Source: EXXON Minerals Company

2.8 Methodology of NEPA Compliance and Alternatives Identification and Analysis During EIR/EIS Process

2.8.1 Scoping and Alternatives Identification

In December 1982, EXXON proposed that the BLM offer public lands in the vicinity of Mt. Hope for sale. In January 1983, the BLM sponsored a series of meetings with the public and State of Nevada. These meetings were held in accordance with Section 1501.7 of the CEQ regulations for the purpose of "determining the scope of the issues to be addressed and for identifying the significant issues related to a proposed action". On May 18, 1983, the BLM published a summary of the issues brought out during the scoping process (Appendix A of the EIS). A review of this summary indicates that the public is most concerned about the potential environmental impacts accruing from the possible construction and operation of a mine/process plant rather than the method of land transfer.

Scope is further determined by the CEQ regulations themselves which require that connected actions be discussed in the same EIS (40 CFR 1508.25). Although it was EXXON's proposal that the BLM offer federal lands for purchase that triggered the NEPA-compliance process, there are several such connected federal decisions and actions associated with the proposed Mt. Hope Project. These connected actions fall into two broad categories -- right-of-way granting and permitting.

EXXON is not at this time initiating either of these categories of activities and would not do so until a conclusion was reached with respect to property development. However, the importance of complying with the CEQ regulations, thereby eliminating the need for multiple EIS's, and satisfying the public desire and right to understand what may happen subsequent to the land transfer has been addressed in the EIS. EXXON has identified those activities that would be the subject of rights-of-way granting and permitting by generating a likely project development scheme based upon similar mine/process plants in similar geographic areas, and the analyses of impact have thereafter been conducted by independent third parties and the BLM.

2.8.2 Impact Assessment

Section 1502.5 of the CEQ regulations require that an agency "commence preparation of an environmental impact statement as close as possible to the time the agency is developing or is presented with a proposal". For proposals to the agency, such as EXXON's, this commencement shall be no later than immediately after the application is received.

The regulations also encourage and provide authority for combining actions within a single EIS. Section 1502.4 identifies the following situations when actions may be combined:

1. proposals that are so closely related as to constitute a single course of action; and,

2. actions occurring in the same general location.

Most often when applications/proposals from members of industry trigger the NEPA-compliance process, it is very early on in that company's project planning. Final engineering design has not been initiated and indeed frequently depends on the decision that will be made by the federal agency and is the subject of NEPA-documentation. In the absence of final engineering design, some uncertainty must necessarily exist regarding the quantitative estimates of environmental loadings (e.g., air emissions, effluent quality, areal disturbance, etc.). Such is the case for EXXON's Mt. Hope Project. To accommodate this situation and fulfill the above-stated requirements, the concept of "worst case analysis," as provided for in Section 1502.22 of the CEQ regulations, has been utilized.

Alternatives, including those associated with the mine/process plant, are described based upon state-of-the-art technology and represent EXXON's best understanding of project components at this time. Environmental loadings (e.g., air emissions) are estimated assuming the installation and proper operation of federally-required best available control technology. Based on accepted procedures and best engineering judgment, environmental impacts are determined by imposing these loadings on the existing environment and estimating changes

to that environment (e.g., change in ambient air quality). Where appropriate, accepted modeling techniques have been applied (e.g., predictive air dispersion modeling) as a means of assessing impacts.

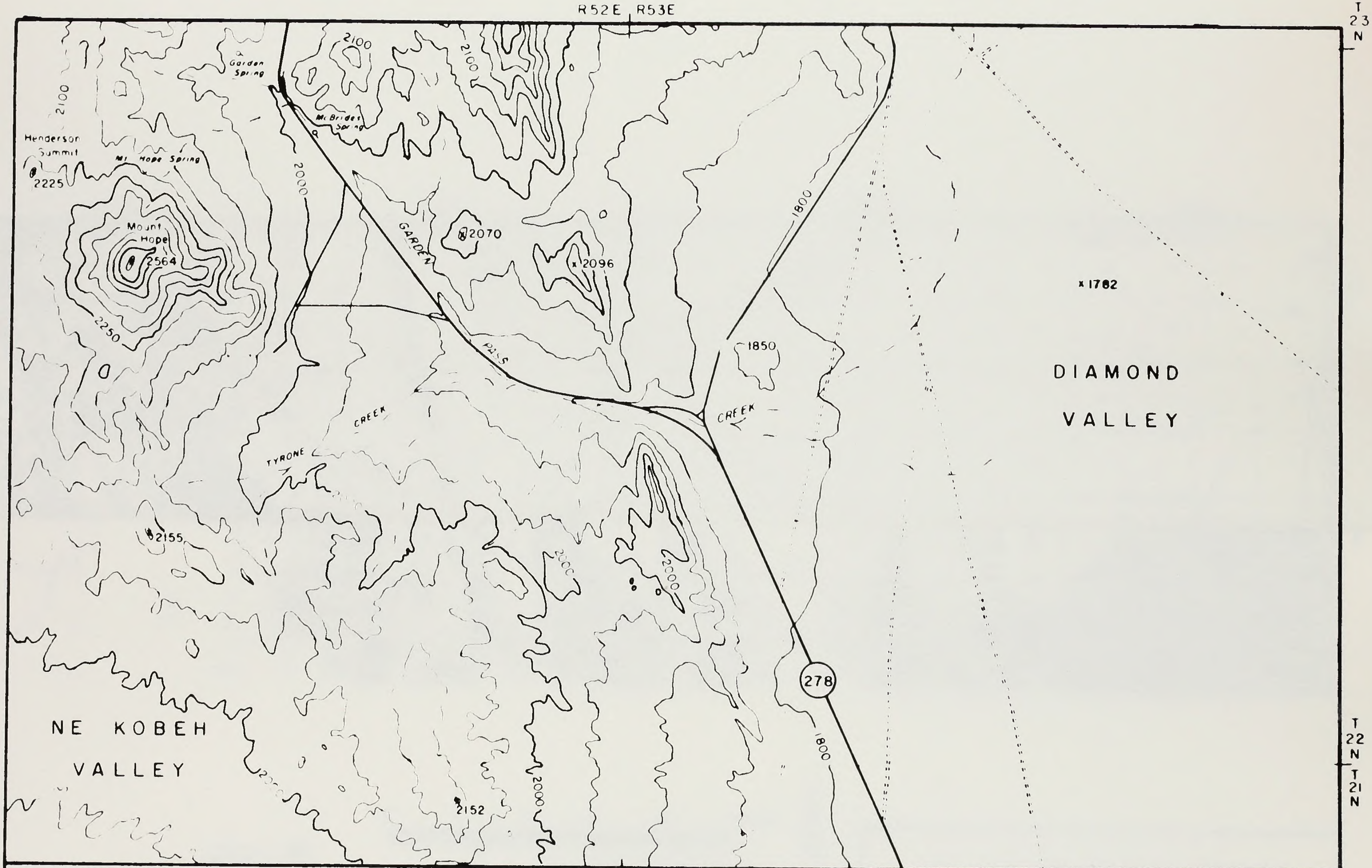
During the years of project maturation and design optimization, there may be changes introduced in the process which cannot be forseen at this time and are not specifically described in the EIS. However, due to the "worst-case analysis" approach these changes would not result in impacts that are more severe than those described in the EIS document.

2.8.3 Study Area Definition

For the purposes of impact analyses two study areas, site-specific and regional, have been defined and are shown in Figures 2-25 and 2-26, respectively. In performing a socioeconomic impact analysis the regional study area has been enlarged to include communities considered to be those most likely affected by the population influx.

2.8.4 Tiering

The CEQ regulations address the concept of tiering in a number of sections (40 CFR 1500.4, 1502.4, 1502.20 and 1508.28). The purpose of tiering is "to eliminate repetitive discussions of the same issues and to focus on the actual issues ripe for discussion at each level of environmental review". EIS's that address site-specific actions that are part of a larger federal program or policy for which a programmatic EIS has been prepared should incorporate by reference the issues that have previously been addressed in the programmatic EIS and are common to both actions. The Final Shoshone-Eureka Resource Management Plan and Environmental Impact Statement and the EXXON Mt. Hope Project Land Acquisition EIS are related EIS's. Consequently, the latter will be tiered to the former, and discussions in the former pertinent to the Mt. Hope Project Land Acquisition EIS are incorporated by reference.

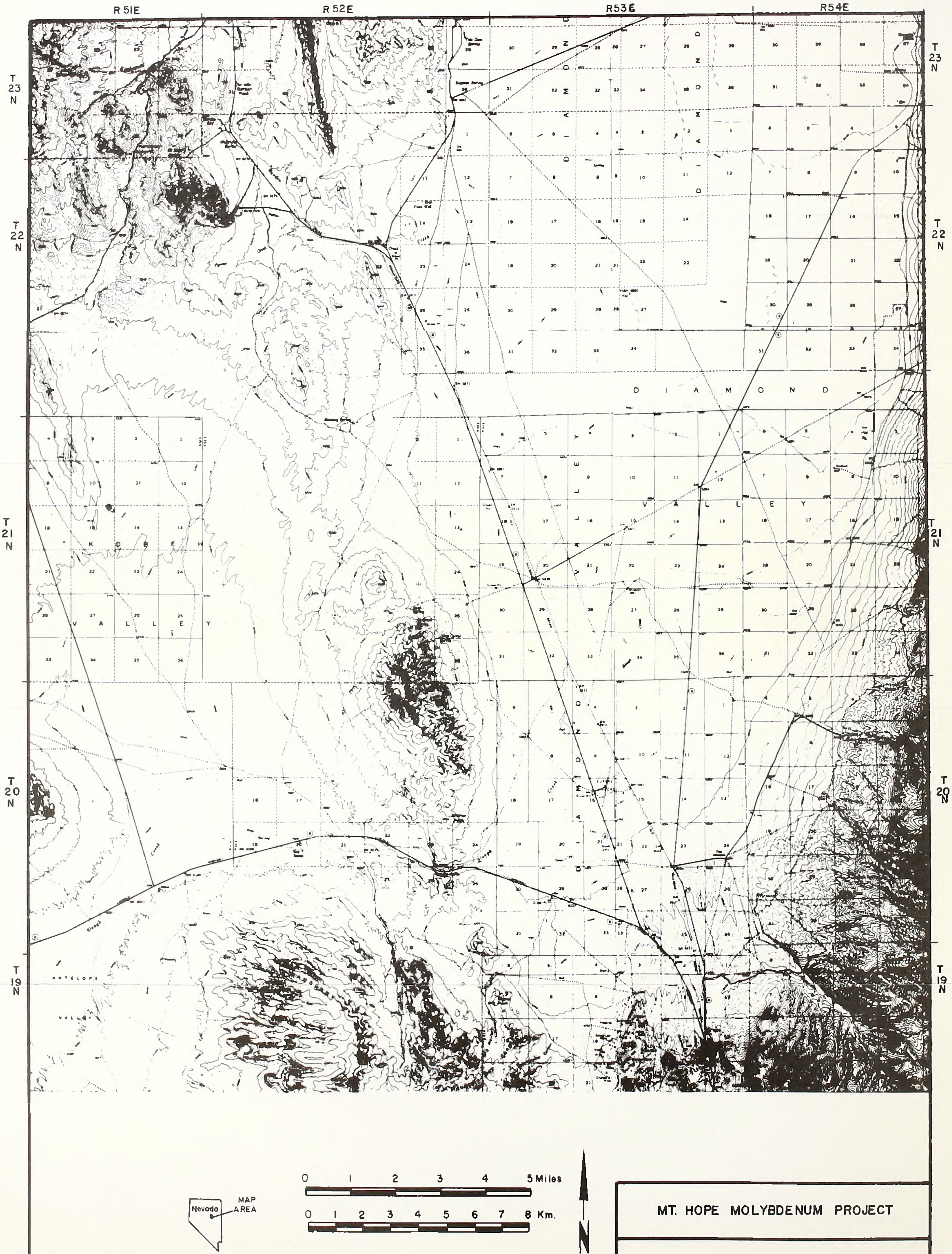


MT. HOPE MOLYBDENUM PROJECT

SITE STUDY AREA

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

FIGURE 2-25



BASE: USGS TOPO QUADRANGLES, GARDEN VALLEY, WHISTLER MTN., DIAMOND SPRINGS & EUREKA, NEVADA.

MT. HOPE MOLYBDENUM PROJECT

REGIONAL STUDY AREA

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

FIGURE 2-26

2.8.5 Cost-Benefit Analysis

The concept of cost-benefit analysis is addressed in Section 1502.23 of the CEQ regulations; it states " ... the weighing of the merits and drawbacks of the various alternatives need not be displayed in a monetary cost-benefit analysis and should not be when there are important qualitative considerations". Preparation of a cost-benefit analysis is not mandatory and occurs only if relevant.

Costs to potentially affected communities have been assessed via a fiscal impact analysis. This fiscal impact analysis answers the basic question of whether revenues (tax or otherwise) that would accrue to communities from the project would cover the cost of providing services to the project.

CHAPTER 3.0

LIST OF PREPARERS

3.1 EXXON MINERALS COMPANY

WALTER R. DAVIES, Minerals Processing Engineering

Higher National Certificate (Chemical Engineering), Birkenhead Technical College, U.K.

Mt. Hope Project: Responsible for processing engineering development of molybdenite process facilities.

Experience includes process engineering design and project engineering of major copper and uranium processing facilities and the supervision of primary copper production facilities. For several years managed laboratory and centralized pilot plant facilities for large, integrated, primary metals producer.

CHARLES E. DOWNS, Ph.D., Mine Engineering Division

Ph.D. Water Resources Systems Management, Engineering Planning Program, Stanford University. M.S. Water Resources Engineering, Civil Engineering, Stanford University. B.S. Hydrology, University of Arizona.

Mt. Hope Project: Responsible technical design of water engineering aspects of project including in-house and contracted hydrologic studies, flow modeling, well drilling, water supply development, water rights and monitoring well systems.

Experience includes design, implementation and management of numerous multidisciplinary water/energy resource development projects: e.g. hydrologic safety and monitoring programs for nuclear power plants, uranium tailings ponds, transmission corridors, flood control and agricultural/irrigation projects.

EVAN J. ENGLUND, Mining Geology Division

B.S. in Geology, University of Wisconsin

M.S. in Geology, University of Vermont
Ph.D. in Geology, Dartmouth College

Mt. Hope Project: Assisted in preparation of computerized displays of topography.

Experience includes computer applications in geology, resource evaluation, and open pit design.

H. PAUL ESTEY, Environmental and Regulatory Affairs

B.S. Civil Engineering, Washington State University
M.S. Sanitary Engineering, Washington State University

Mt. Hope Project: Established site reclamation requirements; assisted in establishing landfill requirements; assisted in developing mitigating measures and monitoring programs; assisted in developing pre-operational groundwater monitoring program.

Experience includes licensing and compliance programs for major nuclear fuel fabrication plants at three sites; also responsible for all environmental issues and programs at those sites. Have worked directly with environmental protection and regulatory agencies of eight states, the U.S. Federal government, and the Federal Republic of West Germany. Participated in writing EIRs for four nuclear fuel fabrication plants, one nuclear fuel reprocessing plant, and two uranium enrichment (one laser and one centrifuge) plants.

MOISES J. GARCIA, Engineering Advisor

B.S. Mining Engineering, New Mexico Institute of Mining and Technology.

Mt. Hope Project: Project core team member responsible for coordinating feasibility work in mine design, hydrology, topographic mapping, and bulk sampling.

Experience includes twenty four years in designing, operating, and managing open pit mines. Several years in reclaiming open pit mine areas.

KIT R. KRICKENBERGER, Environmental and Regulatory Affairs

B.S. Geology/Chemistry, Bowling Green State University
Ph.D. Marine Geochemistry, University of Maryland

Mt. Hope Project: Responsible for overall supervision in preparation of EIR, liaison and coordination with BLM and other federal agencies.

Experience includes management of large multi-disciplinary environmental consulting group preparation of many site-specific, regulatory and programmatic NEPA compliance documents for several federal agencies.

CHARLES F. LANO, Engineering Advisor

B.S. Civil Engineering, Georgia Institute of Technology

Mt. Hope Project: Project core team member responsible for coordinating electrical, socioeconomic, community development, communications, transportation, general facilities on-off site, and manpower studies.

Experience includes supervision or management of railway maintenance, brick manufacturing petroleum marketing terminal and mine production operations.

EDWIN S. ROUSSEAU, Engineering Advisor

B.S. Metallurgical Engineering, Michigan Technology University
B.S. Engineering Administration, Michigan Technology University
M.S. Metallurgical Engineering, University of Minnesota

Mt. Hope Project: Responsible for process design of process plant and tailing disposal system including descriptions of emissions and effluents and process wastes.

Experience includes testing, project manager and operation of large copper porphyry and uranium hydrometallurgical plants and preparation of environmental impact reports and license applications for uranium plant construction/modifications.

F.P. SCHWARZ, Staff Geologist

B.S. Geologic Engineering, Colorado School of Mines
Ph.D. Geologic Engineering, Colorado School of Mines

Mt. Hope Project: Responsible for field supervision of mining geology activities and preparation of geology narrative.

Experience includes sixteen years in exploration and project evaluation of geology on numerous properties in the western United States and Alaska containing base and specialty metals.

JOHN L. SHAFER, Mineral Process Engineering

B.S. Chemistry, Allegheny College
Ph.D. Inorganic Chemistry, University of California, Berkeley

Mt. Hope Project: Assisted in prediction of tailing water chemistry, water balances across mill - tailing complex, and tailings site selection and conceptual design.

Experience includes providing hydrogeochemical technical support for other developmental and operational projects; massive sulfide, copper/molybdenum, and uranium in situ.

JOHN F. WALLACE, Mine Engineering Division

B.S. Civil Engineering, S.U.N.Y. at Buffalo
MSCE Geotechnical Engineering, West Virginia University

Mt. Hope Project: Responsible for direction of tailings site selection and conceptual site development studies, seismic hazard assessments.

Experience includes execution and management of tailings facility planning and site development studies; geotechnical evaluations for numerous residential, commercial and industrial facilities; resident engineering for several large earthwork construction projects; and specialty consulting.

KAY KAY WONG, Communication and Computer Science Department

B.S. Physics, Seattle University
M.A. Physics, Columbia University

Mt. Hope Project: Responsible for computer graphics in three-dimensional visual display of mining area. Perform finite element analysis in rock mechanics and hydrology.

