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VOLUME 2

GEOLOGY AND MINING

MINERALS EXPLORATION COMPANY

union 76

MINERALS

FINAL FEASIBILITY STUDY

ANDERSON PROJECT
URANIUM MINE AND MILL
YAVAPAI COUNTY, ARIZONA

JULY, 1978

MORRISON KNUDSEN

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MINERALS EXPLORATION COMPANY

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MINERALS

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URANIUM MINE AND MILL
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Drawing No. MEC-000	Geology
Drawing No. MEC-001	Mine Area Plot Plan
Drawing No. MEC-002	Tailing Disposal System
Drawing No. MEC-003	Lube & Tire Shop, Plans & Elevations
Drawing No. MEC-004	Fueling Island & Tank Farm, Plans & Elevations
Drawing No. 21-53-0-104	Mill & Mine Facility Plot Plan
Drawing No. 21-53-0-011	Administration Building General Arrangement Plan & Elevations
Drawing No. 21-53-0-012	Shop, Warehouse & Change House General Arrangement Plan & Elevations

EXHIBIT II-B - MINE EQUIPMENT HOURLY COST CALCULATIONS

EXHIBIT II-C - EQUIPMENT JUSTIFICATION

EXHIBIT II-D - MINING ASSUMPTIONS AND FACTORS

VOLUME II INTRODUCTION

This feasibility study report is a compilation and summation of three years of investigations by Minerals Exploration Company and their consultants for the purpose of evaluating the economic viability of the Anderson Project, Yavapai County, Arizona. The study is reported in three volumes:

Volume I - Executive Summary

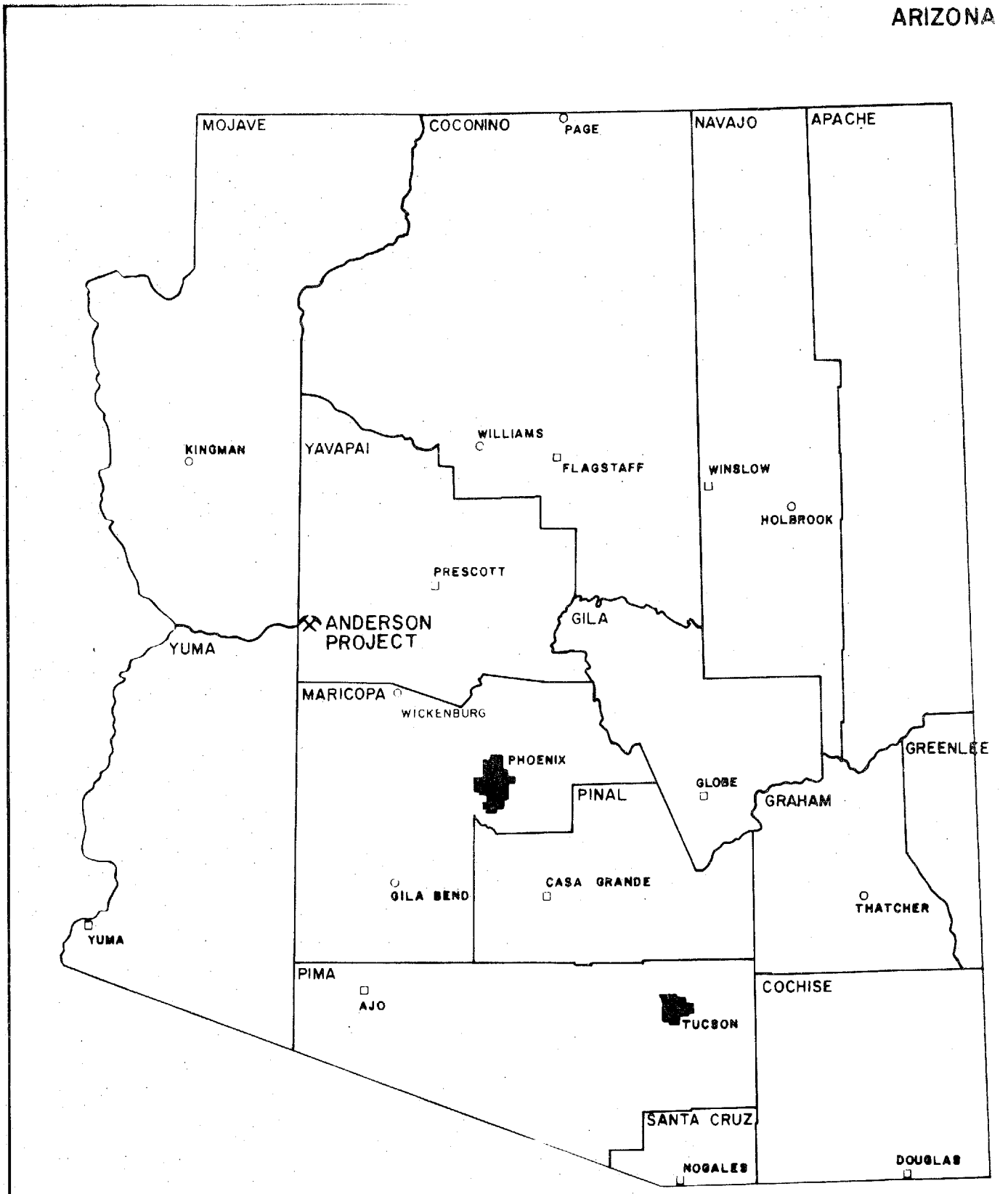
Volume II - Geology and Mining

Volume III - Ore Processing

Volumes I and III were written jointly by Minerals Exploration Company and Morrison-Knudsen Company. The Minerals Exploration Company's Mine Development Group has undertaken the sole responsibility for Volume II of the Anderson Project Final Feasibility Study. This volume encompasses the geology, ore reserves, mine engineering studies, and a description of mining procedures and facilities. The principal intent of this volume is to examine the capital requirements and operating economics involved in the open pit mining of the Anderson Project.

The project location is shown on Figure 5-1, Location Map, Anderson Project.

The results of all the investigations to date are incorporated into a Financial Analysis presented in Volume I. The remainder of the report describes the design basis and operating philosophy used to estimate the capital and operating costs required to develop this analysis.



SCALE IN MILES
0 10 20 50

V

UNION MINERALS EXPLORATION CO.

FIGURE 5-1

LOCATION MAP-ARIZ.

ANDERSON PROJECT

SCALE	DATE FEB, 1978	APPROVED	REVISIONS
H: 1" = 40MI.	DRAWN BY: L R R		
V	CHECKED:		
	DESIGN:		FILE:

This report is considered to be a final feasibility study, accurate to within plus or minus 15 percent. Additional investigations are recommended in certain areas to study possible cost reductions. However, these possible reductions or unforeseen cost additions are not expected to exceed the stated limits of accuracy.

The investigations and studies which generated the data and criteria for this volume of the Feasibility Study are described in the following reports:

ORE RESERVES

a. Anderson Mine Geology Report, Minerals Exploration Company, August 1977

b. Ore Control Techniques at the Anderson Mine, Minerals Exploration Company, September 1977

c. A Review of Estimated Mineable Uranium Reserves, Anderson Mine Project, Chapman, Wood & Griswold, September 1977

d. Anderson Mine Bulk Density Study, Minerals Exploration Company, January 1978

e. Development Report on Equilibrium at the Anderson Mine Project, Minerals Exploration Company, April 1978

TECHNICAL STUDIES

a. Slope Stability Studies - Proposed Anderson Mine Property - Open Pit Uranium Mine, Dames & Moore, April 1977

b. Preliminary Geotechnical Investigation Report - Mill and Tailings Disposal Site, Sergent, Hauskins & Beckwith, August 1977

c. Preliminary Feasibility Study, Morrison-Knudsen, December 1977

d. Design Report - Proposed Tailings Impoundment, Anderson Uranium Project, Dames & Moore, May 1978

HYDROLOGICAL

a. Progress Report - Exploration for Water Supply, Anderson Mine, Arizona, Water Development Corporation, June 1977

b. Anderson Mine Surface Water, Water Development Corporation, July 1977

c. Groundwater Hydrology of Anderson Mine Area, Arizona, Water Development Corporation, February 1978

d. Legal Evaluation of Alternative Sources of Water for the Anderson Mine Project, Yavapai Co., Arizona, D.P. Kearns & J.C. Lacy, March 1978

e. Surface Water Hydrology of Bill Williams River System, Arizona, Water Development Corporation, March 1978

VOLUME II SUMMARY

COSTS

Capital and operating costs are based on equipment manufacturer's quotes and recommendations and local mining company representatives' experience under Arizona conditions. The economics are as of June 1, 1978, using the constant dollar technique. The reserves that were evaluated are as follows:

Tons of Ore	7,181,962
Contained Pounds of U_3O_8	10,299,189
Average Grade (%)	0.072

The capital and operating cost estimates are summarized below:

MINE CAPITAL COST SUMMARY

	Initial Capital	Addition and Replacement Capital	Total Project Capital
Preproduction	$14,092,643	$ - 0 -	$14,092,643
Mine	14,549,596	3,753,141	18,302,737
Maintenance	3,803,882	701,936	4,505,818
Administrative	721,418	132,000	853,418
TOTALS	$33,167,539	$4,587,077	$37,754,616

MINE OPERATING COST SUMMARY

Period	Annual Cost	Total Period Cost
Production I	$12,557,616	$ 56,599,272
Production II	10,580,870	50,256,283
TOTALS		$106,855,555

U_3O_8 PRODUCTION

Period	Mill Feed Tons/Year	Feed Grade %	Recovery	Total lbs U_3O_8
Yrs 1-2	730,000	0.080	90.13	2,105,437
Yrs 3-9.84	730,000	0.0696	88.55	7,054,508

OPERATING COST

	$/Ton Milled	$/lb	$/lb	$/Ton Mined
Preproduction *	- -	- -	- -	0.361
Production I **	17.228	11.940	13.978	0.386
Production II ***	14.494	- -	11.759	0.437

*Preproduction tonnage is estimated at approximatley 39,037,800 tons over an 18-month period including a 3-month pioneering period.

**Based on 730,000 tons/year @ 0.080% U_3O_8 and 90.13% recovery for the first two year.

***Based on 730,000 tons/year @ 0.0696% U_3O_8 and 88.55% recovery for the remainder of operation life.

PROJECT SCHEDULE

The project schedule provides the basis for manpower loading and equipment purchasing schedules. The key dates are as follows:

Mine Facilities	January 1, 1979 - October 1, 1979
Pioneering	July 1, 1979 - October 1, 1979
Preproduction Stripping	October 1, 1979 - January 1, 1981
Preproduction Mining	April 1, 1980 - January 1, 1981
Mill Start-up*	January 1, 1981

*Stripping and mining are classified as Production I and II from that date to completion of the project.

SECTION 5

GEOLOGY, ORE RESERVES AND HYDROLOGY

This section addresses the geology of the project area and its relationship to the ore reserves. The ore reserve estimate is based upon an economic cutoff grade and is further influenced by:

a. backslope as determined by the Geotechnical Study

b. bulk densities for the different lithologic units and varying water content

c. grade refinement utilizing individual disequilibrium factors.

The final portion of this section discusses the hydrological aspects including surface and groundwater and pump tests leading to recommendations as to the source of mill water.

5.1 GEOLOGY

In late 1977, Minerals' personnel completed a report defining the geological aspects of the project area. The resultant geological definition was based upon review of 513 drill holes, of which 72 were cored through the ore zone. Surface reconnaissance and drill hole correlation resulted in a detailed understanding of structures, lithologies and other geologic features.

The mineralization is primarily associated with the carbonaceous siltstones and lignitic materials associated with the lacustrine sequence in the area. The beds overlie andesitic volcanics and are overlain by conglomerates and basaltic flows as shown in Figure 5.1-1, Generalized Cross Section of the Anderson Property.

5.1.1 Regional Geology

The Anderson Mine Property is located along the northeast margin of the Date Creek Basin in west-central Arizona. The basin is bordered by the Black Mountains on the north and northeast, by the Rawhide, Buckskin, and McCracken Mountains on the west. To the south and southeast it is bordered by a low drainage divide governed in part by the Harcuvar Mountains and/or the Black Mountains. The basin has a gently sloping topography to the west and northwest.

Surface Flow across the basin is accomplished by three drainages: the Santa Maria River, Date Creek, and Bullard Wash. The south-flowing Big Sandy River joins the Santa Maria River in the northwest portion of the basin just west of the confluence of Date Creek and the Santa Maria River. This combined drainage flows southward into Alamo River Reservoir, becoming the Bill Williams River.

The area has been on the margin of several regional deformations. It was on the northwestern margin of Mazatzal Land, the southeastern margin of the Cordillarian Geosyncline, deformed by the Laramide Orogeny, and is presently on the margin of the Basin and Range Physiographic Province.

The area around Anderson Mine exhibits structures typical of the Basin and Range and it is the Basin and Range deformation which is evident in the area today. The structural trends of this deformation are a dominant northwest-southwest trend of parallel to subparallel hinged block faults and a less dominant west-northwest-

east-southeast fault system. Many of these faults exhibit recurrent movements.

The regional stratigraphy may be briefly summarized by: 1) a Precambrian or Jurassic granitic basement complex; 2) the lacustrian, clastic and volcanic members of the Paleocene-Eocene Artillery Peak Formation; 3) the Arrastra Volcanic Complex, including dacitic intrusions, andesitic flows and volcaniclastic members of early to mid-Tertiary age; 4) the Chapin Wash Formation - Anderson Mine Lacustrian sediments of miocene age; 5) a conglomeritic-sandstone unit possibly equivalent to upper Chapin Wash; 6) a Miocene basalt; 7) a Plio-Pleistocene Conglomerate; and 8) Quaternary Alluvium. These are identified on Drawing No. MEC-000, Geology Map, in Exhibit II-A.

5.1.2 Geology of Mine Area

All the drainage on the Anderson Mine Property is to the north and northwest into the Santa Maria River. The headward erosion of these tributaries southward into the Date Creek Basin surface has resulted in a series of subparallel gullies and ridges trending north to northwest. Maximum topographic relief at Anderson Mine is 700 feet.

Faulting in the area trends northwest-southeast and many of the tributaries are developed partially along fault traces. The southerly dip and resistance to erosion of the stratigraphic section have tended to inhibit the headward migration of the tributaries.

Three major faults, the East Boundary Fault System, Fault 1878, and the West Boundary Fault System are present in the area. In addition to these are many parallel faults which have less displacement than the major faults. All of these faults trend between N30^{o}W and N55^{o}W. Another set of faults trending more westerly (N65^{o}W) are present at least in the south-central portion of the property. A set trending northeast has been conjectured by Urangesellschaft and others, but has not been observed in the field.

Within the boundaries of the Anderson Mine claims, nine (9) informal stratigraphic units have been recognized by Minerals Exploration Company. From oldest to youngest, these are: 1) Crystalline Intrusive Rocks; 2) Felsic to Intermediate Intrusions and Flows; 3) Felsic to Intermediate Volcaniclastic Sediments; 4) Andesitic Volcanic ; 5) Lacustrian Sediments; 6) Lower Conglomerate; 7) Basaltic Volcanic Flows and Dikes; 8) Upper Conglomerate; and 9) Alluvium.

As the Lacustrian Sediments are the only mineralized unit on the property, only they are described in detail. The lacustrian sediments unconformably overlie the andesitic volcanics over most of the Anderson Mine Property. However, to the east-central they overlie the volcaniclastic sediments and further to the east they onlap the felsic to intermediate volcanics. Several drill holes in the center of the mine area have encountered the felsic to intermediate volcanics or the tuffaceous part of the volcaniclastic sediments immediately below the lacustrine sediments.

Evidence now suggests that deposition of the lacustrine sediments occurred in a restricted basin. Therefore, these sediments represent time-transgressive facies deposited within a narrow, probably shallow, basinal feature. This type of depositional environment exhibits complex relationships between individual facies; lensing out, vertical and horizontal gradation, interfingering, etc.

The lake sediments include green siltstones and mudstones, white calcareous siltstones, and silty limestone or calcareous tuffaceous material. Much of this material is silicified to varying extents and was derived in part from volcanic ashes and tuffs common throughout the lake beds. Also present in the lacustrine sequence are zones of carbonaceous siltstone and lignitic material. Along the southern boundary with Urangesellschaft, drill holes encounter the basal arkosic sandstone. To the south and southwest the "typical" lake beds interfinger with and eventually are replaced by a thick, medium to coarse-grained, arkosic sandstone unit.

In addition to the organic material in the carbonaceous zones, abundant plant remains (including twigs, reeds, and small roots) are present in the lacustrine sediments. Reyner, et al (1956), recognized abundant silicified palm-type wood. Fresh water mollusks, up to 1-1/2 inches in length, are locally common. Thin laminated calcareous siltstone near the top of the lake beds contain small freshwater fish fossils. A jaw of a rhinoceros reportedly found at Anderson Mine is on display at the Wickenburg Museum. The leg

bone of a duck found in the unit has been dated as Miocene by the Los Angeles County Museum. William Breed (1977) of the Museum of Northern Arizona, and his associates, collected fossils at Anderson Mine in April of 1977. Included in their finds were freshwater fish (Eocene to Recent), a camel bone, and a rhinoceros tooth (Miocene).

All of the lake beds facies may exhibit some uranium mineralization. However, the highest grade and most consistent mineralization is located in the carbonaceous siltstones and lignitic materials.

Occasional mineralization has also been noted in the basal sandstone of the lacustrine sediments and in the lower conglomerate. Carbonaceous material is known to interfinger with the basal sandstone, and carbon has been noted in the lower conglomerate. Remobilization of the uranium has resulted in the deposition of mineral as fracture fillings around and below the main mineralized zones.

The mineralization is syngenetic as evidenced by the continuation and offset of mineralization across faults. Carbon tends to immediately fix uranium when soluble uranium comes in contact with it. Much of the mineralization is at the top or bottom of the carbonaceous facies; however, mineralization does occur in the middle of some carbonaceous zones. This later relationship implies that mineralization occurred during the deposition of the carbonaceous material.

Silicification of various parts of the Anderson Lake sediments probably occurred soon after deposition. Devitrification of the tuffaceous and ashy lake bed sediments and/or the felsic volcanics were probably the primary sources of silica. This silicification would tend to lock the uranium mineralization and protect it from remobilization.

The following origins have been suggested for the uranium mineralization at Anderson Mine.

a. Leaching of volcanic tuffs
b. Solution, mobilization and deposition from granites in the area
c. Combination of 1 and 2
d. Hypogene
e. Hot springs

Whatever the origin, it was the reducing environment of the lake or swamp that provided the structural and stratigraphic trap necessary for the retention of the uranium.

5.2 ORE RESERVES

Anderson Mine reserves are based on radiometric and chemical data taken from a total of 513 drill holes of which 72 holes were cored through the ore zone and sampled for chemical analysis. Radiometric data was submitted to Digitgraph Computer Systems for interpretation and ore reserve evaluation. Ore reserves were estimated through perpendicular bisector areas of influence (polygons) constructed for each drill hole. Holes were evaluated on vertical 2-foot slices through the mineralized zone, and adjusted to the closest even foot.

A cutoff grade of 0.04% U_3O_8 (based on estimated costs and recoveries) was used to determine the economic pit limits for design purposes. Subsequent to defining the pit limits, a marginal cutoff grade of 0.028% U_3O_8 was used to define the reserves existing within the pit limits. All material less than 0.028% U_3O_8 within the mining zone is classified as internal waste.

