COST REPORT
TAILINGS STORAGE AND EVAPORATION
POND EVALUATION
LONG PARK AND PARADOX VALLEY SITES
URAVAN URANIUM MILL
MONTROSE COUNTY, COLORADO
FOR UNION CARBIDE CORPORATION

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May 23, 1980

Union Carbide Corporation
Metal Division
137 47th Street
Niagara Falls, New York 14302

Attention: Dr. Jack Kagetsu

Gentlemen:

This letter transmits 35 copies of our report entitled "Cost Report, Tailings Storage and Evaporation Pond Evaluation, Long Park and Paradox Valley Sites, Uravan Uranium Mill, Montrose County, Colorado, for Union Carbide Corporation."

Preliminary findings and conclusions were presented and discussed with Dr. Kagetsu during the course of study.

It has been a pleasure to assist you in this project. If you have any questions or if we can be of service during the review process, please call us.

Very truly yours,

DAMES & MOORE

James R. Boddy
Project Manager

JRB/ll

cc: Mr. Jack Frost - Union Carbide (1)
Mr. Pete Rekemeyer - Union Carbide (1)

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INTRODUCTION

This report presents cost estimates and assumptions for tailings disposal and evaporation pond alternatives presented in the report "Tailings Storage and Evaporation Pond Evaluation, Long Park and Paradox Valley Sites, Uravan Uranium Mill, Montrose County, Colorado, for Union Carbide Corporation," which has been prepared concurrently with this study. The purpose of this work is to outline economic considerations and prepare preliminary cost estimates for each of the options discussed in the above referenced report.

Detailed discussions of the overall purpose and scope of work, a project description, and design evaluations are presented in the companion report.

SUMMARY

Table 1 presents an overall cost summary for all tailings and mill effluent disposal schemes considered for this project. On the basis of alternatives investigated for this project, estimated tailings disposal costs range from approximately 32 to 46 million dollars (1980 dollars at 0% discount) or \$3.40 to \$4.94 per ton of dry tailings. Estimated evaporation pond costs range from 24.0 to 78.4 million dollars or \$2.58 to \$8.43 per ton of mill feed. These costs include pre-operational engineering evaluations, tailings haulage, tailings burial, effluent pipeline system, evaporation pond embankments and liner, and reclamation. Detailed discussions of cost items are presented in the sections that follow.

Tailings haulage is the major cost item when considering tailings disposal costs, accounting for approximately 46 to 65 percent of the total cost depending on the option selected. Reclamation costs vary from about 10 to 26 percent for the tailings disposal options.

The major cost items of the overall mill effluent disposal costs are 1) evaporation pond embankment and liner installation 2) reclamation and 3) pipeline installation and operation. Embankment and liner installation account for about 21 to 43 percent of the total cost; reclamation for about 16 to 22 percent; and pipeline installation and operation for about 18 to 35 percent.

METHODOLOGY AND COST ASSUMPTIONS

Cost summaries presented herein are based upon 1980 dollars and have not been discounted or adjusted for inflation. Uniform unit costs and uniform annual operating costs have been used where applicable. Cost summaries have been divided into capital, operational and final reclamation costs. No staging of construction of facilities has been assumed.

Cost summaries have been prepared to follow the general format of the companion technical evaluation report and have been separated into four basic categories:

- Tailings Haulage
- Tailings Impoundments
- Pipeline System
- Evaporation Pond Embankment and Liner

Unit costs and quantities for the tailings haulage were developed in a report prepared by the firm of Eckhoff, Watson and Preator which is attached as Appendix A of this report. Summary tables of their findings are presented herein. Pipeline system unit costs and quantities were evaluated in a report prepared by Industrial Design Corporation, which is presented as Appendix B of this report.

Tailings impoundment and evaporation pond embankment and liner unit costs and quantities were developed for this project. Unit costs were estimated from our experience on previous projects, discussion with local contractors and published construction cost information. Quantities were presented in the companion technical feasibility report and summary tables are presented herein. Tables detailing capital, operational and reclamation expenditures during the life of the proposed alternatives have been prepared for each option.

LONG PARK SITE

TAILINGS DISPOSAL

GENERAL

The tailings disposal system consists of two major elements: tailings haulage and tailings impoundment. Unit costs and assumptions are developed in the following sections. Tailings impoundment quantities were developed in the companion report and are summarized herein.

TAILINGS HAULAGE

The tailings haulage system consists of two basic components: a haul road and trucks. One haul road route from the mill to the Long Park site paralleling the existing county road was investigated. The route location is discussed in the companion report. This section presents a brief summary of the report prepared by Eckhoff, Watson and Preator to evaluate tailings haulage requirements.

Many road pavement alternatives were investigated including several bituminous and gravel options. In addition, five types of trucks were evaluated for both one and two shifts. The most economical road and truck combination for Long Park was determined to be a road with five inches of bituminous paving over eight inches of base course and five 114,000-pound gross vehicle weight (GVW) trucks and pups hauling two shifts per day.

Capital expenditures have been assumed to include only the haul road estimated at $2.75 million. Operational expenditures include all vehicle costs including truck and trailer purchase, major repairs and normal maintenance for the trucks, road maintenance, fuel, labor, taxes and insurance. Administrative, scheduling and other indirect costs have not been included. Table 2 summarizes the quantities, unit cost assumptions and calculated total costs for tailings haulage. Approximately 75 percent of the total haulage cost consists of fuel, labor, maintenance and repair for the vehicles. Based on past cost trends, the proportion of the above mentioned items to total cost will likely increase in the future.

TAILINGS IMPOUNDMENTS

Three tailings impoundment options were investigated for the Long Park site. Option 1 is a scheme to place all tailings at least 10 feet below existing grade and backfilling to original grade. Options 2 and 3 provide a cover over tailings placed partially below and partially above grade. The sequencing and technical aspects of the tailings impoundment options are discussed in the companion report. Tables 3 and 4 summarize the unit costs and quantitites for the Long Park tailings impoundment options, respectively.

Tables 5 through 7 display detailed yearly expenditures for Long Park Options 1, 2 and 3. Capital expenses include embankment construction, mine backfilling, road relocation, construction of runoff diversion ditches, haul road construction, and engineering evaluations. Not included are costs for land purchase, right-of-way and administration.

Operational expenses include tailings placement, monitoring and all tailings haulage costs discussed previously. Tailings impoundment operational costs were assumed to be uniformly distributed over the 17-year operational life. Non-routine maintenance and administrative costs such as bonds, license fees, permit acquisition and supervision have not been included. Operational costs assume that tailings would be spread by dozers. If tailings cannot be spread in this manner because the tailings are too soft to support equipment, more expensive measures would be required as discussed in the brief report prepared by Industrial Design Corporation attached as Appendix C.

Post-operational reclamation expenses are solely for final reclamation and include final site grading, revegetation and erosion protection. Not included in the post-operational costs are long-term surveillance and monitoring costs.

The most significant variable cost item for the tailings impoundment options is trench excavation and reclamation cover. Tailings haulage is a major fixed cost item as discussed previously. Placement of the tailings is also a fixed cost for all options. Therefore, disposal costs and land disturbance can be minimized by placing the tailings as thick as technically and environmentally feasible over a small area. Option 2, which covers the least area, is the cost-effective alternative as displayed on Table 6.

EVAPORATION POND SYSTEM

The evaporation system consists of two major elements: a pipeline system to transport the effluent and a pond system for evaporation and storage of effluent. A common main pipeline design has been evaluated for all Long Park evaporation pond alternatives.

Liquid Effluent Main Pipeline

The pipeline design is discussed in the companion report. Construction data and unit cost estimates are summarized from the Industrial Design Corporation report as shown on Table 8.

Capital costs shown include costs of pumps and pumping stations, powerlines, substations, monitoring (leakage detection system), pipe and installation. Not included in the capital cost elements are engineering and environmental studies (these are included under the individual option), land purchase and right-of-way costs. Ditches to collect accidental spills and other safety features which may be required for the pipeline system are included in the pipe installation cost.

Operational costs will include power and maintenance costs, inspection and monitoring, and administrative costs. Pump maintenance and servicing costs were assumed to be 10 percent of initial capital cost per year. It has been assumed that no replacement of the tailings line would be required during the operational life. Cost factors not inlcuded in the analysis are administrative cost and cost of accidents.

Reclamation costs include removal of the buried pipe and contaminated equipment with disposal in the tailings area, reclamation of ponds and ditches and revegetation. It was assumed that contaminated pipe would be disposed of at Long Park as tailings. If greater haul distances were required, additional costs would be incurred.

Evaporation Pond Embankment and Liner

Evaporation pond construction and unit cost data are summarized on Tables 9 and 10, respectively. Tables 12 through 14 present estimated costs for Options 4 through 6. Option 6 is a combined tailings disposal and evaporation pond system scheme. Tailings disposal costs for Option 6 were obtained from Table 6, Long Park Option 2.

Capital costs include the costs of engineering and environmental studies, relocation of the county road, stripping and stockpiling topsoil, backfilling mine shafts, embankment construction, liner construction, construction of diversion ditches and construction of the main pipeline system and local distribution pipeline. Land purchase and right-of-way costs have not been included in the estimates.

Operating costs include maintenance of dams and liners, daily inspection, moving effluent discharge lines, monitoring and pipeline pumping costs. Annual monitoring and study costs were assumed to be 15 percent of the pre-operational studies. Non-routine maintenance, accidents and administrative costs such as bonds, license fees and supervision have not been included in the cost estimate.

Reclamation costs include removal and disposal of contaminated soils and equipment, removal of dams and temporary diversion ditches, pipeline reclamation, revegetation and long-term surveillence. It was assumed that contaminated soils and equipment would be disposed as tailings at Long Park. No costs for long-term surveillence were included.

Option 4 is 50 percent lower in cost than Option 5, primarily because of the much smaller quantities required for embankment construction and liners. The multiple evaporation pond system considered for Option 6 is slightly less costly than Option 5 because of somewhat smaller embankment and liner volumes due to increased liquid storage. Option 5 was found to be more favorable than Options 4 and 6 from an environmental standpoint, however, as discussed in the companion report.

PARADOX VALLEY SITES

Cost evaluations have been made for the Paradox 2 site for an evaporation system and for the Paradox 3 site for tailings disposal. However, these sites have been found to be unfavorable from technical or environmental standpoints. Therefore detailed discussions of cost aspects will not be provided herein.

TABLE 1

OVERALL COST SUMMARY[1]

	TOTAL COSTS (Millions of 1980 $)			
	CAPITAL	OPERATIONAL	RECLAMATION	TOTAL
LONG PARK				
Option 1 - Tailings Disposal[2] (Plate 6)[4]	14.6	19.1	11.8	45.5
Option 2 - Tailings Disposal[2] (Plate 7)	9.5	19.1	3.3	31.9
Option 3 - Tailings Disposal[2] (Plate 8)	10.6	19.1	3.9	33.6
Option 4 - Evaporation Ponds[3] (Plate 9)	10.6	7.7	5.6	24.0
Option 5 - Evaporation Ponds[3] (Plate 10)	32.6	7.7	7.8	48.1
Option 6 - Combined Evaporation and Tailings Disposal[2,3] (Plate 11)	41.0	26.8	10.6	78.4

1) Summary does not include all costs associated with project - see text for explanation.
Cost breakdowns are shown on Tables 5 through 13.
Costs have not been discounted nor have provisions for inflation been included.

2) Includes tailings haulage.

3) Includes effluent pipeline.

4) Plate number showing option in main text.

TABLE 2

LONG PARK HAULAGE DATA AND UNIT COSTS[1]

ITEM	QUANTITY	UNIT COST (1980 Dollars)	TOTAL (1000 1980 Dollars)
Trucks			
Truck & Pup	20	$115,000	2,300
Major Repairs			2,199.4
Tax & Insurance			488.8
Fuel[2]	54,430 gal	$1.00	4,626.7
Operator[2]	2	$36,540	6,211.8
Maintenance[2]	1	$24,190	2,056.2
Roads			
Road Construction	51,120 feet	$53.84	2,752.5
Road Maintenance	1 year	$16,700	283.9
		Total	$20,919.3

1) Costs and quantities adopted from Eckoff Watson Preator report, attached as Appendix A.

2) Quantity listed is for each truck per year.