Experience includes developing a graphics system for satellite data at NASA.

3.2 CONSULTANTS

ROBERT C. WYATT, Project Manager

B.S. in Biology, University of Miami
Post Graduate Study, Biology, University of Miami

Mt. Hope Project: Responsible for coordination of environmental discipline impact analyses (except cultural resources) and direction of the third party EIS scientific team; technical and regulatory (NEPA) oversight and management of EIS documentation; and liaison and coordination with the Bureau of Land Management (BLM) and EXXON.

Experience includes management and technical analyses of environmental impact studies involving surface and underground mines, nuclear and coal-fire electrical generating plants, petrochemical and mineral process facilities, and hazardous waste/nuclear disposal site regulatory analysis. Professional experience involving activity in 23 states, Mexico and Puerto Rico has included the technical critique and environmental discipline analysis of hydrology, air quality, chemical and mine engineering, terrestrial and aquatic biology, socioeconomics, land use, pollutant toxicity and regulatory compliance.

MAXWELL K. BOTZ, Senior Hydrologist

B.S. in Geological Engineering, University of Nevada
M.S. in Geological Engineering, University of California, Berkeley
Ph.D in Hydrology, University of Arizona (dissertation not completed)
Professional Engineer, States of Colorado, Wyoming, Utah

Mt. Hope Project: Responsible as senior scientist for design and supervision of geohydrologic analyses, impact assessments and technical report preparation pertinent to EIS documentation.

Professional experience in excess of twenty years includes project direction for major mining, reclamation and water resources investigations. Emphasizing hard rock and coal mining, experience has included engineering design and construction of a hazardous waste site, development of water surplus, mineral processing treatment research, and groundwater pollution investigations. Employment history has included responsibility as Head of Technical Investigation Section, Water Quality Bureau, Montana Department of Health and Environmental Sciences.

KENNETH W. MACKENZIE, JR., Senior Air Quality Scientist

B.S. in Pre-Med, Wayne State University, Detroit, Michigan
M.S. in Engineering, University of Washington, Seattle, Washington

Mt. Hope Project: Responsible for assisting in impact analysis related to air quality fugitive dust emissions, noise and transportation.

Mr. MacKenzie has over twenty years experience in environmental management with both the private and public sector. He is an expert in all aspects of regulatory compliance at U.S.E.P.A. and state levels. He has served as chairman of the Southwest Section of the Air Pollution Control Association (APCA) and as President of the Association of Local Air Pollution Control Officials (ALAPCO). He was for a number of years the Air Quality Manager for a large environmental consulting firm, and his project experience includes management of several large environmental projects. He has held the posts of chief environmental officer for the cities of Houston, Texas and Fairbanks, Alaska. He is currently active in Houston on the Chamber of Commerce Environmental Committee and the Mayor's Environmental Task Force consulting on regulatory and air quality matters.

JAMES MIKULA, Air Quality Scientist

B.S. in Atmospheric Science, Purdue University, West Lafayette, Indiana
M.S. in Atmospheric and Oceanic Science, Old Dominion University, Norfork, Virginia

Mt. Hope Project: Provided air quality and emissions modeling expertise in developing the Valley Model results and interpretation.

Experience includes meteorology and air quality projects in the U.S. and Saudi Arabia as senior air quality scientist with several consulting firms. His expertise includes work as a major investigator for a national commission on air quality standards to review and revise PSD offset permits standards.

LAL BABOOLAL, Air Quality Scientist

B.S. in Physics, University of California at Los Angeles
M.S. in Physics, University of Washington
Ph.D in Atmospheric Science, University of California at Los Angeles

Mt. Hope Project: Responsible for direction and performance assistance of the air quality impact analyses utilizing computer models. Reviewed and prepared technical reports and section discussion of EIS (climatology, air quality).

Professional experience in excess of fifteen years includes program directorship for both international and domestic projects. Technical activity has involved air quality and meteorologic baseline characterizations; development and simulations of air dispersion models in coordination with regulatory and public agencies; design and management of air quality monitoring networks; and the analytical treatment of data pertinent to direct and indirect environmental air quality impacts.

VICTOR M. YAMADA, Air Quality Scientist

B.S. in Civil Engineering, University of Washington

M.S. in Environmental Engineering, University of Washington

M.B.A., Pepperdine University

Mt. Hope Project: Assisted in determinations of air quality impact and process plant environmental loadings.

Professional experience involves over fourteen years of consulting and government employment. Project specialties include fugitive dust emissions inventory and control measures design, impact analysis of alternative new source review policies and economic analysis relative to air pollution control technology. Employment history has included responsibilities as Section Chief, Air Program Development, EPA Region V.

MARK STEPHENS, Air Quality Technician

B.A. in Environmental Studies, California State University, Northridge

Mt. Hope Project: Responsible for meteorologic/air quality data gathering and assisting in data analysis exercises.

Professional experience includes air quality monitoring network establishment, data acquisition equipment maintenance and operation, and primary data review and reduction.

CHAPTER 4.0
GLOSSARY

Acquired land. Land obtained through the Federal Land Policy and Management Act (FLPMA) or through the General Mining Law of 1872.

Aquifer. A formation, group of formations, or part of a formation that is water bearing.

Centerline method. A method of dam construction involving the cycloning procedure whereby the centerline of the embankment crest remains essentially in the same horizontal position as the dam is raised.

Class II cultural resource survey. A cultural resource survey conducted by sample reconnaissance of part or a percentage of the total area of investigation.

Class III cultural resource survey. A cultural resource survey involving intensive reconnaissance and identification of all cultural sites within all of the areas to be impacted.

Cycloned tailings embankment. An embankment (such as for a dam) constructed from fine-grained tailings material. This material is derived by a process of gravitational separation (cycloning) along the dam crest.

Cycloning. A process of gravitational separation whereby solid mill waste is separated into underflow tailings sands that will constitute the tailings embankment and overflow tailings slimes will be deposited into the pond behind the dam.

Drawdown. The lowering of the water table or piezometric surface caused by pumping or artesian flow. (After Theis, Econ. Geol., vol. 33, no. 8, p. 891, 1938).

Environmental impact. Effect of environmental loading on existing physical, bilogical and socioeconomic environment (e.g., change in air quality, groundwater quality or soil loss). These changes to the current or projected conditions may be beneficial, inconsequential or adverse.

Environmental loading. Emission from proposed action or alternatives that has potential to change existing environment (e.g., air emissions, effluent quality, areal disturbance, etc.).

Hydrometallurgical plant. Pertaining to hydrometallurgy. The treatment of ores by wet processes (as leaching).

Molybdenum. A lead ore; a metallic element that resembles chromium and tungsten in many properties, is used esp. in strengthening and hardening steel.

Non-mineralized material storage. That portion of the excavated material which cannot be economically processed.

Permeability. The capacity of rock for transmitting a fluid. Also, the ease with which gases, liquids or plant roots penetrate or pass through a bulk mass of soil or a soil layer.

Short-term impact. Impacts encompassing a 60-year period and based on an assumed mine life of 50 years and a reclamation success period of 10 years.

Tailings pond. A pond which holds the non-ore residue that has been separated out in the preparation of various ores.

Tiering. A concept addressed by a number of sections in the CEQ regulations, the purpose of which is "to eliminate repetitive discussions of the same issues and to focus on the actual issues ripe for discussion at each level of environmental review." EIS's that address site-specific actions that are part of a larger federal program or policy for which a programmatic EIS has been prepared should incorporate by reference the issues that have previously been addressed in the programmatic EIS and are common to both actions. Consequently, a latter EIS will be tiered to the former EIS, and discussions in the former EIS which are pertinent to the latter EIS are incorporated by reference.

CHAPTER 5.0
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APPENDIX 1-A

TAILINGS POND SITE SELECTION STUDY

This Appendix presents information concerning the analysis and selection criteria pertaining to tailings pond design and siting for the Mt. Hope project. EXXON commissioned the independent study by Wahler Associates (Palo Alto, California); the results of which were reported in January, 1983. This Appendix presents pertinent abstracts from the Wahler Associates report. The reader should be aware that initial project design parameters included a 30-year life and that Wahler's work was performed under this assumption. Information in this Appendix reflects a 30-year life. Later project efforts included a 50-year life and this assumption was incorporated into the EIS for only those three alternatives presented in that document.

Consequently, there are some differences between the two presentations. These differences do not affect the relative rankings of alternatives or the impact analysis.

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TABLES

FIGURES

EXECUTIVE SUMMARY

Project Description

The Wahler report compared and evaluated ten alternative tailings disposal sites and presented the conceptual designs of two selected alternatives for EXXON Minerals Company's Mt. Hope Project. This summary is included to provide a convenient overview of the alternative evaluations and the conceptual designs of the two best alternatives.

Site Conditions

Ten alternative sites were evaluated for tailings disposal. All of the sites were located within a ten mile (16.1 km) radius of Mt. Hope. Conditions at the ten sites can be divided into 3 general categories. Alternative Sites B, I (4-B)*, and J (4-C)* can be characterized as having little to very little overall topographic relief and are underlain by extensive and probably very deep alluvial deposits. Sites A (4-A)*, C, D, and F have moderate topographic relief and are underlain by alluvial materials with bedrock materials at or near the surface on the dam abutments and outer edges of the impoundment. Alternative Sites E, G, and H have generally moderate to steep topography and are underlain by apparently limited quantities of alluvium. All of the sites were considered to have moderate to high seepage potential because of the underlying alluvium or probably pervious bed rock at the sites.

Sites C and D were located on BLM and fee land. The remaining 8 sites were located entirely on BLM land. Sites B, D, F, G, and I (4-B) have competitive mining claims or had oil and gas leases on them. There were no mining claims or oil and gas leases on Site E. Sites A (4-A), C, and J (4-C) have Mt. Hope Group mining claims.

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* Site designations were changed for EIS purposes. Wahler sites A, I, and J were redesignated 4-A, 4-B, and 4-C, respectively. Other sites were not designated.

Evaluation of Alternative Tailings Disposal Sites

The ten alternative tailings disposal sites were identified for comparison and evaluation using both quantitative data and qualitative assessments. Using the developed data, the alternatives were compared and rated in a matrix. All of the sites except Site G had sufficient storage capacity for the anticipated tailings tonnages. Site G was dropped from further consideration because of lack of capacity and because it did not have significant apparent advantages as a disposal site.

Embankment quantities, drainage areas, and distances for tailings conveyance and reclaim water conveyance facilities were computed from USGS topographic maps. Tailings conveyance and reclaim water facilities were sized, based upon anticipated tailings tonnages and estimated quantities of reclaim water. Hydrologic, geologic, and environmental assessments were based upon the available data and on brief site reconnaissance. All of the sites except Sites A (4-A) and I (4-B) would require pumping for tailings transport from the preferred mill site location.

The alternative sites were evaluated under five major considerations; initial capital costs, annual operating costs, technical considerations, environmental considerations, and land use considerations.

The results of the alternative evaluations and rating matrices indicated that Alternative A (4-A), the tailings impoundment across Garden Pass Creek, and Alternative J (4-C), the tailings impoundment in Upper Kobeh Valley, were the two best alternatives.

Conceptual Design of Tailings Impoundment at Alternative Site A (4-A)

The principal features of the tailings impoundment at Alternative Site A (4-A) include an earthfill starter dam, a rockfill toe dam, the cycloned tailings embankment, the tailings conveyance and reclaim water facilities, and the rerouting of a portion of Nevada State Route 278.

The earthfill starter dam would be 95 feet (29 m) high, while the rockfill toe dam would be 23 feet (7 m) high. The initial construction of these starter facilities would involve about 1.12 million cubic yards (860,000 m^3) of earth fill, 105,000 cubic yards (80,000 m^3) of rockfill, 312,000 cubic yards (237,000 m^3) of finger drain material, and 576,000 cubic yards (440,000 m^3) of foundation excavation.

The tailings embankment would be constructed of cycloned tailings sands using the centerline method. It would have an ultimate height of 286 feet (87 m).

Tailings conveyance facilities include approximately 4.3 miles (6.9 km) of 30-inch (76 cm) reinforced concrete pipeline, drop boxes to dissipate excess energy, and tailings cyclones. The reclaim water system would include 3 barge-mounted pumps, 3.8 miles (6.1 km) of 16-inch (40.6 cm) diameter pipeline, seepage collection pumps and pipelines, and 13.8 KV power lines. Access roads from the mill site to the disposal facilities are also required. About 5.5 miles (8.9 km) of rerouted paved state highway is also required to develop the site.

<u>Conceptual Design of Tailings Impoundment at Alternative Site J (4-C)</u>

The principal features of the tailings impoundment at Alternative Site J (4-C) include the earthfill starter dam, the rockfill toe dams, the cycloned tailings embankment, and the tailings conveyance and reclaim water facilities.

The earthfill starter dam would be 56 feet (17 m) high, and about 12,370 feet (3,773 m) long. Seven rockfill toe dams are required for the Site J (4-C) tailings embankment because of the topography at the site. All of these toe dams are less than 16 feet (5 m) high. The initial construction of the starter facilities would involve about 2.3 million cubic yards (1.8 million m^3) of earthfill, 149,000 cubic yards (114,000 m^3) of rockfill, 510,000 cubic yards (390,000 m^3) of finger drain material, and 1.12 million cubic yards (854,000 m^3) of foundation excavation.

The tailings embankment would be constructed of cycloned tailings sands using the centerline method. It would have an ultimate height of 200 feet (61 m) and be about 3.9 miles (6.3 km) long.

Tailings conveyance facilities would include two 20-inch (50.8 cm) lined concrete pipelines about 7.1 miles (11.4 km) long, tailings pumps, tailings cyclones, and power facilities and access roads. The reclaim water system would include 3 barge-mounted pumps, 4.6 miles (7.4 km) of 14-inch (35.6 cm) diameter pipeline, seepage collection pumps and pipelines, and a 13.8 KV power line.

Recommendations

The alternative site rankings indicate that Site A (4-A) is the preferred alternative for tailings disposal. In addition, the conceptual design cost estimates developed for Sites A and J indicate that Site A (4-A) would be less costly to develop and operate. Therefore, unless other, currently unknown overriding considerations develop, it is recommended that future tailings disposal studies and design work be concentrated on Site A (4-A).

1.0 Introduction

1.1 Project Description

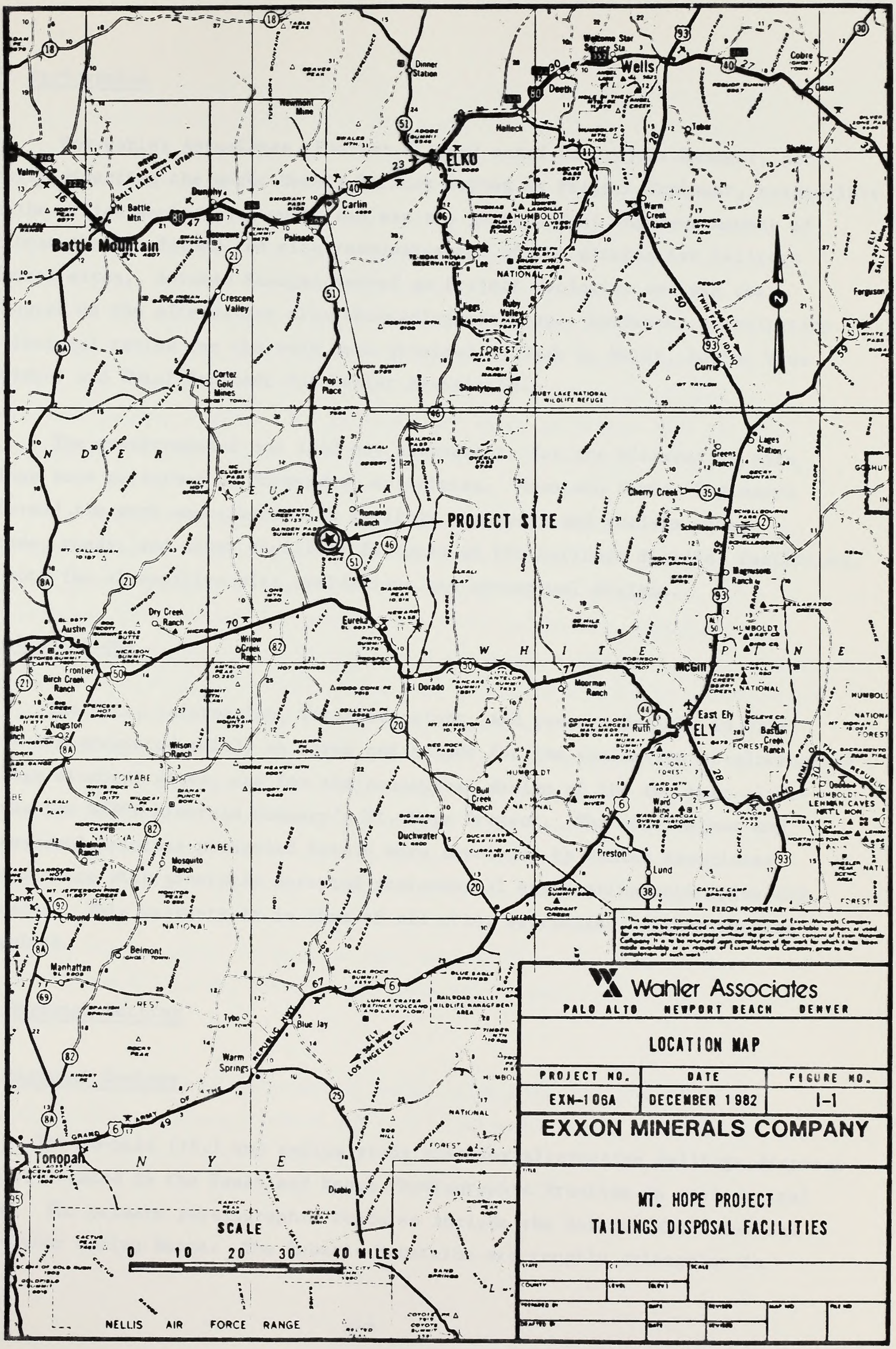
This report presents Wahler Associates' evaluation and comparison of alternative tailings disposal sites and the conceptual design of the two best alternatives for EXXON Minerals Company's Mt. Hope Project. The alternative disposal sites are all located in Eureka County in Central Nevada (see Figure I-1).

