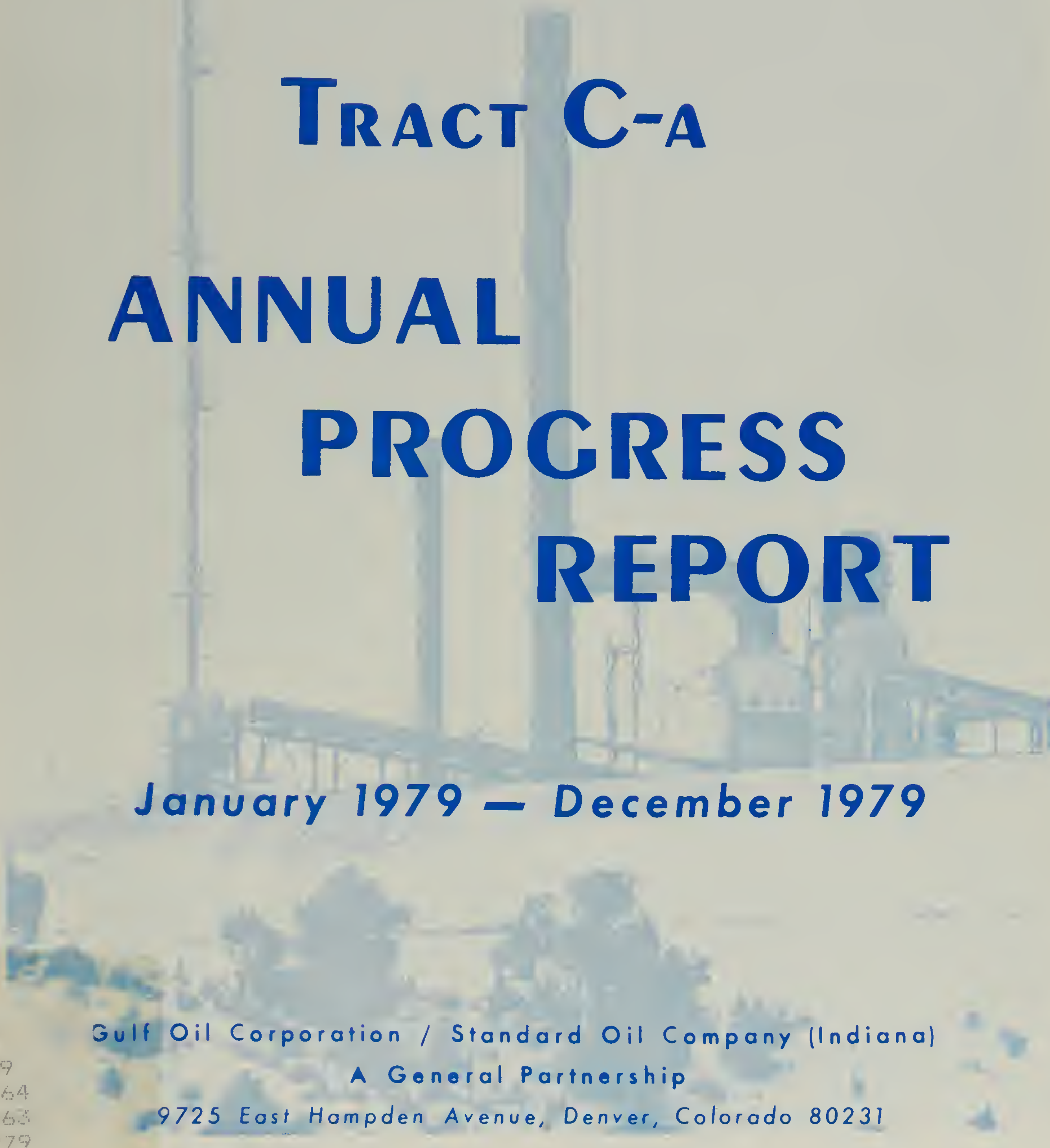
Rio Blanco Oil Shale Company

Tract C-a

Annual Progress Report



January 1979 — December 1979

Gulf Oil Corporation / Standard Oil Company (Indiana)
A General Partnership
9725 East Hampden Avenue, Denver, Colorado 80231

Rio Blanco Oil Shale Company

ANNUAL PROGRESS REPORT
TRACT C-a

January 1979 — December 1979

Gulf Oil Corporation / Standard Oil Company (Indiana)

April, 1980

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INTRODUCTION & SUMMARY

CHAPTER 1

PROJECT BACKGROUND

1.1 INTRODUCTION

The requirement to submit an Annual Progress Report (APR) on each anniversary date of the lease following approval of a development plan is contained in Section 1(C)(4) of the Environmental Stipulations to the federal oil shale lease (Serial No. C-20046) under which the Rio Blanco Oil Shale Company (hereinafter "RBOSC") is operating. The Gulf Oil Corporation and Standard Oil Company (Indiana) formed RBOSC as a general partnership to develop Tract C-a with the intention of engaging in the commercial production of oil shale. The legal description of Tract C-a, as defined in the lease is:

T. 1 S., R. 99 W., 6th P.M.
Sec. 32: E½, E½W½
Sec. 33: All
Sec. 34: W½, SE¼, W½NE¼, SE¼NE¼

T. 2 S., R. 99 W., 6th P.M.
Sec. 3: All
Sec. 4: All
Sec. 5: E½, E½W½ (incl. Lots 1, 2 and 3)
Sec. 8: E½
Sec. 9: All
Sec. 10: All

situated in the County of Rio Blanco, State of Colorado containing 5,089.70 acres, more or less.

This APR describes the operational programs on federal Tract C-a from January 1, 1979 through December 31, 1979. An environmental monitoring report is being submitted separately for the seasonal year (December 1 - November 30) for air quality, meteorologic, biologic and hydrologic data. Since this annual report is defined to include a report on the monitoring programs, Section 7 of this report contains a concise summary of the environmental programs for the 1979 seasonal year.

Approval to develop Tract C-a was received by RBOSC on September 22, 1977. The first report which described operations from that date through the end of 1978 was submitted to the Area Oil Shale Supervisor (AOSS) in Grand Junction, Colorado on April 11, 1979. It also contained a summary of environmental assessment and monitoring for the 1978 seasonal year.

Information and background material contained in the previous report is not included in this report. The previous report was distributed by the Area Oil Shale Office (AOSO) to many federal, state and local agencies, libraries and private industry. It is on open file in many public places for reference and should be referred to for operational and monitoring information prior to 1979.

CHAPTER 2
PROJECT OVERVIEW

2.1 DESCRIPTION AND SCHEDULE OF PROJECT

At the end of 1979, RBOSC was approximately two and one half years into a four and one half year development program designed to determine the technological, economical and environmental viability of its modified in situ (MIS) recovery process. In 1977, Gulf and Standard had authorized a five underground retort program costing $93 million. These retorts were to be built and operated during 1977-82. The retorts would be built and burned in sequence to gain operating experience, improve process efficiency, and confirm capital and operating cost estimates. Retort 1 start-up was planned for 1980. This program was described in more detail in the previous APR.

During the first half of 1979, RBOSC completed an extensive review of MIS technology with a result that some changes in mining plans were made. This led to a request and approval for a Technical Modification to the Detailed Development Plan (DDP). This modification mainly concerned the method of mining underground retorts and the number of retorts scheduled to be burned during the operational portion of the Modular Development Phase (MDP).

The MDP program has been changed to initially include three retorts rather than five. Retort 0 will be approximately 30 ft. x 30 ft. x 170 ft. high, and will serve to better define blasting requirements and shake down the Processing Plant system. Retort 1 will be approximately 60 ft. x 60 ft. x 400 ft. high, and Retort 2 is tentatively planned to be approximately 60 ft. x 150 ft. x 400 ft. high. The final size of this retort will be based on experience gained by developing and burning the prior two. The MDP period also includes the development and burn of Retorts 3 and up, if required, and lasts until commercial operations begin.

The MDP mine development configuration for Retorts 0, 1 and 2 are shown in Figure 1-2-1.

RBOSC now plans to develop a retort with a porosity of approximately 40 percent, instead of the original planned 20 percent, to ensure even distribution throughout the retort. This change has eliminated the necessity of developing the mine through costly intermediate mine levels at rather close intervals as was described in the previous APR. (The previous MDP retort and mine level configuration is shown in Figure 2-2-1.) Now, two levels (one for water management) are planned to exploit the entire height of the resource (for the MDP retorts).

Development and ignition of Retorts 0 and 1 are scheduled for 1980 and 1981 respectively. Retort 2 should be completed during 1982. Retort 0 is essentially for the purpose of equipment testing and will contain few instruments. Commercial scale retorts are envisioned as being approximately 700 ft. tall with a cross section area approximating that planned for Retort 2.

Figure 1-2-2 illustrates the latest construction and operations schedule.

2.2 TRACT ACTIVITIES, JANUARY 1979 - DECEMBER 1979

Table 1-2-1 is a summary of the 1979 construction milestones for Tract C-a. Table 1-2-2 is a list of RBOSC's major contractors and their responsibilities for work on Tract C-a.

Construction of the shaft continued during the year and was highlighted by the shaft reaching the planned total depth of 979 ft. in October. The shaft sinking equipment, such as the Cryderman mucking machine and Galloway work platform, was removed from the shaft. Work began on equipping the shaft for hoisting men, material and mined shale. By year-end, outfitting the shaft was about 95 percent complete and included the installation of shaft guides, skips and a man cage. During shaft outfitting, a methane bleeder ignited while torch cutting. This resulted

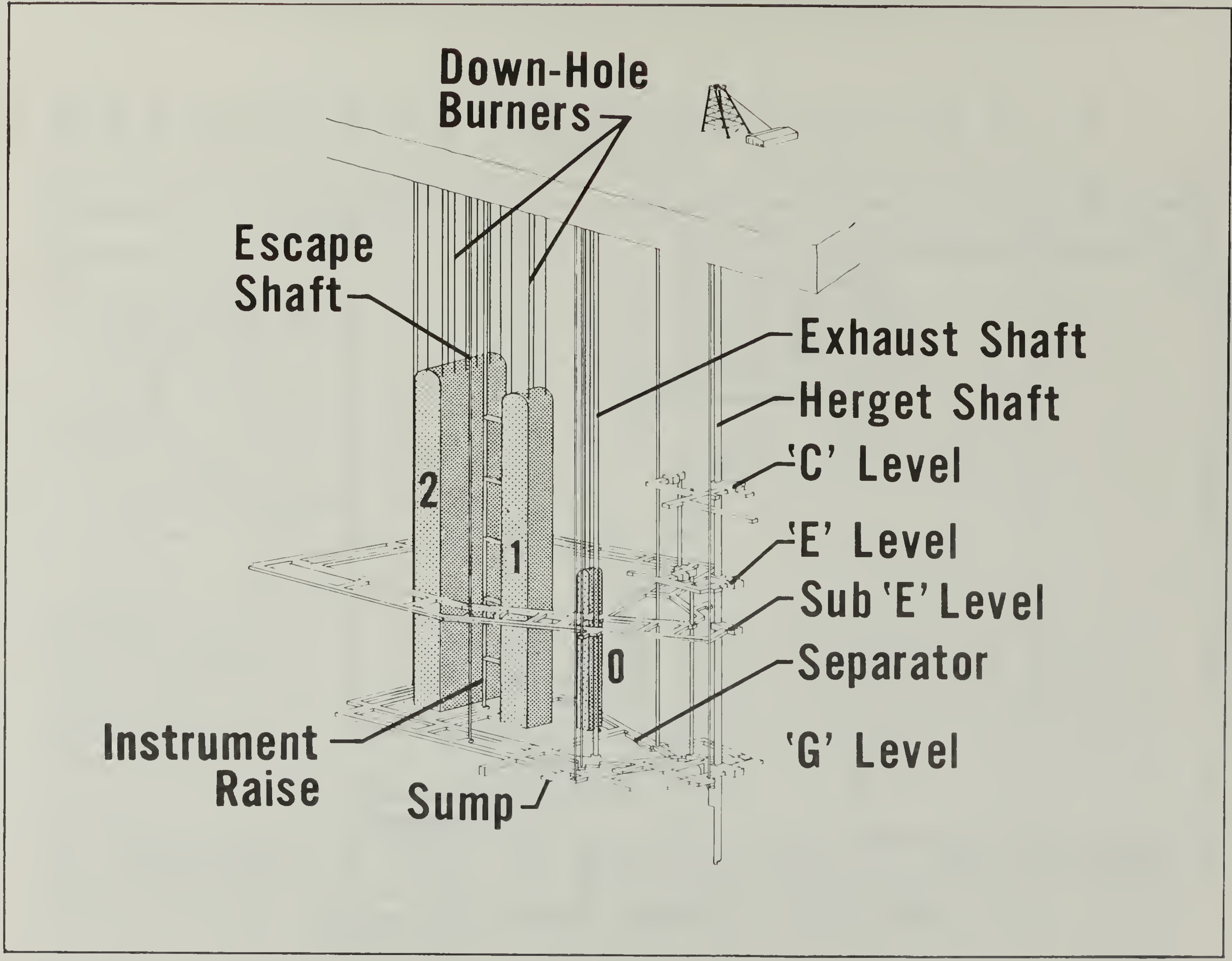

FIGURE 1-2-1
MDP MINE AND RETORT DEVELOPMENT

RBOSC MDP Schedule, Retorts 0, 1, 2, 3 & Up

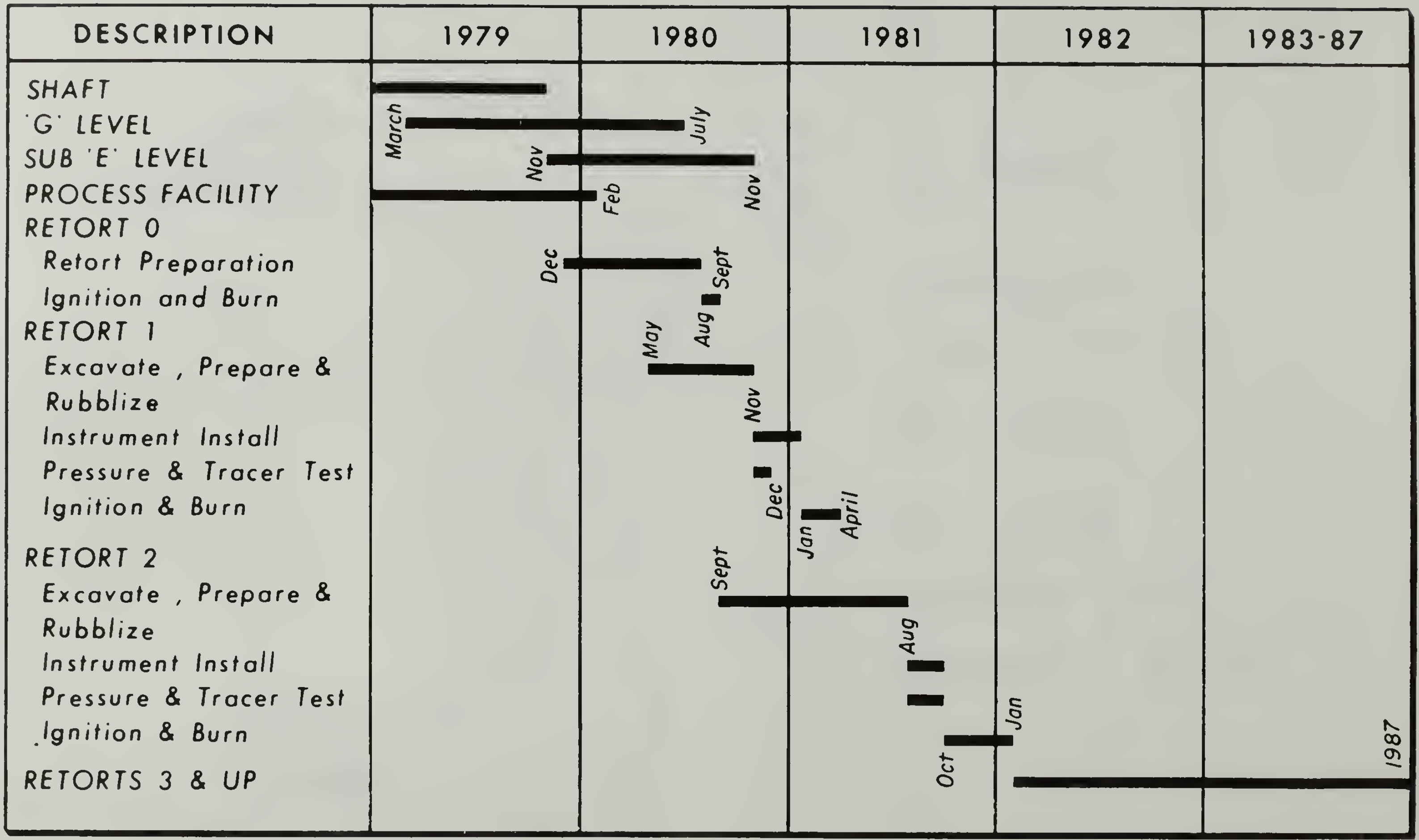

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FIGURE 1-2-2
RBOSC MDP SCHEDULE

TABLE 1-2-1

TRACT C-a CONSTRUCTION MILESTONES, 1979

	Start	Completion
Sewage Treatment System	December 1978	February 1979
Potable Water Plant	May 1978	March 1979
Mine Rescue Building	October 1978	March 1979
Generator Building	May 1978	April 1979
Mine Compressor Building	September 1978	May 1979
Permanent Electrical Distribution	September 1978	October 1979
West Retention Pond Piping	May 1978	October 1979
West Retention Ponds 2500 GPM Reinjection Pump	September 1979	November 1979
Construction Area Fence	October 1978	May 1979
Processing Area Foundations	September 1978	April 1979
Aboveground Processing Facility	April 1979	December 1979
Scrubber Blowdown Evaporation Ponds	August 1979	- - - - -
Sour Water Evaporation Pond	August 1979	- - - - -
Airstrip	October 1979	December 1979
Processing Area Motor Control Center	May 1979	August 1979
Processing Area Control Building Complex	May 1979	August 1979
Processing Area Water Treatment Building	May 1979	August 1979
Natural Gas Line (High Pressure)	July 1979	August 1979
Tract C-a Access Road Paved	July 1979	July 1979
Reroute Airplane Ridge Road	August 1979	December 1979
Dewatering Well D-8	December 1979	December 1979
Dewatering Well D-9	December 1979	December 1979

TABLE 1-2-2

TRACT C-a MAJOR CONTRACTORS AND RESPONSIBILITIES, 1979

Contractor	Responsiblity
Morrison-Knudsen Company (M-K)	Construction Management, Design Engineering, Quality Control and Administrative Functions
American Mine Service (AMS)	Shaft Sinking
Mine, Shaft & Tunnel (MS&T)	Mine Development
Ruscon, Becon and Associates (RBA)	Below Grade Construction for Processing Facility
The Industrial Company (TIC)	General Services Contractor, Above Grade Construction for Processing Facility
Wright Water Engineers	Environmental Hydrology
Randall and Blake, Inc.	Reclamation Work
NUS	Environmental Program Support
Mariah Associates	Aquatic Monitoring
Becon and Associates	Water Treatment and Control Facilities
Harrison Electric Constructors, Inc.	Electrical Distribution
Eidson Metals	Processing Facility Tank Erection
Robinson and Son, Inc.	Evaporation Pond Construction
Colorado Well Service	Blasthole Drilling
Gulf (Kilgore)	Blasthole Drilling
Construction Surveys	Site Survey
James Drilling Company	Dewatering Wells
Western Slope Natural Gas Company	High Pressure Natural Gas Line
Sterling	Paving Access Road

in the mine being declared "gassy" by MSHA. At year-end, RBOSC was modifying equipment for operation in a "gassy" mine.

Drifting and station development were done during the year. The extent of mine level and shaft development completed by the end of 1979 is shown in Figure 1-2-3.

The 10 ft. diameter ventilation shaft was completed in May 1979. The permanent ventilation shaft fan which was installed and tested by the end of December was being prepared for start-up and permanent use.

Drilling of surface blast holes for Retort 0 began during the second half of the year.

During development, water continued to flow into the shaft at an average rate of 1100 to 1200 gpm. One bank of permanent mine pumps has been installed on G Level. The pumps on C and E Levels will be left there temporarily to be used as backup pumps.

The mine dewatering requirement for MIS is to virtually dry up the retort area and to prevent any groundwater from flowing into the retorts. Dewatering wells around the shaft and pumps in the shaft are being used for this purpose. At the beginning of the year, five dewatering wells were on-stream, pumping their discharge into injection wells on-tract. Due to loss of pressure from dewatering in the shaft area, four of the wells were shut down by the end of the year. Only one well, pumping at about 500 gpm, remained in service. Until June, water from the shaft was pumped to the East Retention Pond for settling while work was proceeding on the West Retention Pond. After June, shaft water was pumped to the West Retention Pond for settling. Reinjection of water into on-tract wells was suspended in February and reinstated in September, and by November all the water was being reinjected. Until November, excess water was discharged into Corral Gulch.

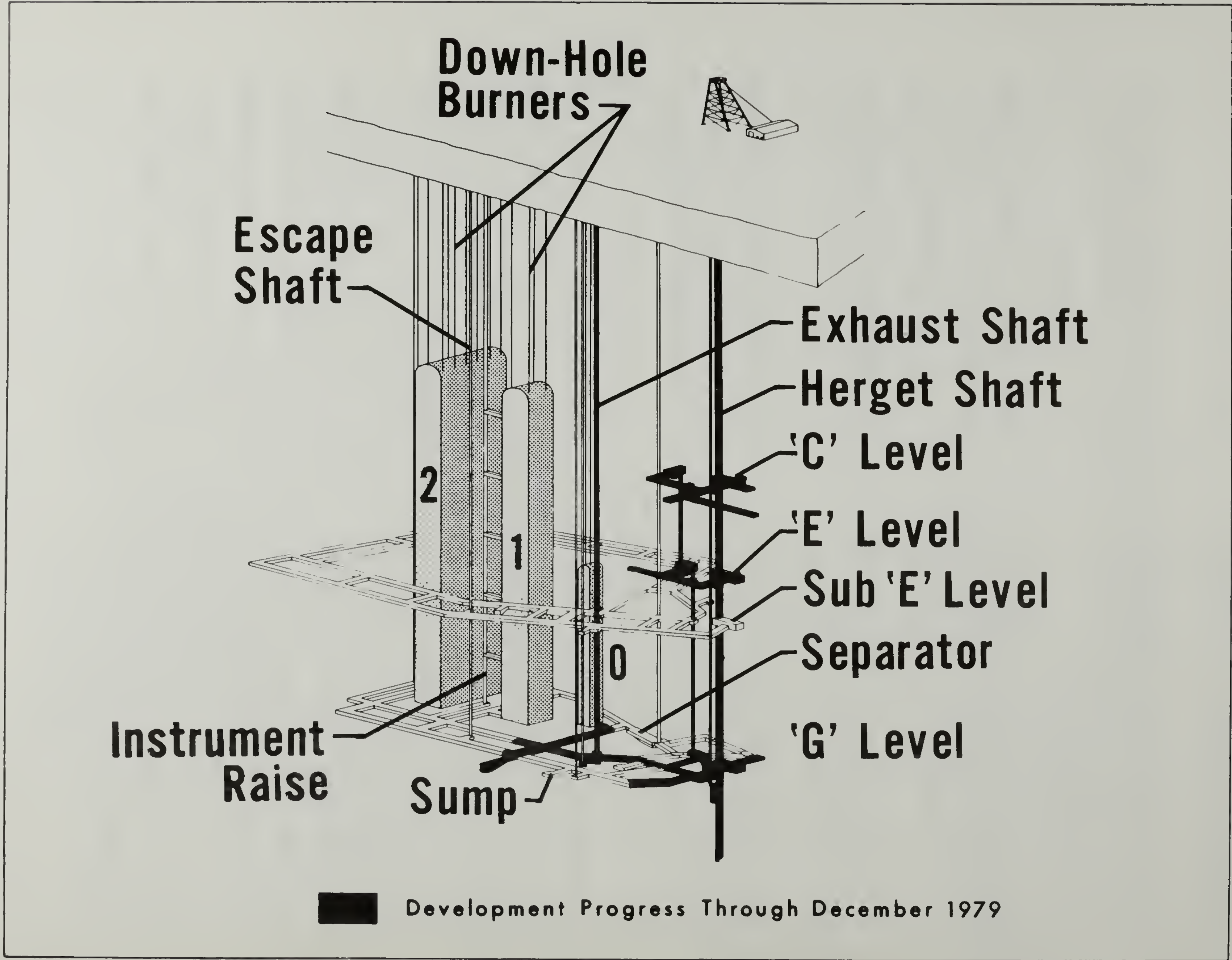


FIGURE 1-2-3

MDP MINE DEVELOPMENT PROGRESS THROUGH DECEMBER 1979

During the year, various tests were performed on the dewatering-reinjection system to determine the nature of recharge and to arrive at a plan to dry out the mine. These tests included: 1) drilling drainage holes from the mine into the Upper Aquifer, 2) ceasing reinjection, and 3) testing the feasibility of recharging the aquifer through the surface downstream of the tract. As a result of information learned from these tests, RBOSC updated its dewatering plan. Four additional dewatering wells will be developed. The first two were drilled in December. Two additional reinjection wells will also be drilled. The Lower Aquifer will not be affected by the MDP operations.

The Sewage Plant was completed during February and used throughout the year. The most notable highlight for the field operation work force as a result of this was the commissioning of indoor flush toilets in the Administration Building.

The Potable Water Plant was completed in March, but problems with suspended solids and H_2S in the supply water have kept the plant from becoming fully operational. Potable water continues to be purchased from nearby Meeker, Colorado.

The Processing Facility foundations were completed in the spring of 1979. At that time, construction of the surface Processing Facility began. By the end of December, the facility was about 95 percent complete. Associated with the Processing Facility are four large scrubber blowdown and sour water evaporation ponds. These are being built in the southeastern portion of the construction area. Earthwork for the ponds was completed and two of the four ponds were lined with high grade laminated polymer-coated fabric liners. Inclement weather prevented lining the remaining two ponds before the end of the year.

In the area of transportation, Rio Blanco County paved County Road 24 from Piceance Creek Road to the tract entrance. RBOSC then paved the access road from the tract entrance to the construction area. RBOSC also obtained a right-of-way for land about five miles northeast of the tract on 84 Mesa and built a one-mile long dirt airstrip. The airstrip is only available for use by RBOSC and federal, state and local governmental officials in the course of their official duties, or for activities related to Tract C-a operations.

Underground electrical power line distribution was completed on-tract during October. The natural gas line was brought to the tract during the summer and distribution was done during the fall. This work was complete at the end of the year. In the spring, the 2500 KW standby electrical generator was checked out and put on-stream as backup to the Moon Lake electrical supply. This generator is tested weekly to confirm its readiness.

In November, Mountain Bell completed the laying and hookup of telephone lines to the tract. The ability to communicate with the tract has been immeasurably enhanced.

Environmental protection and health and safety programs continued to be implemented and refined during the year. Training programs were given to various personnel in the areas of mine safety and fire fighting. Safety meetings and indoctrinations were held with all contractors on a regularly scheduled basis. Two dust exposure checks and a radiation survey were performed during the year. Dust control measures and revegetation were continued to mitigate air pollution problems.

Subsidence monitoring was performed twice during the year. No subsidence was measured from surveys of the subsidence monitoring network.

Environmental monitoring studies were ongoing throughout the reporting period. Various air quality and meteorology parameters were measured during the year. Most of the parameters were measured continuously. A joint study with Tract C-b on visibility was run twice during 1979. Biotic monitoring programs were conducted and included mule deer and feral horse surveys, color infrared aerial photography, range productivity and utilization studies, and browse condition and utilization.

Aquatic ecology samples were collected six times during the year. Physical and water quality measurements were taken and periphyton and benthos were sampled. Ecological studies were performed on Tract C-a, within a three-mile perimeter of the tract, on Yellow Creek and on the White River. Hydrology studies of surface water, alluvial groundwater and the Upper and Lower Aquifer were performed. Physical and chemical parameters were measured in compliance with requirements of lease and permits that were in effect during the year.

Figures 1-2-4, 1-2-5 and 1-2-6 are plot plans showing all existing structures or facilities either completed or under construction as of December 31, 1979 for the tract, the MDP construction area and the Processing Facility area, respectively. Figures 1-2-7 through 1-2-11 are aerial photographs of the main development area at Tract C-a. Table 1-2-3 is a legend identifying some of the facilities shown on these photographs.

2.3 SOCIOECONOMIC ACTIVITIES

Reports of socioeconomic plans and activities related to tract development are not required by the lease and are not included in the body of this report. However, because such activities are an integral portion of the Tract C-a effort, a brief summary is provided in this section.

The number of employees working on Tract C-a during 1979 ranged from 175 to 277. By year's end, the number was around 230.

A survey of employees taken in the last quarter of the year showed that nearly 50 percent were living in Rifle, 25 percent in Meeker and 5 percent in Rangely. About 11 percent were staying on tract during the week. These were primarily people on call 24 hours a day. The balance of employees was distributed in several western Colorado communities.

Agreement with Rio Blanco County was reached for bachelor housing for temporary retort-burn personnel and for key employees on call for emergencies.