TABLE 3

TAILINGS IMPOUNDMENT UNIT COST DATA

ITEM	UNIT COST
Embankment Fill	$2.00/cu yd
Reclamation Cover	$2.00/cu yd
Bottom Preparation[1]	$1.00/cu yd
Stripping	$1.25/cu yd
Tailings Placement by Dozer	$.10/ton
Mine Backfilling	$100/cu yd
Revegetation[2]	$2,000/acre
Erosion Protection	$10/cu yd
Diversion Ditch Excavation	$.50/cu yd
Diversion Ditch Riprap	$25.00/cu yd

[1] Includes disking, moisture conditioning and compaction

[2] Includes placing stockpiled topsoil and seeding

TABLE 4

TAILINGS IMPOUNDMENT QUANTITIES[1]

SITE[2]	OPTION	EMBANKMENT FILL (1000) (cu yds)	BOTTOM PREPA-RATION (1000) (cu yds)	STRIPPING (1000) (cu yds)	RECLAMATION COVER (1000 cu yds)	REVEGE-TATED AREA (Acres)	EROSION PROTECTION (1000) (cu yds)	DITCH EXCAVATION (1000) (cu yds)	DITCH RIPRAP (1000) (cu yds)
Long Park	1	0	484	242	6,900	50	484	142	3.3
Long Park	2[3]	450	258	141	2,750	175	16	52.4	
Long Park	3	450	306	165	3,300	205	16	28.8	

1) Tailings quantity for all sites is 9.3×10^6 dry tons

2) Long Park site mine backfill quantity assumed as 2,000 cu yds for all options

3) Option 2 tailings disposal was used for combined liquid and tailings disposal, Long Park Option 6

TABLE 5

COST SUMMARY[1]
LONG PARK OPTION 1 FILTERED TAILINGS DISPOSAL SYSTEM

	COSTS (Thousands of 1980 $)
CAPITAL COSTS	
Site Preparation[2]	7,965.1
Diversion Ditches	71
Road	2,752.5
Engineering, Geotechnical, and Environmental	1,620
Contingency	2,160
OPERATIONAL COSTS	
Tailings Placement[3]	935.0
Road Maintenance	283.9
Haulage	17,880.5
RECLAMATION	
Final Reclamation[4]	11,798.6
TOTAL	45,466.6

1) Costs not included: land purchase, right-of-way, administration

2) Includes: stripping, excavation, bottom preparation, mine backfill, and road relocation

3) Assumed placement by dozer

4) Includes: cover and erosion protection or revegetation

TABLE 6

COST SUMMARY[1]
LONG PARK OPTION 2 FILTERED TAILINGS DISPOSAL SYSTEM

	COSTS (Thousands of 1980 $)
CAPITAL COSTS	
Site Preparation[2]	3,387.4
Embankment	900
Diversion Ditches	26.2
Road	2,752.5
Engineering, Geotechnical, and Environmental	1,060
Contingency	1,410
OPERATIONAL COSTS	
Tailings Placement[3]	935.0
Road Maintenance	283.9
Haulage	17,880.5
RECLAMATION	
Final Reclamation[4]	3,260.6
TOTAL	31,896.1

---

1) Costs not included: land purchase, right-of-way, administration

2) Includes: stripping, excavation, bottom preparation, mine back-fill, and road relocation

3) Assumed placement by dozer

4) Includes: cover and erosion protection or revegetation

TABLE 7

COST SUMMARY[1]
LONG PARK OPTION 3 FILTERED TAILINGS DISPOSAL SYSTEM

	COSTS (Thousands of 1980 $)
CAPITAL COSTS	
Site Preparation[2]	4,178
Embankment	900
Diversion Ditches	14.4
Road	2,752.5
Engineering, Geotechnical, and Environmental	1,180
Contingency	1,570
OPERATIONAL COSTS	
Tailings Placement[3]	935
Road Maintenance	283.9
Haulage	17,880.5
RECLAMATION	
Final Reclamation[4]	3,869.7
TOTAL	33,564.0

1) Costs not included: land purchase, right-of-way, administration

2) Includes: stripping, excavation, bottom preparation, mine back-fill, and road relocation

3) Assumed placement by dozer

4) Includes: cover and erosion protection or revegetation

TABLE 8

PIPELINE CONSTRUCTION DATA AND UNIT COSTS
TO LONG PARK

ITEM	QUANTITY		UNIT COST
Main Pipeline and Installation	53,705 feet		$26.64/foot
Instrumentation	Total System		$200,000
Pond Distribution System	1,000 feet	(Option 4)	$13.32/foot
Pond Distribution System	9,600 feet	(Option 5)	$13.32/foot
Pond Distribution System	3,000 feet	(Option 6)	$13.32/foot
Installation of Pond Distribution Pipes	--		$1,000/pond
Pumps	19 pumps		$5,570/each
Pump Buildings	5 buildings		$22,500/each
Power Line	7.88 miles		$25,000/mile
Electrical Substations	5 substations		$10,000/each
Electrical Consumptions	5.96 million KWH/year		$ .05/KWH
Maintenance and Servicing	--		5% of capital cost
Pipeline Reclamation	53,705 feet		$13.32/foot

TABLE 9

CONSTRUCTION DATA FOR EVAPORATION POND ALTERNATIVES

OPTION	EMBANKMENT VOLUMES (thousands cu yds) SHELL	CORE	RIPRAP	DRAINS & FILTERS	DITCH VOLUMES (thousands cu yds) EXCAVATIONS	RIPRAP	LINER VOLUMES (thousands cu yds)	ROAD RE-LOCATION (feet)
LONG PARK - OPTION 4 SINGLE RESERVOIR	487	245	8.2	50.0	54.6	0	1,370	5,300
LONG PARK - OPTION 5 MULTIPLE RESERVOIR	2,300	1,520	90.0	530.0	164.0	18.7	1,700	10,800
LONG PARK - OPTION 6 COMBINED EVAPORATION AND TAILINGS DISPOSAL	1,981	1,393	78.7	485.5	95.9	18.7	1,440	12,800

TABLE 10

EVAPORATION POND UNIT COST DATA

ITEM	UNIT COST
Embankment Shell	$2.00/cubic yard
Clay Core and Liner[1)]	$3.25/cubic yard Long Park
Wave Protection	$25.00/cubic yard
Processed Sand and Gravel	$10.00/cubic yard
Ditch Excavation	$.50/cubic yard
Stripping	$1.25/cubic yard
Movement of Contaminated Soils	$1.25/cubic yard
Reclamations Material	$2.00/cubic yard
Level Embankments	$0.50/cubic yard

1) Liner thickness is 3 feet

TABLE 11

COST SUMMARY
LONG PARK OPTION 4 EVAPORATION POND SYSTEM

	COSTS (Thousands of 1980 $)
CAPITAL COSTS	
Site Preparation	485
Embankments	796
Liners	4,452
Diversion Ditches	27.3
Road Relocation	18
Pipeline	2,110.3
Engineering, Geotechnical, and Environmental	1,183
Contingencies	1,578
OPERATIONAL COSTS	
Pipeline	6,847.6
Pond O&M	850
RECLAMATION	
Pond Reclamation	4,910
Pipeline Reclamation	715.4
TOTAL	23,972.6

TABLE 12

COST SUMMARY
LONG PARK OPTION 5 EVAPORATION POND SYSTEM

	COSTS (Thousands of 1980 $)
CAPITAL COSTS	
Site Preparation	533.1
Embankments	16,418.6
Liners	4,339.6
Diversion Ditches	549.5
Road Relocation	43.2
Pipeline	2,236.0
Engineering, Geotechnical, and Environmental	3,618
Contingencies	4,824
OPERATIONAL COSTS	
Pipeline	6,847.6
Pond O&M	850
RECLAMATION	
Pond Reclamation	7,100
Pipeline Reclamation	715.4
TOTAL	48,075.0

TABLE 13

COST SUMMARY
LONG PARK OPTION 6 EVAPORATION POND AND
TAILINGS DISPOSAL COMBINATION SYSTEM

	COSTS (Thousands of 1980 $)
CAPITAL COSTS	
Site Preparation	3,438
Embankments	16,800
Liners	4,682
Diversion Ditches	556
Road	2,796
Pipeline	2,146
Engineering, Geotechnical, and Environmental	4,563
Contingencies	6,084
OPERATIONAL COSTS	
Pipeline	6,847.6
Pond O&M	850
Tailings Placement	935
Road Maintenance	284
Tailings Haulage	17,880.5
RECLAMATION	
Final Tailings Reclamation	3,261
Pond Reclamation	6,600
Pipeline Reclamation	715
TOTAL	78,438.1

APPENDIX A

FEASIBILITY REPORT FOR HAULING URANIUM TAILINGS AT URAVAN, COLORADO

BY

ECKHOFF, WATSON & PREATOR

April, 1980

Feasibility Report

for

Hauling Uranium Tailings at
Uravan, Colorado

(Abridged Report)

Prepared for

DAMES AND MOORE

Prepared by

ECKHOFF, WATSON & PREATOR

April 1980

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I. INTRODUCTION

REQUIREMENTS

Eckhoff, Watson and Preator was retained by Dames and Moore to perform a feasibility analysis of hauling uranium tailings from the Union Carbide mill at Uravan to three alternate disposal sites. Additionally, a preliminary road design was prepared for the haul route to Long Park.

The alternate sites considered in the study were:

- LONG PARK - Located in portions of Sections 27, 34, and 35 of Township 47 North, Range 17 West
- PARADOX #2 - Located in portions of Sections 23, 25, and 26 of Township 47 North, Range 18 West
- PARADOX #3 - Located in portions of Section 33 and 34 of Township 46 North, Range 16 West

OBJECTIVES OF STUDY

The objectives of the haul feasibility study were to:

A. Investigate and make recommendations for haul vehicles. Special consideration was given to features that would minimize the potential for radioactive contamination along the haul route.

B. Prepare a preliminary road design from the mill at Uravan to the Long Park site.

C. Establish capital, operation and maintenance costs for vehicle and haul route alternates for each disposal site.

D. Using both present worth and annual costs analyses, compare the economics of each site from a haulage stand point.

SCOPE OF INVESTIGATION

VEHICLE SPECIFICATIONS - A canvass of local, state and federal agencies was performed to determine the need for special features or provisions. Truck and trailer manufacturers were contacted to establish vehicle alternates and availability of equipment able to handle the corrosiveness of the tailings.

ECONOMIC ANALYSIS - Present worth and annual cost analyses were performed for each site. A computer model was used to perform the analysis for discount rates from 0 to 20 percent at 5 percent increments.

In addition, both single and double shifts were considered in the analysis.

PRELIMINARY ROAD DESIGN - A preliminary design for the haul road to Long Park was prepared from enlarged USGS 7 1/2 MINUTE QUADS. The road was designed to Montrose County Standards.

Structural road sections for the various truck alternates were prepared by Dames and Moore.

II. SUMMARY OF RESULTS

VEHICLES [1]

No state or local agency had any special requirements for vehicles hauling uranium tailings. However, it is recommended that the following features be specified for all vehicles:

- o Neoprene watertight tailgate seals
- o Vacuum actuated tailgate locking mechanisms
- o Steel bed liners
- o Canvas bed covers
- o End dump trucks and trailers

Table 1 summarizes the truck alternates considered in the study.

Table 1 - TRUCK ALTERNATES

Truck Alternate	Gross Weight	Pay Load	Axles
I - Truck and Trailer	80,000 lbs.	51,000 lbs.	6
II - Truck and Pup	85,000 lbs.	56,000 lbs.	5
III - Truck and Pup	114,000 lbs.	79,000 lbs.	7
IV - Mine Truck	115,700 lbs.	48,000 lbs.	2
V - Mine Truck	158,300 lbs.	71,600 lbs.	2
VI - Mine Truck	224,410 lbs.	100,000 lbs.	2

Colorado Department of Transporation's weight limit for all non-interstate roads is 85,000 GVW. Therefore, only truck alternates I and II can be used on existing state roads.

For Truck Alternates I, II and III the following engine and drive train specifications would provide the necessary torque to meet all speed, startability and gradeability requirements.

400 Horsepower Turbo-Charged Engine
5 Speed Main Transmission
4 Speed Auxilary Transmission
6:1 or 5:3 Read Axle Ratio, depending on application

The Mine Truck alternates were standard design and met all speed, startability and gradeability requirements.

HAUL ALTERNATES

A discussion of the disposal sites from a haulage stand point follows. The most attractive is presented first, and the least attractive is presented last. For continuity of discussion all costs are for a zero discount rate. Costs associated with other discount rates are presented in Appendix 1. [Excluded in Abridged Report]

Appendix 1 presents the economic analysis for each site. Only the optimum situation is presented in this summary.

PARADOX #3 SITE

The haul is along existing state highways, therefore no roadway costs are incurred. The route follows Highways 141 and 90 and is about 17.3 miles one way. Only Truck Alternates I and II were applicable since the highways are state controlled.

Table 2 - PARADOX #3 OPTIMUM HAUL COSTS

Truck Alternate	I Truck and Trailor	GVW 80,000 lbs.
Number of Shifts	Two	
Number of Vehicles	6	
Annualized Cost:		
Vehicles	81,000	
Vehicle O & M	$944,000	
Roadway	EXISTING	
Roadway O & M	COUNTY MAINTAINED	
Cost Per Wet Ton		$ 1.50

LONG PARK SITE

A preliminary road design was prepared for the haul route to the Long Park site. The route follows along the existing dirt road alignment for the majority of its length and is 10.3 miles long. The design speed for the road is 40 m.p.h. except for the segment at the top of Hieroglyphic Canyon which is designed for 30 m.p.h. The road is designed to Montrose County standards. The maximum grade encountered is 11 percent with a 1000 foot run.

A preliminary earthwork analysis was run to estimate the quantity of excavation required for construction of the road. Total excavation was estimated at 305,000 cu.yd. Embankments will require approximately 220,000 cu.yd. These figures are the best estimates available using the existing topographic maps. More accurate estimates of earthwork quantities will require a field survey.

Appendix 3 contains the plan and profile sheets for the Long Park road design and the typical road section

Table 3 - LONG PARK OPTIMUM HAUL COSTS

Truck Alternate	III Truck and Pup	GVW = 114,000 lbs.
Number of Shifts	Two	
Number of Vehicles	5	
Annualized Cost:		
Vehicles	$ 92,000	
Vehicles O & M	807,000	
*Roadway 5"/8"	162,000	
Roadway O & M	17,800	
Cost Per Wet Ton		$1.60

* 5"/8" represents the structural road section. Five inches of Bituminous asphalt over 8 inches of base.