The major components of the proposed project will include an open pit molybdenum mine, a mill to process the ore, and the tailings disposal facilities. The proposed mill has a presently planned production capacity of 30,000 tons (27,210 metric tons) of ore per day with a planned thirty-year life. Approximately 331 million tons (300 million metric tons) of tailings will be generated during the operating life of the mill.

1.2 Scope of Work

The work performed and documented in this report consists of alternative tailings disposal site evaluations and the conceptual design of the tailings disposal facilities at the two best disposal sites. Specifically, the project scope of work included the following 8 major tasks:

- Task 1 - Review and Evaluate Date
- Task 2 - Develop Criteria for Site Selection
- Task 3 - Identify Alternative Sites
- Task 4 - Alternative Site Reconnaissance
- Task 5 - Develop Evaluation Criteria for Alternative Sites
- Task 6 - Evaluate and Rank Alternative Sites
- Task 7 - Conceptual Design of Preferred and Alternative Sites
- Task 8 - Report Preparation


PROJECT SITE
SCALE
0 10 20 30 40 MILES
NELLIS AIR FORCE RANGE
Battle Mountain
ELKO
Wells
Carlin
Palisade
Crescent Valley
Cortez Gold Mines
Pop's Place
Romano Ranch
Eureka
Austin
El Dorado
Ruth
ELY
East Ely
McGill
Cherry Creek
Currie
Lages Station
Duckwater
Curran
Preston
Lund
Warm Springs
Blue Jay
Tybo
Belmont
Manhattan
Round Mountain
Carver
Tonopah
Diablo
Dry Creek Ranch
Willow Creek Ranch
Wilson Ranch
Bull Creek Ranch
Moorman Ranch
Magnuson Ranch
Schellbourne
Halleck
Lee
Jiggs
Ruby Valley
Shantytown
Warm Creek Ranch
Tobar
Oasis
Cobre
Dinner Station
Newmont Mine
Valmy
N. Battle Mtn.
Dunphy
Beowawe
Frontier
Birch Creek Ranch
Kingston
Mosquito Ranch
Moore Ranch
Bastian Creek Ranch
Ward Mine
N Y E
W H I T E P I N E
E U R E K A
L A N D E R
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EXXON PROPRIETARY
Wahler Associates
PALO ALTO NEWPORT BEACH DENVER
LOCATION MAP
PROJECT NO. DATE FIGURE NO.
EXN-106A DECEMBER 1982 I-1
EXXON MINERALS COMPANY
MT. HOPE PROJECT
TAILINGS DISPOSAL FACILITIES

1.3 Performance

For Wahler Associates, Forrest Gifford acted as Project Manager, personally directing the work; Dennis Buranek served as Project Engineer, responsible for the office engineering work, and was the geotechnical engineer member of the team that performed the site reconnaissance of the alternative tailings disposal sites. Antonio Buangan served as Project Geologist and was the geologist on the alternative site reconnaissance team. Guidance, consultation and internal review for the work were provided by Jack G. Wulff, Senior Vice President and Chief Engineer for Wahler Associates.

The environmental and land use assessments for the alternative site ratings were performed by Normandeau Associates. Mountain States Engineers performed the work associated with tailings transport and reclaim water systems, roads, and other ancillary features of the tailings disposal facilities, for both the alternative site evaluations and conceptual designs.

1.4 Limitations

The data, information, interpretations, and recommendations in this report are presented solely as bases and guides for the evaluation of alternative tailings disposal sites, and for the conceptual design of the two best alternatives for EXXON Minerals Company's Mt. Hope Project. The conclusions and professional opinions presented herein were developed by Wahler Associates in accordance with generally accepted geotechnical engineering principles and practices. This warranty is in lieu of all other warranties, either express or implied.

2.0 Regional Setting

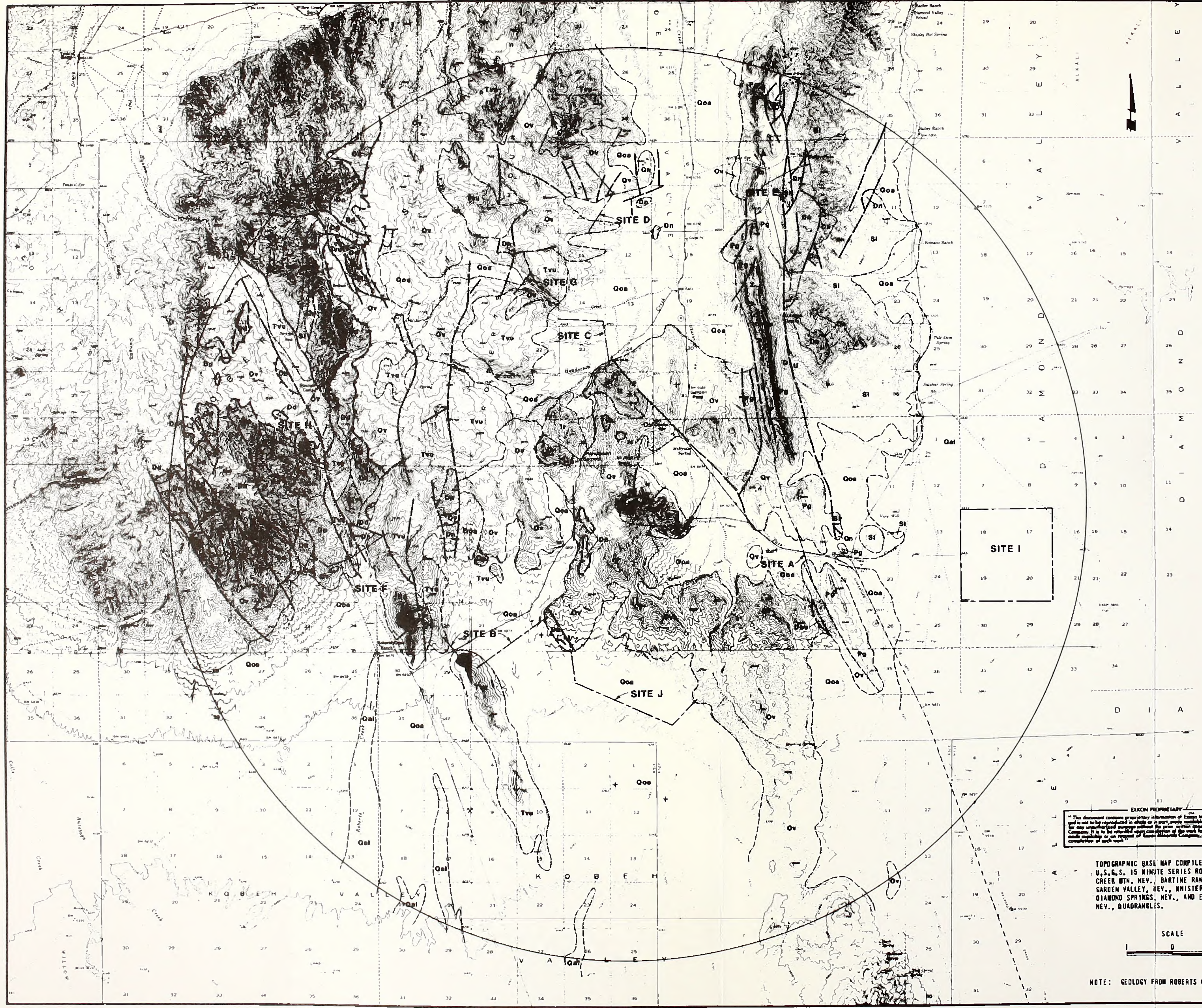
2.1 Regional Geology

The 10-mile (16.1 km) radius study area for alternative tailings disposal sites is located in the Basin and Range Physiographic Province in east-central Nevada. The primary physiographic features include the Roberts Mountains and the Sulphur Spring Range. The Roberts Mountains are roughly triangular in

shape and attain maximum elevations of over 10,000 feet (3,050 m). The southeast flanks in the vicinity of Mt. Hope consist of low foothills that join the Sulphur Spring Range to the east. The Sulphur Spring Range is a north-south trending narrow range that lies between the Roberts Mountains and Garden Valley to the west and Diamond Valley to the east. South of the Roberts Mountains and west of the southern portion of the Sulphur Springs Range lies Kobeh Valley. Several alternative tailings disposal sites were evaluated on the southeast portion of Roberts Mountains, two in the Sulphur Spring Range and one each in Diamond Valley and in the northeastern edge of Kobeh Valley. The geology of the project area was previously studied by Roberts and others, (1967). The geologic map shown on Figure II-1 is based on mapping by them with minor modifications noted during site reconnaissance.

The mountain ranges in the study area are underlain mostly by faulted and folded Paleozoic sedimentary rocks that conist mainly of two principal facies of pre-orogenic sedimentary rocks ranging from Ordivician to Early Mississippian Age. These are called the western assemblage, comprised primarily of siliceous and volcanic rocks; and the eastern assemblage, consisting mostly of carbonate rocks. These rocks were deposited in a broad geosyncline; the carbonate rocks to the east, and the siliceous and volcanic rocks to the west. During the Antler Orogeny in late Devonian and Mississippian time, the rocks were folded and the western assemblage was thrust over the eastern assemblage along the Roberts Mountains thrust. The Roberts Mountains are essentially an eastward-tilted block of western assemblage rocks with a belt of windows of eastern assemblage rocks, that are overlapped on the east by volcanic rocks. Following the Antler Orogeny, a coarse clastic sedimentary sequence of Mississippian to Permian age, derived from the orogenic belt, was deposited and overlaps the older assemblages and is hence called the overlap assemblage.

Volcanic rocks of Tertiary age occur throughout the project area. Plugs of rhyolite porphyry intrude the older sediments in the southeastern flanks of Roberts Mountains. Quaternary alluvium fills the valleys, extends up to the flanks of the mountains and consists of older and younger alluvium.



EXPLANATION

CRETACEOUS QUATERNARY

Qal	ALLUVIUM, YOUNGER STREAM AND VALLEY FILL DEPOSITS; INCLUDES SILTY MATERIALS ALONG DRAINAGE COURSES; SHOWN ONLY WHERE MAPPABLE AT THE SCALE OF THIS MAP.
Qoa	OLDER ALLUVIUM, ALLUVIAL FANS; POORLY SORTED SANDS AND GRAVELS; INCLUDES INTERVENING LIMITED AREAS OF YOUNGER ALLUVIAL DEPOSITS.
Tvu	VOLCANIC ROCKS; INDIVIDED RHYOLITIC TUFF AND BRECCIA; ANDESITIC LAVA FLOWS; QUARTZ LATITE FLOWS; OLIVINE BASALT.
Ir	INTRUSIVE ROCKS; QUARTZ MONZONITE; GRANODIORITE; ALASKITE; RHYOLITE PORPHYRY.

PALEOZOIC

OVERLAP ASSEMBLAGE
(CLASTIC ROCKS)

Pg	GARDEN VALLEY FORMATION; CONSISTS OF a) LIMESTONE MEMBER, b) SILICEOUS COBBLE TO BOULDER CONGLOMERATE, SANDY CARBONACEOUS SHALE AND CARBONACEOUS SANDSTONE, c) REDDISH BROWN SILICEOUS CONGLOMERATE, HIGH RESISTANT RIDGE-FORMING, d) RED AND PURPLE SHALES AND CONGLOMERATE

EASTERN ASSEMBLAGE
(CARBONATE ROCKS)

Od	DEVILS GATE LIMESTONE; THICK-BEDDED, GRAY TO BLUE GRAY LIMESTONES; CLIFF-FORMING.
On	NEVADA FORMATION; WELL BEDDED LIMESTONE; CALCAREOUS DOLOMITE AND THIN TO THICK BEDDED MOTTLED DOLOMITE.
Oau	SEDIMENTARY ROCKS, UNDIVIDED.
Sl	LONE MOUNTAIN DOLOMITE; LIGHT GRAY TO DARK GRAY, THICK BEDDED TO MASSIVE DOLOMITE TO DOLOMITIC LIMESTONE.
Sr	ROBERTS MOUNTAINS FORMATION; PLATY SILTY LIMESTONE AND AND MINOR AMOUNTS OF DOLOMITE.

WESTERN ASSEMBLAGE
(SILICEOUS AND VOLCANIC ROCKS)

Ov	VININI FORMATION; LOWER MEMBER; GRAY BROWNISH WEATHERING BEDDED QUARTZITES, GRAY ARENACEOUS LIMESTONE OR CALCAREOUS SANDSTONE; BROWNISH GRAY SILTY SEDIMENTS; ANDESITES FLOWS AND TUFFS; UPPER MEMBER: INTERBEDDED RED CHERT AND BLACK SHALE, TERMS SMOOTH SLOPES.

GEOLOGIC CONTACT, APPROXIMATELY LOCATED

FAULT; APPROXIMATELY LOCATED, D, DOWNTHROWN SIDE, U, UPTHROWN SIDE

THRUST FAULT; APPROXIMATELY LOCATED; SAWTEETH ON UPPER PLATE

+ WELL LOCATION NOTED DURING SITE RECONNAISSANCE

⚒ EXISTING QUARRY NOTED DURING SITE RECONNAISSANCE

TOPOGRAPHIC BASE MAP COMPILED FROM U.S.G.S. 15 MINUTE SERIES ROBERTS CREEK MTN. NEV., BARTINE RANCH, NEV., GARDEN VALLEY, NEV., WHISTER MTN. NEV., DIAMOND SPRINGS, NEV., AND EUREKA, NEV., QUADRANGLES.

SCALE

1 0 1 MILE

NOTE: GEOLOGY FROM ROBERTS AND OTHERS, 1967

Wahler Associates

GEOLOGIC MAP

PROJECT NO.	DATE	FIGURE NO.
EXN-106A	NOVEMBER 1982	II-4

EXXON MINERALS COMPANY

HOUSTON TEXAS

TITLE

MT. HOPE PROJECT
TAILINGS DISPOSAL FACILITIES

STATE	C.I.	SCALE
COUNTY	LEVEL (DATUM)	

PREPARED BY	DATE	REVISED	MAP NO.	FILE NO.
DRAFTED BY	DATE	REVISED		

The geologic formations underlying the project site are shown and described on Figure II-1. The Vinini Formation of Ordovician Age comprises the western assemblage in the project area. The eastern assemblage rocks relevant to this investigation of the alternative tailings disposal sites consist of the Devils Gate Limestone, Nevada Formation and Lone Mountain Dolomite.

3.0 Candidate Sites

3.1 General Criteria

The primary criteria for identifying candidate tailings disposal sites included:

- The sites should be located within a 10-mile (16.1 km) radius of Mt. Hope.
- The candiate sites should be capable of containing tailings from at least 331 million tons (300 million metric tons) of ore at one or not more than three locations.
- The candidate sites should not be located over proven ore zones.

An initial review of topographic maps indicated that there did not appear to be many desireable sites with adequate storage capacity within the 10-mile (16.1 km) radius study area. In addition to the primary criteria, the secondary criteria listed below were utilized to identify the more promising sites and to limit the number of candidate sites to not more than ten.

- The disposal sites should be located off major drainages.
- The candidate disposal sites should avoid perennial streams and springs.
- The disposal sites should be located so as to limit disturbance to antiquities or environmentally sensitive areas.

- The disposal facilities should be located, where possible, away from adverse geological conditions, particularly where seepage potential was high. A particular effort was made to locate sites in different geological environs.

Such things as land ownership, leases, claims, distances from mine and mill, access, power, and disruption of existing roads and utilities were not considerations in selecting candidate sites. These types of considerations were evaluated during the ranking process to select the two most desirable sites.

3.2 Identification of Candidate Sites

Ten alternative tailings disposal sites were identified using USGS topographic quadrangles. The locations of the ten sites, as well as the approximate locations of the proposed mine and the preferred mill site, are shown on Table III-1. Two of the sites were located east of the proposed mine, a large ring dike facility in Diamond Valley and a tailings embankment across Garden Pass Creek. Four sites were located north of Mt. Hope, one on Henderson Creek, one on Frazier Creek, one on Vinini Creek, and one site in a narrow valley in the Sulfur Spring Range. Two alternative sites were located west of the proposed mine on Roberts Creek and two alternative sites were located south of the proposed mine at the northern edge of Kobeh Valley.

Pertinent data for the ten sites and disposal facilities are described in more detail in Chapters IV and V of this report.