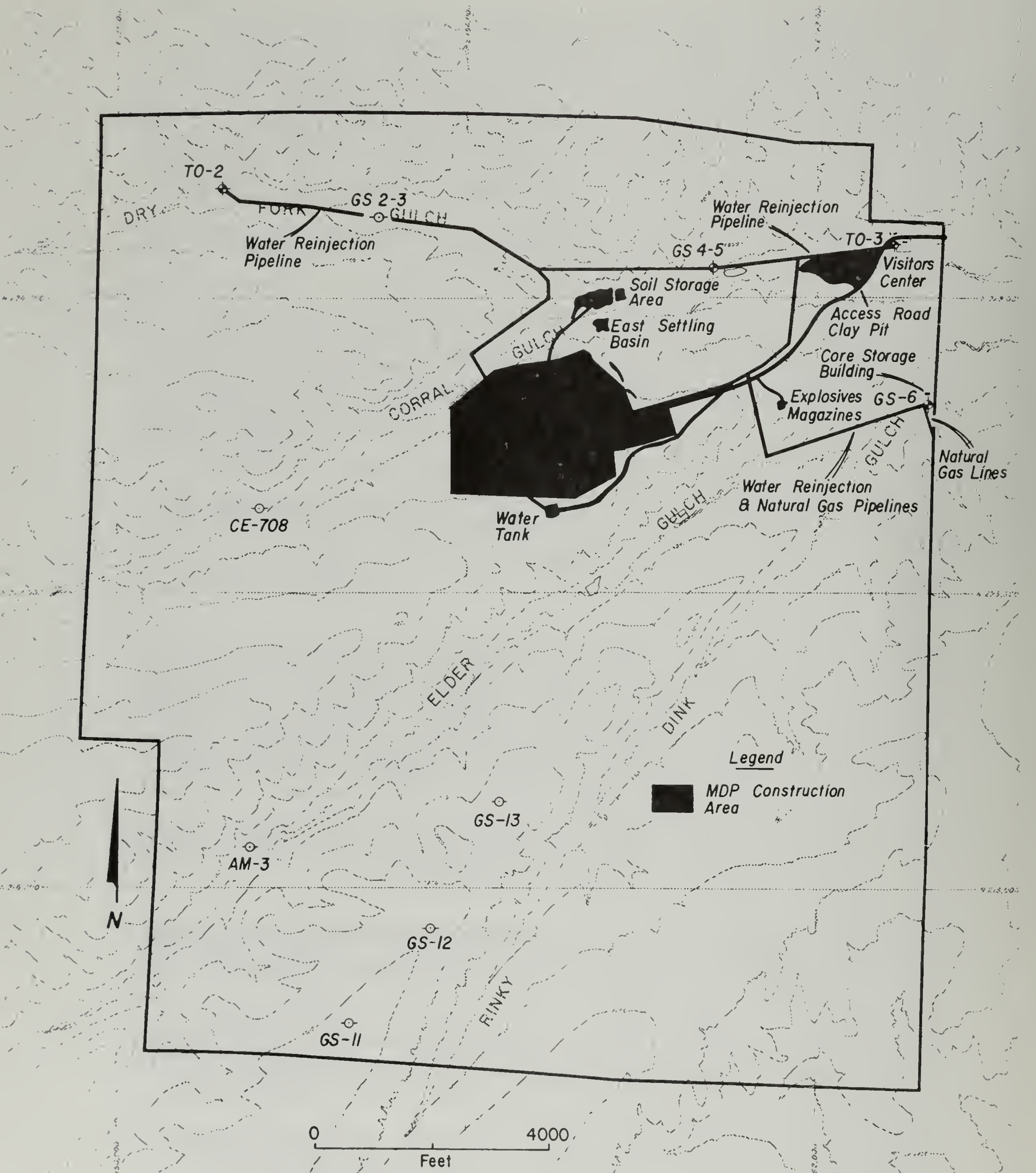


FIGURE 1-2-4

TRACT C-a PLOT PLAN, DECEMBER 1979

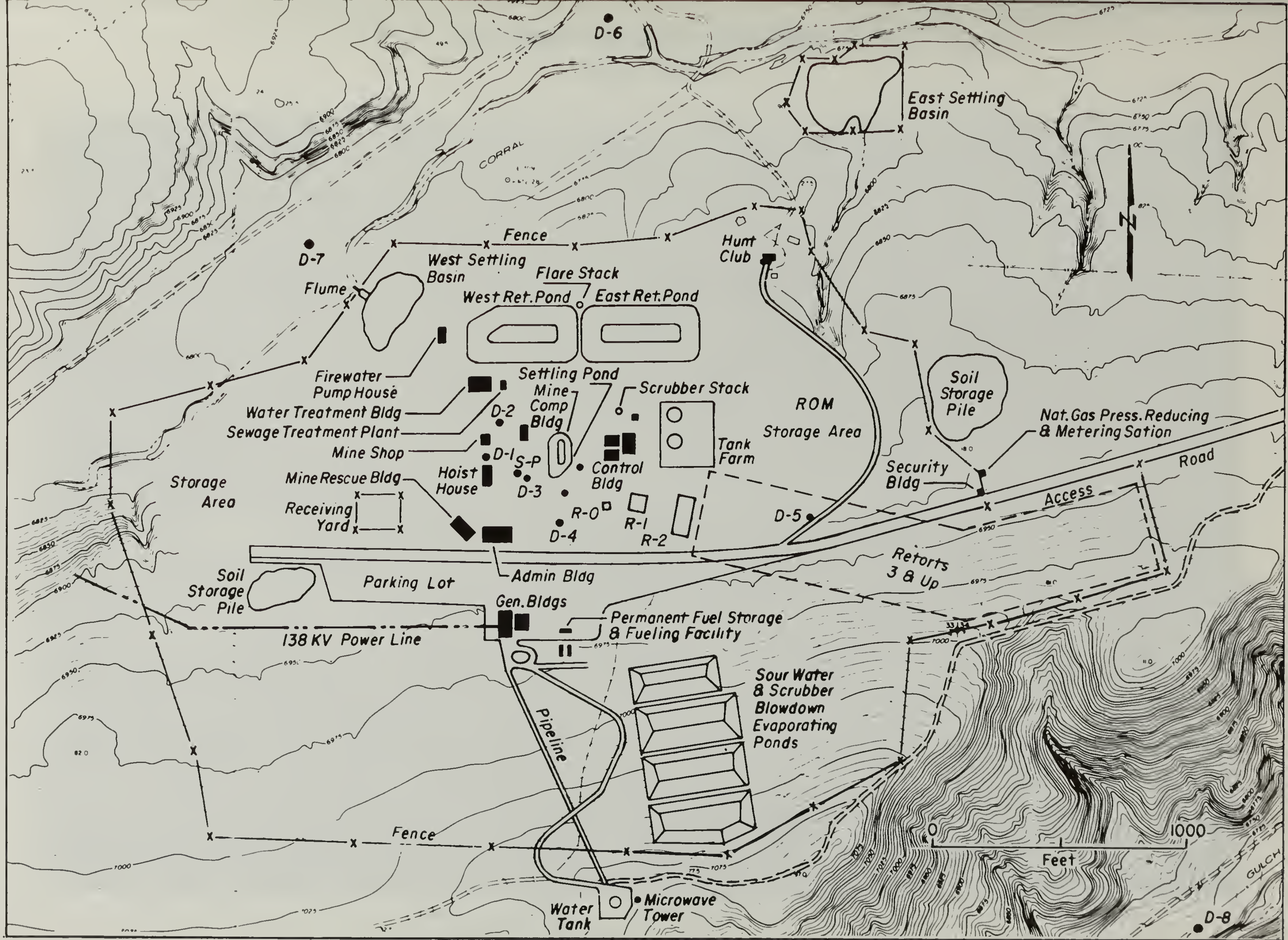


FIGURE 1-2-5

MDP CONSTRUCTION AREA, DECEMBER 1979

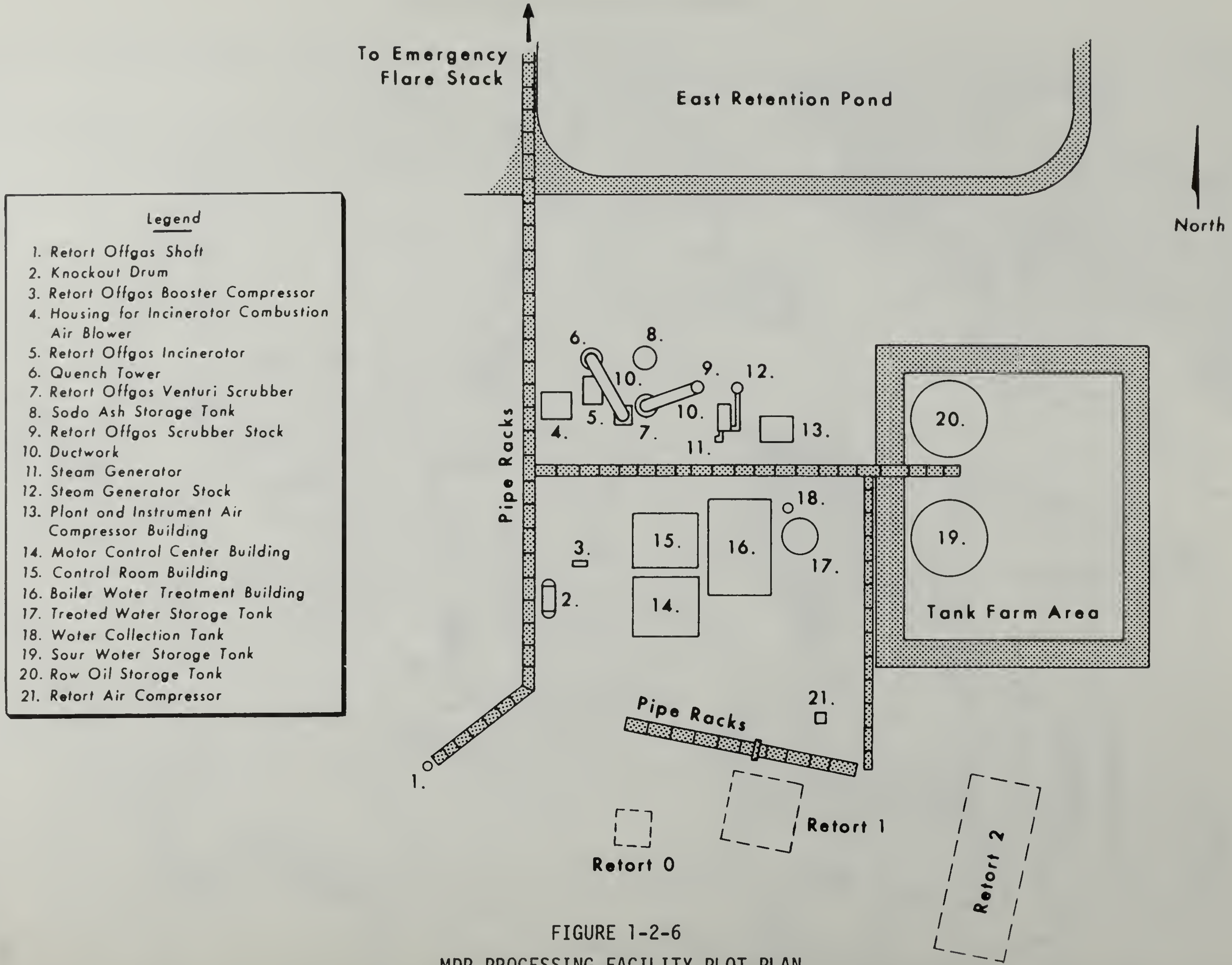


FIGURE 1-2-6

MDP PROCESSING FACILITY PLOT PLAN

FIGURE 1-2-7

MDP CONSTRUCTION AREA OVERVIEW LOOKING SSW, SEPTEMBER 1979

FIGURE 1-2-8

MDP CONSTRUCTION AREA OVERVIEW LOOKING NNW, JANUARY 1980

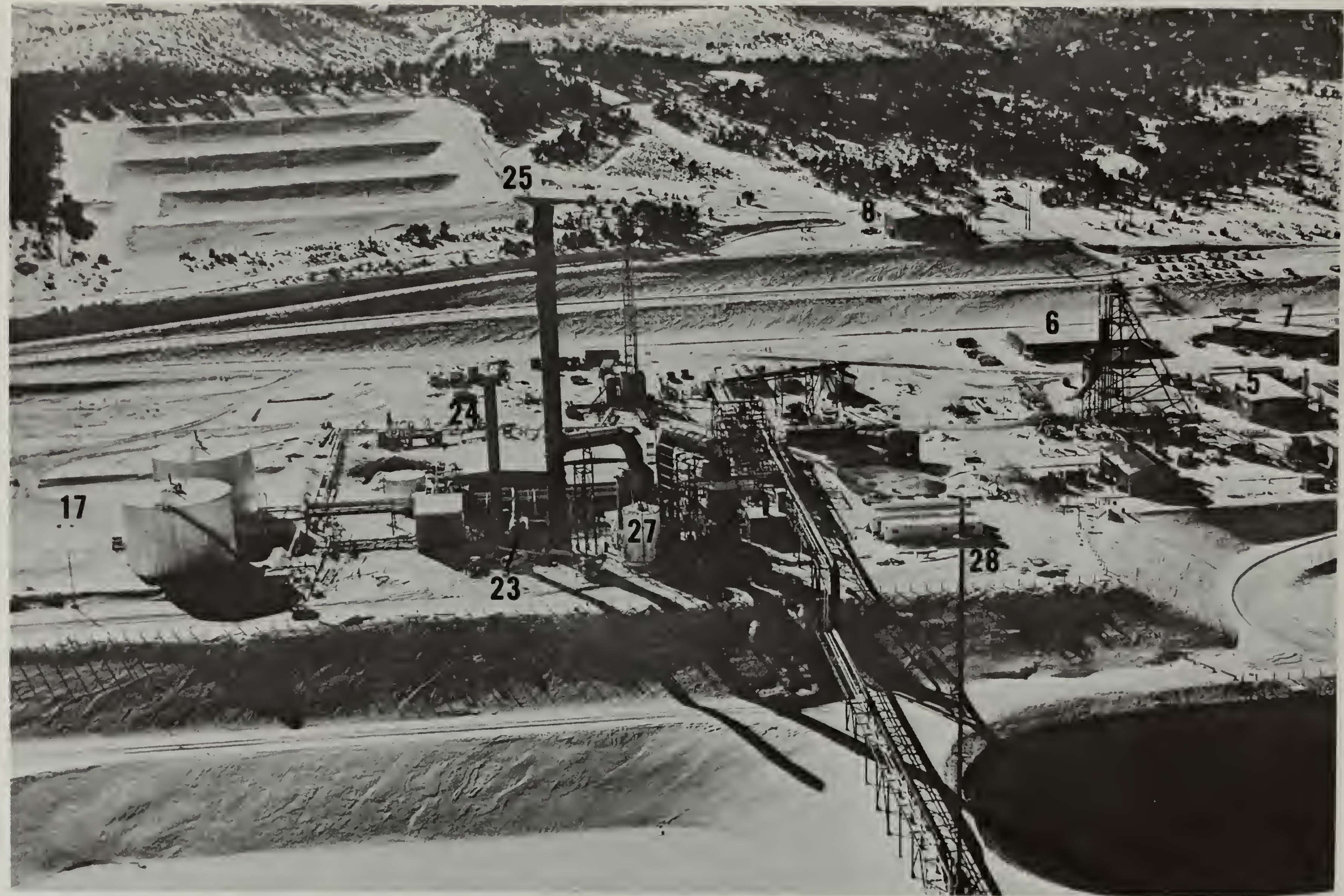


FIGURE 1-2-9

MDP PROCESSING AREA OVERVIEW LOOKING SOUTH, JANUARY 1980

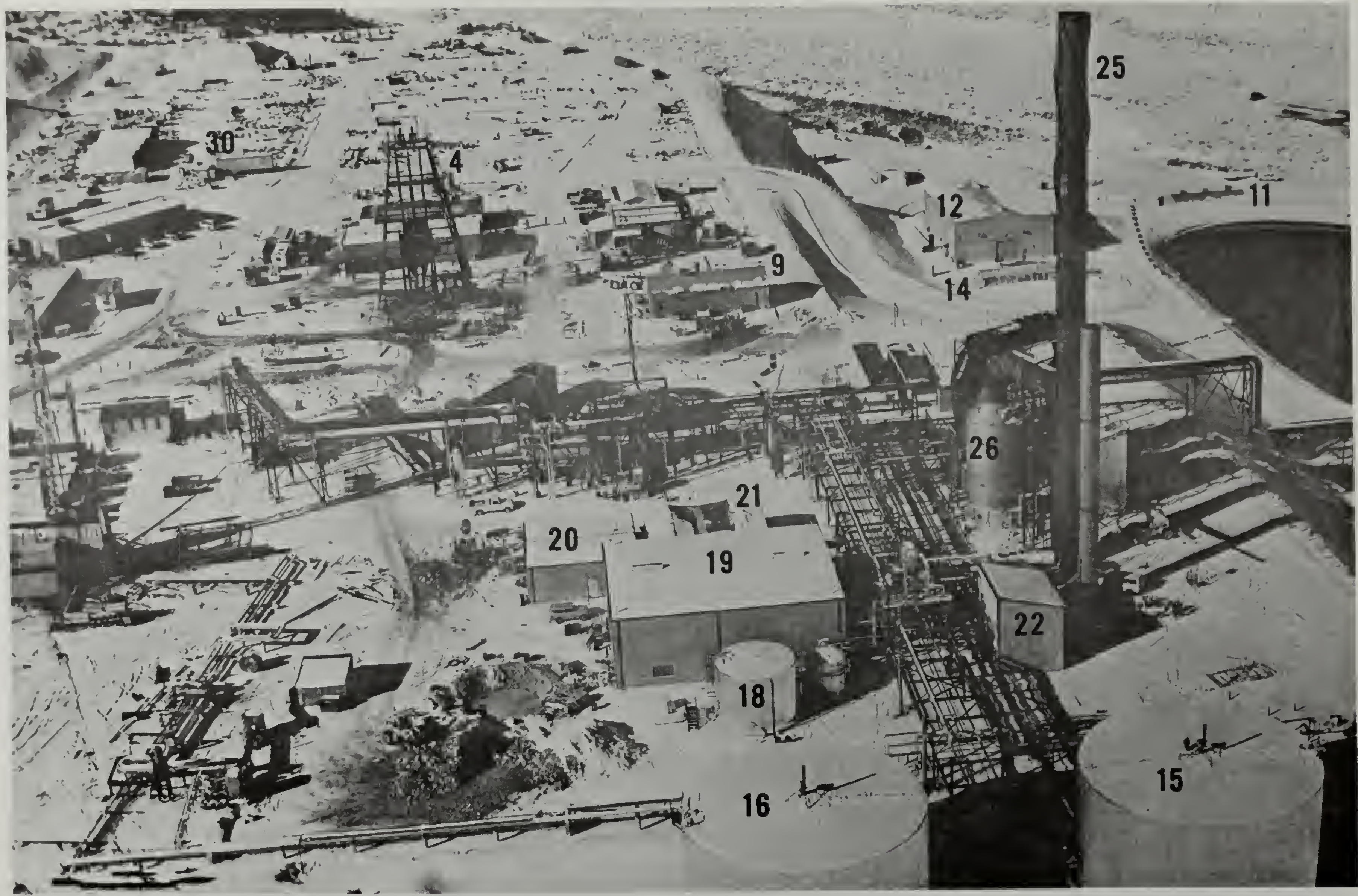


FIGURE 1-2-10

MDP PROCESSING FACILITY (FOREGROUND) AND MINING AREA LOOKING WEST, JANUARY 1980

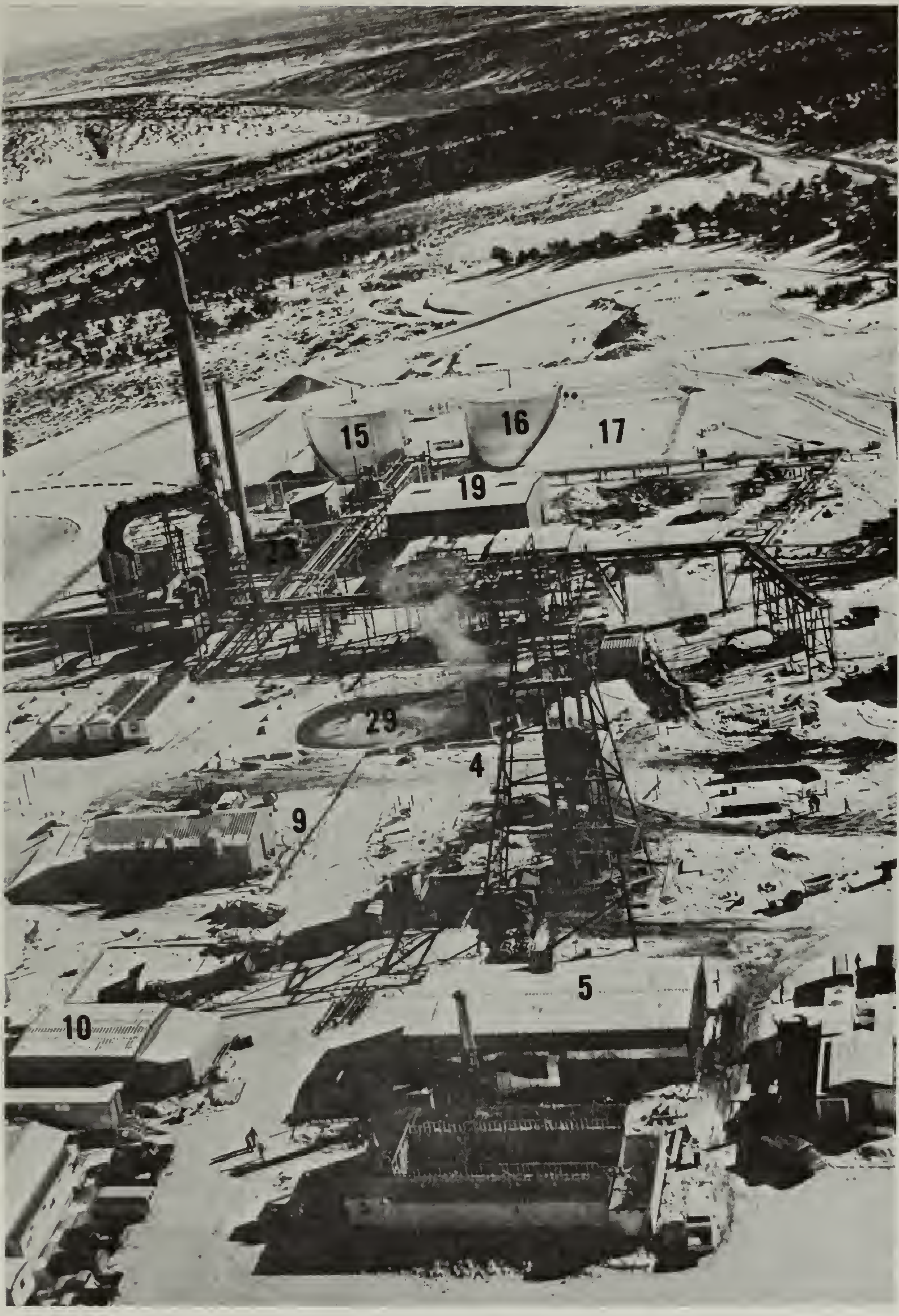


FIGURE 1-2-11

MDP MINING AREA (FOREGROUND) AND PROCESSING FACILITY LOOKING EAST, JANUARY 1980

TABLE 1-2-3

LEGEND IDENTIFYING FACILITIES FOR FIGURES 1-2-7 to 1-2-11

1. East Retention Pond
2. West Retention Pond
3. Scrubber Blowdown and Retort Sour Water Evaporation Ponds
4. Headframe
5. Hoist House
6. Administration Building
7. Mine Rescue Building
8. Standby Generator Building
9. Mine Compressor Building
10. Mine Mechanics Shop
11. Fire Water Pump House
12. Water Treatment Building
13. West Settling Basin
14. Sewage Treatment Plant
15. Raw Oil Storage Tank
16. Retort Sour Water Storage Tank
17. Tank Farm Area
18. Treated Water Storage Tank
19. Processing Plant Boiler Water Treatment Building
20. Processing Plant Motor Control Center Building
21. Processing Plant Control Room Building
22. Plant and Instrument Air Compressor Building
23. Steam Generator
24. Steam Generator Stack
25. Retort Off-gas Scrubber Stack
26. Retort Off-gas Scrubber
27. Soda Ash Storage Tank
28. Emergency Flare Stack
29. Settling Pond
30. Receiving Yard
31. Water Tank

The construction of a road between Rangely and Tract C-a remains the most likely factor which could change the population distribution. RBOSC's efforts regarding the road were discussed in the first APR. Rangely would be the closest town to the tract if a new road could be built. Existing one-way commuting distances to Tract C-a from the three towns are 68 miles to Rangely, 58 miles to Rifle and 51 miles to Meeker.

The Colorado West Area Council of Governments (COG), on Rio Blanco County's recommendation, has placed a Tract C-a to Rangely road alternative at the top of the priority list for this year's requests to the Joint Budget Committee (JBC). The alternative to the one proposed by RBOSC, shown by the dotted line of Figure 1-2-12, is ten miles longer than the route originally recommended. It would be built in stages and would only cost about $6 million.

As shown in the figure, a portion of the road is common to both routes, but the alternative would go over Calamity Ridge instead of through Gillam Draw as the original design called for. The county feels that since it costs about one-third as much as the original route, the JBC will be more willing to fund it. The 1979 session of the legislature, allocated $300,000 for design and engineering of this route. For 1980, COG is asking for $2,658,000 for the first portion of the new part of the road. If that request is approved, additional funds would be requested in the next two sessions to complete construction.

RBOSC is still carpooling to and from Tract C-a in most cases, owning three 9-passenger suburbans and one 15-passenger van which are used for employee transport. The Industrial Company (TIC) has six 15-passenger vans. American Mine Services (AMS), the shaft-sinking contractor, had two 15-passenger vans. Mine, Shaft and Tunnel (MS&T), the mining contractor, has four 15-passenger vans to transport their employees. More than 90 percent of Tract C-a employees are carpooling as of our 1979 survey.

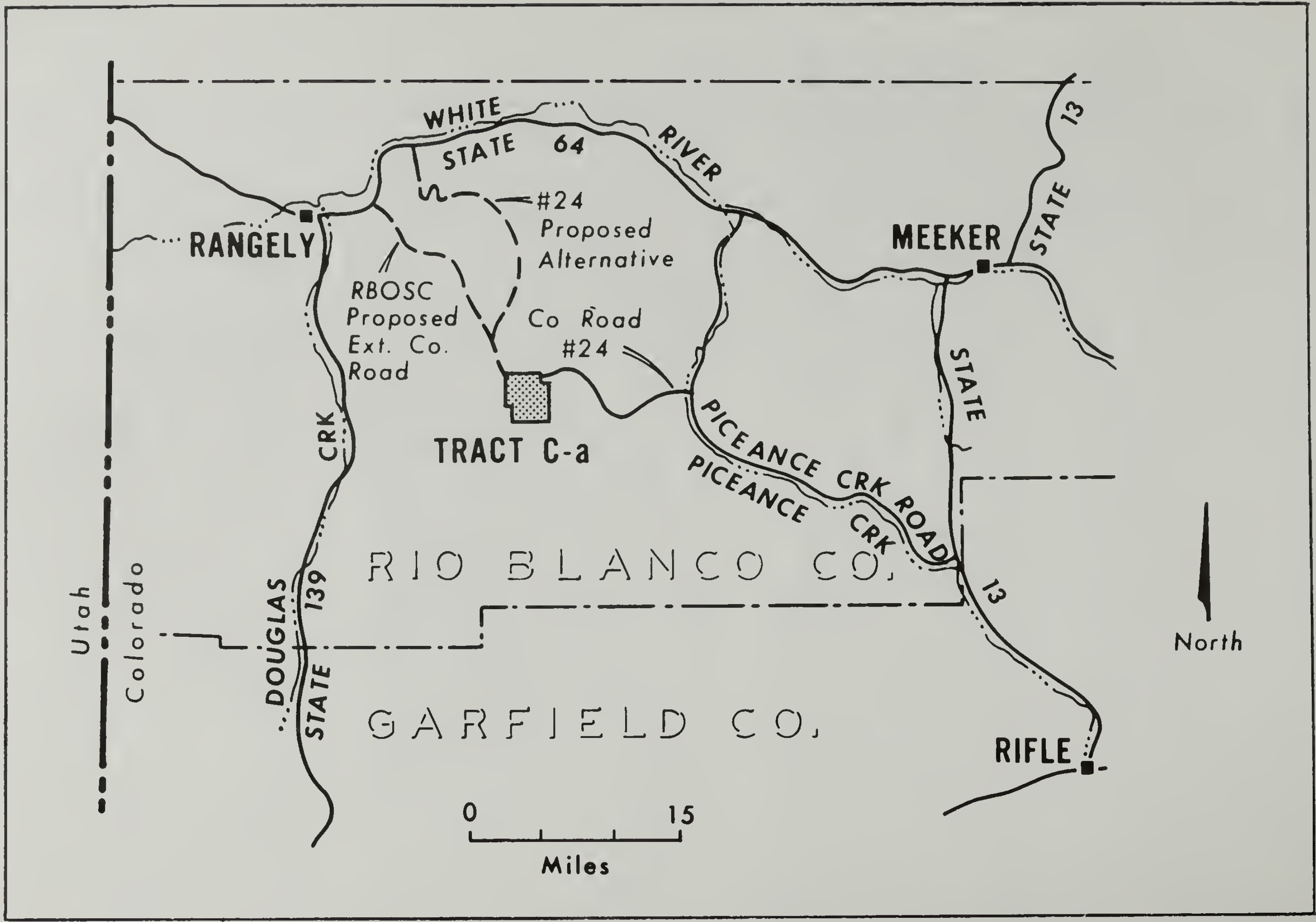


FIGURE 1-2-12

LOCATION MAP OF TRACT C-a

As shown on Figure 1-2-13, RBOSC doesn't anticipate manpower numbers on Tract C-a any greater than about 300 through the end of 1981. The table below presents the actual maximum monthly manpower for 1979.

MAXIMUM MONTHLY MANPOWER, TRACT C-a,' 1979

Month	Maximum Manpower
January	227
February	234
March	233
April	226
May	251
June	264
July	265
August	277
September	275
October	277
November	256
December	237

During the last quarter of 1979, RBOSC was negotiating with the Lurgi Corporation for the first phase of a program for the design, construction and operation of a Lurgi-Ruhrgas surface oil shale retort. Since this study has just started, the number of employees required has not yet been projected. RBOSC speculates that a construction force would begin to build up by 1981 and continue through the construction period. Maximum number of workers by 1982 could be approximately 400 people.

RBOSC signed an agreement to guarantee rental of 25 mobile home spaces in Rangely. At the end of the year, 20 of the units were ready for occupancy pending final electrical hookup and receipt of gas meters. RBOSC had been trying to get a mobile home park built in Rangely for some time. With oil shale development looking more feasible, RBOSC hopes this will prove to be one of the examples where private business takes advantage of a good opportunity.

