VOLUME 1

# BYPRODUCT MATERIAL LICENSE APPLICATION AND EXECUTIVE SUMMARY

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BYPRODUCT MATERIAL LICENSE APPLICATION

FORM NRC-2
(7-77)
10 CFR 40

Approved by GAO
R0203

# U.S. NUCLEAR REGULATORY COMMISSION

# APPLICATION FOR ~~SOURCE~~ BY-PRODUCT MATERIAL LICENSE FOR URANIUM MILL TAILINGS

Pursuant to the regulations in Title 10, Code of Federal Regulations, Chapter 1, Part 40, application is hereby made for a license to receive, possess, use, transfer, deliver or import into the United States, ~~xxxxx~~ by-product material for the activity or activities described.

1. (Check one)
   - [X] (a) New license
   - [ ] (b) Amendment to License No. ______
   - [ ] (c) Renewal of License No. ______
   - [ ] (d) Previous License No. ______

2. NAME OF APPLICANT
GULF OIL CORPORATION, Acting by and through its Division, Gulf Mineral Resources Co.

3. PRINCIPAL BUSINESS ADDRESS
1720 South Bellaire Street
Denver, Colorado 80222

4. STATE THE ADDRESS(ES) AT WHICH ~~XXXXX~~ by-product MATERIAL WILL BE POSSESSED OR USED
Section 1, T13N, R8W, McKinley County, New Mexico; Sections 10, 11, 14 & 15, T14N, R8W, McKinley County, New Mexico; Corridor of land north from Section 1, T13N, R8W, to Section 14, T14N, R8W.

5. NAME OF PERSON TO BE CONTACTED CONCERNING THIS APPLICATION
W. L. Rogers, Manager, Environmental Affairs

6. TELEPHONE NO. OF INDIVIDUAL NAMED IN ITEM 5
303/758-1700

7. DESCRIBE PURPOSE FOR WHICH ~~XXXXXX~~ by-product MATERIAL WILL BE USED
Tailings are a by-product of uranium milling operation, and therefore will not be utilized, but rather will be disposed of in an environmentally acceptable manner, as described in Section 3.4, Vol. 3 of the Environmental Report.

8. STATE THE TYPE OR TYPES, CHEMICAL FORM OR FORMS, AND QUANTITIES OF ~~XXXXX~~ by-product MATERIAL YOU PROPOSE TO RECEIVE, POSSESS, USE, OR TRANSFER UNDER THE LICENSE

| (a) TYPE | (b) CHEMICAL FORM | (c) PHYSICAL FORM (Including % U or Th.) | (d) MAXIMUM AMOUNT AT ANY ONE TIME (kilograms) |
|---|---|---|---|
| NATURAL URANIUM | Various uranium compounds | 0.016% U in tailings | 24 MM tons containing approx. 3.5 MM kg Uranium |
| URANIUM DEPLETED IN THE U-235 ISOTOPE | - | - | - |
| THORIUM (ISOTOPE) | Thorium Compounds | 190 pCi/g ($9.4 \times 10^{-7}$% Th) | 207 kg |

(e) MAXIMUM TOTAL QUANTITY OF ~~XXXXX~~ by-product MATERIAL YOU WILL HAVE ON HAND AT ANY TIME (kilograms)
24 MM tons tailings, equivalent to 21,800 MM kg

9. DESCRIBE THE CHEMICAL, PHYSICAL, METALLURGICAL, OR NUCLEAR PROCESS OR PROCESSES IN WHICH THE ~~XXXXX~~ by-product MATERIAL WILL BE USED, INDICATING THE MAXIMUM AMOUNT OF ~~XXXXXX~~ by-product MATERIAL INVOLVED IN EACH PROCESS AT ANY ONE TIME, AND PROVIDING A THOROUGH EVALUATION OF THE POTENTIAL RADIATION HAZARDS ASSOCIATED WITH EACH STEP OF THOSE PROCESSES
See Section 3.4, Vol. 3.

10. LIST THE NAMES AND ATTACH A RESUME OF THE TECHNICAL QUALIFICATIONS INCLUDING TRAINING AND EXPERIENCE OF APPLICANT'S SUPERVISORY PERSONNEL AND THE PERSON RESPONSIBLE FOR THE RADIATION SAFETY PROGRAM (OR OF APPLICANT IF AN INDIVIDUAL).
Radiation Safety Officer - Philip W. Morton (Resume attached)
Operations Manager )
Mill Superintendent ) Individuals to fill these positions not yet selected.
Laboratory Superintendent) Names and training will be forwarded as available.

11. DESCRIBE THE EQUIPMENT AND FACILITIES WHICH WILL BE USED TO PROTECT HEALTH AND MINIMIZE DANGER TO LIFE OR PROPERTY AND RELATE THE USE OF THE EQUIPMENT AND FACILITIES TO THE OPERATIONS LISTED IN ITEM 9. INCLUDE: (a) RADIATION DETECTION AND RELATED INSTRUMENTS (including film badges, dosimeters, counters, air sampling, and other survey equipment as appropriate. The description of radiation detection instruments should include the instrument characteristics such as type of radiation detected, window thickness, and the range(s) of each instrument).
See Section 4.0, Vol. 4.

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(b) METHOD, FREQUENCY, AND STANDARDS USED IN CALIBRATING INSTRUMENTS LISTED IN (a) ABOVE, INCLUDING AIR SAMPLING EQUIPMENT (for film badges, specify method of calibrating and processing, or name supplier).
Semi-annual calibration using sources traceable to National Bureau of Standards. Pre-use checks using vendor furnished check sources. Check sources will include alpha, beta and gamma sources.

11(c). VENTILATION EQUIPMENT WHICH WILL BE USED IN OPERATIONS WHICH PRODUCE DUST, FUMES, MISTS, OR GASES, INCLUDING PLAN VIEW SHOWING TYPE AND LOCATION OF HOOD AND FILTERS, MINIMUM VELOCITIES MAINTAINED AT HOOD OPENINGS AND PROCEDURES FOR TESTING SUCH EQUIPMENT

Not applicable to tailings management or by-product materials licensing

12. DESCRIBE PROPOSED PROCEDURES TO PROTECT HEALTH AND MINIMIZE DANGER TO LIFE AND PROPERTY AND RELATE THESE PROCEDURES TO THE OPERATIONS LISTED IN ITEM 9. INCLUDE (a) SAFETY FEATURES AND PROCEDURES TO AVOID NONNUCLEAR ACCIDENTS, SUCH AS FIRE, EXPLOSION, ETC., IN SOURCE MATERIAL STORAGE AND PROCESSING AREAS

See Sections 3.4 and 6.2, Vol. 3.
(a) No potential for non-nuclear accidents within tailings management system.

(b) EMERGENCY PROCEDURES IN THE EVENT OF ACCIDENTS WHICH MIGHT INVOLVE ~~SOURCE~~ by-product MATERIAL

See Section 7.0, Vol. 3

(c) DETAILED DESCRIPTION OF RADIATION SURVEY PROGRAM AND PROCEDURES

See Section 4.0, Vol. 4

13. WASTE PRODUCTS: *If none will be generated, state "None" opposite (a), below. If waste products will be generated, check here* ☐ *and explain on a supplemental sheet:*

(*a*) Quantity and type of radioactive waste that will be generated. None, other than the tailings or by-product material itself.

(*b*) Detailed procedures for waste disposal.

14. IF PRODUCTS FOR DISTRIBUTION TO THE GENERAL PUBLIC UNDER AN EXEMPTION CONTAINED IN 10 CFR 40 ARE TO BE MANUFACTURED, USE A SUPPLEMENTAL SHEET TO FURNISH A DETAILED DESCRIPTION OF THE PRODUCT, INCLUDING: NOT APPLICABLE

(*a*) PERCENT SOURCE MATERIAL IN THE PRODUCT AND ITS LOCATION IN THE PRODUCT.

(*b*) PHYSICAL DESCRIPTION OF THE PRODUCT INCLUDING CHARACTERISTICS, IF ANY, THAT WILL PREVENT INHALATION OR INGESTION OF SOURCE MATERIAL THAT MIGHT BE SEPARATED FROM THE PRODUCT.

(*c*) BETA AND BETA PLUS GAMMA RADIATION LEVELS (*Specify instrument used, date of calibration and calibration technique used*) AT THE SURFACE OF THE PRODUCT AND AT 12 INCHES.

(*d*) METHOD OF ASSURING THAT SOURCE MATERIAL CANNOT BE DISASSOCIATED FROM THE MANUFACTURED PRODUCT.

## CERTIFICATE

(*This item must be completed by applicant*)

15. *The applicant, and any official executing this certificate on behalf of the applicant named in Item 2, certify that this application is prepared in conformity with Title 10, Code of Federal Regulations, Part 40, and that all information contained herein, including any supplements attached hereto, is true and correct to the best of our knowledge and belief.*

BY: F S Mooney
(*Signature*)

Dated July 23, 1979

F. S. Mooney
(*Print or type name*)

Senior Vice-President, Uranium Operations & Marketing
(*Title of certifying official authorized to act on behalf of the applicant*)

**WARNING:** 18 U.S.C. Section 1001; Act of June 25, 1948; 62 Stat. 749; makes it a criminal offense to make a willfully false statement or representation to any department or agency of the United States as to any matter within its jurisdiction.

Form NRC-2 (7-77)

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APPLICATION REGISTRATION

FORMAT FROM ITEMS 8 & 9, RPS FORM 16

8. TRAINING

| NAME, TITLE, DEGREE | WHERE TRAINED | LENGTH OF ACADEMIC TRAINING | LENGTH OF ON-THE-JOB TRAINING |
|---|---|---|---|
| orton, Philip, W. | Kansas State University | 4 years A B C D * | 2 years A B C D * |
| RSO | University of Maryland Graduate School | 1 year A B C D | |
| BS Nuclear Engineering | Walter Reed Army Medical Center | 2 weeks A D | 3.5 years A B C D |
| | Thailand | | 2 years B C |
| | Viet Nam | | 1 year C |
| | Fort Meade, MD | 12 weeks A B C D | 3 years A B C D |
| | Okinawa, Japan | 2 weeks A B C D | 4 years A B C D |
| | Environmental Hygiene Agency | 2 weeks A B C D | 1 year A B C D |
| | Gulf Oil Corporation | 2 weeks A B C D | 9 months A B C D |
| | Mine Safety & Health Administration | 4 weeks A B C D | |

9. EXPERIENCE WITH

| ISOTOPE | MAXIMUM AMOUNT | LOCATION | DURATION | TYPE OF USE |
|---|---|---|---|---|
| 94% enriched Uranyl Sulfate solution and Fission Products | | Walter Reed Research Reactor | 2-1/2 years | Senior Reactor Operator (AEC Licensed); 50 KW, liquid fuel, North Carolina State Water boiler type reactor used for medical research. |
| $^{41}A$ | Kilocurie amounts | Walter Reed Research Reactor | 2-1/2 years | Daily waste generated |
| $^{60}Co$ | Kilocurie amounts | Walter Reed Army Institute of Research | 2-1/2 years | Supervisor of AECL Cammacell 220 and Budd Co. Small Animal Irradiator operations including source reloading |
| $^{226}Ra$ | Approximately 800 mg in various sized medical applicators | Walter Reed General Hospital | 1 year | Health Physics tech; leak testing and assisting on human therapy implants |
| $^{137}Cs$ | Up to 1 kilocurie | Walter Reed AMC | 1 year | HP tech; leak testing sealed and unsealed sources. |
| | | Okinawa, Japan | 4 years | Calibration and lead testing. |
| Standard Military Alpha, Beta & Gamma Sources | Multicurie | All of the above and Fort Meade, MD | 10-1/2 years | Calibration and leak testing. |
| Enriched Uranium & Fission Products | | Harry Diamond Labs | 2-1/2 years | Alternate Member Reactor Safetuards Committee, 250 KW TRIGA MARK IV with stainless steel clad fuel. |
| Enriched Uranium & Fission Products | | Kansas State University | 2 years | Reactor Startup Crew and student user, 100 KW TRIGA MARK II with aluminum clad fuel. |
| Depleted Uranium | | Kansas State University | 4 years | Student user KSU Subcritical pile. |
| Ra - Be<br>Pu - Be | Neutron sources | Kansas State University | 4 years | Reactor startup sources, student user and leak testing. |
| Pu - Be | | Walter Reed AMC<br>Okinawa, Japan | 2-1/2 years<br>4 years | Reactor startup sources and leak testing.<br>Moisture [illegible]sity guage & leak testing. |
| Atomic Numbers 3-83 and $^{3}H$ | Up to 1 curie at a time. | Walter Reed AMC | 1 year | HP tech on numerous human patient procedures; receiving and shipping waste. |
| Neutron Activated Materials | | Walter Reed Research Reactor<br>KSU<br>Harry Diamond Labs | 2-1/2 years<br>2 years | Numerous materials, medicines and live animals (mice, rats, pigs, dogs, etc.). |
| X-Ray Units | 300 | Walter Reed Army Institute of Research | [illegible] years | Supervisor, Irradiation Facilities for the Army Anti-Radiation Drug Program. |
| Radiation Protection Surveys | Certified by the U. S. Army Surgeon General to perform Radiation Protection Surveys (including human use), medical x-ray protection and Subchapter J certification surveys, micro-wave oven surveys and acceptance testing Instructor qualified in Nuclear, Biological and Chemical Sciences, U.S. Army Medical Field Services School. Conducted numerous radiation protection surveys over a 9 year period throughout the Continental U. S., Asia and the near East for the Army, Navy, Marine Corps and the Foreign Service, Department of State. | | | |

A) Nuclear physics, atomic structure, and interaction of radiation with matter
B) Radiation detection instrumentation, calibration, and standardization
C) Radiation protection, waste disposal, and survey and dosimetric procedures
D) Radiobiology, including effects of radiation on the human body

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# Executive Summary

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## EXECUTIVE SUMMARY

1.0

# PROPOSED ACTIVITIES

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Gulf Mineral Resources Co., a division of Gulf Oil Corporation, proposes to construct and operate a tailings disposal system for the Mt. Taylor Uranium Mill Project. This project is located in northwestern New Mexico approximately 60 miles west northwest of Albuquerque, and 30 miles northeast of Grants. The mill facility will be located in Lower San Lucas Canyon, Section 1, T13N, R8W, McKinley County, New Mexico, approximately 3.5 miles north of the town of San Mateo. The tailings impoundment will be located in La Polvadera Canyon, Sections 10, 11, 14 and 15, T14N, R8W, McKinley County, New Mexico, approximately six miles north of the mill. Uranium ore will be supplied from the Gulf Mt. Taylor mine currently under development in Section 24, T13N, R8W, Valencia County. The mine, which lies approximately 0.5 mile northeast of the town of San Mateo is approximately three miles south of the mill.

The proposed mill will process blended ore assaying between 0.05 and 0.5 percent uranium ($U_3O_8$) to a finished yellowcake product at a design rate of 4200 dry tons of ore per day. This throughput rate will produce an average 8.6 million pounds of yellowcake per year. Final yellowcake quality should assay greater than 85 percent $U_3O_8$. Based on current ore reserves and market assessments, the productive life of the mill will be 20 years.

Detailed design of the mill commenced in the second half of 1978, with site preparation and constructing expected to begin the first half

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of 1980. Construction of the tailings dam and pond is also scheduled to commence the first half of 1980. Both the mill and tailings facility are targeted to be in operation in the last half of 1981.