4.0 Site Conditions

4.1 General

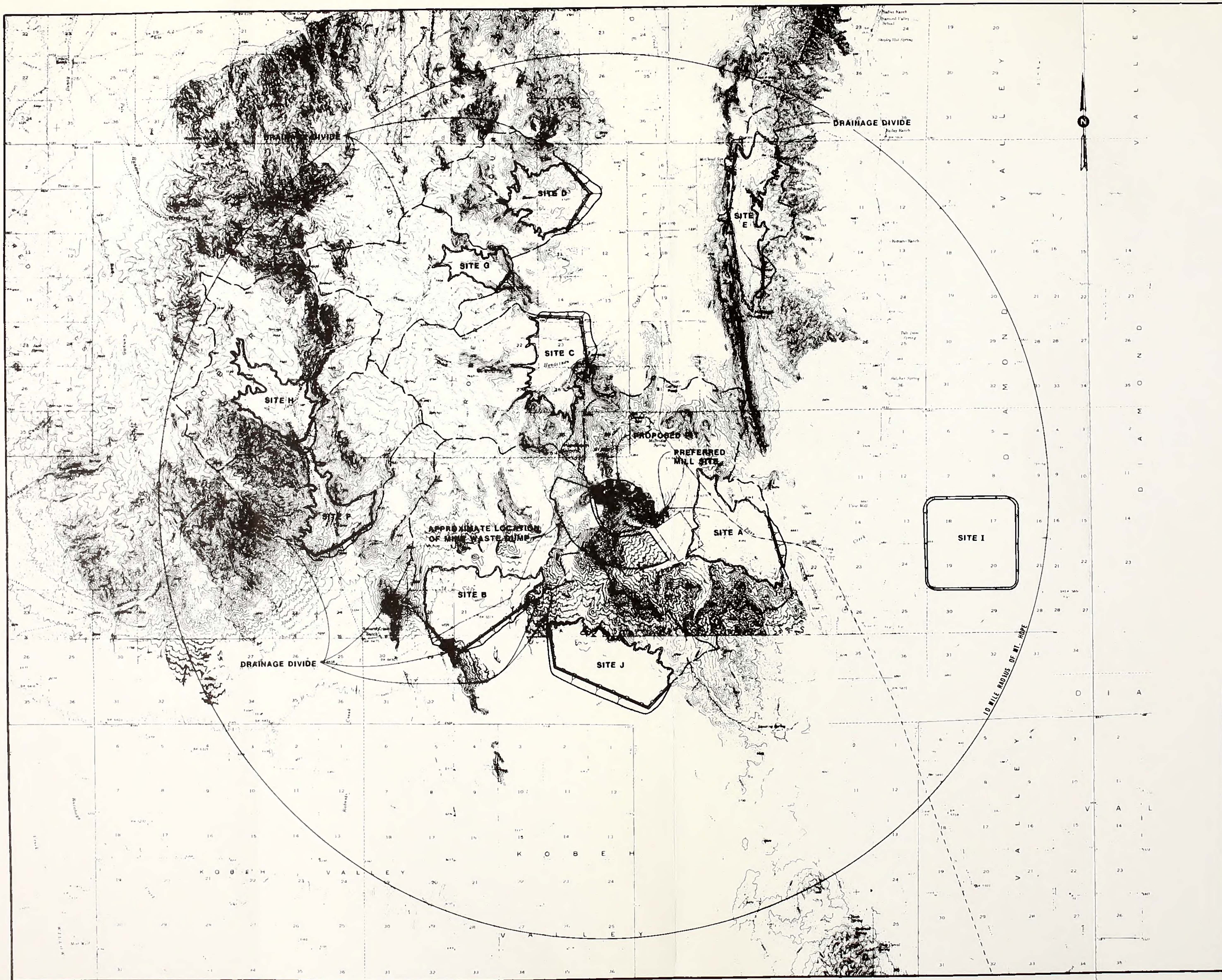
A total of 10 alternative tailings disposal sites within a 10-mile (16.1 km) radius of Mt. Hope project were assessed and evaluated during this investigation. The 10 sites are shown on Figures II-1 and III-1. This study was based on topographic conditions, a review of available geologic data, air-photo interpretation, available land use maps, literature on the area, and a brief site reconnaissance. Site specific geology was based largely on a published regional geologic map and report of Eureka County, Nevada by

Mt. Hope Molybdenum Project

Table III-1 Alternative Tailings Disposal Sites

Site	Location	Drainage Area mi^2	(km^2)	Linear Distance from Preferred Mill Site mi	(km)	Approximate Base Elevation[1] ft.	(m)
A (4-a)	Garden Pass Creek	19.32	(50.04)	2.1	(3.4)	6,065	(1,850)
B	Upper Kobeh Valley (west)	14.19	(36.75)	5.2	(8.4)	6,472	(1,974)
C	Henderson Creek	12.23	(31.68)	4.8	(7.7)	6,648	(2,028)
D	Frazier Creek	6.82	(17.66)	7.7	(12.4)	6,437	(1,963)
E	Sulfer Springs	4.39	(11.37)	6.8	(10.9)	6,504	(1,984)
F	Lower Roberts Creek	23.11	(59.85)	7.2	(11.6)	6,673	(2,035)
G	Vinini Creek	7.70	(19.94)	6.6	(10.6)	7,020	(2,141)
H	Upper Roberts Creek	10.92	(28.28)	8.1	(13.0)	7,000	(2,135)
I (4-B)	Diamond Valley	4.0	(10.36)	6.3	(10.1)	5,843	(1,782)
J (4-C)	Upper Kobeh Valley (east)	7.17	(18.57)	3.6	(5.8)	6,397	(1,951)

1/Base elevation is the lowest point on the existing ground beneath the tailings embankment.



TOPOGRAPHIC BASE MAP COMPILED FROM U.S.G.S. 15 MINUTE SERIES ROBERTS CREEK MTN. NEV., BARTINE RANCH, NEV., GARDEN VALLEY, NEV., WHISTER MTN. NEV., DIAMOND SPRINGS, NEV., AND EUREKA, NEV., QUADRANGLES.

SCALE

1 0 1 MILE

NOTE: CONTOUR INTERVAL 40 FEET

Wahler Associates

PALO ALTO NEWPORT BEACH DENVER

ALTERNATIVE
TAILINGS DISPOSAL SITES

PROJECT NO.	DATE	FIGURE NO.
EXN-106A	JULY 1982	III-1

EXXON MINERALS COMPANY

HOUSTON TEXAS

MT. HOPE PROJECT
TAILINGS DISPOSAL FACILITIES

Roberts and others, (1967), and field checking of site conditions during site reconnaissance conducted on July 12 through 15, 1982. No subsurface exploration was performed during this investigation.

Vegetation and habitats in the 10-mile (16.1 km) radius around Mt. Hope are quite homogeneous. Although terrain varies through 3 basic zones from the Diamond Valley flats through the middle slopes of the Roberts and other mountains, vegetation and habitats do not vary all that much. All three zones contain extensive open areas dominated by shrubs and grasses. Pinon-Juniper woods are found on steeper slopes at higher elevations and junipers are also found scattered throughout much of the shrub-grasslands. The most significant variations between sites considered in this evaluation include the presence or absence of water and riparian habitat, and site relief. Otherwise, site size, the proportion of shrubland to wooded land and the distance from the preferred mill site are the major variants.

4.2 Alternative Site A (4-A)

4.2.1 Site Geology

Site A (4-A) damsite is located across a narrow gap of the Sulphur Spring Range; Garden Pass Creek and Nevada State Highway 278 pass through this gap. Site A (4-A) is located about 3 miles (4.8 km) east of the Mt. Hope mine area. The channel elevation is at about 6,065 feet (1,850 m).

The narrowest portion of the gap cuts through a prominent conglomerate bedrock ridge that is a member of the Garden Valley Formation. This rock unit in the abutments consists of very resistant, hard, outcropping reddish-brown siliceous pebble conglomerate that is massive to thick bedded. Immediately upstream and down-section of the conglomerate is a relatively less resistant sequence of carbonaceous shales and sandstone with interbeds of conglomerate. Other than the conglomerate beds, outcrops (of the shale and sandstone) are scarce.

The lowest member of the Garden Valley Formation located further upstream of the narrow gap consists of calcareous sandstone, siliceous shales

and cherty limestone. It is in this area that the dam axis is located.

Although no outcrops were noted during the site reconnaissance, a 550-foot (168 m) upper member, stratigraphically above the resistant conglomerate, reportedly exists in the Garden Valley Formation (Roberts and others, 1967). This upper member consists of purple and red shales and conglomerate and would occur downstream of the resistant conglomerate ridge.

Bedding, measured in conglomerate outcrops on both abutments, trends roughly north-south and dips very steeply, 65° to 75° to the east and downstream. Fracturing in the conglomerate is widely spaced, 1 to 5 feet (0.3 to 1.5 m) and consists of both bedding and cross fractures. A few of the surface fractures are open and are probably attributable to stress relief. The finer grained rock units are closely fractured and generally appear tight.

The channel alluvium is about 600 feet (183 m) wide and relatively flat. Exposures along the near-vertical banks of Garden Pass Creek show up to 12 feet (3.7 m) of brown, porous sandy silt to clayey silt with lenses of gravelly sand. This finer unconsolidated material apparently comprises part of the younger alluvium and its lateral extent is defined by the relatively flat flood plain adjoining Garden Pass Creek. Beneath and surrounding the younger alluvium is the older alluvium consisting of relatively permeable mixed gravel, sand, and some silt. Along the dam axis, the depth of alluvium is unknown. However, based on interpretation and correlation of geomorphic features similar to the gap, it is possible that the maximum alluvium thickness is on the order of 150 to 200 feet (46 to 61 m) and that the bedrock surface beneath the alluvium is probably V-shaped.

The impoundment area is underlain largely by both younger and older alluvium; bedrock units of the Garden Valley and Vinini Formation occur at higher elevations.

4.2.2 Foundation Conditions

Based on the topographic and geologic conditions, there are two possible dam alignments in the Garden Pass Creek gap; a downstream alignment across

the resistant conglomerate ridge and an upstream alignment across low bedrock ridges of Vinini and Garden Valley Formation bedrock. The abutments of the downstream alignment are in conglomerate of the Garden Valley Formation which forms bold, steep outcrops, some of which appear detached. The conglomerate is moderately fractured, both along bedding planes and across bedding. Some of these fractures are open on the surface and could be attributed to stress relief. The narrow ridge and the possible existence of open fractures at depth poses a potential seepage path in this area. Furthermore, because of the hard, massive, steep outcrops, foundation shaping and treatment would be necessary and will be difficult.

The abutments of the upstream and recommended alignment, on the other hand, are in low rounded ridges of surface to near-surface bedrock consisting of siliceous shales and carbonaceous sandstones, of the Garden Valley Formation, in contact with quartzites of the Vinini Formation. These units are well-fractured but strong and should adequately support a dam embankment with minimal foundation stripping. Positioning the dam alignment in this area would also increase the potential horizontal seepage path through the entire 3,000-foot (915 m) sequence of the Garden Valley Formation. Bedding trends observed indicate a general north-south strike, with very steep dips ranging from 65° to 75° to the east and downstream. Therefore, preferred seepage paths in a vertical direction parallel to bedding would probably be very steep and deep. Although the rocks are well-fractured, occasional outcrops that were observed during the site reconnaissance indicate tight fractures; this condition is anticipated to persist at depth, but would need to be confirmed by coring and water testing.

In the channel area, the younger silty alluvium is porous and is probably collapsible. If this site is selected, the properties of the alluvium should be investigated and design provision should be made to account for this potentiality. Permeable older alluvium most likely underlies the younger alluvium and the lower protions of the left abutment; provisions should be considered for seepage mitigation measures. As a foundation material, the older alluvium appears to be dense and competent and should adequately support a dam embankment. If this site is selected, subsurface exploration and testing should be performed to verify the strength and permeability of the

older alluvium during design studies.

Groundwater in the channel is shallow. Measurements of water levels in three wells in the alluvium about 1 mile (1.61 km) upstream of the gap indicate depths ranging from 29 to 31 feet (8.8 to 9.5 km) below ground surface.

4.2.3 Environmental Conditions

Site A is crossed by both the Pony Express Trail and an abandoned narrow-gauge railroad grade. There are no perennial streams at the site and Garden Pass Creek was dry at the time of the site visit.

4.3 Alternative Site I (4-B)

4.3.1 Site Geology

Site I (4-B) is located on the alluvial flats in the western portion of Diamond Valley about 7 miles (11.3 km) east of the Mt. Hope mine site (Figure II-1). This alternative disposal site would consist of a ringed dike founded entirely on alluvium. The depth of the alluvium probably attains several hundred feet. Groundwater levels based on groundwater contour elevations developed by Hydro-Search, Inc. (1982), indicate water level depths on the order of 20 to 30 feet (6.1 to 9.2 m). Silt and alkali salts are exposed on the surface. Thickness of alluvium is unknown, although arroyos west of Site I (4-B) show up to 8 feet (2.4 m) of brown porous silty soil. The gravel pits located about 2 miles (3.2 km) southwest of Site I (4-B) are in the gravelly alluvial fan at higher elevations. Wells in Diamond Valley indicate gravel aquifers a few feet from the surface.

4.3.2 Foundation Conditions

A layer of silty material appears to blanket the entire site. This silt is probably both porous and collapsible and therefore require treatment if left in the dam or impoundment foundation.

4.3.3 Environmental Conditions

Site I (4-B) is located on the floor of Diamond Valley. The valley floor in the site area has generally low utility and a high degree of homogeneity. Other parts of Diamond Valley have been developed for agriculture. There are no known cultural resources at the site.

4.4 Alternate Site J (4-C)

4.4.1 Site Geology

Site J (4-C) located on a broad alluvial fan located on the northeastern edge of Kobeh Valley, about 3 miles (4.8 km) south of the Mt. Hope mine site (Figure II-1). The west end of the dam abuts against a ridge of faulted Nevada limestone and quartzites of the Vinini Foundation. Both units probably extend and lie buried beneath the alluvium. The east end of the dam is situated on a ridge of Vinini quartzite. For the most part, the dam alignment is located along a broad, older alluvial fan dissected by several small north-south to northeast trending drainage courses emanating from the foothills south of Mt. Hope. Adjacent to, and along these drainage courses are deposits of younger silty alluvial materials. The coarse older alluvium consists of subangular to subrounded gravels, cobbles, sands, and silts and probably attains maximum thickness of several hundred feet. During the site reconnaissance, two wells were noted about 1.5 to 2 miles (2.4 to 3.2 km) south of Site J (4-C). The wells are estimated to be several hundred feet deep.

4.4.2 Foundation Conditions

The Vinini quartzites and Nevada limestone on the abutment ends of the proposed dam are strong and competent and should provide adequate support for the dam. The coarse alluvium is likewise strong; however, local areas of porous, probably collapsible silty materials are present along drainage courses. These materials will have to be treated or removed from the foundation. Seepage through the coarse alluvium is very likely because of its apparent high permeability.

4.4.3 Environmental Conditions

Site J (4-C) is located in upper Kobeh Valley. There are no identified ephemeral or perennial streams at the site. The site is drained by several dry arroyos. The site area is presently used for grazing. There are no known cultural resources at the site.

4.5 Alternative Site B

4.5.1 Site Geology

Site B is located in the foothills of the Roberts Mountains and extreme northern edge of Kobeh Valley about 4 miles (6.4 km) southwest of the Mt. Hope mine area. The lowest elevation along the dam axis is about 6,470 feet (1,973 m). In order to provide topographic closure, the dam alignment includes a west dam across a relatively narrow bedrock gap and a long east dam across a wide alluvial valley.

The west dam abutments are in Tertiary volcanic rocks that form smooth, rounded slopes with few exposures. The rock units consist of hard, gray andesite and rhyolite. The channel is about 400 feet (122 m) wide with younger silty alluvium adjoining the flat arroyo flood plains and older coarser alluvium at higher elevations.

The left abutment ridge of the west dam forms the right abutment of the east dam, located on the north nose of a northwest-trending linear ridge of Tertiary volcanic rocks rising above the alluvium of Kobeh Valley. The left abutment of the east dam is in low rolling hills. The lower portion of the abutment adjacent to the alluvium is in the Nevada Formation in fault contact with the Vinini Formation which comprises the remainder of the abutment. The Nevada Formation consists of hard, light gray, fractured limestone that occurs as isolated outcrops in the abutment. Some outcrops show overhangs and cavities that could be related to solution of the limestone. The Nevada Formation comprises a relatively narrow strip of the abutment, however it is possible that the limestone extends beneath the alluvium in this area. The Vinini Formation as interpreted from scattered float is

comprised of buff, silceous siltstone and light yellow-brown, fine-grained quartzites.

The alluvium across the east dam is about 8,500 feet (2,593 m) wide and is comprised mostly of older coarser alluvium with intervening relatively narrow bands of younger silty alluvium adjacent to drainage courses dissecting the older alluvium. The maximum thickness of the alluvium is unknown.

The impoundment area is largely underlain by older alluvium with bedrock units of the Vinini Formation, Nevada Formation and Tertiary volcanic rocks exposed at higher elevations.

4.5.2 Foundation Conditions

The west dam abutments are in strong and competent volcanic rocks that occur on or near the surface. The few outcrops observed show hard, moderately fractured andesite. Foundation stripping should be minimal. In the channel area, the younger silty alluvium adjacent to the drainage courses are porous and probably collapsible. If this site is selected, the properties of the alluvium should be investigated and design provision should be made to account for this potentiality. It is very likely that coarse permeable older alluvium exists deeper in the channel. This alluvium is probably very pervious. The depth of the alluvium is not known; however, it could attain maximum thickness on the order of 100 feet (30 m).

The right abutment of the east dam coincides with the left abutment of the west dam and is underlain by Tertiary volcanic rocks, therefore the foundation conditions are similar. On the left abutment, strong competent quartzites of the Vinini Formation underlie the upper part of the abutment. The quartzites are closely fractured. The limestone of the Nevada Formation forms the lower portion of the left abutment and occurs in fault contact with the Vinini Formation. The fault trends northwest and is therefore adverse to the dam axis. The limestone is a strong foundation material. However, solution openings may exist which could provide a seepage path for impounded fluids. Although the limestone is mapped in a relatively small area of the dam alignment and the impoundment area, which would probably allow reasonable

treatment against seepage, it is very likely that it extends beneath the permeable alluvium in the right side of the east dam. The extent of the limestone should therefore be defined if this site is selected as an alternative tailings disposal site.

The other significant concern with respect to seepage potential is the extensive deposit of coarse older alluvium across the channel section of the east dam. It is very likely that the alluvium attains a maximum thickness at least on the order of 200 feet (61 m). Downstream of the left abutment is an active well and windmill. Attempts to measure the water level during the site reconnaissance were unsuccessful; however, the water surface probably occurs at a shallow depth.

4.5.3 Environmental Conditions

Site B is crossed by the Pony Express Trail. There are no perennial streams at the site. An unimproved road from Henderson Summit crosses the site.

4.6 Alternative Site C

4.6.1 Site Geology

Site C is located across the alluvial fan of Henderson Creek on the extreme south end of Garden Valley about 3 miles (4.8 km) north of Mt. Hope. The lowest elevation along the dam alignment is about 6,650 feet (2,028 m). The dam alignment consists of a roughly north-south trending wing across an alluvial fan, then turning west along a broad ridge of older alluvium which forms the left abutment of the dam. The right abutment is on a steep bedrock slope of rhyolite porphyry, which intrudes the Vinini Formation. Henderson Creek, a perennial stream, is located close to the right abutment. Two smaller tributaries dissect the alluvial fan of the north-south dam wing. Except for the right abutment, which is underlain by the rhyolite porphyry, the entire dam alignment and most of the impoundment area is underlain by thick older alluvium.

4.6.2 Foundation Conditions

The rhyolite porphyry in the right abutment is light gray, hard, well-fractured, and occurs on the surface or near-surface. The rock is strong and competent. Because of its fractured nature, it appears to be readily rippable. In the few outcrops observed, fractures appear close and tight, and would probably be tighter at depth.

The older alluvium along the remainder of the dam alignment is a mixture of subangular to subrounded cobbles, gravels, sand and silt. Occasional boulders and caliche-cemented lenses were noted. Vinini Creek, located immediately north of the west segment of the dam, cuts through at least 100 feet (30.5 m) of older alluvium; therefore the maximum thickness of the alluvium may greatly exceed 100 feet (30.5 m). The alluvium is most likely permeable and provisions to control seepage through it should be considered. Porous, probably collapsible silty alluvium occurs locally along drainage courses.