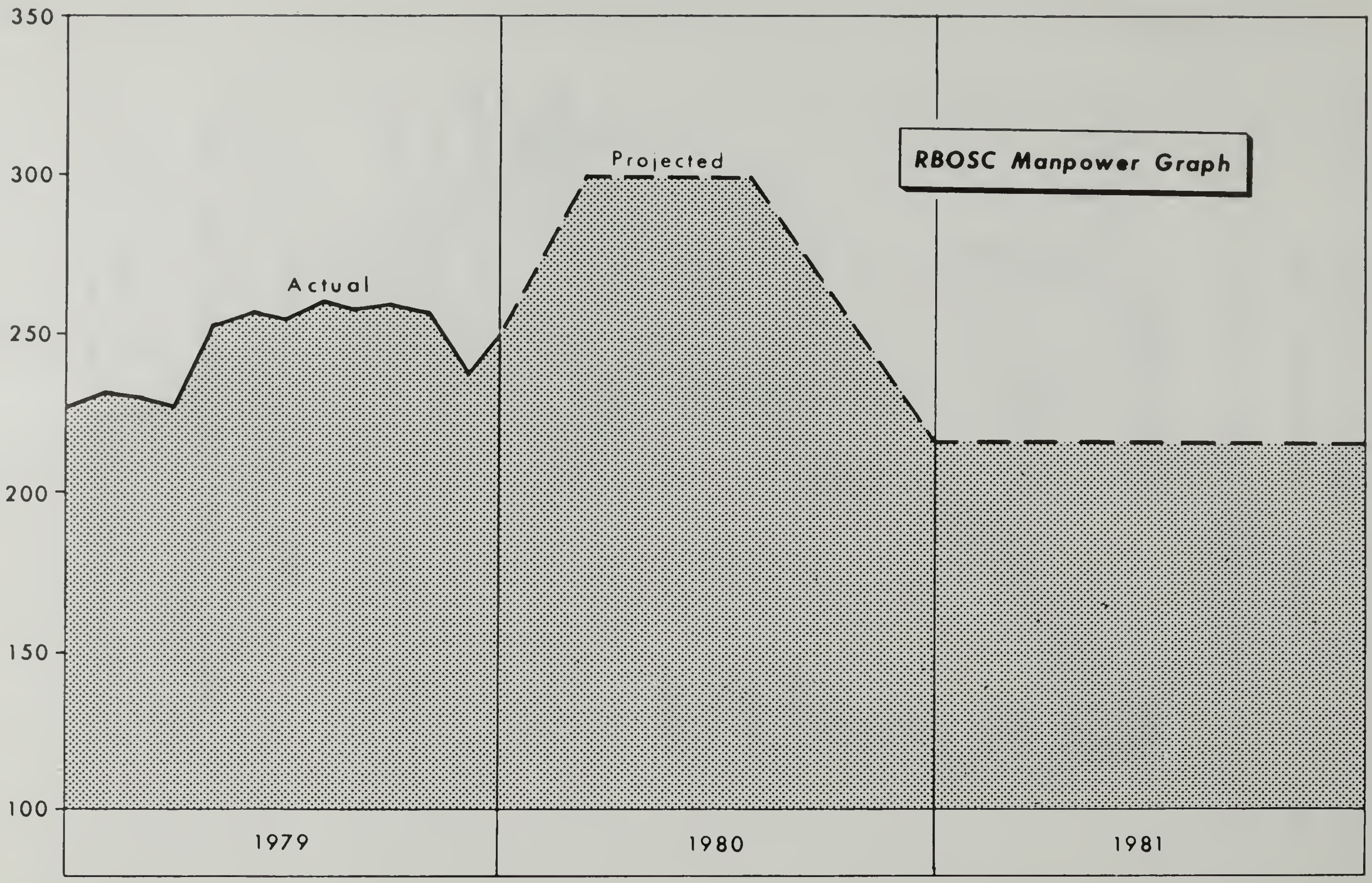


FIGURE 1-2-13

RBOSC ACTUAL AND PROJECTED MANPOWER

2.4 REGULATORY REQUIREMENTS

RBOSC had obtained all major permits and approvals to allow construction to proceed during 1979. A Subsurface Disposal Permit to allow underground burning of the retorts was obtained from the Colorado Department of Health's Water Quality Control Division in June. Revisions were made to RBOSC's existing Prevention of Significant Deterioration (PSD) permit for stack height and SO_2 emissions. A variance was received from MSHA to allow underground fires. All other necessary permits, variances, right-of-ways and approvals were obtained to allow continued construction, testing and operation during the year.

2.5 FINANCIAL INFORMATION

The 1979 Summary of Costs for RBOSC is given in Table 1-2-4.

2.6 ANNUAL PROGRESS REPORT (APR) ORGANIZATION AND USE

RBOSC's APR was written and organized to closely follow the organization of the first APR which in turn corresponded to the organization of the DDP of May 1977. All section titles of the APR are the same as the DDP except Section 7 which combines Sections 7 and 8 of the DDP. By referencing the section number and title, the reader can refer to the first APR or the DDP for additional information on the plan being implemented. If no new work in a particular subject area was done during the year, the related chapter is not included in this report.

The DDP presented RBOSC's plan of action. The first progress report told what had occurred on Tract C-a since operations commenced after approval through the end of 1978. This report covers progress for 1979.

A three-digit page numbering system is used throughout the APR. Page numbers are keyed to the chapters within the section; page 5-3-4, for example, refers to Section 5, Chapter 3, page 4. A similar system is used for figure and table numbers.

TABLE 1-2-4

RBOSC SUMMARY OF COSTS - 1979
($000)

Engineering, Construction and Development	
Sewage and Seepage Plants	$ 80
Dewatering	486
Site Work	1,503
Power Plant	162
Processing Facility	9,593
Shaft, Hoist and Headframe	4,080
Mine Services	5,129
Drifting, Retorting	1,368
Operations	2,830
Managing Contractor Services	3,784
Technological Design	4,152
Environmental	571
Other	281
Total Development	$34,019
Administrative	$ 2,636
Total C-a Project	$36,655

SECTION II

MINING

CHAPTER 1

INTRODUCTION

During 1979, RBOSC modified its mining plan for the MDP to develop three underground retorts instead of the originally planned five retorts. This was discussed in Section 1 and is discussed in more detail in Chapter 2 of this section. Chapter 3 is a summary of the progress in the shaft and mine development during 1979.

The site selected for the three retorts of the MDP is in the same area as the previous retort locations. Figure 2-1-1 illustrates the relationship of the MDP features relative to the planned commercial retorts. Figure 2-1-2 is a cross section through the Herget Shaft (service-production) and the three retorts of the MDP.

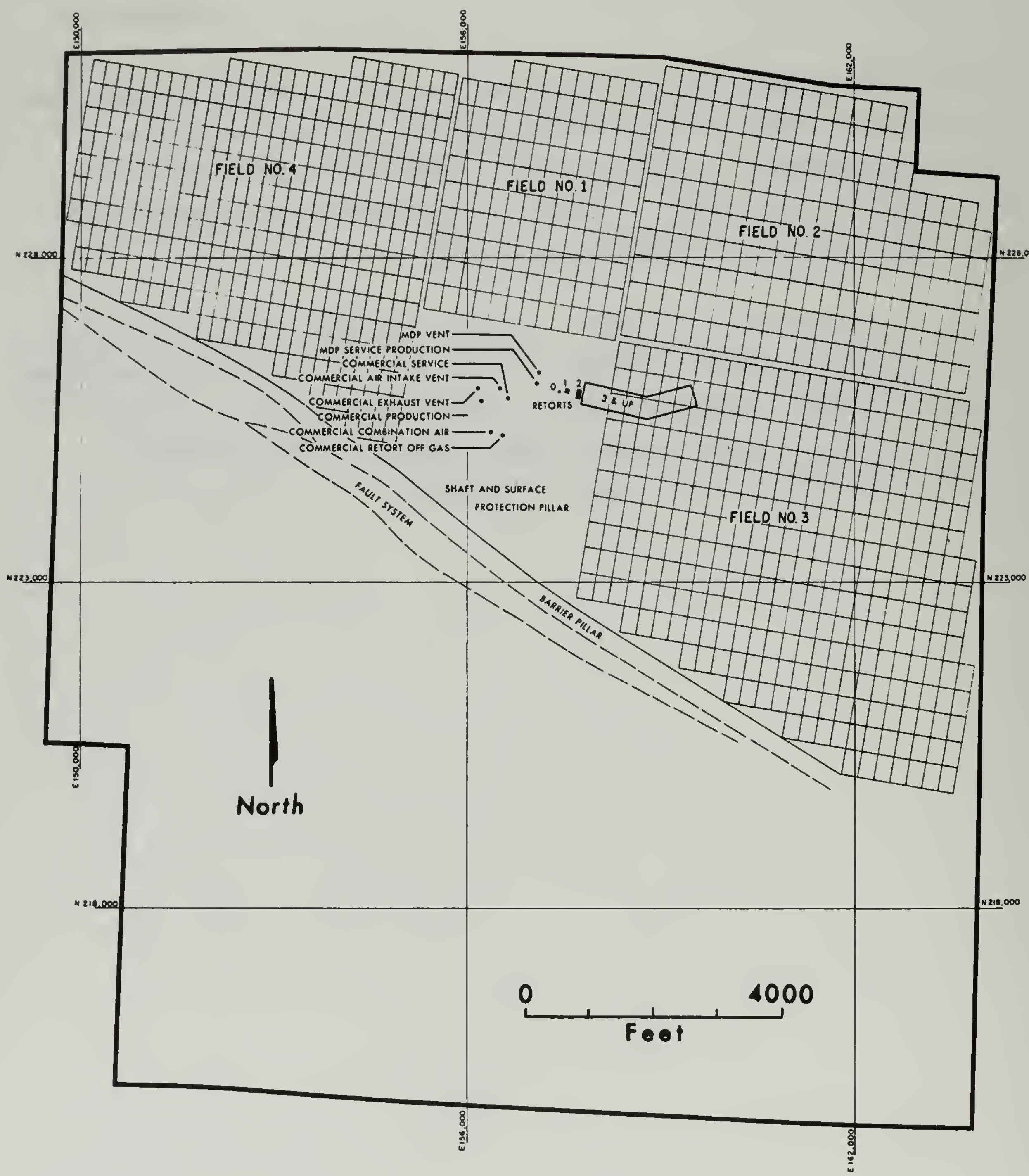


FIGURE 2-1-1

TRACT C-a GENERAL MIS LAYOUT

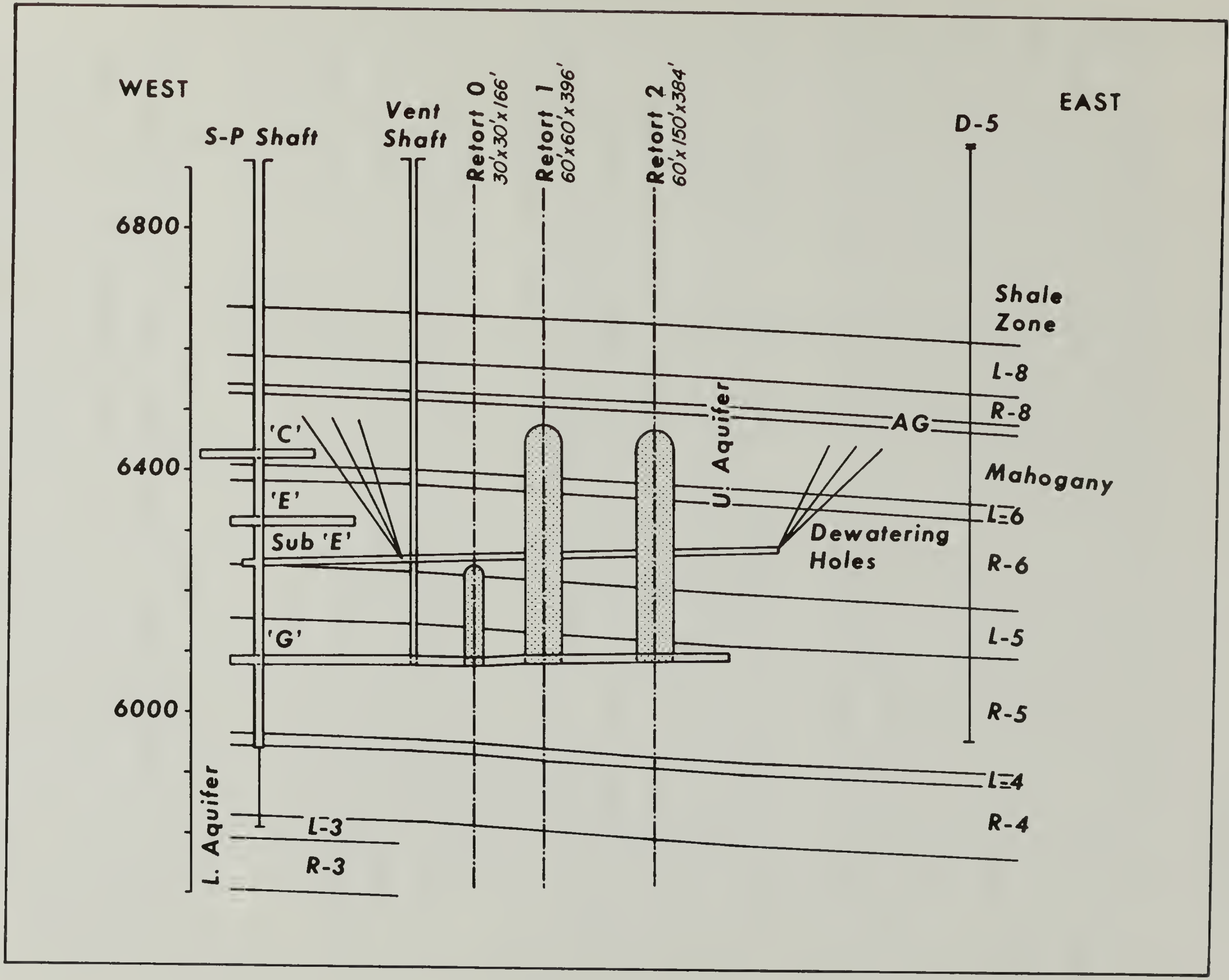


FIGURE 2-1-2
CROSS SECTION OF MDP AREA

CHAPTER 2
MINE DESIGN

Originally, the MDP consisted of a planned five-retort program. This was described extensively in the DDP and in the first APR. Retort 1, planned to start up in 1980, would have allowed evaluation of the retorting model prediction, provide practical field operating experience and supply oil shale and shale oil samples for laboratory and field experiments. The next four retorts would have tested mining concepts and factors affected by scale-up of the size of the retorts. These four retorts were scheduled to be developed and burned from 1980 through 1982. All retorts were planned to have had a void fraction of about 20 percent.

RBOSC's objective in constructing these retorts was to achieve a relatively low void volume within the rubble, generally in the range of about 20 percent of total retort volume. This range had been regarded to be desirable because it minimized the quantity of oil shale which must be mined out to prepare the retorts, and yet it was viewed to be adequate for providing the permeability to conduct hot retorting fluids through the rubble bed.

From a processing point of view, the success of in situ retorting is heavily dependent on achieving a uniform distribution of voids in the retort rubble in order to obtain high permeability within the bed and promote the even distribution of the hot retorting fluids; additionally, relatively small fragments of generally uniform size are required to enhance shale oil recovery.

During the first half of 1979, RBOSC completed an extensive review of MIS technology with a result that some modifications were made to mining methods and retort configuration. Several approaches to shale rubbling, including blasting into both vertical and horizontal voids, and different blasting parameters were evaluated. This study indicated that a satisfactory rubble size could be produced, and that this appears to be possible with a reasonable blasthole spacing. Remaining to be solved, however, was the problem of obtaining a uniform distribution of voids in order to preclude the channeling of gases during the retort burns and, consequently, low oil shale oil recovery.

To overcome the problem of obtaining a uniform distribution of voids, RBOSC concluded that a void fraction of about 40 percent of retort volume will be necessary to achieve good void distribution, and the basic change in the MDP program is a method of developing such high void retorts. This will be achieved by designing and blasting for a random free fall of rubbled material and, consequently, a random or uniform distribution and porosity. In this method, a single level crater retreat blasting approach is used with a number of vertical blastholes drilled from the surface to intersect the roof of the retort.

The high void method of development has the further advantage of requiring less mine development than the original plan. This is immediately obvious by comparing the previous development plan, shown on Figure 2-2-1, with the present plan shown on Figure 1-2-1. The previous plan, which was based on low void fraction, required very extensive multi-level development. RBOSC's present plan utilizes the basic mine facilities of the previous plan, much of which had already been completed, but involves substantially less mining.

The MDP program has been modified to include three retorts. Retort 0 will be approximately 30 ft. x 30 ft. x 170 ft. high, and will serve to better define blasting requirements and shake down the processing system. Retort 1 will be approximately 60 ft. x 60 ft. x 400 ft. high, and Retort 2 is tentatively planned to be approximately 60 ft. x 150 ft. x 400 ft. high. The final size of this retort will be decided on the basis of experience gained in the prior two.

The modified plan shown in Figure 1-2-1 requires only a single mine development level, G Level, for retort preparation. This is in contrast to the multiple levels required for the original approach. G Level plan view is shown in Figure 2-2-2. The double east-west headings at the top

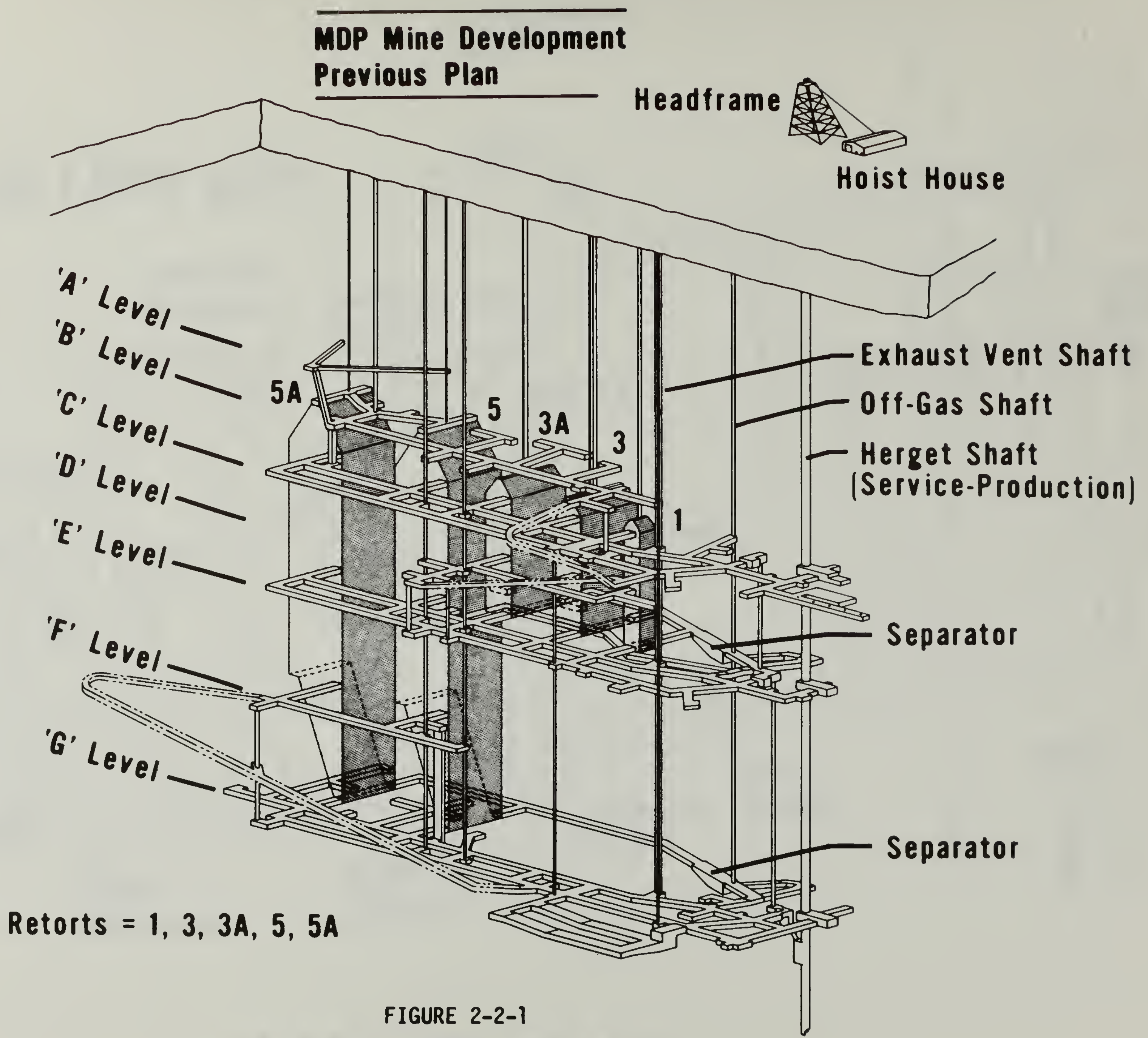


FIGURE 2-2-1

MDP MINE DEVELOPMENT, PREVIOUS PLAN

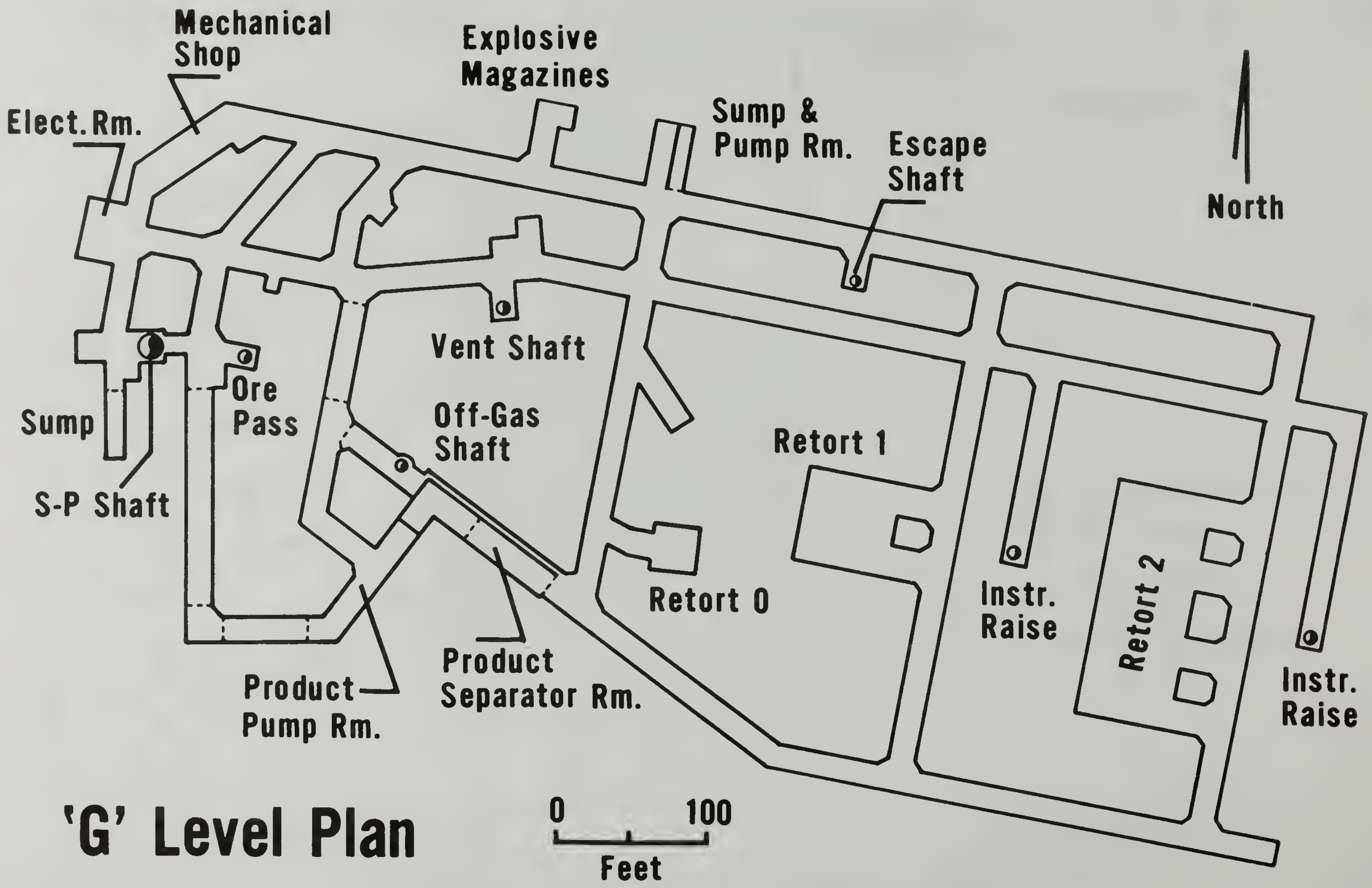


FIGURE 2-2-2
'G' LEVEL PLAN

of the figure serve as the main ventilation network and the primary mine haulage drifts. The single drift on the bottom will convey fluids produced from the retorts to a separator from which they will be pumped to the surface. The retort and the product drift will be isolated from other mine workings by bulkheads. The second level shown on the figure will be used for water management purposes.

The above described modification in plans was submitted to the AOSO on June 2, 1979 and approved on August 29, 1979.

CHAPTER 3

SHAFT AND MINE DEVELOPMENT

3.1 SHAFT SINKING PROGRESS

Table 2-3-1 shows the 1979 milestones in the Herget (service-production) shaft sinking operation. Figure 2-3-1 is a cross section of the shaft showing the ore loading arrangement described in this chapter. The main items shown in this figure are described below:

- Ore Pass - blasted ore is dumped into this 8 ft. diameter vertical chute.
- Sub-E Ore Pass Station - Sub-E drainage level developed off existing 8 ft. diameter ore pass to avoid tying up Herget Shaft.
- Grizzly - stationary large opening screen to prevent oversize pieces of ore from blocking the skip loading chute.
- Water Ring - Catches water running down Herget Shaft.
- Pants Leg Chute - a "Y" type chute for alternately loading either the south or north shaft compartment skip.
- Chute from G Level Ore Pass - Carries rock to pants leg chute from the ore pass or from G Level.
- Man Cage - a cage-like elevator compartment for hoisting men and supplies.
- Ore Skip - a heavy-duty four-ton capacity bucket for hoisting blasted rock.
- Sump - a collection area for mine seepage water.
- Pump - pumps the mine seepage water to the surface.

Drifting on E Level was discontinued in mid-January 1979 and sinking recommenced. The shaft reached G Level in February and drifting on that level was continued into mid-August. During this period, the 8 ft. diameter ore passes from G to E Level and from E to C Level were upreamed by the shaft contractor using RBOSC's raise boring equipment. The 10 ft. diameter ventilation shaft was upreamed from G Level to the surface during May 1979.

TABLE 2-3-1

1979 MILESTONES IN
HERGET (SERVICE-PRODUCTION) SHAFT SINKING OPERATION

MILESTONE	DATE
Complete E Level drifting and recommence sinking	January
Drive drifts on G Level to Retort 0	March - August
Shaft reaches total depth and outfitting is started	October 8
Mining contractor takes over from the shaft sinking contractor	November 20
Mine is classed gassy due to a minor methane ignition	November 30

Shaft depth at the end of each month was as follows:

Month	Shaft Depth	Remarks
December 1978	638	- - - - -
January	638	Drifting on E Level toward vent shaft
February	750	Sank shaft below to G Level
March	868	Developed G Level Station
April	868	Drifting on G Level
May	868	Drifting on G Level
June	868	Drifting on G Level
July	868	Drifting on G Level
August	890	Mined loading pocket in shaft
September	943	Concreted shaft loading pocket
October	979	Total depth reached on October 8 - Shaft outfitting commenced
November	-	Shaft outfitting
December	-	Shaft outfitting completed

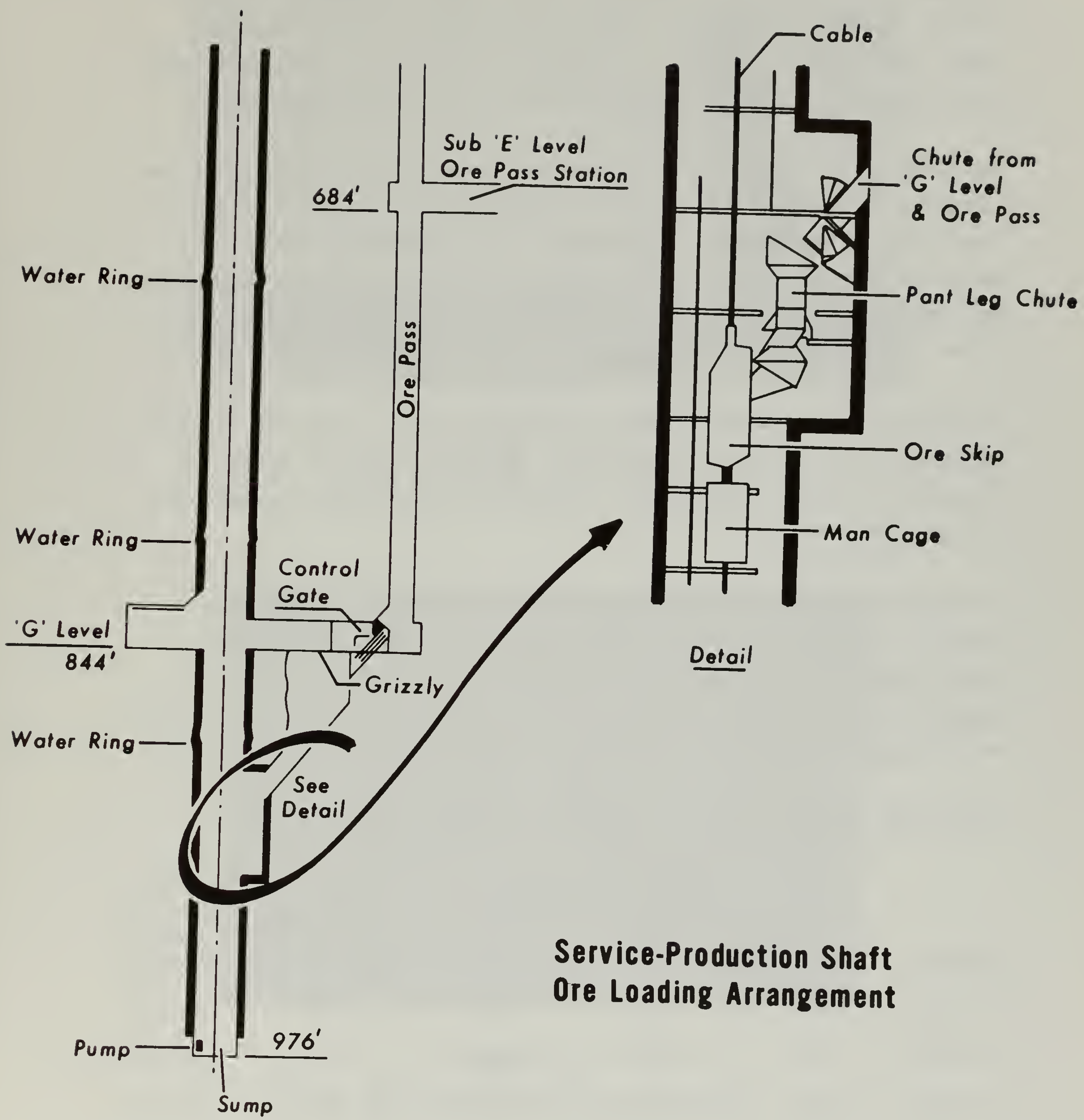


FIGURE 2-3-1
SERVICE-PRODUCTION SHAFT ORE LOADING ARRANGEMENT

Shaft sinking below G Level was resumed in August and the skip loading pocket below G Level was excavated in August and lined in September.