Mill tailings, excepting that fraction of sands to be separated out and returned to the mine for use as backfill, will be pumped to the La Polvadera tailings impoundment. The tailings pipeline is described in Section 3.4.1 of the Environmental Report. The impoundment is sized to contain all wastes derived over the mill's 20 year operating life. The dam, which is a zoned earth and rockfill structure designed as a water-reservoir type of dam, will be constructed in four stages over the life of the project. Details on the design of the impoundment, control of fugitive dust emanating from the impoundment, and seepage evaluation can be found in Section 3.4.2 of the Environmental Report. The reclamation plan for the tailings impoundment area presently calls for placement of ten feet of earth and clay cover on top of the deactivated tailings pond. Reclamation of the tailings impoundment area is more fully discussed in Section 9.1 of the Environmental Report.

Evaluations of alternative sites for below grade burial are being developed for tailings disposal. Target completion date for this work is September 1, 1979.

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# 2.0
# SITE DESCRIPTION

## 2.1 GEOGRAPHY AND DEMOGRAPHY

### 2.1.1 Geography

The Mt. Taylor Uranium Mill Project is located in northwestern New Mexico on the McKinley-Valencia County border, near the town of San Mateo. San Mateo lies about 30 miles northeast of Grants along Highway 53 (Figure 2.1-1). The project area lies in the eastern part of the Ambrosia Lake mining district, one of New Mexico's major uranium-producing areas. The location of the proposed mill and tailings impoundment, as well as the fenced boundaries of land used for the project, is shown in Figure 2.1-2.

The status of land owned and leased by Gulf in the project area, and the ownership of surrounding property, is shown on Figure 2.1-3. Provisions have been made and will continue to be made for Gulf, or any assignee, to enter the premises after operations are terminated for the purpose of monitoring or maintenance in accordance with federal and/or state law.

The two water bodies in the project area, San Mateo Reservoir and Laguna Polvadera, are also noted on Figure 2.1-3. It should be pointed out that the presence of the "lake" at Laguna Polvadera is due principally to the discharge of treated mine water from the Gulf Mt. Taylor Mine.

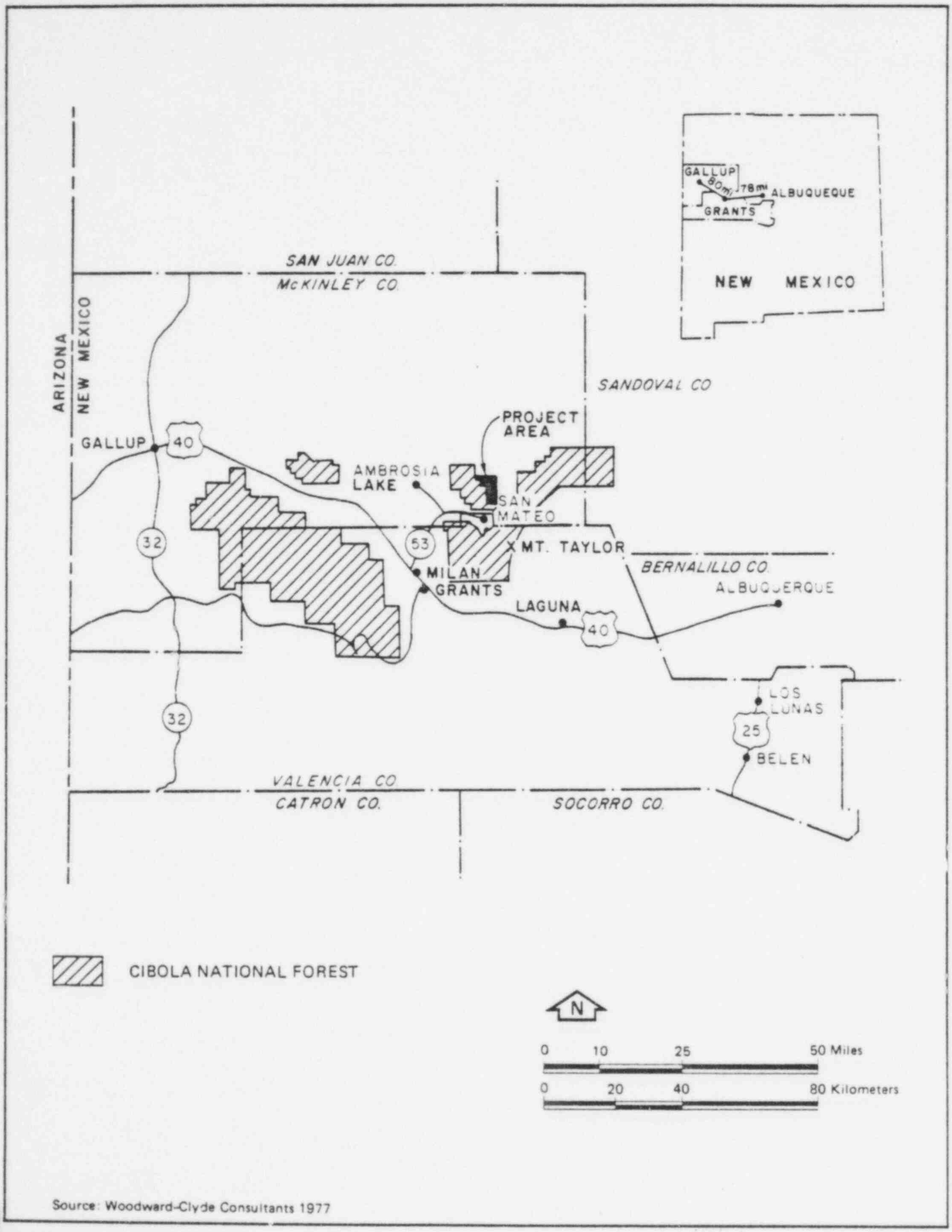


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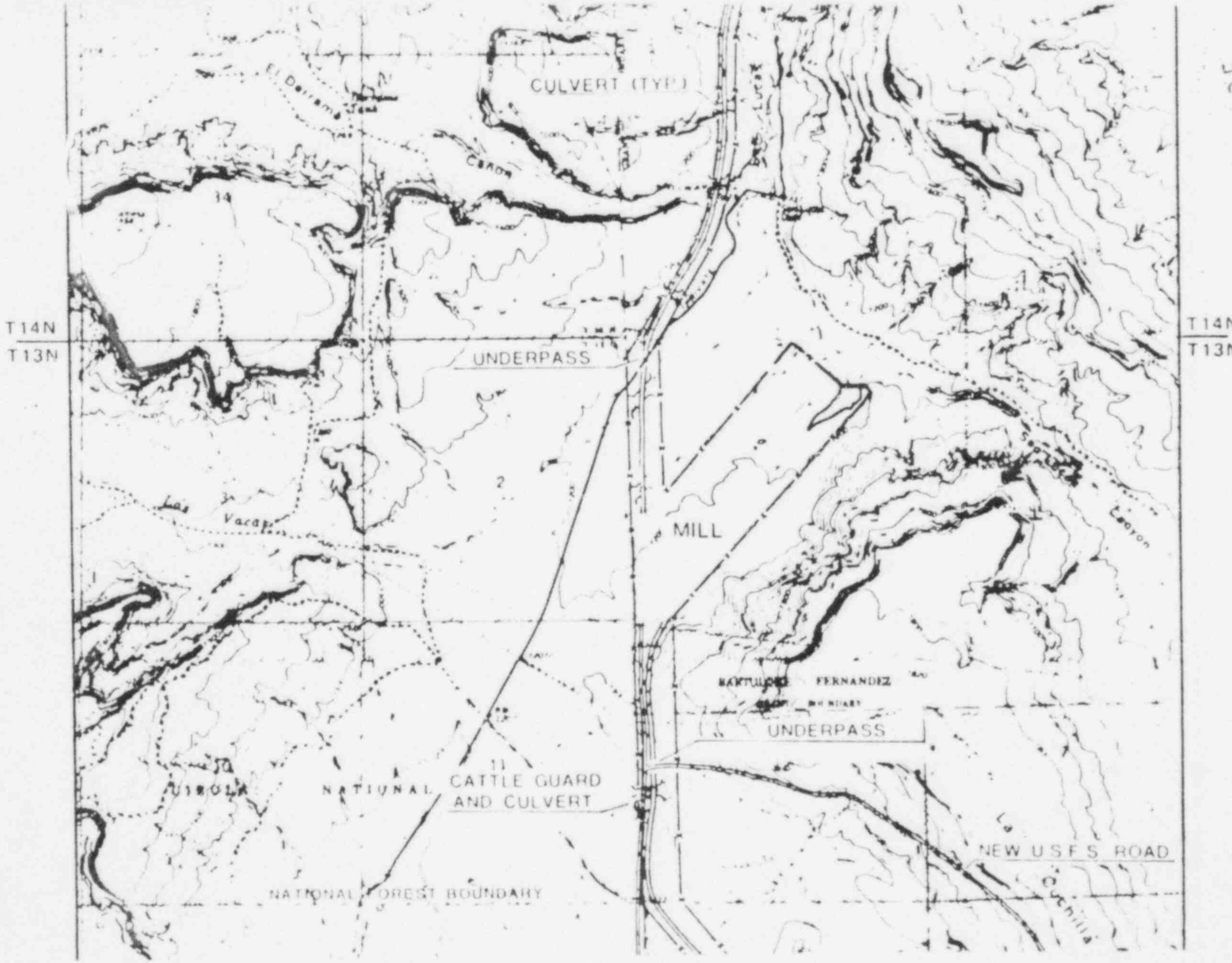
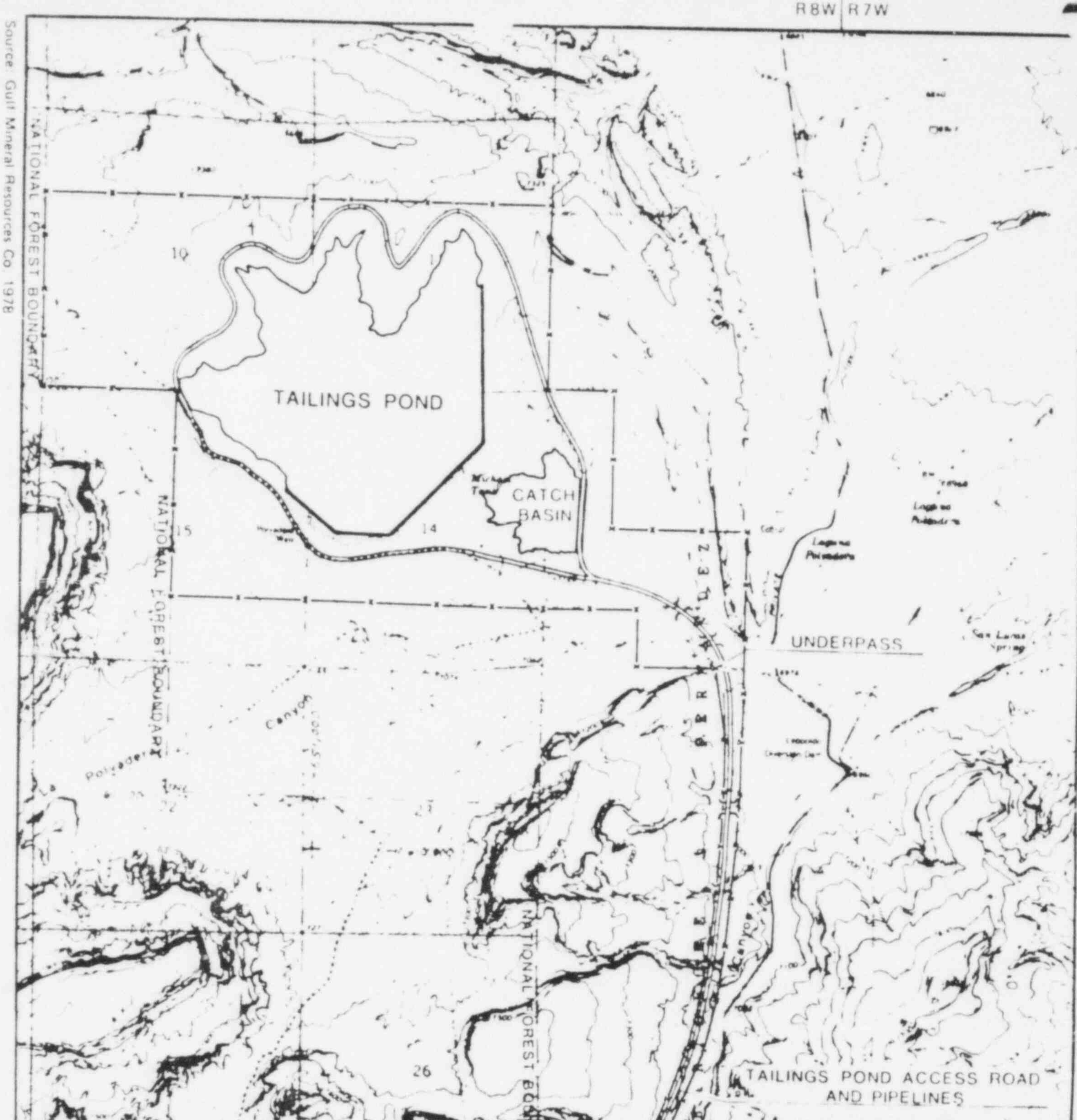
Figure 2.1–1.
PROJECT LOCATION




Figure 2.1-2.
PROJECT LAYOUT


CULVERT (TYP)
El Derramadero
Cañon
14
T14N
T13N
UNDERPASS
2
Las Vacas
MILL
Leyon
BARTOLOME FERNANDEZ
UNDERPASS
11
CIBOLA
NATIONAL
CATTLE GUARD
AND CULVERT
NEW U.S.F.S. ROAD
NATIONAL FOREST BOUNDARY