4.6.3 Environmental Conditions

Site C is located across Henderson Creek, a perennial stream. The site has relatively diverse habitat, and relatively high biological and scenic values as a result of this. There are no known cultural resources at the site but the environmental conditions could have encouraged aboriginal occupancy.

4.7 Alternative Site D

4.7.1 Site Geology

Site D is located across a broad valley of Frazier Creek between the western edge of Garden Valley and the southeast foothills of Roberts Mountains; and is about 7 miles (11.3 km) north of the Mt. Hope mine site (Figure II-1). The lowest elevation in the Frazier Creek channel along the dam alignment is at about Elevation 6,440 feet (1,964 m). Most of the dam and impoundment area is in the Vinini Formation. Alluvium is confined to the valley adjacent to

Frazier Creek and smaller drainage courses tributary to Frazier Creek. The Vinini Formation at this site forms low, rolling rounded, smooth hills and slopes. Along the dam alignment, the Vinini Formation consists of gray-brown siliceous shales and fine-grained quarzites. These units are apparently closely fractured, judging from the 1/2 to 2-inch (1.27 to 5.08 cm) angular float fragments on the surface. Probable faults are shown on the geologic map cutting the Vinini near the dam alignment; some of these structures are shown subparallel although others are transverse to the dam axis (Figure II-1). Alluvium along the dam alignment and the impoundment area consists of the younger silty alluvium along the relatively flat flood plains of Frazier Creek and older alluvial fan deposits at slightly higher elevations. The alluvial area is about 3,000 feet (915 M) wide along the dam alignment and its thickness is unknown. Based on interpretation of the geomorphic features in the area, specifically the low ridges of Vinini Formation adjoining the alluvium on both sides of Frazier Creek valley, the alluvium is probably less than 100 feet (30.5 m) thick; however, this should be verified by drilling.

4.7.2 Foundation Conditions

The siliceous shales and quartzites of the Vinini Formation are strong and competent bedrock material and should provide a good foundation material for a proposed dam. Because of its fractured nature, it should lend itself to easy excavation during foundation preparation. Stripping of the foundation should be minimal because of the near-surface occurrence of bedrock. Although the Vinini is closely fractured, as noted in a few outcrops, the fractures appear tight; therefore, it is probable that the gross permeability of this rock unit is low.

As in the other alternative sites, light brown porous, probably collapsible silts, at least 10 feet (3 m) thick, occur along the flood plain of Frazier Creek. If this site is selected, the properties of these material should be investigated, and suitable provision incorporated into the dam design. The older coarse alluvium is most likely permeable and would provide a potential seepage path for impounded fluids.

4.7.3 Environmental Conditions

Site D is located across Frazier Creek, an ephemeral stream. The stream was not flowing at the time of the site reconnaissance (July, 1983) but boggy (subirrigated) areas were noted. There are no known cultural resources at the site.

4.8 Alternative Site E

4.8.1 Site Geology

This alternative tailings disposal site is located within the Sulphur Spring Range about 7 miles (11.3 km) north of the Mt. Hope mine site. Site E would consist of 4 dams; two dams across narrow bedrock gaps on the west side, a dam located on the east side of the south end of the impoundment area, and a saddle dam at Bailey Pass on the north portion and east side of the disposal area (Figure II-1). The west dams would be founded on the resistant, outcropping conglomerate of the Garden Valley Formation similar to the bedrock unit of Site A (4-A). However, at Site E, the bedding dips are moderate, ranging from 30° to 50° to the east and towards the impoundment area. Bold, steep outcrops of hard, pebble conglomerate occur on the abutments of the west dams. The southern west dam has a relatively narrow channel and bedrock is probably shallow. The channel on the north dam is about 150 to 200 feet (45.8 to 61 m) wide and is underlain by coarse alluvium that is probably at least 50 feet (15.3 m) in maximum depth.

The east dam at the south end of the reservoir is across a relatively broader canyon in Nevada Formation limestone. The left abutment is steep with scattered outcrops of well-fractured, gray limestone. The right abutment consists of moderately sloping, rounded ridges of limestone. The channel alluvium at this site is about 300 feet (91.5 m) wide and consists of mixed gravels, sands and silts of unknown thickness. The saddle dam at Baily Pass is in faulted Lone Mountain Dolomite, with probably a sliver of Nevada Formation Limestone.

The impoundment area is a narrow, north-south trending linear valley. For the most part, it is underlain by bedrock units of the Garden Valley Formation with a cover of alluvium. The Garden Valley Formation is in fault contact with the Nevada Limestone and Lone Mountain Dolomite along the east portion of the impoundment area. This fault is a major north-south trending structure that is traceable for several miles along the Sulphur Spring Range and passes parallel to and upstream of the east dam alignment. On the north and east side of the impoundment area near Bailey Pass, several faults branching off this major north-south fault are shown cutting the Lone Mountain Dolomite and Nevada limestone. The soluble nature of the limestone bedrock, as well as the deformation (fracturing and crushing due to faulting) of the bedrock units, poses a potential area of seepage in this vicinity.

4.8.2 Foundation Conditions

The abutments of the west dams are in the strong, resistant conglomerate that should provide adequate support for dam embankments. The bold, steep outcrops, some of which show open fractures on the surface and appear detached, would have to be shaped or excavated and removed as part of foundation preparation. It is anticipated that foundation excavation would be difficult because of the hard and massive nature of the conglomerate. Because of the relatively shallow thickness of the channel alluvial materials compared to the other sites, it appears possible to provide a seepage cut-off through the alluvium.

The Nevada limestone comprises the bedrock unit underlying the east dam. It is strong and competent and should provide adequate dam support. The potential for seepage through the untreated limestone foundation is probably high. The permeable, coarse alluvium of unknown thickness underlies the channel and control of seepage through the alluvium, if left in-place, should also be considered. The saddle dam at Bailey Pass is mostly in competent Lone Mountain Dolomite. The mapped faults cutting the dam axis could pose potential seepage paths in the dam foundation.

4.8.3 Environmental Conditions

There are no known cultural resources at the site. However, several mineral exploration adits and pits were noted during the site reconnaissance.

There are relatively diverse habitats at the site because of the variety of terrain. There are no identified streams onsite and no surface water was noted during the site reconnaissance.

4.9 Alternative Site F

4.9.1 Site Geology

Site F is located across perennial-flowing Roberts Creek at a point where it enters Kobeh Valley. The dam alignment follows a series of bedrock ridges with intervening valleys and saddles. Pertinent bedrock units along the dam alignment include the limestone of the Nevada Formation on both abutments and Tertiary volcanic rocks in the left abutment adjacent to Roberts Creek and on the east end of the left abutment. During the site reconnaissance, an area of reddish-brown chert (probably Vinini Formation) was noted on the lower part of the right abutment in an area mapped as Nevada Formation limestone by Roberts and others (1967). The Vinini Formation is in contact with the Nevada limestone; however, their contact relationship is not known. The Tertiary volcanic rocks on the upper left abutment is shown on the geologic map in fault contact with the Nevada Formation with the fault trending tranverse to the dam axis. The valley of Roberts Creek and tributary valleys are underlain by younger silty alluvium and older coarse alluvium.

4.9.2 Foundation Conditions

The Nevada limestone, Tertiary volcanic and Vinini chert occur on or near surface. Those rock units are strong and competent and should provide good dam foundation material with minimal stripping. The volcanic rocks are closely fractured and are probably relatively tight. The limestone may be potentially permeable due to the possible presence of solution cavities. The fault contacts between the volcanic rocks and limestone trend adversely in

relation to the dam axis and are therefore potential seepage paths through the dam foundation.

Alluvium occurs in two sections of the dam alignment; in the valley of Roberts Creek and in an alluvial fan on the east portion of the dam. Along Roberts Creek, a 12-foot (3.7 M) high bank of light brown silt with lenses of gravel is exposed. This young alluvium is porous and probably collapsible. The maximum thickness of alluvium is unknown; however, it is estimated to be less than 100 feet (30.5 m) thick. Permeable granular material probably exist in the alluvium which, if untreated, would provide a potential seepage path through the dam foundation.

4.9.3 Environmental Conditions

Site F is located across Roberts Creek, a perennial stream. The site has diverse habitat, varied terrain, and relatively high biological values, and recreation potential. There is evidence of past mining on the northwestern part of the site. A dirt road leading to a summer camp and a wilderness study area passes through the site.

4.10 Alternative Site G

4.10.1 Site Geology

Site G damsite is located across a bedrock constriction of Vinini Creek about 6 miles north-northeast of the Mt. Hope mine site. The lowest point in the Vinini Creek channel along the dam alignment is at approximately Elevation 7,020 feet (2,141 m). Bedrock in the impoundment area consists entirely of the quartzites, cherts, and carbonaceous sandstones and siliceous shales of the Vinini Formation. Along the dam alignment on the right abutment, quartz latite is exposed and is probably part of the Tertiary volcanic rocks. In the central portion of the impoundment area is older alluvium that underlies a broad confined valley. Younger silty alluvium is found along the flood plains of Vinini Creek.

4.10.2 Foundation Conditions

The right abutment is on a steep slope underlain by surface to near surface volcanic rock consisting of light-gray, hard, quartz latite. Outcrops show a jointed, very hard rock that would probably be difficult to rip for excavation. The closely spaced fractures appear tight on the surface and are anticipated to be tight at depth. Outcrops were not observed on the left abutment; however floats of sandstone, chert, breccia, and volcanic rocks suggest that this abutment is underlain by bedrock both of the Vinini Formation and Tertiary volcanics. Bedrock is probably shallow, on the order of a few feet deep. The permeability of both the Vinini Formation and Tertiary volcanics is probably low.

The channel is about 150 to 200 feet (46 to 61 m) wide. Porous silty alluvium is exposed on 10-foot-high (3 m) vertical banks. This material is probably collapsible. Coarse permeable alluvium probably underlies the younger silty alluvium; however, its maximum thickness is unknown. It is possible that a buried incised channel exists beneath the alluvium.

4.10.3 Environmental Conditions

Site G is located across Vinini Creek, which may be a perennial stream in the site area. The site has relatively diverse habitat because of the availability of water. There are no known cultural resources at the site.

4.11 Alternative Site H

4.11.1 Site Geology

Site H is located in the upper part of Roberts Creek and upstream of Site F. The dam is across a steep, narrow canyon of Devils Gate limestone. The bottom of the canyon is at an elevation of approximately 7,000 feet (2,135 m). The left abutment ridge is underlain by quartzites of the Vinini Formation. The Vinini Formation is in thrust fault contact with the limestone, with the thrust fault crossing the dam axis in the upper part of the left abutment. Bold, steep, outcrops with occasional overhangs of bedded,

gray limestone exist in both abutments of the main dam. Cavities in the limestone are common and are probably related to solution of the limestone. Bedding in the limestone, where noted on the left abutment, trends N40W and dips 40° to NE. Close to the thrust fault, the limestone is well-fractured. The channel of Roberts Creek along the alignment is about 50 feet (15 m) wide. Water was flowing along the Roberts Creek during the time of our site reconnaissance. The thickness of the alluvium is unknown and the possibility of a deep, incised bedrock channel exists at this site.

4.11.2 Foundation Conditions

Both the Vinini quartzites and Devils Gate limestone are competent foundation materials that occur on or near the surface. Foundation shaping of the limestone outcrops, especially on the right abutment, will be difficult because of very steep, irregular exposures and the hardness of the rock. The potential for seepage through solution openings in the limestone and through the thrust fault zone will probably require considerable treatment to cut-off seepage in the dam foundation. The channel alluvium is probably also permeable and may bury a deep, incised channel. Groundwater appears to be shallow and will most likely impact foundation preparation.

4.11.3 Environmental Conditions

Site H is located across Roberts Creek, a perennial stream. Because of this and the varied terrain, there are diverse habitats on and adjacent to the site. It is also adjacent to a wilderness study area and a road to this area passes through the site. There are no known cultural resources at the site.

5.0 Tailings Disposal Alternatives

5.1 Introduction

The proposed Mt. Hope mill will produce approximately 11.55 million tons (10.5 million Mt) of tailings per year (350 operating days per year) during the 30-year project life. Thus, approximately 331 million tons (300

million Mt) of tailings will be produced during the life of the project.

Initially, ten alternative disposal sites were identified; these sites are shown on Figure II-1. However, capacity computations for one of the sites, Site G, indicated that this site had capacity for only about 1/2 of the tailings. This site did not have any significant apparent advantages over other sites under consideration, therefore, Site G was dropped from further consideration.

Alternative disposal methods were considered for the project. These alternatives included tailings disposal behind zoned earthfill embankments and disposal behind cycloned tailings embankments constructed by either the upstream, centerline or downstream method. Initial tailings characterization studies indicated that the tailings would be a sandy silt with about 50 to 60 percent finer than the No.200 sieve. Therefore, it appears that the tailings would be suitable for cycloning and tailings dam construction. The total quantity of tailings to be produced--331 million tons (300 million Mt) is very large, thus requiring relatively large retention embankments for the nine alternative sites. Because of the large retention embankments required, with the corresponding earthwork quantities and associated large costs, and because the tailings material appeared suitable for dam construction, earthfill tailings retention dam alternatives were dropped from further consideration.

Construction of tailings dams, using the upstream construction method, can allow for reclamation and vegetation of the dam downstream slope during disposal operations. This construction method also requires less tailings management (moving of cyclones and discharge points) during disposal operations. However, the tailings dams for the 9 alternative sites under study are relatively high, between about 79 and 433 feet (24.1 and 132.1 m) high. Construction of tailings dams by the upstream method to these heights is not considered to be good engineering practice, because as the height of the dam increases, the dam is eventually founded over weak, unstable tailings slimes material. In addition, the upstream method of construction results in a higher phreatic surface near the downstream slope of the dam. This condition can be detrimental to static stability. It also increases the liquefaction

potential of the embankment if subjected to earthquake loadings. Therefore, the upstream method of construction was dropped from consideration.

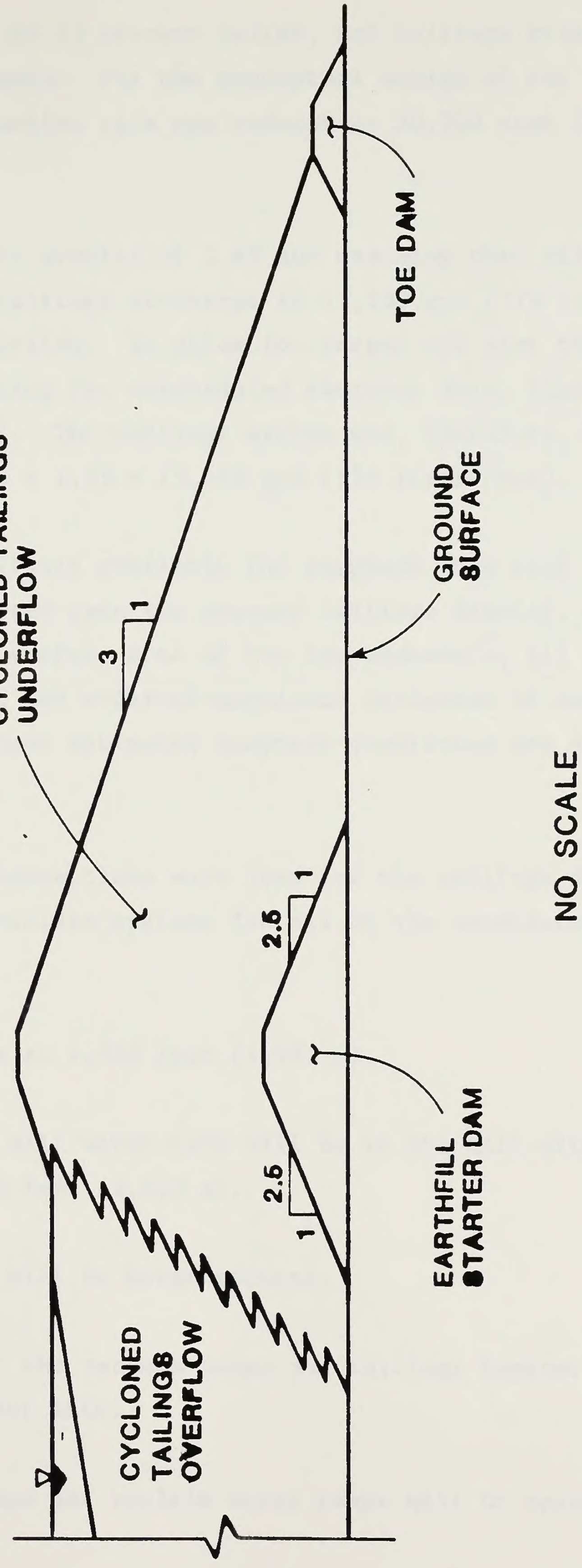
Both the centerline and downstream methods of tailings dam construction, when the dams are properly designed and constructed, are suitable methods of tailings disposal using high embankments. However, the downstream method of construction requires a larger quantity of tailings sand for embankment construction and more intensive tailings management for dam construction. Because of this, and since using a downstream construction method would have no significant advantages for the Mt. Hope Project, the centerline method of tailings dam construction was selected for consideration for the nine alternative tailings disposal sites. A typical section of centerline method tailings embankment is shown on Figure V-1.

5.2 Tailings Quantities, Disposal Facility and Tailings Transport Sizing Criteria

The initial characterization studies on the tailings indicated that the material would be a fine sandy silt with about 60 percent passing the No. 200 sieve and with a specific gravity of the solids of 2.65. Based upon this preliminary information, and the results of laboratory testing and in-situ densities for similar tailings materials, a dry density of 80 pounds per-cubic-foot (1,281 kg/m^3) was assumed for the deposited tailings material for the sizing of the alternatives. Using this dry density, approximtely 190,000 acre-feet (2.34×10^8 m^3) of storage will be required for the 331 million tons (300 million Mt) of tailings produced during the project life. Subsequent to the completion of the alternative site selection studies, more detailed laboratory test data on tailings properties was received. This data was used for conceptual designs of the identified two best alternatives.

For the comparison of alternatives, it was assumed that the starter dams would be sized to provide 6,650 acre-feet (8.2 million m^3) of storage. This would be equivalent to one year of tailings production.

The tailings transport facilities for the nine alternatives were sized, based upon daily tonnage of 33,000 (30,000 Mt), 2.65 solids specific



MT. HOPE MOLYBDENUM PROJECT

TYPICAL TAILINGS EMBANKMENT SECTIONS

gravity, tailings pulp at 35 percent solids, and tailings grind with 60 percent minus No. 200 mesh. For the conceptual design of the two selected alternatives, the production rate was reduced to 30,000 tons (27,210 Mt) of ore per day.