The small raise between the loading pocket and G Level that ultimately will be widened into the drive-over grizzly covered dump was mined. Total shaft depth of 979 ft. was reached on October 8. Work then began on outfitting the shaft for hoisting men, material and mined shale.

The shaft steel supporting the manway on the east side of the shaft was installed as the shaft was sunk and concrete lined. After reaching total depth, the remaining shaft steel and the wooden guides for the skips and cage were installed proceeding from the collar downward. This was completed in December. The Galloway (four-level work deck) was cut up and removed from the shaft at this time.

The 50-ton bin at the headframe was erected (Figure 2-3-2) and measure pockets below G Level were installed. The shaft should be ready for hoisting oil shale in early 1980. Work will then resume on developing the two mine levels.

The hoist house ventilation system was installed to cool the hoist electrical grids during normal operation and especially during the summer months. In addition, a dust filtering system helps keep the numerous electrical contacts in the hoist house from getting dirty which could result in outages and down time. Figure 2-3-3 shows this setup.

Tonnage and blasting data by quarter for 1979 were as follows:

Quarter	Shaft Sinking (Tons)	Drift Mining (Tons)	Material Removed (Tons)	Number Blasts	Quantity Blasting Powder (Pounds)
1st 1979	2,499	1,867	4,366	194	16,050
2nd 1979	345	10,500	10,845	118	22,985
3rd 1979	2,342	4,077	6,419	98	14,579
4th 1979	416	0*	416	12	1,620
TOTALS	5,602	16,444	22,046	422	55,234

*Shaft outfitting during 4th quarter.

FIGURE 2-3-2

50 TON ORE BIN MOUNTED ON HEADFRAME

FIGURE 2-3-3

HOIST HOUSE VENTILATION AND FILTER DUCT

3.2 MINE DEVELOPMENT

The milestones for the mine development for 1979 are shown on Table 2-3-2. The extent of the drifting on G Level by year-end is shown in Figure 2-3-4 (also, see Figure 1-2-3). Some basic mine features of the previous plan (before the DDP technical modification) had been completed and will be used in the present plan. C and E Level stations were used as pump stations. A set of backup pumps remain on E Level. The ore pass was completed from E to G Level and will be used for Sub-E Level development.

A borehole was drilled from the surface to G Level for the main mine power line. Several of the holes from the surface were drilled for Retort 0. Some were drilled with the raise boring machine and others were drilled with a conventional rotary rig. These will be used for blasting, air and steam injection, and for lowering downhole burners to the top of the retorts to ignite the shale rubble.

3.3 SUPPORT OPERATIONS

A. Ventilation - Upon completion of the exhaust ventilation shaft in May 1979, a 150 hp axial flow fan was temporarily installed over it to power the main ventilation circuit. The permanent 300 hp fan is installed and operable and will be put into continuous service in 1980. Fresh air is drawn down the service-production shaft, traverses G Level, and is exhausted up the ventilation shaft. Two 50 hp axial flow, auxiliary fans on G Level, just upstream of the ventilation shaft, carry air through a metal duct and flexible fan bags to the various working faces on G Level.

A 50 hp auxiliary fan on C Level and a 40 hp auxiliary fan on E Level draw intake air from the shaft and deliver it to the headings on each of these levels. Small auxiliary fans ventilate the shaft bottom and the mechanics shop on G Level. This arrangement is temporary and the permanent coursed ventilation system will be implemented in 1980.

Figure 2-3-5 shows the main mine ventilation fan. Figure 2-3-6 shows the ventilation shaft collar.

TABLE 2-3-2

1979 MINE DEVELOPMENT MILESTONES

JANUARY	Drifted on E Level to the ore pass. Concreted E Station sump and drift dam. Concreted E Station. Sank shaft.
FEBRUARY	Drilled long-holes from E Station to the final shaft depth. Some problems with CH_4 and H_2S. Sank shaft to G Level.
MARCH	Sank shaft. Concreted G Level to E Level foundation for ore pass. Set up raisebore machine on the foundation. Mined G Station and G Level sump. Drifted to ore pass from the service-production shaft.
APRIL	Drifted on G Level to ore pass area and to vent shaft. The raisebore machine upreamed 8 ft. diameter ore passes from G Level to E Level and from E Level to C Level. Constructed concrete ventilation shaft collar and drilled the pilot hole with the raiseboring machine.
MAY	Completed upreaming the ventilation shaft to 10 ft. diameter from the 11 inch diameter pilot hole. The mine standby diesel generator (2500 KW) was put into service. Drifted on G Level toward Retort 0 and second G Level sump. Some H_2S problems on G Level.
JUNE	Completed the 10 ft. diameter upreamed ventilation shaft. Mounted temporary 150 hp fan on vent shaft. Drifted on G Level toward Retort 1, Retort 0 and No. 2 G Level sump. Lowered two LHD units and one jumbo to G Level. Started Retort 0 blasthole drilling from the surface with the raiseboring machine.
JULY	Mined underneath Retort 0 on G Level. Completed drifting to No. 2 G Level sump. Mined G Level mechanics shop. Continued drilling Retort 0 blastholes with raisebore machine.

TABLE 2-3-2 (continued)

AUGUST	Completed G Level mechanics shop. Completed G Level electrical substation. AMS dry house burned down. Concreted G Station. Fourth Retort 0 blasthole completed by the raiseboring machine. Resumed shaft sinking.
SEPTEMBER	Started pouring concrete shaft loading pocket. Installed permanent pumps on G Station. Drilled long-hole from G Station area to below final shaft bottom depth. Put one permanent mine air compressor into service.
OCTOBER	Shaft bottomed on 10-8-79 at a total depth of 979 feet. Connected permanent power feeder cable to C Level and G Level. Completed loading pocket concrete pour (over 300 yd^3 total). Removed service-production shaft steel ventilation line and the shaft concrete forms. Started shaft bottom loading and spill pocket steel. Started outfitting the shaft with structural steel.
NOVEMBER	Removed Galloway and Cryderman hoists and sheaves. Installed new shaft collar safety doors. Started installing wooden shaft guides for the two skips. MSHA declared the mine "gassy" (November 30). Permanent G Level mine pumps in operation. Drilling rig started drilling Retort 0 blastholes from the surface. The first of two permanent mine compressors was put into service.
DECEMBER	Completed spill pocket steel installation. Fabricated measuring pocket and chutes. Cut Galloway spill pocket steel installation. Completed shaft outfitting. Completed headframe modifications for the skips. Put new ropes on both hoist drums. The skips were drop tested. Constructed 50 ton ore bin at headframe. The 35 ton ROM haul truck was put into service on Tract C-a. Put Jeffrey main mine fan into service on the ventilation shaft.

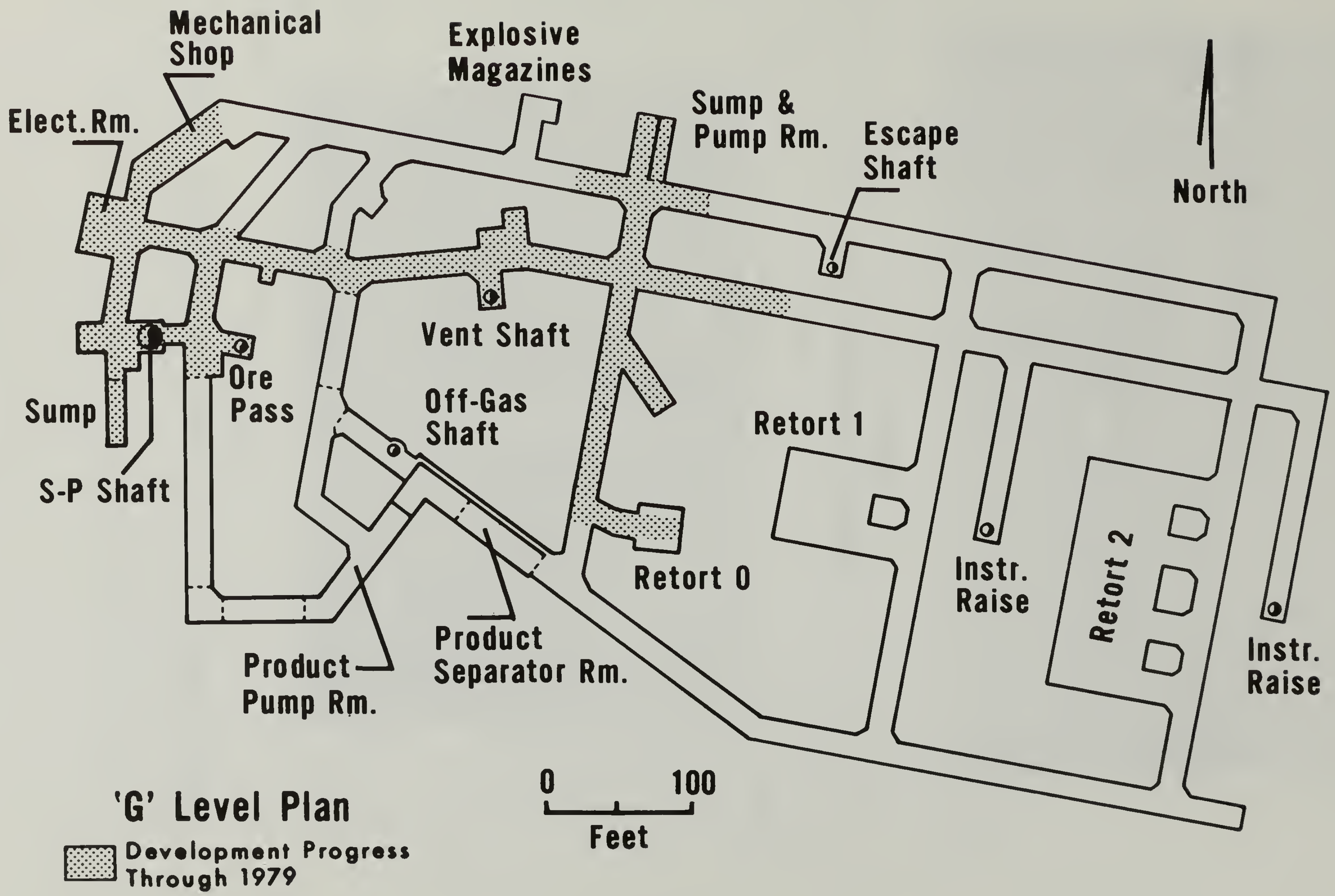


FIGURE 2-3-4

'G' LEVEL DEVELOPMENT PROGRESS THROUGH DECEMBER 1979

12/79

FIGURE 2-3-5

MAIN MINE VENTILATION FAN

FIGURE 2-3-6

VENTILATION SHAFT COLLAR PRIOR TO INSTALLATION OF JEFFREY FAN

A "check in - check out" system for mine atmosphere testing equipment has been put into effect. The "unit number", "time in" and "time out" are noted as well as any defects to the equipment. Minor repairs are made on site by the Safety Department and the units are calibrated at least once a week and so noted in a log book.

B. Control of Mine Gases - Hydrogen sulfide gas liberated from the mine water continued as a potential hazard, but caused no problems as severe as when it was first encountered last year. It has been continually present in many of the working places at levels of 2 or 3 parts-per-million (ppm), well below the Threshold Limit Value (TLV) of 10 ppm. Parts of E Level were "dangered off" (a "danger" sign was hung) since no work on that level was necessary for the remainder of the year.

The presence of methane in the mine has been a problem during the year. Smoking and carrying of smoking materials underground has continued to be forbidden. Small methane bleeders were encountered in the shaft near G Level and on G Level toward the eastern limit of development. Ventilation has, for the most part, held methane concentrations well below the 0.25 percent allowable limit. In early October, flame cutting in the shaft was enhanced by a small bleeder but was quickly extinguished. On November 30, another small ignition of methane in the shaft was again caused by flame cutting and, on this occasion, MSHA declared the mine "gassy". Many of the procedures required for "gassy" mine operation were already being practiced and all the required procedures are now being followed. Diesel and other equipment are being modified as required.

C. Mine Drainage - Total water inflow to the mine has been approximately 1200 gpm. Currently, a bank of pumps on G Level, a bank of pumps on C Level, and a system of submersible pumps comprise the system for pumping water out of the mine.

Most of the water entering the mine comes into E Level drifts and into the ore pass and ventilation shaft in the first few tens of feet below E Level. This vertical interval represents the bottom of the Upper Aquifer.

Of the five dewatering wells described in last year's report, only one, D-5, is still pumping. The other four, D-1, D-2, D-3 and D-4 have ceased to be productive because of the loss of head. Dewatering is discussed in more detail in Section 5, Chapter 3.

D. Power - The decision was made during the past year to bring both parallel permanent 4160 volt mine electrical feeders down boreholes rather than down the shaft. Accordingly, one of these boreholes has been drilled to G Level (intersecting C Level), cased, and the power line installed. The second borehole and feeder will be put in place in 1980, thus looping the system.

In May, the 2500 KW O'Brien generator was put into standby service. In the event of a power outage this unit would be manually started and would provide enough power for ventilation, pumping, hoisting and some other minor functions to continue until the line power was restored. The unit is tested once each week.

3.4 MINE SAFETY

A. Mine Rescue - The Mine Rescue Program has been upgraded with the purchase of four new Drager self-contained breathing apparatus making a full complement of ten units. An RZ-25 testing unit and a Haskell oxygen pump have been installed to keep the units in a state of constant readiness. The Haskell oxygen pump is also used to fill medical oxygen cylinders for the ambulances.

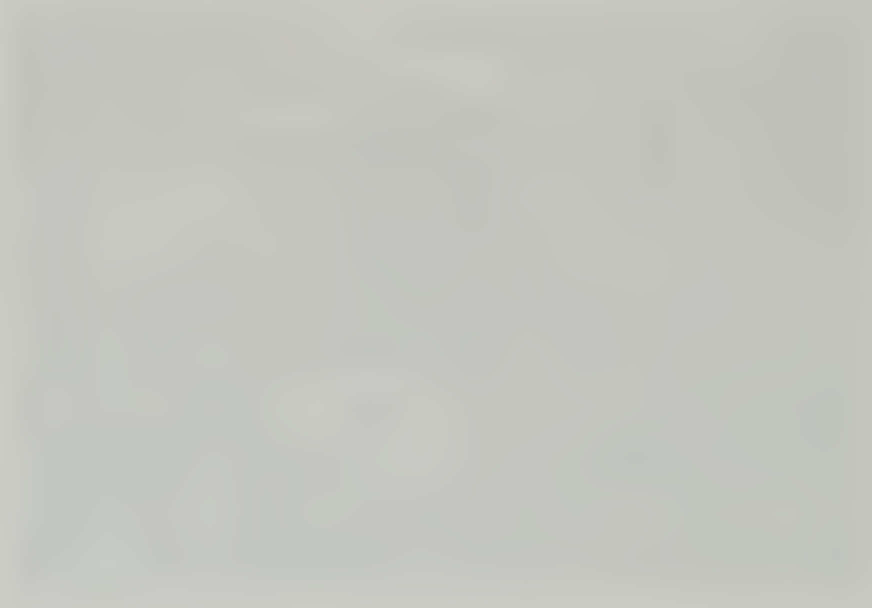
The Mine Rescue Training Room and the first aid stations have been completed. Figure 2-3-7 shows the Mine Rescue Training Room.

Miners self-rescue units are physically checked and weighed monthly to assure the units are in good working order. Results of the inspection are logged and filed in the Safety Department. Damaged units are used for self-rescuer training.

FIGURE 2-3-7
MINE RESCUE TRAINING ROOM

B. Mine Emergency - A positive identification system for persons working underground has been implemented. The miner's name and social security number are engraved on a tag that is riveted to the miner's belt. This is used in conjunction with the mine "log in" and "log out" board on the surface.

Fire extinguishers and first aid kits have been placed in strategic locations on each level underground. Mine maps showing the direction of ventilation and the route to the surface have also been placed on each level. A routine check program is in existence and fire extinguishers are recharged on tract by trained tract personnel.



SECTION III

PROCESSING

CHAPTER 1

MDP DESIGN

1.1 DESIGN BASIS

In April 1979, permission was received from the AOSO to commence construction of the scrubber blowdown and sour water evaporation ponds. Construction progress is described in Chapter 2 of this section.

As a result of the approved modification to the method of construction and configuration of the MDP retorts (discussed in Section 2, Mining), changes were made in the equipment used for retort ignition, combustion and quenching. One of the multiple uses of some of the blastholes will be for retort ignition and burn control.

Originally, a single hole from the surface to the roof of the retort was intended to supply the following from the surface:

- Gas from an inert gas generator - used for initial heating
- Combustion air supplied from a compressor - to support retort burn
- Steam from a boiler - used for temperature control of retort burn
- Quench water - to control inert gas temperature

It is now planned to use some of the vertical blastholes for downhole burners and injection of air, steam and water. Since several blastholes will be used for Retorts 1 and up, the piping will be manifolded on the surface for distribution to each hole. Different methods for establishing ignition will be evaluated during the MDP. These include stoichiometric and excess air combustion.

This modification does not cause any change in the MDP estimated stack emissions data as incorporated in the PSD permit issued by the EPA in December 1977.

Quench air and/or steam will be used to control gas temperature during ignition. The use of retort water for quenching will be evaluated and tested during the MDP.

Retorts 0 and 1 will be burned at the highest rate consistent with temperature control and good yield. Subsequent retort(s) will be burned at the same or a lower rate depending on their cross-sectional area, changes in other variables in developing the retort, and experience gained from prior retorts. The retorts can still be burned under positive or negative pressure, or a combination of both.

The mine was designed to keep retort water from mingling with mine seepage water. This is accomplished by the installation of bulkheads and construction of separate collection drifts and pumping facilities.

The maximum daily oil yield from Retorts 0, 1 and 2 is estimated to be 750 BPSD. Total oil recovery for these three retorts is estimated to be about 50,000 barrels. No changes have been made to the product recovery and handling systems as a result of the mining modification.

1.2 FUTURE PLANS

If RBOSC's MIS developmental program is successful, an efficient surface (aboveground) retorting process is needed to process the mined 40 percent fraction from the in situ retorts brought to the surface during MIS development. If the MIS program is unsuccessful for any reason, then a surface retorting process is a fallback position for development. Surface retorting is critical for both development scenarios.

During the last quarter of 1979, RBOSC was negotiating with the Lurgi Corporation for the first phase of a program for the design, construction and operation of a Lurgi-Ruhrgas surface oil shale retort. To prove the aboveground Lurgi retorting process, RBOSC plans a three-phase program. Phase I will include the process design and a definitive cost estimate for the two subsequent phases. It is expected to require twelve months to complete at which time a go-ahead decision on Phases II and III would be made. Phase II would encompass the detailed design of the plant and is currently estimated to be 33 months. The final phase would be the operation of the demonstration plant and would last for 18 months. Agreement with Lurgi is expected to be reached in early 1980.

CHAPTER 2
PROCESSING FACILITY CONSTRUCTION

Ruscon, Becon and Associates (RBA) was awarded the below grade level construction contract for the Processing Facility's concrete foundation, underground piping and electrical distribution ducts. RBA commenced field work in September of 1978 and completed this phase in April 1979. Under separate contract RBA was also awarded the construction contract to provide three Processing Facility buildings: 1) the Boiler Water Treatment Facility; 2) the Motor Control Center (MCC); and 3) the Control Room Building.

Construction for these three buildings began in May 1979 and was completed by August 1979. Figures 5-6-1, 5-6-2 and 5-6-3 (Section 5, Chapter 6, Buildings) show these three buildings completed.

The construction bid package for the aboveground Processing Facility was awarded to The Industrial Company of Steamboat Springs (TIC) and the contractor mobilized in April 1979. Work began soon after and the surface facility was 95 percent complete by year-end 1979.

An overview of the Processing Facility is shown in Figure 3-2-1 (located to the east (left) of the headframe). Other overviews were presented in Section 1. See Figures 1-2-9 through 1-2-11. (A functional description of the Processing Facility, including a flow diagram, was given in the first APR, September 1977 - December 1978.)

Figure 3-2-2 shows the low Retort Offgas Booster Compressor which takes suction off the bottom of the retort.

Figure 3-2-3 shows the Retort Offgas Refractory Lined Incinerator (left) and Quench Tower. The incinerator oxidizes the hydrogen sulfide in the low Btu gas to sulfur dioxide prior to entering the Retort Offgas Scrubber. An end-view of the incinerator is shown in Figure 3-2-4 (the

Quench Tower is seen in the background). The Quench Tower with the top duct going to the Retort Offgas Scrubber (Venturi Scrubber) is shown in Figure 3-2-5.

Figure 3-2-6 shows the Retort Offgas Scrubber where the sulfur dioxide is scrubbed from the flue gas by reaction with soda ash and recycled sodium sulfite. The scrubber is designed to remove 90 percent of the sulfur dioxide from the flue gas before it is emitted to the atmosphere. The 200 ft. scrubber stack is shown in Figure 3-2-7. An Emergency Flare Stack, used to burn the retort offgas during an upset condition of the incinerator-scrubber, is shown in Figure 3-2-8.

The Plant Steam Generator Boiler is shown in Figure 3-2-9. This boiler has a capacity to generate 65,000 lbs/hr steam at 120 psig. The 100 ft. boiler stack is shown in Figure 3-2-10.

Additional views of the Processing Facility are shown in the following figures:

- Figure 3-2-11, Processing Facility Structures - Emergency Flare Stack; Steam Generator Stack, Scrubber Stack; Soda Ash Storage Tank; Scrubber, and Quench Tower
- Figure 3-2-12 - Knockout Drum
- Figure 3-2-13 - Boiler Feedwater Storage Tank
- Figure 3-2-14 - Processing Plant Pipe Rack and Condensate Collection Tank
- Figure 3-2-15 - Soda Ash Storage Tank
- Figure 3-2-16 - Processing Plant Control Room

A separate contract for the construction of three scrubber blowdown evaporation ponds and one sour water evaporation pond was awarded to R. N. Robinson and Sons, Inc. in August 1979. Construction of these four ponds was scheduled for completion by November 1979, however early snowfall prevented the installation of two of the pond liners. Completion of construction will probably occur after mid-April 1980. The four ponds will be lined with high grade laminated polymer-coated fabric liners to make them leak-proof. A gravel pack and pipe collection system was installed beneath the pond liners to monitor and ensure the leakproof construction of these ponds. The blowdown from the Scrubber will be pumped to the three scrubber evaporation ponds for disposal. These three ponds have a volume capacity of 873,800 cubic feet. The sour water formed during the retort burn period will be disposed of in the 267,500 cubic feet sour water evaporation pond. The liner placed during pond construction is shown in Figure 3-2-17. The four ponds are shown in the top left part of Figure 3-2-1 and also in Figure 1-2-8.

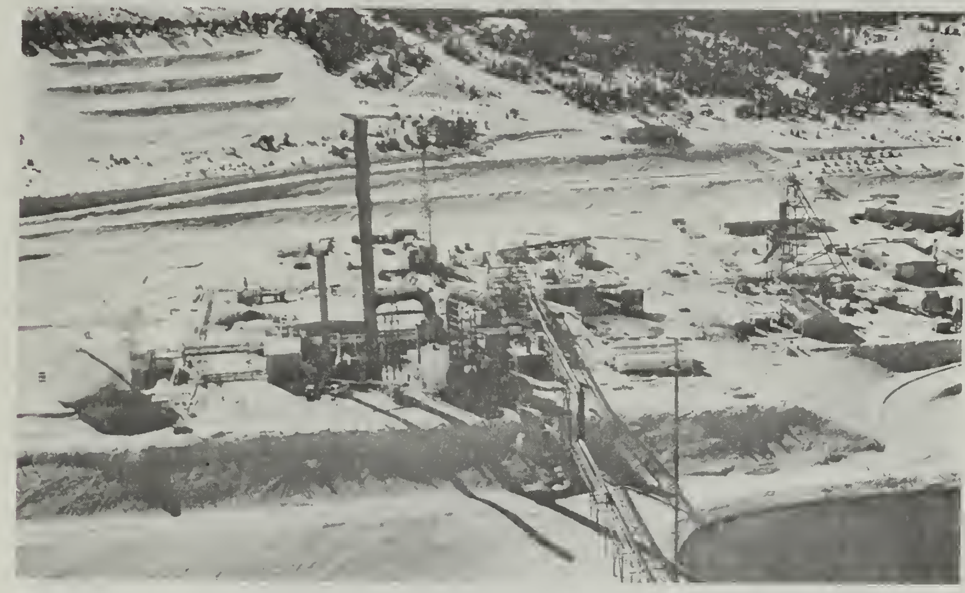


FIGURE 3-2-1
PROCESSING FACILITY OVERVIEW

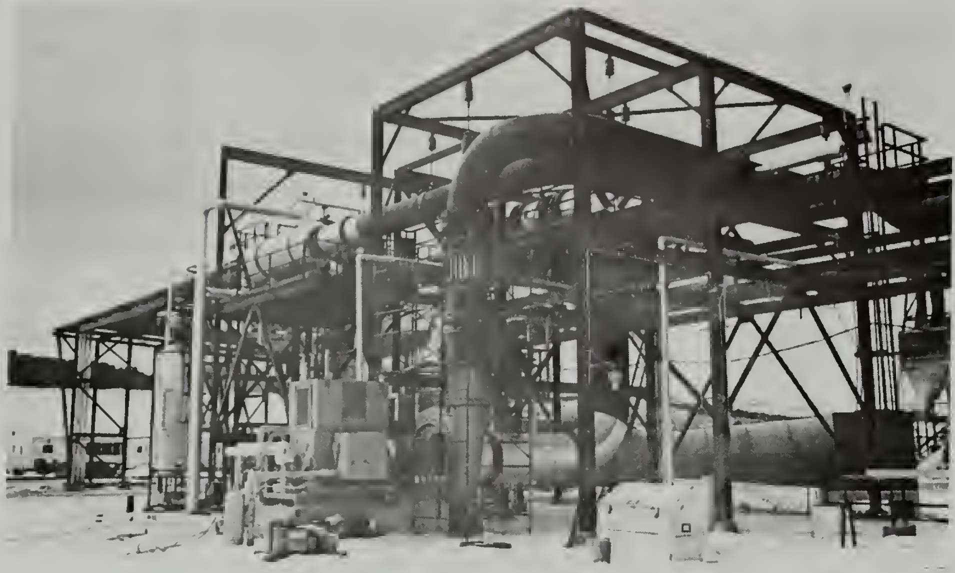


FIGURE 3-2-2
RETORT OFFGAS BOOSTER COMPRESSOR

FIGURE 3-2-3
RETORT OFFGAS INCINERATOR (LEFT) AND QUENCH TOWER

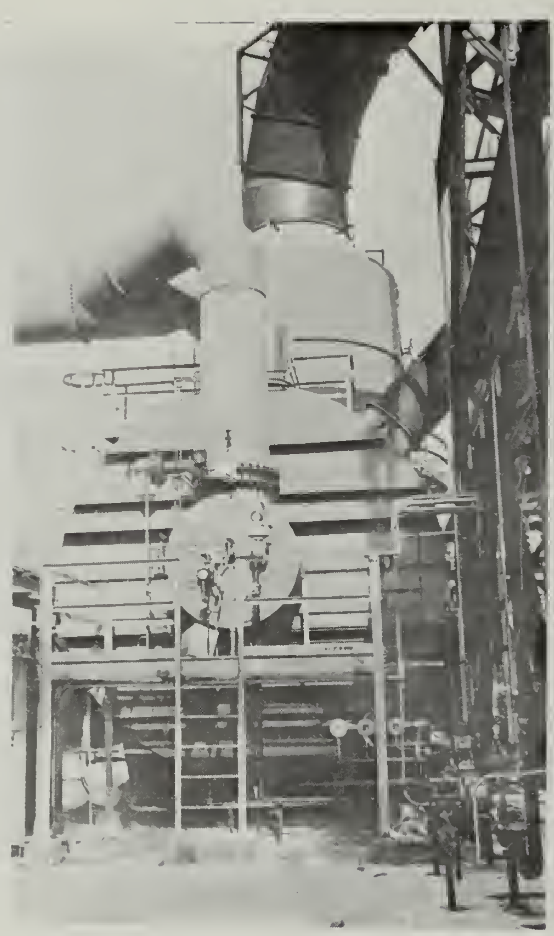


FIGURE 3-2-4
RETORT OFFGAS INCINERATOR

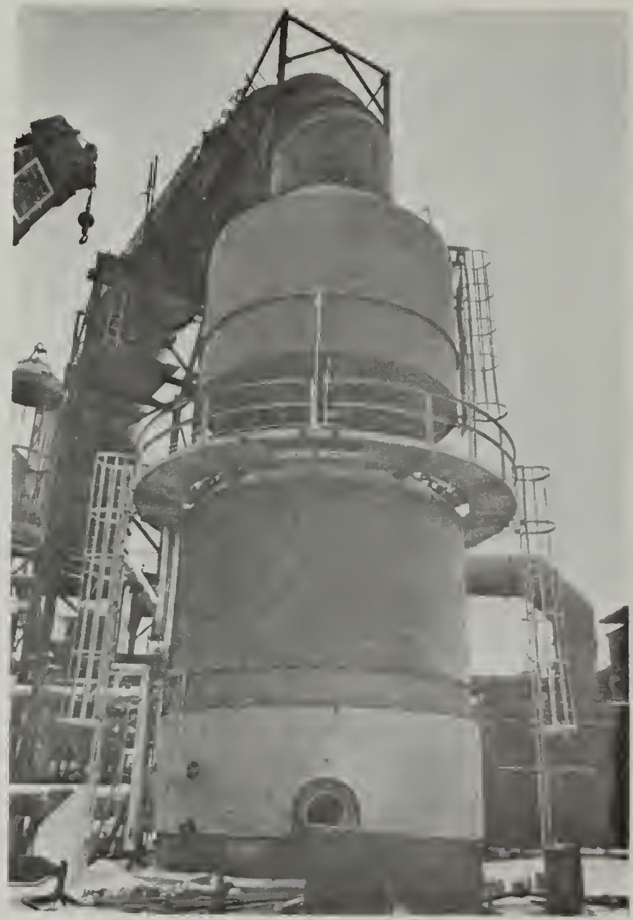


FIGURE 3-2-5
QUENCH TOWER

FIGURE 3-2-6
RETORT OFFGAS SCRUBBER

FIGURE 3-2-7
200 FT. SCRUBBER STACK (CENTER)