Source: Gulf Mineral Resources Co. 1978



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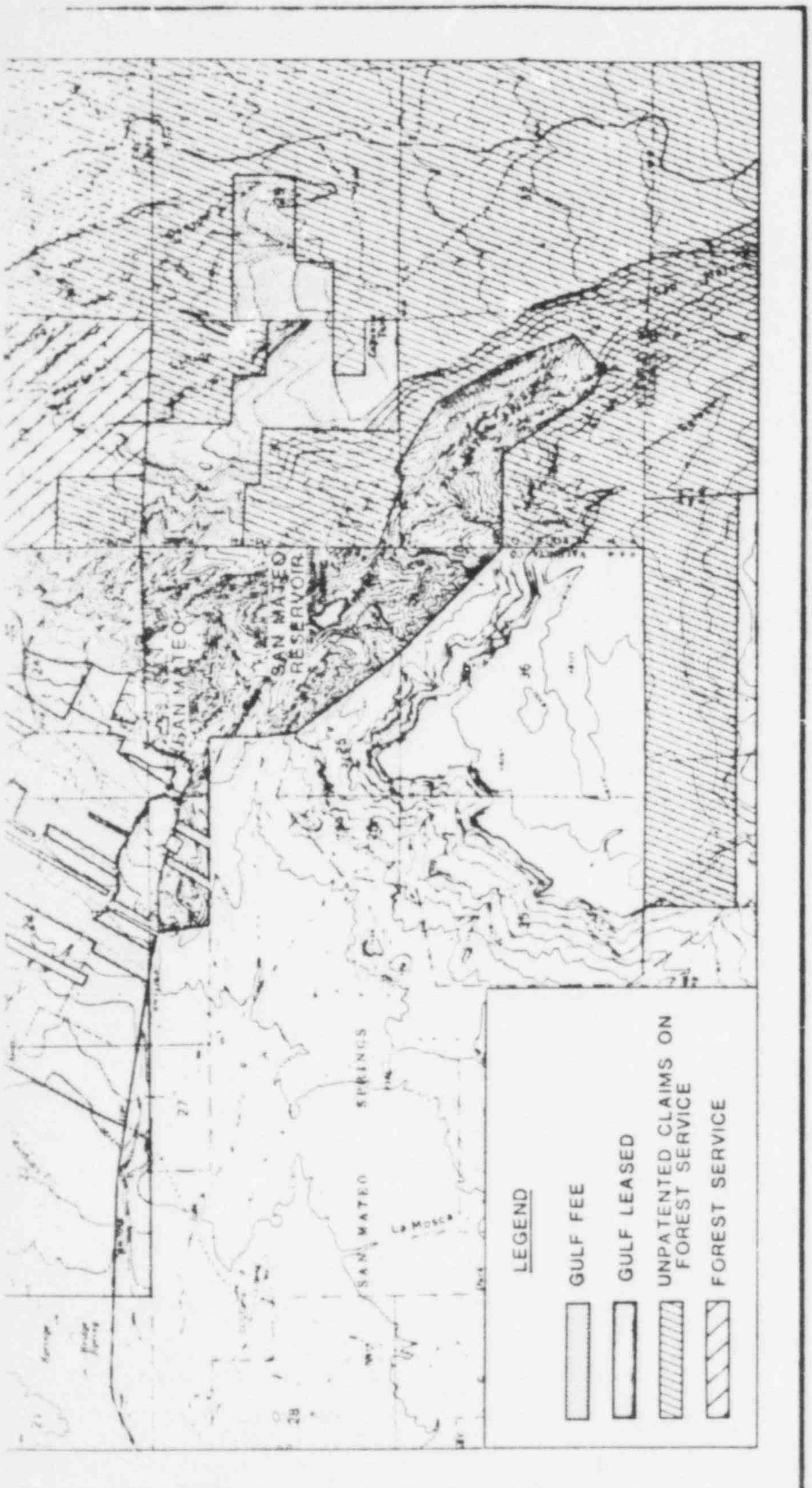
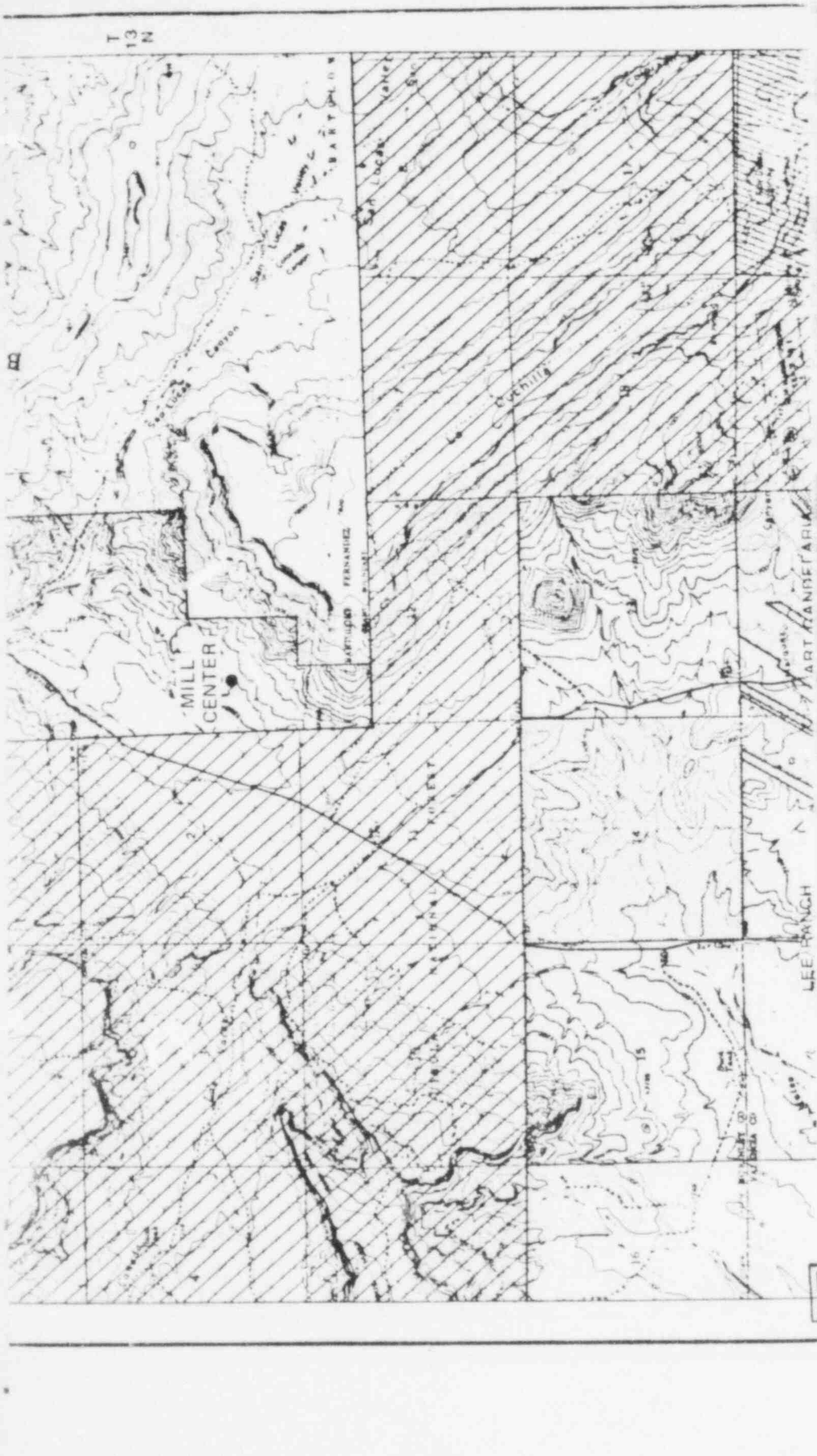





Figure 2.1-3.
MT. TAYLOR LAND STATUS FOR MC KINLEY AND VALENCIA COUNTIES, NEW MEXICO



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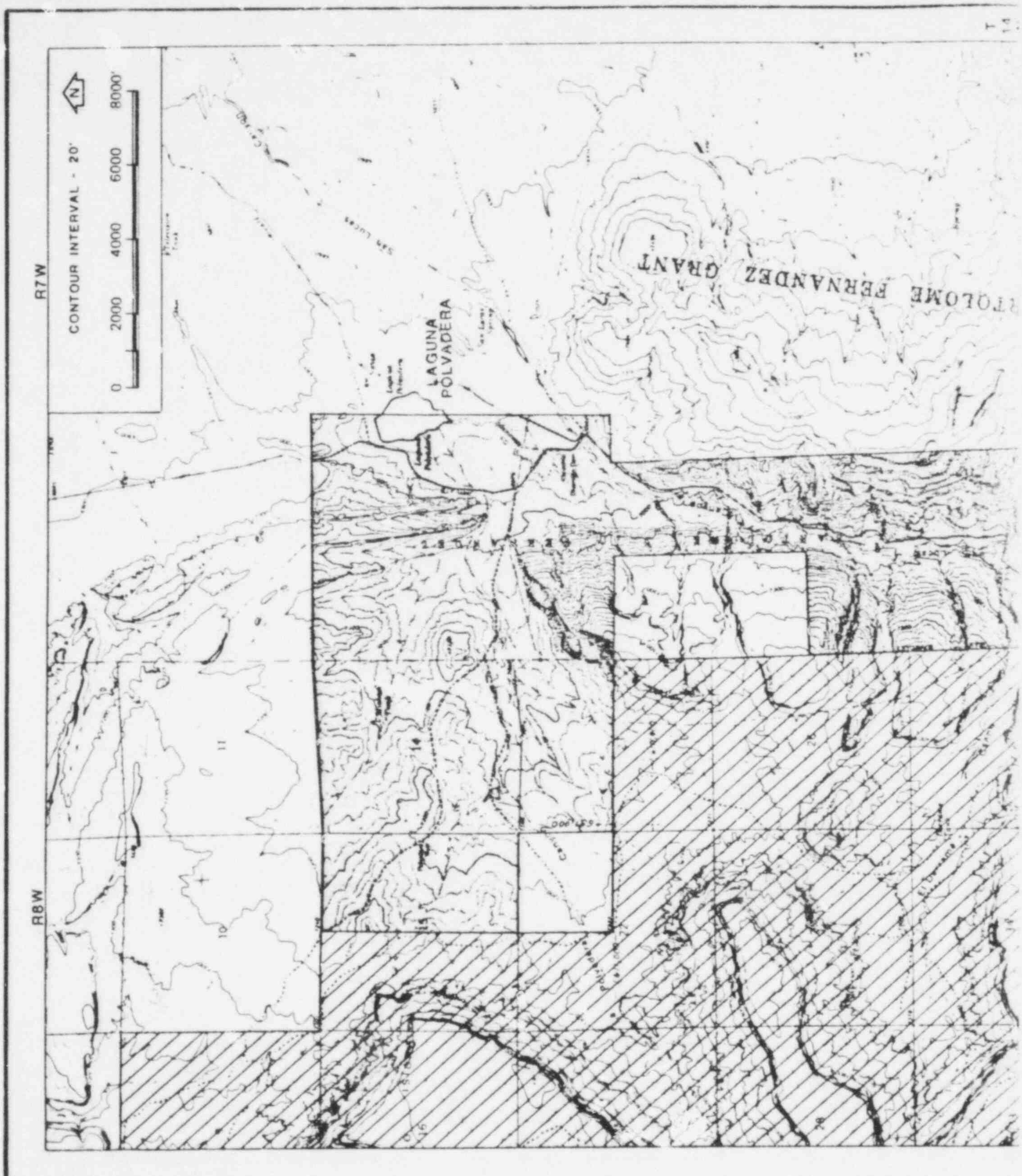


Source: Gulf Mineral Resources Co.

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The most prominent topographic feature in the region is Mt. Taylor, a Miocene volcano surrounded by basalt-capped plateaus. The broad valleys of the project area are separated from the mesa tops by steep slopes abruptly dissected by arroyos. The uplands of the Mt. Taylor volcanic plateau and San Mateo mesa are part of the Cibola National Forest, which crosses the center of the project area.

2.1.2 Demography

Figure 2.1-4 notes the location of those residences and population centers within a five mile radius of the mill for which radiological dose assessments were calculated in Section 5.2 of the Environmental Report. It should be noted that Gulf has learned that the Marcus Ranch, for which dose calculations were also given in Section 5.2, has been abandoned for some time.

The two residences nearest the mill are the Candelaria residence with an associated population of six persons, and the Lee Ranch with an associated yearly average population of 25 persons.

The population center nearest to the project area is the unincorporated town of San Mateo. It is located within one mile of the Gulf Mt. Taylor mine and within four miles of the proposed mill site. The number of families living in San Mateo has been estimated at 75, with a total population of about 200 persons. The employment and economic base in the community has been primarily ranching and farming, although a shift to employment in uranium mining and milling operations has occurred over the last 15 years. Since the city of Grants is located only 30 miles from the project, it is anticipated that population growth resulting from the Mt. Taylor Project will occur there rather than in San Mateo.

Grants, the principal city in Valencia County, and its close neighbor Milan, represented 27 percent of the total county population in 1970. The

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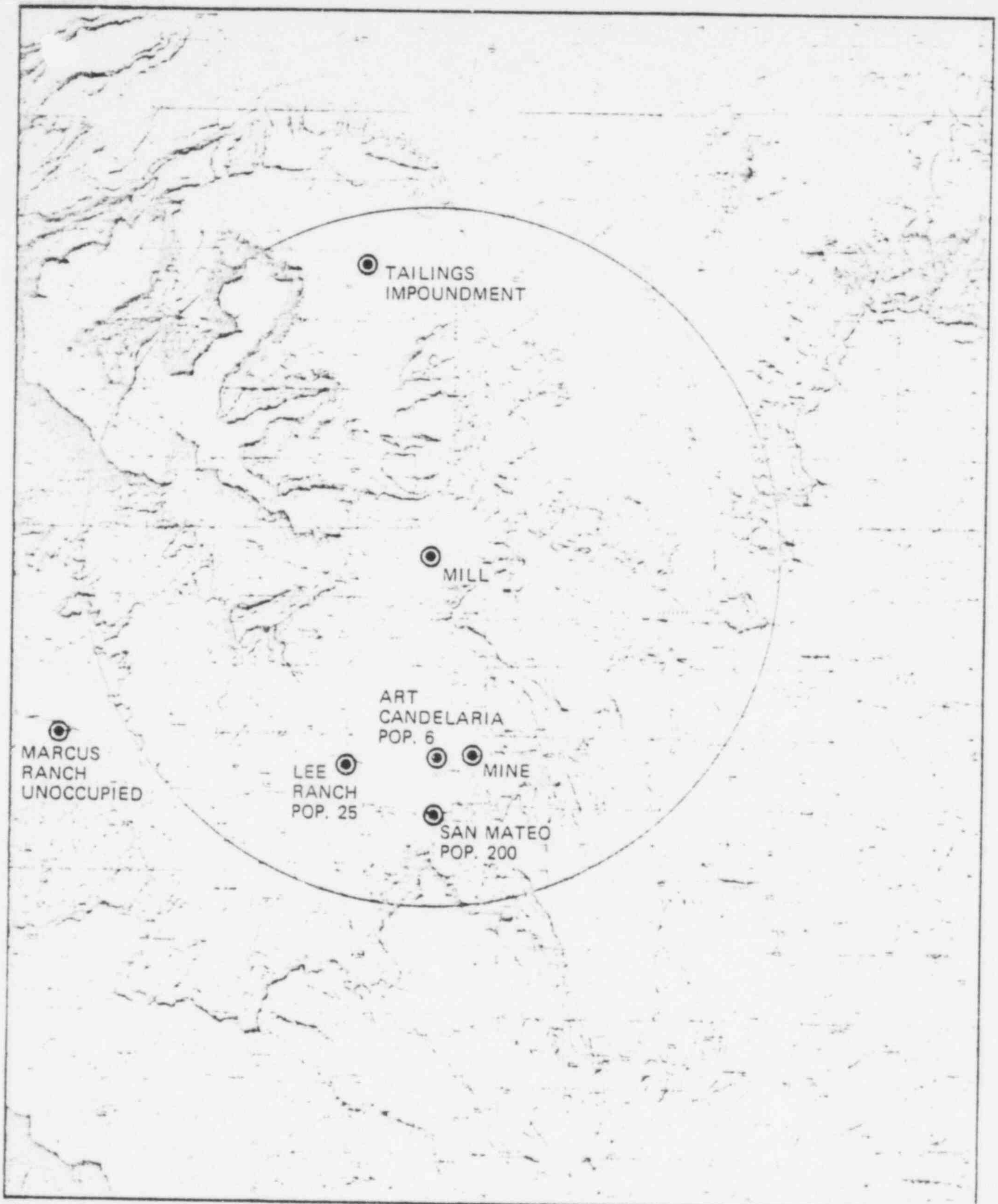


Source: Gulf Mineral Resources Company.

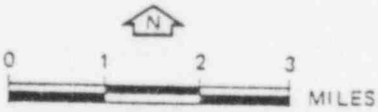


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Figure 2.1–4.
POPULATION DISTRIBUTION
WITHIN 5 MILE RADIUS OF MILL

population characteristics of the Grants/Milan community have been greatly influenced by mineral extraction and beneficiation activities in the Grants Uranium Belt. Whereas the advent of mining and milling activities in the 1950's brought over 8000 additional persons to the area, the reduction in areawide mineral extraction activities in the late 1960's caused a significant decrease in population which stabilized at approximately 400 percent of what it had been in pre-mining days. Recent mineral industry development in the region has begun to draw residents to Grants once again. A 1976 population estimate indicates that the Grants/Milan community has grown to 18,800 persons. A detailed discussion of population characteristics and projections are provided in Section 2.2 of Volumes 2 and 3 (hereafter referred to as the Environmental Report) of this mill license application.