All tonnages expressed are dry weights. All ore grades have been adjusted to reflect the correct equilibrium factor for each area of influence.

Based on the above restraints and procedures, a final ore reserve estimate for the Anderson Mine was received from Digitgraph Computer Systems. The reserves are listed in Table 5.2-1.

The mine will provide the mill with an average feed grade of approximately 0.08% U_3O_8 for the first two years at an approximate average grade of 0.07% U_3O_8 for the remaining years. The reserves are sufficient to maintain a mill throughput of 730,000 tons per year for 9.84 years.

TABLE 5.2-1

ANDERSON MINE

ORE AND WASTE MATERIALS SUMMARY

Pit Sequence #	Primary Stripping Tons x 10^6 Dry Tons	Secondary Stripping Tons x 10^6 Dry Tons	Associated Waste Tons x 10^6 Dry Tons	Ore Tons Dry Tons	Ore Grade % U_3O_8	Pounds U_3O_8	Tons Waste / Ton Ore	Tons Waste / Pound U_3O_8
1	15.10	1.71	0.269	531,000	0.082	871,000	32:1	20:1
2	26.90	2.22	0.199	836,000	0.097	1,622,000	35:1	18:1
3	18.47	1.84	0.223	504,000	0.064	646,000	41:1	32:1
4	45.95	4.08	0.334	1,033,000	0.069	1,428,000	49:1	35:1
5	53.99	2.83	0.307	967,000	0.070	1,344,000	59:1	43:1
6	20.47	2.39	0.363	769,000	0.069	1,060,000	30:1	22:1
7	17.50	2.50	0.295	634,000	0.062	786,000	32:1	26:1
8	25.45	1.95	0.269	780,000	0.058	903,000	35:1	31:1
9	15.57	2.26	0.159	762,000	0.080	1,212,000	24:1	15:1
10	14.96	2.05	0.051	365,000	0.059	427,000	47:1	40:1
TOTAL	254.36	23.95	1.89	7,181,962	0.072	10,299,189	39:1	27:1

5.2.1 GEOTECHNICAL STUDY

Dames & Moore submitted a slope stability report to MEC in April, 1977. This report makes recommendations which have been used in the pit design.

A field investigation program was undertaken to evaluate the geotechnical problems posed by open pit mining in the formations at the Anderson property. Two core holes were drilled along the southern boundary of the proposed open pit from the surface to a point below the pit floor. The recovered core was logged and point load tests were run on 2-foot intervals to estimate compressive strength. Log information included rock quality designation, fractures per foot and core condition.

A laboratory testing program was performed on representative core samples to determine the engineering properties which influence slope stability. Uniaxial compressive strength tests were performed to ensure proper correlation with point load test results. Moisture and density determinations were made on selected core samples used for direct shear testing.

Material properties for slope design, such as bulk density, friction angle and cohesion, were based on the above field and laboratory testing, and on the results of previous slope designs and block analyses of slope failures performed by Dames & Moore in comparable materials. Results of the testing program are as follows:

Material	Bulk Density (lbs/cu ft)	Friction Angle (degrees)	Cohesion (lbs/sq ft)
Capping Conglomerate	140	40	4,000
Well Cemented Sandstone Conglomerate	130	32	4,000
Poorly Cemented Sandstone Conglomerate	130	32	2,000
Lacustrine Sediments	130	28	3,000

Limited surface mapping of the orientation of the various lithologic units was supplemented by the study of existing geologic maps and sections. The orientation of major faults and other potential failure planes with respect to the major pit slopes was examined to determine the potential of failure planes exposed during the mining operation.

Faults in the mine area generally strike North 35°-50° West and dip steeply, generally to the southwest. The pit walls are so oriented that slope failure will not result from the known faults.

Adequate control of water from all sources is important for slope stability. Control and diversion of surface runoff during rainstorms will be accomplished with dams and ditches. The information available on groundwater within the pit indicates that an average of 200 gpm will inflow from the lower conglomerate unit and from the barren sand unit. Pump tests will be conducted to determine ways to obtain a fully drained slope. All slopes require a fully drained condition.

Results of the slope design analyses indicate that for a slope 800 feet high, a stable design would be a 40° slope through the lacustrine sediments and the lower half of the tertiary sandstone conglomerate unit, and at 50° over its remaining height. A 100-foot-wide bench will separate the two portions of the slope. That 100-foot bench increases the stability of the slope and acts as a useful catch bench. Slopes of less than 400 feet are designed at higher angles. The present mine design requires only a short time of highwall exposure before backfilling begins. Slopes are designed with factors of safety of 1.1 to 1.2.

The design recommendations for the main southern slope should be valid for any significant side slopes encountered during mining. Footwall failure is not anticipated because of the low angle of bedding. Slope design conclusions are based on the assumption that the ultimate pit slope will not have major horizontal curvature. As mining progresses, the actual observation of the mine slopes will provide important additional information through backslope analyses procedures.

Safe operating slopes at varying heights, obtained from interpolation between the recommended design slopes, are represented below:

Slope Height (ft)	Operating Slope	Angle
100	0.36:1	70°
200	0.36:1	70°
300	0.68:1	56°
400	0.84:1	50°
500	0.94:1	47°
600	1.00:1	45°
700	1.04:1	44°
800	1.06:1	43°

5.2.2 BULK DENSITY

Bulk density values for primary stripping, secondary stripping, interior waste, and ore were determined from core specimens. Samples of primary stripping material were taken from the geotechnical holes which were drilled for slope stability determinations. Secondary stripping, interior waste and ore samples were taken during a later core drilling program. Extreme care was taken to preclude the possibility of error during the latter testing program to insure that material used for testing accurately represented the inplace materials. Actual values represent averages of a total sample population number in excess of 250.

Tabulated below are the bulk density values used in this feasibility study. The dry densities represent the ore reserves calculations and the wet densities were used for equipment selection and operating costs.

	Cubic Feet/Ton	
	Dry	Wet
Primary Stripping	15.6	14.95 *
Secondary Stripping	17.0	15.45 **
Interior Waste	17.0	15.45 **
Ore	20.46	---

* 5% H_2O

** 10% H_2O

5.2.3 EQUILIBRIUM

Minerals has drilled a total of 72 core holes on the Anderson Property. These core holes represent 14 percent of all exploration drill holes and are located on a 400-foot grid. Approximately 3,125 assays were run on core and cuttings by colorimetric and fluorimetric techniques.

The first 14 holes were assayed by Chemical-Geological Laboratory of Casper, Wyoming, using the colorimetric assay. The next 19 holes were fluorimetrically assayed by Hazen Research of Golden, Colorado. The remaining 39 holes were assayed by Skyline Laboratory of Tucson using the fluorimetric technique. All assays were checked by either reassaying selected samples or pulps of the original samples. Values may be considered accurate to $\pm$ 5 percent.

An equilibrium factor was calculated as a ratio between chemical uranium and the gamma log. This ratio was determined from a hole-by-hole total of values and by constructing a polygon map and calculating pounds U_3O_8 for both chemical and gamma log. No values were included for either method unless both chemical and log data was available for the given interval. The average equilibrium factor for the entire property, with pounds U_3O_8 weighted equally, is 0.999. The average factor within the open pit is 1.05.

The equilibrium factor will vary depending on the proximity to the nearest fault. Core holes near faults are depleted in uranium while holes isolated from faults are in equilibrium or enriched. Because of this effect, each hole on the property has been assigned a different equilibrium factor. These values were interpolated on Figure 5.2.3-1.

Equilibrium varies with grade. Very high grades ($>$ .090% U_3O_8) are 6 percent higher in equilibrium than average, while low grades ($<$ 0.015% U_3O_8) are 1 percent lower than average. This grade relationship was determined from the first 33 core holes using chemical versus closed-can radiometrics. No closed-can assays were run on the remaining 39 holes.

5.3 HYDROLOGY

Information regarding water at Anderson Mine has been provided by Water Development Corporation (WDC) studies, and by Dames & Moore studies on slope stability and the tailings impoundment design.

5.3.1 Groundwater

The Bill Williams River Basin is contained within the Central Highlands and the Basin and Range Provinces, two major physiographic regions in Arizona. In the Basin and Range Province, groundwater generally occurs in unconfined or "water table" aquifers formed in alluvial valleys between mountain blocks. The alluvium, which may be several thousand feet thick, consists of interbedded clays, silts, sands, and gravels. Recharge is small and occurs mainly along mountain fronts and the normally dry stream courses. In the Central Highlands province, small valleys between volcanic mountain blocks filled with unconsolidated sediments are the main source of groundwater.

The alluvial valley of the Santa Maria River varies substantially in width and depth to bedrock. The volume of alluvium, and particularly the depth of the material, influences the proportion of surface flow to underflow in the river valley. The groundwater in the alluvium consists of underflow that is forced toward the surface as the depth of the alluvium decreases.

Within the immediate vicinity of the Anderson Property, the lower sandstone conglomerate unit is the only producing groundwater zone. A pump test in this zone yielded an average flow rate of 57 gpm. The initial and final water depths in this test were 56.2 and 78.6 feet, respectively, yielding a total drawdown of 22.4 feet and a specific capacity of 2.5 gpm/ft of drawdown. This low yield did not warrant calculation of formation constants.

Another possible water producing zone, the Barren Sand Unit, pinches out south of the Anderson property. From well pump test data obtained from Urangesellschaft, it appears this unit is confined with an artesian head in the range of 500 feet and has a specific capacity of approximately 1.4 gpm/ft of drawdown.

Considerable faulting and fracturing in the vicinity of the Anderson property has resulted in sufficient movement of water between units so that it is not appropriate to treat the units as independent. The water elevations for wells in the Barren Sand unit generally decrease to the west and north toward the Santa Maria River. This movement is in opposition to the general dip of the sediments to the south and the east.

Groundwater elevations in wells penetrating the lower conglomerate decrease to the west-southwest. A west-southwest decline in water table elevations in this unit is further substantiated by Grapevine Springs, which begins at approximately 1400 feet in elevation.

There appears to be a general west-southwesterly movement of groundwater in the lower conglomerate unit that is strongly influenced locally by the northwesterly-trending faults in the area. The effects of these faults are indicated by local northwesterly-trending anomalies in water table elevations. Presumably such anomalies are associated with groundwater movements along the faults.

The recharge potential, both during active operation and after project termination, in the vicinity of the mill and tailing disposal areas is considered negligible. Laboratory tests on cores from the andesite flow underlaying the ore zone indicate vertical and horizontal permeabilities to be one foot per year. The water-bearing lower sandstone conglomerate overlaying the ore zone has a vertical and horizontal permeability of forty and eighty feet per year, respectively. Water movement in this latter zone is toward the north and will flow in to the pit area. The average inflow into the pit has been estimated by WDC to be 200 gpm although the amount will fluctuate as new areas are exposed.

The major potential uses of groundwater in the vicinity of the Anderson property are wildlife and livestock watering and domestic consumption. Groundwater in the area is of fairly good quality for these uses.

5.3.2 Surface Water

The Bill Williams River Basin covers approximately 5140 square miles. The Anderson property is drained by tributaries to the Santa Maria River. The Santa Maria watershed covers approximately 1520 square miles and constitutes about 30 percent of the Bill Williams River Basin. Unit runoff for streams in this province ranges from 1 to about 10 inches. The rest of the Bill Williams River Basin is located within the Basin and Range Province. Surface runoff in the low mountains and alluvial valleys of this province ranges from less than 0.1 inch to 0.5 inch.

Precipitation within the Bill Williams River Basin is strongly influenced by elevation and ranges from up to 20 inches per year in the higher mountains to the north and east to less than 10 inches per year in the desert regions to the south. Throughout the basin, precipitation normally occurs in the late summer and early fall in conjunction with thunderstorm activity and during the winter in the form of snow at high elevations.

Evaporation rates in the basin are influenced by elevation. The average annual lake evaporation rate is approximately 50 inches at higher elevations, while it reaches 80 inches in the hotter desert regions.

The large rivers in the basin, the Santa Maria, Big Sandy and Bill Williams River, are located in the hot, dry southern portion of the basin. All of the rivers are intermittent. Smaller washes in the

southern portion of the basin such as Date Creek, Bullard Wash, Centenial Wash, and Castenada Wash are dry during most of the year.

The maximum monthly discharge for the streams in the basin normally occurs in February or March. This discharge is in response to increased runoff resulting from snowmelt. The other major period of flow in these streams occurs in the late summer and early fall in response to precipitation and runoff from thunderstorms.

Infiltration plays an important role in the surface hydrology of the basin. Long reaches of the Santa Maria, Big Sandy and Bill Williams Rivers, and of the principal washes in the basin, are composed of coarse alluvium. The high permeability of this material, coupled with groundwater levels well below the depth of the stream channel, can drastically reduce surface flows. Substantial groundwater flow, in the form of underflow, occurs in these channels where the alluvium is underlain by impervious material such as bedrock. Consequently, surface flow in the major streams of the basin may be highly influenced by surface-subsurface water exchange that is regulated by the nature of the underlying sediments and the degree of saturation of these sediments.

Surface flow seldom occurs in the drainages on the Anderson property except for flash flooding. The dry soil of the washes and canyons tends to seal when wet, inhibiting infiltration and resulting in relatively high runoff. This runoff is normally quite erosive, particularly in the steeper, narrower canyons.

Surface flow in the vicinity of the Anderson Project normally occurs for only short periods during and immediately after precipitation. A single brief period of runoff was recorded on the property during the study period; however, personnel were not present to obtain water samples. Consequently, surface water quality data are not available for the property.

5.3.3 Pump Testing

The required mine water supply of 1000 gpm for 10 years can be developed from two sources. One of these is the recent alluvium along the Santa Maria River at Palmerita Ranch. The other is the sandstone and conglomerate unit in the southwest half of Section 16, T11N, R10W. There are five (5) irrigation wells at Palmerita Ranch. One of these could supply the required 1000 gpm, and a second could be used for standby reserve. Wells in the southwest half of Section 16 need to be drilled to a depth of about 1500 feet and would be capable of yielding 350 gpm each. Four wells would be needed, three for active use and one for standby.

Test Well AM-507 is located in Section 16. Basalt was encountered at a depth of 285-365 feet, and the underlying sandstone and conglomerate unit extends from 365 feet to bedrock at a depth of 1495 feet. The materials were examined, and with the exception of a white siltstone from 410 to 485 feet and a silty clay from 1150 to 1200 feet, appeared to be relatively unconsolidated with a fair degree of porosity. The hole encountered water at a depth of 485 feet, giving a saturated thickness of 1010 feet. Based on the data

from AM-507, a decision was made to drill and test a larger diameter well, AM-516, located 101 feet south of AM-507. The hole was rotary drilled 20-inch diameter to bedrock at a depth of 1490 feet, and 14-inch preperforated casing was installed to 1460 feet. Perforations were 1/8-inch by 3-inch sawcut slots extending from a depth of 550 feet to 1460 feet below land surface. Total number of perforations amounted to 44 per foot, giving an open area of 16.50 square inches per linear foot of casing. Following installation of casing, the well was packed with 1/8-inch to 3/8-inch siliceous gravel and then washed and jetted with the rotary rig.

A turbine test pump, powered by a diesel engine, was installed in the well, and the well was further developed by surging and backwashing. Maximum discharge during the pump development work was 539 gpm. Near the end of development, discharges were in the range of 500 to 520 gpm with a pumping water level in excess of 780 feet. At the 153 gpm rate, the transmissibility is in the range of 1600 gpd per foot of aquifer width; and at the 301 gpm rate, the value is 1000 gpd per foot of aquifer width. Insufficient time was available for stabilization at the 350 gpm rate. However, the transmissibility value for this rate would be something less than 1000 gpd per foot of aquifer width.

Wells at the Palmerita Ranch, which are planned as an alternate source of mill water, are developed in the alluvium. One of these wells yielded 2198 gpm with 17.49 feet of drawdown in 24 hours.

There are five (5) large diameter wells at the Palmerita Ranch which could be used for mill water supply.

Production of 1000 gpm for 10 years from the alluvial fill at Palmerita Ranch would not affect surface flows in the Santa Maria River, and therefore would not affect natural inflow to the recreation pool of water stored in the reservoir behind Alamo Dam. Production of 1000 gpm for 10 years from a well field that would produce from the Sandstone and conglomerate unit in Section 16, could reduce flow at Grapevine Springs, but would not affect water levels in any other springs, nor in wells within or beyond 11 miles of the center of pumping.

Observations during drilling indicates that faults within the pit area may carry sufficient water to require pit dewatering. A well field has been constructed consisting of 6 wells and 12 observation holes, but pump testing has not yet been carried out. Results from this pumping will indicate how much water will be expected in the pit, although the average inflow is not likely to exceed 200 gpm. A possibility exists, however, that fairly brief inflows, larger than the average, might occur due to the dense fracture and faulting system in the mine area.

While mining is in progress, seepage from the tailing impoundment will be negligible and, if any flow does exist, it will be captured in the pit sump.

SECTION 6

MINING

This section describes the mine location, mining procedures, plans and costs. The general mine layout and sequence are shown in Drawing No. MEC-001 of Exhibit II-A. The tailing dam, located in the mine area, is shown in Drawing No. MEC-002.

6.1 OVERBURDEN REMOVAL

The general development theory behind the overburden removal calculations is to, first, expose the initial tailings impoundment area, and secondly, to open up areas which carry a slightly higher grade than the ore body as a whole to maximize the cash flow. In no instance was the mining allowed to catch up with the stripping to allow for adequate working room to ensure proper ore grade control.

Table 6.1-1, Stripping and Mining Balance, details the flow of waste and ore in relation to milling requirements.

Primary stripping tonnages have been estimated at five percent water by weight and mining wastes at ten percent water content for the derivation of required equipment and resulting operating costs.

TABLE 6.1-1

STRIPPING AND MINING BALANCE

Sequence Production	Tons Ore	(x 10^6) Tons Stripping	Time in Months: Milling	Stripping	Advance Stripping	Remarks credited to sequences
		36.50	0	15	15	
1	530,999	15.86	8.7	6.5	17.2	
2	836,013	28.24	13.7	11.6	19.3	Stripping @
3	504,259	19.39	8.3	8.0	19.6	35 shifts/wk
4	1,033,255	48.25	17.0	19.8	16.8	29.2 million tons/yr
5	966,683	56.69	15.9	23.3	9.4	
6	768,796	21.49	12.6	12.4	9.6	
7	634,275	18.37	10.4	10.6	9.4	Stripping @
8	780,046	26.72	12.8	15.4	6.8	25 shifts/wk
9	762,369	16.35	12.5	9.4	9.9	20.8 million tons/yr
10	365,267	15.71	6.0	9.1	6.8	

6.1.1 Preproduction Stripping

Ore at the Anderson Mine is overlain by an average of 400 plus feet of overburden. Removal of this material will begin 15 months prior to mill startup. This preproduction period will allow sufficient time to strip, mine and construct a tailings dam in an area of shallow overburden thickness located in the north-center of the ore body. Excavated material will be used for fill in the mill area, tailings dam construction, or placed in surface waste dumps.

Prior to removal, overburden material will be blasted to facilitate loading. Two rotary drills will be used to drill 10-inch diameter holes which will be charged by a prill truck with an explosive mixture of ammonium nitrate and fuel oil. Detonation of the charged holes will then provide the desired fragmentation. Removal of overburden material will be accomplished using two 17-cu yd electric shovels loading into 120-ton capacity haulage trucks. Eleven 120-ton capacity haulage trucks will be needed to meet production requirements during preproduction.