PARADOX # 2 SITE

Two haul routes were analyzed for the Paradox # 2 Highways 141 and 90 and is 34 miles one way. The second is through the San Miguel River Canyon. The road through the canyon will have to be widened. The maximum design speed is 30 m.p.h. Due to the many curves in the canyon, this section of road has a high accident potential. The proximity of the San Miguel River poses the additional danger of having a spill occur into the river.The haul through the canyon to the disposal site is 14.4 miles.

The haul through the San Miguel Canyon proved to be more economical than the longer route over existing roads.

Table 4 - PARADOX # 2 OPTIMUM HAUL COSTS

Truck Alternate	III Truck and Pup	GVW = 114,000 lbs.
Number of Shifts	Two	
Number of Vehicles	6	
Annualized Cost		
Vehicles	$ 110,000	
Vehicle O & M	1,010,000	
Roadway 5"/8"	[291,000]	
Roadway O & M	24,800	
Cost Per Wet Ton		$2.12

III. METHODOLOGY

HAUL CYCLE [2]

The haul cycle was analyzed with the use of a computer model. The model uses the following parameters to calculate the cycle time.

- o ENGINE HORSE POWER RATING
- o VEHICLE RIMPULL (FORCE AVAILABLE TO PROPELL VEHICLE)
- o ROLLING RESISTANCE OF ROAD
- o GRADE OF ROAD
- o LENGTH OF ROAD SEGMENT
- o WHETHER THE VEHICLE IS IN MOTION OR IS STOPPING OR STARTING
- o SPEED FACTORS TO ACCOUNT FOR SHIFTING TIME
- o DUMP AND LOAD TIMES
- o ALTITUDE CORRECTION FACTORS (Not applicable to Turbo-charged engines.)

The output from the model for each site and sub alternatives is presented in Appendix 2. [Excluded in Abridged Report]

ECONOMIC ANALYSIS

An economic analysis was performed on each combination of truck and surface alternative. Two methods were used: (1) equivalent annual cost and (2) present worth.

Each unique combination of factors considered the following:

(a) Initial and Replacement Vehicle Costs

(b) Annual Vehicle Operation and Maintenance (O & M) Costs

(c) Salvage Value of Vehicles

(d) Initial (and, if applicable, resurfacing) Roadway Costs

(e) Annual Roadway Maintenance and Operations Cost

The capital costs for vehicles included a five year replacement program. A 20% salvage value was used. Since the project is set to end in year 17, 3/5 of the last vehicle fleet's value would not have been "used." The vehicle costs are reduced by this amount.

Each roadway alternative is built at time zero. Some alternatives have additional construction in year 5. Operation and mainenance (O & M) costs remain constant over the life of the project.

The total cost of a given alternative may be expressed as an annual cost by adding annual maintenance and operations to the annual cost of capital investment. The annual cost of a capital investment may be expressed as the cost times the appropriate capital recovery factor for the service life and interest rate used. This figure is normalized further when the investment does not occur at the beginning of the project. The alternate with the lowest total cost is the most desireable from an economic standpoint.

Alternate improvements may also be compared on the basis of their total present worths for some specified period of analysis (17 years). The present worth of an alternative represents the sum of money necessary at time zero to finance the project over the analysis period of the alternatives compared. The one with the lowest present worth is more economical.

IV. COST COMPONENTS

VEHICLE COSTS

CAPITAL [3]

The capital costs of the trucks and trailers used in the analysis were obtained from several manufacturers and truck dealerships.

OPERATION AND MAINTENANCE [4]

Table 5 presents factors used to establish vehicle hourly and annual costs. Appendix 4 contains the actual calculations for each truck alternate.

Each vehicle was assumed to have a service life of 5 years and a salvage value of 20 percent of the initial capital cost. Depreciation was figured using the straight line method.

Vehicles were assumed to operate for 7 hours per shift for 360 days per year. This results in 2520 hours of usage per shift-year.

Diesel was assumed to cost $1.00/gal.

Table 5 - VEHICLE OPERATION AND MAINTENANCE COSTS

	SHIFTS	
	ONE	TWO
ANNUAL FIXED COST:		
Depreciation	16% ICC*	16% of ICC
Major Repairs	15% ICC	22.5% of ICC
Tax and Insurance	5% ICC	5% of ICC
TOTAL FIXED	36% of ICC	43.5% of ICC
HOURLY COSTS:		
Fixed	.36 x ICC/2520	.435 x ICC/5040
Fuel Cost	$0.027/HP	$0.027/HP
Maintenance	$0.012/HP	$0.012/HP
Driver	$14.50	$14.50

*ICC = INITIAL CAPITAL COST

ROAD COSTS

CAPITAL [5]

A detailed cost estimate was prepared for the Long Park haul road. Earthwork quantities were estimated by using a mass diagram computer program. Preliminary hydrologic calculations were performed to estimate the size of culverts. Quantities and costs of base course, bituminous surfacing and primer coat were calculated for all 21 road surfacing alternates.

The preliminary bid estimate for the optimum alternate is provided in Appendix 5.

The road costs for the San Miguel Canyon Road were determined by using a cost per mile [all costs except surfacing] of a road designed in vary similar terrain [FISCHCREEK CANYON, CARBON COUNTY, UTAH]. The costs for the surfacing were then superimposed. Appendix 5 contains the estimated cost for this road.

OPERATION AND MAINTENANCE [6]

Table 6 shows the operational and maintenance cost used in this study.

TABLE 6 - ROAD MAINTENANCE AND OPERATION

GRAVEL SURFACING	$4,992/mile
BITUMINOUS SURFACING	1,725/ mile

Bituminous surfaced roads were considered to need only minimal maintenance. This is based on the assumption that the initial road section was adequately designed and constructed.

Gravel surfaced roads were considered to need continual maintenance. Two bladings a week were assumed to be required.

APPENDIX

1

Economic Analysis

Appendix 1 contains the economic analysis of each disposal site for discount rates from 0 to 20% in 5% increments and for both one and two shifts.

The surfacing notation is as follows:

Gravel 32.5	represents a gravel road surfacing with a structural depth of 32.5 inches
BIT. 4/8	represents a bituminous asphalt road with 4 inches of asphalt over 8 inches of base course
BIT. 2/10-2	represents a staged construction of a bituminous asphalt road with 2 inches of asphalt over ten inches of base course followed by a 2 inch overlay at year five.

0 DISCOUNT RATE

TABLE 6

LONG PARK HAUL ROAD - ONE SHIFT DISCOUNT RATE : 0 %

ALTERNATIVE		ANNUALIZED COST: VEHICLE ($1000)		ANNUALIZED COST: ROADWAY ($1000)		ANNUALIZED COST: TOTAL		PRESENT WORTH: TOTAL	
TRUCK	SURFACE	CAPITAL	O & M	CAPITAL	O & M	$1000	COST/TON*	$1000	COST/TON*
I	GRAVEL 32.5	$163	$1,060	$195	$51.4	$1,470	$2.17	$24,996	$2.17
I	BIT. 5.5/8.5	$163	$1,060	$172	$17.8	$1,413	$2.09	$24,035	$2.09
I	BIT. 4/13.5	$163	$1,060	$175	$17.8	$1,416	$2.09	$24,075	$2.09
I	BIT. 4/6.5-2	$163	$1,060	$178	$17.8	$1,419	$2.10	$24,137	$2.10
I	BIT. 3/10-2	$163	$1,060	$180	$17.8	$1,421	$2.10	$24,157	$2.10
II	GRAVEL 35	$161	$981	$202	$51.4	$1,396	$2.06	$23,746	$2.06
II	BIT 6/9	$161	$981	$178	$17.8	$1,339	$1.98	$22,765	$1.98
II	BIT 4/15.5	$161	$981	$181	$17.8	$1,342	$1.98	$22,815	$1.98
II	BIT 4/7-2.5	$161	$981	$190	$17.8	$1,351	$2.00	$22,969	$2.00
II	BIT 3/11-2.5	$161	$981	$188	$17.8	$1,348	$1.99	$22,929	$1.99
III	GRAVEL 31	$166	$938	$191	$51.4	$1,347	$1.99	$22,896	$1.99
III	BIT 5/8	$166	$938	$162	$17.8	$1,285	$1.90	$21,845	$1.90
III	BIT 4/12	$166	$938	$170	$17.8	$1,292	$1.91	$21,975	$1.91
III	BIT 4/6-2	$166	$938	$177	$17.8	$1,300	$1.92	$22,098	$1.92
III	BIT 3/9.5-2	$166	$938	$178	$17.8	$1,301	$1.92	$22,118	$1.92
IV	GRAVEL 30	$544	$2,020	$188	$51.4	$2,804	$4.15	$47,668	$4.15
IV	BIT 4/18	$544	$2,020	$190	$17.8	$2,771	$4.10	$47,117	$4.10
V	GRAVEL 36	$531	$1,980	$205	$51.4	$2,768	$4.10	$47,060	$4.10
V	BIT 5/22	$531	$1,980	$210	$17.8	$2,739	$4.05	$46,559	$4.05
VI	GRAVEL 43	$608	$2,050	$232	$51.4	$2,941	$4.35	$50,006	$4.35
VI	BIT 6/26	$608	$2,050	$230	$17.8	$2,905	$4.30	$49,394	$4.30

*NOTE: WET TONS

TABLE 7

LONG PARK HAUL ROAD - TWO SHIFTS DISCOUNT RATE : 0 %

ALTERNATIVE		ANNUALIZED COST						PRESENT WORTH	
		VEHICLE ($1000)		ROADWAY ($1000)		TOTAL		TOTAL	
TRUCK	SURFACE	CAPITAL	O & M	CAPITAL	O & M	$1000	COST/TON*	$1000	COST/TON*
I	GRAVEL 32.5	$211	$943	$195	$51.4	$1,401	$2.07	$23,823	$2.07
I	BIT. 5.5/8.5	$211	$943	$172	$17.8	$1,344	$1.99	$22,862	$1.99
I	BIT. 4/13.5	$211	$943	$175	$17.8	$1,347	$1.99	$22,902	$1.99
I	BIT. 4/6.5-2	$211	$943	$178	$17.8	$1,350	$2.00	$22,964	$2.00
I	BIT. 3/10-2	$211	$943	$180	$17.8	$1,352	$2.00	$22,984	$2.00
II	GRAVEL 35	$88	$959	$202	$51.4	$1,301	$1.92	$22,126	[illegible]
II	BIT 6/9	$88	$959	$178	$17.8	$1,243	$1.84	$21,145	$1.84
II	BIT 4/15.5	$88	$959	$181	$17.8	$1,246	$1.84	$21,195	$1.84
II	BIT 4/7-2.5	$88	$959	$190	$17.8	$1,255	$1.86	$21,349	$1.86
II	BIT 3/11-2.5	$88	$959	$188	$17.8	$1,253	$1.85	$21,309	$1.85
III	GRAVEL 31	$92	$807	$191	$51.4	$1,141	$1.69	$19,405	$1.69
III	BIT 5/8	$92	$807	$162	$17.8	$1,079	$1.59	$18,354	$1.59
III	BIT 4/12	$92	$807	$170	$17.8	$1,087	$1.61	$18,484	$1.61
III	BIT 4/6-2	$92	$807	$177	$17.8	$1,094	$1.62	$18,606	$1.62
III	BIT 3/9.5-2	$92	$807	$178	$17.8	$1,095	$1.62	$18,626	$1.62
IV	GRAVEL 30	$27	$1,600	$188	$51.4	$1,867	$2.76	$31,743	$2.76
IV	BIT 4/18	$27	$1,600	$190	$17.8	$1,835	$2.71	$31,192	$2.71
V	GRAVEL 36	$318	$1,730	$205	$51.4	$2,305	$3.41	$39,193	$3.41
V	BIT 5/22	$318	$1,730	$210	$17.8	$2,276	$3.37	$38,692	$3.37
VI	GRAVEL 43	$380	$1,980	$232	$51.4	$2,644	$3.91	$44,954	$3.91
VI	BIT 6/26	$380	$1,980	$230	$17.8	$2,608	$3.86	$44,342	$3.86

*NOTE: WET TONS

TABLE 8

PARADOX #2 VIA SAN MIGUEL VALLEY - ONE SHIFT DISCOUNT RATE : 0 %

ALTERNATIVE		ANNUALIZED COST						PRESENT WORTH	
		VEHICLE ($1000)		ROADWAY ($1000)		TOTAL		TOTAL	
TRUCK	SURFACE	CAPITAL	O & M	CAPITAL	O & M	$1000	COST/TON*	$1000	COST/TON*
I	GRAVEL 32.5	$204	$1,380	$341	$71.9	$1,997	$2.95	$33,963	$2.95
I	BIT. 5.5/8.5	$204	$1,380	$304	$24.8	$1,913	$2.83	$32,532	$2.83
I	BIT. 4/13.5	$204	$1,380	$310	$24.8	$1,919	$2.84	$32,632	$2.84
I	BIT. 4/6.5-2	$204	$1,380	$315	$24.8	$1,925	$2.85	$32,727	$2.85
I	BIT. 3/10-2	$204	$1,380	$317	$24.8	$1,926	$2.85	$32,757	$2.85
II	GRAVEL 35	$192	$1,310	$351	$71.9	$1,925	$2.85	$32,736	$2.85
II	BIT 5/9	$192	$1,310	$315	$71.9	$1,889	$2.79	$32,116	$2.79
II	BIT 4/15.5	$192	$1,310	$320	$24.8	$1,846	$2.73	$31,395	$2.73
II	BIT 4/7-2.5	$192	$1,310	$333	$24.8	$1,860	$2.75	$31,625	$2.75
II	BIT 3/11-2.5	$192	$1,310	$330	$24.8	$1,857	$2.75	$31,575	$2.75
III	GRAVEL 31	$184	$1,050	$334	$71.9	$1,640	$2.43	$27,890	$2.43
III	BIT 5/8	$184	$1,050	$291	$24.8	$1,549	$2.29	$26,349	$2.29
III	BIT 4/12	$184	$1,050	$302	$24.8	$1,561	$2.31	$26,549	$2.31
III	BIT 4/6-2	$184	$1,050	$313	$24.8	$1,572	$2.32	$26,734	$2.32
III	BIT 3/9.5-2	$184	$1,050	$315	$24.8	$1,574	$2.33	$26,764	$2.33
IV	GRAVEL 30	$622	$2,350	$330	$71.9	$3,374	$4.99	$57,362	$4.99
IV	BIT 4/18	$622	$2,350	$332	$24.8	$3,329	$4.93	$56,601	$4.93
V	GRAVEL 36	$584	$2,120	$356	$71.9	$3,132	$4.64	$53,249	$4.64
V	BIT 5/22	$584	$2,120	$362	$24.8	$3,091	$4.58	$52,559	$4.58
VI	GRAVEL 43	$683	$2,340	$386	$71.9	$3,481	$5.15	$59,186	$5.15
VI	BIT 6/26	$683	$2,340	$392	$24.8	$3,440	$5.09	$58,495	$5.09