Using a specific gravity of 2.65 and assuming that all ore is wasted as tailings, then the tailings discharge is 12,350 gpm (779 l/sec) at a density of 35 percent solids. To allow for surges and give the plant the capability of compensating for unscheduled shutdown days, this number was increased by 25 percent. The tailings system was, therefore, sized for a slurry volume of 12,350 x 1.25 = 15,440 gpm (974 liters/sec).

The amount of liquid available for pumpback from each of the disposal sites was estimated, based upon the assumed tailings density, rainfall inputs, the drainage area, and surface area of the impoundements, all of which impact runoff and evaporation, and order-of-magnitude estimates of seepage losses for the facilities. These estimated pumpback quantities are shown in Table V-1.

The following assumptions were used for the tailings distribution systems and the water reclaim systems for all of the candidate sites under investigation.

- Plant site elevation at 6,500 feet (1,982 m).
- An adequately sized mill water tank will be at the mill site with high water level at 6,630 feet (2,022 m).
- Reclaim water pumps will be barge-mounted.
- Electrical power for the reclaim pumps and tailings booster pumps will originate at the plant site.
- Tailings booster pumps and reclaim water pumps will be operated from the mill control room.

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Table V-1 Estimated Quantities of Reclaim Water Pump-Back

Alternative	Reclaim Water Pump-Back gpm (lps)
A (4-A)	3,500 (220.9)
B	2,500 (157.8)
C	4,000 (252.4)
D	4,500 (283.9)
E	4,000 (252.4)
F	5,000 (315.5)
H	5,000 (315.5)
I (4-B)	1,500 (94.7)
J (4-C)	3,000 (189.3)

- Velocity of slurry for both gravity and pumped lines will be in the range of 4.5 FPS to 7.5 FPS (1.4 to 2.3 m/s).

- Tailings lines will terminate in cyclones on the certerline of the tailings dam. Cyclones will be approximately 10 feet (3 m) above the crest of the dam and will be spaced at 100-foot (30.5 m) intervals along the dam.

- It is assumed that the plant electrical distribution will be at 4.16 KV so that the pumps at the plant site will be powered directly from the distribution system. A 13.8 KV pole line system will be installed along the tailings line to provide power for the tailings booster pumps and the reclaim pumps at the dam. The remote booster station and reclaim pumps will be operated from the mill control room by means of a programmable controller, utilizing telephone lines supported on the electrical pole line.

- For slurry pumping, horizontal centrifugal, high efficiency, high-pressure slurry pumps, Warman 12/10 TAHP with 600 psig case pressure rating, or equal, were assumed.

- For reclaim water pumping, Goulds barge-mounted, close-coupled, multi-stage turbine pumps, or equal, were assumed.

- For pumped slurry lines, Ameron concrete cylinder pipe, 300 psi (2,068 kpa) rating, was assumed.

- For gravity slurry lines, Ameron reinforced concrete pipe was assumed.

- For pumped reclaim lines, Schedule 40 carbon steel pipe was assumed.

Significant quantitative data for the nine alternatives are summarized in Table V-2. The alternatives are described in more detail in the following sections.

Table V-2 Significant Quantitative Data - Tailings Disposal Alternatives

ALTERNATIVES: Location	A (4-A)	B	C	D	E	F	H	I	J (4-C)
	Garden Pass Creek	Upper Kobeh Creek	Henderson Creek	Frazier Creek	Sulphur Springs	Lower Roberts Creek	Upper Roberts Creek	Diamond Valley	Upper Kobeh Valley
Lineal Distance from Preferred Mill Site - miles - (km)	2.1 (3.4)	5.2 (8.4)	4.8 (7.7)	7.7 (12.4)	6.8 (10.9)	7.2 (11.6)	8.1 (13.0)	6.3 (10.1)	3.6 (5.8)
Drainage Area - acres - (ha)	12,352 (5003)	9,088 (3681)	7,808 (3162)	4,352 (1763)	2,816 (1140)	14,784 (5988)	8,256 (3344)	2,560 (1037)	4,608 (1866)
Starter Dam Crest Elevation - Ft - (m)	6,148 (1875)	6,544 (1996)	6,753 (2060)	6,550 (1998)	6,657 (2030)	6,746 (2058)	7,160 (2184)	5,864 (1789)	6,455 (1969)
Starter Dam Height - Ft - (m)	83 (25.3)	72 (22.0)	105 (32.0)	113 (34.5)	153 (46.7)	73 (22.3)	160 (48.8)	21 (6.4)	58 (17.7)
Starter Dam Volume million yd^3 million (m^3)	1.06 (0.81)	0.58 (0.44)	2.37 (1.81)	2.19 (1.67)	1.93 (1.48)	0.37 (0.28)	0.77 (0.59)	1.00 (0.76)	1.49 (1.14)
Ultimate Dam Crest Elevation - Ft - (m)	6,351 (1937)	6,705 (2045)	7,004 (2136)	6,814 (2087)	6,882 (2099)	6,974 (2127)	7,433 (2267)	5,922 (1806)	6,615 (2018)
Ultimate Dam Height - Ft - (m)	286 (87.2)	233 (71.1)	356 (108.6)	377 (115.0)	378 (115.3)	301 (91.8)	433 (132.1)	79 (24.1)	218 (66.5)
Ultimate Dam Volume million yd^3 million (m^3)	32.1 (24.5)	46.7 (35.7)	73.4 (56.1)	82.3 (62.9)	85.9 (65.7)	47.8 (36.5)	64.0 (48.9)	30.6 (23.4)	89.1 (68.1)
Tailings Conveyance Type of Flow	Gravity	Pumped	Pumped	Pumped	Pumped	Pumped	Pumped	Gravity	Pumped
Length of Tailings Line - mi - (km)	4.4 (7.1)	6.5 (10.5)	8.0 (12.9)	11.2 (18.0)	10.5 (16.9)	10.3 (16.6)	14.5 (23.3)	15.0 (24.2)	7.5 (12.1)
Tailings Conveyance Lift - Ft - (m)	-300* (91.5)	350 (106.8)	550 (167.8)	350 (106.8)	350 (106.8)	500 (152.5)	900 (274.5)	-580* (176.9)	100 (30.5)

*Drop

Table V-2 Significant Quantitative Data - Tailings Disposal Alternatives (continued)

ALTERNATIVES:	A (4-A)	B	C	D	E	F	H	I (4-B)	J (4-C)
Location	Garden Pass Creek	Upper Kobeh Creek	Henderson Creek	Frazier Creek	Sulphur Springs	Lower Roberts Creek	Upper Roberts Creek	Diamond Valley	Upper Kobeh Valley
Number and Diameter of Tailings Line(s) - in. - (cm)	1ea. 30 (76.2)	2ea. 20 (50.8)	2ea. 20 (50.8)	2ea. 20 (50.8)	2ea. 20 (50.8)	2ea. 20 (50.8)	2ea. 20 (50.8)	1ea. 36 (91.4)	2ea. 20 (50.8)
Pumps Required for Tailings Conveyance	None	2 sets of 3 pumps ea. w/500 HP (372.9 KW) motors	4 sets of 2 pumps ea. w/500 HP (372.9 KW) motors	4 sets of 2 pumps ea. w/500 HP (372.9 KW) motors	4 sets of 2 pumps ea. w/500 HP (372.9 KW) motors	4 sets of 3 pumps ea. w/500 HP (372.9 KW) motors	8 sets of 2 pumps ea. w/600 HP (447.4 KW) motors	None	2 sets of 2 pumps ea. w/600 HP (447.4 KW) motors
Number of Tailings Cyclones	20	30	30	30	40	20	20	40	40
Reclaim Water Return Type of Flow	Pumped	Pumped	Pumped	Pumped	Pumped	Pumped	Pumped	Pumped	Pumped
Reclaim Water Return Line Length - mi - (km)	3.7 (6.0)	5.5 (8.9)	7.0 (11.3)	10.3 (16.6)	10.3 (16.6)	9.5 (15.3)	14.0 (22.5)	8.0 (12.9)	5.3 (8.5)
Reclaim Water Return Line Diameter - in. - (cm)	12 (30.5)	12 (30.5)	16 (40.6)	16 (40.6)	16 (40.6)	16 (40.6)	16 (40.6)	10 (25.4)	14 (35.6)
Pumps Required for Reclaim Water Return	Turbine w/11 stages and 1000 HP (745.7 KW) motor	Turbine w/8 stages and 600 HP (447.4 KW) motor	Turbine w/ 1 stage & 250 HP (186.4 KW) motor	Turbine w/ 5 stages & 1000 HP (745.7 KW) motor	Turbine w/ 3 stages & 600 HP (447.4 KW) motor	Turbine w/ 4 stages & 800 HP (596.6 KW) motor	Turbine w/ 3 stages & 500 HP (372.9 KW) motor	Turbine w/ 5 stages & 700 HP (522.0 KW) motor	Turbine w/3 stages & 600 HP (447.4 KW) motor
Access Road Length - mi - (km)	3.2 (5.2)	3.8 (6.1)	6.0 (9.7)	9.3 (15.0)	10.0 (16.1)	8.5 (13.7)	13.7 (22.1)	7.0 (11.3)	3.6 (5.8)
Number of Access Road Drainage Structures Required	6	6	17	9	0	14	20	2	2

Table V-2 Significant Quantitative Data - Tailings Disposal Alternatives (continued)

ALTERNATIVES: Location	A (4-A)	B	C	D	E	F	H	I (4-B)	J (4-C)
	Garden Pass Creek	Upper Kobeh Creek	Henderson Creek	Frazier Creek	Sulphur Springs	Lower Roberts Creek	Upper Roberts Creek	Diamond Valley	Upper Kobeh Valley
Power Line Length									
- mi.	3.7	5.5	7.0	10.3	10.3	9.5	14.0	8.0	5.3
- (km)	(6.0)	(8.9)	(11.3)	(16.6)	(16.6)	(15.3)	(22.5)	(12.9)	(8.5)
Power Line Capacity and Voltage	1500 KVA 13.8 KV	1000 KVA 13.8 KV	3750 KVA 13.8 KV	3750 KVA 13.8 KV	3750 KVA 13.8 KV	5000 KVA 13.8 KV	10,000 KVA 13.8 KV	1500 KVA 13.8 KV	1500 KVA 13.8 KV

NOTES:

1. Data is presented in English units with metric equivalents shown in parenthesis.

2. Alternatives B and E required more than one starter dam. The starter dam and ultimate dam heights for these alternatives are for the highest dam. The starter dam and ultimate dam volumes are for the combined embankment volume for the dams.

5.3 Alternative A (4-A)

This alternative would utilize a cycloned sand tailings embankment located about 2,000 feet (610 meters) upstream of the narrow gap in the Sulphur Spring Range. The location of this site is shown on Figure III-1, and a typical tailings embankment section is shown on Figure V-1. This alternative site is located adjacent to, and downstream of the preferred mill site.

Initially, an earthfill starter dam would be constructed to elevation 6,148 feet (1875 meters). The starter dam would be 83 feet (25.3 meters) high and would contain 1.06 million cubic yards (0.81 million cubic meters) of material. The starter dam would have a 30-foot (9.1 m) crest width and 2.5:1 slopes. The ultimate tailings dam would have a crest elevation of 6,351 feet (1,937 meters).

This alternative would have a relatively large drainage area, 19.3 square miles (50.0 square Km). However, diversion facilities could be provided to direct runoff around the impoundment. Since the site is located lower than the preferred mill site, tailings transport could be by gravity flow.

The channel area of the dam axis and much of the impoundment area is underlain by alluvial material of undetermined depths. The younger silty alluvium is porous and appears collapsible. Permeable older alluvium probably underlies the younger alluvium. Thus, the site has a relatively high seepage potential, but is amenable to seepage mitigation measures. These measures could include seepage interceptor wells located downstream of the dam axis, impoundement blanketing with the silty younger alluvium, and selective tailings management techniques in order to utilize tailings slimes as a "lining".

Utilization of this site would require abandonment of approximately 2 miles (3.2 km) of paved state highway. About 5 miles (8.05 km) of new highway would be required to bypass the impoundement.

5.4 Alternative I (4-B)

Alternative I (4-B) is located in the alluvial flats in the western part of Diamond Valley about 7 miles (11.3 km) east of the Mt. Hope Mine site. The disposal facility for this alternative would consist of a large ring dike impoundment, ultimately having an impoundment area of 4 square miles (10.4 square km). The initial earthfill starter dike for this alternative would be 21 feet (6.4 m) high, 3 miles (4.8 km) long, and require about 1.0 million cubic yards (0.76 million cubic meters) of material. The ultimate tailings dam would have a crest elevation of 5,922 feet (1806 m).

For this alternative, the tailings dam and impoundment would be founded on silty alluvium in Diamond Valley. The silty alluvium is porous and probably collapsible. Alluvial gravel aquifers reportedly underlie the silty alluvium at relatively shallow depths. Seepage mitigation measures, if needed, could include impoundment lining and selective tailings management, in order to utilize tailings slimes as a lining.

Since Alternative I (4-B) is a ring dike scheme, the impoundment has essentially no contributory drainage area.

Site I (4-B) is located down-gradient from the preferred mill site. Tailings transport for this alternative would be by gravity with reclaim water return requiring pumping.

5.5 Alternative J (4-C)

Alternative J (4-C) is located in Upper Kobey Valley, about 4 miles (6.4 km) south of the proposed Mt. Hope Mine. The initial starter dam for this alternative would be constructed to elevation 6,455 feet (1,969 m). The starter dam would be 58 feet (17.7 m) high and contain about 1.49 million cubic yards (1.14 million cubic meters) of material. The ultimate tailings dam would have a crest elevation of 6,615 feet (2,018 m).

The foundation for the dam would consist of Vinini Formation quartzites, Nevada Formation limestone, and older and younger alluvium. The foundation

of the majority of the dam will consist of a broad expanse of coarse, probably deep, pervious older alluvium. Along the drainage courses, porous, possibly collapsible alluvium exists. Seepage potential at the site is high because of the coarse alluvium and the fault contact of the Nevada limestone and Vinini quartzites on the dam's right abutment. Seepage mitigation methods, if needed, could include impoundment lining and selective tailings management techniques to utilize tailings slimes as a lining.

Site J (4-C) has a relatively small drainage area, 7.2 square miles (18.6 square km). Diversion channels can be utilized to direct storm runoff around the site.

Because of the location of Site J (4-C), with respect to the preferred mill site, both tailings transport and reclaim water return would require pumping.

5.6 Alternative B

This alternative is located at the extreme northern edge of Kobeh Valley about 4 miles (6.4 km) southwest of the Mt. Hope Mine area. The initial starter dam for this alternative would be constructed to elevation 6,544 feet (1,996 m), it would be 72 feet (22 m) high, and contain approximately 0.58 million cubic yards (0.44 million cubic meters) of material. The tailings dam would have an ultimate crest elevation of 6,705 feet (2,045 m) and would be 233 feet (71.1 m) high. Two dams, with a total ultimate length of about 12,400 feet (3,782 m), would be required for the site.

Seepage potential at Site B is relatively high because of extensive deep alluvial deposits and the existence of the Nevada Limestone on one of the dam's abutments. Seepage mitigation methods, if needed, could include impoundment lining and selective tailings management to utilize tailings slimes as a "lining". The dam's foundation is also underlain by porous, possibly collapsible alluvium in the channel area.

Site B has a moderately large drainage area, 14.2 square miles (36.8 square km). Storm runoff can be diverted around the tailings impoundment

with diversion channels. The location of the site would require pumping for both tailngs conveyance and the reclaim water system.

This alternative would inundate about 2.3 miles (3.7 km) of existing gravel road. Approximately 5 miles (8.1 km) of new road would be required to bypass the impoundment.

5.7 Alternative C

Alternative C, as shown on Figure III-1, is located approximately 3.0 miles (4.83 km) northwest of the proposed Mt. Hope Mine area, across upper Henderson Creek. The initial starter dam for this alternative would be constructed to elevation 6,753 feet (2060 m). The starter dam would be 105 feet (32.0 m) high and contain about 2.37 million cubic yards (1.81 million cubic meters) of material. The ultimate tailings dam would have a crest elevation of 7,004 feet (2,136 meters).

Except for the right abutment, which is underlain by the rhyolite porphyry, the entire dam alignment and most of the impoundment area is underlain by thick pervious older alluvium. Seepage mitigation techniques, if needed, could include impoundment lining and selective tailings management operations, in order to utilize tailings slimes as a "lining".

Porous, possibly collapsible silty alluvium occurs locally along drainage courses at the site.

Site C has a moderately large drainage area, 12.2 square miles (31.6 square km). Diversion channels can be utilized to direct storm runoff around the impoundment.

This alternative would inundate about 2 miles (3.2 km) of gravel road. About 10 miles (16.1 km) of road would be required to by-pass the impoundment.

5.8 Alternative D

Alternative D, shown on Figure III-1, is located approximately 6.7 miles (10.8 km) north of the proposed Mt. Hope Mine, across Frazier Creek. The initial starter dam for this alternative would be constructed to elevation 6,550 feet (1,998 m). The starter dam would be 113 feet (34.5 m) high and contain about 2.19 million cubic yards (1.67 million cubic meters) of material. The ultimate tailings dam would have a crest elevation of 6,814 feet (2,087 m).

Foundation for the tailings dam would consist of the siliceous shales and quartzites of the Vinini Formation and both older and younger alluvium. The older alluvium appears to be quite pervious. The younger alluvium along the drainage courses is probably collapsible. Seepage mitigation techniques, if needed, could include impoundment lining and selective tailings discharge operations in order to utilize tailings slimes as a "lining".

Site D has a relatively small drainage area, 6.8 square miles (17.6 square km). Diversion channels can be utilized to direct storm runoff around the site.

Because of the location of Site D with respect to the preferred mill site, both tailngs transport and reclaim water return would require pumping.

5.9 Alternative E

Alternative Site E, as shown on Figure III-1, is located in a narrow valley within the Sulphur Springs Range about 7 miles (11.3 km) north of the Mt. Hope Mine site. This alternative would require four dams to provide storage for the tailings produced by the proposed mill. Three initial starter dams would be required for this alternative. The starter dams, constructed to elevation 6,657 (2030 m) would be 37, 105, and 153 feet (11.3, 32, and 46.7 m) high and contain a total of about 1.93 million cubic yards (1.48 million cubic meters) of material.