Pioneer ramp construction will be handled by two track-type dozers and an air-track drill. Roads will be maintained by a waterwagon and a motor grader. Surface dumps will be maintained by a track-type dozer.

6.1.2 Production Stripping

Overburden removal during the production phase of mine life will require the addition of a few pieces of equipment to the existing

mine fleet. One additional 120-ton capacity haulage truck will be needed in the first year to meet static production demands coupled with increasing truck cycle times and an additional truck will be required in the sixth year.

Working pit slopes will be maintained at 2:1. Final pit slopes will be excavated to the steeper slopes recommended in the Dames & Moore Slope Stability Report. Waste material will be placed in surface waste dumps, used for tailings dam construction, or used to backfill abandoned pit sequences.

Overburden removal activities will terminate six months prior to the end of mill production.

6.2 ORE AND WASTE MATERIALS HANDLING

Upon completion of the high volume stripping requirements, the ore zone material will be mined at a much slower rate to allow for precise differentiation between ore and waste. Approximately 14,000 tpd, 250 dpy, of mining is scheduled based on an average waste to ore ratio of 3.6:1 and a 2,000 tpd, 365 dpy, milling feed rate. Actual rates may vary with differences in mining characteristics such as ore thickness and hardness and also as the waste to ore ratio varies between sequences.

6.2.1 Secondary Stripping

For purposes of evaluation, secondary stripping material is considered to be any waste, 10 feet or greater in thickness, which is encountered in the ore zone. Material classified as secondary stripping will be loaded using a 5-cu yd front shovel loading into 35-ton capacity haulage trucks. Close survey control will allow maximum removal of such waste material during mining.

6.2.2 Interior Waste Removal

Interior waste is considered to be ore zone waste material which is less than 10 feet thick. Interior waste will be removed by a combination of a 3-cu yd capacity hydraulic backhoe or a 5-cu yd front shovel loading into 35-ton capacity haulage trucks. Removal of this material will be closely coordinated with survey control and probe men. Ore zone material will go through the probe tower if there is any doubt as to it classification. Upon completion of the tailings impoundment, both the

secondary stripping and interior waste will be backfilled into mined out pit sequences.

6.2.3 Ore Mining

Based on current economics for the Anderson Mine, ore is identified as uranium bearing material having a grade of, or greater than, 0.028 percent U_3O_8. This material will be selectively removed, probed and hauled to stockpiles at the mill site. A 3-cu yd capacity hydraulic backhoe will load the ore into 35-ton capacity haulage trucks. In certain instances where thick lenses of ore occur, the front shovel may be used to accelerate ore mining production. Occasional hard lenses of limestone and silicified material are expected to occur in the ore zone. These materials will be ripped by a large track type dozer prior to loading. Most of the mining is anticipated to be directly excavated by the backhoe without previously being ripped. Roads and working areas in the mining area will be maintained by a motor grader and a waterwagon which will be shared with the stripping operations.

Ore mining will commence 9 months prior to mill startup and is scheduled for 10.5 years. Ore will be stockpiled at the mill site to provide the necessary flexibility in mill feed grade control.

6.3 ORE GRADE CONTROL

Given the normal erratic nature of uranium deposits and coupled with the extensive faulting and varying equilibrium factors found at the Anderson Mine, a precise system of ore control is required to maintain the desired mill feed grade.

Prior to excavation of the final stripping bench, each pit sequence will be drilled out on a minimum of 50-foot centers. The holes will be probed and the information used for controlling the bottom of stripping above the first ore intercept and in locating the deeper intercepts that mining will progress through. During actual mining operations, survey crews and probe men, equipped with Geiger-Mueller tube-type detectors, will locate ore-waste boundaries and give the loader operators guidance in making ore-waste determinations. Two probe men will be assigned to the tractor-ripper whenever it is working in or near an ore area.

Subsequent to loading the ore and subgrade material into haulage trucks, a determination of ore grade for each truckload will be made at a centrally located probe tower. This facility will be equipped with a high resolution gamma ray spectrometer with two movable probes which will penetrate the load, providing an accurate radiometric assay of each load. After grade determination the truck will be assigned to a stockpile area or sent to a waste area. As a cross-check to the probes accuracy, selected samples will be assayed daily in the mill lab to provide any correction factors that might be required.

6.4 STOCKPILING PROCEDURE

After the ore trucks pass through the probe tower and the individual loads are assayed, the units will be radio dispatched to one of three stockpile areas. Each area will be of a different average grade to provide the means for controlling mill feed grade. One area will be maintained at average mill grade with a smaller area of the high grade ore to be blended with the low grade area. The grade distribution, in respect to the total ore production, at any given time should be approximately 40 to 50 percent low grade, 30 to 40 percent mill run and 10 to 15 percent high grade. The grade distribution of the total ore body is shown on Table 6.4-1.

Preproduction mining will create a total stockpile inventory of approximately 550,000 tons of ore grade material. This stockpile will be maintained at roughly the same size until the last years of production at which time its size gradually diminishes to zero at project's end.

During mill operation, ore will be withdrawn from all three stockpile areas and blended to produce the required feed grade.

TABLE 6.4-1

ANDERSON MINE ORE RESERVE

GRADE DISTRIBUTION

% U_3O_8	Tons Ore	Lbs U_3O_8	% Total Tons Ore	% Total Lbs U_3O_8
0.028-0.03	471,000	273,000	7	3
0.03-0.04	1,634,000	1,133,000	23	11
0.04-0.05	1,295,000	1,158,000	18	11
0.05-0.06	898,000	984,000	13	10
0.06-0.07	699,000	906,000	7	9
0.07-0.08	438,000	655,000	6	6
0.08-0.09	325,000	551,000	5	5
0.09-0.10	282,000	532,000	4	5
0.10-0.11	153,000	320,000	2	3
0.11-0.12	119,000	273,000	2	3
0.12-0.13	101,000	253,000	1	3
0.13-0.14	93,000	248,000	1	2
0.14-0.15	80,000	231,000	1	2
$\geq$ 0.15	590,000	2,707,000	8	27

6.5 MINING SEQUENCE

Sequential pit layout for the Anderson Mine has been developed around four criteria:

a. Obtaining an early tailings pond site

b. Maximizing initial mill feed grade

c. Allowing reasonable flexibility in constructing tailings dam stages

d. Maximizing material volumes to backfill areas

Initial mining will provide an early short term tailings repository. The first stage tailings dam will allow time for excavating the main tailing impoundment site and for initial construction of the main stage dam. Upon completion of stripping in Sequence #1, activity will be directed to Sequence #2, which is in the northwest section of the ore body. This pit sequence is not required for the tailings dam but will serve to maintain a higher mill feed grade than the tailings pond area. Mining of Sequence #2 will be completed in sufficient time to allow the stripping and mining of Sequences #3 and #4 to be completed, providing for additional tailings area. Upon completion of Sequence #4, mine development will proceed south and then west. Due to the low grade and logistics associated with the East and West pits, they will be mined at the end of the project.

6.6 SCHEDULE AND CONSTRAINTS

6.6.1 Activity Schedule

a. Site preparation work for the administration building, shop, garage and warehouse facilities will commence on January 1, 1979. Mine strip material will be used for engineered fill. Construction of these mine facilities will commence on April 1, 1979, and be completed by October 1, 1979.

b. Pioneering to begin on July 1, 1979, and continue through September 1979.

c. Preproduction stripping to begin on October 1, 1979, and continue through December 1980.

d. Ore development for stockpiling and subsequent production to begin on March 1, 1980, and continue through September 1990.

e. Mill operation to begin in the first quarter of 1981, and continue into the fourth quarter of 1990.

f. Mine stripping production is based on 350 days per year.

g. Mine ore production is based on 250 days per year.

h. Mill to operate 365 days per year.

6.6.2 Stripping

Three periods of time have been established for the life of the mine: Preproduction of 15 months plus 3 months of pioneering work; Production I, extending for 4.5 years after start of production; and Production II, continuing for 4.75 years.

Preproduction is the time necessary to strip, mine and prepare the tailing dam area. The stripping shovels and their respective fleet of trucks will operate 35 shovel shifts per week.

Production I is scheduled at 35 shovel shifts per week. In Production II, the schedule is reduced to 25 shovel shifts per week.

Based on this schedule, the peaks occurring as the operation advances toward the high tonnage areas to the south are minimized.

The 35-shift week is composed of 7 crews; 4 crews rotating to generate 20 shifts per week and 3 crews rotating to yield 15 shifts per week. The specific manpower for operating units are detailed in Manpower Required Tables 6.9-1 through 6.9-9.

6.6.3 Mining

The mining is scheduled to work 3 crews rotating to generate 15 mining shifts per week throughout the mine life. See Tables 6.9-2 through 6.9-4.

6.6.4 Mine Parameters

a. Road travel width - 90 feet

b. Ramp grades - stripping 8%

- mining 12%

c. Bench height - 50 feet

d. Safety bench width - 100 feet (one bench)

e. Net highwall slopes (safety factor of 1.1:1)

Height	Slope
200 feet	0.36:1
400 feet	0.84:1
600 feet	1.00:1
800 feet	1.06:1

6.6.5 Material Production Rates

a. Preproduction

(1) 15 months of stripping totaling 36.5 million tons of overburden

(2) 9 months of secondary and interior waste removel of 2.03 million tons of waste and 547,500 tons of ore

b. Production I

(1) Strip at 29.2 million tons of overburden per year

(2) Secondary and interior waste removal of 2.71 million tons per year and mine at 730,000 tons of ore per year

c. Production II

(1) Strip at 20.8 million tons of overburden

(2) Secondary and interior waste, and ore mining remains at the same rate as in years 1 through 4.5

6.6.6 Equipment Operating Parameters

a. Shovel dipper fill factor - 0.90

b. Use of availability (excavation equipment) - 83% preproduction to year 5, 60% year 6 to 10

c. Mechanical availability (haulage truck) - 75%

d. Rolling resistance:

Roads - 2%

Ramps - 3% plus 1% per 1% grade

Loading area and dump - 4%

6.6.7 Mine Maintenance

The mine maintenance crew is on a parallel schedule with the mine, 4 rotating crews on 20 shifts per week. Tables 6.9-5 through 6.9-8 show the required manpower by category. The number of men required was obtained by applying historical factors to the total machine operating hours.

6.7 MINE EQUIPMENT LIST

Item	No. Units
Stripping:	
Shovels	2
Trucks - Preproduction	11
1st year add	1
6th year add	1
Drills	2
Prill Truck	1
Air Trac. & Compressor	1
Dozers with Rippers	3
Mining:	
Front Shovel/Backhoe	2
Trucks	10
Dozer with Ripper	1
Ore Control:	
Probe Tower	1
Spectrometer	1
Probes	8
Drill	1
Support:	
Motorgraders	2
Rubber Tire Dozer	1
Waterwagons	2

Item	No. Items
Miscellaneous:	
Light Plants	4
Bank Spray System	1
Sump Pumps	2
Pickup Trucks	6

6.8 MINE CAPITAL COST

Mine equipment capital costs were derived by taking the average of over 60 written quotations received from approximately 13 local equipment dealers. The costs are based on standard budgetary pricing per unit without any multiple order or competitive market discounts. Transportation (FOB minesite) and erection costs have been estimated and included whenever appropriate. The quotes reflect June 1, 1978 prices, and are presented in Tables 6.8.1 (Operations Equipment), 6.8.2 (Maintenance Equipment), and 6.8.3 (Administrative Function Equipment).

6.9 MANPOWER REQUIREMENTS

The mine and maintenance manpower requirements are itemized in Tables 6.9-1 through 6.9-9. The stripping, mining, ore control and support manpower are derived directly from the required operating units. The maintenance requirements were obtained by applying historical factors to the total unit operating hours.

The mine and maintenance supervision are addressed in Table 6.9-9.

The labor pool manpower requirement has been estimated at six percent of the minimum total manpower requirement to account for vacations and absenteeism.

TABLE 6.9-1

MINE MANPOWER - PIONEERING (13 WEEKS)

Crews	Shifts/Week	Total Personnel
Dozers	10	4
Air Trac Drill	10	4
Drills*	10	8
Prill Truck*	5	1
Motorgrader	10	2
Waterwagon	10	2
Powderman*	5	1
Labor*	10	2
		24

* Required after 8.7 weeks.

TABLE 6.9-2

MINE MANPOWER - PREPRODUCTION (15 MONTHS)

Crews	Shifts/Week	Total Personnel
Stripping		
Shovel - A	20	8
Shovel - B	15	6
Truck - A	20	16
Truck - B	15	12
Drills	15	12
Explosives	5	4
Prill Truck	5	1
Dozers - Pioneer	10	4
Dozers - Dump	20	4
Mining		
Front Shovel	15	6*
Truck	15	24*
Dozer	15	3*
Prober	15	15*
Drill - Ore Control	15	6*
Probe Tower	15	3*
Support		
Grader - A	20	4
Grader - B	15	3*
Rubber Tire Dozer	20	4
Waterwagon - A	20	4
Waterwagon - B	10	2*
Dump Spotters	20	4
Pipe Tenders	5	1
Labor Pool		8
TOTAL		154

* These people will be required after the twenty-fifth (25) week of preproduction.

TABLE 6.9-3

MINE MANPOWER - PRODUCTION I (4.5 YEARS)

Crews	Shifts/Week	Total Personnel
Stripping		
Shovel - A	20	8
Shovel - B	15	6
Truck - A	20	18
Truck - B	15	14
Drill	15	12
Explosives	5	4
Prill Truck	5	1
Dozers - Pioneer	10	4
Dozers - Dump	20	4
Mining		
Front Shovel	15	6
Truck	15	24
Dozer	15	3
Prober	15	15
Drill - Ore Control	15	6
Probe Tower	15	3
Support		
Grader - A	20	4
Grader - B	15	3
Rubber Tire Dozer	20	4
Waterwagon - A	20	4
Waterwagon - B	10	2
Dump Spotters - A	20	4
Dump Spotters - B	15	3
Pipe Tender	5	1
Labor Pool		9
TOTAL		162

TABLE 6.9-4

MINE MANPOWER - PRODUCTION II (4.75 YEARS)

Crews	Shifts/Week	Total Personnel
Stripping		
Shovel - A	15	6
Shovel - B	10	4
Truck - A	15	15
Truck - B	10	10
Drill	17	8*
Explosives	5	4
Prill Truck	5	1
Dozers - Pioneer	10	2
Dozers - Dump	20	4
Mining		
Front Shovel	15	6
Truck	15	24
Dozer	15	3
Prober	15	15
Drill - Ore Control	15	6
Probe Tower	15	3
Support		
Grader - A	15	3
Grader - B	10	2
Rubber Tire Dozer	20	3
Waterwagon - A	15	3
Waterwagon - B	5	1
Dump Spotters - A	15	3
Dump Spotters - B	10	2
Pipe Tenders	5	1
Labor Pool		7
TOTAL		136

* 3 shifts per week crew covers the track drill.

TABLE 6.9-5

MAINTENANCE MANPOWER - PIONEERING (13 WEEKS)

	Drill	Dozer & Waterwagon	Grader	Small & Service Vehicle	Total Men By Category
Mechanics	1.3	0.9	0.3	0.6	3
Mechanics & Welders Helpers	0.6	0.4	0.2	0.3	2
Welders	0.6	0.4	0.2	0.3	2
Lube Mechanics					1
Helpers					1
				TOTAL	9

TABLE 6.9-6

MAINTENANCE MANPOWER - PREPRODUCTION (15 MONTHS)

	Shovel	Truck	Drill	Dozer & Waterwagon	Mining Loader	Mining Truck	Mining Dozer	Grader	Total Men By Category
Mechanics	2.8	2.9	2.0	1.6	2.0	2.0	0.3	0.7	14
Mechanic & Welder Helpers	0.8	1.0	0.7	0.6	0.9	0.6	0.1	0.3	5
Welders	1.6	2.0	0.7	0.8	0.9	1.1	0.2	0.4	8
Electricians	4.0	2.0							6
Electrician Apprentices									2
Lube Mechanics									4
Lube Mechanic Helpers									2
Fuelman									4
Machinists									2
Steam Cleaners & Janitors									4
Service Vehicle Mechanics									5
Labor Pool									5
TOTAL									61

TABLE 6.9-7

MAINTENANCE MANPOWER - PRODUCTION I (4.5 YEARS)

	Shovel	Truck	Drill	Dozer & Waterwagon	Mining Loader	Mining Truck	Mining Dozer	Grader	Total Men By Category
Mechanics	2.8	3.2	2.0	1.6	2.0	2.0	0.3	0.7	15
Mechanic & Welder Helpers	0.8	1.2	0.7	0.6	0.9	0.6	0.1	0.3	5
Welders	1.6	2.3	0.7	0.8	0.9	1.1	0.2	0.4	8
Electricians	4.0	2.3							6
Electrician Apprentices	0.8	0.5							2
Lube Mechanics									4
Lube Mechanic Helpers									2
Fuelmen									4
Machinists									2
Steam Cleaners & Janitors									4
Service Vehicle Mechanics									5
Labor Pool									5
							TOTAL		62

TABLE 6.9-8

MAINTENANCE MANPOWER - PRODUCTION II (4.75 YEARS)

	Shovel	Truck	Drill	Dozer & Waterwagon	Mining Loader	Mining Truck	Mining Dozer	Grader	Total Men By Category
Mechanics	2.0	3.6	2.0	1.6	2.0	2.0	0.3	0.5	14
Mechanic & Welder Helpers	0.6	1.3	0.7	0.6	0.9	0.6	0.1	0.2	5
Welders	1.2	2.6	0.7	0.8	0.9	1.1	0.2	0.3	8
Electricians	2.8	2.6							5
Electrician Apprentices	0.6	0.5							1
Lube Mechanics									2
Lube Mechanic Helpers									2
Fuelman									4
Machinists									2
Steam Cleaners & Janitors									4
Service Vehicle Mechanics									5
Labor Pool									4
								TOTAL	56

TABLE 6.9-9

MINE AND MAINTENANCE SUPERVISION

<u>Mine</u>	
Mine Superintendent	1
Mine General Foreman	1
Shift Foreman	4
Mine Planning Engineer	1
Ore Foreman	1
Chief Mine Engineer	1
Mine Geologist	1
Clerk	1
Ore Control Engineer	1
Mine Surveyor	1
Surveyor Helper	1
Draftsman	1
TOTAL	15
<u>Maintenance</u> (Mine and Mill)	
Maintenance Superintendent	1
General Maintenance Foreman	3
Shift Foreman	4
Mechanical Engineer	1
Maintenance Clerk	1
TOTAL	10

6.10 OPERATING AND MAINTENANCE COSTS

Operating costs for the Anderson Mine are based on equipment numbers and operating hours developed for equipment selection and justification. Hourly equipment operating costs were developed by estimating costs for individual pieces of equipment. Itemized operating costs reflect:

a. Fuel and fluid consumption

b. Parts and supplies

c. Maintenance labor

d. Major repairs

e. Operating labor

Costs are applied only to actual machine operating hours. This excludes time for lunch breaks, and time while operator is in transit to or from the machine. Operating labor is based on an eight-hour day but is factored into the operating cost so as to reflect the actual operating hours (typically: 8 hr day ÷ 7 or 7-1/2 hr operated x hourly wage).

Wages for maintenance personnel are built into the operating costs with the exception of the following categories:

a. Fueling personnel

b. Machinists

c. Steam cleaners and janitors

d. Service vehicle personnel

e. Miscellaneous labor

These categories and engineering and supervision have been itemized separately. Table 6.10-1 summarizes the operating costs by periods.

Tables 6.10-2 through 6.10-12 provide mine operating cost estimate details.