FIGURE 3-2-8
ELEVATED PIPELINE AND EMERGENCY FLARE STACK

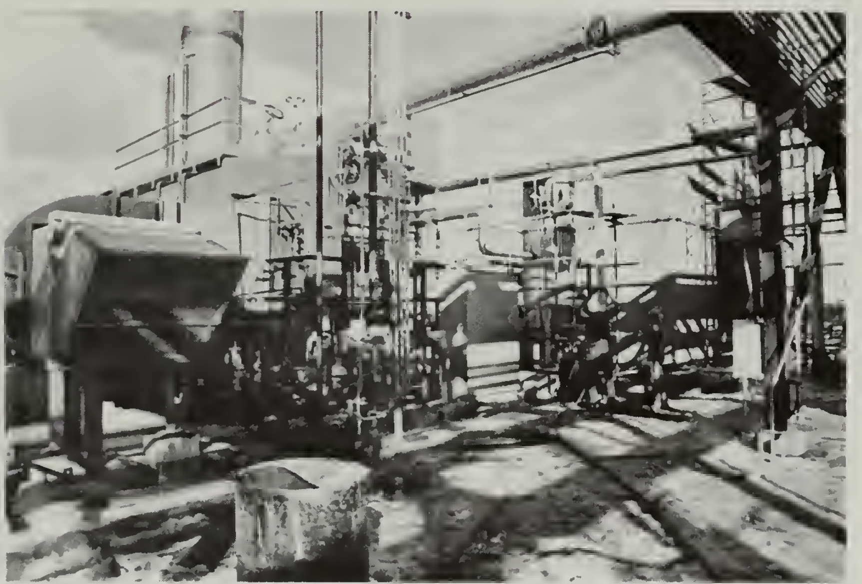


FIGURE 3-2-9
PLANT STEAM GENERATOR

FIGURE 3-2-10

STEAM GENERATOR BOILER STACK

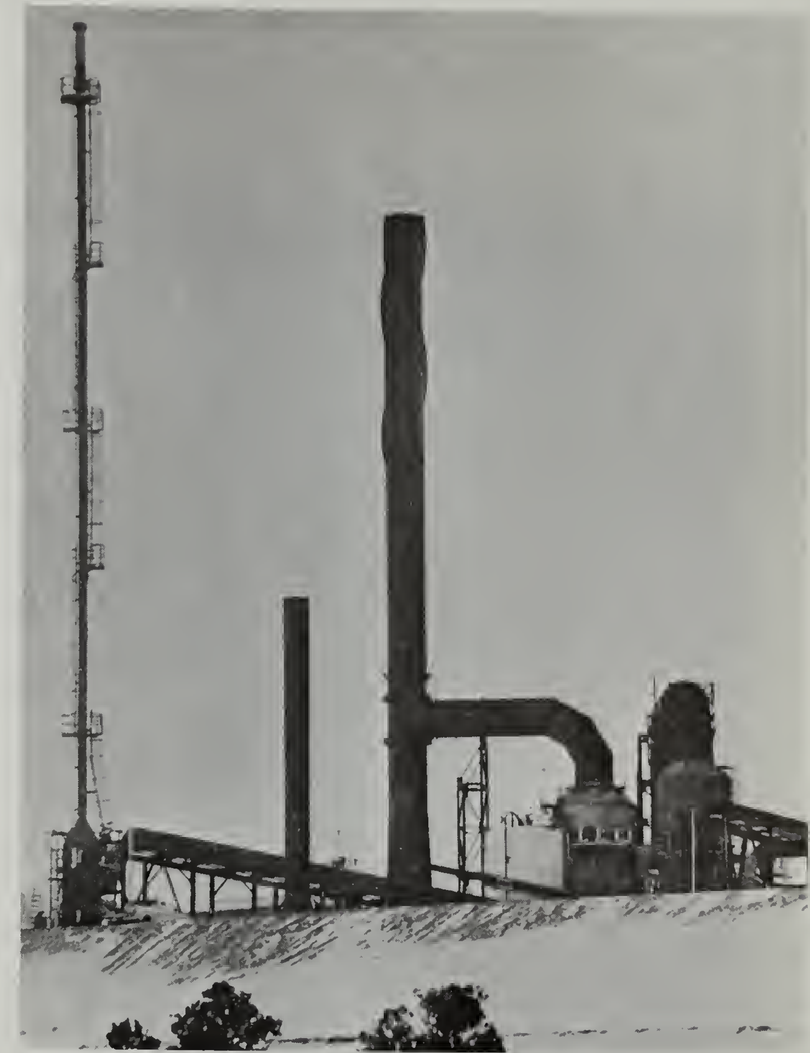


FIGURE 3-2-11

EMERGENCY FLARE STACK, BOILER STACK, SCRUBBER STACK, SODA ASH STORAGE TANK, SCRUBBER, AND QUENCH TOWER (L. TO R.)

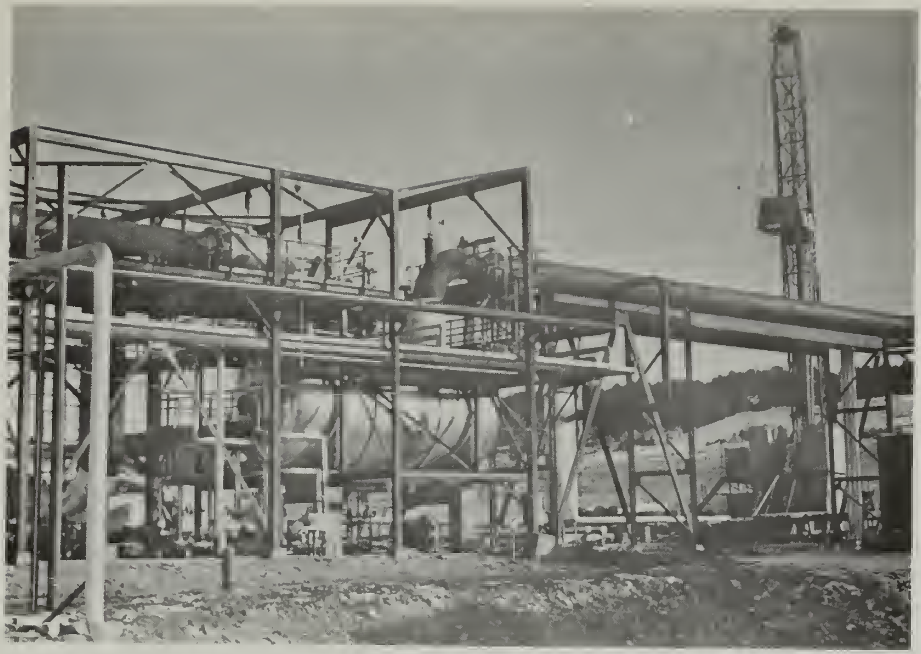


FIGURE 3-2-12
KNOCKOUT DRUM

FIGURE 3-2-13
BOILER FEEDWATER STORAGE TANK

FIGURE 3-2-14

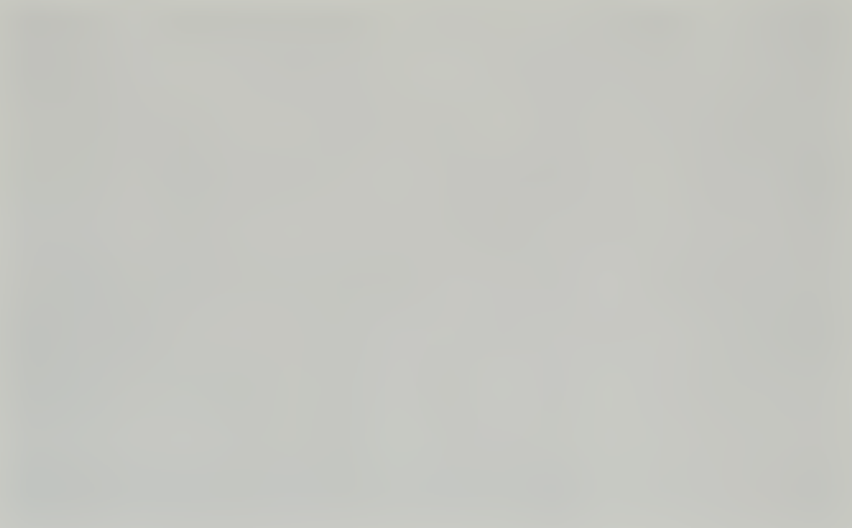
PROCESSING PLANT PIPE RACK AND CONDENSATE COLLECTION TANK

FIGURE 3-2-15

SODA ASH STORAGE TANK (FOREGROUND)

FIGURE 3-2-16
PROCESSING PLANT CONTROL ROOM

FIGURE 3-2-17
RETORT SOUR WATER POND CONSTRUCTION



SECTION IV

ORE STORAGE

CHAPTER 1
ORE STORAGE

The run-of-mine (ROM) ore storage area was reworked during 1979. The roads to the storage area and to the Hunt Club Offices were rerouted to facilitate the storage pile construction according to specified procedures. The ultimate pile size will be slightly smaller than originally designed because of the change in mine development. Less tonnage will be hoisted for the three planned MIS retorts than for the original five retorts.

Plans were developed in conjunction with the USGS and EPA to construct a leachate collection system (lysimeter) under a portion of the run-of-mine ore pile. Results of the ROM leachate study should provide information on the characteristics of leachate from stockpiled raw oil shale.

[illegible]

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SECTION V

SUPPORT FACILITIES

CHAPTER 1
TRANSPORTATION

During the late spring and early summer of 1979, Rio Blanco County improved the existing 13 mile portion of County Road 24 by paving it with asphalt from the tract east to Piceance Creek Road. Funds were provided by the state from the Oil Shale Trust Fund. The paving was completed in July 1979.

After completion of the paving of the county road, the contractor was retained by RBOSC to pave the 1½ mile Tract C-a access road from the eastern Tract C-a boundary near the visitors center up to the construction site. A total of 3,174 tons of asphalt was used to pave the 26 ft. wide, two lane access road to a thickness of 3½ inches. The road shoulders were then covered with gravel. Additional guard rails, as required by MSHA, were installed during 1979. The access road is shown on Figure 5-1-1.

A portion of Airplane Ridge Road was rerouted during the summer and fall of 1979. This was done to improve the road alignment and avoid the scrubber blowdown pond construction area. The realignment was done concurrently with the pond construction using fill material obtained from the pond. Public use of the road was never impeded. Road work started in August 1979 and was completed in December 1979.

A 5,000 foot, 50 foot wide unpaved private airstrip capable of landing general utility twin-engine planes was built in the fall. Construction started in October and was completed in December. The airstrip is <u>not</u> open to public use, but is available to federal, state and local governmental officials for use in the course of their official duties, or for activities related to Tract C-a operations. It is located just northeast of Tract C-a on 84 Mesa and is less than a ten minute drive to the tract entrance.

The 84 Mesa location was the best choice taking into consideration terrain, proximity to the tract, prevailing wind direction, and minimum wildlife disturbance. The airstrip's orientation was crossed by a secondary county road. In October 1979, RBOSC reached an agreement with the Rio Blanco County Commissioners whereby RBOSC agreed to reroute the county road around the airstrip and assume liability arising out of construction, operation and maintenance of the road and airstrip. A right-of-way (C-27351 RW) was then obtained from the BLM in October.

Figure 5-1-2 shows the location of the airstrip relative to Tract C-a. Figure 5-1-3 shows the berms of the airstrip being reclaimed immediately upon completion of construction.

FIGURE 5-1-1
TRACT C-a PAVED ACCESS ROAD

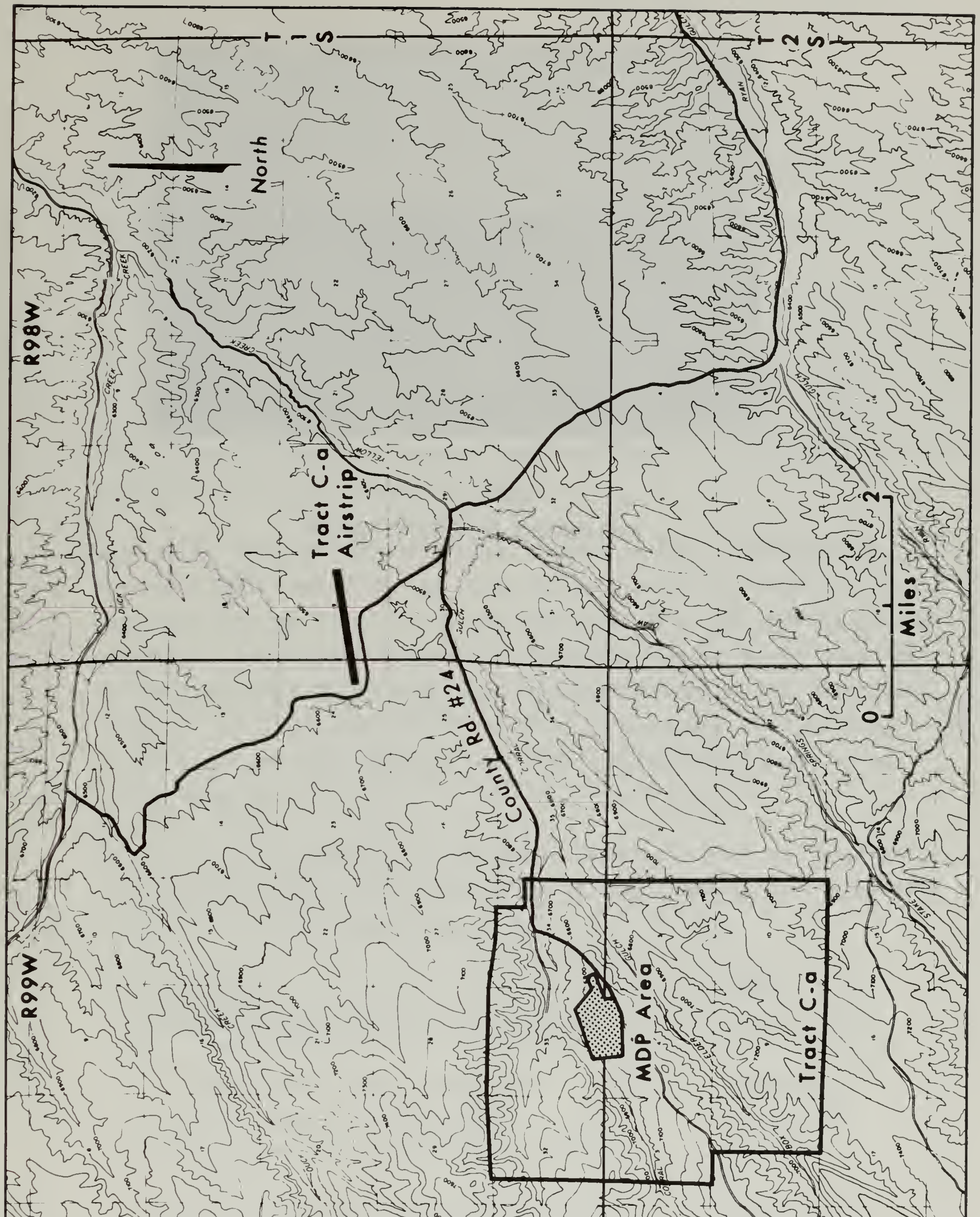


FIGURE 5-1-2

LOCATION OF TRACT C-a AIRSTRIP

FIGURE 5-1-3
RECLAMATION OF AIRSTRIP BERMS

POWER SUPPLY AND DISTRIBUTION

2.1 ELECTRICAL

Tract C-a power requirements are met by a 138 KV transmission line owned by Moon Lake Electric Association, Inc. The site's permanent electrical distribution system was completed in October 1979, with the last feeder being pulled from the substation switchgear to the Processing Area.

Presently there are six main feeders from the substation to the site. The Mine and Processing Area have two each (one energized and one spare) to facilitate emergency use and scheduled maintenance of switchgear. Also, the site buildings and dewatering wells have separate feeders. Construction is underway to install separate interrupter switches for each building so each can be shut down individually. Completion is scheduled for January 1980.

Moon Lake's temporary substation was removed in April 1979 when the permanent RBOSC substation was ready for commissioning. This activity coincided with the final run-in and commissioning of the 2500 KW standby generator. The standby generator is presently used to supply power to key tract areas, mainly the Mine and Processing Area, during electrical outages. It is exercised weekly to keep it in a state of readiness. All operators and key personnel have been trained in the start-up of this generator.

The last temporary generator was removed in October upon the termination of an electric feeder line to the tract telephone microwave. Major 1979 electrical activities are listed below:

MILESTONE	DATE
Completed most concrete work (pads and conduit runs)	January 1979
Finished backfilling conduit runs	February 1979
Permanent substation energized	April 1979
Standby generator (2500 KW) energized and run-in	May 1979
Finished mine power center installation	October 1979
Pulled final feeder from substation to site (to Processing Plant Area)	October 1979

2.2 NATURAL GAS

The Western Slope Gas Company extended their feeder pipeline to Tract C-a during 1979. Most of the on-tract construction occurred during July. The pipeline enters the tract on the eastern boundary (Figure 1-2-4) and extends to the Mine and Processing Plant area. An existing dewatering-reinjection pipeline corridor was utilized for the gas pipeline in order to minimize environmental damage. Less than one acre of vegetation was disturbed on Tract C-a for the natural gas line installation.

A metering station (Figure 5-2-1) was installed just north of the construction site security building. The high pressure gas is reduced to low pressure and distributed in a 4-inch diameter pipeline to the Processing Facility and in a 3-inch diameter pipeline to the various buildings as shown on Figure 5-2-2. The gas is used for heating and in processing operations.

FIGURE 5-2-1
NATURAL GAS METERING STATION

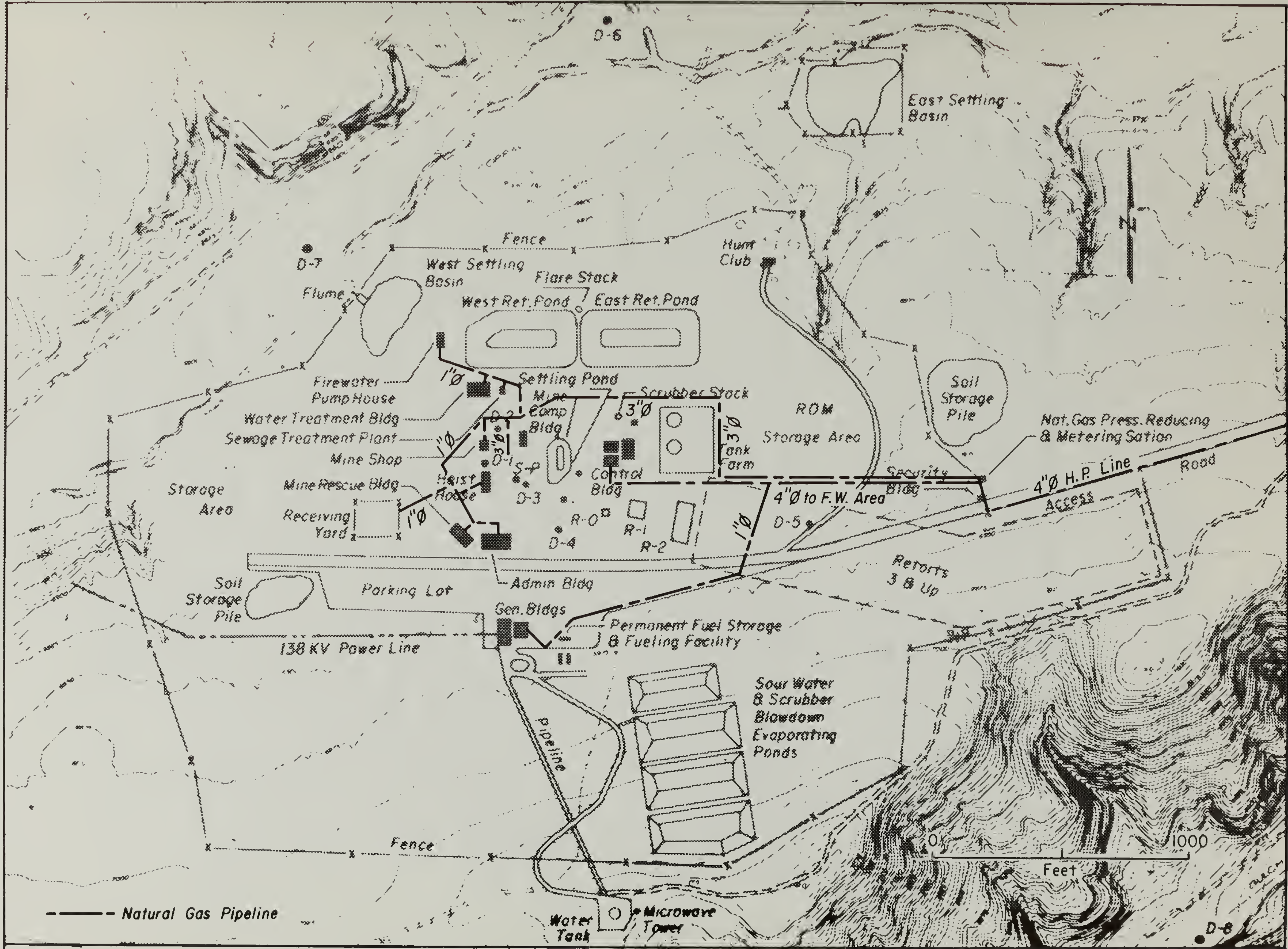


FIGURE 5-2-2
NATURAL GAS PIPELINE ROUTING

CHAPTER 3
WATER MANAGEMENT AND QUALITY CONTROL

3.1 GENERAL CONCEPT

RBOSC's water management and quality control plans, as revised by the AOSO's approvals of April 11 and August 31, 1979, presented RBOSC's concept for water handling during the MDP. The April approval was for the water management system as presented in Section 5, Chapter 3 of the first APR. This plan for water handling continued to be used during part of 1979. The August approval covered the Sub-E Level drainage gallery.

As mine development and mine dewatering operations progressed through 1979, new information on the quantity and quality of the Upper Aquifer water was obtained which necessitated further modification of these plans. The major changes requiring approval by the AOSO and permitting agencies relate to dewatering and reinjection operations, surface water discharge and related monitoring.

Adjustments are proposed to the water control system for the MDP to now include continuous and intermittent water discharges under an NPDES permit to naturally existing surface drainage courses. This represents a change from RBOSC's original plan which was based on the concept of total zero discharge. However, this change away from the total zero discharge concept relates only to good quality groundwater, resulting from dewatering the MDP mine area, and incorporates no change with respect to the poor quality process streams. The modified plan incorporates the objectives and principal features of RBOSC's augmentation plan and retains the objectives of controlling spread of the cone of depression and minimizing environmental impact. New off-tract monitoring facilities will be added to the present system to monitor the hydrologic effects of the increased dewatering and reinjection.

Figure 5-3-1 shows the MDP proposed water management system, as of December 1979.

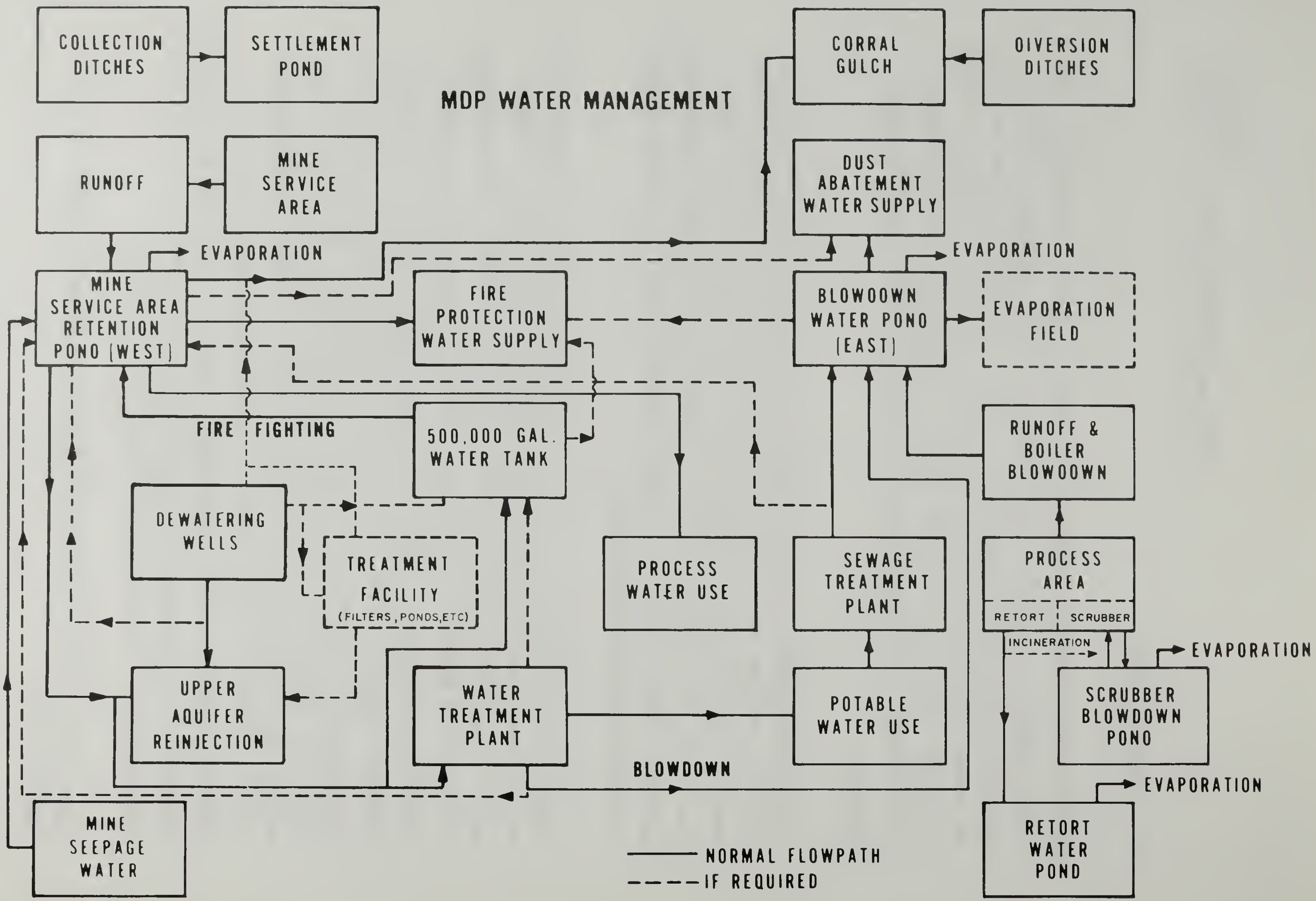


FIGURE 5-3-1

PROPOSED MDP WATER MANAGEMENT SYSTEM

3.2 STATUS

A. Potable Water Plant

Construction of Tract C-a's 25,000 gallon per day reverse osmosis potable water plant was completed in March 1979. In March, all tract potable water lines were sanitized with 50 parts-per-million chlorine. In early April 1979, RBOSC commissioned the potable water system using water hauled in from the City of Meeker. Water was hauled in because of the high solid and H_2S content of the dewatering water which was designed to feed water to this plant. Additional filters and coagulant feed lines were installed in order to make the plant operational with the dewatering water. After a three week experimentation period in August 1979, the system was observed as being too costly with respect to operation expense (mainly chemicals and filters used). Presently, RBOSC is working to use injection water which has been aerated and settled as the feed stream to this plant. The potable water plant has been inspected by the State of Colorado, but has not yet been classified since RBOSC is not producing its own water.

B. Seepage Water Plant

In late March 1979, Rio Blanco discontinued use of the seepage treatment plant. This was a result of a change in the dewatering and reinjection system whereby mine water is discharged in the West Retention Pond and is aerated and settled prior to reinjection or discharge. The plant is presently only used intermittently to supply some water for testing or taking the load off the West Retention Pond.

C. Dewatering and Reinjection

The water management plan for mine dewatering has as its goal the elimination of mine inflow to retorts while minimizing environmental impact and abiding by the plan for augmentation to protect other water users rights.

Reinjection was chosen as the method of augmentation - that is maintaining water levels in the Upper Aquifer, for neighboring water users, through reinjection of water from mine seepage and dewatering wells.

During the planning stages for the MDP, the original study for the reinjection system resulted in plans for 22 reinjection wells on tract, some located within 3,000 feet of the mine in the direction of maximum permeability. This was based on the assumption that significant mine inflow to the shafts and retorts would be tolerated. Since that time process requirement has limited the inflow to the retorts to about 10 gpm, or less than one percent of the present mine inflow. Analyses of the original system, in light of the new requirements for basically dry retorts, have demonstrated that the original plan is not feasible and the reinjection wells would have to be much further away. Dewatering wells should be located where the first line of reinjection wells were originally located. The construction of such an expanded reinjection system to handle the large volume of water anticipated from the mine drainage gallery would be prohibitively expensive for the short time it would be used. As a result, RBOSC has been working to modify the water management plan to dispose of excess mine water from the drainage gallery by surface discharge into Corral Gulch and to pump groundwater obtained from dewatering wells directly to the reinjection wells.

This new plan also calls for four new dewatering wells (D-6, D-7, D-8 and D-9) located 2,000 to 3,000 ft. from the mine and two new reinjection wells (GS-20 and GS-21) located in the southeast corner of the tract. Wells D-8 and D-9 were drilled in December 1979. The location of the wells are shown in Figure 5-3-2.

In 1979, RBOSC tested the feasibility of recharging the Upper Aquifer by surface spreading the discharge water in a small gulch to the north of the tract. The Surface Induced Recharge (SIR) test ran for three months during the summer. The results indicated that while portions of the alluvium were saturated, the Upper Aquifer did not respond significantly to the recharge in the limited time of the test.