Foundation conditions at Site E appear relatively good, compared to the other sites under consideration. Three of the dams could be founded on

rock with only limited excavation. The fourth dam could be founded on alluvium that would have a maximum thickness on the order of 50 feet (15.3 m). Shaping of the rock abutments would be required at the four tailings dam sites. The east dam would be founded on Nevada Limestone, which could have a high seepage potential. The relatively shallow bedrock at the site would make seepage cutoffs and rock foundation treatment feasible for seepage mitigation, if necessary.

Site E has a very small drainage area, 4.4 square miles (11.4 square km). Most of the drainage area is occupied by the tailings impoundment itself.

Because of the location of the Site with respect to the preferred mill site shown on Figure III-1, both tailings transport and reclaim water return would require pumping.

This alternative would inundate about 3.5 miles of dirt road within the valley. These roads would most likely be abandoned.

5.10 Alternative F

Alternative F is located across Roberts Creek, at the point where it enters Upper Kobeh Valley. This alternative site is located approximately 6 miles (9.7 km) west of the proposed Mt. Hope Mine. The initial starter dam for this alternative would be constructed to elevation 6,746 feet (2,058 M). The starter dam would be 73 feet (22.3 m) high and contain about 0.37 million cubic yards (0.28 million cubic meters) of material. The ultimate tailings dam would have a crest elevation of 6,974 feet (2,127 m).

The foundation for most of the tailings dam would consist of limestone, Tertiary volcanics and chert. These rock units should provide an adequate foundation for the dam. The limestone may be permeable, due to the possible present of solution cavities. Alluvial materials exist in the valley of Roberts Creek and an alluvial fan on the left abutment (east) side of the dam axis. The younger alluvium along Roberts Creek is porous and may be collapsible. It is anticipated that some of the material will be quite

pervious. Seepage mitigation measures, if needed, could include impoundment lining and selective tailings discharge operations, in order to utilize tailings slimes as a "lining".

Site F has a large drainage area, 23.1 square miles (59.8 square km). The steep and rugged terrain at and around the site would make construction of diversion channels difficult and expensive.

Because of the location of Site F with respect to the preferred mill site, both tailngs transport and reclaim water return would require pumping.

About 2.5 miles (4.0 km) of dirt road would be inundated by the tailings impoundment. The steep and rugged terrain would make road relocation difficult.

5.11 Alternative H

Alternative H is located in the upper part of Roberts Creek about 7 miles (11.3 km) from the proposed Mt. Hope Mine site. The initial starter dam for this alternative would be constructed to elevation 6,160 feet (2,184 m). The starter dam would be 160 feet (48.8 m) high and contain 0.77 million cubic yards (0.59 million cubic meters) of material. The ultimate tailings dam would have a crest elevation of 7,433 feet (2,267 m).

The foundation for the dam would consist of Devils Gate limestone and Vinini Formation quartzites. The quartzites are in fault contact with the limestone. The dam's right abutment is very steep, with occasional overhangs. Foundation shaping will be difficult because of the hardness of the rock. The channel of Roberts Creek is very narrow, with a maximum width of about 50 feet (15.3 m) in the dam axis area. The depth of alluvium in this channel is unknown, but a very deep, incised buried channel could exist. Seepage potential through solution openings in the limestone, through the thrust fault zone in the left abutment, and through the alluvium in the channel area should be considered high. Seepage mitigation measures, if needed, could include excavation of a cutoff in the channel area and pressure grouting. The terrain at the site would make impoundment lining difficult.

Site H has a relatively large drainage area, 12.9 square miles (33.4 square km). The steep and rugged terrain at the site would make diversion channel construction difficult and expensive.

Because of the location of Site H with respect to the preferred mill site, both tailings tranport and reclaim water return would require pumping.

About 1.2 miles (1.9 km) of dirt road would be inundated by the tailings with this alternative. The steep and rugged terrain would make road relocation difficult.

6.0 Evaluation and Comparison of Tailings Disposal Alternatives

6.1 General

Nine tailings disposal alternatives were evaluated for the Mt. Hope project. To aid in the evaluation and comparison of these alternatives and the selection of the two best alternatives for further study, the alternatives were compared using both quantitative data and qualitative assessments. Using the developed information, the alternatives were compared and rated using a matrix approach.

The quantitative data; starter dam quantities, drainage areas and distances from the preferred millsite were computed using USGS topographic quad sheets. Sizing of facilities, starter dams, tailings conveyance and reclaim water pumpback, and access roads were based upon the design criteria and assumptions stated in Section 5.0. Geologic, hydrologic, and land use, and environmental assessments were made based upon the available data and a brief site reconnaissance.

The alternatives were evaluated under five major considerations; Capital Costs, Operating Costs, Technical Considerations, Environmental Considerations, and Land Use Considerations. The rating matrix and evaluation criteria are described and discussed in the following (Table VI-1).

Mt. Hope Molybdenum Project

Table VI-1, Alternative Site Unit Costs

ITEM	Site A	Site B	Site C	Site D	Site E	Site F	Site H	Site I	Site J
Starter Embankment	$2.50/m^3$ ($1.91/yd^3$)	$2.50/m^3$ ($1.91/yd^3$)	$2.50/m^3$ ($1.91/yd^3$)	$2.50/m^3$ ($1.91/yd^3$)	$3.00/m^3$ ($2.29/yd^3$)	$2.75/m^3$ ($2.10/yd^3$)	$3.25/m^3$ ($2.48/yd^3$)	$2.50m^3$ ($1.91/yd^3$)	$2.50/m^3$ ($1.91/yd^3$)
Foundation Preparation	$3.50/m^2$ ($2.93/yd^2$)	$3.00/m^2$ ($2.51/yd^2$)	$3.00/m^2$ ($2.51/yd^2$)	$3.00/m^2$ ($2.51/yd^2$)	$4.00/m^2$ ($3.34/yd^2$)	$4.00/m^2$ ($3.34/yd^2$)	$5.00/m^2$ ($4.18/yd^2$)	$2.50/m^2$ ($2.09/yd^2$)	$2.00/m^2$ ($1.67/yd^2$)
Tailings Dam Construction	$.20/m^3$ ($.15/yd^3$)	$.20/m^3$ ($.15/yd^3$)	$.20/m^3$ ($.15/yd^3$)	$.20/m^3$ ($.15/yd^3$)	$.20/m/^3$ ($.15/yd^3$)	$.20/m^3$ ($.15/yd^3$)	$.20/m^3$ ($.15/yd^3$)	$.20/m^3$ ($.15/yd^3$)	$.20/m^3$ ($.15/yd^3$)
Membrane Liner	$1.00/m^2$ ($.09/yd^2$)	$1.00/m^2$ ($.09/yd^2$)	$1.00/m^2$ ($.09/yd^2$)	$1.00/m^2$ ($.09/yd^2$)	$1.00/m^2$ ($.09/ft^2$)	-- --	-- --	$1.00/m^2$ ($.09/ft^2$)	$1.00/m^2$ ($.09/ft^2$)

6.2 Alternative Comparison Analyses - Rating Matrix

6.2.1 Description of Rating Criteria

This section provides a description of the economic, technical, environmental, and land use considerations used in the evaluation of tailings disposal alternatives (Table VI-2).

The criteria under the capital cost consideration included the following items.

- Starter Dam - This criterion considered and compared the capital cost associated with construction of the earthfill starter dam.

- Tailings Transport System - This criterion compared the capital cost associated with tailings conveyance from the mill to the disposal facility. Items would include pipelines, pumps, and booster pumps.

- Reclaim Water System - This criterion compared the capital cost for reclaim water return from the tailings impoundment to the mill. Items would include pipelines and pumps.

- Site Preparation - This criterion compared the estimated capital cost associated with foundation preparation for the tailings dam. This cost is mostly a reflection of the dam foundation areas and conditions at the sites.

- Liner - This criterion was used to compare the sensitivity of the alternative rating matrix (Table VI-3) to the estimated capital cost associated with lining the impoundment with a membrane lining.

- Access Roads - This criterion compared the estimated costs for access road construction to the disposal facilities from the preferred mill site.

TABLE VI-2
MT. HOPE PROJECT
RATING MATRIX
WITHOUT LINING

NOTE: UPPER NUMBER = RAW SCORE 2.00
LOWER NUMBER = WEIGHTED SCORE 3.00

** CAPITAL COSTS X $1,000 ***
****

	SITE A	SITE B	SITE C	SITE D	SITE E	SITE F	SITE H	SITE I	SITE J
	********	********	********	********	********	********	********	********	********
STARTER DAM WEIGHTING FACTOR = 1.00	2650.	1460.	5920.	5470.	5570.	1000.	2500.	2500.	3720.
TAILINGS TRANSPORT SYS. WEIGHTING FACTOR = 1.00	4390.	9330.	10130.	13860.	12130.	12990.	16690.	10220.	11010.
RECLAIM WATER SYSTEM WEIGHTING FACTOR = 1.00	2170.	2700.	4240.	6000.	5910.	5550.	6060.	3160.	3020.
SITE PREPARATION WEIGHTING FACTOR = 1.00	380.	420.	670.	440.	430.	160.	120.	780.	1390.
LINER (IF REQUIRED) WEIGHTING FACTOR = 1.00	0.	0.	0.	0.	0.	0.	0.	0.	0.
ACCESS ROADS WEIGHTING FACTOR = 1.00	290.	300.	580.	630.	520.	700.	1070.	400.	300.
POWER SYSTEM WEIGHTING FACTOR = 1.00	530.	780.	1040.	1520.	1400.	1360.	2350.	1010.	760.
EXIST. FAC. RELOCATION WEIGHTING FACTOR = 1.00	1850.	810.	1630.	0.	0.	410.	200.	0.	0.
SUBTOTAL RAW SCORE	12260.	15800.	24210.	27920.	25960.	22170.	28990.	18070.	20200.
PROPORTIONED RAW SCORE WEIGHTING FACTOR = 2.60	9.00	7.31	3.29	1.51	2.45	4.25	1.00	6.22	5.20
SUBTOTAL WEIGHTED SCORE	23.40	19.00	8.54	3.93	6.37	11.08	2.60	16.13	13.53
RANKING	1	2	6	8	7	5	9	3	4

TABLE VI-2 (Continued)

* OPERATING COSTS X $1,000 **
****

	SITE A	SITE B	SITE C	SITE D	SITE E	SITE F	SITE H	SITE I	SITE J
	********	********	********	********	********	********	********	********	********
TAILINGS DAM CONSTRUCTION WEIGHTING FACTOR = 1.00	190.	300.	490.	550.	580.	320.	430.	770.	590.
TAILINGS TRANSPORT WEIGHTING FACTOR = 1.00	240.	1420.	1970.	1790.	1880.	2140.	3250.	750.	1080.
RECLAIM WATER WEIGHTING FACTOR = 1.00	530.	400.	240.	580.	370.	450.	410.	430.	360.
FUGITIVE DUST STABILIZATION WEIGHTING FACTOR = 1.00	30.	20.	20.	20.	10.	0.	0.	100.	50.
SUBTOTAL RAW SCORE	990.	2140.	2720.	2940.	2840.	2910.	4090.	2050.	2080.
PROPORTIONED RAW SCORE WEIGHTING FACTOR = 5.40	9.00	6.03	4.54	3.97	4.23	4.05	1.00	6.26	6.19
SUBTOTAL WEIGHTED SCORE	48.60	32.57	24.49	21.43	22.82	21.84	5.40	33.83	33.41
RANKING	1	4	5	8	6	7	9	2	3

TABLE VI-2 (Continued)

TECHNICAL CONSIDERATIONS*
****

	SITE A	SITE B	SITE C	SITE D	SITE E	SITE F	SITE H	SITE I	SITE J
	********	********	********	********	********	********	********	********	********
SURFACE WATER HYDROLOGY	3.00	5.00	6.00	9.00	10.00	1.00	6.00	10.00	8.00
WEIGHTING FACTOR = .30	.90	1.50	1.80	2.70	3.00	.30	1.80	3.00	2.40
GROUNDWATER HYDROLOGY	2.00	2.00	4.00	4.00	8.00	4.00	6.00	2.00	3.00
WEIGHTING FACTOR = .40	.80	.80	1.60	1.60	3.20	1.60	2.40	.80	1.20
GEOLOGY AND SEISMICITY	8.00	5.00	6.00	7.00	5.00	6.00	5.00	5.00	6.00
WEIGHTING FACTOR = .30	2.40	1.50	1.80	2.10	1.50	1.80	1.50	1.50	1.80
TOPOGRAPHY AND GEOGRAPHY	8.00	6.00	6.00	7.00	6.00	7.00	6.00	10.00	6.00
WEIGHTING FACTOR = .30	2.40	1.80	1.80	2.10	1.80	2.10	1.80	3.00	1.80
LOCATION W/RESPECT TO MILL	10.00	6.00	2.00	5.00	4.00	3.00	1.00	9.00	7.00
WEIGHTING FACTOR = .40	4.00	2.40	.80	2.00	1.60	1.20	.40	3.60	2.80
EXPANSION POTENTIAL	7.00	9.00	4.00	5.00	1.00	3.00	6.00	10.00	8.00
WEIGHTING FACTOR = .40	2.80	3.60	1.60	2.00	.40	1.20	2.40	4.00	3.20
OPERATIONAL EASE-	9.00	7.00	5.00	6.00	4.00	2.00	2.00	8.00	7.00
WEIGHTING FACTOR = .20	1.80	1.40	1.00	1.20	.80	.40	.40	1.60	1.40
SUBTOTAL RAW SCORE	47.00	40.00	33.00	43.00	38.00	26.00	32.00	54.00	45.00
SUBTOTAL WEIGHTED SCORE	15.10	13.00	10.40	13.70	12.30	8.60	10.70	17.50	14.60
RANKING	2	5	8	4	6	9	7	1	3

TABLE VI-2 (Continued)

ENVIRONMENTAL CONSIDERATIONS
****

	SITE A	SITE B	SITE C	SITE D	SITE E	SITE F	SITE H	SITE I	SITE J
	********	********	********	********	********	********	********	********	********
GROUNDWATER PROTECTION	4.00	2.00	3.00	4.00	3.00	3.00	3.00	2.00	2.00
WEIGHTING FACTOR = .50	2.00	1.00	1.50	2.00	1.50	1.50	1.50	1.00	1.00
SCENIC VALUES	4.00	3.00	4.00	4.00	7.50	7.50	5.00	8.00	9.00
WEIGHTING FACTOR = .40	1.60	1.20	1.60	1.60	3.00	3.00	2.00	3.20	3.60
BIOLOGICAL VALUES	8.00	4.50	3.00	4.50	6.00	1.50	1.50	9.00	7.00
WEIGHTING FACTOR = .40	3.20	1.80	1.20	1.80	2.40	.60	.60	3.60	2.80
IMPACTED CULTURAL RESOURCES	5.00	6.00	7.00	8.00	10.00	8.00	8.00	10.00	9.00
WEIGHTING FACTOR = .20	1.00	1.20	1.40	1.60	2.00	1.60	1.60	2.00	1.80
FUGITIVE DUST POTENTIAL	7.00	6.00	6.00	6.00	8.00	9.00	10.00	1.00	5.00
WEIGHTING FACTOR = .10	.70	.60	.60	.60	.80	.90	1.00	.10	.50
SITE ACCESS IMPACTS	10.00	6.00	5.00	4.00	4.00	3.00	1.00	7.00	8.00
WEIGHTING FACTOR = .10	1.00	.60	.50	.40	.40	.30	.10	.70	.80
RECLAMATION POTENTIAL	7.00	4.00	4.00	7.00	9.00	2.00	3.00	6.00	6.00
WEIGHTING FACTOR = .30	2.10	1.20	1.20	2.10	2.70	.60	.90	1.80	1.80
SUBTOTAL RAW SCORE	45.00	31.50	32.00	37.50	47.50	34.00	31.50	43.00	46.00
SUBTOTAL WEIGHTED SCORE	11.60	7.60	8.00	10.10	12.80	8.50	7.70	12.40	12.30
RANKING	4	9	7	5	1	6	8	2	3

TABLE VI-2 (Continued)

********' LAND USE ***********
****

	SITE A	SITE B	SITE C	SITE D	SITE E	SITE F	SITE H	SITE I	SITE J
	********	********	********	********	********	********	********	********	********
WATER RIGHTS	3.00	10.00	8.00	9.00	8.00	6.00	3.00	5.00	10.00
WEIGHTING FACTOR = .30	.90	3.00	2.40	2.70	2.40	1.80	.90	1.50	3.00
SITE ACCESS	10.00	6.00	5.00	4.00	4.00	3.00	1.00	7.00	8.00
WEIGHTING FACTOR = .20	2.00	1.20	1.00	.80	.80	.60	.20	1.40	1.60
OWNERSHIP/MINERAL RIGHTS	9.00	2.00	7.00	3.00	10.00	9.00	1.00	4.00	9.00
WEIGHTING FACTOR = .50	4.50	1.00	3.50	1.50	5.00	4.50	.50	2.00	4.50
EXISTING/PROPOSED LAND USE	6.00	6.00	5.00	9.00	9.00	6.00	7.00	7.00	9.00
WEIGHTING FACTOR = .30	1.80	1.80	1.50	2.70	2.70	1.80	2.10	2.10	2.70
DOWNSTREAM RISK	2.00	7.00	4.00	4.00	5.00	3.00	3.00	10.00	9.00
WEIGHTING FACTOR = 1.00	2.00	7.00	4.00	4.00	5.00	3.00	3.00	10.00	9.00
POPULATION DISPLACEMENT	10.00	10.00	10.00	10.00	10.00	10.00	8.00	10.00	10.00
WEIGHTING FACTOR = .20	2.00	2.00	2.00	2.00	2.00	2.00	1.60	2.00	2.00
SUBTOTAL RAW SCORE	40.00	41.00	39.00	39.00	46.00	37.00	23.00	43.00	55.00
SUBTOTAL WEIGHTED SCORE	13.20	16.00	14.40	13.70	17.90	13.70	8.30	19.00	22.80
RANKING	8	4	5	6	3	7	9	2	1

TABLE VI-2 (Continued)