*NOTE: WET TONS

TABLE 9

PARADOX #2 VIA SAN MIGUEL VALLEY - TWO SHIFTS DISCOUNT RATE : 0 %

ALTERNATIVE		ANNUALIZED COST						PRESENT WORTH	
		VEHICLE ($1000)		ROADWAY ($1000)		TOTAL		TOTAL	
TRUCK	SURFACE	CAPITAL	O & M	CAPITAL	O & M	$1000	COST/TON*	$1000	COST/TON*
I	GRAVEL 32.5	$108	$1,320	$341	$71.9	$1,841	$2.72	$31,311	$2.72
I	BIT. 5.5/8.5	$108	$1,320	$304	$24.8	$1,757	$2.60	$29,880	$2.60
I	BIT. 4/13.5	$108	$1,320	$310	$24.8	$1,763	$2.61	$29,980	$2.61
I	BIT. 4/6.5-2	$108	$1,320	$315	$24.8	$1,769	$2.62	$30,075	$2.62
I	BIT. 3/10-2	$108	$1,320	$317	$24.8	$1,770	$2.62	$30,105	$2.62
II	GRAVEL 35	$103	$1,150	$351	$71.9	$1,676	$2.48	$28,503	$2.48
II	BIT 6/9	$103	$1,150	$315	$71.9	$1,640	$2.42	$27,883	$2.42
II	BIT 4/15.5	$103	$1,150	$320	$24.8	$1,597	$2.36	$27,163	$2.36
II	BIT 4/7-2.5	$103	$1,150	$333	$24.8	$1,611	$2.38	$27,393	$2.38
II	BIT 3/11-2.5	$103	$1,150	$330	$24.8	$1,608	$2.38	$27,343	$2.38
III	GRAVEL 31	$110	$1,010	$334	$71.9	$1,527	$2.26	$25,958	$2.26
III	BIT 5/8	$110	$1,010	$291	$24.8	$1,436	$2.12	$24,418	$2.12
III	BIT 4/12	$110	$1,010	$302	$24.8	$1,448	$2.14	$24,618	$2.14
III	BIT 4/6-2	$110	$1,010	$313	$24.8	$1,459	$2.16	$24,802	$2.16
III	BIT 3/9.5-2	$110	$1,010	$315	$24.8	$1,460	$2.16	$24,832	$2.16
IV	GRAVEL 30	$310	$1,870	$330	$71.9	$2,582	$3.82	$43,893	$3.82
IV	BIT 4/18	$310	$1,870	$332	$24.8	$2,537	$3.75	$43,138	$3.75
V	GRAVEL 36	$318	$1,730	$356	$71.9	$2,476	$3.66	$42,104	$3.66
V	BIT 5/22	$318	$1,730	$362	$24.8	$2,436	$3.60	$41,414	$3.60
VI	GRAVEL 43	$380	$1,980	$386	$71.9	$2,819	$4.17	$47,925	$4.17
VI	BIT 6/26	$380	$1,980	$392	$24.8	$2,778	$4.11	$47,234	$4.11

*NOTE: WET TONS

TABLE 10

PARADOX # 2 VIA HIGHWAY 141 & 90 - ONE SHIFT   DISCOUNT RATE : 0 %

ALTERNATIVE		ANNUALIZED COST						PRESENT WORTH	
		VEHICLE ($1000)		ROADWAY ($1000)		TOTAL		TOTAL	
TRUCK	SURFACE	CAPITAL	O & M	CAPITAL	O & M	$1000	COST/TON*	$1000	COST/TON*
I	EXISTING	$259	$1,810	$0	$0.0	$2,069	$3.06	$35,176	$3.06
II	EXISTING	$265	$1,740	$0	$0.0	$2,005	$2.97	$34,094	$2.97

*NOTE: WET TONS

TABLE 11

PARADOX # 2 VIA HIGHWAY 141 & 90 - TWO SHIFTS DISCOUNT RATE : 0 %

ALTERNATIVE		ANNUALIZED COST						PRESENT WORTH	
		VEHICLE ($1000)		ROADWAY ($1000)		TOTAL		TOTAL	
TRUCK	SURFACE	CAPITAL	O & M	CAPITAL	O & M	$1000	COST/TON*	$1000	COST/TON*
I	EXISTING	$136	$1,700	$0	$0.0	$1,836	$2.72	$31,209	$2.71
II	EXISTING	$132	$1,530	$0	$0.0	$1,662	$2.46	$28,259	$2.[illegible]5

*NOTE: WET TONS

TABLE 12

PARADOX # 3 VIA HIGHWAY 141 & 90 - ONE SHIFT DISCOUNT RATE : 0 %

ALTERNATIVE		- - - - - - ANNUALIZED COST - - - - - -						- - PRESENT WORTH - -	
		VEHICLE ($1000)		ROADWAY ($1000)		TOTAL		TOTAL	
TRUCK	SURFACE	CAPITAL	O & M	CAPITAL	O & M	$1000	COST/TON*	$1000	COST/TON*
I	EXISTING	$136	$958	$0	$0.0	$1,094	$1.62	$18,596	$1.62
II	EXISTING	$147	$981	$0	$0.0	$1,128	$1.67	$19,177	$1.67

*NOTE: WET TONS

TABLE 13

PARADOX # 3 VIA HIGHWAY 141 & 90 - TWO SHIFTS DISCOUNT RATE : 0 %

ALTERNATIVE		ANNUALIZED COST						PRESENT WORTH	
		VEHICLE ($1000)		ROADWAY ($1000)		TOTAL		TOTAL	
TRUCK	SURFACE	CAPITAL	O & M	CAPITAL	O & M	$1000	COST/TON*	$1000	COST/TON*
I	EXISTING	$81	$944	$0	$0.0	$1,025	$1.51	$17,433	$1.51
II	EXISTING	$88	$959	$0	$0.0	$1,047	$1.55	$17,802	$1.55

*NOTE: WET TONS

APPENDIX

2

Haul Cycle Analysis

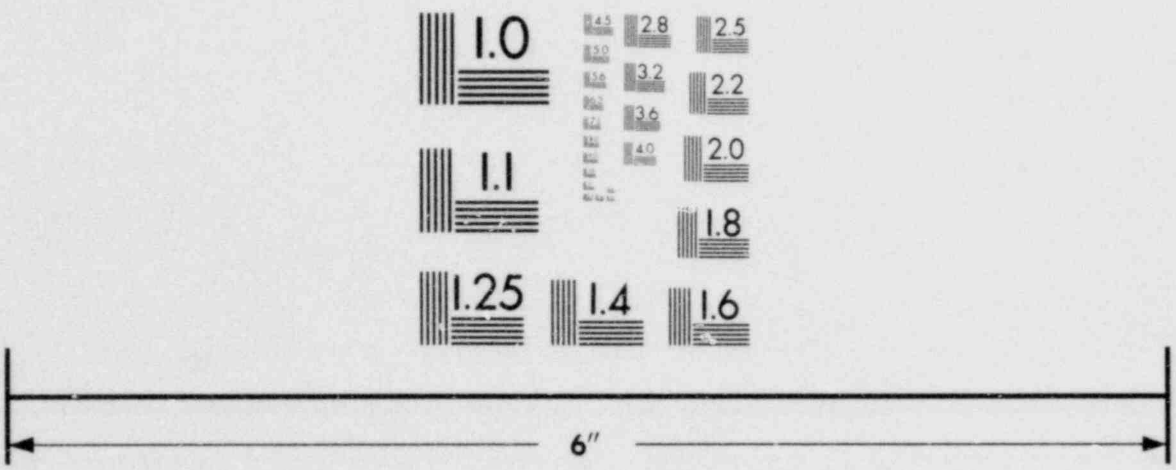
(Excluded in Abridged Report)

IMAGE EVALUATION
TEST TARGET (MT-3)

6"

MICROCOPY RESOLUTION TEST CHART

IMAGE EVALUATION TEST TARGET (MT-3)