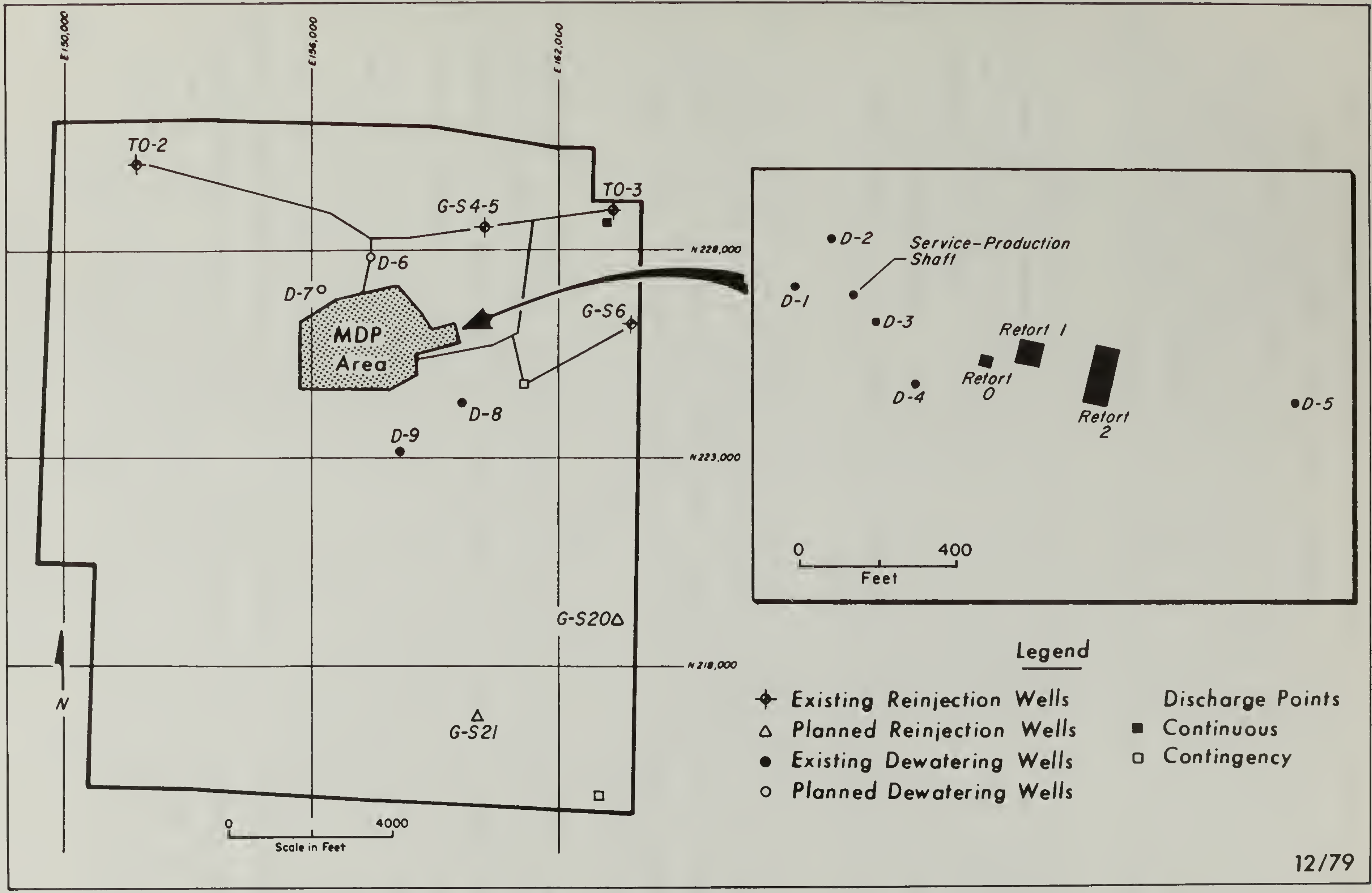


FIGURE 5-3-2

TRACT C-a DEWATERING-REINJECTION PROGRAM

Mine dewatering was accomplished through the use of three sumps in the mine and a system of five dewatering wells (D-1, D-2, D-3, D-4 and D-5). Four of these wells ceased to produce water during the year as initial dewatering reduced the operating head to levels below which the wells could produce water. Only D-5 remained pumping. (See also Section 2, Chapter 2.3.C.) The total water production from dewatering over the two year period since the pumps were turned on is shown in Figure 5-3-3.

Surface discharge has been required during the last year because the capacity of the reinjection system was exceeded; however, in November and December surface discharge was not required. The total reinjection over the two year period is also shown in Figure 5-3-3. Water was reinjected into four wells: G-S 4-5, G-S 6, TO 2 and TO 3. Reinjection was suspended in February and reinitiated in September in only three of the wells (G-S 4-5, G-S 6 and TO-3) to reduce mine recycling.

The total amount of water produced during the year was 935 acre feet. Of this amount, 258 acre feet was reinjected, 661 acre feet was discharged and 19 acre feet was consumed. There was an apparent loss of 2 acre feet through evaporation. Table 5-3-1 is a monthly summary of water production and disposition.

Four holding ponds on Tract C-a were utilized for temporary or permanent storage of various water sources associated with the development activities during the year. Mine seepage water was discharged into a headframe pond for initial settling during shaft construction and pumped from this pond into the West Retention Pond. The well production and surface runoff from the mine area were also collected in the West Retention Pond where it is stored until needed for reinjection, discharge to Corral Gulch, or consumptive use (fire, storage and drilling water). The East Retention Pond is an evaporation pond used for treated sewage and blowdown to be produced from future operations. A settling pond, located adjacent to the main ventilation fan, was established in the fall. This pond is used for settling of drill cuttings from the surface drill hole program and settling of construction site drainage of rain and snow melt.

CUMULATIVE VOLUME OF WATER PUMPED AND REINJECTED

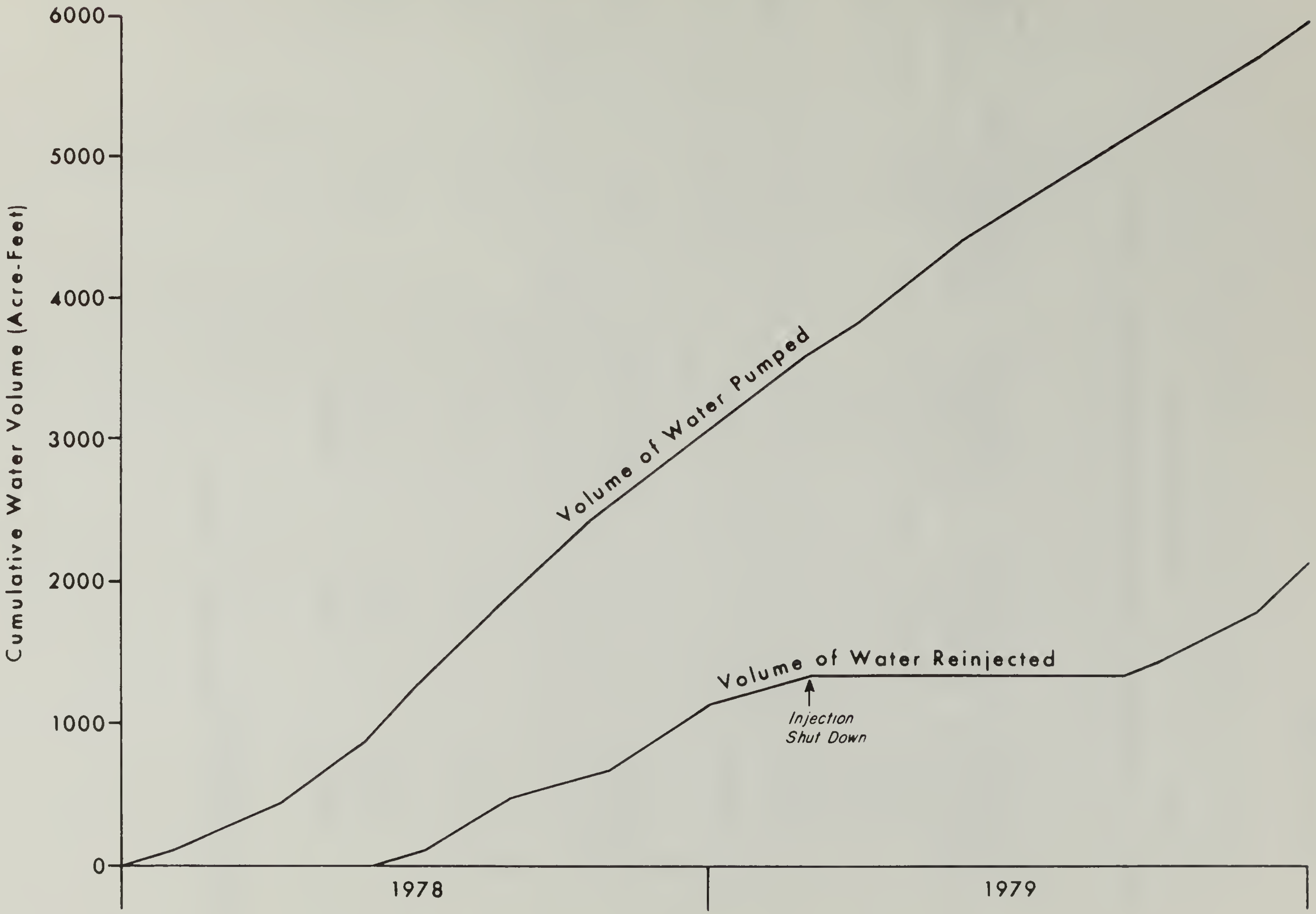


FIGURE 5-3-3

CUMULATIVE VOLUME OF WATER PUMPED AND REINJECTED, 1978-79

TABLE 5-3-1

SUMMARY OF WATER PRODUCTION AND DISPOSITION

		Production Gallons 10^6	Reinjection Gallons 10^6	Discharge Gallons 10^6	(-) Losses/ (+) Accumulation Gallons 10^6	Consumptive Use Gallons 10^6
January		89.0	55.3	38.6	- 4.9	0
February		80.4	37.7	45.3	- 2.6	0
March		92.0	--	92.0	0	
April		83.0	--	81	0	2.0
May		82.1	--	78.9	+ 2.9	.3
June			--			
July	*	220.9	--	159.6/71.4**	-14.1	4.0
August			--			
September						
October	*	212.6	97.5	93.8	+12.1	9.2
November						
December		75.2	67.4	.1	+ 4.5	3.2
		935.2	257.9	660.7	- 2.1	18.7

* Three months accumulation
** Corral Gulch/SIR Gulch (Duck Creek) Tributary

CHAPTER 4
COMMUNICATIONS

During most of 1979, RBOSC utilized a six channel microwave telephone system. The microwave towers were spaced between the job site and Grand Junction with the local tract exchange being a Grand Junction number. In October 1979, Mountain Bell commenced installation of an 18 line telephone system from Meeker to the tract. The buried system roughly follows Colorado Highway 64, Rio Blanco County Road 5 (Piceance Creek Route) and County Road 24 (Ryan Gulch Road). The tract PBX system was then upgraded by the General Services contractor to 30 trunks and an 80 line capability. The tract microwave system was deactivated on December 4, when the permanent telephone system of Mountain Bell from Meeker, Colorado was put into service.

As of the end of 1979, utilization of all 18 lines was not available as Mountain Bell was going through a start-up/de-bugging process. A separate storage room was constructed in the Administration Building to house Mountain Bell's on-site equipment.

By the end of the year, preparations were underway to install a Unicom VHF communication system whereby a pilot can call the tract and obtain information on the condition of the airstrip prior to landing.

CHAPTER 5

STORAGE AND DISTRIBUTION OF FUEL AND OTHER SERVICE PRODUCTS

Figure 5-5-1 is a location drawing for the four permanent and seven other fuel tanks located in the MDP construction and operations area. All permanent tanks are located underground and were installed during April 1979. The table below identifies the tanks and gives their usage and capacities.

	Location	Capacity (Gallons)
1.	Generator Substation - Unleaded (Underground)	10,000
2.	Generator Substation - Regular (Underground)	10,000
3.	Generator Substation - Diesel (Underground)	20,000
4.	Parking Bench - Unleaded	5,000
5.	Parking Bench - Diesel	10,000
6.	Parking Bench - Diesel	5,000
7.	Administration - Diesel (Underground)	10,000
8.	Mine Air Compressor - Diesel	10,000
9.	Mining/Shaft Sinking Contractor - Diesel	10,000
10.	Mining/Shaft Sinking Contractor - Regular	5,000
11.	Mining/Shaft Sinking Contractor - Unleaded	4,000

An estimate of the gasoline and diesel usage by quarter at Tract C-a for 1979 is given as follows:

Quarter - 1979	Gasoline (Gallons)	Diesel (Gallons)
1st	43,409	16,430
2nd	42,559	64,304
3rd	46,115	80,792
4th	44,452	66,638

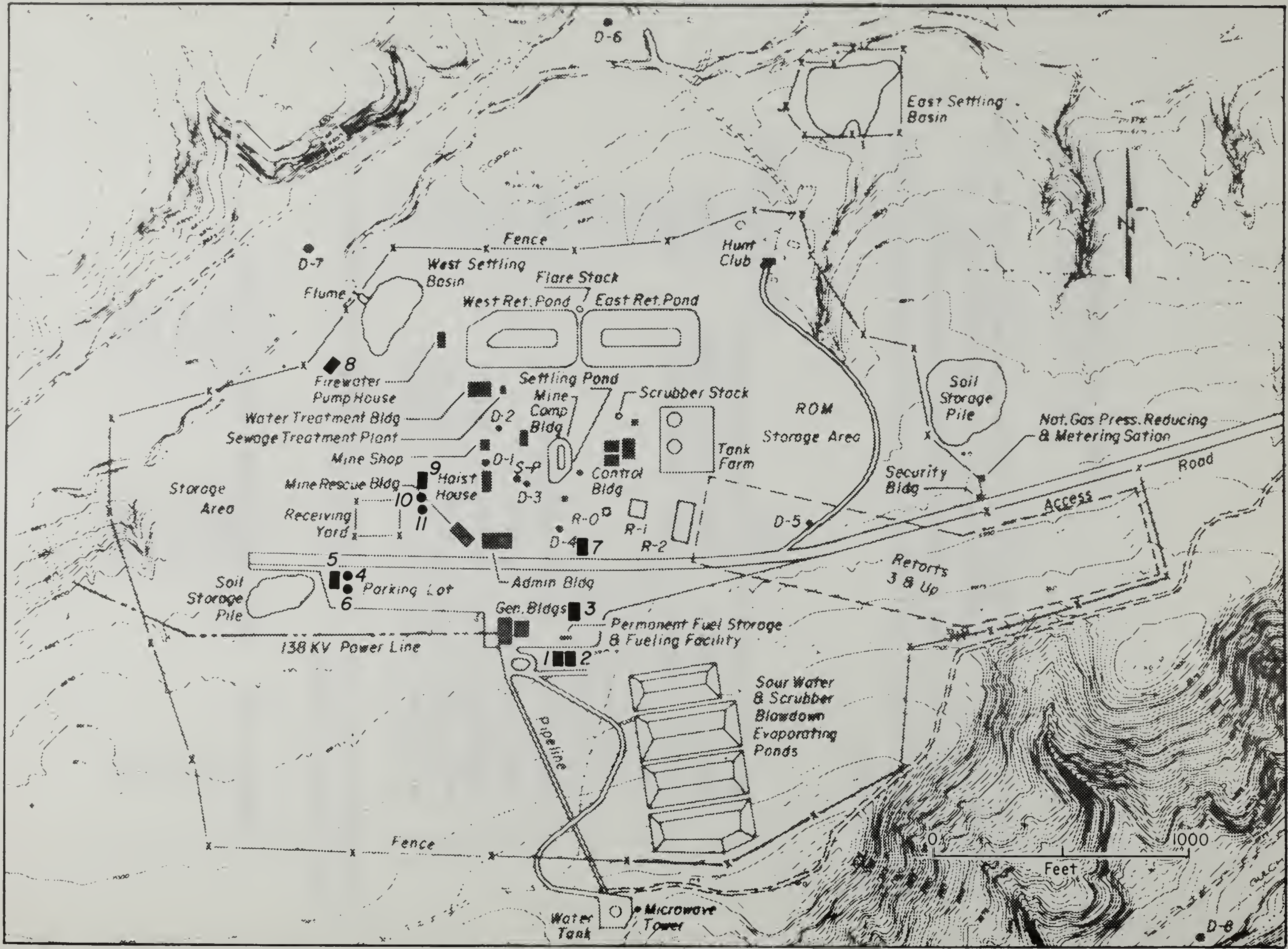


FIGURE 5-5-1

LOCATION OF FUEL STORAGE TANKS

The gasoline fueling island (for tanks 1, 2 and 3) is shown in Figure 5-5-2.

FIGURE 5-5-2
GASOLINE FUELING ISLAND

RBOSC completed construction of five buildings and one building addition in 1979. In March 1979, the Mine Rescue Building was ready for occupancy. This building houses the safety, quality control and mechanical maintenance groups. It has four overhead door bays, two used by safety and two used by the maintenance group, as well as storage, a change room, a first aid training room and four offices. Also in March 1979, the addition to the Fire Water Pump House was completed. This change was required because of the addition of a 3,000 gpm injection pump. The Compressor Building housing two mine air compressors and the dewatering well switchgear was completed in May 1979. In April 1979, the contract for the Processing Area building was awarded. Construction began in May 1979 and included the Processing Area Motor Control Center, the Control Building Complex and the Water Treatment Building. Construction of these buildings was completed in August 1979. The office complex for the Processing Area is a complex of three 12 x 60 ft. trailers and was set in December 1979.

A computer was purchased in 1979 and installed in a permanent trailer located next to the Administration Building. This computer is presently handling financial and administrative data but will eventually be used for warehouse inventory control.

Figures 5-6-1 through 5-6-4 shows some of the buildings completed during the year.

FIGURE 5-6-1

MINE COMPRESSOR BUILDING

FIGURE 5-6-2

BOILER WATER TREATMENT BUILDING

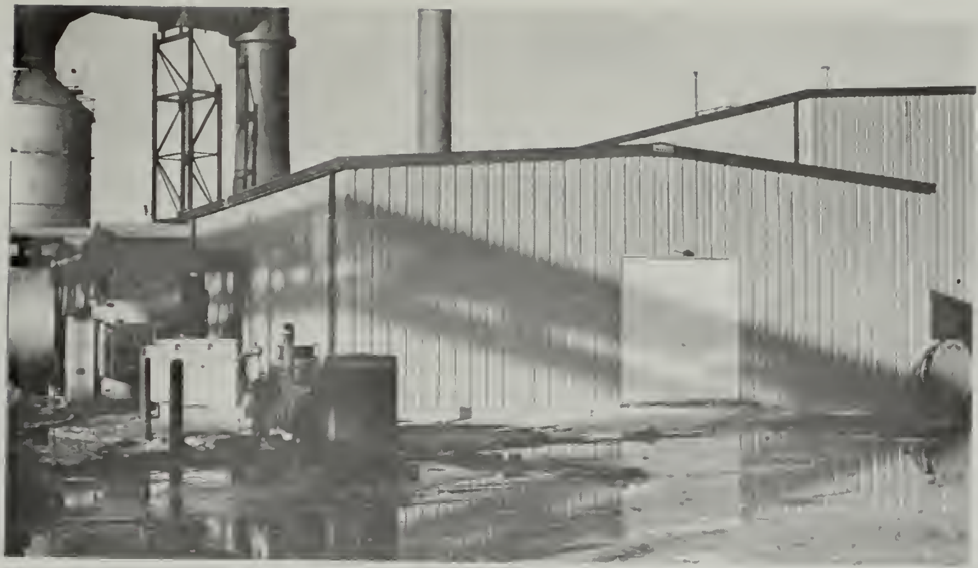


FIGURE 5-6-3
MOTOR CONTROL CENTER

FIGURE 5-6-4
CONTROL ROOM BUILDING

CHAPTER 7
EXPLOSIVE STORAGE AND HANDLING

The mining contractor replaced the two explosive magazines on Tract C-a at the end of the year. These two new magazines have a larger capacity to store the larger amount of explosives required for mine development. The location of the magazines is unchanged.

SECTION VI

ENVIRONMENTAL PROTECTION, HEALTH & SAFETY

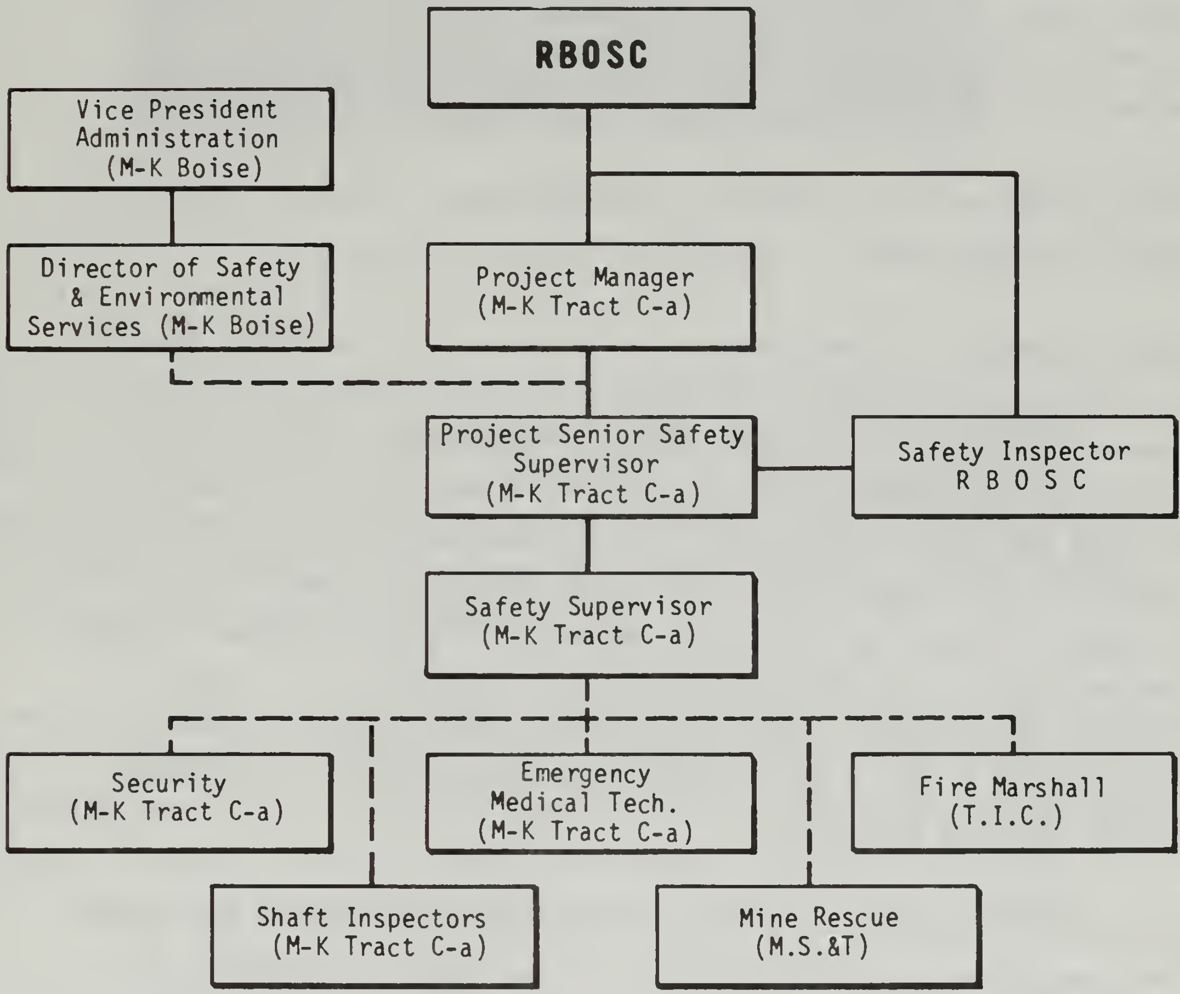
CHAPTER 1
INTRODUCTION

This section contains discussions on the following areas: health and safety; fire prevention and control; air quality control; oil and hazardous material control; land rehabilitation and erosion control; solid waste control; fish and wildlife management plan; protection of objects of historic and scientific interest; and subsidence control. Water quality control was discussed in Section 5, Chapter 3, and will not be repeated in this section. Detailed information on the experimental revegetation section, discussed in the chapter on land rehabilitation and erosion control, is included in the MDP Monitoring Report 5 submitted to the AOSO under separate cover.

Actual construction and operation provided additional information on materials, environmental control, and health and safety activities. Changes were made in various areas as a result of this experience. These are discussed within the individual chapters.

2.1 GENERAL

During 1979, the Morrison-Knudsen (M-K) Company of Boise, Idaho continued to provide project construction management and provide technical and administrative services on Tract C-a. By the end of the year, the safety organization was set up as shown below.



In addition to M-K and RBOSC, safety personnel for specific functions are provided by the General Services Contractor, The Industrial Company (TIC) and Mine, Shaft & Tunnel Corporation (MS&T), the Mining Contractor.

2.2 GENERAL HEALTH AND SAFETY PRACTICES

During the year, training of key personnel was provided for the use of the Self-Rescue Unit, in Mine Gas Detection and in First Aid. Cooperative arrangements were made with Colorado Mountain College and Colorado Northwest Community College to supplement the M-K, MS&T and RBOSC instructors in fulfilling MSHA training requirements. Formal required training programs were submitted to MSHA for approval. There are four MSHA trained instructors on-site approved to instruct in the following courses: Mine Rescue; Mine Emergency; Accident Prevention; Hazard Awareness; the use of Self-Rescue Unit; Flame Safety Lamp; Mine Gas Detection; Oxygen Analyzer; Dust Control; Noise Control; Instructor Training; First Aid and Cardio Pulmonary Resuscitation. Approval for these courses is expected in January 1980.

The mine rescue and mine emergency procedures were covered in Section 2, Chapter 3.4, Mine Safety.

A hazard awareness training program was developed by the Safety Department in accordance to MSHA requirements. This is a ten minute silentque photo slide show (with sound track) presentation tailored to the tract situations to make visitors and workers aware of the potential hazards on and around Tract C-a. This push-button activated presentation is located in the Security Building at the entrance to the MDP construction area. For security and safety purposes, this building was located at the entrance to the MDP construction area during the early part of the year. The building, containing an office and a first aid room, is manned 24 hours a day, 7 days a week by certified EMTs. Figure 6-2-1 shows the Security Building.

Tract C-a is in process of obtaining the services of a local doctor to be the contracted Approving Physician for the tract. Agreements have been sent to the Palisade Clinic to contract for the service of a physician to be the Physician Advisor for continuous EMT training.

FIGURE 6-2-1
TRACT C-a SECURITY BUILDING

Inspections by the Safety Department are made daily to make the work place safe and ensure compliance with state and federal regulations. Safety violations are written up by M-K and RBOSC safety inspectors and presented to the appropriate contractor. These inspectors follow through to make sure the violations are corrected.

A weekly reporting system has been established with all contractors which enables the Safety Department to receive timely and accurate information regarding plant safety training, accident treatments and safety meetings. Accident statistics for the site, by contractor, are updated monthly. All accidents are immediately investigated to find causes and remedies.

The AOSO conducts inspections on a regular basis. In addition, MSHA and the Colorado Division of Mines have made numerous inspections on Tract C-a during the year.

Following are accident statistics for Tract C-a for 1979:

1979 ACCIDENT STATISTICS
Tract C-a
(All Contractors Combined)

	Number of Manhours Worked	Lost Time Injuries	Lost Time Days	Incidence Rate	Severity Rate	Injury Index
1st Qtr.	112,276.5	7	50	12.5	89.1	1.11
2nd Qtr.	114,595.0	7	29	12.2	50.6	.62
3rd Qtr.	166,642.5	6	95	7.2	114.0	.82
4th Qtr.	143,844.5	5	48	7.0	66.7	.5
Total Yr.	537,358.5	25	222	9.3	82.6	0.8

$$\text{Incidence Rate} = \frac{\text{No. of recordable injury/illness cases} \times 200{,}000}{\text{Exposure or Total Employee-Hours}}$$

$$\text{Severity Measure} = \frac{\text{No. of Lost Workdays} \times 200{,}000}{\text{Exposure or Total Employee-Hours}}$$

$$\text{Injury Index} = \frac{\text{Incidence Rate} \times \text{Severity Measure}}{1000}$$

2.3 INDUSTRIAL HYGIENE

During 1979, three industrial hygiene related surveys were performed. Occupational dust exposure surveys were done in March and May and a radiation survey was performed in November. In March, lump and hi-vol dust samples were taken, and shelf and hi-vol dust samples were taken in May.

2.4 TOXICOLOGY

Samples of raw ore which were shipped to Amoco Research Center in Naperville, Illinois have been examined and have been determined to be "representative" of MIS retorts. Arrangements are now being made with Union Oil Company Research Institute to conduct chemical characterization of these samples. Union's Research Institute was chosen because they conducted the testing of oil shale materials used in the American Petroleum Institute tests. Results of these tests will establish the need for future toxicology testing.

Concurrently, RBOSC has been cooperating with the Department of Energy (DOE) Oil Shale Task Force to carry out extensive toxicology testing with Tract C-a materials. Table 6-2-1 summarizes the testing program proposed by the task force. Collection of samples is scheduled for spring 1980, prior to the first retort burn. Sampling and testing will continue through and following the burn of Retort 0.

Future plans call for chemical characterization and, if appropriate, toxicological testing of Lurgi spent shale ash. This will be carried out as soon as spent shale ash becomes available from Lurgi retorts in Germany, around mid-summer.

TABLE 6-2-1

PROPOSED TOXICOLOGY TESTING PROGRAM FOR TRACT C-a

		In vitro				In vivo				
	Chemical Character-ization	Ames	Chromo-somes	Mammal cells	Cyto-tocity	Inhal-alation	SCE*	Pre-natal	Acute	Skin Paint.
Liquids:										
Oil	X	X	X	X	X	?	X	?	X	X
Retort water	X	X	?	?	X		?	X	X	
Mine seepage water	X	X	?	?	X		?	X	X	
Dewatering water	X	X	?	?	X		?	X	X	
Scrubber blowdown	X	X	?	?	X		?	X	X	
Leachate	X	X	?	?	X		?	X	X	
Solids:										
Particulates	X	X	X	X	X	X	X	X	X	X
Scrubber sludge	X	X	?	?	?	?	?	?	?	?
Raw ore	X	?	?	?	?	?	?	?	?	?
Spent shale	X	?	?	?	?	?	?	?	?	?
Gases:										
Offgas	X	?	?	?	?	?	?	?	?	?