There are no significant transient or seasonal population variations near the project area. The Lee Ranch does experience some seasonal flux due to ranching operations, but this variation has been taken into account in the population estimate for that residence. There are no other ranching or farming units in the project area whose size would warrant transient or seasonal help.

## 2.2 METEOROLOGY

Meteorological monitoring stations were established at five locations in the general Mt. Taylor Uranium Mill vicinity (Figure 2.2-1) to provide data for comparison with surrounding local and regional long-term stations. The information on local climate presented here consists of a synthesis of the available project area data and the long-term regional data. More detailed information on this subject can be found in Section 2.7 of the Environmental Report.

The site area exhibits a large diurnal range in temperature. Project area data, including monthly and annual mean ranges and extremes, are shown in Table 2.2-1. Relative humidity in the area over the long term is estimated to range from an average of 65 percent at sunrise to near 30 percent in midafternoon. Data collected at Monitoring Station #1 over a 12-month period indicate the same relative humidity pattern as Albuquerque with a mean annual relative humidity approximately three percent higher at the project area.

Wind speed and wind direction were monitored at four locations in the project area (Figure 2.2-1). Diurnal distributions of winds for Site #3 indicate the overriding diurnal influences resulting from drainage from San Mateo Mesa and La Polvadera Canyon during the nighttime-evening hours and the upslope effects during the midday periods. The patterns are both consistent and identifiable with respect to controlling wind circulation influences and can be considered to be most representative of the project area. The wind rose for Site #3 is shown in Figure 2.2-2.

Using temperature differences ($\Delta T$'s) obtained from the two-tower network (Monitoring Sites #1 and #2), stability classifications for each hour of the day were determined over a 12-month period. The resulting stability class distributions closely match the long-term Albuquerque regional

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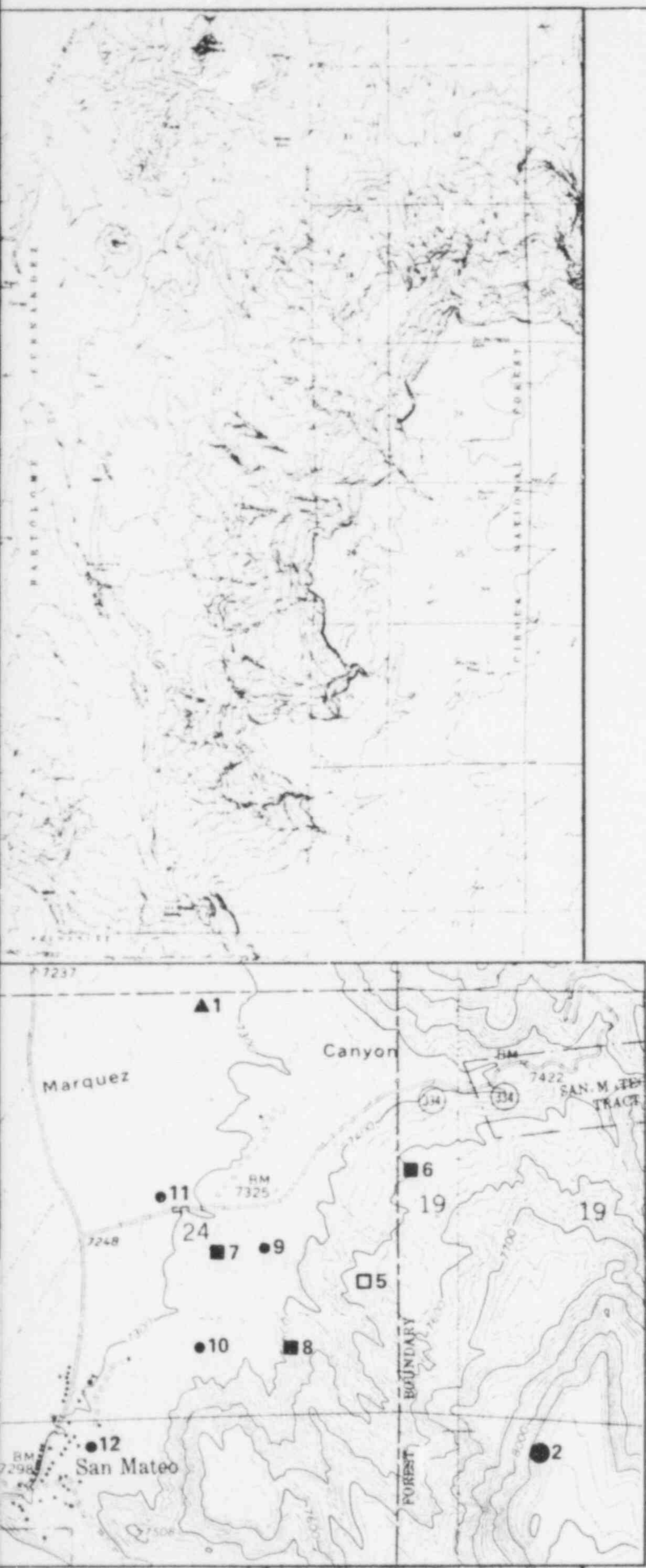


N

0 3000 6000 12000 Feet

0 1000 2000 3000 Meters

MONITORING SITE

- ▲ TEMPERATURE, WIND DIRECTION AND SPEED, RELATIVE HUMIDITY, SULFATION PLATES
- ● TEMPERATURE, WIND DIRECTION, AND SPEED, SULFATION PLATES
- △ TEMPERATURE, WIND DIRECTION AND SPEED
- □ HI VOL SAMPLER, PRECIPITATION, EVAPORATION, SUFATION PLATES
- ■ SULFATION PLATES
- • NOISE SAMPLING

N

0 1000 2000 4000 Feet

0 500 1000 Meters

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Figure 2.2–1.
METEOROLOGICAL AIR QUALITY
MONITORING STATIONS

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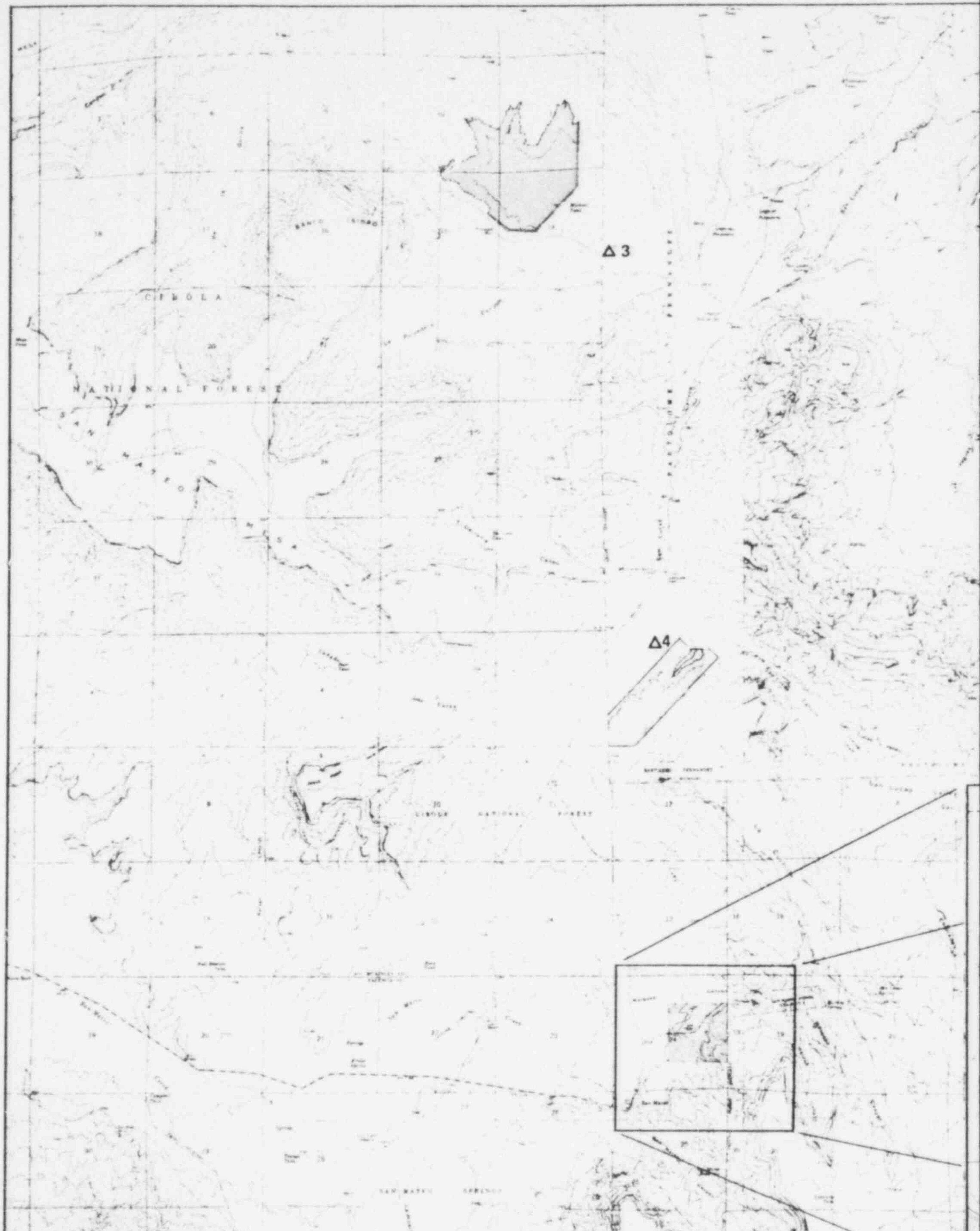


Source: Woodward-Clyde Consultants 1977

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Table 2.2-1. MONTHLY AND ANNUAL MEANS AND EXTREMES OF TEMPERATURE (°F) RECORDED AT THE MT. TAYLOR URANIUM MILL PROJECT MONITORING SITE #1 ELEVATION, 7280 FEET MSL

| Month | Mean | Mean Daily Maximum | Mean Daily Minimum | Extreme Maximum | Extreme Minimum |
|---|---|---|---|---|---|
| 1976 | | | | | |
| February | 37.1 | 46.2 | 28.7 | 58.0 | 14.0 |
| March | 34.6 | 45.6 | 22.5 | 63.0 | 10.5 |
| April | 48.0 | 57.3 | 36.9 | 65.5 | 19.0 |
| May | 55.2 | 64.7 | 45.1 | 76.0 | 30.0 |
| June | 64.5 | 75.1 | 52.8 | 84.0 | 42.0 |
| July | 67.3 | 78.3 | 57.1 | 86.0 | 52.0 |
| August | 66.2 | 76.5 | 56.7 | 83.0 | 44.5 |
| September | 59.8 | 70.4 | 49.8 | 82.0 | 39.5 |
| October | 48.3 | 57.6 | 38.9 | 72.0 | 29.5 |
| November | 38.8 | 49.8 | 28.3 | 62.0 | -5.0 |
| December | 31.9 | 43.8 | 22.4 | 58.0 | 10.0 |
| 1977 | | | | | |
| January | 28.5 | 38.3 | 20.3 | 48.0 | 3.0 |
| Annual | 48.4 | 58.7 | 40.3 | 86.0 | -5.0 |

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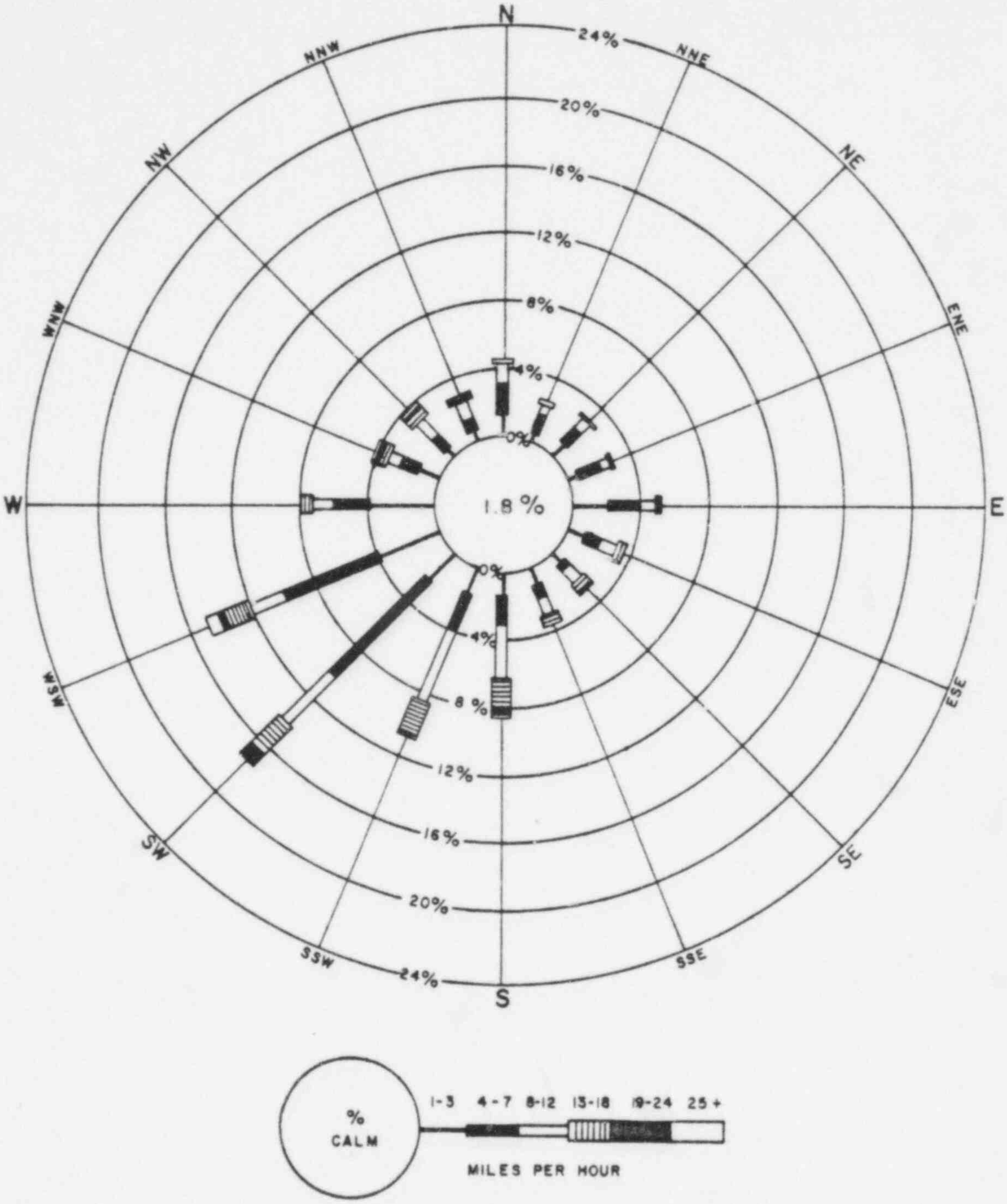


Monitoring Site No. 3
Period of Record
JULY 7 – SEPT. 3, 1976
NOV. 24 – JAN. 20, 1977

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Source: Woodward-Clyde Consultants 1977

Figure 2.2–2.
LA POLVADERA VALLEY WIND ROSE

data and the SOHIO L-Bar Ranch data with good stability conditions (Stability Classes A through D) occurring 70 percent of the time. Boundary layer inversion conditions (Stability Classes E, F, and G) occurred approximately 30 percent of the time, primarily during nighttime and early morning hours. It is important to note that inversion conditions at the project site are almost exclusively associated with downslope drainage from San Mateo Mesa. Consequently, poor dispersion conditions, which would be associated with highly stable air impacting on the mesa canyon slopes, are generally avoided.

Precipitation in the project area occurs primarily during the thunderstorm season (July through September), although total annual and monthly rainfall amounts vary considerably from year to year. The on-site precipitation data approximated the long-term records for San Mateo with the exception that somewhat higher rainfall amounts were measured in July, and lesser amounts were measured in the fall and winter.