TABLE 6.10-1

MINE OPERATING COST SUMMARY BY PERIOD

Preproduction	15 Month $	$/Ton Milled	$/Lb U_3O_8[1]	$/Lb U_3O_8[2]	$/Total Tons Mined
Pioneering	254,909*	--	--	--	0.007
Stripping	8,521,982	--	--	--	0.218
Mining	1,682,733	--	--	--	0.043
Ore Control	584,990	--	--	--	0.015
Support & sm. veh.	1,408,730	--	--	--	0.036
Superv. & Eng.	639,292**	--	--	--	0.016
Maint. & Labor	579,900	--	--	--	0.015
Maint. Superv.	420,107	--	--	--	0.011
TOTAL	14,092,643***				0.361

Production I	Annual $	$/Ton Milled	$/Lb U_3O_8[1]	$/Lb U_3O_8[2]	$/Total Tons Mined
Stripping	7,168,512	9.820	6.810	7.967	0.220
Mining	2,243,625	3.073	2.131	2.493	0.069
Ore Control	779,940	1.068	0.741	0.866	0.024
Support & sm. veh.	1,301,670	1.783	1.236	1.447	0.040
Superv. & Eng.	426,195	0.584	0.405	0.474	0.013
Maint. & Labor	437,000	0.598	0.414	0.486	0.013
Maint. Superv.	220,674	0.302	0.203	0.245	0.007
TOTAL	12,577,616	17.228	11.940	13.978	0.386

Production II	Annual $	$/Ton Milled	$/Lb U_3O_8[1]	$/Lb U_3O_8[2]	$/Total Tons Mined
Stripping	5,675,561	7.775	--	6.308	0.234
Mining	2,122,875	2.908	--	2.359	0.088
Ore Control	779,940	1.068	--	0.867	0.032
Support & sm. veh.	938,565	1.286	--	1.043	0.039
Superv. & Eng.	426,195	0.584	--	0.474	0.018
Maint. & Labor	417,060	0.571	--	0.463	0.017
Maint. Superv.	220,674	0.302	--	0.245	0.009
TOTAL	10,580,870	14.494		11.759	0.437

NOTES: 730,000 tpy ore

1. 1,052,718 lb U_3O_8/yr @ ore grade 0.080% U_3O_8, 90.13% recovery for the first two years
2. 899,810 lb U_3O_8/yr @ ore grade 0.0696% U_3O_8, 88.55% recovery for the remainder of operation life

*Based upon 3 months

**Based upon 18 months

***Preproduction operating costs treated as a capital expense for the cash flow analysis.

TABLE 6.10-2

OPERATING HOURS - PIONEERING (13 WEEKS)

	Hours/Shift	Units	Shifts/Week	Total Hours
Dozers-Pioneer	7.5	2	10	1950
Air Trac Drill	7.5	1	10	975
Compressor	7.5	1	10	975
Drills	7.5	2	10 x 4 wks.	600
Prill Truck	7.5	1	5 x 4 wks.	150
Motor Grader	7.5	1	10	975
Waterwagon	7.5	1	10	975
Small Vehicles	7.5	2	10	1950
Powderman	8	1	5 x 4 wks.	160
Labor	8	2	5 x 4 wks.	320

TABLE 6.10-3

UNIT OPERATING COSTS - PIONEERING (13 WEEKS)

	Cost/Hour	Total Hours	Total Cost
Dozers-Pioneer	$43	1950	$ 83,850
Air Trac Drill	35	975	34,125
Compressor	14	975	13,650
Drills	70	600	42,000
Prill Truck	14	150	2,100
Motor Grader	26	975	25,350
Waterwagon	38	975	37,050
Small Vehicles	6	1950	11,700
Powderman	12.04	160	1,926
Labor	9.87	320	3,158
		TOTAL	$254,909

TABLE 6.10-4

OPERATING HOURS - PREPRODUCTION (15 MONTHS)

	Hours/Shift	Units	Shifts/Week	Total Hours
Stripping				
Shovels	7	2	17.5	15,312
Trucks	7.5	8	17.5	65,625
Drills	7	2	15	13,125
Powdermen	8	5	5	12,500
Prill Truck	7	1	5	2,188
Air Trac Drill	7.5	1	5	2,344
Compressor	7.5	1	5	2,344
Dozers-Pioneer	7	2	10	8,750
Dozers-Dump	7.5	1	20	9,375
Mining				
Front Shovels	7	2	15	7,875
Trucks	7.5	8	15	33,750
Dozer-Ripper	7.5	1	15	4,219
Ore Control				
Probe Tower	8	1	15	4,500
Probe Men	8	5	15	22,500
Drill-Ore Control	7	1	15	3,938
Support				
Motor Grader A	7.5	1	20	9,375
Motor Grader B	7.5	1	15	4,219
Dozer - Rubber Tire	7.5	1	20	9,375
Waterwagon A	7.5	1	20	9,375
Waterwagon B	7.5	1	10	2,813
Dump Spotters	8	4	5	10,000
Pipe Tender	8	1	5	2,500
Small Vehicles				23,437
Labor				
Primary Stripping	8	5	5	12,500
Mining	8	3	5	4,500

TABLE 6.10-5

UNIT OPERATING COSTS - PREPRODUCTION (15 MONTHS)

	Cost/Hour	Total Hours	Total Cost
Stripping			
Shovel	$89	15,312	$ 1,362,768
Truck	60	65,625	3,937,500
Drill	70	13,125	918,750
*Explosives			1,227,601
Powdermen	12.04	12,500	150,500
Prill Truck	14.00	2,188	30,632
Air Trac Drill	35	2,344	82,040
Compressor	14	2,344	32,816
Dozers-Pioneer	43	8,750	376,250
Dozer-Dump	43	9,375	403,125
Mining			
Front Shovel	46	7,875	362,250
Truck	32	33,750	1,080,000
Dozer-Ripper	57	4,219	240,483
Ore Control			
Probe Tower	12.04	4,500	54,180
Probe Men	11.34	22,500	255,150
Drill-Ore Control	70	3,938	275,660
Support			
Grader A	26	9,375	243,750
Grader B	26	4,219	109,694
Dozer-Rubber Tire	35	9,375	328,125
Waterwagon A	38	9,375	356,250
Waterwagon B	38	2,813	106,894
Dump Spotters	9.87	10,000	98,700
Pipe Tender	9.87	2,500	24,695
Small Vehicles	6	23,437	140,622
TOTAL COST			$12,198,435

*See Drilling & Blasting Cost Summary

TABLE 6.10-6

OPERATING HOURS - PRODUCTION I (4.5 YEARS)

	Hours/Shift	Units	Shifts/Week	Annual Hours
Stripping				
Shovels	7	2	17.5	12,250
Trucks	7.5	9	17.5	59,063
Drills	7	2	15	10,500
Powdermen	8	5	5	10,000
Prill Truck	7	1	7	1,750
Air Trac Drill	4	1	5	1,000
Compressor	4	1	5	1,000
Dozers - Pioneer	7	2	10	7,000
Dozer - Dump	7.5	1	20	7,500
Mining				
Front Shovel	7	2	15	10,500
Trucks	7.5	8	15	45,000
Dozer - Ripper	7.5	1	15	5,625
Ore Control				
Probe Tower	8	1	15	6,000
Probe Men	8	5	15	30,000
Drill-Ore Control	7	1	15	5,250
Support				
Grader A	7.5	1	20	7,500
Grader B	7.5	1	15	5,625
Dozer - Rubber Tire	7.5	1	20	7,500
Waterwagon A	7.5	1	20	7,500
Waterwagon B	7.5	1	10	3,750
Dump Spotters A	8	4	5	8,000
Dump Spotters B	8	3	5	6,000
Pipe Tender	8	1	5	2,000
Small Vehicles				18,750
Labor	8	8	5	16,000

TABLE 6.10-7

UNIT OPERATING COSTS - PRODUCTION I (4.5 YEARS)

	Cost/Hour	Total Hours	Annual Cost
Stripping			
Shovel	$89	12,250	$ 1,090,250
Truck	60	59,063	3,543,780
Drill	70	10,500	735,000
*Explosives			982,082
Powdermen	12.04	10,000	120,400
Prill Truck	14.00	1,750	24,500
Air Trac Drill	35	1,000	35,000
Compressor	14	1,000	14,000
Dozer-Pioneer	43	7,000	301,000
Dozer-Dump	43	7,500	322,500
Mining			
Front Shovel	46	10,500	483,000
Truck	32	45,000	1,440,000
Dozer-Ripper	57	5,625	320,625
Ore Control			
Probe Tower	12.04	6,000	72,240
Probe Man	11.34	30,000	340,200
Drill-Ore Control	70	5,250	367,500
Support			
Motor Grader A	26	7,500	195,000
Motor Grader B	26	5,625	146,250
Dozer-Rubber Tire	35	7,500	262,500
Waterwagon A	38	7,500	285,000
Waterwagon B	38	3,750	142,500
Dump Spotter A	9.87	8,000	78,960
Dump Spotter B	9.87	6,000	59,220
Pipe Tender	9.87	2,000	19,740
Small Vehicle	6	18,750	112,500
TOTAL COST/YEAR			$11,493,747

*See Drilling & Blasting Cost Summary

TABLE 6.10-8

OPERATING HOURS - PRODUCTION II (4.75 YEARS)

	Hours/Shift	Units	Shifts/Week	Annual Hours
Stripping				
Shovels	7	2	12.5	8,750
Trucks	7.5	10	12.5	46,875
Drills	7	2	8.5	5,950
Powdermen	8	4	5	8,000
Prill Truck	7	1	5	1,750
Prill Truck Driver	8	1	5	2,000
Air Trac Drill	4	1	5	1,000
Compressor	4	1	5	1,000
Dozer-Pioneer	7	1	10	3,500
Dozer-Dump	7.5	2	20	15,000
Mining				
Front Shovels	7	2	15	7,875
Trucks	7.5	8	15	45,000
Dozer-Ripper	7.5	1	15	5,625
Ore Control				
Probe Tower	8	1	15	6,000
Probe Men	8	5	15	30,000
Drill-Ore Control	7	1	15	5,250
Support				
Motor Grader A	7.5	1	15	5,625
Motor Grader B	7.5	1	10	3,750
Dozer - Rubber Tire	7.5	1	15	5,625
Waterwagon A	7.5	1	15	5,625
Waterwagon B	7.5	1	5	1,875
Dump Spotters A	8	3	5	6,000
Dump Spotters B	8	2	5	4,000
Pipe Tender	8	1	5	2,000
Small Vehicles				15,750
Labor	8	7	5	14,000

TABLE 6.10-9

UNIT OPERATING COSTS - PRODUCTION II (4.75 YEARS)

	Cost/Hour	Total Hours	Annual Cost
Stripping			
Shovel	$89	8,750	$ 778,750
Truck	60	46,875	2,812,500
Drills	70	5,950	416,500
*Explosives			702,491
Powdermen	12.04	8,000	96,320
Prill Truck	14	1,750	24,500
Air Trac Drill	35	1,000	35,000
Compressor	14	1,000	14,000
Dozer-Pioneer	43	3,500	150,500
Dozer-Dump	43	15,000	645,000
Mining			
Front Shovel	46	7,875	362,250
Truck	32	45,000	1,440,000
Dozer-Ripper	57	5,625	320,625
Ore Control			
Probe Tower	12.04	6,000	72,240
Probe Men	11.34	30,000	340,200
Drill-Ore Control	70	5,250	367,500
Support			
Motor Grader A	26	5,625	146,250
Motor Grader B	26	3,750	97,500
Dozer - Rubber Tire	35	5,625	196,875
Waterwagon A	38	5,625	213,750
Waterwagon B	38	1,875	71,250
Dump Spotter A	9.87	6,000	59,220
Dump Spotter B	9.87	4,000	39,480
Pipe Tender	9.87	2,000	19,740
Small Vehicle	6	15,750	94,500
TOTAL COST/YEAR			$9,516,941

* See Drilling & Blasting Cost Summary

TABLE 6.10-10

SUPERVISION & ENGINEERING ANNUAL COST

	$/Yr	$/Ton	$/Lb[1] U_3O_8	$/Lb[2] U_3O_8
1 Mine Superintendent	$ 33,000	0.045	0.031	0.037
1 Mine General Foreman	28,600	0.039	0.027	0.032
4 Shift Foremen @ $24,200	96,800	0.133	0.092	0.108
1 Mine Planning Engineer	24,200	0.033	0.023	0.027
1 Ore Foreman	24,200	0.033	0.023	0.027
1 Chief Mine Engineer	28,600	0.039	0.027	0.032
1 Mine Geologist	24,200	0.033	0.023	0.027
1 Clerk	16,500	0.023	0.016	0.018
1 Ore Control Engineer	19,800	0.027	0.019	0.022
1 Mine Surveyor	17,600	0.024	0.017	0.020
1 Surveyor Helper	16,500	0.023	0.016	0.018
1 Draftsman	16,500	0.023	0.016	0.018
	$346,500	0.475	0.330	0.386
Burden @ 23%	79,695	0.109	0.076	0.089
TOTAL	$426,195*	0.584	0.406	0.475

NOTES: 730,000 tpy Ore
1. 1,052,718 lb U_3O_8/yr @ ore grade 0.080% U_3O_8, 90.13% recovery
2. 899,810 lb U_3O_8/yr @ ore grade 0.0696% U_3O_8, 88.55% recovery

*Preproduction (18 months) cost is $639,292 or 1.5 x $426,195

TABLE 6.10-11

MAINTENANCE OPERATING COST, LABOR AND MOBILE EQUIPMENT

The mechanics, welders, electricians, lubrication mechanics, and helpers are included in the unit hourly operating costs. The following categories are not included in those costs:

	Annual Costs		
	Preproduction	Production I	Production II
Fuel Men	$ 90,720	$ 90,720	$ 90,720
Machinists	48,160	48,160	48,160
Steam Cleaner & Janitors	90,720	90,720	90,720
Labor Pool	99,700	99,700	79,760
Labor Cost/Year	$329,300	$329,300	$309,360
Per 15 Months	$411,625		
Mobile Equipment Cost/Year	$134,620	$107,700	$107,700
TOTAL LABOR AND MOBILE EQUIPMENT COST/YEAR	$463,920	$437,000	$417,060
PER 15 MONTHS	$579,900		

*Used in Table 6.10-1

TABLE 6.10-12

MAINTENANCE SUPERVISION ANNUAL COST

	$/Yr	$/Ton	$/Lb[1] U_3O_8	$/Lb[2] U_3O_8
1 Maintenance Superintendent	$ 33,000	$0.045	$0.031	$0.037
3 General Maintenance Foremen @ $28,600	85,800	0.117	0.081	0.096
4 Shift Foremen @ $24,200	96,800	0.133	0.092	0.108
1 Mechanical Engineer	24,200	0.033	0.023	0.027
1 Maintenance Clerk	16,500	0.023	0.016	0.018
	$256,300	$0.351	$0.243	$0.286
Burden @ 23%	58,949	0.081	0.050	0.066
TOTAL (Mine & Mill)	$315,249	$0.432	$0.293	$0.352
Allocated to Mill Maint.	(94,575)	(0.130)	(0.090)	(0.106)
Allocated to Mine Maint.	$220,674*	$0.302	$0.203	$0.246

NOTES: 730,000 tpy Ore
1. 1,052,718 lb U_3O_8/yr @ ore grade 0.080% U_3O_8, 90.13% recovery
2. 899,810 lb U_3O_8/yr @ ore grade 0.0696% U_3O_8, 88.55% recovery

*Preproduction (18 months) cost is $315,249 x 1.5 = $472,874 - no allocation to mill maintenance.

6.11 MAINTENANCE PROCEDURES

6.11.1 Field Maintenance

Field maintenance services consist of those tasks which cannot be performed in the maintenance shop. This will be limited to those equipment items which are too large or slow to transport to the shop. For the Anderson Mine, this will refer only to repairs and services for the two electric shovels and to servicing tracked equipment. Major repairs on all equipment, except the electric shovels, will be performed at the shop. Equipment will be transported to the shop on a lowboy trailer if necessary. The field service fleet will consist of a 2-ton shovel service truck, a welding and compressor truck, 15-ton rough terrain and 75-ton lattice boom cranes and a 10-ton fork-lift.

6.11.2 Shop Maintenance

Maintenance shops will provide a work area for equipment servicing, mechanical repairs and major component replacement. Rebuilding of major components will be performed by the various vendors at their facilities. A minimum stock of components will be warehoused due to the close proximity of vendor warehouses. Shop operation will be maintained 20 shifts per week. Equipment will be rotated through the shop for preventative maintenance on a regular basis.

SECTION 7

MINING FACILITIES

This section incorporates the portion of the plant site relating to administration, maintenance and mine-related facilities. Addressed are the administration building, maintenance and service shops, fuel storage and distribution which are depicted on Drawing 21-53-0-104, Mill and Mine Facility Plot Plan.

7.1 ADMINISTRATION BUILDING

The floor plan and elevation of this building is found on Drawing No. 21-53-0-011. The building contains 12,800 square feet and is a pre-engineered structure enclosed by factory-finished and insulated metal wall and roof panels.

The overall plan of the building was designed to group personnel by functions. Office locations and halls were arranged to minimize traffic and noise. The office portion of the building includes administrative offices, technical service offices, and a safety and first aid area. The laboratory portion of the building contains the metallurgical and analytical laboratories, including a balance room, atomic absorption room and sample preparation area. The balance room and the sample preparation room will be built on vibration-free pads.

Partitions will be of steel stud and gypsum board construction. The wall separators, mechanical equipment room, and the sample

preparation room shall be constructed of 8-inch conrete block and have a four-hour fire rating.

The heating and air conditioning system will have three zones. The sample preparation system will be equipped with dust control. The laboratory area will be equipped with fume control. The remainder of the building will be combined into a common system. The heating system will be total electric.

7.2 MAINTENANCE AND SERVICE SHOPS

Two prefabricated buildings will house all the maintenance and service facilities. One building will incorporate the maintenance shop, warehouse and change rooms. (Drawing No. 21-51-0-012). The other building will include tire repair, lubrication and wash facilities. (Drawing No. MEC-003).

The heavy equipment repair area consists of five (5) repair bays, a welding bay and a bay for mill repair. These facilities cover 12,400 square feet. The 54-foot height will accommodate a 20-ton overhead bridge crane. An additional 12,400 square feet will be built to 24 feet in height. This area will include the warehouse, change rooms, utility vehicle shop, electrical shop, lunch room and maintenance offices. The warehouse covers 5500 square feet with extra storage coming from a loft covering half the area, and a 6900 square foot fenced area immediately adjacent to the warehouse. The change rooms are designed to provide facilities for 225 people at an 80 percent men/20 percent women ratio. The heavy equipment repair bays will use radiant type heaters. The remaining areas will utilize baseboard heaters.

The tire repair and lubrication building covers 7300 square feet, and is 32 feet high. The tire repair area is 3600 square feet. The lubrication bay is designed to handle servicing for all vehicles and is equipped with a hydraulic lift to handle small vehicles and medium size trucks. A 1800 square foot area adjacent to the building is provided with equipment wash facilities.

7.3 FUEL STORAGE

The fueling island is east of the lube and tire repair shop. Its location provides access on either side. Its function is to provide diesel fuel, engine coolant, hydraulic fluids, engine oil and air to the mine equipment.