*SCE = Sister Chromatid Exchange
X = Program agreed to be conducted
? = Program being considered

CHAPTER 3

FIRE PREVENTION AND CONTROL

3.1 MANAGEMENT AND TRAINING

During 1979, a Fire Marshall was appointed and sent to the Texas A&M Fire School for instruction and training in the latest methods of fire fighting. This knowledge is passed onto the Fire Brigade, formed during 1979. The personnel had seven hours training during 1979 and will have 26 hours per year in the future.

3.2 FIRE PREVENTION AND CONTROL EQUIPMENT AND PROCEDURES

The following updates information presented in this section in the first APR.

- A storage capacity of 500,000 gallons maximum will be reserved in the Fire Water Reserve Tank (formerly denoted as 500,000 Gallon Water Tank) for fire protection water use via the Fire Water Pump House. The West Retention Pond and the Reinjection Water System will be the secondary fire protection water supply. The Fire Water Reserve Tank will have a minimum of 330,000 gallons reserved for fire protection. If necessary, reinjection could be temporarily stopped or reduced to augment the supply of fire protection water into the tank and into the West Retention Pond.
- The diesel-driven pump and electric-motor-driven pump with capability of supplying 750 gpm at 125 psi water pressure to the tract fire hydrant system are in full service.
- The International Midship Pumper truck is located in the heated Mine Rescue Building and is capable of pumping 750 gpm for fighting isolated fires.
- The Site Fire Plan (as included in the RBOSC Tract C-a Safety and Health Program) was written to reorganize the Emergency Manpower Call-out.

Tract C-a has a total of twelve fire hydrants connected to either 6 inch or 8 inch diameter pipelines. These twelve hydrants are located throughout the Mine and Processing Plant site. Three of the hydrants in the Processing Plant Area are permanently equipped with turret nozzles mounted on top of the fire plugs for rapid fire-fighting response. Figure 6-3-1 shows a Processing Plant fire-fighting turret nozzle and fire hydrant.

FIGURE 6-3-1
FIRE HYDRANT AND TURRET NOZZLE - PROCESSING PLANT AREA

3.3 FIRE EMERGENCY ON SITE

On Monday, July 30, 1979, the AMS shaft sinking contractor's shower trailer caught fire. The cause of the fire was apparently an electrical short in the locker room wall. The trailer received extensive interior damage, but no one was injured.

The Fire Brigade was called out and several fire hoses were hooked up to the nearest fire hydrants. These hydrants were within 100 feet of the trailer. The fire was totally extinguished within one hour and no other tract buildings were seriously threatened. The AMS equipment operators quickly moved two adjacent trailers to prevent the spread of the fire. The flames were momentarily shooting about 25 feet into the air.

This emergency provided an excellent opportunity for the site emergency response protocols to be put into use and several revisions were implemented as a result of the experience. Training of the Fire Brigade is done once a month and a full fire drill is held once every six months. A fire siren was then mounted on the headframe to be activated by the hoistman when he is called on the special tract fire telephone line.

The Fire Water Reserve Tank that stands above the site served its purpose in supplying all the necessary water to the fire hydrants for this emergency.

CHAPTER 4
AIR QUALITY CONTROL

RBOSC continued its dust control measures during 1979. The 1.5 mile access road from the visitors center to the construction site was paved with asphalt during July 1979. In addition, the county paved 13 miles of County Road 24 from the tract entrance east to the Piceance Creek Road. This helped mitigate the dust caused by traffic on and around the tract.

RBOSC continued using a water-sprinkling truck for applying water as a fugitive dust-control measure in the construction and unpaved road areas. In addition, chemical palliatives continued to be applied to haul roads, topsoil piles, ore piles, mine and plant bench slopes, road berms, borrow pits and other disturbed areas. The following lists the amount of water and dust palliatives used in 1979.

1979 WATER AND DUST PALLIATIVE APPLICATION, TRACT C-a

Quarter	Water (Gallons)	Dust Palliative (Gallons of Concentrate)	Comment
1	None	None	Snow Cover
2	2,153,960	Coherex	Applied on tract and on County Road 24
3	3,335,140	1650 CSS-1	
4	825,402	2695 CSS-1	

Burning of slash from the scrubber pond construction area was done in accordance with the open burning permit from the Colorado Air Pollution Control Division.

CHAPTER 5

OIL AND HAZARDOUS MATERIAL CONTROL

Two large tanks were erected in the tank farm area during 1979. One tank, with a 20,000 barrel capacity (840,000 gallons) will store the shale oil; the other tank (with the same capacity) will store the retort water (sour water). A containment dike was built around the area where the volume of the containment structure is at least 110 percent of the largest tank displacement plus displacement of all other tanks in the compound below the dike height or liquid level plus a volume sufficient for maximum trapped precipitation and runoff. Figure 6-5-1 shows the two tanks. The tanks and diked area with relation to the Processing Facility can also be seen in Figure 3-2-1 (left side).

Fuel tank storage was discussed in Section 5, Chapter 5 "Storage and Distribution of Fuel and Other Service Products".

FIGURE 6-5-1
RETORT OIL AND SOUR WATER STORAGE TANKS

6.1 GENERAL

The information contained in this report covers a reporting period from February 16, 1979 through February 29, 1980. This is consistent with the Colorado Mined Land Reclamation Board (CMLRB) annual report listed below. It should be noted that about 8.5 acres were disturbed during the first two months of 1980. With this exception, the figures for this reporting period refer to 1979. General areas of disturbance are shown in a figure included in this chapter. Details of these general disturbed areas are on a map entitled, "Tract C-a Areas Disturbed by Year", dated 3-3-80, which is on file in the Area Oil Shale Office and the Mined Land Reclamation, Department of Natural Resources.

In compliance with lease stipulations and CMLRB Permit requirements, RBOSC continued the reclamation program on Tract C-a during 1979 to: reclaim disturbed areas; control fugitive dust and erosion; and conserve natural soils. This chapter of the APR is submitted to the AOSO in compliance with 43 CFR Part 23.10 as appended to the Tract C-a Oil Shale Lease. In addition, an annual report to the CMLRB is required per Permit Number 77-497.

6.2 AREA DISTURBED DURING 1979

During the aforementioned reporting period new disturbance amounted to 26.8 acres. Areas affected during the 1979 calendar year were greatly reduced from the estimated 97 acres estimated in the first APR. This resulted from reduced activity on the water reinjection system and in reservoir and/or soil pits (Figure 6-6-1 and Table 6-6-1). The primary sources of the newly disturbed lands include construction of scrubber blowdown ponds, relocation of a portion of the Airplane Ridge Road, drilling of new dewatering wells, construction associated with dewatering pipeline corridors, and expansion of the impervious materials borrow pit

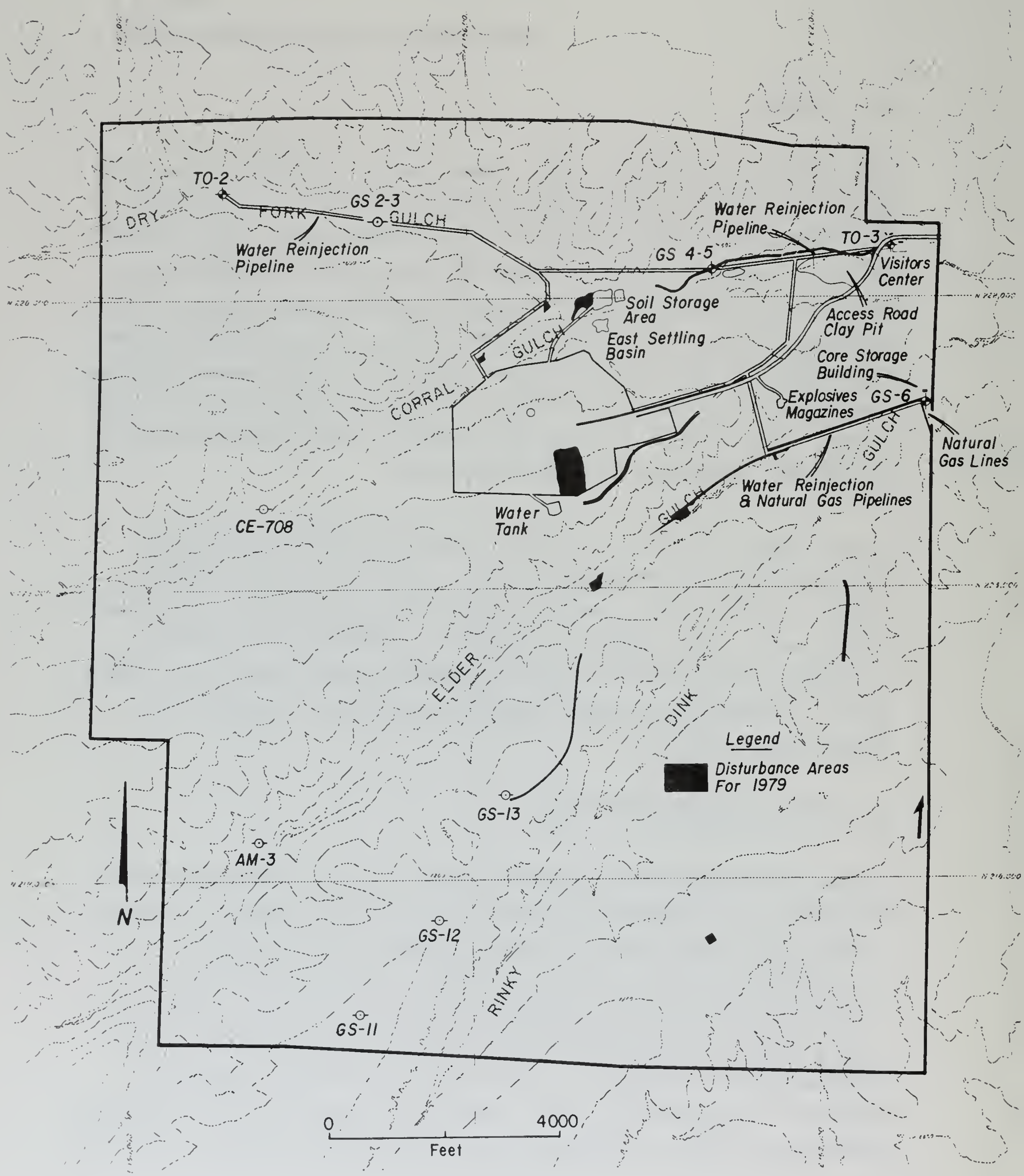


FIGURE 6-6-1
TRACT C-a DISTURBANCE AREAS FOR 1979

TABLE 6-6-1

ESTIMATES OF MDP ACREAGES DISTURBED AND ACREAGES REVEGETATED[1]

Disturbed Area	Disturbance Type	Acreages Disturbed				Acreages Revegetated		
		1977	1978	1979[2]	1980[3]	1978	1979[4]	1979[5]
Mine Service Area Retention	Major	48.2	3.2					
Ponds & Plant Site								
Retention Ponds						8.0		
Plant Sideslopes						12.0		
Area Near Hunting Club						2.0	1.0	
Area Between Water Tank and Plant Site						5.0		
Diversion System			4.2			3.0	3.0	
Settling Basins			3.4			1.0	1.0	0.1
Equipment Yard						3.0		
Area Near Substation							1.0	
Access/Service Roads	Moderate	10.0	3.0	0.4		6.5	6.5	0.5
ROM Disposal Area	Major		12.3			10.0		
Soil Storage (1,2,3)	Major	4.0				3.0		1.3
Storage A,B,C,D			3.0					
Powder Magazine	Moderate	0.9						
Water Reinjection System	Moderate		12.2	13.8	25.0	7.0		
Transmission Line (on-tract)	Moderate		0.5					
Natural Gas Pipeline (on-tract)	Moderate			0.8				
Reservoirs & Soil Pits	Major				50.0			
Access Road Sand Pit			9.5				5.0	
Hunting Road Clay Pit			4.0	0.9		2.0		
Monitoring Facilities	Moderate		0.2					
Trailer Parking Facility					5.0			
Evaporation Field	Major		7.0					
Scrubber Blowdown Ponds	Major			8.9	10.0			
Scrubber Blowdown Pond Pipeline	Moderate			0.05				
Airplane Ridge Road Relocation	Moderate			1.9				
Old Airplane Ridge Road Segment							8.5	
TOTALS		63.2	62.5	26.8	90.0	62.5	26.0	1.9

[1] Acreages revised from 1978 Annual Report based on "as built" survey data

[2] Includes 8.5 acres disturbed between February 16, 1979 and February 29, 1980

[3] Estimated disturbance for reporting period March 1980 - February 1981

[4] Areas revegetated May 1979

[5] Areas redisturbed during 1979 and reseeded in November 1979

(Hunting Road Clay Pit). Table 6-6-2 summarizes the technical revisions to the CMLR permit that were approved during 1979.

In addition to the newly disturbed regions, several areas, initially disturbed prior to 1979, were disturbed again during the reporting period. Additional topsoil-like material was stripped from the East Retention Pond site and added to Soil Storage Pile 1, located to the west of the contractor's parking area. With the addition of 12,241 cu. yds. of topsoil, redisturbance at this site amounted to approximately 1.3 acres at the pile and 0.3 acres for access to the pile. Soils were tested prior to stripping and stockpiling and were found to have low electrical conductivity, with the range being .43 to .87 mmhos/cc. Values for pH ranged from 7.0 to 7.7.

Disturbance in the Hunt Club Clay Pit was initiated in 1978 and continued through 1979, with an additional 0.9 acres being disturbed during the reporting period. It is expected that this borrow pit will remain active during 1980.

The Access Road Sand Pit also remained active during the year, and use is projected into 1980. Access to this borrow pit is being gained via the old Airplane Ridge Road, portions of which were initially seeded during May 1979.

The installation of a natural gas pipeline from the eastern tract boundary to the Mine Service Area resulted in the redisturbance of portions of the reinjection system corridor extending from G-S 6 in Box Elder Gulch to the Airplane Ridge Road. However, new disturbance along this section of corridor amounted to only 0.8 acres. Portions of the corridor seeded in fall 1978 and spring 1979 were redisturbed by this activity. These areas include north-facing road cuts along the Airplane Ridge Road, and a 0.5 acre plot for installation of the natural gas metering station. All areas disturbed by pipeline installation are scheduled for seeding by Western Slope Gas Company during 1980.

TABLE 6-6-2

SUMMARY OF TECHNICAL CMLR PERMIT REVISIONS REQUESTED DURING 1979

Date Requested		Subject of Revision	Resolution of Request
February 19, 1979	1.	Relocation of Airplane Ridge Road and boundry fence due to construction of scrubber blowdown ponds	Approval confirmed in CMLRB letter of March 2, 1979
	2.	Continued use of Access Road Clay (Sand) Pit	
April 18, 1979		Extension of corridor for natural gas pipeline, eastern Tract boundary	Approval confirmed in CMLRB letter of April 27, 1979
June 8, 1979		Designation of trailer parking area in Corral Gulch	Approval confirmed in CMLRB Letter of July 2, 1979
September 24, 1979	1.	Revised schedule for reclamation activities	Approved at September meeting of CMLRB
	2.	Alteration of shrub species used in reclamation	
	3.	Use of native hay mulch	
October 22, 1979		Realignment of injection corridors and placement of five wells	Approved at October meeting of CMLRB
December 10, 1979		Realignment of injection corridors and placement of one reinjection well	Approved at December meeting of CMLRB

6.3 AREAS SEEDED DURING 1979

A total of 27.9 acres was seeded during the reporting period (Table 6-6-1). Of this total, 26.0 acres were originally scheduled for seeding in fall 1978 but were rescheduled due to adverse weather conditions. These areas were seeded and mulched, as per methods listed on Tables 6-6-3 and 6-6-4, during May 16-23, 1979. The remaining 1.9 acres were seeded and mulched November 16-17, 1979. All but 0.2 acres of these areas had been seeded with a temporary seed mix (Table 6-6-3) during either spring 1978 or fall 1979. Redisturbance resulted from addition of topsoil to Storage Pile 1. No fertilizers were applied during the reporting period.

The low number of acres seeded during 1979 relative to the total newly disturbed acreage is related to the schedule of disturbance. Most new disturbance began in the fourth quarter of 1979 and will continue into 1980. These areas will be seeded in 1980 or as soon thereafter as disturbance ceases.

6.4 STATUS OF ACREAGE SEEDED DURING 1978

Germination success of areas seeded in 1978 was determined by qualitative visual estimates during May 1979. Seeding success was assessed quantitatively during October 1979, using cover estimates within 1 x 1m sampling frames placed at 5m intervals along transects within the seeded areas. When seeded areas were redisturbed or reseeded during 1979, coverage was not quantitatively assessed during this reporting period. Revegetated areas will be observed in subsequent years, with cover estimates being taken at the end of each growing season.

Acreages revegetated in 1978 are listed on Table 6-6-1. Areas seeded in the Mine Service and Plant Site areas totaled 34 acres and experienced varying degrees of success. Inspection of exterior slopes of retention ponds indicated fair to poor germination success. These slopes were slightly disturbed in the first quarter of 1979 when piping and stack anchors were put in place. These slopes were reseeded in May 1979.

TABLE 6-6-3

SEED MIXTURES USED FOR RBOSC REVEGETATION ACTIVITIES ON TRACT C-a

Seed Mixture	Plant Species	Seeding Rate* (lbs PLS/acre)
1 - Permanent	Luna pubescent wheatgrass	2.5
	Western wheatgrass	3.5
	Sodar streambank wheatgrass	2.0
	Indian ricegrass	1.5
	Green needlegrass	1.5
	Manchar brome	1.5
	Cicer milkvetch	1.5
	Madrid yellow sweetclover	0.75
	Lewis flax	1.0
	Winterfat	1.0
	Fourwing saltbush	1.0
	Bitterbrush	1.0
	Total	18.75
2 - Temporary	Yellow sweetclover	1.0
	Barley	1.0
	Western wheatgrass	6.0
	Luna pubescent wheatgrass	8.0
	Total	16.0
3 - Temporary	Yellow sweetclover	4.0
	Crested wheatgrass	8.0
	Barley	8.0
	Luna pubescent wheatgrass	5.0
	Total	25.0

*Based on drilling rate; rate for broadcasting will be doubled

TABLE 6-6-4

A SUMMARY OF SEEDING MIXTURES AND MULCHING TECHNIQUES USED DURING 1979 ON TRACT C-a[1]

Disturbed Area	Seed Mixture	Seeding Method	Seeding Rate (lbs PLS/acre)	Mulch Type
Plant Site/Mine Service Area				
Area Near Hunt Club	1	H	38	HYDRO
Diversion System	2	D/B	16/32	HYDRO
East Settling Basin	2	D	16	HYDRO
East Settling Basin[2]	2	B	32	HAY
Area Near Substation	2	D	16	HYDRO
Access/Service Roads	1	H	38	HYDRO
Access to Soil Storage (1)[2]	2	D	16	HAY
Soil Storage (1)[2]	2	D/B	16/32	HAY
Reservoirs & Soil Pits				
Access Road Sand Pit	1	D	19	HYDRO
Old Airplane Ridge Road Segment	1	D	19	HYDRO

Legend

Seed Mixture - See Table 3

D = Drill

B = Broadcast

H = Hydroseed

[1]See Figure 1 for location of the revegetated areas

[2]Redisturbed and reseeded Fall 1979 with experimental use of hay mulch as per Technical Revision approved by CMLRB, September 1979.

Visual inspection in fall 1979 showed scattered coverage of grass and shrub species. Winterfat appeared to be doing particularly well.

Germination on the interior slopes of the retention ponds was fair to good during the spring of 1979. Warmer temperatures resulting from increased insolation on south-facing interior slopes may account for better germination success there as compared to exterior slopes. Germination was particularly evident in furrows resultant from "tracking" the slopes with a Caterpillar tractor. Early seeding success was accentuated throughout the growing season in areas marginal to the water levels in the retention ponds. However, long-term success on the interior slopes is expected to be poor due to fluctuating water levels. The West Retention Pond was filled to capacity in early fall, and the East Retention Pond has experienced several minor fluctuations in water level.

Other portions of the water handling system adjacent to the Mine Site had fair germination success. However, several sections of the diversion ditch system were redisturbed by construction associated with the scrubber blowdown ponds construction, and the East Settling Basin was subjected to minor redisturbance when the flume was redesigned in June 1979. By the end of the growing season both settling basins had scattered coverage of grass species. In spite of fencing around these basins, there was some impact from grazing by cattle.

Plant side slopes were seeded during 1978 to aid in stabilization and to reduce dust. These slopes were subjected to varying degrees of disturbance associated with construction of Processing Facilities during the reporting period. This disturbance, in conjunction with the large percentage of rock and lack of topsoil, accounts for the limited germination success on these slopes.

Examination of the area between the plant site and water tank indicated slow germination in the spring, perhaps due to the north-facing exposure. By the end of the growing season, this area had coverage averaging nearly 32 percent. Grasses averaged 20.3, forbs 4.6, shrubs 1.6, and invaded forbs 3.8 percent coverage. Russian thistle accounted for most of the coverage of invading species, but its distribution was clustered at two sampling points rather than being uniformly dispersed.

Soil Storage Pile 2 and the area designated "equipment yard" had fair germination success during spring 1979. The margins of these areas were redisturbed slightly by the installation of the natural gas facility. Visual inspection at the end of the first growing season indicated scattered to rare coverage of grass species.

Seeding success on the water reinjection system was good, with coverage ranging from 7 to 45 percent at the end of the first growing season. Planted grasses accounted for 6.2, forbs 1.6, and shrubs 0.3 percent coverage. Invading shrubs and/or forbs totaled 11.8 percent coverage. Chenopodium species were responsible for the majority of invader coverage. Invading shrubs included both rabbit brush and sagebrush, both of which are typical of habitats surrounding these reinjection corridors. Grazing by cattle on these corridors was moderate throughout the growing season.

Approximately two acres adjacent to the Hunt Club Clay Pit were reclaimed in 1978. Most of this area was subjected to continued disturbance during the reporting period; therefore, seeding success was not ascertained.

Soil Storage area 'B' exhibited fair germination of grass species on the surfaces which were drilled. Coverage of grass species averaged 3.8 percent. Invading forbs were very abundant on side slopes of this pile. Invaders averaged 25 percent coverage on areas that had been seeded with a rangeland drill.

6.5 STATUS OF ACREAGE SEEDED DURING 1979

During May 1979, six acres associated with the Mine Service Area and Processing Plant Site were seeded (Table 6-6-1). Portions of seeded areas near the Generator Substation, East Settling Basin, and on the diversion system were redisturbed during the reporting period. Areas in the settling basin and near the Generator Substation were reseeded in

November 1979 (Table 6-6-4). A visual assessment of the remaining acreage indicated a fair germination success on undisturbed sites.

Seeding success on 6.5 acres marginal to the Airplane Ridge Access Road, revegetated during May 1979, was highly variable. A number of areas exhibited good seeding success, with approximately 15 percent coverage. However, the majority of the road cuts only had marginal germination success. The abundance of rock on north-facing cuts along the Tract C-a Access Road may account for poor establishment on these exposures.

Approximately 8.5 acres along the old segment of the Airplane Ridge Road were seeded in May 1979. A portion of this area was redisturbed during the reporting period in order to gain entry to the Access Road Sand Pit. Areas not disturbed showed fair to good germination.

As a means of augmenting reclamation success on both the old and new segments of the Airplane Ridge Road, three species of shrub seedlings were planted. Approximately 1950 mountain mahogany, 200 fourwinged saltbush, and 200 rabbit brush tublings were planted October 23-25, 1979. These plantings represent efforts in excess of requirements as set forth in the CMLR permit.

Reclamation of ten acres within the Access Road Sand Pit also was initiated in May 1979. As a result of continued use of the pit, only five acres remain undisturbed. Total vegetational coverage on the undisturbed portion was 24.6 percent. Respective coverages of planted grasses, forbs, and invaded forbs were 7.7, 6.9, and 8.9 percent.

6.6 EXPERIMENTAL REVEGETATION

Experimental revegetation studies were initiated on Tract C-a in 1975. Three plots were established during the study. The third plot, R3, was designed to demonstrate revegetation in an articifical soil profile overlying spent shale. During 1979, revegetation study Site R3 was monitored for vegetation coverage, aboveground biomass, precipitation and electrical conductivity of soils. Coverage and biomass were determined within eighteen treatment combinations (108 sample sites).

Coverage of grasses and shrubs increased whereas that of forbs decreased relative to 1978 data. Wheatgrass, Indian ricegrass, cicer milkvetch, winterfat, and four-winged saltbush were the dominant species contributing to an average cover of 52 percent. Seeding rate (main effect) resulted in significant differences in coverage for all growth form categories tested. Substrate and mulch (main effects) and various interactive effects were found to be of significance in a limited number of cases.

Average biomass also increased relative to 1978 values and totaled 2151 kg/ha during 1979. Grasses and shrubs provided the majority of this material, 838 and 1258 kg/ha respectively. High biomass values for shrubs were due, in part, to inclusion of woody stems in the determinations. Production available for forage would be considerably lower.

Precipitation during the 1979 growing season was greater than that for 1978. May had the highest monthly precipitation total, but there was a period of drought from early June through mid-July. Electrical conductivity of soils increased somewhat relative to previous years; however, this increase is believed to be the result of a change in sampling techniques. Both techniques will be used in 1980 studies to test this assumption.

Data from 1979 demonstrate that, after three years, revegetation efforts have resulted in coverage and biomass which exceed that of naturally occurring plant communities on Tract C-a. Furthermore, no significant differences in total coverage or biomass have been noted between spent shale and no-shale substrates. Data collected thus far suggest that RBOSC's artificial soil profile over spent shale provides a suitable growth medium which can be used for reclamation of wastes generated by an oil shale operation.

CHAPTER 7

SOLID WASTE CONTROL

In December 1979, the Town of Meeker, in a joint operation with Rio Blanco County, opened a new sanitary landfill. The landfill is being operated under a lease agreement between the town and a private operator. The Board of Trustees of the town had no objections to the use of the landfill by RBOSC provided that such use was limited to non-construction type wastes.

RBOSC plans on continued use of the Meeker sanitary landfill. Small amounts of wood, scraps, paper bagging and plastic film wastes will continue going to Meeker. Scrap metal is currently being picked up by a dealer and larger pieces of scrap wood are being taken off as firewood. Waste oil is being accumulated for recycling.

The RBOSC Fish and Wildlife Management Plan is designed to minimize damage to fish and wildlife and their habitats by assuring minimal land disturbance by providing alternate habitat and/or by preventing unnecessary stress caused by human activity. Aquatic habitat is limited in northwest Colorado and no commercial or recreational fisheries exist in the vicinity of the tract. The aquatic monitoring program is designed to detect abnormalities, should they occur, in small tributaries that drain the tract and in the White River at the confluence of Yellow Creek. To date, less than 160 acres of wildlife habitat have been disturbed. Of the amount disturbed, about 92 acres have been seeded with vegetation species which will support a variety of wildlife species (see Chapter 6 on Land Rehabilitation). Mitigation of disturbed wildlife habitat will be accelerated when and if the results of the terrestrial monitoring program indicate that RBOSC's activities have resulted in a reduction in wildlife numbers. Refer to Section 7 on Environmental Assessment and Monitoring for a summary of aquatic and terrestrial monitoring activities. Measures to lessen potential wildlife stress as a result of tract development are practiced on a regular basis as described below.

8.1 LAND DISTURBANCE CONTROL

Disturbances of land during development activities have been limited to a restricted area immediately adjacent to the Mine Site and certain corridors and monitoring sites necessary for operation. All disturbed lands are confined to areas identified and permitted for disturbance by state and federal agencies. Also, all disturbed lands are reclaimed in accordance with stipulations set forth in the CMLRB Permit when the disturbance is terminated. For example, pipeline corridors, short term haul roads and the like may be cleared and reseeded within the same growing season. Often the reclaimed lands are better suited to certain wildlife species than the habitat they replace. Because deer and feral horses are regularly observed a short distance from the development area, deer-proof fences have been erected around certain development areas which may be harmful to them. These areas include the scrubber blowdown and retort sour water ponds.

8.2 HUMAN DISTURBANCE CONTROL

Increased human activity in unpopulated areas frequently leads to wildlife disturbances such as road kills, increased hunting pressure and general harassment--intentional or otherwise. In anticipation of the problems, RBOSC has taken the following steps to mitigate potential disturbances.

- Using multi-passenger vehicles and carpools to transport workers to and from the tract and to reduce vehicle numbers on roads.
- Alerting workers and visitors that wildlife commonly cross the roadways abruptly without warning.
- Posting of speed control signs on tract to reduce speed and encouraging workers to reduce speeds on highways to tract.
- Conducting deer carcass counts to identify areas most likely to experience animal/vehicle collisions and to identify extent of deer loss.
- Providing information to workers relative to state penalties for harassment of wildlife.
- Control of dogs on tract.
- Restricting off-road vehicle use.
- Providing information on hunting and fishing restrictions to workers and visitors to discourage illegal activities.
- Providing information to tract personnel concerning important wildlife areas such as sage grouse strutting grounds and raptor nests to prevent disturbance.

The success of these mitigation measures has been demonstrated by the continued utilization of the area by large game animals and other wildlife species. For example, a golden eagle was fledged within 50 yards of the off-tract access road and deer and feral horses frequently drink in the warm water discharge from mine dewatering when conventional water sources are unavailable.

8.3 PUBLIC INFORMATION

Humans are frequently party to unintentional wildlife disturbances because of their failure to recognize the potential impacts of their activities. Examples of such disturbances include indiscriminate use of off-road vehicles (e.g. snowmobiles, motorcycles), introduction of unleashed pets, disposition of harmful trash or garbage where it is accessible to wildlife and careless use of fire. The most direct and effective means of mitigating these impacts is to inform tract visitors and workers that these activities can result in adverse impacts. To accomplish this, RBOSC provides an informative brochure to all visitors and new workers who enter the site. This brochure contains information on hunting and fishing regulations, lists wildlife likely to occur in the area and discusses some of the impacts which can result when humans carelessly pursue their activities. Also, a Wildlife Biologist, who is stationed on tract, is available to discuss potential wildlife problems with workers and visitors.

The frequency of habitat abuses by humans in the area is extremely low indicating a good degree of success of the Fish and Wildlife Management Plan. Continued monitoring of selected wildlife and their habitats will assure a continued success of the plan.