MICROCOPY RESOLUTION TEST CHART

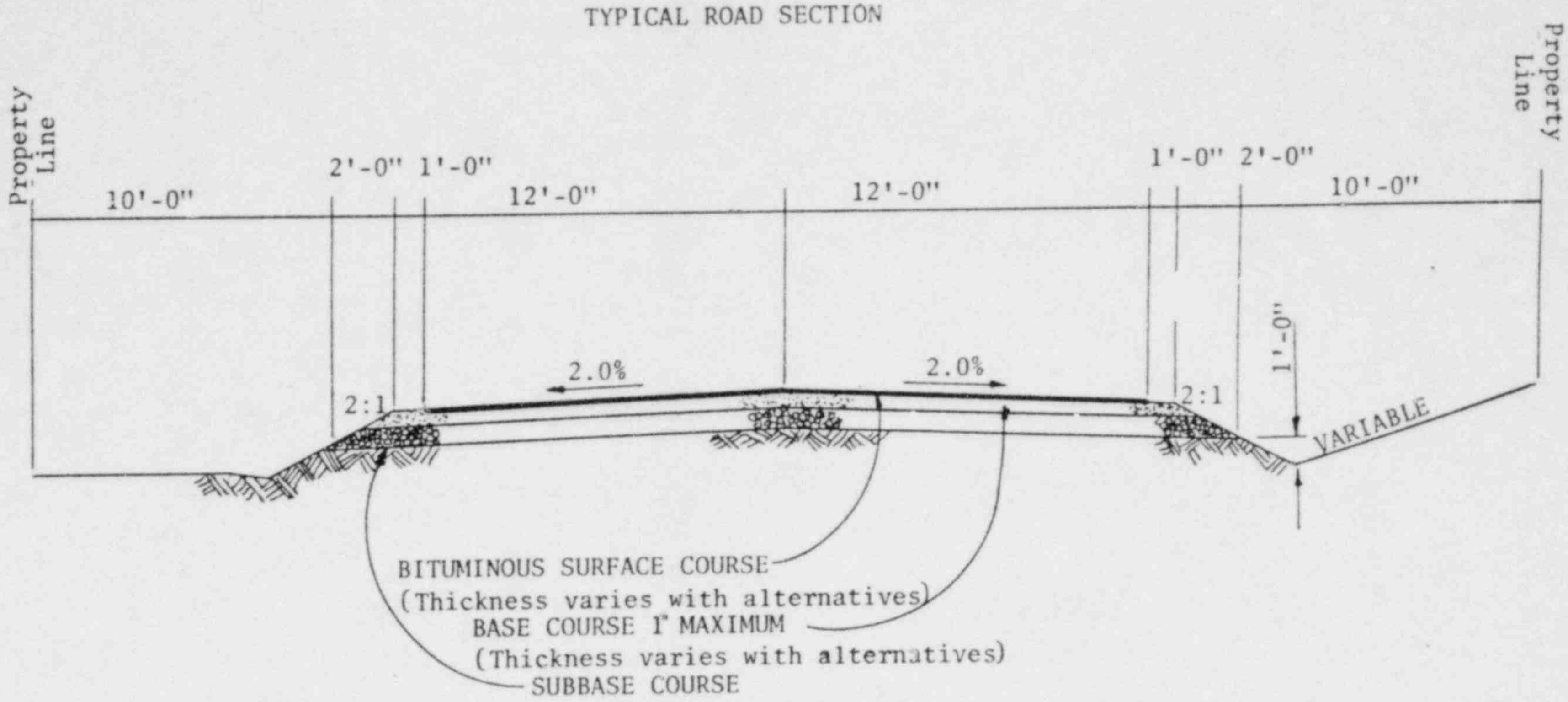
APPENDIX

3

Long Park Plan and Profile

Typical Road Section

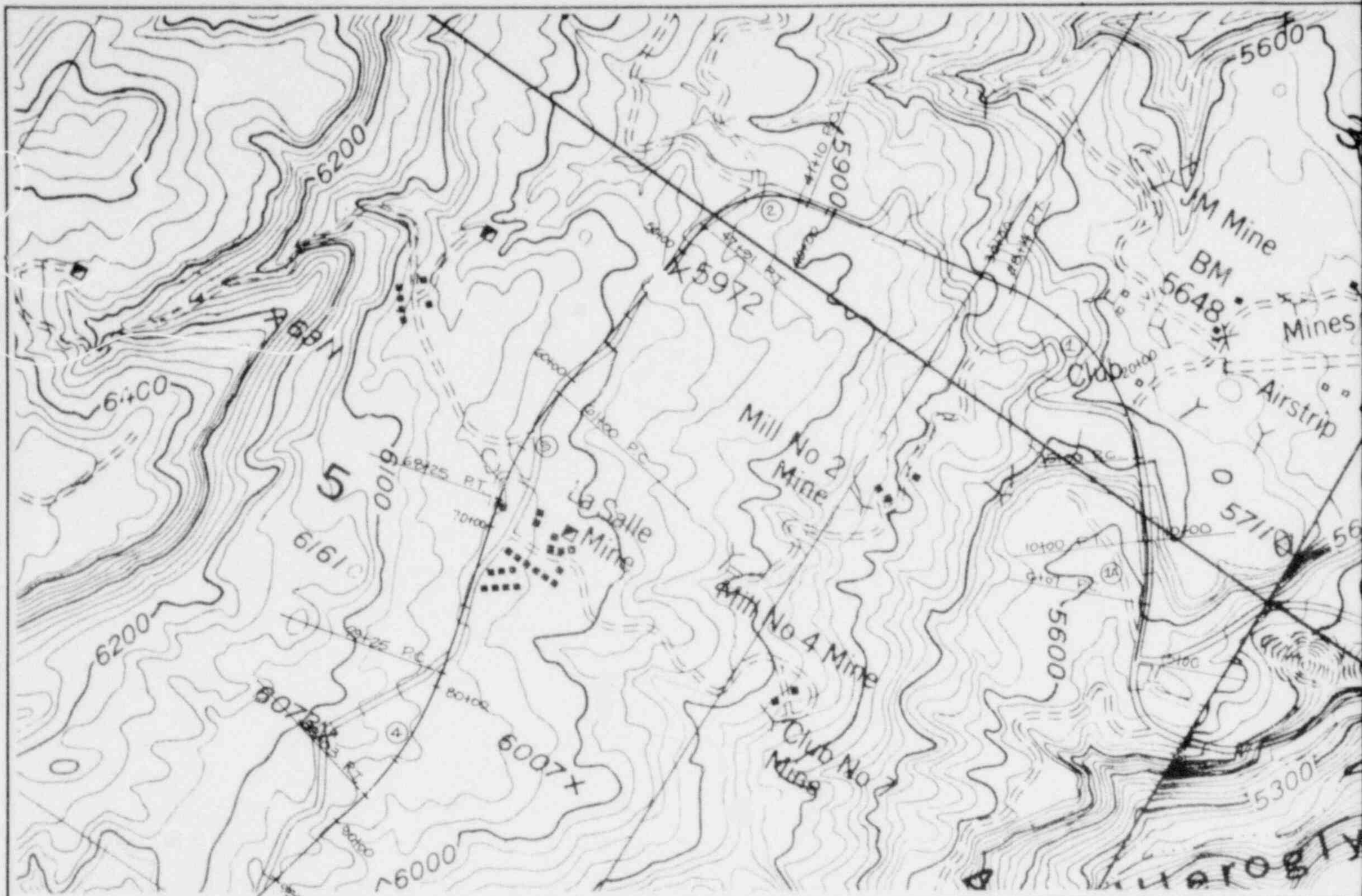
TYPICAL ROAD SECTION



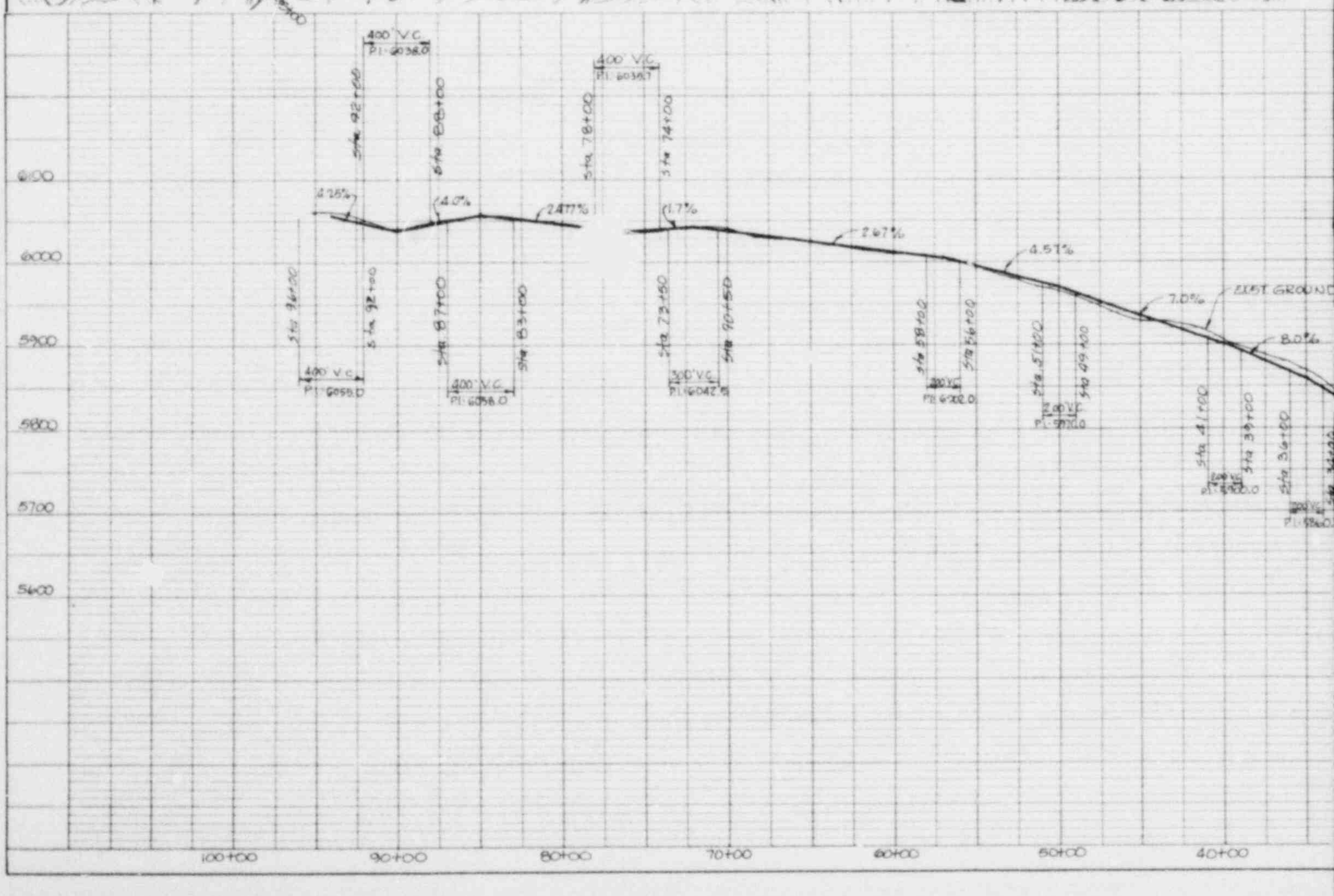
50-FOOT WIDE

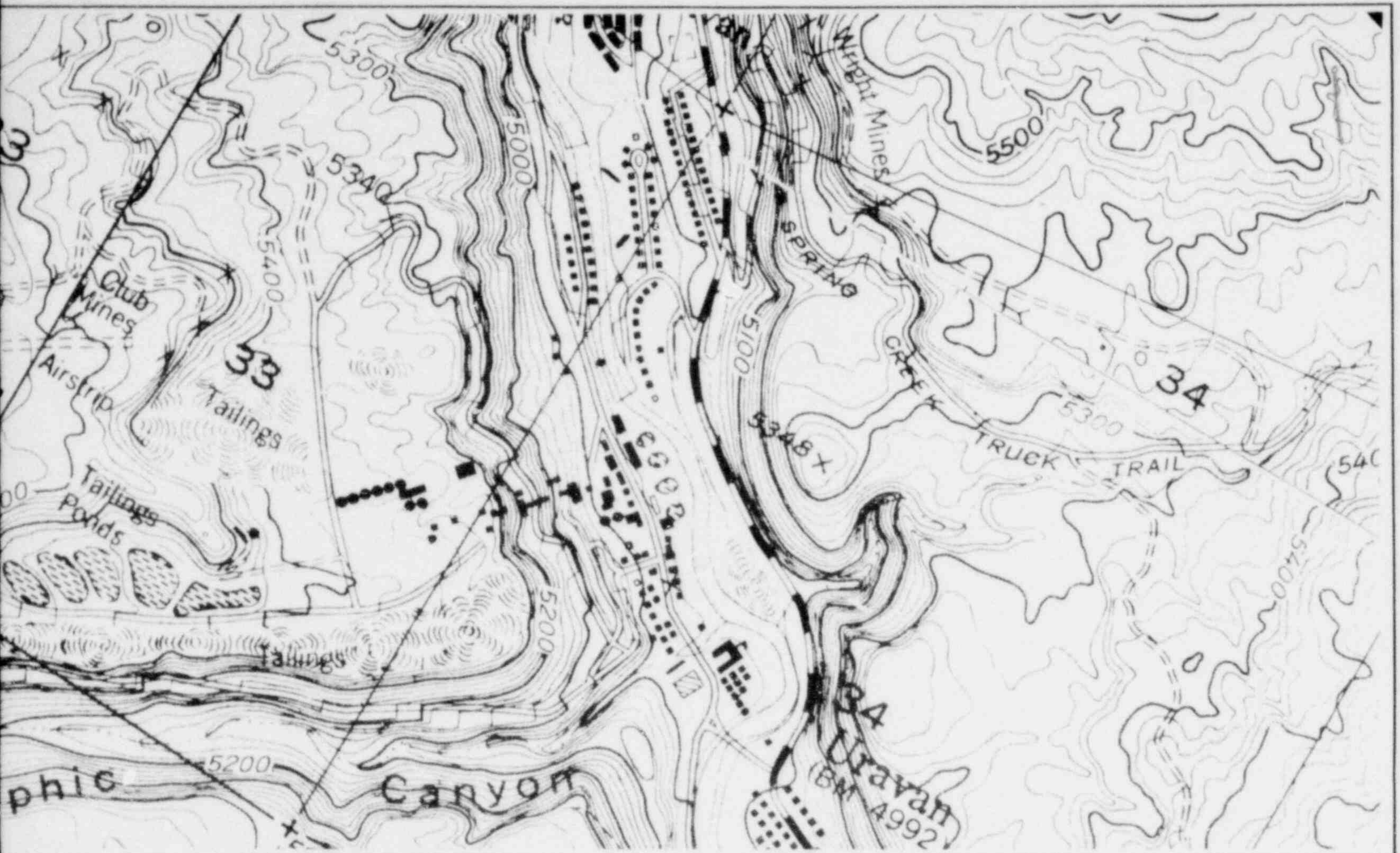
RIGHT-OF-WAY

PLAN

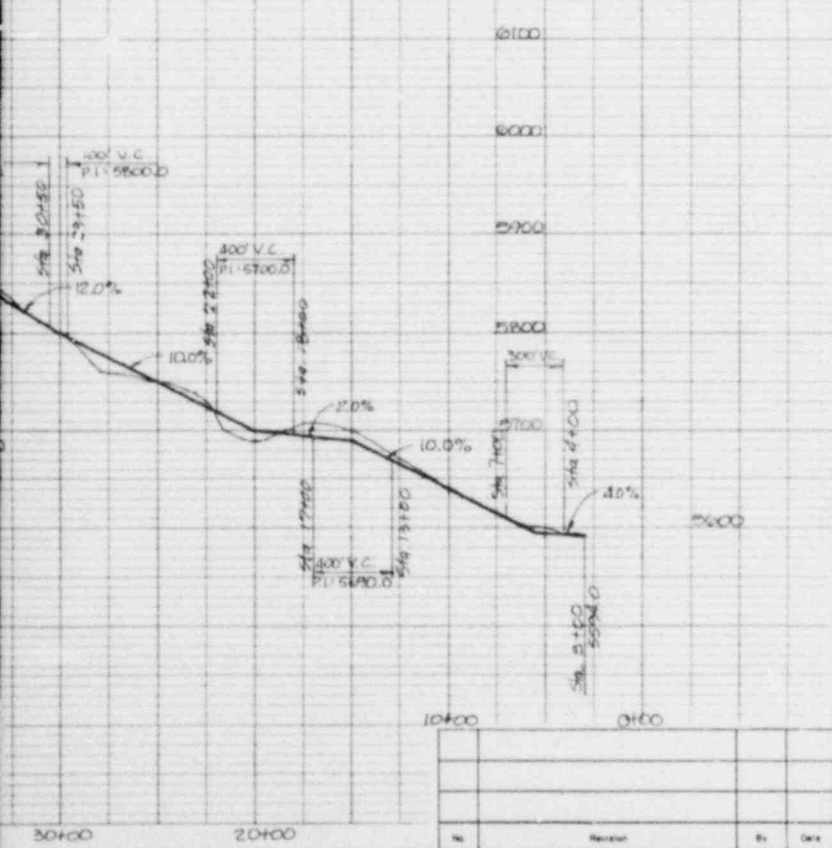


PROFILE





Curve	Δ	R	T	L
1A	15°00'	1250.0'	197.58'	392.70'
1	60° 15'	1250.00'	725.33'	1314.45'
2	71°00'	550.00'	392.31'	681.56'
3	23°45'	1750.00	367.98'	725.40'
4	28° 45'	1750.00'	448.51'	878.12'