The tank farm is designed for two weeks storage of the major lubricants for the mine and two weeks diesel fuel storage for the entire mine and mill complex. Lubricants were standardized to three principle grades and stored in 300 to 500 gallon prefabricated vertical tanks. Bulk storage of lubricants include: Engine oil (2-500 gal); transmission and hydraulic oil (2-500 gal), and final drive (1-300 gal). Engine coolant is also contained in a 500 gallon tank. Greases, solvents and special-purpose lubricants consumed in smaller quantities will be purchased and stored in 55 gallon drums. Two 100,000 gallon vertical fuel tanks will store #2 diesel fuel. Local manufacturers supplied capital cost figures including appropriate site-preparation and erection expenditures. Layout of the tank farm and fuel island is shown in Drawing No. MEC-004.

EXHIBIT II-A
DRAWINGS

EXHIBIT II-B
EQUIPMENT OPERATING
COST CALCULATIONS

EXHIBIT II-B

MINE EQUIPMENT HOURLY COST CALCULATIONS

17 Cu Yd Stripping Shovel

	Cost/Operating Hour
Electric Power	
450 kwh x 0.04 $/kwh	$18.00
Repairs, Maintenance & Supplies	
@ $0.018/ton, 2,380 t/hr x 0.018	42.84
Labor	
Operator	14.64
Oiler	13.76
	$89.24
	USE $89.00

Reference P & H Costing Method

120-Ton Hauler

	Cost/Operating Hour
Maintenance, Service & Repair Fc[Pf + (Lf x Mw)] Fuel Consumption (Fc) = 29.29 gal/hr Part Factor (Pf) = 0.443 Labor Factor (Lf) = 0.0292 Mechanic Wage (Mw) = 8.6 x 1.40 = $12.04	
MS & R 29.29 [0.443 + (0.0292 x 12.04)]	$23.27
Tires Life - 3,500 hrs 30 x 51-52 ply = $6,282/tire x 6 = $37,698	10.77
Fuel Consumption = 29.2 gal/hr Unit Cost = $0.38/gal	11.10
Preventative Maintenance	1.73
Operator	12.84
	$59.71
	USE $60.00

Reference Wabco Costing Method

Rotary Drill

	Cost/Operating Hour
Fuel 18.8 gal/hr @ $0.38/gal	$ 7.14
Lube Oil	1.26
Tires	0.52
Parts & Supplies 6.90 x (5 hp ÷ 3 hp)	11.50
Labor Operator @ 7/8 hrs - 13.76 Helper @ 7/8 hrs - 12.96	26.72
Subtotal Operating	$47.14
Bits 10" @ $600 @ 3,000 ft @ 80 ft/hr x 0.83	13.28
Drill Pipe $12,000 set 100,000 ft life $5,000 rebuild (2) x 0.83	4.87
Stabilizers $3,000 - 40,000 ft life	4.98
Subtotal Consumables	$23.13
TOTAL OPERATING COSTS	$70.29
	USE $70.00

Reference Updated Ingersoll-Rand T-4 Drilling Costs

Dozers - Pit & Dump (less than 20% ripping)

	Cost/Operating Hour
Fuel 18.8 gal/hr x $0.38/gal	$ 7.14
Preventative Maintenance	0.46
Repair $\frac{0.09 \text{ factor } (\$256,000)}{1,000}$	23.04
Operator 8.60 x 1.40 x 8/7.5	12.84
	$43.48
	USE $43.00

Dozers - Mining Application

	Cost/Operating Hour
Ripper - Teeth, Shanks, Adaptors & Repair	$13.40
Cost from above	43.48
	$56.88
	USE $57.00

Reference Caterpillar Performance Handbook

Hydraulic Excavator

	Consumption/Hour	Unit Cost	Cost/Operating Hour
Fuel	12 gal	$0.38	$ 4.56
Lube & Preventative Maintenance			
Crankcase Oil	0.15	1.50	0.23
Final Drive	0.02	1.50	0.03
Hydraulic Oil	0.15	1.50	0.23
Grease	0.05 lb	0.30	0.02
Filters			0.13
Repairs			
$\frac{0.07 \text{ factor} \times \$314,000}{1,000}$			21.98
Bucket & Teeth			4.00
Operator			14.64
			$45.82
			USE $46.00

Reference Caterpillar Performance Handbook

35-Ton Hauler

	Cost/Operating Hour
Fuel	
10.2 gal/hr x $0.38/gal	$ 3.88
Lube	0.93
Repairs	
Maintenance & Repair Fc[Pf + (Lf x Mw)]	
Fc = 10.2	
Pf = 0.577	
Lf = 0.0527	
Mw = 8.60 x 1.40 = 12.04	
M&R 10.2[0.577 + (0.0527 x 12.04)]	12.36
Tires	
Life = 4,000 hrs	
Cost = 1,098 x 6 = $6,588	1.65
Operator	12.84
	$31.66
	USE $32.00

Reference Wabco Costing Method

Motorgrader - 16 Ft Moldboard

	Consumption/Hour	Unit Cost	Cost/Operating Hour
Fuel	9.5 gal	$0.38	$ 3.61
Lube & Preventative Maintenance			
Crankcase Oil	0.11	1.50	0.17
Transmission Fluid	0.05	1.50	0.08
Final Drive	0.02	1.50	0.03
Hydraulic Oil	0.02	1.50	0.03
Grease	0.02 lb	0.30	0.01
Filters			0.08
Repairs $\frac{0.05\ ($155,863)}{1,000}$			7.79
Tires $6,437 @ 3,500 hrs			1.84
Operator			12.84
			$26.48
			USE $26.00

Reference Caterpillar Performance Handbook

Rubber-Tired Dozer

	Cost/Operating Hour
Fuel 11.2 gal/hr x $0.38/gal	$ 4.26
Preventative Maintenance	0.56
Tires Life = 3,500 hrs Cost = $12,000	3.43
Repair $\frac{0.09\ (\$150,600)}{1,000}$	13.55
Operator	12.84
	$34.64
	USE $35.00

Reference Caterpillar Performance Handbook

50-Ton Water Truck

	Consumption/Hour	Unit Cost	Cost/Operating Hour
Fuel	17.0 gal	$0.38	$ 6.46
Engine Oil	0.07	1.610	0.11
Transmission Oil	0.04	2.07	0.08
Final Drive	0.014	3.15	0.04
Hydraulic Oil	0.04	1.50	0.06
Grease	0.10 lbs	0.42	0.04
Filters			0.20
Repairs $\frac{0.07\ (\$223,298)}{1,000}$			15.63
Tires Life = 4,000 hrs Cost = $11,840			2.96
Operator			12.84
			$38.42
			USE $38.00

Reference International Earthmoving Principles

Miscellaneous Equipment

	Cost/Operating Hour
Air Track Drill (includes operator)	$34.56
	USE $35.00
Compressor	$14.23
	USE $14.00
12-Ton Prill Truck (operator not included)	$13.93
	USE $14.00

Reference "Preliminary Feasibility Study, 12/77", Morrison-Knudsen

Small Vehicles	USE $ 6.00

Reference "Cost Reference Guide", Equipment Guide-Book Company

Medium Size Vehicles	$10.06
	USE $10.00

Reference "Cost Reference Guide", Equipment Guide-Book Company

EXHIBIT II-C
EQUIPMENT JUSTIFICATION

EXHIBIT II-C

EQUIPMENT JUSTIFICATION

MINING EQUIPMENT AND FACILITY SIZING CALCULATIONS

A. Equipment

1. 17 cu yd Stripping Shovel

Material Density @ 10% H_2O = 1.81 ton/Bank cu yd

Dipper Capacity - 17 cu yd

Dipper Fill Factor = 0.90

Swell Factor @ 25% = 0.80

Effective tons/dipper:

17 cu yd x 1.81 ton/Bank cu yd x 0.80 x 0.90 = 22.15 tons/cycle

Cycle Time @ 90% Swing = 27.8 seconds

Job Efficiency Factor = 83%

Effective tons/hr:

22.15 tons/cycle x (3600 sec/hr x 0.83) ÷ 27.8 sec/cycle
= 2381 ton/hour

Effective Operating Hours per 8-hr shift = 7 hours (actual)

Production/shift:

2381 tons/hr x 7 hrs/shift = 16,667 tons/shift

Annual Production during Period I:

16,667 tons/shift x 35 shifts/wk x 50 wk/yr = 29,167,250 tons/yr
approximately 29.2 million tons/yr

% Utilization = 35 scheduled shifts ÷ 42 potential shifts = 83%

Annual Production during Period II:

16,667 tons/shift x 25 shifts/wk x 50 wk/yr = 20,833,750 tons
approximately 20.8 million tons/yr

% Utilization = 25 scheduled shifts ÷ 42 potential shifts = 60%

2. Front Shovel

Material Weight: 2.71 million tons @ 15.45 cu ft/ton
0.73 million tons @ 20.46 cu ft/ton
3.44 million tons @ 16.51 cu ft/ton

Material required per shift = 4590 tons

Dipper Fill Factor = 100% assumed

% Swell Factor = 25%

Working time per shift = 7 hr x 60 min x 60 sec = 25,200 sec

Tons per cu yd = 27 cu yd ÷ (16.51 x 1.25)

Front Shovel Production:

5 cu yd dipper = 5 cu yd x 1.31 tons/bank cu yd = 6.55 tons/dipper

3 cu yd dipper = 3 cu yd x 1.31 tons/bank cu yd = 3.93 tons/dipper

Work efficiency = 0.83

cycle time = 35 sec

availability = 0.75

5 cu yd:
6.55 x (25,200 x 0.83) ÷ 35 x 0.75 = 2936 tons/shift

3 cu yd:
3.93 x (25,200 x 0.83) ÷ 35 x 0.75 = 1761 tons/shift
4697 total tons/shift

Safety factor: 4697 tons ÷ 4590 tons = 1.02

3. 120-ton Truck Fleet Estimation

Assumptions:

Material Density = 14.95 cu ft/ton

Shovel Production = 16,685 ton/shift x 2 = 33,700 total tons/shift

Truck Capacity = 120 tons

Time Available per Shift - 354 minutes per shift

Calculations:

tons/shift per unit = (min/shift x 120 tons/cycle) ÷ min/cycle

units required = (33,700 tons/shift shovel production) ÷ tons/shift/unit

120-Ton Truck Requirements for Project Life

Years of Stripping	Accumulated Years	Increments	Cycle Time	Tons/ Shift	Units Required	Units Req. @ 75% Avail.
0.54	0.54	A-1	9.93	4278	7.80	10.40
0.97	1.51	A-2	9.39	4524	7.38	9.84
0.67	2.18	A-3	10.67	3981	8.38	11.17
1.65	3.83	A-4	10.65	3989	8.37	11.16
1.94	5.77	A-5	12.13	3502	9.53	12.77
1.03	6.80	A-6	12.81	3316	10.06	13.41
0.88	7.68	A-7	12.62	3366	9.91	13.21
1.28	8.96	A-8	12.37	3434	9.72	12.92
0.78	9.74	A-9	12.08	3516	9.49	12.60
0.76	10.50	A-10	12.08	3516	9.49	12.60

4. Rotary Drills

10-inch, truck mounted

Assumptions:

Preproduction and Production I:	29.2×10^6 tons/year (years 1-5)
Production II:	20.8×10^6 tons/year (years 6-10)
Density:	14.95 ft^3/ton
Scheduled weeks/year:	50 weeks/year
Drill Productivity:	550 feet/shift (maximum est. drilling rate)
Feet/hole:	50 ft bench plus 5 ft subgrade = 55 ft
Drill Pattern:	25 ft (burden) x 30 ft (spacing) pattern x 50 ft bench

Calculations:

Tons/hole = (25 ft x 30 ft x 50 ft) ÷ 14.95 ft^3 ton = 2,508.36 tons/hole

Holes/shift = 550 ft/shift ÷ 55 ft/hole = 10

Tons/shift = 10 x 2,508.36 = 25,083.6 tons/shift

Production Annual Tons	Required Tons/Week	Required Shifts/Week	Scheduled Shifts/Week	Utilization of Scheduled Shifts
29.2×10^6	584,000	23.28	(2) 30	77.6%
20.8×10^6	416,000	16.59	(2) 17	97.6%

Stripping activity will require two rotary drills scheduled for 30 shifts per week during Preproduction and Production I, and only 17 shifts per week during Production II.

5. Ore Control Drill

Basis: 1. Required Productivity = 2.71 million tons/year secondary and interior waste
0.73 million tons/year ore

2. Average Density = 16.51 ft^3/ton

3. Estimated average drill patterns = B x S x Depth

(A) 10x10x10 (B) 15x15x15 (c) 20x20x20

4. Drill Productivity (failing 1000)

400 ft/8 hr shift actual productivity, includes a low job efficiency due to the many shallow holes and irregular nature of drilling. (Does not include machine availability).

5. 50 scheduled weeks/yr

6. Required drill holes per year = 3.44 million tons/yr x 16.51 ft^3/ton ÷ cu ft per drill hole

56,794	16,828	7,099

7. Ft drilling/yr = drill holes/yr x depth

576,940	252,420	141,980

8. Required drill shifts/wk = annual ft drilling ÷ 50 wk/yr ÷ 400 ft/shift

28.4	12.62	7.10

Recommendation:

Based upon an estimated average drill pattern of 15x15x15 and applying an 85% machine availability, required shifts/week are 12.62 ÷ .85 = 14.85

Conclusion:

1 (one) ore control drill scheduled 15 shifts/wk

6. Mining Dozer (Ripping)

Basis:

1. 68,800 t/wk or 4,587 t/shift

2. 7 operating hours/8 hour schedule

3. 83% job efficiency

4. Effective available time/shift = 350 min

5. 2.71 million tons/yr secondary @ 15.45 BCF/ton
   0.73 million tons/yr ore @ 20.46 BCF/ton

   Weighted average material density = 16.51 BCF/ton

6. Required panel per shift
   4,587 tons/shift x 16.51 cu ft/ton - 75,731 ft^3/shift
   @ 2 ft ripping depth = 37,866 sq ft/shift
   250 ft x 150 ft panel

7. Cycles/shift (based upon 2 ft ripping width)
   150 ft ÷ 2 ft/cycle + 250 ft ÷ 2 ft/cycle = 200 cycles/shift

8. Linear ft ripping/shift

   75 cycles x 250 ft + 125 cycles x 150 ft = 37,500 ft/shift

9. Total cycle time/shift required

   a) Fixed time based on a maneuver time of 0.5 min/cycle
      0.50 min/cycle x 200 cycles/shift = 100 min/shift

   b) Travel time based on average ripping speed of 150 ft/min
      37,500 ft/shift ÷ 150 ft/min = 250 min/shift

   Required cycle time/shift = 350 min

Recommendation:

Units required per shift = Required cycle time/shift ÷ effective available time/shift

= 350 min ÷ 350 min = 1.0

Down time due to machine availability (estimated at 75%) can be adequately covered during the non-scheduled mining shifts, (i.e., machine utilized only 15 out of 21 potential shifts). Backup is available from the dozers assigned to pioneer work.

Conclusion:

1 (one) track dozer with ripper scheduled 15 shifts per week

7. Track Dozer and Rubber-Tired Dozer

(3 dozers)

1. Rubber-tired dozer is allocated for pushing newly blasted material and will also clean up rock spills on haul roads and mining areas, and the working area around the shovel.

2. Dump Dozer - 1 dozer will be required on the waste dump to push the material over the side and create a safety berm. It will also be utilized to maintain the level dumping area.

3. Pioneer Dozer - 2 dozers are scheduled to prepare access drill roads and preliminary levels. These two dozers will provide backup for the dump and mining dozers. In the latter years of the mine life, one dozer will be transferred to the mining backfill dump.

8. 35-Ton Truck Fleet Estimation

Assumptions:

Annual Production	=	3.44 million tons
Shift Production	=	3.44 million tons ÷ 50 wk/yr ÷ 15 shifts/wk
	=	4590 tons/shift
Truck Capacity	=	35 tons
Time Available/ shift	=	354 min/shift
Average cycle time (Ore/waste hauls)	=	20.4 min

Calculations:

Tons/shift/unit	=	(354 min/shift x 35 tons/cycle) ÷ 20.4 min/cycle
	=	607.4
Units required	=	4,590 tons/shift ÷ 607.4 = 7.56 or 8 units
Units required @ 75% fleet availability	=	10.08 or 10 units

9. Motorgrader

1. Length of Hauls:

		Width
Stripping	6,000 ft (2 shovels)	90 ft
Mining-ore run	5,600 ft	90 ft
Mining-waste	3,300 ft	90 ft
TOTAL	14,900 ft = 2.82 miles	90 ft

2. Travel Speed:

1st gear forward = 2.4 mph
1st gear reverse = 3.9 mph

Average Travel Speed $(4.8 \times 3.9) \div (2.4 + 3.9) = \frac{18.72}{6.3} = 2.97$ mph

3. Required Blading (assume 12 ft of blade surface):

(2.82 miles)(90 ft/12 ft) = 21.15 miles

4. Blade Production/Shift (assume 83% job efficiency):

(2.97 mph)(7½hr/shift)(0.83) = 18.49 miles/shift

5. Blades Required/Shift:

21.15 miles ÷ 18.49 miles/shift = 1.14 blades

6. Blades Required @ 75% Availability:

1.14 ÷ 0.75 = 1.53 blades

∴ Use 2 Motorgraders

10. Water Truck

1. Area required to cover:

		Area (Ft^2)
Stripping		
Roads	6,000 ft x 60 ft	360,000
Dumps		1,000
Pits		2,000
Mining		
Roads - Ore	5,600 ft x 50 ft	280,000
Roads - Backfill	3,300 ft x 50 ft	165,000
Stockpile		1,000
	TOTAL	809,000

2. Coverage = 25 ft/pass:

$$\text{Linear Coverage} = \frac{809{,}000\ ft^2}{25\ ft} \times 3 \text{ passes} = 97{,}080 \text{ ft}$$

Speed - 17 mph

Spray Time = 10,000 gal ÷ (1,500 gal/min x 0.5) = 13 min

3. Time Required per Pass:

Fix and fill time @ 400 gpm	30 min
Travel time	15
Spray time	13
TOTAL	58 min/trip

4. Water Schedule:

Day Shift	4
Swing	3
Graveyard	2
Average	3 passes (used above)

5. Units Required:

Coverage/Trip = 13 min x 17 mph x 5,280 ft/mi x hr/60 min
= 19,448 ft/trip

Time to cover - 97,080 ft ÷ 19,448 ft/trip x 58 min/trip = 290 min

Add 3 hrs (180 min) to cover mill and office

Units Required (75% availability) = (290 min + 180 min) ÷ 373 min/shift ÷ 0.75 = 1.68 units/shift

∴ Use 2 Units

11. 12-Ton Prill Truck

Basis: 1. Preproduction and Production I (highest stripping period)

2. 11,641 holes/yr ÷ 50 wk/yr = 233 holes/wk

3. Capacity based upon certain periods when loading 100% dry holes.

4. Tons ANFO/wk = 838 lb/hole x 233 holes/wk ÷ 2000 lb/ton = 97.63 tons/we

5. Prill truck scheduled 5 shifts/wk = 19.53 tons/shift OR 10 tons ANFO/shift/blast-site

Recommendations:

A prill truck with a 10-ton tank would adequately cover each drill with a single trip under fully dry loading conditions during the highest productivity periods of the mine.

The following points justify going to the next larger commercial tank size, which is a 12 ton:

1. At 98% capacity with a 10-ton tank when servicing each blast site with a single trip. Any change in rock type and powder factor may require an additional trip.

2. Amerind-MacKissic's capital cost sheets indicate the extra 20% capacity will cost only 1% over the smaller 10 ton truck.