CHAPTER 9
PROTECTION OF OBJECTS OF HISTORIC AND SCIENTIFIC INTEREST

These were two major areas of new construction during 1979; the scrubber blowdown and sour water ponds and the airstrip. These areas were surveyed for cultural resources prior to MDP construction. All objects of scientific importance were collected and catalogued. Prior to all construction activities, heavy equipment operators were shown photographs of typical artifacts which could be present in the construction area. These photographs are also posted on the bulletin board on tract as a reminder. No artifacts were found during the 1979 construction work period.

CHAPTER 10
AESTHETICS

As done previously, all buildings constructed during 1979 utilized sage green or beige siding to blend with the surrounding area. In addition, the scrubber blowdown and retort sour water ponds area was left with a buffer of trees around this site to provide a visual screen. This can be seen in Figure 1-2-8.

CHAPTER 11
SUBSIDENCE MONITORING

The fifty subsidence monuments located on the surface above the MDP retorts and other areas were surveyed for horizontal and vertical movement. The survey was completed and maps were sent to the AOSO in June 1979. No horizontal or vertical movement was detected. The year-end survey of the subsidence monuments was begun in December and was scheduled to be completed in January 1980.

SECTION VII

ENVIRONMENTAL ASSESSMENT & MONITORING

CHAPTER 1
INTRODUCTION

Since its inception in 1974, RBOSC has been conducting extensive environmental data collection programs. Between October 1974 and September 1976, two years of baseline data were gathered. From September 1976 through August 1977, interim environmental data were collected. In September 1977, RBOSC initiated their Modular Development Phase (MDP) Environmental Monitoring Program. Data are reported twice a year. The first report of MDP environmental activities (September - November 1977) was published in Feburary 1978; the second (December 1977 - May 1978) was published in September 1978; the third (December 1977 - November 1978) was published in March 1979; and, the fourth report (December 1978 - May 1979) was published in August 1979. RBOSC MDP Monitoring Report 5 presents and evaluates data collected from December 1978 through November 1979.

All monitoring reports are on file in their entirety in the AOSO office in Grand Junction, Colorado. A summary of Monitoring Report 5 is presented in this APR. Atmospheric, terrestrial, aquatic, hydrologic, special studies, and ecological interaction aspects of the monitoring program are summarized. Detailed discussions and data pertaining to each discipline may be found in the sections of Monitoring Report 5 listed below.

Volume 1 of the RBOSC MDP Monitoring Report 5 contains eight sections as follows:

Section 1	Introduction
Section 2	Atmospheric Studies
Section 3	Terrestrial Studies
Section 4	Aquatic Studies
Section 5	Hydrology Studies
Section 6	Special Studies
Section 7	Ecological Interactions
Section 8	Summary

Volumes 2 and 3 contain appendices as listed below:

2-1	Air Quality Data
2-2	Meteorological Data
2-5	Visibility Data
3-1	Vegetation Data
3-2	Fauna Data
4-0	Aquatic Data
5-1	Surface Water Data
5-2	Groundwater Data
6-2	Revegetation Data

Both air quality and meteorological data were collected on a continuous basis during the reporting period. Components measured included gaseous pollutants, total suspended particulates, meteorological parameters, noise and visibility. These data are compared against data collected during previous years to identify changes which may be associated with tract development.

During the year an unusual event occurred--the installation of an underground pipeline immediately adjacent to Monitoring Site 1. See Figure 7-2-1. At the peak of this construction, the primary 24 hour National Ambient Air Quality Standard (NAAQS) for total suspended particulates was exceeded once at the monitoring site. Ironically, this activity, which was unrelated to the development of Tract C-a, resulted in the highest measurement of total suspended particulates (303/mg/m^3) in four years of monitoring at any of the three monitoring sites.

The continuous monitoring system recorded only a very small number of events during which the concentrations of NO, NO_x, SO_2, H_2S, and CO were above the threshold of detection. Ozone and total suspended particulates were the only components measured which consistently exhibited concentrations above the threshold of detection. Elevated levels of these two pollutants are not uncommon in the west.

Analysis of four years of ozone data has shown that a diurnal cycle of relatively high ozone concentrations during the day and relatively low ozone concentrations at night is one of the most striking aspects of the data. This cycle has a much greater magnitude at Site 3. Review of the data indicates that the possible mechanism for this phenomenon is a nocturnal inversion which commonly develops over the gulch where Site 3 is located. This inversion effectively isolates the site from the relatively ozone-rich air present above the lowest atmospheric boundary layer. After the inversion forms, typically around sunset, much of the

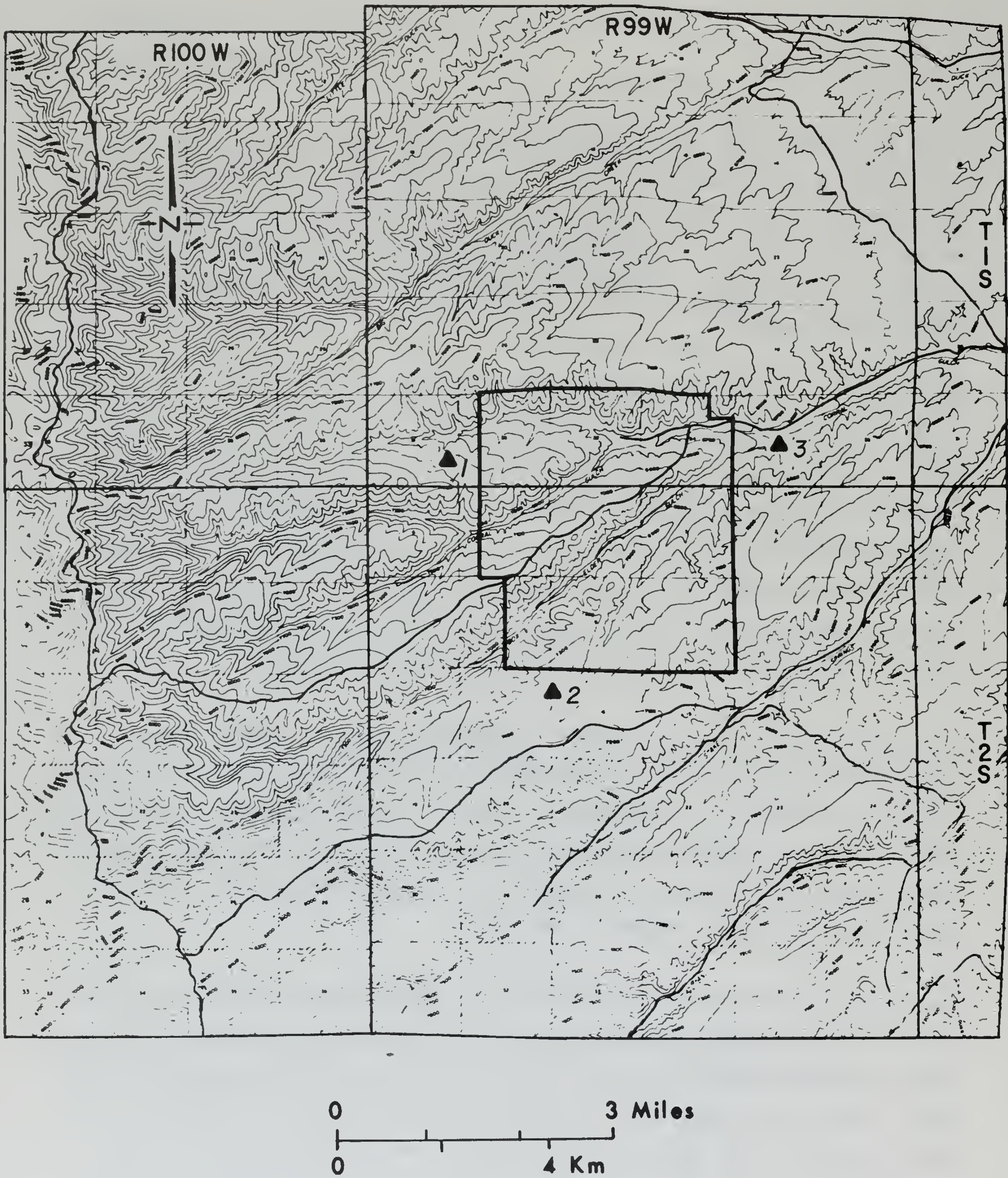


FIGURE 7-2-1
LOCATION OF MDP AIR STUDIES MONITORING SITES

ozone remaining in the ambient air trapped within the gulch is destroyed during the night by surface reactions. The breakup of the nocturnal inversion shortly after sunrise allows replenishment of the ozone in the gulch from upper levels. At Site 1, the diurnal cycle is greatly reduced because the location near the top of a hill is not conducive to the formation of a nocturnal inversion.

This hypothesized mechanism explains most of the observed variations in the local ozone concentrations, with the exception of the annual summer peak commonly found at many rural sites. There is no evidence of local photochemical production from either natural or anthropogenic sources. Thus, tract development to date appears to have had no effect on the ambient ozone levels.

Ozone concentrations do occasionally reach or exceed 0.080 ppm, primarily during the summer, but have never been recorded at levels approaching the NAAQS for oxidants (0.12 ppm). Concentrations comparable to those measured at Tract C-a have been found at many rural sites throughout the United States. The exact source of these relatively high ozone levels is currently the subject of active research.

The only verifiable change in any air quality constituent to date is the increase in particulate concentrations at Site 3 (the treatment site generally downwind from the main tract development area). The 24-hour secondary NAAQS for particulates was exceeded once at Site 3 during the current year. However, a stepwise multiple regression analysis showed that the high particulate levels at Site 3 were more closely associated with meteorological conditions (high temperatures and low precipitation) rather than any measure of tract activity.

Several statistical analyses were performed on the particulate data sets, including correlations, multiple regressions, stepwise multiple regressions, and analysis of variance. It was found that the particulate concentrations measured at the tract could be divided into two periods with minimum overlap: 1) the winter season (the period with a semi-permanent snow cover), and 2) the summer season (the period with no snow cover). The statistical analyses were carried out on the winter, summer, and combined yearly data sets.

The correlation analysis showed that Sites 1 and 2 (the control sites generally upwind of the main development area) were the most highly correlated ($r = 0.84$ for the current year), whereas Sites 1 and 3 were the most weakly correlated ($r = 0.62$). There was little seasonal effect on the correlations.

The multiple regressions showed that approximately two-thirds of the variation in particulate concentrations can be explained by a combination of meteorological and site activity variables. Stepwise regressions indicated that, for the summer and combined data sets, the important factors in explaining the variation in particulate concentrations at Sites 1 and 2 were meteorological variables (i.e., precipitation, wind speed, and temperature). None of the site activity variables made significant contributions to the regression equations for these data sets.

At Site 3, an indicator of development activity was a significant variable in the regression, but it ranked no higher than third in importance of explaining the variation in particulate concentrations. Thus, development activity apparently had an impact on particulate concentrations only at Site 3 in the summer and yearly data sets. The regressions on the winter data set generally were not as successful in explaining the variation in particulate concentrations. This is probably due to the lower particulate levels and the much lower variation which decreases the reliability of the regression analysis.

Comparison of the meteorological data from the current year with data from previous years has revealed minimal change in the year-to-year meteorology. The only exception is precipitation which, at 14 to 15 inches in 1978-79 (the best estimate based on eight precipitation gauges), is the highest of the four years on record. The temperature range of 60 C (-30 C to +30 C) found during the reporting period is typical of continental sites. Wind speed at the tract has been relatively low, reaching a maximum of only 37 mph at the 10-m level. After four years of monitoring, RBOSC is beginning to develop a reasonable climatological record, although no long-term means can yet be determined.

The 1979 visibility program did not indicate any change from previous measurements in visual ranges in the Piceance Creek Basin. The mean annual visual range for 1979 was 80 miles, compared to 79 miles during the two previous monitoring years, 1978 and 1975-76. There is a large day-to-day variability in the visual range, but this is primarily a result of widely varying meteorological conditions. The maximum visual range of 154 miles, measured during the three years of monitoring, occurred in 1979. Visual ranges near 150 miles were occasionally recorded during the two earlier years of monitoring. This value approaches the theoretical limit of visual range in the atmosphere (200 miles).

Two noise surveys were taken during the reporting period. The measured sound levels generally ranged from 25 to 50 dBA, except near the main construction area (adjacent to the headframe), which averaged 77 dBA. If the measurements taken near the main construction area are excluded, these sound levels are comparable to data taken during the baseline period.

CHAPTER 3
TERRESTRIAL STUDIES

The components of the Terrestrial Monitoring Program examined during the December 1978 through November 1979 reporting period include vegetation mapping and stress, phytosociological, range production and utilization, browse utilization and condition, small mammal, avifauna, mule deer, and feral horse studies.

Color infrared photographs taken in 1974 were studied and "moist pockets" were identified. Comparisons with 1979 photographs indicated that moist areas identified from 1974 photography also were evident during 1979. Preliminary determinations suggest increases in moisture balance in some areas. These increases may be attributable to natural variations between years in many instances. However, increases noted in several portions of Corral Gulch, and one location in Box Elder Gulch, seem to be related to reinjection and/or dewatering discharge. Although vegetation changes have not been observed within each of these areas, expected changes would be reductions in bottomland sagebrush and increases in grass communities.

Phytosociological studies were conducted on 10 transects (5 control, 5 treatment) within the pinyon-juniper habitat type on and adjacent to Tract C-a. Coverage of trees and shrubs was similar between the study areas, but density of woody species was greater within the treatment area. Herbaceous vegetation averaged 13.7 percent coverage in the control area and 14.8 within the treatment area. There was no significant difference ($\alpha = 0.05$) in herbaceous coverage between areas. Graminoid species were the dominant contributors to herbaceous coverage in both areas. Bluegrass (<u>Poa</u> spp.) and Indian Ricegrass (<u>Oryzopsis hymenoides</u>) were the most prevalent grass species observed.

Range productivity and utilization studies indicated that production varied from 44 kg/ha in the pinyon-juniper to 209 kg/ha in the mixed brush habitat type. Production within the mixed brush and pinyon-juniper types was similar to that recorded in 1978, but increased significantly ($\alpha = 0.05$) within the sagebrush type. Relative to 1978, percent utilization increased in the mixed brush type and decreased within both the pinyon-juniper and upland sagebrush types. Graminoid species were used more heavily than were forbs in all three vegetation types. Data indicate that variability in both production and utilization is inherent within the ecosystems being studied. Therefore, definitive trends for production and/or utilization cannot be ascertained at this time.

Browse condition and utilization data show that average utilization decreased between 1978 and 1979 within the pinyon-juniper and upland sagebrush vegetation types, whereas utilization for the mixed brush type remained about the same. Mountain mahogany (*Cercocarpus montanus*) use increased significantly ($\alpha = 0.05$) within the mixed brush type in 1979, but decreased significantly ($\alpha = 0.05$) within the pinyon-juniper type. Sagebrush (*Artemisia tridentata*) utilization was significantly greater within the pinyon-juniper type in 1979, and significantly lower ($\alpha = 0.05$) in the upland sagebrush type. Browse use ratings were similar to those reported for 1978, and indicated that, for the most part, utilization values were "acceptable" for average winter range. Browse condition also was similar to that for 1978 and ranged from "poor" to "good" depending on the species and/or vegetation type being considered. RBOSC browse data are based on consideration of the same individual plants on a yearly basis and, consequently, do not reflect changes in age structure of browse species which may be taking place. Therefore, one should take caution in making basin-wide generalizations based on these data.

Four small mammal species were captured during the 1979 sampling period. The deer mouse was the most frequently trapped species in both pinyon-juniper and sagebrush habitats in both the treatment and control areas. The least chipmunk was the second most frequently caught. These species were also the most frequently caught during baseline studies. The ratio of deer mice caught per 100 trap nights during the sampling period for all areas was higher than that ratio during baseline. Small mammal populations normally fluctuate widely, and the high deer mouse population may have been related to the deep snow which covered the ground for much of the previous winter. The deep winter snows may have provided protection from adverse weather and predators and ample moisture for a wet spring which then resulted in greater vegetation production in some locations. The high trap success for deer mice may have reduced the number of captures of other small mammal species because a trap with an individual in it is incapable of capturing other individuals of the same or other species.

More species of birds were observed in the pinyon-juniper habitat than in the sagebrush habitat in both the treatment and control areas. This distribution was also noted during baseline studies. A total of 12 bird species was observed in the treatment area and 12 species also were observed in the control area of the pinyon-juniper habitat type. A total of four bird species was observed in the treatment sagebrush habitat and six were observed in the control sagebrush type.

The most frequently sighted species in the pinyon-juniper habitats were the chipping sparrow and the black-throated gray warbler in both treatment and control areas. Other frequently observed species in the pinyon-juniper habitat were the brown-headed cowbird and the mountain bluebird (treatment area) and Brewer's sparrow, the green-tailed towhee, and the common raven (control area). In the sagebrush habitat, the most frequently observed species were Brewer's sparrow and the green-tailed towhee in both treatment and control areas. The sage thrasher was frequently seen in the sagebrush habitat in the treatment area but was not observed in the control area. There appeared to be little correlation between the bird populations in the same habitat type in the treatment versus the control areas. Similar variability between bird populations in the same habitat types were noted during baseline studies.

Comparisons of all mule deer pellet group numbers counted in nine blocks of nine square miles each indicate that the tract (Block 5) has significantly more pellet groups ($\alpha = 0.05$) than six of the nine blocks. The tract block did not have significantly more pellet groups than Blocks 1 and 2 which are located northwest of, north of and adjacent to the tract. If the numbers of pellet groups are extrapolated to represent numbers of deer, about 50.9 and 43.2 deer per square mile were on the RBOSC study area during the winters of 1977-78 and 1978-79, respectively. These numbers are similar to estimates by the Colorado Division of Wildlife (52.4 and 43.6 deer per square mile) for the same years.

Only 10 deer were killed by collisions with vehicles along Rio Blanco County Road 24 during the spring and fall (through November) migration period in 1979. Deer were very numerous along this road during the spring period, accounting for 9 of the 10 deer killed. The number of road kills is low considering the heavy traffic and poor road conditions during that time.

A total of 99 feral horses in 21 bands was counted in the 81 square miles study area in January 1979. During the foal count in September, it was estimated that about 16 percent of the feral horse population in the area was composed of young-of-the-year.

No threatened or endangered species were observed in the vicinity of Tract C-a during the reporting period. A protected species, the golden eagle, nested and successfully fledged one chick near Rio Blanco County Road 24 during the summer.

The RBOSC aquatic studies program provides physical and chemical data and a measure of the biotic (periphyton and benthos) communities in aquatic habitats near Tract C-a and along Yellow Creek to the White River.

Physical parameters examined at each of the aquatic sampling stations indicate both seasonal and annual variability. Few trends or major changes in the physical measurements can be detected from the data. The volume of flow increased at sampling Stations 13 and 14. See Figure 7-4-1. This increase is hypothesized to be the result of operational discharge of water into Corral Gulch, which in turn increased the depth, width, and velocity of water at Stations 13 and 14. A slight increase in conductivity and turbidity was noted at Station 13, presumably as a result of water discharge into Corral Gulch.

Water quality measurements made in 1979 indicate no large changes in White River water quality above or below its confluence with Yellow Creek. Examination of the 1979 data and data collected in the baseline and early monitoring phase, also shows no detectable differences in water quality or aquatic sampling stations on or near Tract C-a.

The 1979 total mean periphyton density for all aquatic sampling stations was 2698 units/mm^2. Mean density values ranged from a high at Station 14 (6446 units/mm^2) to a low at Station 29 (411 units/mm^2). Annual variations in periphyton densities are large on a monthly basis, and are directly related to such highly variable environmental parameters as light, temperature, current velocity, spring run-off, turbidity, and substrate type.

Generally, 1979 densities, diversities, and biomass estimates were somewhat lower than 1978 and 1977 values. Periphyton were dominated by *Achnanthes* spp., primarily *Achnanthes minutissima*, at Station 13 during

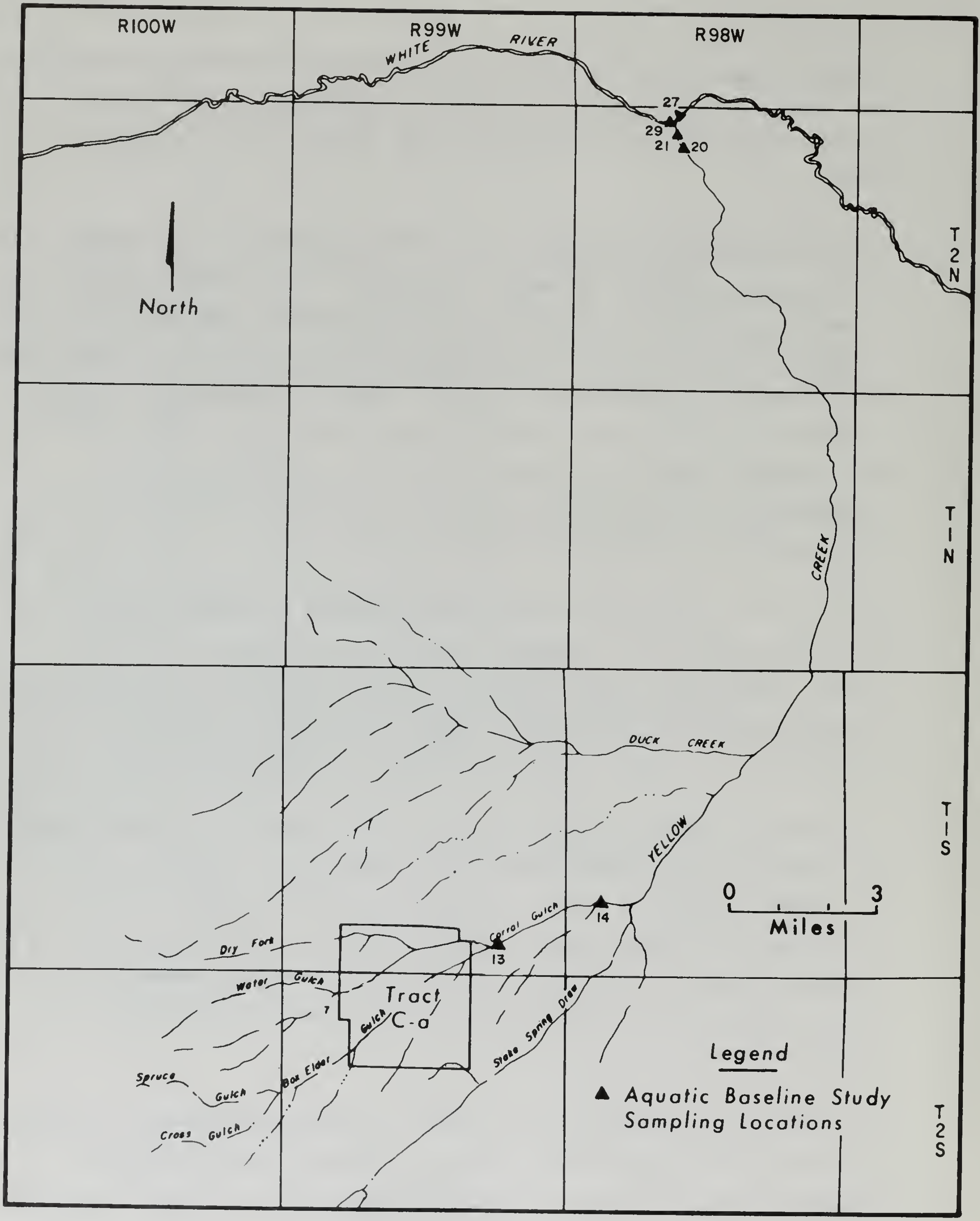


FIGURE 7-4-1
LOCATION OF MDP AQUATIC STUDIES SAMPLING SITES

the baseline period, while *Phormidium* spp. dominated during the spring and early summer and *Achnanthes* spp. dominated during the fall of 1979. This change in dominant species may be due to the increase in turbidity and flow of water at Stations 13 and 14 during the spring. Variations in species dominance is not uncommon in aquatic community structures with a high degree of variability such as increased turbidity and velocity. Change in dominance of one species over another is frequently seen within variable physical environments. When more data are collected, significant changes in correlation between dominance by particular species and associated physical measurements can be addressed and tested statistically. To date, all that can be stated is that changes (not accounted for by seasonal variations) may have occurred in the periphyton communities since the baseline period. Further examination over a longer time period is warranted.

Benthos samples collected from Stations 13 and 14 in 1979 indicate a decrease in the number of representative taxa and total numbers of macroinvertebrates, probably due to increased water velocity which results in habitat modification, stream erosion, and scouring of the gravel and sand substrate. An increase in *Baetis* sp. and the Plecopteran family Capmidae was noted in 1979 indicating a slight recovery in the numbers of these organisms from 1978 at Stations 13 and 14. Considerable habitat alteration at Station 14 over the years has resulted in a change in basic species composition from pond-like genera, such as *Callibaetis*, to a silted pond-like habitat taxa, such as members of the class Oligochaeta. Differences in life history strategies indicate that *Callibaetis* survive in a solid non-depositional substrate habitat, while the Oligochaeta thrive on a silted highly depositional habitat.

The macroinvertebrate communities of Stations 20 and 21 were fairly consistent between 1974 and 1978. A slight decrease in density and diversity was seen in 1979. This may have been caused by the flash flooding experienced in late 1978, which resulted in considerable substrate scouring and removal of macroinvertebrates. Stations 27 and 29 have shown slight differences between baseline and MDP monitoring. In general, there appear to be no changes in the benthos communities of Stations 20, 21, 27, and 29 which can be attributed to mining activities on Tract C-a.

Statistical analysis of the benthic sampling program is presently limited to relative abundance, density, and diversity measurements. The procedures are limited to annual comparisons and cannot give an overall, long-term picture of the changes in benthic community structure. When adequate data are collected, additional analysis of the benthos community will be used for examination of long-term changes.

CHAPTER 5
HYDROLOGY STUDIES

The hydrology program provides data necessary to satisfy lease stipulations and conditions of approval from the AOSO; assess impacts of dewatering and reinjection (development activities); provide input to engineering design of the mine and water handling system; supply information necessary for environmental disciplines to determine if mitigative measures are necessary; and collect data for compliance with permit stipulations. The hydrology program supplements baseline data which was initiated in 1974 and is used as a means of providing current data for comparison purposes. Stream gaging and erosion stations, springs and seeps, alluvial and deep aquifer holes, surface water impoundments, discharges, and reinjection and dewatering wells are monitored.

The results of the hydrology program are summarized below:

Surface Water - Of the six gaging stations, two, Rinky Dink Gulch and Dry Fork, failed to show any flow during the reporting period. The natural flows for 1979 were similar to those for 1975 and 1978. The discharge of excess water affected the flows in Corral Gulch, but the discharge attenuated in Yellow Creek well above the Yellow Creek gaging station. The leading edge of water in the creek was monitored during discharge periods.

Examination of the water quality data collected at surface gaging stations during 1979 indicates that concentrations of some constituents were statistically different from baseline data. These differences represent both increases and decreases in concentrations of chemical constituents. Differences may reflect the use of overly strict statistical tests. They do not necessarily represent adverse impacts.

Springs and Seeps - Flow at all the springs was highly variable during the reporting period. Temperature, conductivity and pH varied somewhat.

Alluvial Groundwater - Many of the alluvial wells remained dry throughout the reporting period similar to baseline. Water levels in alluvial wells on Corral Gulch were influenced by discharge of dewatering water. For the wells where data were available, differences between baseline and reporting period values of chemical concentration were noted for some parameters when sensitive statistical tests were applied. These differences may be more reflective of the testing sensitivity than of actual changes. The validity of underlying assumptions must be studied in more detail.

Upper and Lower Aquifer Water - The cone of depression from dewatering the upper aquifer is elliplical with major axes to the north and northeast. Natural recharge occurs in the west and northwest portions of the tract. Reinjection is taking place in the northeast corner of the tract. The lower aquifer has not shown any response to dewatering; however, it apparently shows a small response to reinjection in the northeast corner of the tract. The nature of this response is being examined in greater detail and results will be presented when the mechanisms are more fully understood. Chemical data for deep aquifers taken during 1979 exhibit statistical differences (both increases and decreases) from baseline data for several parameters. The differences in water quality data may be accounted for by (1) natural variability, (2) sampling bias, and (3) the rigors of the testing procedure. More work is required to isolate the cause.

Development Activities - Flow data taken during the reporting period reflect discharges to Corral Gulch during the pump testing program. Likewise erosion data indicate that discharges to Corral Gulch resulted in minor changes of the stream channel profiles.

Subsurface disposal permit data have been reported monthly since the onset of the testing program. These reports are on file at the Colorado Department of Health and the AOSO and data are included in MDP Monitoring Report 5.

Data taken in compliance with the NPDES permit were reported quarterly during 1978. These reports are on file at the Colorado Department of Health, the EPA, and the AOSO and a summary is contained in Monitoring Report 5.

CHAPTER 6
ECOLOGICAL INTERACTIONS

Ecological interactions are not measured or monitored directly. However, RBOSC's environmental monitoring program is providing data on a number of major ecosystem components. Assimilation and synthesis of these data have begun to confirm conceptual models and reveal certain (tentative) trends.

Deep, long-lasting snowcover during the winter of 1978-1979 may have influenced both the hydrologic and biologic systems. Increased spring runoff in 1979 relative to 1978 possibly resulted in a greater sediment load and increased erosion. The dilution factor associated with larger volumes of water may be related to a decrease in conductivity at certain stations. Furthermore, increased erosion alters the stream substrate, as well as the aquatic biota which are dependent on this substrate.

The terrestrial ecosystem may also have been influenced by the long-lasting snowcover. Small mammals tend to be protected from cold temperatures and predation by deep snowcover and deer are forced to lower elevations for winter range, and/or may be restricted to south-facing slopes or ridgetops where snow accumulation is low. Increased moisture availability during the early portion of the growing season can enhance forage production. However, if deer are concentrated in limited areas due to deep snowcover, browse utilization patterns may be altered.

Discharge of mine inflow seems to duplicate many of the processes and interactions which take place during normal periods of high runoff. In this instance, the activities on Tract C-a may be increasing the rate at which normal system interactions occur.

During the reporting period, human activity in the vicinity of Tract C-a has increased. In addition to oil shale development, there has been a noticeable influx of people related to natural gas exploration. The effects of development activities on wildlife are largely unknown.

However, wildlife losses resulting from collisions with automobiles have increased slightly with increasing traffic but these losses were still low when compared to winter losses. In spite of increased human presence, it appears that mule deer hunting may have declined during the fall of 1979.

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