Thunderstorms are relatively frequent in the area during the summer months. Due to the elevated levels of precipitation occurring over a short time period, runoff, both within drainage courses and on the sides of slopes, is a common result of thunderstorm events. Thunderstorms may also result in elevated wind speeds.

Additional meteorologic monitoring is under way in La Polvadera and San Lucas Canyons in order to provide a full year of meteorological data for those sites.

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## 2.3 HYDROLOGY

### 2.3.1 Ground Water

The project area is located northwest of the Mt. Taylor volcanic field in the Bluewater and Rio Grande Underground Water basins. The most important hydrogeologic units that occur beneath the project area include the Cretaceous Dakota Sandstone, Jurassic Westwater Canyon member of the Morrison Formation, Permian Glorieta Sandstone, and Permian San Andres Limestone. Hydrogeologic units of less importance as water supply sources include the Quaternary alluvial and volcanic deposits, Cretaceous Point Lookout and Gallup Sandstones of the Mesa Verde Group, Jurassic San Rafael Group, and Triassic Chinle Formation. Discussion of the hydrogeologic characteristics of these aquifers, including flow yields and recharge potential, are given in detail in Section 2.6.1 of the Environmental Report.

The regional aquifers probably are recharged by infiltration of precipitation falling on their outcrop zones south and west of the project area, by infiltration of runoff in stream valleys where the alluvium has hydraulic connection with the aquifers, or by direct percolation where streams transect outcrop areas. There is no evidence of any groundwater recharge within the tailings impoundment area. Natural ground water discharges in several locations in the general project area in stream valleys as springs. Such springs generally flow only a short distance downstream before evaporating or seeping back into the aquifer.

With the exception of water wells and exploration boreholes drilled by Gulf, wells and springs in the region are few and widely scattered. Aquifers into which wells are completed include the alluvial deposits, Menefee Formation, Point Lookout Sandstone, Gallup Sandstone, Dakota Sandstone, and Westwater Canyon Member. Most water derived from area wells is used for livestock purposes; only San Mateo has wells drilled for domestic supply purposes in the project area. As the direction of groundwater flow in the area is easterly and, due to the isolated nature of the area north and east of the mill and tailings impoundment site, the water supplies of downstream users, if any, should not be affected. Tables 2.6-2 and 2.6-3 of the Environmental Report tabulate existing private users within the region, their locations and the physical characteristics of the water wells.

Extensive testing for reliable field permeability data was performed in La Polvadera Canyon for the purposes of estimating pond seepage. From test results, weighted average permeability values were computed to be:

| Geologic Unit | Permeability (feet per year) |
|---|---|
| Dilco | 4.4 |
| Gallup | 8.8 |
| Mancos | 0.05 |

It is believed that the field permeabilities reflect near-horizontal or bedding plane directions, but these values most probably reflect vertical permeabilities as well.

2.3.2 Surface Water

Surface water drainage from the mill and tailings impoundment sites flows overland in an easterly direction into San Lucas Canyon, a tributary of San Miguel Creek. From here the drainage trends generally in a northeast direction to Arroyo Chico which eventually merges with the Rio Puerco. The Rio Puerco joins the Rio Grande near Bernardo, approximately 45 miles south of Albuquerque. These drainage patterns are shown on Figures 2.3-1 and 2.3-2.

839 140

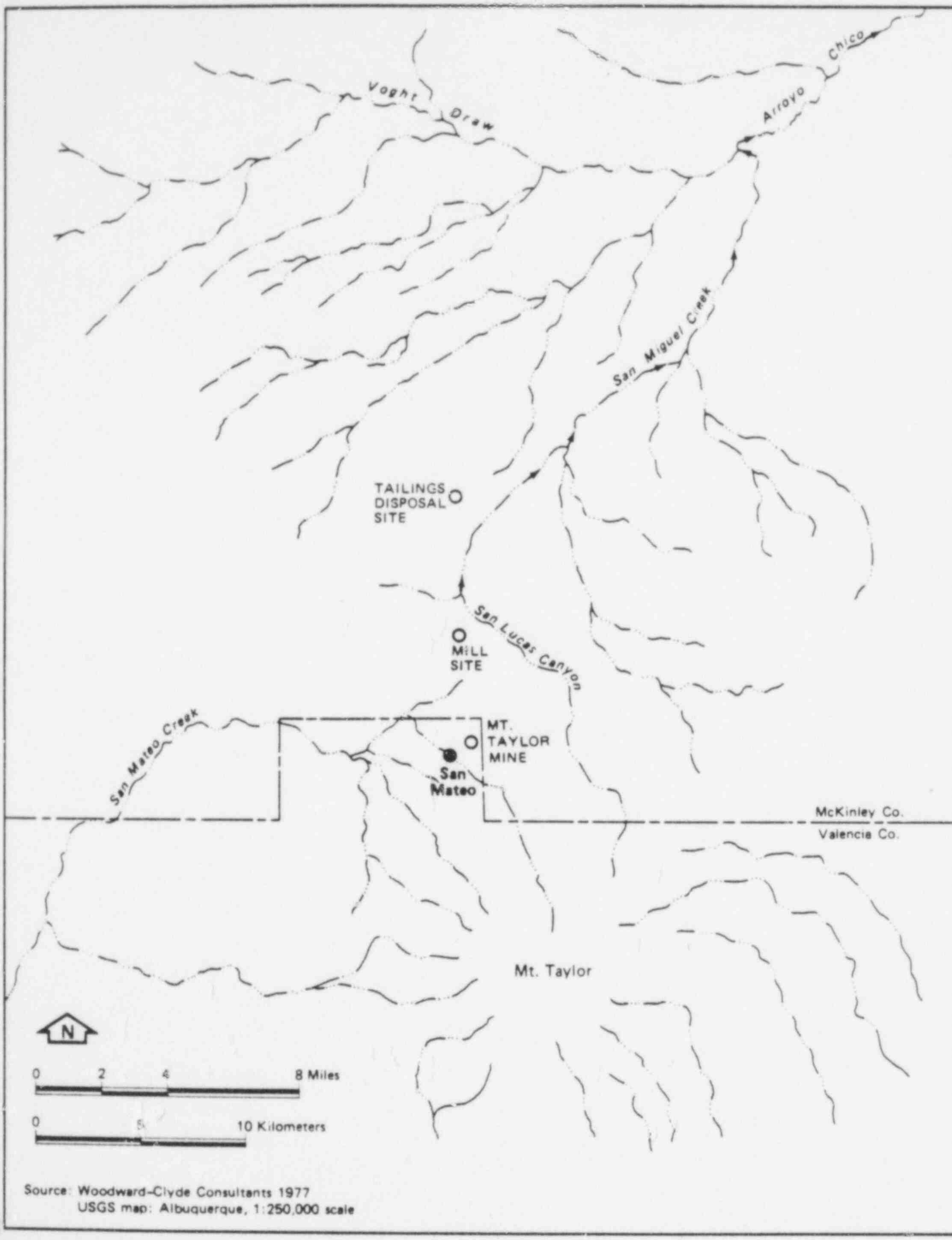


Figure 2.3–1.
REGIONAL DRAINAGE PATTERNS

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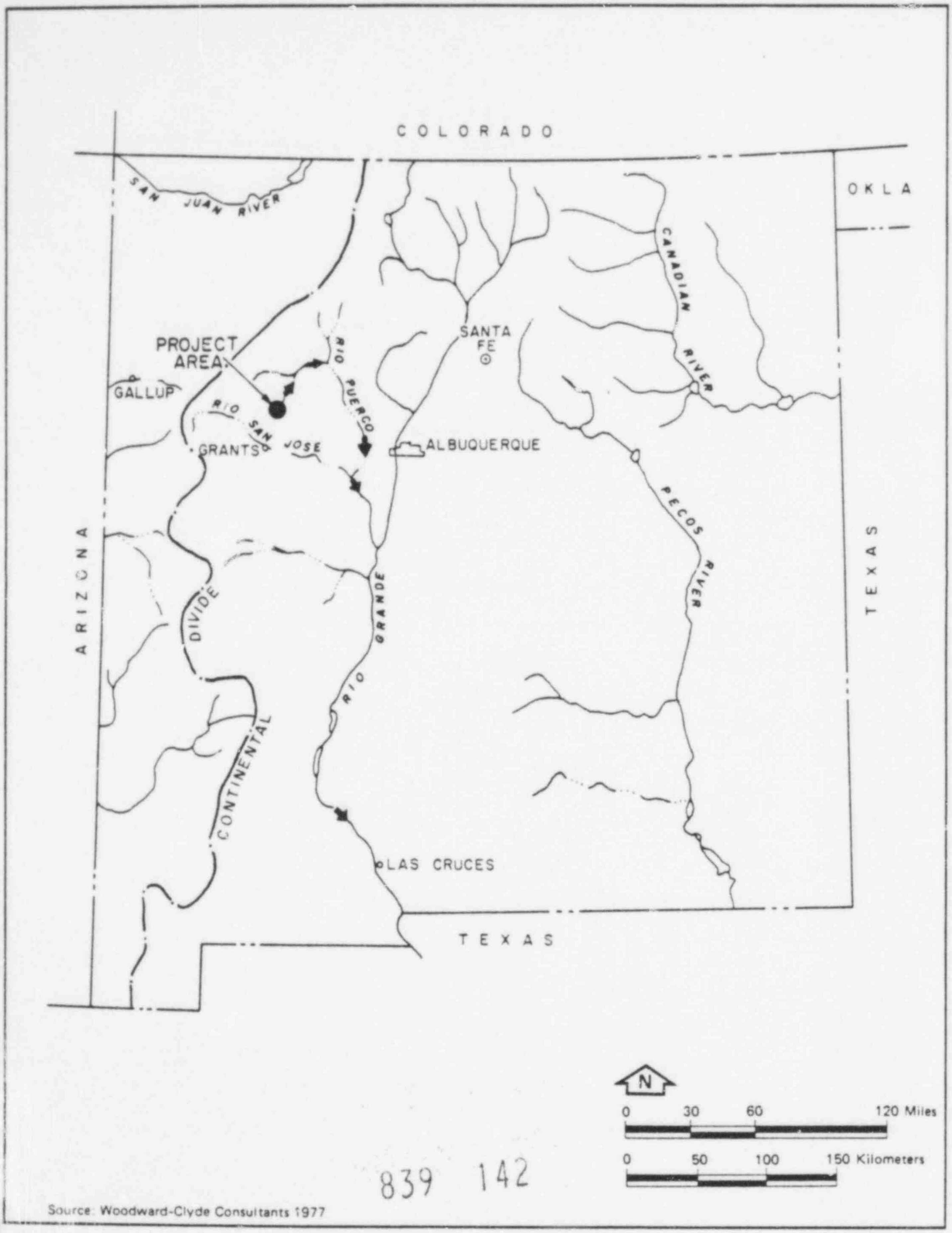


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Figure 2.3–2.
DRAINAGE PATTERNS IN NEW MEXICO

Precipitation ranges from approximately 10 to 12 inches per year in the project vicinity up to about 20 inches per year near Mt. Taylor. Because much of the annual precipitation occurs during brief, intense thunderstorms which often cause flooding and extreme peak discharges, the land surface is incised by many pronounced drainage channels. These channels, or arroyos, are usually dry and on a regional basis exhibit low annual runoff rates. There are no standing bodies of water within the project area, and streams would best be termed intermittent. San Mateo Creek, the perennial stream nearest the project area, is in a different drainage basin and therefore will not be impacted by operation of either the mill or the tailings impoundment. One of the primary factors in selecting the San Lucas mill site was its location north of a natural drainage divide. As a result, any unexpected surface drainage from the mill will flow north via the unpopulated San Lucas Canyon rather than south near the community of San Mateo. Ground water remains the principal water supply source in the region.

## 2.4 GEOLOGY AND SEISMOLOGY

### 2.4.1 Geology

The project area lies in the eastern part of the Colorado Plateau geologic province near the southern boundary of the San Juan Basin. The site is about 35 miles west of the San Ignacio faulted monocline that forms the boundary between the Colorado Plateau and the Rio Grande Depression (Figure 2.4-1).

La Polvadera Canyon, the site of the proposed tailings impoundment, is at the northeast end of San Mateo Dome, an elongated structure that trends northeasterly. The flank of the dome coincides with a part of the west flank of the McCartys syncline. Contours drawn at the base of the Dakota Sandstone show that the San Mateo Dome retains its general structure at depths of 1600 to 2000 feet. The dome is cut by normal faults which can be traced for several miles and exhibit both vertical and horizontal displacement. The canyon area is a broad, rolling, bowl-shaped basin drained by several washes that converge and drain through a series of low hogback ridges into San Lucas Canyon. The hogbacks, formed by resistant sandstone beds dipping 20 to 30 degrees east, form the eastern flank of the San Mateo Dome. The axis of the dome bisects the central portion of the canyon. As a result the bedrock units, consisting primarily of a thick sequence of interbedded sandstones and shales, are generally flat-lying or gently dipping in the broader parts of the basin. The impoundment will be located in this area. Bedrock outcrops in the canyon include Cretaceous sandstone, siltstone and shales of the Menefee Formation, Point Lookout Sandstone, Crevasse Canyon Formation, Gallup Sandstone, and Mancos Shale. Their stratigraphic and structural relationship in the Canyon area is shown in Figure 2.4-2.
The advantage of the La Polvadera Canyon site is that it is underlain by essentially impervious Mancos Shale. This formation will effectively preclude any intrusion of tailings impoundment seepage into the deep aquifers.