Conclusion:

1 (one) 12-ton prill truck

B. Facilities

1. AN Prill Storage

Basis:

1. 1-week storage
2. Highest stripping period (preproduction & production I)
3. Dry loading conditions - blasting 100% ANFO
4. Required Tons AN Prill/wk = 91.7
   (233 holes/wk x 787 lbs AN/hole ÷ 2000 lb/ton)

Recommendations:

1. Multiple tanks - allows the capability of periodically cleaning and repairing one while others remain in service. Structural damage which would bring the storage tank out of service is much less likely with multiple tanks.
2. Storage capacity factor - 20%
   Considers the possible increase in powder consumption during the stripping of harder than average rock conditions. 91.7 tons/wk x 1.20 = 110 ton capacity
3. Design considerations - Amerind-Mackissic recommends two identical storage units of 60-ton capacity each.

Conclusion:

(two) 2 60-ton vertical storage units

2. Explosives Magazine

Basis:

1. 1-week of storage of slurry

2. 2 weeks storage of ancillary explosives, most specifically primers and primer cord.

3. Highest stripping period (preproduction & production I)

4. Loading condition - temporary severe conditions of wet holes, estimated at 2x the average 25% giving 2 x 25% x 233 holes/wk = 117 holes/wk

5. Blasting caps are stored separate and distant from the above explosive magazine. Cap storage is necessary but incidental.

6. Slurry storage: 117 holes/wk x 1072 lbs/hole ÷ 65.6 lbs/cu ft = 1912 cu ft
   1912 cu ft ÷ 6 ft high piles = 319 sq ft

7. Primers and Primer cord storage:

   Primers/2 wk = 466 holes/2 wk x 2/hole = 932

   Primer storage = 932 primers ÷ 60/case x 4.5 cu ft/case
   = 70 cu ft
   70 cu ft ÷ 6 ft high piles = 12 sq ft

   Primer cord/2 wk = 466 holes/2 wk x 105 ft/hole = 48,930 ft

   Primer cord storage = 48,930 ft ÷ 1000 ft/case x 1 cu ft/case
   = 49 cu ft
   49 cu ft ÷ 6 ft high piles = 8 sq ft

   Total primers and primer cord storage = 20 sq ft

Recommendation:

(based on Table 30-3, DuPont Blaster's Handbook, p.463)

Concrete block magazine, 16 x 26 ft outside dimensions with 336 cu ft of inside space.

3. Fuel and Lubricant Storage Requirements

Conclusions: Apply a factor of 1.10 to the major mine equipment for allowance of all the minor vehicle consumption at the mine.

Results:

Stripping Shovels	
Open Gear Lube	294 lbs/wk
Grease	466 lbs/wk
All Other Mine Mobile Equipment	
Crankcase	494 gal/wk
Transmission	185 gal/wk
Final Drive	127 gal/wk
Hydraulic	331 gal/wk
Grease	338 lbs/wk
Fuel	70,521 gal/wk

Lubricant Storage - Tank Farm Design Capacity

Assumptions:

1. Standardized crankcase (engine oil) to 40W
2. Combine hydraulic and transmission oil to one grade, 10W
3. Standardized final drive to 90W
4. Grease will be stored in 55 gal drums
5. All special lubricants (i.e. 140W wheel motor lube for electric haulers) shall be stored in individual 55 gal drums
6. Storage duration of 2 weeks
7. Design for later use of particular lubricant changes, extra lube grades, etc., by two half-size tanks for each major component above
   2 engine oil tanks
   2 transmission & hydraulic tanks
   1 final drive tank (because of small quantity)
8. Use of a storage ratio of 0.5:1 coolant to engine oil (as shown by Kaiser Engineers Drawing No. 10-23-HV, "Lubricant Storage for Sweetwater Project")

Lubricant Storage - Tank Farm Design Capacity (continued)

Tanks	Lubricant	Unit Capacity gal	Total Capacity gal
2	Engine Oil (40W)	500	1000
2	Transmission and Hydraulic Oil (10W)	500	1000
1	Final Drive (90W)	300	300
1	Coolant	500	500

Fuel Storage - Project Consumption

Point of Use	Two Weeks Supply gal	Fuel Type
Mine Mobile Equipment	141,042	#2
Mill Boilers*	52,752	#2
ANFO Explosive Mix	3,357	#2
	197,151	

*Ramon Pizarro, Morrison-Knudsen
Used Ross Milling Report, p. 523 as basis
Mill consumption - average for leaching, solvent extraction, precipitation, etc.
157 gal/hr x 24 hr x 14 days = 42,752 gal/2 wks
#2 Diesel Fuel (140,000 Btu/gal)

Fuel Storage - Tank Farm Design Capacity

Tanks	Fuel Type	Unit Capacity gal	Total Capacity
2	Diesel #2	100,000	200,000

EXHIBIT II-D
MINING ASSUMPTIONS
AND FACTORS

EXHIBIT II-D

MINING ASSUMPTIONS AND FACTORS

The following assumptions and factors were used to size equipment and calculate operating costs for the Anderson Project:

a. Equipment Production Factors

(1) SAE Dipper Capacity Ratings were used.

(2) Dipper Fill Factors:

17-yd stripping shovels = 0.90
3- & 5-yd mine excavators = 1.00

(3) Job Efficiency Factor = 0.83

(4) Haulage Truck Fleet Availability = 0.75

(5) Percent Utilization = $\frac{\text{Schedule Shifts}}{\text{Potential Shifts}}$

(6) Effective Operating Hours per Shift:

Scheduled hours per shift - (1/2 hr lunch and change of shift and travel to work site and lost time)

(7) Haulage Truck Cycle Times:

Phase I haulage cycle times were used and adjusted according to new increments and approximate times were generated

(8) Loading Cycle Times:

17-yd stripping shovel: 27.8 seconds
3- & 5-yd mine excavators: 35 seconds

b. Material Factors

Densities:		Condition
Primary Stripping:	14.95 cu ft/ton	Bank, wet (10% H_2O)
Secondary Stripping:	15.45 cu ft/ton	Bank, wet (10% H_2O)

	Condition
Interior Waste: 15.45 cu ft/ton	Bank, wet (10% H_2O)
Ore @ 20.46 cu ft/ton	In Bank, dry

Swell Factor @ 25% = 0.80 (for all above classes of material)

Equipment Cost Estimating Factors:

(1) Fuel Cost: 38¢/gal

(2) Operator, parts and maintenance normally included in operating cost per hour

(3) Hourly Wage Rates:

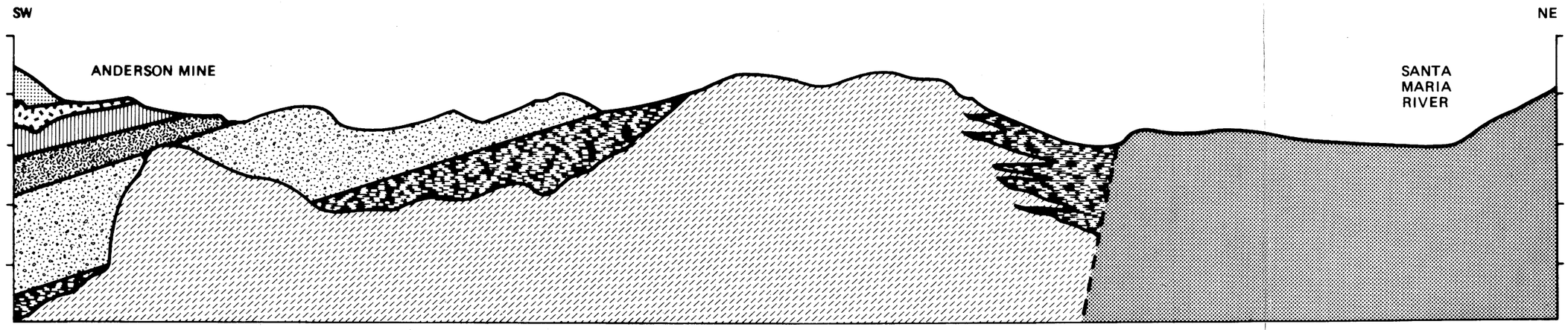
Craftsman	- $9.15
Operator-Repairman	- 8.60
Helper	- 8.10
Trainee	- 7.05

c. Labor Burden

Hourly: 40%
Salary: 23%

d. Mine Spare Parts

8% of initial mine capital



LEGEND

- Quaternery-Tertiary conglomerate, 0-400', tan to white, sandy to very coarse, locally calcite cemented, granitic metamorphic felsic and basalitic clasts
- Tertiary Miocene basalt, black, fine-grained to aphanitic, calcite-filled amygdules, commonly parallel to flow surface, 0-120'
- Tertiary miocene conglomerate, tan to brown siltstone grades upward into arkosic sandstone and then into conglomerate with granitic and felsic clasts, 200-450'
- Tertiary Miocene lacustrine sediments, basal arkosic sandstone, carbonaceous siltstone and lignite, silty limestone, limy siltstone, green siltstones and mudstones, tuffaceous material throughout, 0-400'
- Tertiary volcanic andesite, gray, gray-brown, red-brown, fine-grained, vesicular augite, andesite, locally containing calcite-filled amygdules
- Tertiary volcaniclastic sediments, gray to white, felsic to intermediate tuffs, ash flows, lahar breccias, upper section yellow-tan to tan, sandy
- Tertiary felsic to intermediate volcanics, white to gray, pink-gray, necks, flows and tuffs
- Jurassic granite, brown, purple-gray, biotite granite

0 ½ 1
mile

FIGURE 5.1-1
GENERALIZED CROSS SECTION
OF THE ANDERSON PROPERTY

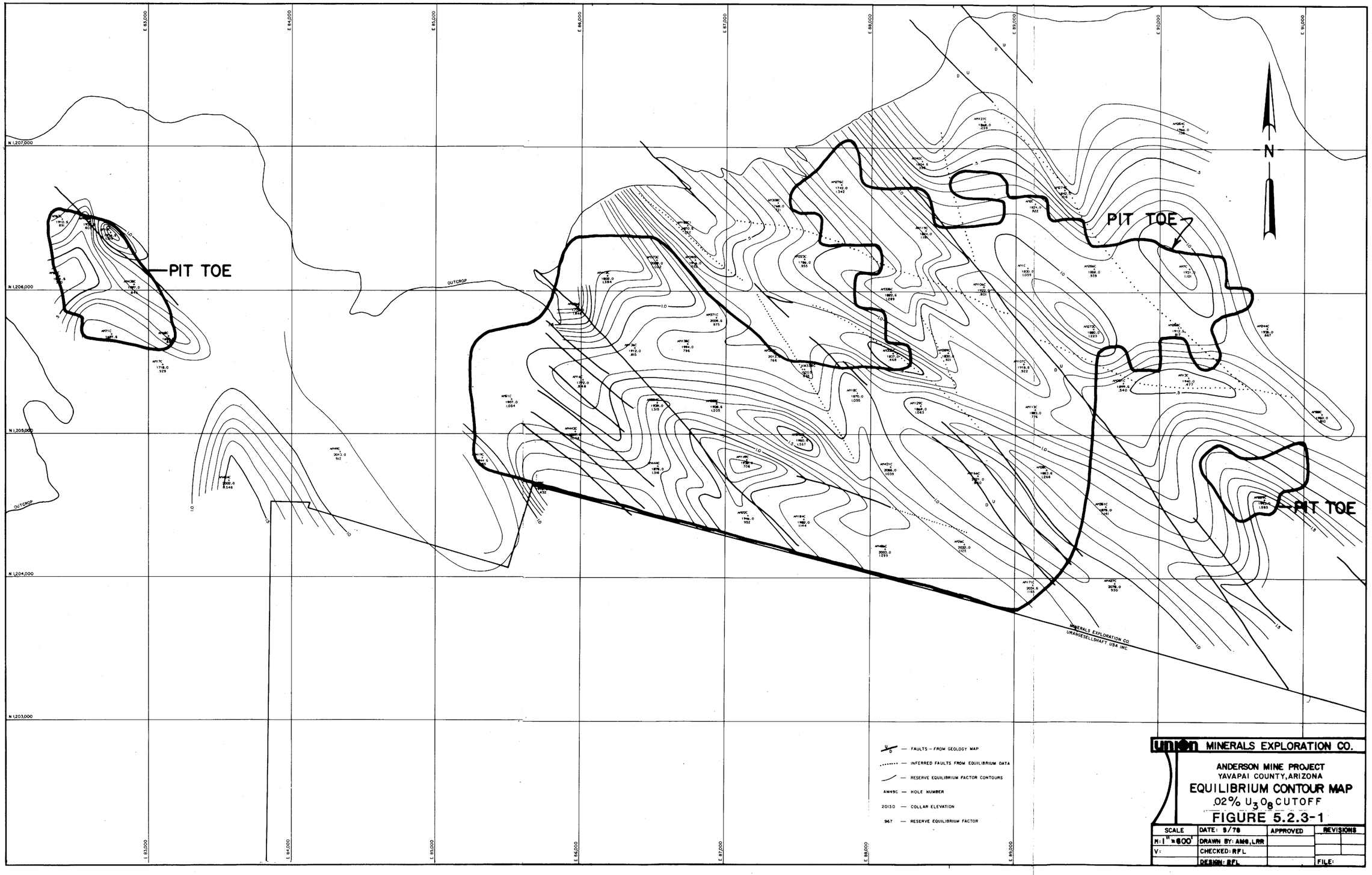

N
PIT TOE
PIT TOE
PIT TOE
OUTCROP
OUTCROP
MINERALS EXPLORATION CO.
URANGESELLSHAFT USA INC.
N 1,207,000
N 1,206,000
N 1,205,000
N 1,204,000
N 1,203,000
E 83,000
E 84,000
E 85,000
E 86,000
E 87,000
E 88,000
E 89,000
E 90,000
E 91,000
— FAULTS – FROM GEOLOGY MAP
— INFERRED FAULTS FROM EQUILIBRIUM DATA
— RESERVE EQUILIBRIUM FACTOR CONTOURS
AM49C — HOLE NUMBER
2013.0 — COLLAR ELEVATION
.967 — RESERVE EQUILIBRIUM FACTOR
union MINERALS EXPLORATION CO.
ANDERSON MINE PROJECT
YAVAPAI COUNTY, ARIZONA
EQUILIBRIUM CONTOUR MAP
.02% U_3O_8 CUTOFF
FIGURE 5.2.3-1
SCALE
H: 1" = 600'
V:
DATE: 5/78
DRAWN BY: AMG, LRR
CHECKED: RFL
DESIGN: RFL
APPROVED
REVISIONS
FILE:

TABLE 6.8-1

MINE CAPITAL COSTS - OPERATIONS

	Average Unit Cost ($)	No. Initial Units	Pioneering	Preproduction	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Total $
Stripping															
Shovel, 17-cu yd	1,813,308	2		3,626,616											3,626,616
Trucks, 120-ton	482,528	11		5,307,808	482,528				482,528						6,272,864
Drills, 10-inch	358,000	2	716,000												716,000
Prill Truck, 12-ton	49,699	1	49,699												49,699
Air Trac Drill	116,345	1	116,345												116,345
Dozer-Pioneer, 400 hp	270,048	2	540,096							270,048	270,048				1,080,192
Dozer-Dump, 400 hp	270,048	1		270,048				270,048				270,048			810,144
Mining															
Front Shovel, 5-cu yd	286,304	2		572,608											572,608
Trucks, 35-ton	170,089	10		1,700,890											1,700,890
Dozer/Ripper, 400 hp	270,048	1		270,048					270,048						540,096
Explosive Truck, 2-Ton	15,663	1		15,663			15,663			15,663			15,663		62,652
Ore Control															
Probe Tower	22,300	1		22,300											22,300
Spectrometer	100,000	1		100,000											100,000
Probes	1,000	8		8,000			8,000			8,000			4,000		28,000
Drill, 5-inch	92,700	1		92,700											92,700
Support															
Graders, 250 hp	169,783	2	169,783	169,783				169,783		169,783					679,132
Rubber-Tired Dozer, 300 hp	161,018	1		161,081				161,081					161,081		483,243
Waterwagon, 10,000-gal	238,939	2	238,939	238,939				238,939				238,939			955,756
Miscellaneous															
Light Plants	6,139	4		24,556					24,556						49,112
Bank Spray System	10,218	1		10,218					10,218						20,436
Sump Pump	7,488	2		14,976					14,976						29,952
Pickup Trucks, 1/2-ton	8,000	2	16,000	32,000			48,000			48,000			48,000		192,000
Mine Radios	Lot	25		37,500					37,500						75,000
Ammonium Nitrate Prill Storage & Explosive Magazines	27,000	1	27,000												27,000
TOTAL $			1,873,862	12,675,734	482,528		71,663	839,851	839,826	511,494	270,048	508,987	228,744		18,302,737