Eckhoff, Watson and Preator

Salt Lake City, UT
Cedar City, UT
Price, UT
Grand Junction, CO

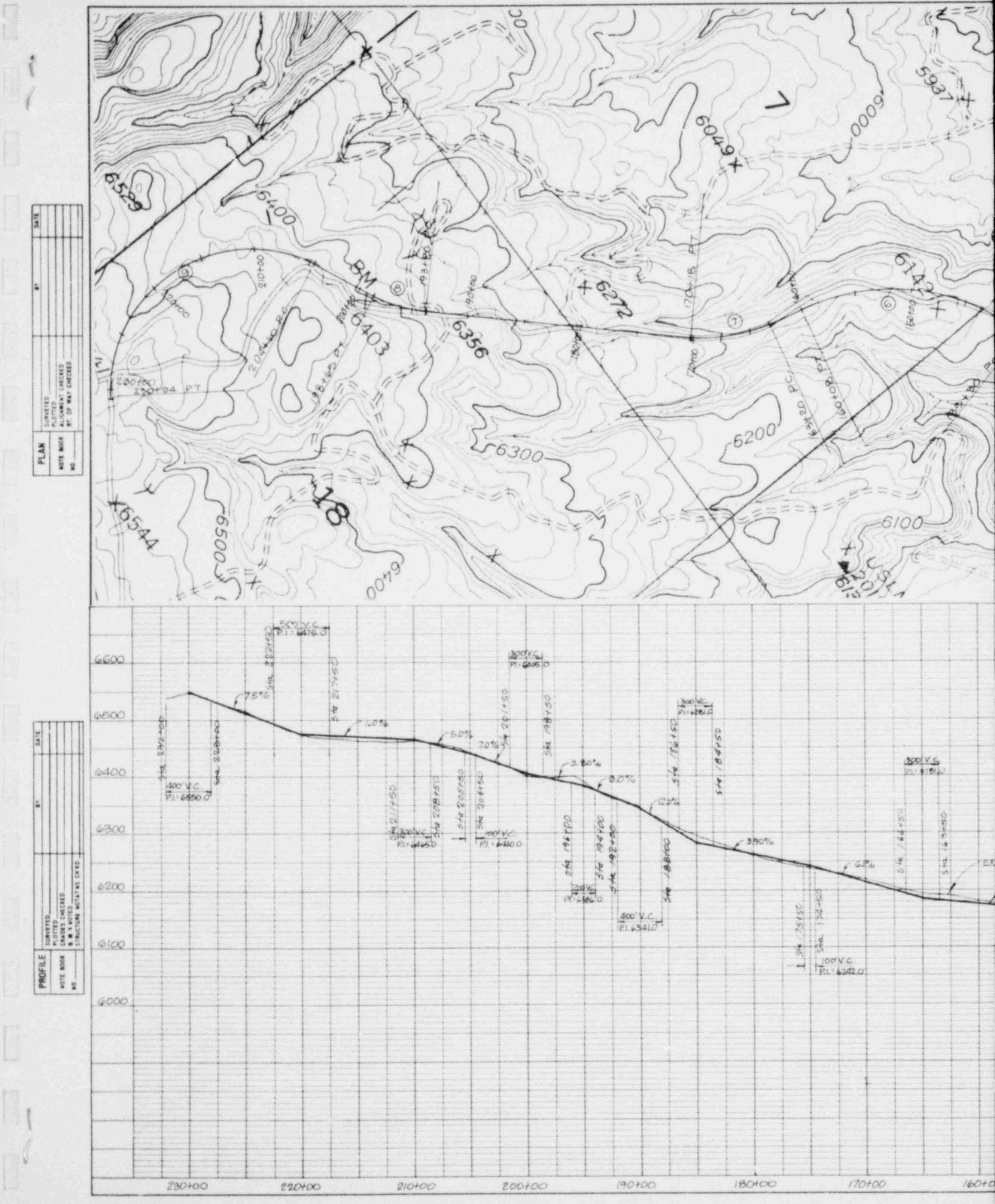
Engineers · Planners · Surveyors

PRELIMINARY
HAUL ROAD TO LONG PARK SITE

STA. 3+00 TO 94+00

Designed	Checked	Approved	Date	Sheet
JN				1
Drawn: F.C.Z.	Date: MAR. '80	Scale: H. 1"=500' V. 1"=100'	Project Number: SD200201	

No.	Revision	By	Date



PLAN
PROFILE
6529
6400
6544
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6300
6200
6100
6049
6000
5937
6142
6272
6356
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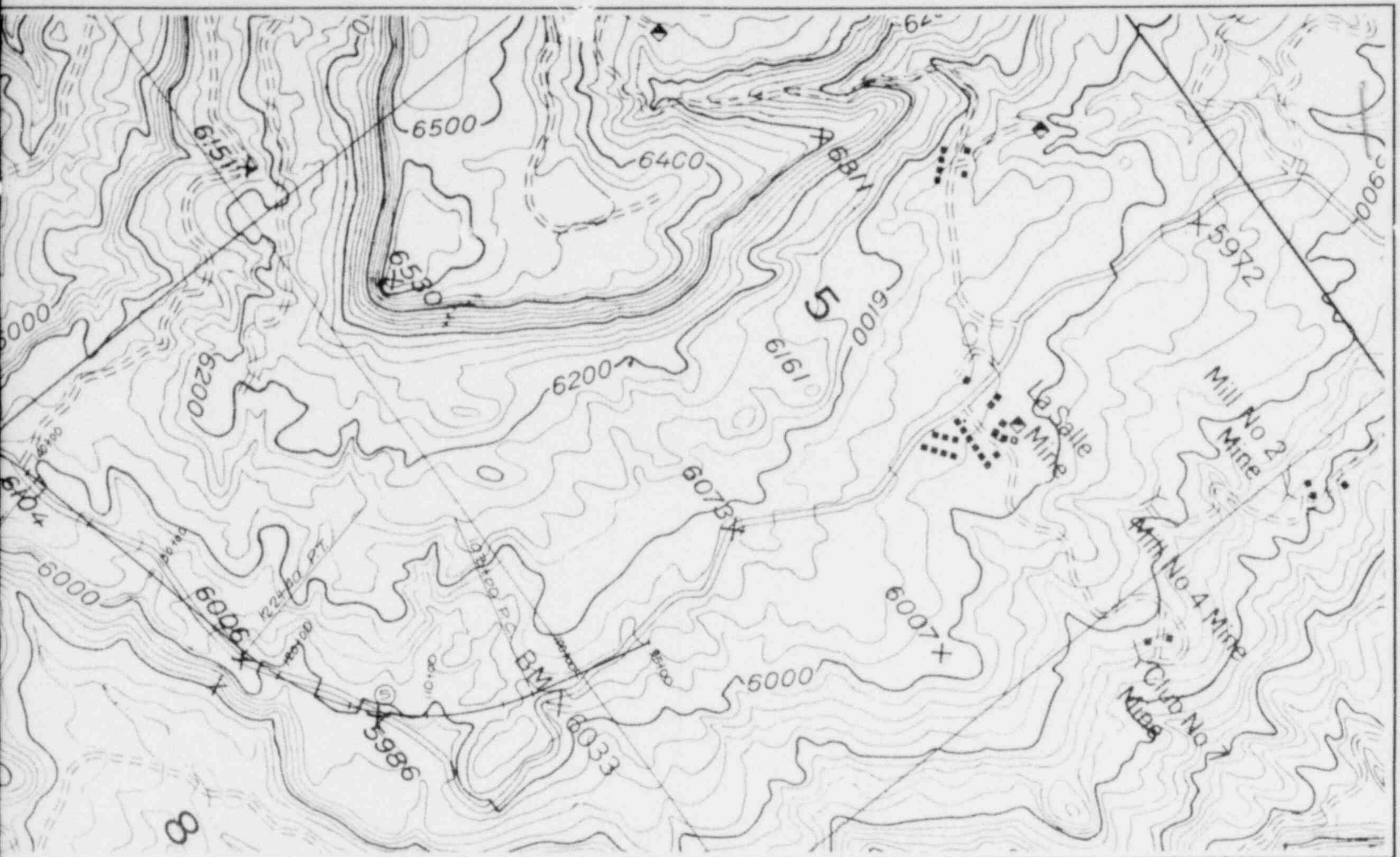
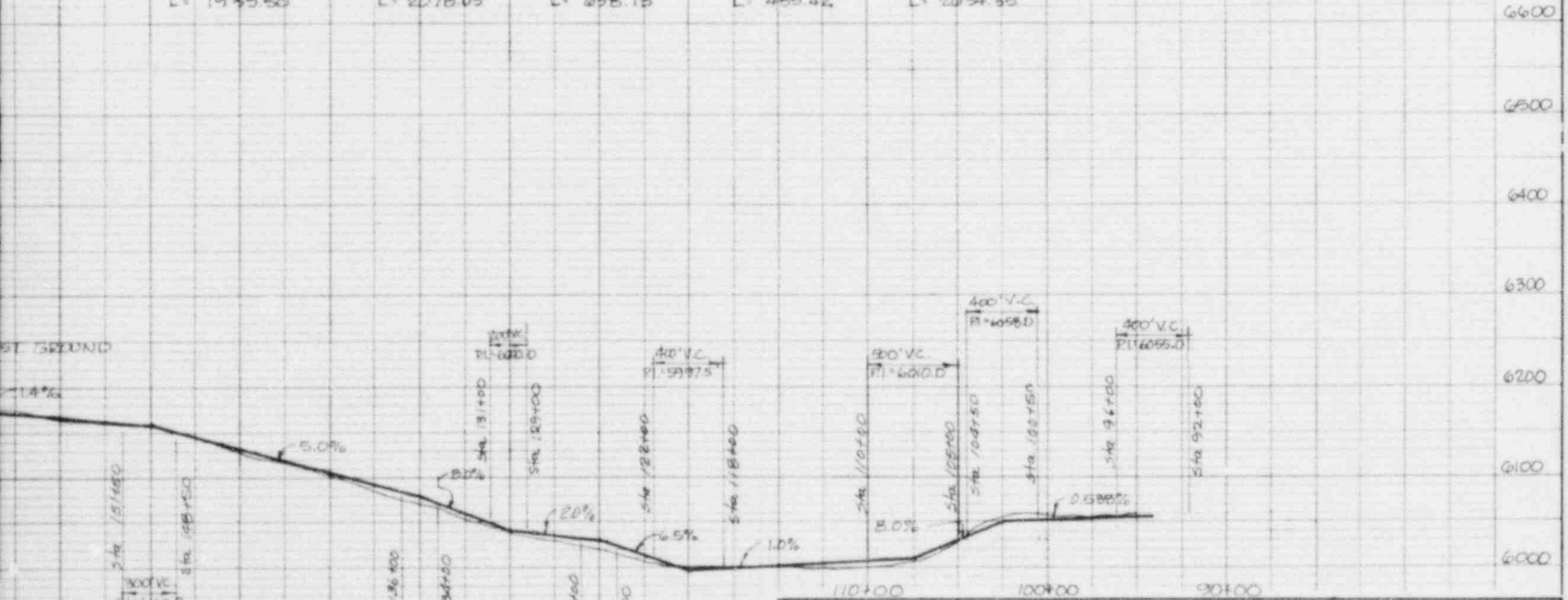


Curve	Δ	R	T	L
(5)	63°30'	1750.0	1082.93'	1939.50'
(6)	63°30'	1875.0	1160.29'	2078.03'
(7)	32°00'	1250.00'	358.43'	698.13'
(8)	22°15'	1250.00	245.81'	485.42'
(9)	120°00'	1250.00'	2198.16'	2634.35'