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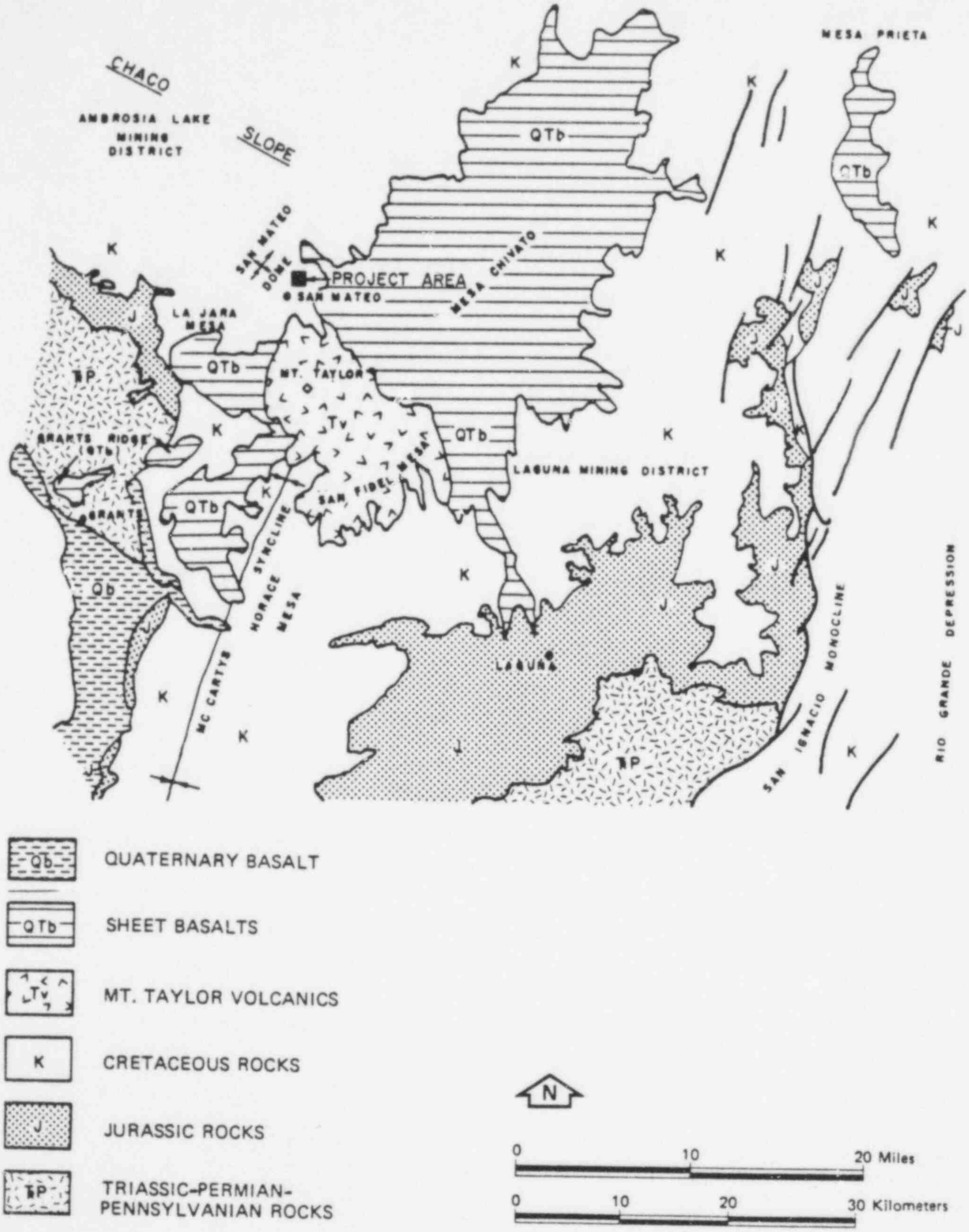


Source: Woodward-Clyde Consultants 1977

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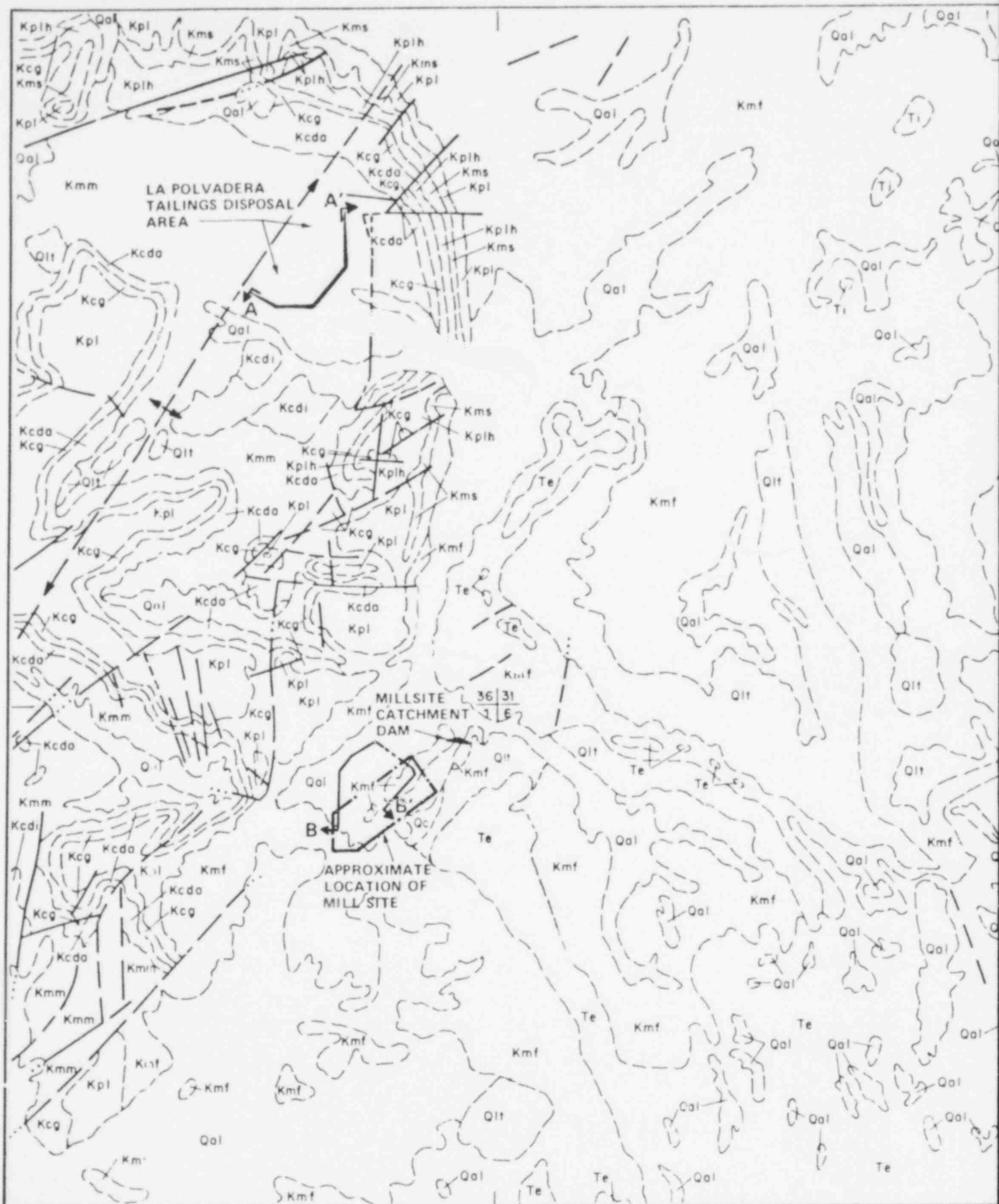
Figure 2.4–1.
REGIONAL GEOLOGIC FEATURES




Source: Modified from Cooper and John 1968; and from Santos 1966

POOR ORIGINAL


| | |
|---|---|
| Qlt | LANDSLIDE AND TALUS MATERIAL |
| Qc | RESIDUAL DEPOSITS: BEDROCK DECOMPOSED TO CLAY, (MAPPED AS SAPROLITE BY USGS) |
| Qal | ALLUVIUM (SILT, CLAY WITH OCCASIONAL GRAVELLY LENSES) |
| Te | BASALT, ANDESITE AND OTHER INTRUSIVE ROCKS |
| Kmf | MENEFEE FORMATION (INTERBEDDED SILTSTONE AND FINE TO MEDIUM GRAINED SANDSTONE) |
| Kpl | POINT LOOKOUT SANDSTONE, MAIN BODY |
| Kplh | POINT LOOKOUT SANDSTONE, HOSTA TONGUE |
| Kcg | CREVASSE CANYON FORMATION, GIBSON COAL MEMBER (INTERBEDDED SANDSTONE, SILTSTONE, SHALE & COAL BEDS) |
| Kcda | CREVASSE CANYON FORMATION DALTON SANDSTONE MEMBER |
| Kcdi | CREVASSE CANYON FORMATION, DILCO COAL MEMBER (INTERBEDDED SANDSTONE, SHALE, AND COAL BEDS) |
| Kms | MANCOS SHALE, SATAN TONGUE (INTERBEDDED SANDSTONE, SILTSTONE, AND SHALE) |
| Kmm | MANCOS SHALE, MULATTO TONGUE (INTERBEDDED SHALE AND SANDSTONE) |

CONTACT BETWEEN GEOLOGIC FORMATION, APPROXIMATELY LOCATED

FAULT, DASHED WHERE LOCATED APPROXIMATELY; DOTTED WHERE CONCEALED

ANTICLINE, SHOWING CREST LINE AND PLUNGE

REFERENCED TAILINGS DAM SITE, APPROXIMATELY LOCATED

N

0 ½ 1 2 Miles

Figure 2.4–2.
GEOLOGIC MAP OF PROJECT AREA

Only one major fault lies within the tailings impoundment area. This normal, near-vertical, east-west trending fault, located near the northern margin of the pond, is considered inactive. Details can be found in Section 2.4 of the Environmental Report.

The mill will be located in the Lower San Lucas Valley. The valley consists of alluvial, eolian, and alluvial fan soil deposits which overlie siltstones and sandstones of the Menefee Formation and the Point Lookout Sandstone. The Menefee Formation, exposed or at very shallow depths on the east side of the valley, underlies most of the mill project area. Pressure tests in the exploration holes indicate that the fracture permeability in the Menefee is low; in fact, in the reservoir area above the proposed mill impoundment dam the Menefee is essentially impervious thus forming a barrier against the migration of any potential seepage. The Point Lookout Sandstone is exposed on the west side of the valley beyond the dam and is characterized by widely spaced jointing. Both the Menefee Formation and Point Lookout Sandstone dip gently to the east.

## 2.4.2 Seismology

Seismic evidence, both historical and instrumentally recorded, indicates that the Mt. Taylor project site is in an area of low seismic activity. Historically recorded tremors in the region have been mild, with reported damage slight and confined to localized areas. Only two earthquakes have occurred within a 50-mile radius of the project area. The first centered near Grants, New Mexico with a Magnitude 4.4 on December 23, 1973. Only minor damage occurred in the area and Grants experienced a maximum intensity of VI. The second and most recent seismic event within a 50-mile radius of the site occurred on January 5, 1976 with the epicenter located 45 miles northwest of the site. This event registered Magnitude 5.0 with the epicentral area experiencing intensity VI.

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There have been numerous other earthquake events within a 250-mile radius of the site. Their effect, if any, in the project area is expected to have been negligible. The Environmental Report (Section 2.5) documents these events as well as presenting an earthquake risk evaluation for the site.

Based on the seismic history of the area, it has been calculated that the area would experience a maximum ground acceleration of 0.07g. Buildings and dam structures are designed to withstand ground accelerations of 0.10g, thereby affording a significant factor of safety.

## 3.1 MILL PROCESS

The mill facility will be located in lower San Lucas Canyon, Section 1, T13N, R8W, McKinley County, New Mexico. The site is in an area isolated from the public. A mill impoundment will preclude the release of any accidental process spills to watercourses in the area. Buildings will house grinding equipment and the yellowcake washing, drying, and packaging, as well as offices, a laboratory, boilers, shops, and warehousing. Tankage will be of various sizes depending on the specific processes involved, and will be positioned in areas where required by the process. The entire mill site will be fenced and access to the facilities will be controlled.

The mill process flow diagram is shown on Figure 3.1-1. The proposed mill will have the design capacity to process blended ore assaying between 0.05 and 0.50 percent uranium ($U_3O_8$) to a finished yellowcake product at a design rate of 4200 dry tons of ore per stream day. Coarse ore will be delivered to the mill via truck and placed into ore storage piles. A front-end loader will be used to feed coarse ore to the mill feed system.

The milling process begins with grinding the coarse ore to separate the sand grains from the interstitial cementing matrix. Uranium values are then leached from the solids in two stages of leach, followed with the leached sand/slime residue being separated from the uranium-rich



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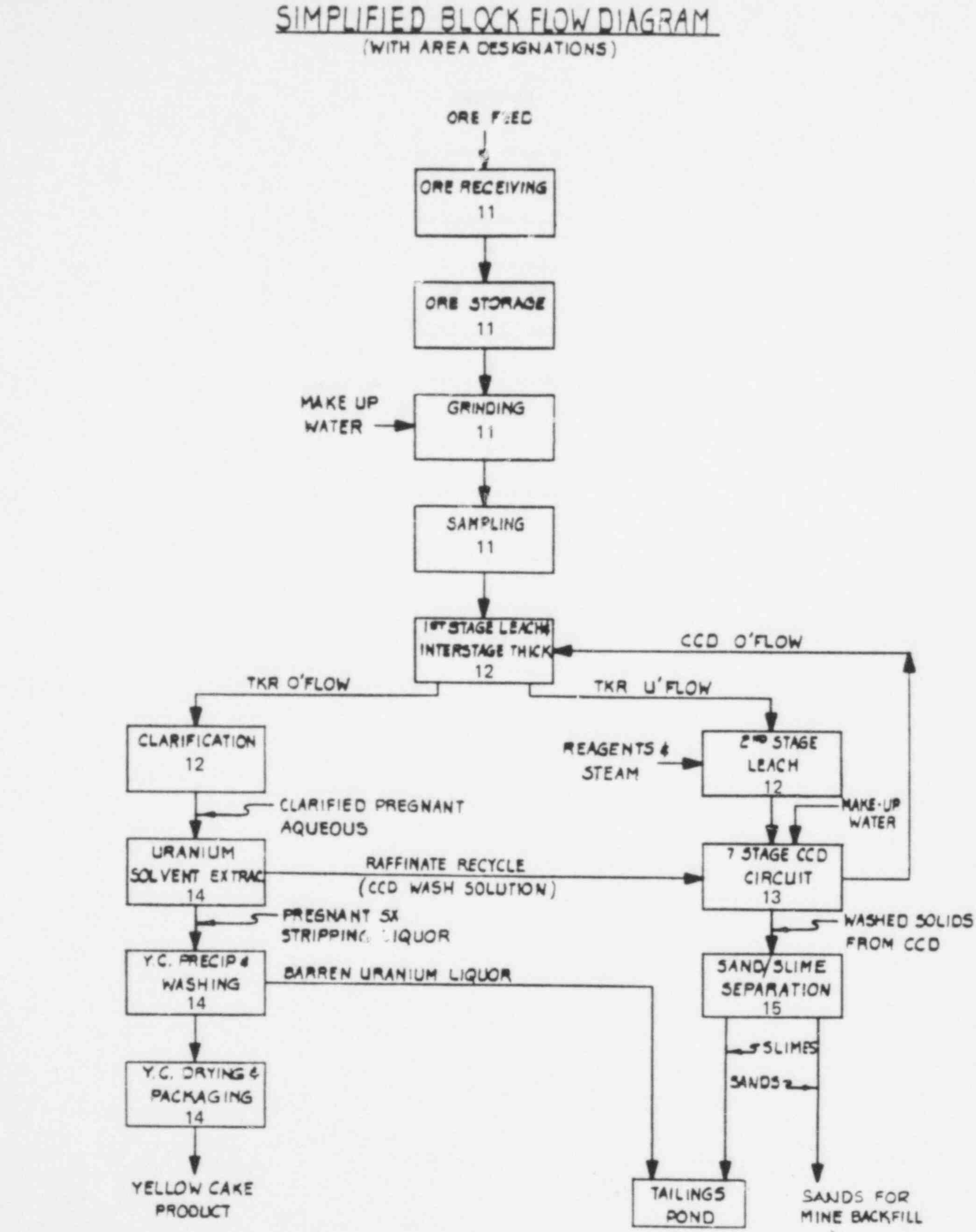


Source: Jacobs Engineering Co. 1979

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Figure 3.1–1.
SCHEMATIC FLOW
DIAGRAM OVERALL PROCESS

POOR ORIGINAL

leach solution by countercurrent washing in thickeners. Provision is made for the uranium-free residues to be classified into sand and slime fractions. The resulting sands, after being washed, can be returned to the mine for backfill or used for tailings pond reclamation. The slime fraction and any sands not separated will be pumped to the tailings pond.

The subsequent steps of the milling process, which consist of recovery and purification of the uranium values from the acid leach solution, begin with clarification of the uranium-rich leach solution, followed by filtration to remove the fine suspended solids, and solvent extraction to recover and purify the uranium. In the solvent extraction process, the uranium is transferred to an organic phase consisting of an amine in a kerosene diluent. After solvent extraction, the uranium-free leach solution (raffinate) is recycled to the countercurrent decantation (CCD) circuit as a wash solution. The uranium is removed from the solvent with a sodium carbonate solution, and the solvent recycled to the solvent extraction circuit. The sodium carbonate solution, now containing the uranium, is acidified and then pumped to precipitation tanks where uranium is precipitated as uranyl peroxide ($UO_4 \cdot 2H_2O$) by digestion in a hydrogen peroxide solution. The uranyl peroxide is then washed in thickeners, centrifuged, and calcined in a multiple hearth furnace. The resulting yellowcake is packaged in drums for shipment via truck in accordance with Department of Transportation regulations.