SUMMATION OF RAW AND WEIGHTED SCORES
****

	SITE A	SITE B	SITE C	SITE D	SITE E	SITE F	SITE H	SITE I	SITE J
TOTAL WEIGHTED SCORE	111.90	88.17	65.83	62.86	72.19	63.72	34.70	98.90	96.64
FINAL RANKING	1	4	6	8	5	7	9	2	3

TABLE VI-3
MT. HOPE PROJECT
RATING MATRIX
WITH LINING

NOTE: UPPER NUMBER = RAW SCORE 2.00
LOWER NUMBER = WEIGHTED SCORE 3.00

** CAPITAL COSTS X $1,000 ***
****

	SITE A	SITE B	SITE C	SITE D	SITE E	SITE F	SITE H	SITE I	SITE J
	********	********	********	********	********	********	********	********	********
STARTER DAM WEIGHTING FACTOR = 1.00	2650.	1460.	5920.	5470.	5570.	1000.	2500.	2500.	3720.
TAILINGS TRANSPORT SYS. WEIGHTING FACTOR = 1.00	4390.	9330.	10130.	13860.	12130.	12990.	16690.	10220.	11010.
RECLAIM WATER SYSTEM WEIGHTING FACTOR = 1.00	2170.	2700.	4240.	6000.	5910.	5550.	6060.	3160.	3020.
SITE PREPARATION WEIGHTING FACTOR = 1.00	380.	420.	670.	440.	430.	160.	120.	780.	1390.
LINER (IF REQUIRED) WEIGHTING FACTOR = 1.00	10459.	13068.	9148.	8276.	0.	0.	0.	13939.	17424.
ACCESS ROADS WEIGHTING FACTOR = 1.00	290.	300.	580.	630.	520.	700.	1070.	400.	300.
POWER SYSTEM WEIGHTING FACTOR = 1.00	530.	780.	1040.	1520.	1400.	1360.	2350.	1010.	760.
EXIST. FAC. RELOCATION WEIGHTING FACTOR = 1.00	1850.	810.	1630.	0.	0.	410.	200.	0.	0.
SUBTOTAL RAW SCORE	22719.	28868.	33358.	36196.	25960.	22170.	28990.	32009.	37624.
PROPORTIONED RAW SCORE WEIGHTING FACTOR = 2.60	8.72	5.53	3.21	1.74	7.04	9.00	5.47	3.91	1.00
SUBTOTAL WEIGHTED SCORE	22.65	14.38	8.34	4.52	18.30	23.40	14.22	10.16	2.60
RANKING	2	4	7	8	3	1	5	6	9

* OPERATING COSTS X $1,000 **
****

	SITE A	SITE B	SITE C	SITE D	SITE E	SITE F	SITE H	SITE I	SITE J
TAILINGS DAM CONSTRUCTION WEIGHTING FACTOR = 1.00	190.	300.	490.	550.	580.	320.	430.	770.	590.
TAILINGS TRANSPORT WEIGHTING FACTOR = 1.00	240.	1420.	1970.	1790.	1880.	2140.	3250.	750.	1080.
RECLAIM WATER WEIGHTING FACTOR = 1.00	530.	400.	240.	580.	370.	450.	410.	430.	360.
FUGITIVE DUST STABILIZATION WEIGHTING FACTOR = 1.00	30.	20.	20.	20.	10.	0.	0.	100.	50.
LINER (IF REQUIRED) WEIGHTING FACTOR = 1.00	2265.	2439.	1699.	1612.	784.	0.	0.	3267.	2265.
SUBTOTAL RAW SCORE	3255.	4579.	4419.	4552.	3624.	2910.	4090.	5317.	4345.
PROPORTIONED RAW SCORE WEIGHTING FACTOR = 5.40	7.85	3.45	3.98	3.54	6.63	9.00	5.08	1.00	4.23
SUBTOTAL WEIGHTED SCORE	42.41	18.65	21.52	19.13	35.79	48.60	27.42	5.40	22.85
RANKING	2	8	6	7	3	1	4	9	5

TABLE VI-3 (Continued)

TECHNICAL CONSIDERATIONS*
****

	SITE A	SITE B	SITE C	SITE D	SITE E	SITE F	SITE H	SITE I	SITE J
	********	********	********	********	********	********	********	********	********
SURFACE WATER HYDROLOGY	3.00	5.00	6.00	9.00	10.00	1.00	6.00	10.00	8.00
WEIGHTING FACTOR = .30	.90	1.50	1.80	2.70	3.00	.30	1.80	3.00	2.40
GROUNDWATER HYDROLOGY	2.00	2.00	4.00	4.00	8.00	4.00	6.00	2.00	3.00
WEIGHTING FACTOR = .40	.80	.80	1.60	1.60	3.20	1.60	2.40	.80	1.20
GEOLOGY AND SEISMICITY	8.00	5.00	6.00	7.00	5.00	6.00	5.00	5.00	6.00
WEIGHTING FACTOR = .30	2.40	1.50	1.80	2.10	1.50	1.80	1.50	1.50	1.80
TOPOGRAPHY AND GEOGRAPHY	8.00	6.00	6.00	7.00	6.00	7.00	6.00	10.00	6.00
WEIGHTING FACTOR = .30	2.40	1.80	1.80	2.10	1.80	2.10	1.80	3.00	1.80
LOCATION W/RESPECT TO MILL	10.00	6.00	2.00	5.00	4.00	3.00	1.00	9.00	7.00
WEIGHTING FACTOR = .40	4.00	2.40	.80	2.00	1.60	1.20	.40	3.60	2.80
EXPANSION POTENTIAL	7.00	9.00	4.00	5.00	1.00	3.00	6.00	10.00	8.00
WEIGHTING FACTOR = .40	2.80	3.60	1.60	2.00	.40	1.20	2.40	4.00	3.20
OPERATIONAL EASE-	9.00	7.00	5.00	6.00	4.00	2.00	2.00	8.00	7.00
WEIGHTING FACTOR = .20	1.80	1.40	1.00	1.20	.80	.40	.40	1.60	1.40
SUBTOTAL RAW SCORE	47.00	40.00	33.00	43.00	38.00	26.00	32.00	54.00	45.00
SUBTOTAL WEIGHTED SCORE	15.10	13.00	10.40	13.70	12.30	8.60	10.70	17.50	14.60
RANKING	2	5	8	4	6	9	7	1	3

TABLE VI-3 (Continued)

ENVIRONMENTAL CONSIDERATIONS
****

	SITE A	SITE B	SITE C	SITE D	SITE E	SITE F	SITE H	SITE I	SITE J
GROUNDWATER PROTECTION	4.00	2.00	3.00	4.00	3.00	3.00	3.00	2.00	2.00
WEIGHTING FACTOR = .50	2.00	1.00	1.50	2.00	1.50	1.50	1.50	1.00	1.00
SCENIC VALUES	4.00	3.00	4.00	4.00	7.50	7.50	5.00	8.00	9.00
WEIGHTING FACTOR = .40	1.60	1.20	1.60	1.60	3.00	3.00	2.00	3.20	3.60
BIOLOGICAL VALUES	8.00	4.50	3.00	4.50	6.00	1.50	1.50	9.00	7.00
WEIGHTING FACTOR = .40	3.20	1.80	1.20	1.80	2.40	.60	.60	3.60	2.80
IMPACTED CULTURAL RESOURCES	5.00	6.00	7.00	8.00	10.00	8.00	8.00	10.00	9.00
WEIGHTING FACTOR = .20	1.00	1.20	1.40	1.60	2.00	1.60	1.60	2.00	1.80
FUGITIVE DUST POTENTIAL	7.00	6.00	6.00	6.00	8.00	9.00	10.00	1.00	5.00
WEIGHTING FACTOR = .10	.70	.60	.60	.60	.80	.90	1.00	.10	.50
SITE ACCESS IMPACTS	10.00	6.00	5.00	4.00	4.00	3.00	1.00	7.00	8.00
WEIGHTING FACTOR = .10	1.00	.60	.50	.40	.40	.30	.10	.70	.80
RECLAMATION POTENTIAL	7.00	4.00	4.00	7.00	9.00	2.00	3.00	6.00	6.00
WEIGHTING FACTOR = .30	2.10	1.20	1.20	2.10	2.70	.60	.90	1.80	1.80
SUBTOTAL RAW SCORE	45.00	31.50	32.00	37.50	47.50	34.00	31.50	43.00	46.00
SUBTOTAL WEIGHTED SCORE	11.60	7.60	8.00	10.10	12.80	8.50	7.70	12.40	12.30
RANKING	4	9	7	5	1	6	8	2	3

TABLE VI-3 (Continued)

******** LAND USE ***********
****

	SITE A	SITE B	SITE C	SITE D	SITE E	SITE F	SITE H	SITE I	SITE J
	********	********	********	********	********	********	********	********	********
WATER RIGHTS	3.00	10.00	8.00	9.00	8.00	6.00	3.00	5.00	10.00
WEIGHTING FACTOR = .30	.90	3.00	2.40	2.70	2.40	1.80	.90	1.50	3.00
SITE ACCESS	10.00	6.00	5.00	4.00	4.00	3.00	1.00	7.00	8.00
WEIGHTING FACTOR = .20	2.00	1.20	1.00	.80	.80	.60	.20	1.40	1.60
OWNERSHIP/MINERAL RIGHTS	9.00	2.00	7.00	3.00	10.00	9.00	1.00	4.00	9.00
WEIGHTING FACTOR = .50	4.50	1.00	3.50	1.50	5.00	4.50	.50	2.00	4.50
EXISTING PROPOSED LAND USE	6.00	6.00	5.00	9.00	9.00	6.00	7.00	7.00	9.00
WEIGHTING FACTOR = .30	1.80	1.80	1.50	2.70	2.70	1.80	2.10	2.10	2.70
DOWNSTREAM RISK	2.00	7.00	4.00	4.00	5.00	3.00	3.00	10.00	9.00
WEIGHTING FACTOR = 1.00	2.00	7.00	4.00	4.00	5.00	3.00	3.00	10.00	9.00
POPULATION DISPLACEMENT	10.00	10.00	10.00	10.00	10.00	10.00	8.00	10.00	10.00
WEIGHTING FACTOR = .20	2.00	2.00	2.00	2.00	2.00	2.00	1.60	2.00	2.00
SUBTOTAL RAW SCORE	40.00	41.00	39.00	39.00	46.00	37.00	23.00	43.00	55.00
SUBTOTAL WEIGHTED SCORE	13.20	16.00	14.40	13.70	17.90	13.70	8.30	19.00	22.80
RANKING	8	4	5	6	3	7	9	2	1

TABLE VI-3 (Continued)

SUMMATION OF RAW AND WEIGHTED SCORES
****

	SITE A	SITE B	SITE C	SITE D	SITE E	SITE F	SITE H	SITE I	SITE J
TOTAL WEIGHTED SCORE	104.97	69.63	62.66	61.15	97.08	102.80	68.34	64.46	75.15
FINAL RANKING	1	5	8	9	3	2	6	7	4

- Power Facilities - This criterion compared the estimated cost for power facilities installation for the disposal facilities.

- Existing Facilities Relocation - This criterion compared the estimated cost associated with relocation of existing facilities (roads) displaced by the disposal facilities.

The items under operating cost considerations included the following criteria.

- Tailings Dam Construction - This criterion compared the estimated operating costs for tailings embankment construction. These differences were a function of tailings dam volume.

- Tailings Transport - This criterion compared the estimated operating costs for tailings conveyance from the mill to the disposal facilities.

- Reclaim Water - This criterion compared the estimated operating costs for reclaim water return from the disposal facilities to the mill.

- Fugitive Dust Stabilization - This criterion compared the estimated operating costs for fugitive dust suppression. The differences were a function of tailings embankment and impoundment area, and the site's topographic features.

- Liner - This criterion was used to compare the alternative rating matrix (Table VI-3) to the estimated operating costs associated with lining the impoundment with a membrance lining.

The items in the rating matrix under Technical Considerations included the following criteria.

- Surface Water Hydrology - This criterion compared the differences between the site drainage area and topography that impact the diversion requirements for tailings disposal.

- Ground Water Hydrology - This criterion compared the sites on the basis of their proximity to known or postulated existing ground water.

- Geology and Seismicity - This criterion compared and considered the sites on the basis of the site geology and geotechnical conditions as they relate to tailings disposal. There does not appear to be any real difference in seismicity for the sites compared.

- Topography and Geography - This criterion considered the effects of the site's geography and topographic features on the design and construction of disposal facilities.

- Location with respect to the Mill - This criterion compared the sites on the basis of their location and distance to the preferred mill site.

- Expansion Potential - This criterion considered the site's potential for expansion to provide storage for more than 331 million tons (300 million metric tons) of tailings.

- Operating Ease - This criterion compared the relative ease of tailings disposal operations between the sites.

The items in the rating matrix under Environmental Considerations included the following criteria.

- Ground Water Protection - This criterion considers the natural existing site features (impervious materials and/or distance from known ground water) that would mitigate potential impacts to ground water from seepage from tailings impoundments.

- Scenic Values - This criterion compared the visual impact of tailings disposal facilities to the scenic quality and viewability of the site. A subjective assessment of scenic quality was loosely based on BLM's visual resource management classification system, along with an estimate of the viewability of the site based on road access and

traffic to or by the site.

- Biological Values - This criterion compared the biological values of the alternative sites that would be impacted by tailings disposal facilities. The general basis of the comparison was on the quality of the habitat. Two factors were considered; apparent diversity and ability to support biological species. These factors were inferred from soil survey, range site data, and from field observation. Also considered was the potential for a site to be considered a special use area.

- Impacted Cultural Resources - This criterion compared the potential impacts to cultural resources due to construction activities at the alternative tailings disposal sites. Two sites have known cultural resources, Sites A (4-A) and B. The probability (based on habitat diversity, the presence of water, or the evidence of past mining activity) that cultural resources might be found if a survey was conducted, was also considered in the comparison.

- Fugitive Dust Potential - This criterion compared the site's fugitive dust potential based upon site size and exposure.

- Site Access Impacts - This criterion compared the impacts due to providing tailings and reclaim water conveyance, power, and access roads to the alternative disposal sites from the preferred mill site. The comparison was based mostly on the pipeline distance involved and to a lesser extent on terrain.

- Reclamation Potential - This criterion compared the relative potential of the alternative sites to be returned to as near a natural condition as possible after abandonment and on the drainage area.

The items in the rating matrix under Land Use Considerations included the following criteria.

- Water Rights - This criterion compared the alternative sites on the

basis of their location, and thus potential impact, with respect to existing water rights.

- Site Access - This criterion compared the alternative sites on the basis of access difficulties for roads, pipelines, and power.

- Ownership/Mineral Rights - This criterion compared the alternative sites based on land ownership, and existence and extent of competitive mineral rights and claims or oil and gas leases.

- Existing/Proposed Land Use - This criterion compared the sites based upon the impacts to existing or proposed land use. Four factors were considered; rangeland loss, crop production potential, recreational use/potential, and transportation uses.

- Downstream Risk - This criterion compared the relative downstream risks from catastrophic impoundment distress, to population or property. The differences between sites are based on location with respect to developed property or improvements and the height of the tailings dam.

- Population Displacement - This criterion had only one site as a variant since no people live on any of the sites. The summer sheepherders camp Site H would be affected by development of that site.

6.2.2 Tailings Disposal Alternative Site Ratings

The nine alternative sites were evaluated using a rating matrix that included considerations of the criteria previously discussed. The matrix utilized is shown on Table VI-2. The rating matrix was used in the following manner.

- The economic considerations for each alternative, which included the estimated capital and annual operating costs for each sub-item or criterion were summed for a total estimated cost.

- A numerical value proportioned raw score, between 1 and 9 (1 least favorable, most expensive; 9 most favorable, least expensive) was assigned to each alternative based on the summed costs. Values between 1 and 9 were assigned to alternatives based upon lineal interpolation of the relationship between the highest cost alternative (1) and lowest cost alternative (9).

- A weighting factor was applied to the proportioned raw score to arrive at a weighted score for both capital cost considerations and operating cost considerations. The weighting factor used for capital cost and operating cost considerations was equal to the sum of the weighting factors suggested by Exxon Minerals Company for each criterion under the capital cost or operating cost considerations.

- For the remaining noneconomic major considerations, Technical, Environmental, and Land Use, a value from 1 to 10 (1 least favorable; 10 most favorable) was assigned to each criterion or sub-item for each alternative site. Values were assigned, based primarily upon comparisons with ideal or extremely poor tailings disposal sites in the industry and not spreading the ratings from 1 to 10 for the sites evaluated, i.e. no site was rated higher than 4 for ground water protection and 8 sites were rated 10 for Population Displacement.

- A weighting factor, recommended by Exxon Minerals Company, was applied to each of the criterion under the Technical, Environmental, and Land Use Considerations, to arrive at a weighted value.

- The weighted values were summed to arrive at a subtotal weighted score for each of the noneconomic major considerations

- The subtotal weighted scores for both economic and noneconomic major considerations were summed to arrive at the total weighted score. The highest weighted score is the best alternative.

The rating matrix (Table VI-2) presents the site ranking under each of the five major considerations, as well as the final combined ranking.

Table VI-3 presents a site rating matrix assuming that impoundment lining would be required to mitigate the impacts of seepage. This rating matrix checks the sensitivity of the site selection process to a major uncertainty concerning tailings disposal, tailings effluent water quality and the impacts to ground water from seepage.

Since sufficient quantities of clayey material were not encountered during site reconnaissance to line the tailings impoundments, it was assumed that impoundment lining would consist of a membrane liner. It was also assumed that Sites F and H would not require lining. Seepage control measures, if needed, would consist of less expensive measures. Lining costs were assigned to both capital and operating cost considerations except for Site E. It was assumed that impoundment lining could proceed during the life of the project as the impoundment filled. For Site E, geologic assessments indicated that lining, if required, would not be needed initially in the lower parts of the impoundment but would be needed later as the impoundment filled. Therefore, lining costs were assigned only to operating cost considerations for Site E.

As shown on Table VI-2, the rating matrix indicates that Alternative Site A (4-A), the site across Garden Pass Creek, is the best alternative. Sites I (4-B) and J (4-C) are ranked 2 and 3, respectively. The total weighted scores of Sites I (4-B) and J (4-C) are within about 2.3 percent.

When sensitivity of the site rating is checked assuming impoundment lining is required (Table VI-3), Site A (4-A) is ranked as the best alternative. Site F and E are ranked 2 and 3, respectively. Site J (4-C) is ranked 4th and Site I (4-B) is ranked 7th.

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