No.	Revision		By	Date

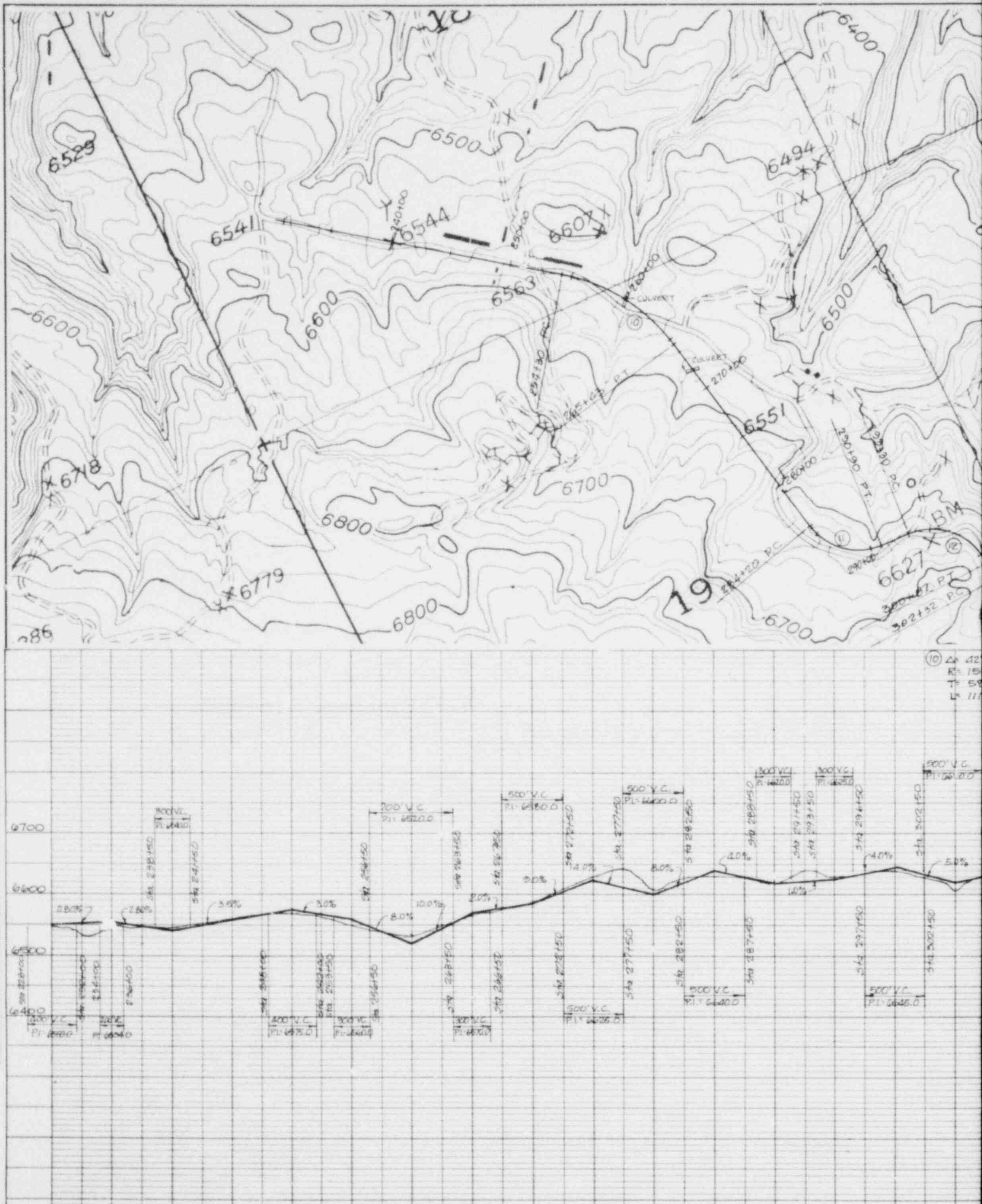
Eckhoff, Watson and Preator Salt Lake City, UT Cedar City, UT Price, UT Grand Junction, CO Engineers - Planners Surveyors	**PRELIMINARY HAUL ROAD TO LONG PARK SITE** STA. 94+00 TO 230+00			
Designed: JN	Checked:	Approved:	Date:	Sheet: 2
Drawn: F.C.Z.	Date: MAR. '80	Scale: H = 1" = 500', V = 1" = 100'	Project Number: SD200201	

PLAN

NOTE BOOK NO.
SURVEYED
PLOTTED
ALIGNMENT CHECKED
RT. OF WAY CHECKED
BY
DATE

PROFILE

NOTE BOOK NO.
SURVEYED
PLOTTED
GRADES CHECKED
B. M.'S NOTED
STRUCTURE NOTATNS CHKD
BY
DATE



No.	Revision	By	Date

Eckhoff, Watson and Preator

EWP

Salt Lake City, UT
Cedar City, UT
Price, UT
Grand Junction, CO

Engineers - Planners Surveyors

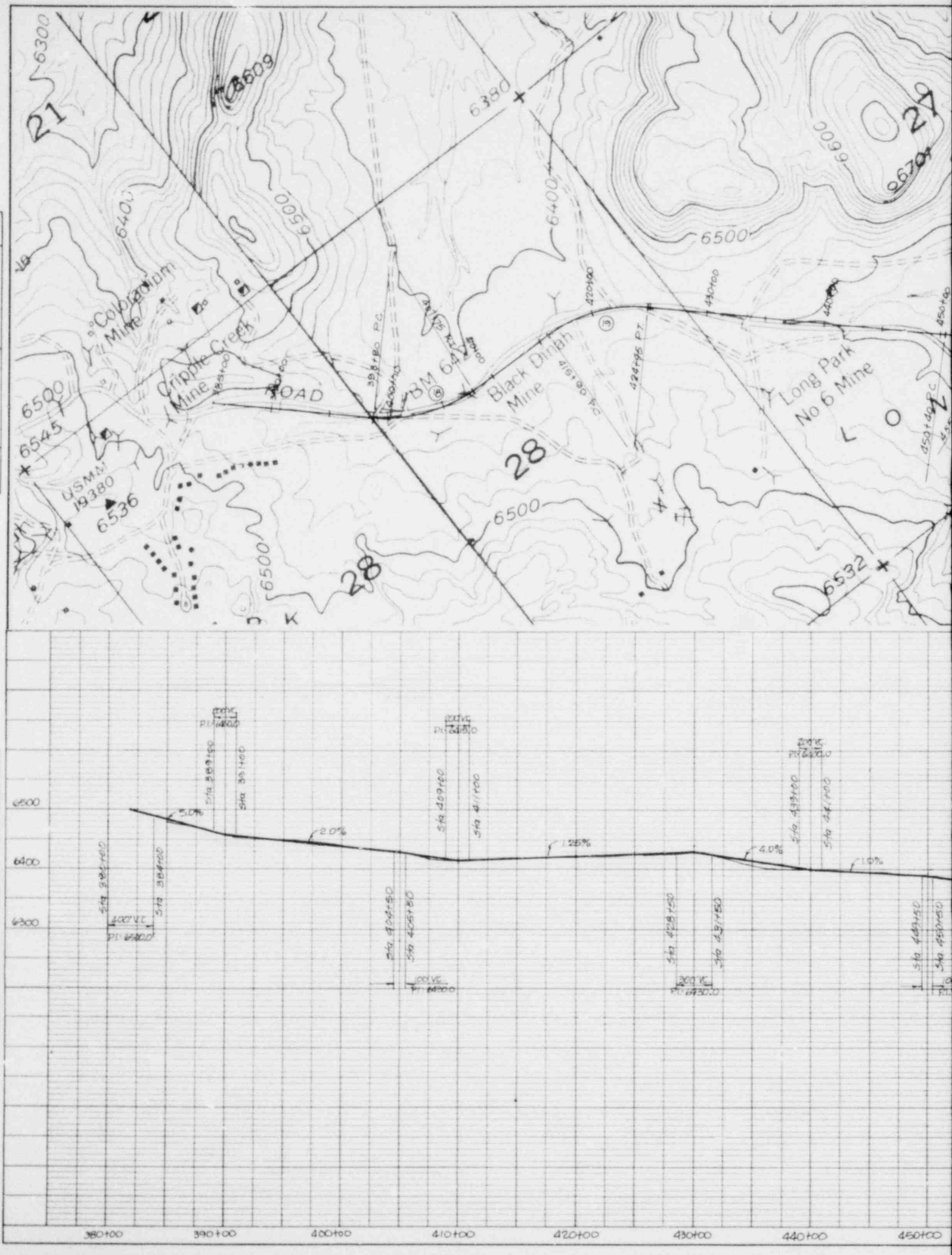
PRELIMINARY
HAUL ROAD TO LONG PARK SITE

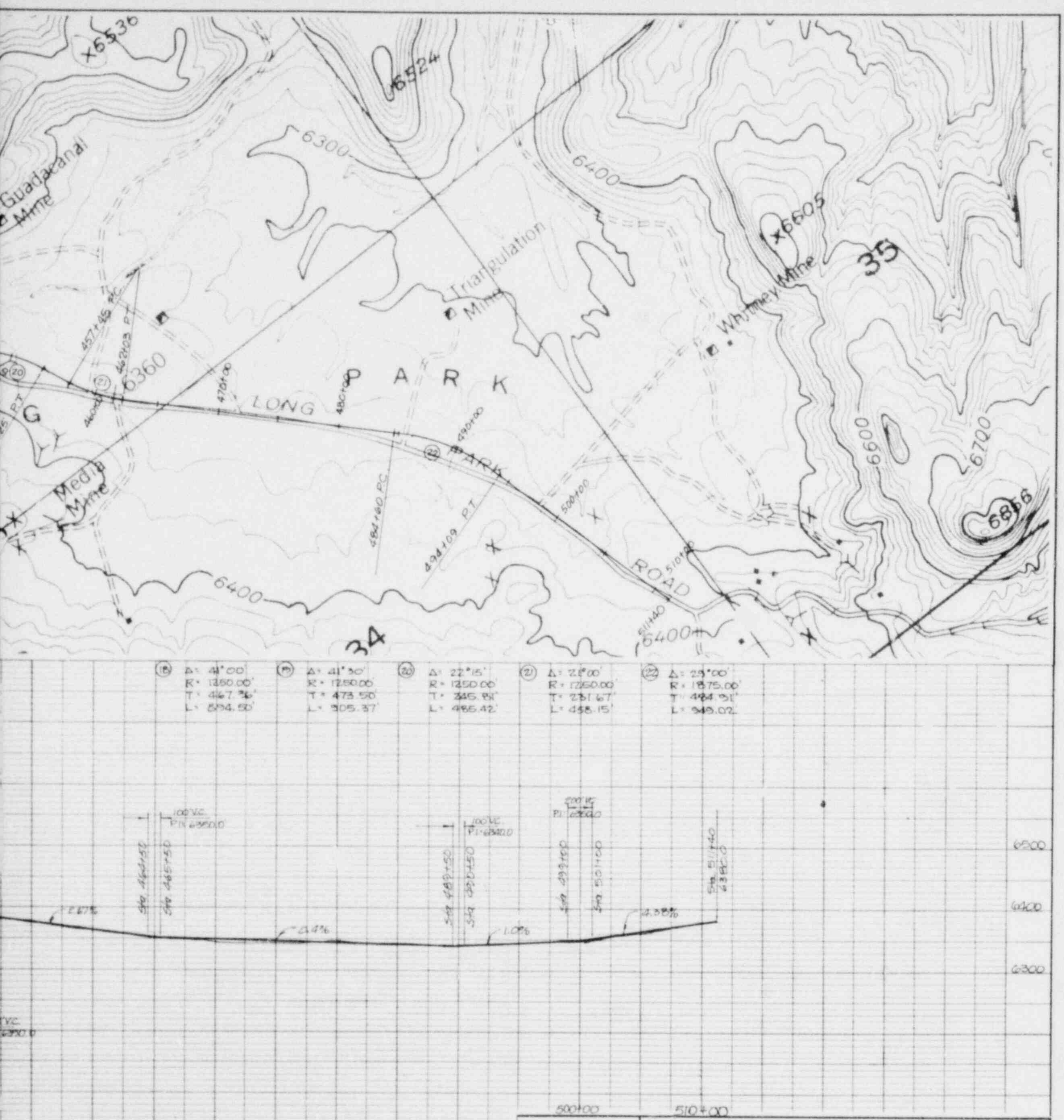
STA. 230+00 **TO** 382+00

Designed	Checked	Approved	Date	Sheet
JN				3
Drawn	Date	Scale	Project Number	
F.C.Z.	MAR. '80	H. 1" = 500' V. 1" = 100'	SD200201	

PLAN	SURVEYED	BY	DATE
NOTE BOOK	PLOTTED		
NO.	ALIGNMENT CHECKED		
	RT. OF WAY CHECKED		

PROFILE	SURVEYED	BY	DATE
NOTE BOOK	PLOTTED		
NO.	GRADES CHECKED		
	B.M.'S NOTED		
	STRUCTURE NOTAT'NS CH'KD		





(18)	(19)	(20)	(21)	(22)
Δ = 41°00'	Δ = 41°30'	Δ = 22°15'	Δ = 21°00'	Δ = 29°00'
R = 1250.00'	R = 1250.00	R = 1250.00	R = 1250.00	R = 1875.00
T = 467.36'	T = 473.50	T = 245.81'	T = 231.67	T = 484.91'
L = 894.50'	L = 905.37	L = 485.42'	L = 458.15'	L = 949.02

No.	Revision	By	Date

Eckhoff, Watson and Preator

EWP

Salt Lake City, UT
Cedar City, UT
Price, UT
Grand Junction, CO

Engineers - Planners Surveyors

PRELIMINARY
HAUL ROAD TO LONG PARK SITE

STA. 382+00 TO 511+40

Designed	Checked	Approved	Date	Sheet
JN				4
Drawn: F.C.Z.	Date: MAR. '80	Scale: H 1"=500' V 1"=100'	Project Number: SD200201	

APPENDIX

4

Vehicle Costs

TRUCK ALTERNATE: I — Truck and Trailer
GVW = 80,000 lbs.
Payload = 51,000 lbs.

INITIAL CAPITAL COST (ICC):		$85,000
SALVAGE VALUE @ 20% ICC:		$17,000
SERVICE LIFF		5 years

ANNUAL COST	ONE SHIFT	TWO SHIFTS
DEPRECIATION	$ 13,600	$ 13,600
MAJOR REPAIRS	12,750	19,125
TAX AND INSURANCE	4,250	4,250
ANNUAL FIXED COST	$ 30,600	$ 36,975
HOURLY COST		
FIXED COST	12.14	7.34
FUEL COST	10.80	10.80
MAINTENANCE	4.80	4.80
DRIVER	14.50	14.50
TOTAL HOURLY COST	$ 42.24	$ 37.44
ANNUAL COST	$106,445	$188,698

TRUCK ALTERNATE: II Truck and Pup
GVW = 85,000
Payload = 56,000

INITIAL CAPITAL COST (ICC):			$ 92,000
SALVAGE VALUE @ 20% JCC:			$ 18,400
SERVICE LIFE:			5 years
ANNUAL COST	ONE SHIFT	TWO SHIFT	
DEPRECIATION	$ 14,720	$ 14,720	
MAJOR REPAIRS	13,800	20,700	
TAX AND INSURANCE	4,600	4,600	
ANNUAL FIXED COST	33,120	40,020	
HOURLY COST			
FIXED COST	13.14	7.94	
FUEL COST	10.8	10.80	
MAINTENANCE	4.8	4.8	
DRIVER	14.5	14.5	
TOTAL HOURLY COST	$ 43.24	$38.04	
ANNUAL COST	$108,965	$191,721	

TRUCK ALTERNATE: III Truck and Pup

GV[illegible] = 114,000 lbs.