A slurry pipeline (described in Section 3.4.1 of the Environmental Report) will transport the tailings to an impoundment located in La Polvadera Canyon approximately six miles north of the mill. The site is a natural canyon bordered on three sides by high bluffs, providing protection from both wind and storm damage as well as total isolation from the public. The tailings retention dam of the impoundment area will be a zoned earth and rockfill structure with a sloping upstream clay core.

Tailings distribution into the impoundment area will be via a sand cell system for total tailings or a perimeter discharge system when only slime tailings are being impounded. Downstream of the tailings impoundment is a catch dam to provide containment of any minor spills. Both the impoundment and catchment areas will be completely fenced. The tailings impoundment area is fully described in Section 3.4.2 of the Environmental Report.

Based on current ore reserve and market assessments, the production life of the mill will be 20 years. At this time, no other outside source of ore is expected to be processed through this facility. The mill will r even days a week, with three eight-hour shifts each day. Production capacity rates for the years 1981 through 1984 will be 2100 dry tons per stream day which could yield a yellowcake product of 12,500 pounds of $U_3O_8$ equivalent per day (4.3 million pounds per year). Commencing in approximately 1985 production capacity will be increased to 4200 dry tons per stream day which could yield a yellowcake product of 25,000 pounds of $U_3O_8$ equivalent per day (8.6 million pounds of $U_3O_8$ per year). Final yellowcake quality will assay greater than 85 percent $U_3O_8$.

## 3.2 SAFETY INSTRUMENTATION AND CONTROL

Any leakage in the tailings line will be detected by flow difference between redundant flowmeters placed at the beginning and end of the tailings line. The redundant flowmeters compare measurements not only from end to end of the pipeline, but from the adjacent units at each end as well. A flow difference between adjacent flowmeters will cause an alarm to sound indicating meter malfunction. A difference in measurement from flowmeters from end to end of the pipeline will result in the sounding of an alarm and shutdown of the tailings pumping system.

## 4.1 GASEOUS

The majority of the mill process equipment will be located outdoors. Two areas will be housed: (1) the grinding and sampling circuit, and (2) yellowcake processing, drying, and packaging. Each of these two buildings will provide positive exhaust ventilation with six complete air changes per hour in each structure to purge radon from the working environment. Fugitive dust will be controlled as appropriate.

Dust emissions from the grinding circuit will be controlled at transfer points. In addition, exhaust hoods will be located over discharges of the grinding mills. The yellowcake dryer and the yellowcake packaging system will each have separate closed circuit ventilation systems, each containing a high energy wet venturi scrubber. Control efficiency for wet venturi scrubbers is rated at 99.4 percent.

A summary of all discharge points affecting radiological emissions, their stack height, proposed control system, rated efficiency and associated emissions is given in Tables 4.1-1 and 4.1-2.

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Table 4.1-1. MILL ATMOSPHERIC EMISSION SOURCES

| Area | Component | Source | Release Height (ft) | Exhaust Volume (acfm) | Stack Diameter (inches) | Exhaust Temperature (°F) | Control Equipment | Rated Control Efficiency (%) |
|---|---|---|---|---|---|---|---|---|
| 11 | Ore Storage | Ore Piles | 30 | NA | NA | NA | Spray Suppression | 98.0 |
| 11 | Ore Storage | Ore Piles & Storage Area | 0-30 | NA | NA | NA | Spray Suppression | 98.0 |
| 12 | First Stage Leach | Stack | 20 | 750 | 18 | 95 | Wet Scrubber | 99.0 |
| 12 | Second Stage Leach | 2 Stacks | 20 | 600 | 30 | 150 | 2 Wet Scrubbers | 99.0 |
| 14 | Solvent Extraction | Tanks | 20 | NA | NA | 104 | None | -- |
| 14 | Yellowcake Packaging & Calcining | Stack | 100 | 13,500 | 36 | 150 | Wet Scrubber | 99.4 |

Table 4.1-2. MILL ATMOSPHERIC EMISSION SUMMARY, CONTROLLED (tons per year)

| Area | Operation | Particulates |
|---|---|---|
| 11 | Ore Receiving, Storage | 5.08 |
| 12 | First Stage Leach | 0.38 |
| 12 | Second Stage Leach | 0.45 |
| 14 | Solvent Extraction | |
| 14 | Yellowcake Calcining & Packaging | 1.59 |
| | TOTAL | 7.50 |

## 4.2 LIQUIDS AND SOLIDS

Tailings that are not utilized for mine backfill, as well as waste fluids from the milling process, are to be transported through a pipeline to the La Polvadera tailings impoundment. The pond is sized to contain all wastes derived over the mill's approximate 20-year operating life. The dam, which will be constructed in four stages over the life of the project, is a zoned earth and rockfill structure designed as a water-reservoir type of dam. The embankment has a sloping upstream clay core and a large downstream earth-rock shell zone. A continuous chimney drain separates the core and the earth-rock section. All overburden soils and alluvium under the foundation will be removed so that the dam will rest entirely on bedrock. A positive clay cutoff is provided under the core and well into the bedrock for foundation seepage control. Significant statistics associated with the impoundment are listed below; details and drawings of the pond and dam construction are given in the Environmental Report.

| | |
|---|---|
| • distance from mill | 6± miles |
| • ultimate pond surface area | 418 acres |
| • drainage area above dam | 1,025 acres |
| • ultimate storage volume | 25,800 acre-feet |
| • dam embankment type | compacted, zoned earth-rock and rockfill |
| • maximum height above streambed | 148 feet |
| • maximum height above foundation | 228 feet |
| • upstream slope | 3:1 (horizontal to vertical) |
| • downstream slope | 2.5:1 (horizontal to vertical) |
| • dam foundation type | rock |
| • ultimate length of dam | 1.5 miles |
| • design flood retention (PMF series) | 2,800 acre-feet |

In order to control fugitive dust emissions from the pond, it is proposed to sluice total tailings into a system of small cells created within the impoundment area. As sluicing into the cells continue, the sand fraction will settle out, leaving the sluice water and slime fraction to overflow the cells into the principal retention area. When a cell is filled with sand it will be immediately covered with earth to control dust. The slimes will not present a fugitive dust problem. Details of this unique system are provided in Section 3.4.2 of the Environmental Report.

Although one small area of the pond (approximately 20 acres) will have a primary membrane liner installed on a 12-inch compacted clay secondary liner due to the presence of a fault zone, the primary control for seepage will be the geologic structure and bedding of the underlying formations. Seepage may move downward through the Dilco and Gallup units and perch on the Mancos Shale. A perched ground water mound may build upward to intersect the pond and spread laterally through the sandstone fractions of the Gallup and Dilco units. Initial seepage rates will appear relatively high until the mound intersects the pond, at which time seepage rates will decrease as the gradient decreases with time. Lateral migration of seepage will occur generally to the north and east. Assuming no retention of seepage water in bank storage (in reality there will be a significant amount) the calculated probable seepage rate totals 142 acre-feet per year or about 0.28 acre-foot per year per acre of pond. The maximum probable seepage rate was calculated to be 425 acre-feet per year or 0.85 acre-foot per year per acre assuming a surface area of 500 acres. It should be noted that the seepage rates noted above do not take into consideration the decrease in seepage rates to be expected as a result of the build-up of slimes on the floor of the tailings impoundment. In addition, natural attenuation processes within the vadose zone will tend to improve the quality of the seepage water; degradation of ground water in the Gallup Sandstone should therefore be minimal. As described in Section 6.2.2 of the

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Environmental Report, a shallow monitoring system has been designed to detect the rate and quality of seepage accumulation perched on the Mancos Shale. The impervious Mancos Shale will act as an aquiclude to prevent migration of seepage to the underlying Dakota Sandstone. Two deep monitor wells will, nonetheless, be drilled to the base of the Dakota (see Section 6.2.2 of the Environmental Report).

A catch dam, to provide emergency storage in the event of an accidental spill resulting from a break in one of the pipelines transporting slurry to the impoundment or clear water back to the mill, will be constructed one-half mile downstream of the tailings dam. The catch dam will have a maximum storage volume of about 100 acre-feet; it is not intended for the dam to retain the spill resulting from a major tailings dam failure. To provide flood protection, the catch dam will be provided with a spillway to store and pass the PMF inflow associated with its drainage basin. The Environmental Report contains a discussion of the subsurface investigation and laboratory testing involved in the tailings dam study, as well as information regarding the construction methods and specifications.

In order to monitor the structural integrity of the tailings impoundment dam, embankment instrumentation will be installed. Surface displacement monuments, which will be located at the downstream edge of the embankment crest, will monitor any horizontal or vertical displacement. Piezometers will be installed to measure and monitor pore water pressures, piezometric levels in the dam embankment and foundation, and the effectiveness of the chimney drain and drain blanket. The piezometers will be operated from terminal boxes located near the toe of the embankment. In addition to the piezometers and surface displacement monuments, seepage into the downstream collection and pump-back sump will be monitored. Two deep wells are provided for monitoring seepage.

The tailings pipeline system consists of two pumping facilities at the mill, two slurry pipelines from the mill to the tailings impoundment and one decant return line from the tailings impoundment to the mill, which if the need arises, can also be utilized as a slurry line. A highly reliable and sophisticated control system has been developed to automatically shut down the tailings pumping system in the event of a significant leak or major failure. Two magnetic flowmeters will be placed at each end of the pipeline system. The flowmeters will compare signals with the adjacent meter and with the meters at the opposite end of the pipeline. A difference between adjacent meters will cause an alarm to sound indicating meter malfunction. A difference between meters on opposite ends of the pipeline will also cause an alarm to sound, indicate failure and commence a shutdown sequence. A separate system for detecting separation of pipe sections is provided in a continuity circuit which also sounds an alarm and institutes shutdown should a continuity failure occur.

A service road will parallel the entire route of the pipeline. The pipeway will be diked. The dikes will direct any leakage or spills to one of ten containment basins located at low points along the route. The pipeline system, including typical cross-sections of the pipeline and containment basins, is shown in Figures 3.4-1 and 3.4-2 of the Environmental Report. The entire route of the pipeline will be inspected each shift.

The basic requirements for reclamation and restoration of the La Polvadera tailings disposal area include:

- control of fugitive dust from dried, exposed tailings surfaces
- control of erosion caused by waters entering and leaving the tailings impoundment area

- reduction of radon gas emanation from the tailings deposit

- amenability to long-term stabilization and isolation and to the eventual return of the land to productive use

The specific requirements for the reduction of radon gas emanation from the deactivated tailings disposal area have not yet been firmly established, but planning at this point in time calls for covering the top of the deactivated tailings pond with six feet of earth cover. The actual thickness of earth or other type of cover used will be in accordance with the "state of the art" at the time of reclamation, probably in the early part of the 21st century.

Gulf will post a bond with the State of New Mexico to ensure compliance with all required reclamation and license provisions. Once all reclamation requirements and license provisions have been met, the bond will be released.

Gulf's legal rights with respect to the tailings impoundment property are as follows:

> Gulf Oil Corporation is the Lessee under a certain Lease Agreement with Fernandez Company, Ltd., the Lessor therein, dated July 15, 1976, effective January 1, 1976. Fernandez Company, Ltd. is the owner of the lands described in the Lease Agreement. The Lease Agreement covers the land upon which the dam covered by this application is to be located. The Lease Agreement is effective through June 30, 2019, and may be extended beyond such date in accordance with the terms contained therein. The Lease Agreement grants Gulf Oil Corporation the right to construct the dam covered by this application.

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Pursuant to 40 CFR 6, Section 6.906, a New Source and Environmental Questionnaire (NS/EQ) was submitted to EPA, Region VI on March 23, 1978. The NS/EQ stated that no discharge to navigable waters would occur as a result of operation of the Mt. Taylor Uranium Mill Project and therefore neither certification nor NPDES discharge permit (pursuant to Sections 401 and 402, FWPCA) requirements were applicable. By letter dated June 21, 1978, Mr. Robert B. Elliot, Chief Permits and Support Branch, Region VI, notified Gulf that no NPDES permit would be required for the Mt. Taylor Uranium Mill Project.

## 4.3 CONTAMINATED EQUIPMENT

All contaminated disposable materials, including coveralls, filters and cleaning materials, will be placed in a container when their useful lives have ended. When any such container is full, it will be sealed and transported to the tailings impoundment for burial. All obsolete, worn-out, or malfunctioning process machinery will be decontaminated using either an acid wash or chelating solutions. These solutions will be contained and pumped to the tailings impoundment. Subsequent to decontamination procedures, all machinery will be scanned with appropriate counting instruments to assure that no residual radioactivity remains. If repairs are needed, the machinery will be released for repair work. If the machinery is of no further use, it will either be released and sold for salvage or stored in the salvage area.

Equipment will be considered to be contaminated if it has removable radionuclides in excess of 1000 alpha disintegrations per minute per 100 square centimeters of surface area. During decontamination efforts, surveys and air samples will be taken as necessary for exposure control. Equipment will be re-surveyed to insure that the radionuclides are reduced to a level consistent with the ALARA philosophy. A reasonable effort will be made to eliminate residual contamination.

Disposal of contaminated equipment or material will be accomplished in accordance with 10 CFR 20.301 and 20.304.

## 5.1 CORPORATE ORGANIZATION AND ADMINISTRATIVE PROCEDURES

### 5.1.1 Corporate Organization

Gulf Mineral Resources Co., headquartered in Denver, Colorado, is a strategy center of the Gulf Oil Corporation, headquartered in Pittsburgh, Pennsylvania. Organizational charts of these companies are shown in Figures 5.1-1 and 5.1-2.

The Mt. Taylor mine/mill operations will be under the direct supervision of an Operations Manager who will report to the Senior Vice-President, Operations & Marketing - Uranium. Mill Operations will be the responsibility of the Mill Manager who will report directly to the Operations Manager. The Radiation Safety Officer (RSO) will be responsible for all aspects of Radiation Safety and will report directly to the Operations Manager. Radiation, health and medical expertise in the Medical Division of the Gulf Science & Technology Company, Pittsburgh, Pennsylvania, will be available to the Radiation Safety Officer as required for medical examinations, data review, auditing, analyses, and advisory purposes.