TABLE 6.8-2

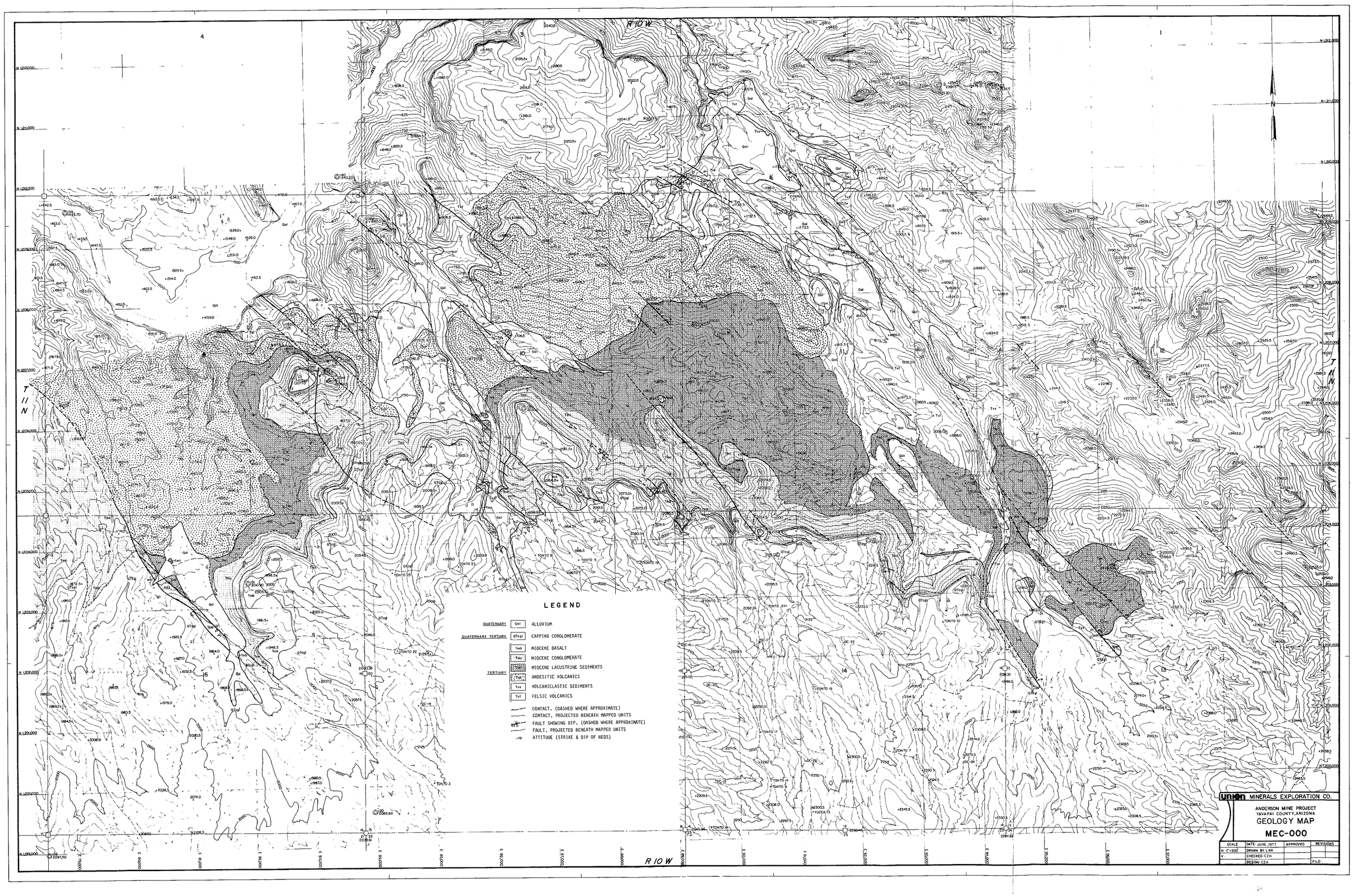
MINE CAPITAL COSTS - MAINTENANCE

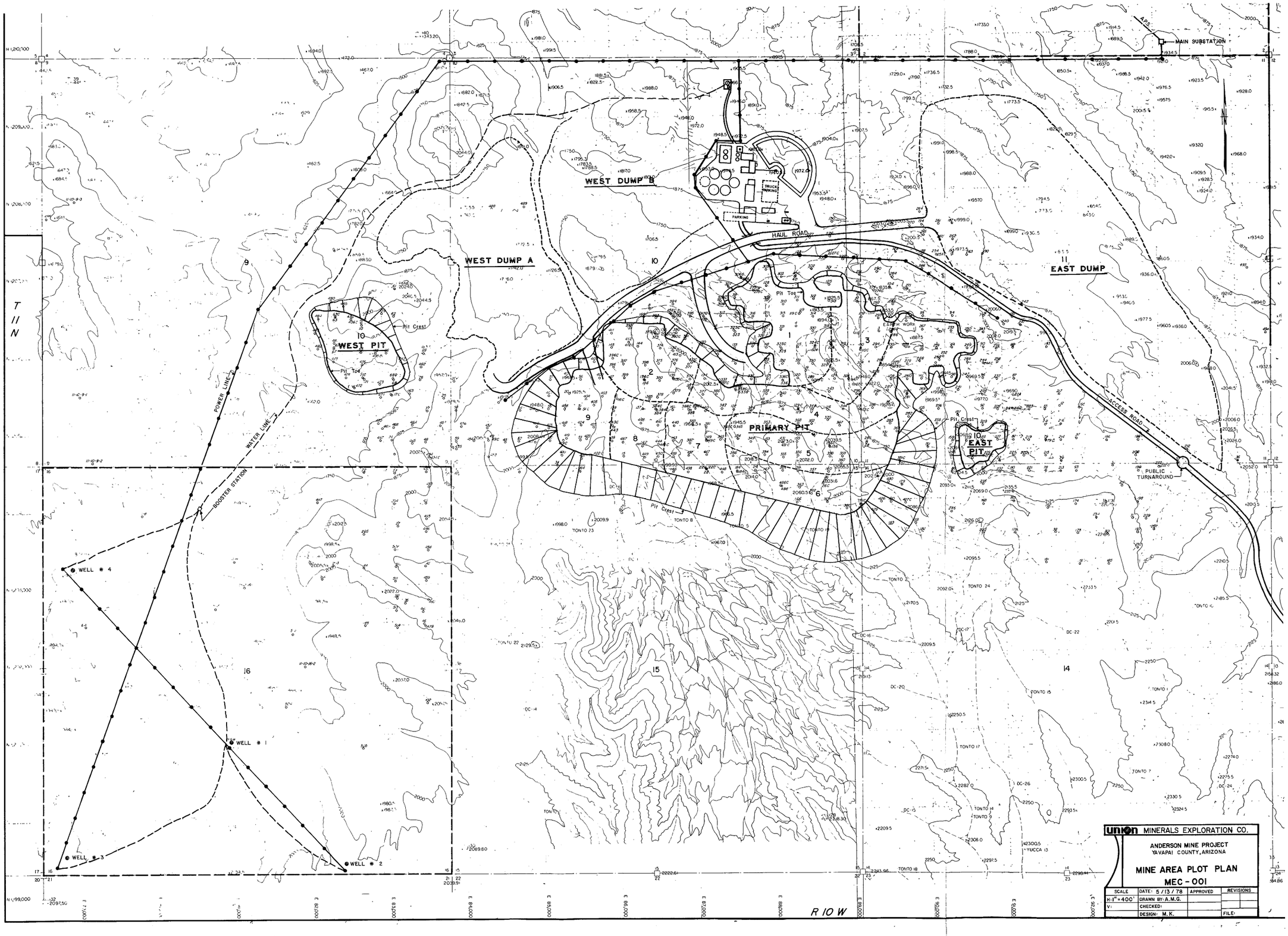
	Average Unit Cost ($)	Number of Units	Replacement Years	18 Months Preproduction	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Totals
Shop, Warehouse & Changehouse	1,783,600	1		1,783,600											1,783,600
Fuel Island & Tank Farm	109,000	1		109,000											109,000
Lube & Tire Shop	550,000	1		550,000											550,000
Maintenance Equipment:															
Crane, 75-ton	286,929	1		286,929											286,929
Crane, 15-ton	92,524	1		92,524											92,524
Forklift, 10-ton	48,815	1		48,815											48,815
Stakebed Truck, 3-ton	15,517	1	3	15,517			15,517			15,517			15,517		62,068
Lowboy Trailer	73,000	1		73,000											73,000
Lube Truck	74,228	1	5	74,228					74,228						148,456
Flatbed Truck, 2-ton	15,663	1	3	15,663			15,663			15,663			15,663		62,652
Flatbed Truck, 1-1/2-ton	13,106	1	3	13,106			13,106			13,106			13,106		52,424
Pickup Trucks, 1/2-ton	8,000	2	3	16,000			16,000			16,000			16,000		64,000
Hand Tool Replacement	1,400/yr		3	1,750			4,200			4,200			4,200		14,350
Mine Spare Parts				723,750	434,250										1,158,000
MAINTENANCE TOTAL				3,803,802	434,250		64,486		74,228	64,486			64,486		4,505,818

TABLE 6.8-3

MINE CAPITAL COSTS - ADMINISTRATIVE

	Average Unit Cost ($)	Number of Units	Replacement Years	18 Months Preproduction	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Totals ($)
Building with Furnishings	658,455	1		658,455											658,455
Mobil Equipment:															
Sedans	8,000	1	3	8,000			8,000			8,000			8,000		32,000
Carry-all	9,000	4	3	36,000			36,000			36,000			36,000		144,000
Ambulance	18,963	1		18,963											18,963
ADMINISTRATION TOTAL				721,418			44,000			44,000			44,000		853,418


R10W
T 11 N
LEGEND
QUATERNARY
Qal
ALLUVIUM
QUATERNARY TERTIARY
QTcgl
CAPPING CONGLOMERATE
TERTIARY
Tmb
MIOCENE BASALT
Tmc
MIOCENE CONGLOMERATE
MIOCENE LACUSTRINE SEDIMENTS
Tva
ANDESITIC VOLCANICS
Tvs
VOLCANICLASTIC SEDIMENTS
Tvf
FELSIC VOLCANICS
CONTACT, (DASHED WHERE APPROXIMATE)
CONTACT, PROJECTED BENEATH MAPPED UNITS
FAULT SHOWING DIP, (DASHED WHERE APPROXIMATE)
FAULT, PROJECTED BENEATH MAPPED UNITS
ATTITUDE (STRIKE & DIP OF BEDS)
union MINERALS EXPLORATION CO.
ANDERSON MINE PROJECT
YAVAPAI COUNTY, ARIZONA
GEOLOGY MAP
MEC-000
SCALE
H. 1"=500'
V.
DATE: JUNE, 1977
DRAWN BY: L.RR
CHECKED: CZH
DESIGN: CZH
APPROVED
REVISIONS
FILE:

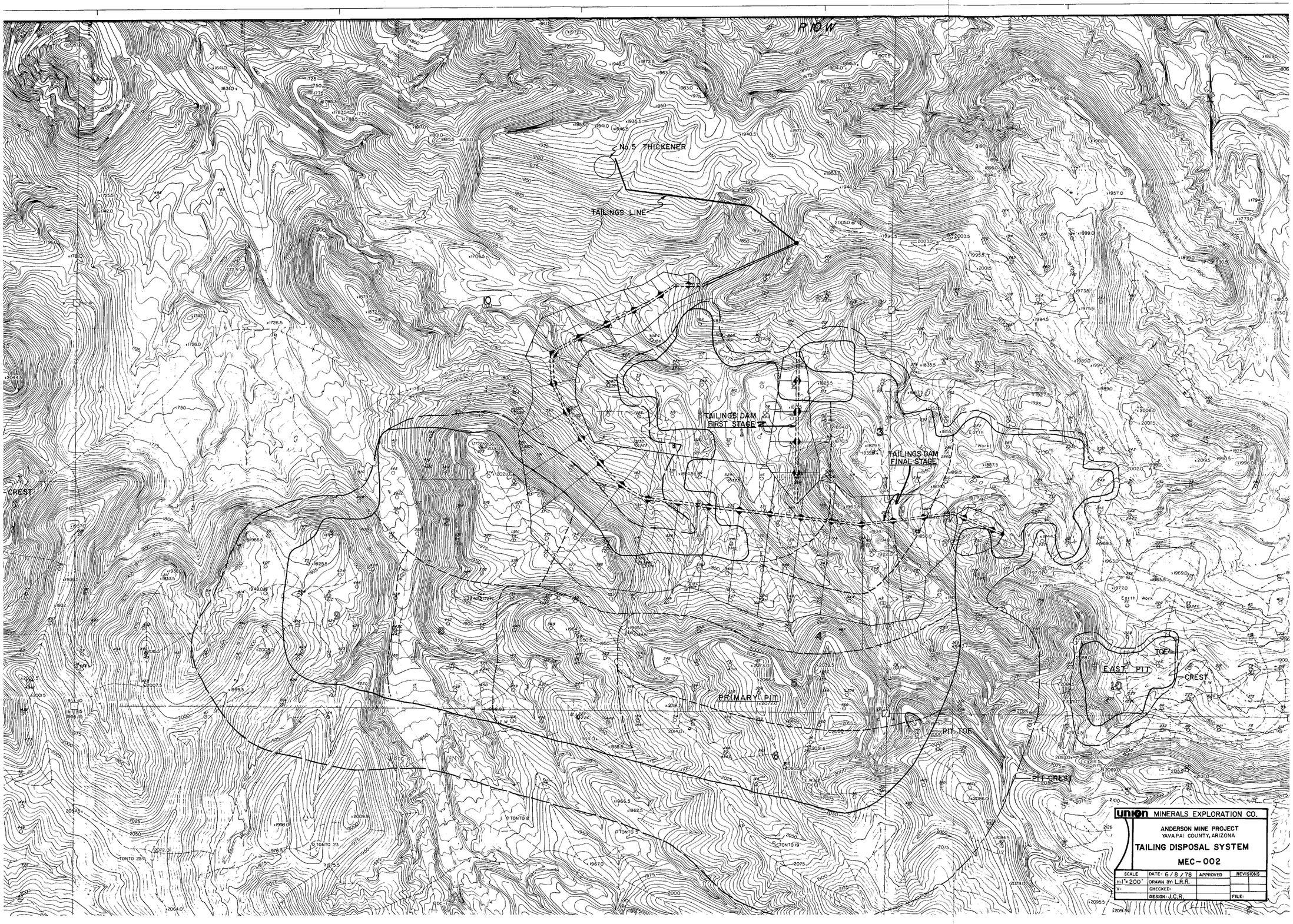


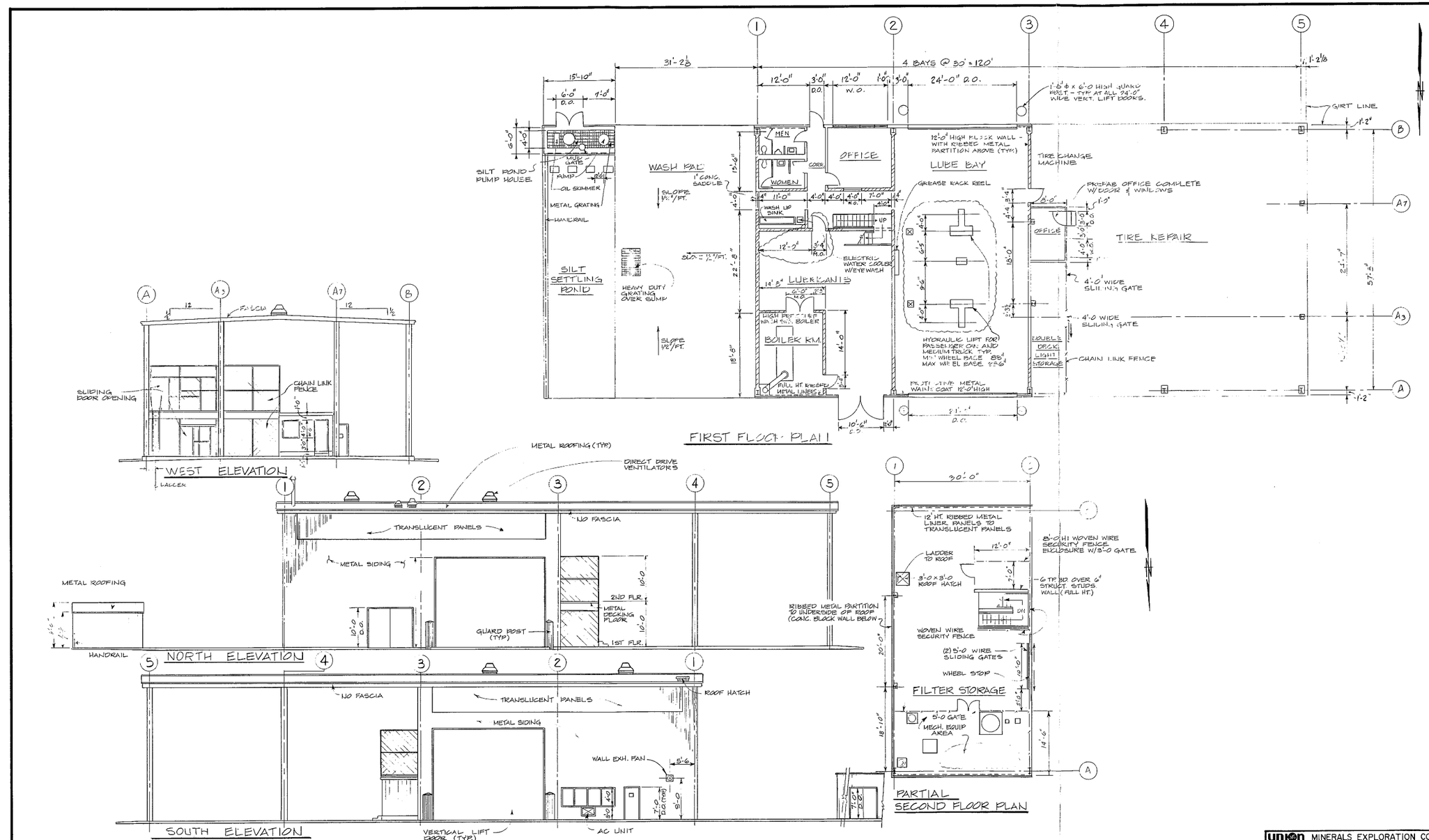
union MINERALS EXPLORATION CO.

ANDERSON MINE PROJECT
YAVAPAI COUNTY, ARIZONA

MINE AREA PLOT PLAN
MEC-001

SCALE	DATE: 5/13/78	APPROVED	REVISIONS
H: 1" = 400'	DRAWN BY: A.M.G.		
V:	CHECKED:		
	DESIGN: M.K.		FILE:


R10W
No. 5 THICKENER
TAILINGS LINE
TAILINGS DAM FIRST STAGE
TAILINGS DAM FINAL STAGE
CREST
PRIMARY PIT
PIT TOE
PIT CREST
EAST PIT
TOE
CREST
union MINERALS EXPLORATION CO.
ANDERSON MINE PROJECT
YAVAPAI COUNTY, ARIZONA
TAILING DISPOSAL SYSTEM
MEC-002
SCALE
H: 1" = 200'
V:
DATE: 6/8/78
DRAWN BY: L.R.R.
CHECKED:
DESIGN: J.C.R.
APPROVED
REVISIONS
FILE:

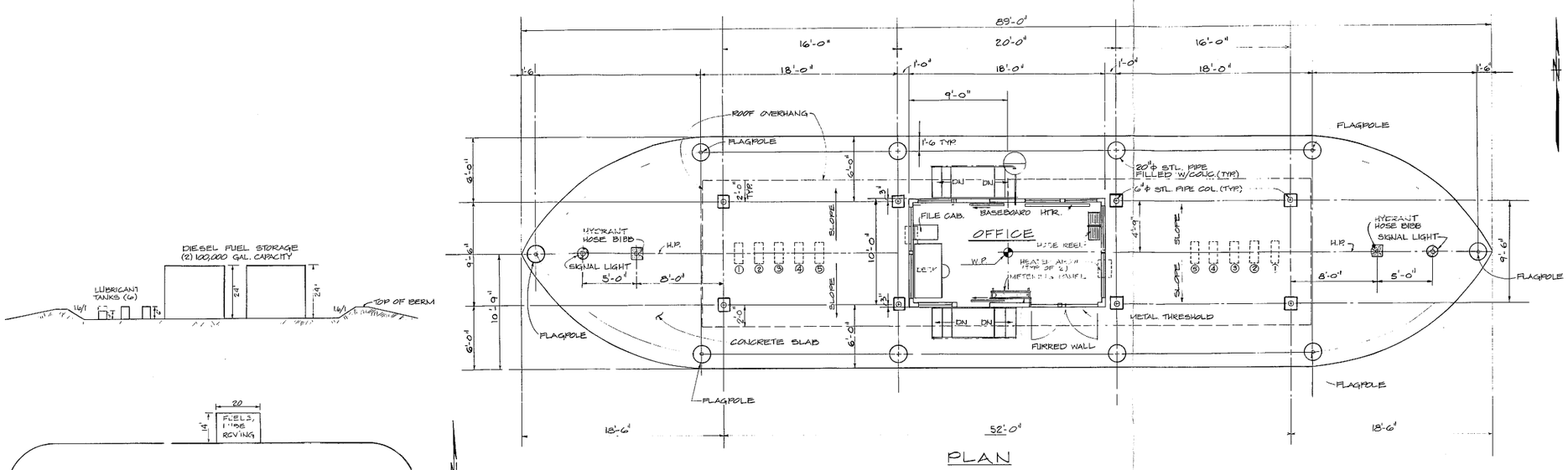


union MINERALS EXPLORATION CO.