[illegible] = 79,000 lbs.

INITIAL CAPITAL COST (ICC):		$115,000
SALVAGE VALUE @ 20% ICC:		23,000
SERVICE LIFE:		5 years

ANNUAL COST	ONE SHIFT	TWO SHIFTS
DEPRECIATION	$ 18,400	$ 18,400
MAJOR REPAIRS	17,250	25,875
TAX AND INSURANCE	5,750	5,750
ANNUAL FIXED COST	41,400	50,025
HOURLY COST		
FIXED COST	16.43	9.93
FUEL COST	10.80	10.80
MAINTENANCE	4.80	4.80
DRIVER	14.50	14.50
TOTAL HOURLY COST	$ 46.53	$ 40.03
ANNUAL COST	$117,256	$201,751

TRUCK ALTERNATE: IV Mine Truck 450 HP
GVW = $115,700 lbs.
Payload = 48,000 lbs.

INITIAL CAPITAL COST (ICC): $243,000

SALVAGE VALUE @ 20% ICC: 48,600

SERVICE LIFE: 5 years

ANNUAL COST	ONE SHIFT	TWO SHIFT
DEPRECIATION	$ 38,880	$ 38,880
MAJOR REPAIRS	36,450	54,675
TAX AND INSURANCE	12.150	12,150
ANNUAL FIXED COST	87,480	$105,705

HOURLY COST		
FIXED COST	34.71	20.97
FUEL COST	12.15	12.15
MAINTENACE	5.40	5.40
DRIVER	14.50	14.50
TOTAL HOURLY COST	66.76	53.02
ANNUAL COST	$168,235	$267,221

TRUCK ALTERNATE: V Mine Truck 650 HP
GVW = 158,265 lbs.
Payload = 71.600 lbs.

INITIAL CAPITAL COST (ICC):		$332,000
SALVAGE VALUE @ 20% ICC:		66,400
SERVICE LIFE		5 years

ANNUAL COST	ONE SHIFT	TWO SHIFT
DEPRECIATION	$ 53,120	$ 53,120
MAJOR REPAIRS	49,800	74,700
TAX AND INSURANCE	16,600	16,600
ANNUAL FIXED COST	$119,520	$144,420
HOURLY COST		
FIXED COST	47.43	28.65
FUEL COST	17.55	17.55
MAINTENANCE	7.80	7.80
DRIVER	14.50	14.50
TOTAL HOURLY COST	$ 87.28	$ 68.50
ANNUAL COST	$219,945	$345,240

ALTERNATE: VI MINE TRUCK 870 HP
GVW = 224,410 lbs.
Payload = 100,000 lbs.

INITIAL CAPITAL COST (ICC):			$475,000
SALVAGE VALUE @ 20% ICC:			95,000
SERVICE LIFE:			5 years

ANNUAL COST	ONE SHIFT	TWO SHIFT
DEPRECIATION	$ 76,000	$ 76,000
MAJOR REPAIRS	71,250	106,875
TAX AND INSURANCE	23,750	23,750
ANNUAL FIXED COST	$171,000	$206,625
HOURLY COST		
FIXED COST	$ 67.86	$ 50.00
FUEL COST	23.50	23.50
MAINTENANCE	10.50	10.44
DRIVER	14.50	14.50
TOTAL HOURLY COST	$116.30	$ 98.44
ANNUAL COST	$293,076	$496,138

APPENDIX

5

Road Costs

COST ESTIMATE

Long Park Haul Road

Truck III 5"/8" Suface

QUANTITY	Unit	Item	Price	Amount
305,400	cu.yd.	Roadway Excavation	1.50	458,100
219,200	cu.yd	Roadway Embankment	2.75	602,800
80	Ln.ft.	18" pipe Culvert	13.85	1,108
200	Ln.Ft.	24" pipe Culvert	23.01	4,602
100	Ln.Ft.	36" pipe Culvert	30.12	3,012
155	Each	Right of Way Marker	42.57	6,598
780	Each	Delineators Type I	14.97	11,677
9.5	Mile	Highway Stripping	2,270.0	21,565
60,240	Tons	Base Course	5.00	301,216
35,100	Tons	Bituminous surface course	18.00	631,800
107	Tons	Primer Coat	210.0	22,470
	Lump	Mobilization		171,000
			SUB TOTAL	2,235,948
		Engineering		293,000
		Contingency 10%		223,595
			CUMULATIVE TOTAL	2,752,543

COST ESTIMATE

San Miguel Canyon Road

Truck III 5"/8" Surface

Quantity	Unit	Item	Price	Amount
14.4	Miles	*Road Cost [Excluding Surfacing]	205,412	$2,957.932
71,000	Tons	Base Course	5.00	355,000
53,230	Tons	Bituminous Surfacing	18.00	958,140
162	Tons	Primer Coat	210.00	34,020
		SUBTOTAL		4,305,092
		Contingency 15%		645,764

*Road cost includes preparation of road up to subgrade, mobilization and engineering

CUMULATIVE TOTAL 4,950,856

APPENDIX B

TAILINGS LIQUID EFFLUENT STUDIES

By

INDUSTRIAL DESIGN CORPORATION

May 2, 1980

INDUSTRIAL DESIGN CORPORATION

TAILINGS LIQUID EFFLUENT STUDIES
UNION CARBIDE COMPANY
URAVAN MILL

The Uravan Mill of the Union Carbide Company is located at Uravan, Colorado, on the San Miguel River drainage. The surrounding area is composed of fairly high ridges with valleys between. The Dolores River flows across the Paradox Valley and is joined by the San Miguel River near Uravan.

To minimize potential environment damage to the river valleys, the tailings disposal system recommended consists of "dry" or filtered tailings disposal below ground surface. Raffinate bleed and waste water from the mill circuit will be transported from the mill by pipeline to evaporation ponds. For ecological reasons, the site selected for these ponds is at Long Park.

The routing from the mill chosen by Dames & Moore is up the road along side Hieroglyphic Canyon to the edge of Paradox Valley, then follows the road past Sharkey Mine to Long Park, estimated distance 53,705 ft.

The pipeline is to be eight inch diameter (8") Driscopipe 8600, or equal, which has a working pressure rating of 220 PSI, design criteria working pressure assumed at 200 PSI. Driscopipe 8600 will withstand the corrosive effects of the liquid.

The simpliest way to protect the pipeline from vandalism is to bury the pipe. To help maintain temperature above 40° in the pipeline during severe winter conditions, the pipe should be buried below the frost line. At ground temperatures below 32°F, the frost line is estimated to be 4-1/2 feet. Using Driscopipe in a properly bedded installation, uninsulated, beneath the frost l ne, the temperature in the liquid in the pipe will drop 15°F between the plant and the Paradox No. 2 site. However, if the pumps are down, the temperature will drop from 75°F to 40°F in 12 hours. If the line is adequately insulated with gilsonite, or equal quality insulation, the temperature drop while running will be 40°F, and the standing time for the line will be extended to 97 hours.

This scheme of burial, 5 feet below the surface, offers the maximum protection from vandalism, however, it may not be possible to obtain 5 foot burial along the entire route. Burial essentially precludes monitoring the line for minor leaks. Burial also makes it difficult to arrange for collection and impoundment of spills along the pipeline. In places where the line is crossing gullies and/or washes, it might be possible to establish a drain layer in the bottom of the ditch and collect most of the spill, thus minimizing a surface spill. This will add considerably to the cost of installing the pipe, as it will require special fill under the pipeline.

An above ground installation would improve monitoring for minor leaks and facilitate impoundment of spills. Providing protection to the environment and to the pipeline would require either a vee ditch or a berm system for the length of the pipe. Either a vee ditch or a berm catchment basins, of a size, to hold the liquid in the pipe would have to be provided. The above ground installation requires that the pipe be anchored regularly and to be supported when crossing gullies or low spots.

To protect the above ground pipeline from loss in temperature, continuous 6" thick insulation will be required.

Either buried or above ground installation will require dump valves and containment basins at low points in the line to drain the line when the pumps are down during severe winter weather.

Some provision should be made at the plant site to contain the effluent in case the pumps are down.

To monitor the line for leaks or spills will require either pressure sensors or flow monitors at intervals along the pipe. The simpliest method of reporting will be by radio to a control panel at the mill.

Estimated costs have been obtained from verbal quotes from vendors and from best available information. These cost estimates are preliminary and should be considered only as order of magnitude.

ESTIMATED CAPITAL COST
OF EIGHT-INCH PIPELINE FROM
MILL AT URAVAN TO EVAPORATION
POND AT LONG PARK

		Cost	HP
Pumps - 19	(5 Stations)	$ 105,800	680
Power Line - 7.88 Miles		197,000	
Substations - 5		50,000	
Pump Buildings - 5		112,500	
Pipe - 53,705 Feet		715,350	
Installation	(Buried)	715,350	
	(Above Ground)	765,600	
Insulation	(Buried)	501,500	
	(Above Ground)	702,100	
Instrumentation		200,000	
Pipeline Removal Cost		715,350	
Engineering		145,000	
	TOTAL: (Buried)	$3,457,850	
	TOTAL: (Above Ground)	$3,708,700	

ESTIMATED OPERATING COST
EIGHT-INCH PIPELINE

Power @ 5¢/KWH	$297,850
Maintenance @ 5% of Capital/Year	172,900
Inspection and Monitoring	40,150
TOTAL:	$510,900

APPENDIX C

PRELIMINARY STUDY ON TAILINGS DISPOSAL
BY MEANS OTHER THAN DOZING

By

INDUSTRIAL DESIGN CORPORATION

May 5, 1980

INDUSTRIAL DESIGN CORPORATION

PRELIMINARY STUDY
ON
TAILING DISPOSAL BY MEANS OTHER THAN DOZING
FOR
UNION CARBIDE URAVAN MILL
VIA
DAMES AND MOORE

On basis of environmental benefits, the recommended method of tailings disposal consists of "dry" or filtered tailings disposal below ground surface with three meters of earth cover. For purpose of this study it is assumed that the tailings will be delivered to the disposal site by truck.

Given: Tailings 1500 TPD dry basis containing 25% moisture; 1875 TPD of wet material. Material pH 1.5 to 2.0 (very acid). The trenches will be 200-250' wide at the ground level; 35 feet deep, and 250 feet long. It is desired to fill one trench from a 20' wide divider while the adjacent trench is being excavated.

Required: Some method to distribute tailings in the trenches other than by the use of a dozer.

Assumed: Trucks will deliver a minimum of 25 tons per load, material will be unloaded in a movable form, trucks will not be able to drive on freshly deposited tails, power will be available to drive all equipment needed, solution which drains from emplaced tailings will not need to be pumped to evaporation ponds. Tailings will be placed on a 24-hour basis, one truck every 18 minutes.

Suggested methods for distributing the tails:

I. Truck dump into hopper. Hopper large enough to hold material while distributor is being moved. All equipment at the dump site will have to be acid resistant. A belt feeder will feed a conveyor belt running the length of the trench and placed between the two filling trenches. This belt will feed a stacker which can be slued to fill the trench and will have ability to swivel to fill both trenches. In order to reach 250 feet, the central divider will have to be widened to hold the weight of the system. The boom will have to be 300 feet long.

   If one trench can be filled at a time, and only half way across, the cost of a stacker can be materially reduced. In either case the stacker and movable conveyors will have to be mounted on wheels to facilitate moving.

II. Trucks will dump into hoppers as in No. I. Tracks will run down each side of the trench. A bridge carrying a shuttle conveyor will travel down these tracks. It will fill one trench at a time. A belt conveyor from the hopper will feed the shuttle. The bridge can be powered to move by itself, or can be towed.

III. Install a Sauerman system. This was not studied as there is no convenient method to keep from pulling the cables through the acid tailings and destroying the cables in a very short time.

IV. Establish a cable tramway using bottom dump cans on the tram. This method poses many problems and is probably ecologically unsuited.

Order of magnitude cost estimates for methods No. I and No. II are shown on attached sheet.

It is questionable if any method yet devised will prove more practical or economical than distributing them with a dozer, probably a wheeled type with flotation type tires, for handling filtered tails.

In view of the fact that the effluent will have to be pumped to evaporation ponds, it might be wise to pump the tailings to the trenches, and then pump the decanted liquid to the evaporation ponds. This will probably be less capital intensive, and will certainly give a lower operating cost.

Placing the tails in a slurry will eliminate the need for acid-proofing all equipment in the handling system.

INDUSTRIAL DESIGN CORPORATION

ORDER OF MAGNITUDE: ESTIMATED CAPITAL COSTS

System I, Two Trenches

Stacker 300 foot Boom	$ 760,000
Conveyor Belts - 2500' at $125/ft	312,500
Hopper	7,000
Motors and Controls	25,000
TOTAL	$1,104,500

System I, One Trench - One Side

Stacker	$ 18,000
Conveyor Belt - 2500' at $125/ft.	312,500
Hopper	7,000
Motors and Controls	10,000
TOTAL	$ 447,500

Estimated Cost System No. II

Rails - 5000' at $16/ft.	$ 80,000
Bridge	110,000
Conveyor on Bridge	35,000
Feed Conveyor	312,500
Motors and Controls	10,000
Hopper	7,000
TOTAL	$ 554,500