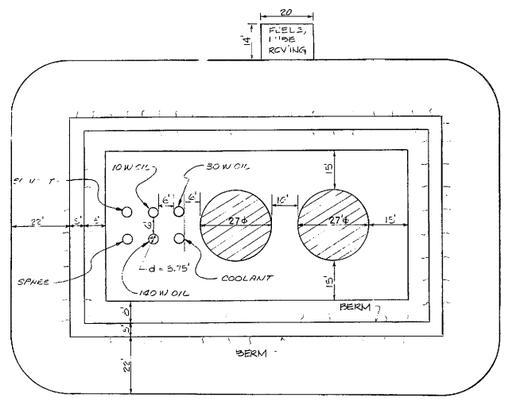
LUBE & TIRE SHOP
PLANS & ELEVATIONS

M.E.C. - 003

SCALE	DATE 5/22/78	APPROVED	REVISIONS
H	DRAWN BY AMG		5/7/78
V	CHECKED		
	DESIGN		FILE



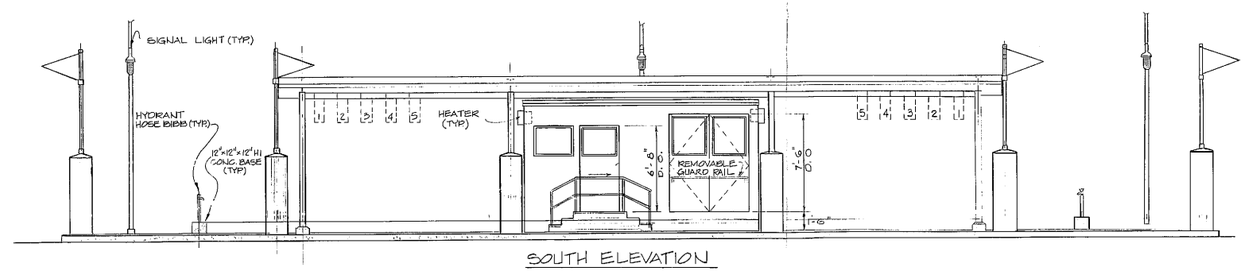
PLAN



PLAN
SCALE: 1" = 20'

SERVICE LEGEND

1. – DIESEL
2. – COOLANT
3. – HYD. FLUID
4. – ENGINE OIL
5. – AIR



SOUTH ELEVATION

union MINERALS EXPLORATION CO.

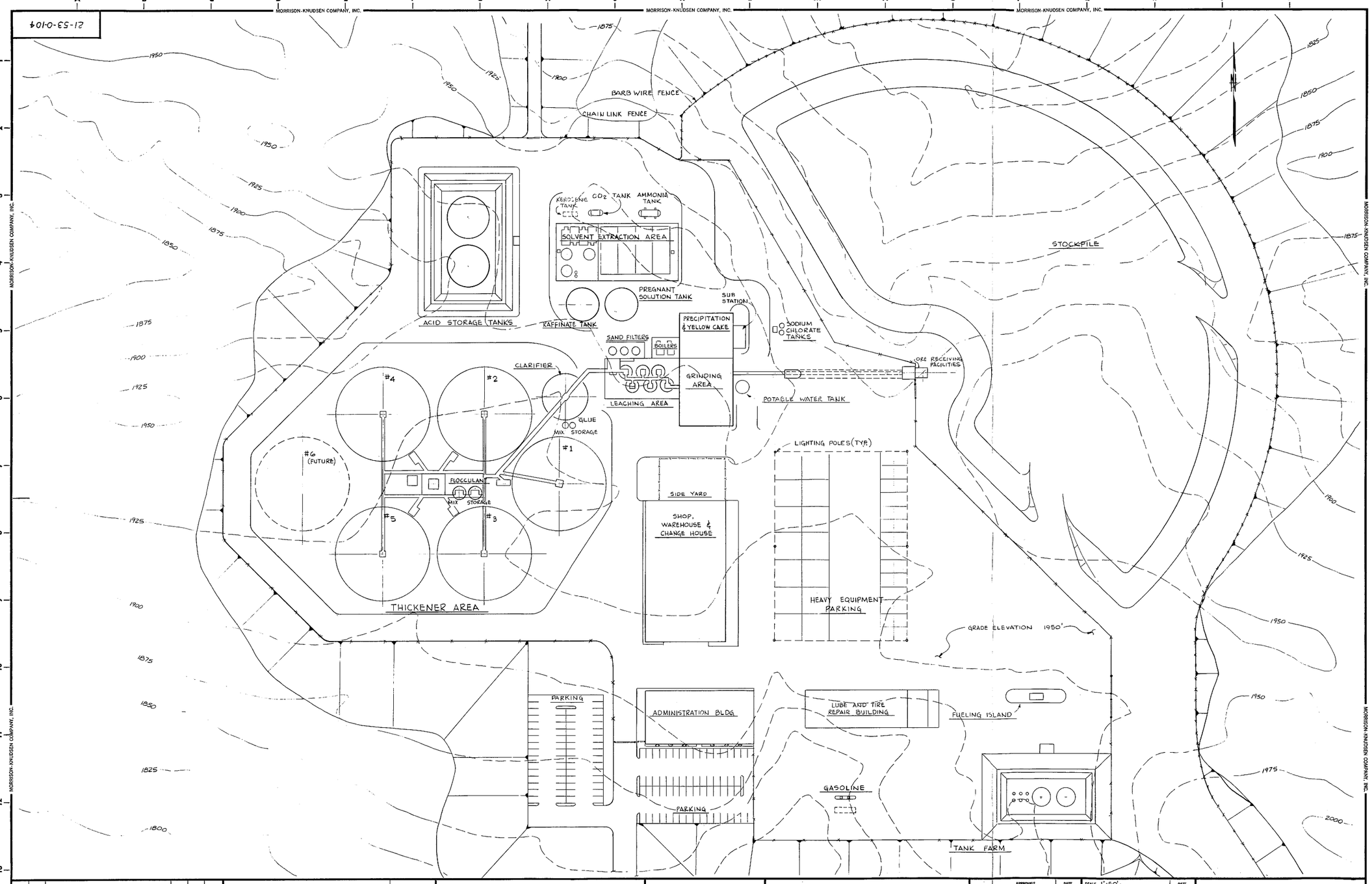
FUELING ISLAND & TANK FARM

PLAN & ELEVATIONS

MEC-004

SCALE	DATE: JUNE 1976	APPROVED	REVISIONS
H: 1/4" = 1'-0"	DRAWN BY: L.R.R.		
V:	CHECKED: G.G.D.		
	DESIGN:		FILE:

21-53-0-104



NO.	DATE	REVISION	BY	APPR.	APPR.

REFERENCE DRAWING	NUMBER

NOTES

DESCRIPTION — COST ACCOUNT

WORK COVERED BY THIS DRAWING CHARGED TO COST ACCOUNT ABOVE

PROPRIETARY STATEMENT

MINERALS EXPLORATION COMPANY
ANDERSON PROJECT

2000 TPD URANIUM MILL FACILITY

YAVAPAI COUNTY, ARIZONA

APPROVALS		DATE
CLIENT		
PROJECT MANAGER	R. Mahle	7-18-78

	DATE
SCALE 1"=50'	
DRAWN BY G. BUTTERBRODT	4/22/78
DESIGNED BY	
CHECKED BY J. LUZILIK	7/11/78
APPROVED R.R. Ingram	7/12/78
APPROVED R.W. Wilson	7/18/78

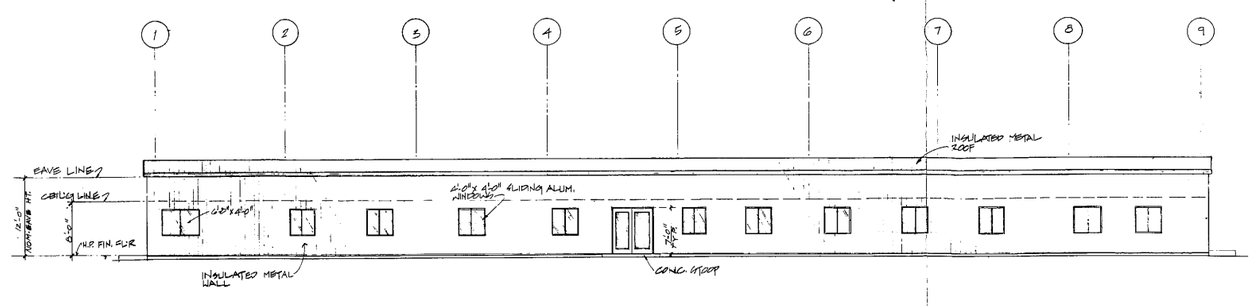
DEPT.	ARCH.	STRUCT.	MECH.	ELECT.	P.&I.	PIPING	SAF. DEPT.	P.E.
INITIAL								
DATE								

MORRISON-KNUDSEN COMPANY INC.
ENGINEERS CONTRACTORS DEVELOPERS
TWO MORRISON-KNUDSEN PLAZA/P.O. BOX 7808/BOISE, IDAHO 83729

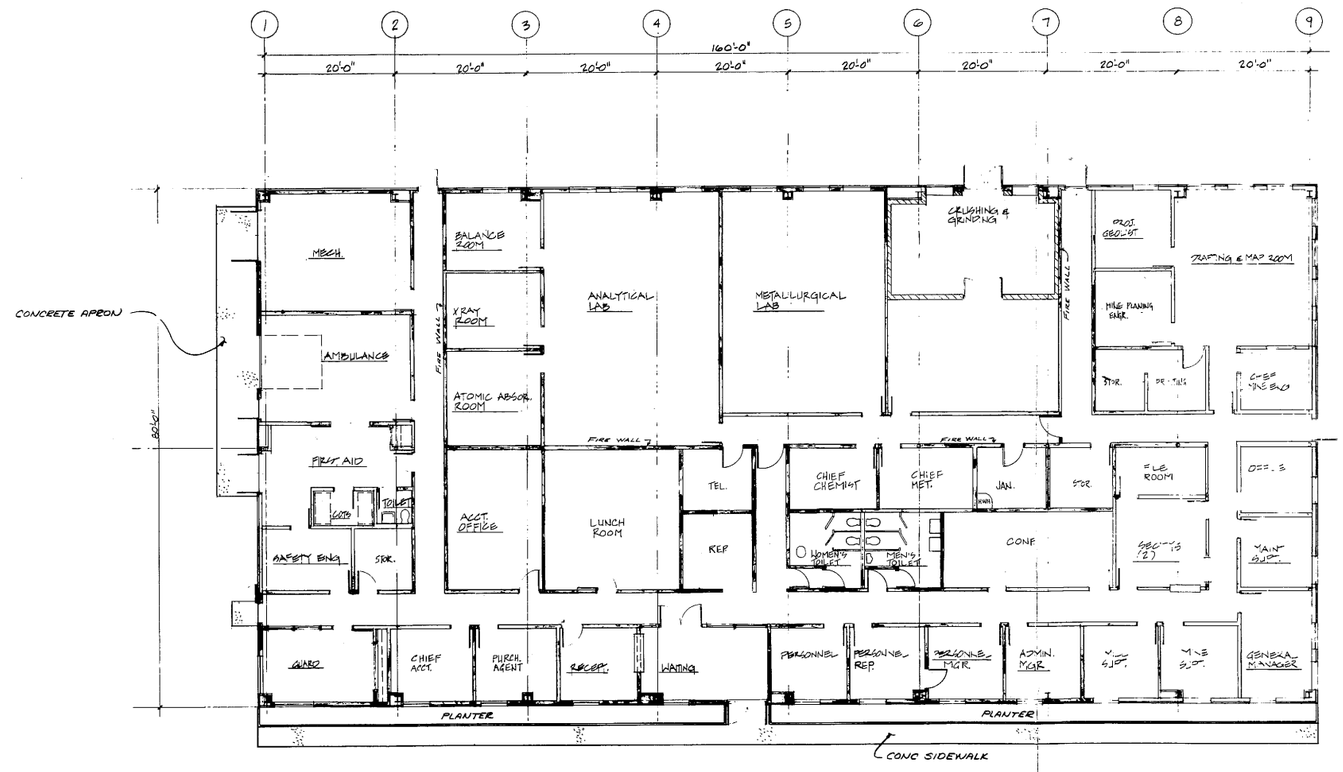
MILL & MINE FACILITY
PLOT PLAN

JOB NO. 1114 | DRAWING NO. 21-53-0-104 | REVISION 0

110-0-15-12



SOUTH ELEVATION
SCALE 1/8"=1'-0"



FLOOR PLAN
SCALE 1/8"=1'-0"

NO.	DATE	REVISION	BY	APPR.	APPR.

REFERENCE DRAWING	NUMBER

NOTES

DESCRIPTION COST ACCOUNT
WORK COVERED BY THIS DRAWING CHARGED TO COST ACCOUNT ABOVE

PRELIMINARY STATEMENT

MINERALS EXPLORATION COMPANY
ANDERSON PROJECT

2000 TPD URANIUM MILL FACILITY

YAVAPAI COUNTY, ARIZONA

APPROVALS		DATE
CLIENT	[illegible]	12/13/77
PROJECT MANAGER	R J Muehlen	12/13/77
	R J Muehlen	7-18-78

SCALE		DATE
DRAWN BY	Ron Hinson	11-21-77
DESIGNED BY		
CHECKED BY	A.E. Foster	12/12/77
APPROVED	T.W. Wilson	12/14/77
APPROVED	R.E. Figueroa	7-18-78

DEPT.	ARCH.	STRUCT.	MECH.	ELECT.	P.&I.	PIPING	SAF.DEPT.	P.E.
INITIAL								
DATE								

MORRISON-KNUDSEN COMPANY INC.
ENGINEERS CONTRACTORS DEVELOPERS
TWO MORRISON KNUDSEN PLAZA • P.O. BOX 7808 • BOISE, IDAHO 83707

ADMINISTRATION BUILDING
GENERAL ARRANGEMENT
PLAN & ELEVATION

JOB NO.	DRAWING NO.	REVISION
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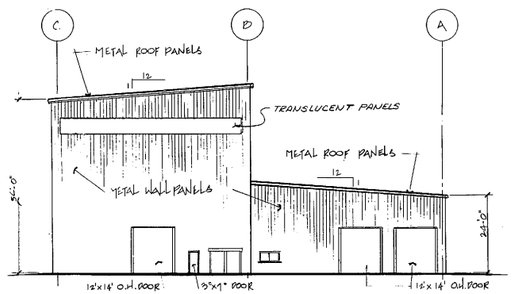
21-51-0-012



SOUTH ELEVATION
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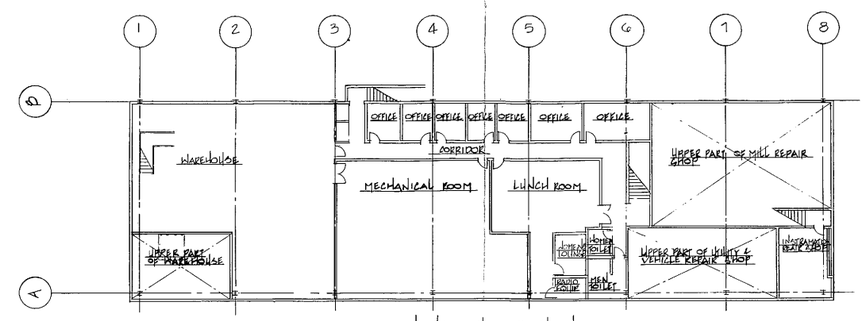
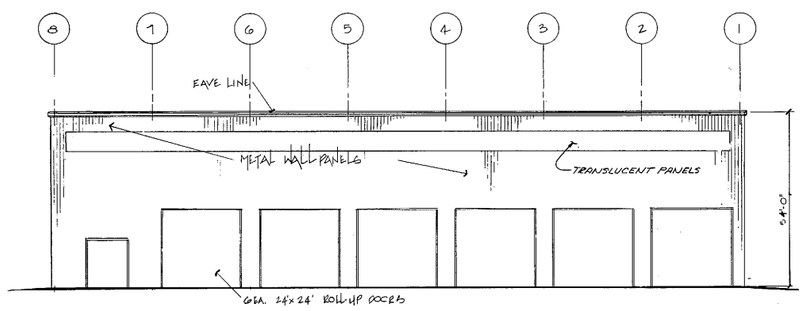
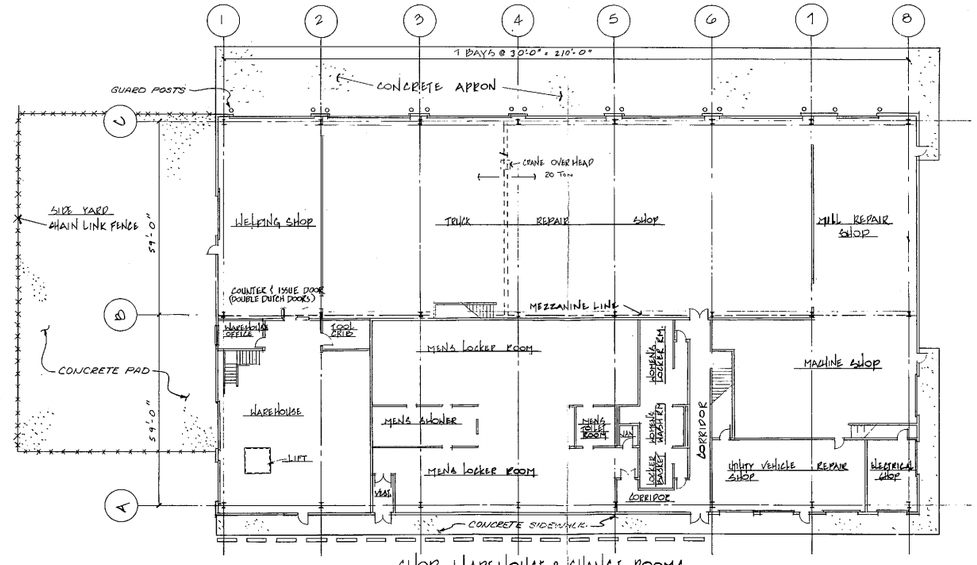


MEZZANINE FLOOR PLAN
SCALE 1/16"=1'0"



EAST ELEVATION
SCALE 1/16"=1'0"



SHOP, WAREHOUSE & CHANGE ROOMS
SCALE 1/16"=1'0"

NO.	DATE	REVISION	BY	APPR	APPR
A	11-29-77	ISSUE FOR OWNERS APPROVAL	DHP		

REFERENCE DRAWING | NUMBER | NOTES

DESCRIPTION | COST ACCOUNT
WORK COVERED BY THIS DRAWING CHARGED TO COST ACCOUNT ABOVE

PROPRIETARY STATEMENT

MINERALS EXPLORATION COMPANY
ANDERSON PROJECT

2000 TPD URANIUM MILL FACILITY

YAVAPAI COUNTY, ARIZONA

APPROVALS		DATE
CLIENT	[illegible]	12/12/77
PROJECT MANAGER	[illegible]	12/13/77
	[illegible]	7-18-78

SCALE		DATE
DRAWN BY	D.H. PENCHARD	11-8-77
DESIGNED BY	P.O. LEE	11-5-77
CHECKED BY	J. E. Foster	12/13/77
APPROVED	T. W. Wilson	12/13/77
APPROVED		

DEPT.	ARCH.	STRUCT.	MECH.	ELECT.	P.&I.	PIPING	SAF.DEPT.	P.C.
INITIAL								
DATE								

MORRISON-KNUDSEN COMPANY INC.
ENGINEERS CONTRACTORS DEVELOPERS
TWO MORRISON-KNUDSEN PLAZA / P.O. BOX 7808 / BOISE, IDAHO 83729

SHOP, WAREHOUSE & CHANGE HOUSE
GENERAL ARRANGEMENT
PLANS & ELEVATIONS

JOB NO.	DRAWING NO.	REVISION
1114	21-51-0-012	0