### 5.1.2 RSO Responsibilities

Any training requirements, process changes, unusual maintenance work or equipment modification requires the approval of the RSO prior to implementation. An operating manual covering each phase of the operation, including both routine and non-routine work, will be written and made

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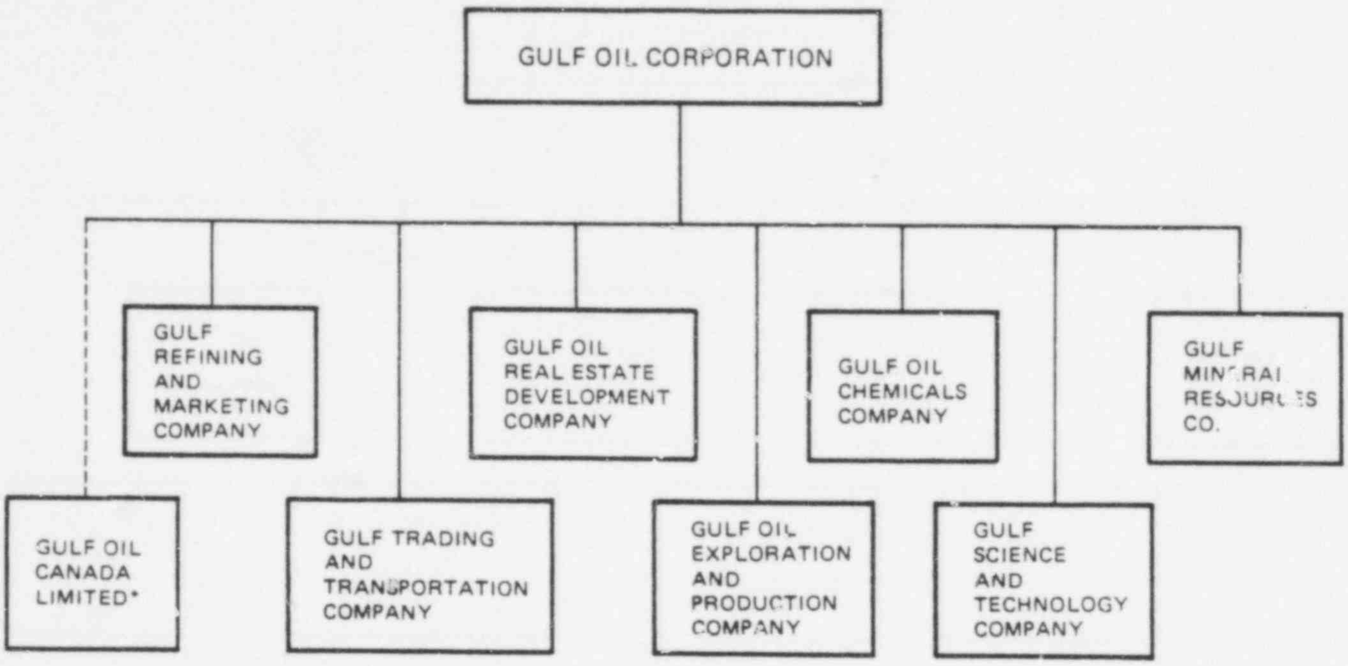


* Subsidiary of Gulf Oil Corporation

Figure 5.1–1.
CORPORATE MANAGEMENT STRUCTURE



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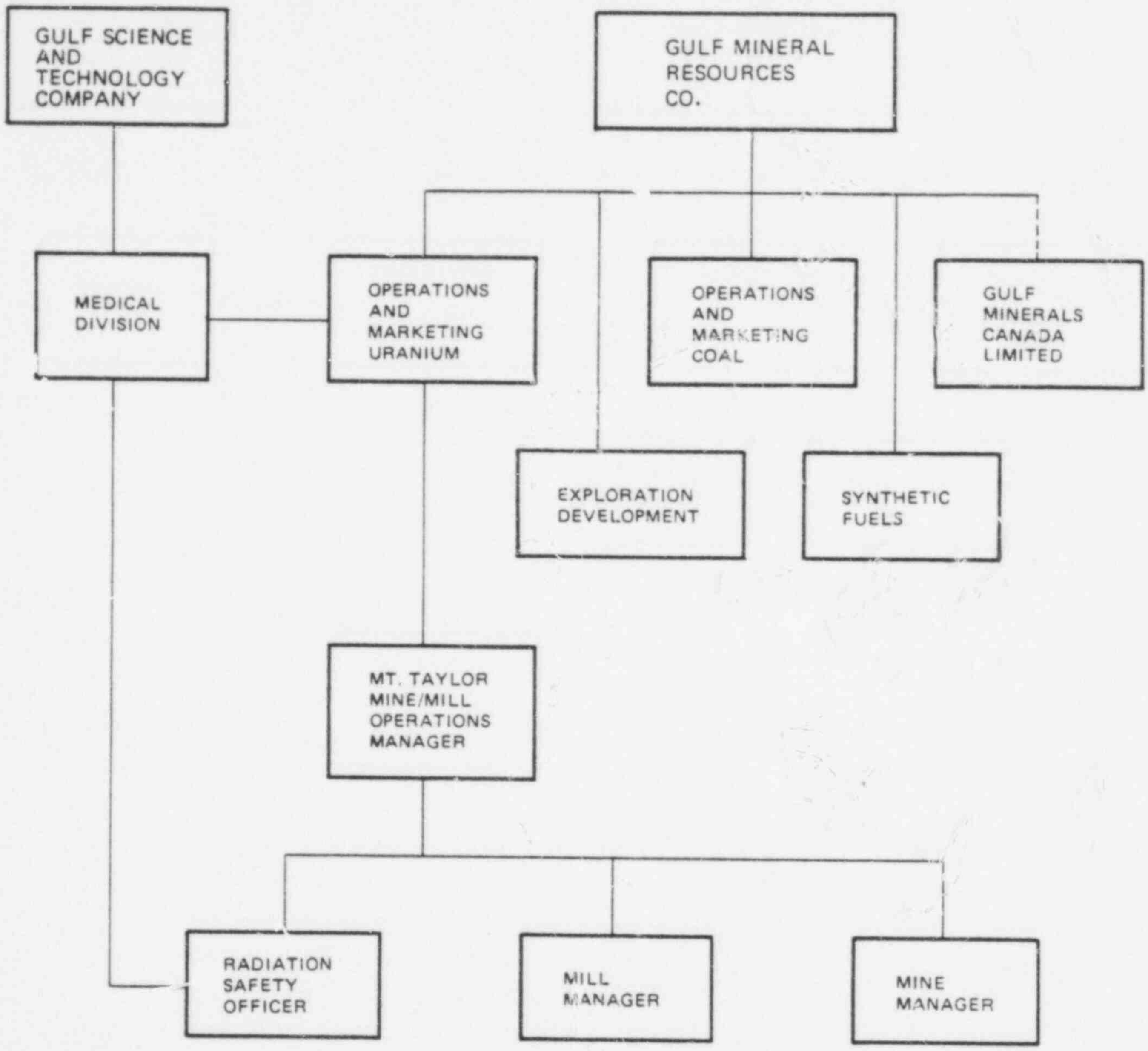


Figure 5.1-2.
GULF MINERAL RESOURCES COMPANY
MANAGEMENT STRUCTURE



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available to each mill and maintenance employee. The RSO will approve the health and safety aspects of the operational procedures. The manual will be updated as necessary. As operations will not commence before 1981, these manuals have not yet been finalized.

### 5.1.3 Employee Exposure Review Program

In addition to routine safety inspections, the RSO will make monthly inspections of work areas and practices. All monitoring and exposure data will be reviewed monthly to insure compliance. Any trends or deviation from the ALARA principle will be addressed. A monthly status report will be prepared for the Operations Manager, with periodic audits by the Corporate Medical Department. Any worker whose exposure is found to exceed 25 percent of the quarterly limit (1.25 rem/quarter total body gamma, 3.75 skin dose beta plus gamma) will trigger action to investigate that employee's work area and work habits, in order to pinpoint the reason for the exposure.

### 5.1.4 ALARA

Gulf's commitment to ALARA and plans for implementing such a program in the work areas is presented in Section 2.1 of Volume 4. In order to maintain effluent releases to a level which is as low as reasonably achievable, Gulf has included as a fundamental part of the mill design dust control features which are described in Sections 3.1, 3.2 and 3.3 of Volume 4. Monitoring and efficiency checks on these control features are described in Section 3.4 of Volume 4.

## 5.2 QUALIFICATIONS

The minimum educational requirements for the individual holding the position of Radiation Safety Officer is a bachelor's degree in the physical sciences, mathematics or engineering from an accredited college or university, equivalent experience, or a combination of equivalent experience and education. Equivalent experience shall be at least four years of relevant radiation safety experience.

The individual holding the position of Radiation Safety Technician shall have as a minimum educational requirement a high school diploma or equivalent, with training in the operation and use of the various monitoring instruments.

As mentioned in Item 10, NRC-2, individuals have not been selected to fill all positions to date, but a synopsis of the qualifications of the RSO is attached to NRC-2.

## 5.3 TRAINING

Each new employee will be given initial training in radiation safety through the use of a slide presentation closely integrated with safety manuals provided the employee. These manuals will be developed specifically for the Mt. Taylor Project and will follow the provisions of 10CFR19.12. Each training session will conclude with an open question-and-answer session after which each employee will be given a short test on the material just presented. Records will be kept on each employee and the date of training. Training sessions will be repeated to each employee at least on an annual basis.

It is anticipated that the training sessions will follow the format outlined below:

(1) Sign in by each employee.
(2) General description of the activities of the RSO.
(3) Presentation of the material in the training manuals, probably with the aid of a slide/audio cassette and/or video tape presentation.
(4) Location of by-product sources and associated safety precautions.
(5) Question and answer session.
(6) Each employee answers the test questions at the end of each presentation corresponding to one of the manuals.

Additional training sessions will be presented from time to time on safety, covering such topics as chemical hazards, physical hazards (noise, heat stress), protective equipment, and self-contained breathing apparatus.

A manual for supervisors will also be available that will cover much of the information in the training manuals and in addition will include a radiation protection guide for each area covering a description of the operation, types of exposures, the radiological hazard involved, protection requirements, emergency procedures, and decontamination procedures.

Female employees, in addition to the training indicated above, will also be given instuctions in accordance with Regulatory Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure." This will include training in the biological effects of ionizing radiation and the effects of that radiation exposure on the fetus.

The employee radiological safety training program is under development.

## 5.4 SECURITY

Both the mill complex and tailings pond areas will be enclosed by a perimeter fence to restrict access. All fences will be posted with appropriate signs in accordance with 10CFR20.

Each visitor will be checked in and out on a visitor's register, issued a security pass, and be escorted at all times while within the confines of the secured area. Visitors having work assignments, such as equipment manufacturer repairmen, may be given security, safety, and radiation protection orientation and subsequently allowed to perform their duties without escort.

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## 5.5 RADIATION SAFETY

### 5.5.1 Instrumentation

The methods, instrumentation, and equipment, including personnel monitoring devices, used to determine employee exposure to external radiation are provided in Section 4.1 of Volume 4. As mentioned in Section 5.1.3 of this volume, the action level for external employee exposure has been set at 25 percent of MPC. The type of surveys to be accomplished and the audit functions are set forth in Sections 4.2.4 and 4.2.5 of Volume 4, respectively. The number and category of personnel involved in the personnel dosimetry program has not yet been determined.

### 5.5.2 In-Plant Air Sampling Program

For some period subsequent to mill start-up, the efficiency of the ventilation system for controlling build-up of radon daughters within various portions of the mill, will be surveyed. Modifications to the ventilation system will be made if monitor results exhibit higher than acceptable concentrations of radon daughters.

Once the ventilation system has been shown to be operating properly, daily radon daughter measurements will be made at the grinding, solvent extraction, acid leach, CCD, mill ore pad and sand tailings pile areas, as described in Section 4.2 of Volume 4. At the time of sampling, a record will be made of any process change (mill down, fans off, repair work in progress, etc.) which could potentially affect the monitoring result. Periodic review may result in monitor program adjustments.

In addition, monthly airborne particulate samples will be taken in several areas of the mill, including the grinding area and the yellowcake drying and packaging area. These samples will be analyzed for uranium, radium and thorium. Once an adequate data base has been collected, this program may be adjusted. While non-routine operations are in progress, daily

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airborne radionuclide particulate analyses and radon daughter analyses will be preformed.

Details of the planned radiation safety program, including corrective action requirements and procedures for sample analysis, etc., have not been finalized.

### 5.5.3 Employee Exposure Measurements

Sampling of the mill atmosphere will be conducted in accordance with paragraph 57.5-37, Title 30 CFR. Individual employee exposure records will be maintained in accordance with 30 CFR 57.5-40. The filter paper used in the sampling program will be analyzed by a reliable laboratory at least monthly to determine the uranium, thorium and radium levels. Action level criteria will be 25 percent of MPC.

### 5.5.4 Prevention of Contamination of Clean Areas

To minimize any potential contamination in administrative offices and clean areas, in addition to routine surveillance, employees (on an individual job basis) may be required to shower and change clothing. For employees not normally considered as part of the mill operating crew and members of the mill operating crew not covered above, normal personal hygiene will be required. Each employee is responsible for individual safety and work quality and for adherence to safety and radiation protection rules as a condition of employment. All supervisory personnel are required to insure these rules are enforced. Additionally, a specific part of employee training will be on personal and area hygiene which will include measures to prevent the spread of contamination and will address specifically eating, drinking, smoking and lunchroom hygiene.

### 5.5.5 Environmental Monitoring - Air

Table 5.5-1 presents a synopsis of the proposed environmental monitoring program. Locations of the airborne radioactive particulate samplers

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Table 5.5-1. PLANNED ENVIRONMENTAL MONITORING PROGRAM

| Description | Parameters | Frequency (No. per year) | Comments |
|---|---|---|---|
| MILL | | | |
| Effluents | | | |
| Airborne | | | |
| • Stacks | | | |
| - Dryer and packaging | Nat. U, Th-230, Ra-226 | 2 | |
| - Other | Nat. U | 2 | |
| • Boundaries | Nat. U, Th-230, Ra-226 Pb-210, Rn-222 | 12 | 1 wk/mo, 3 locations |
| Water | | | |
| • Surface discharge | ---No release to unrestricted surface area--- | | |
| • Tailings Area Seepage | Nat. U, Ra-226, Th-230, | 12 | |
| • Groundwater | Nat. U, Ra-226, Th-230 | 2 | Selected wells |
| Environmental | | | |
| Airborne | | | |
| • Soil | Nat. U, Ra-226, Th-230 | 1 | 4 locations NESW |
| • Vegetation | Nat. U, Ra-226, Th-230 | 1 | 4 locations NESW |
| Penetrating Radiation | Gamma | 1 | 4 sets of duplicate dosimeters |

have not yet been selected. These locations will be specified once the current meteorological monitoring has been completed, but will include sites at the boundary of the exclusion area as well as the nearest residence. Radon samples will also be collected from these same locations.

Direct gamma radiation will be measured using thermoluminescent dosimeters set up in duplicate at four locations outside the mill security fence. From these measurements annual doses will be calculated.

More information of Gulf's proposed environmental monitoring program can be found in Section 6.2 of the Environmental Report.

### 5.5.6 Environmental Monitoring - Water

The liquid effluent monitoring program will focus on tailings pond seepage and ground water quality because there will be no discharge into surface waters. The system of monitoring wells, which include both near surface and deep wells, is described in detail in Section 6.2.2 of the Environmental Report. Water samples from all wells will be analyzed for natural uranium, radium-226, and thorium-230. In addition, water from two area wells studied for baseline purposes will be sampled and analyzed for the same radionuclides. The proposed water monitoring program is summarized on Table 5.5-1.

All water samples will be analyzed in the laboratory facilities to be set up in the mill complex. Certification of the lab will be obtained. Split samples will be sent to a commercial laboratory on a random basis as a means of quality control.

Unless significant changes are made in analytical techniques by the time the mill and laboratory is in operation, the standard approved analytical procedures described in 1975 Annual Book of ASTM Standards, Water Analysis,

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Part 31, will be strictly followed for natural Uranium, Radium-226, and Thorium-230.

### 5.5.7 Radiation Safety Program/Radioactive Sources and Gauges

Until such time as Gulf makes a determination regarding the types of radioactive sources and gauges to be utilized at the mill, if any, development of an associated radiation protection program is premature.

### 5.5.8 Interim Tailings Stabilization Program

The management program proposed to eliminate the blowing of tailings from the tailings retention system is described in Section 3.4.1 of the Environmental Report. Briefly, the program consists of sluicing total tails into a system of small cells within the impoundment, so that the sands will settle out within the cell. Sluice water and slimes will then discharge into the retention area below the cells. Slime tailings should not represent a fugitive dust problem as they will be wet. When dry, slimes tend to form hard cakes which are not susceptible to wind erosion. A high volume particulate sampler will be located nearby to monitor the adequacy of this system.

### 5.5.9 Mill Atmospheric Emissions Control

A narrative of the dust control features throughout the mill, atmospheric emission sources, and control features are provided in Section 4.1 of this volume. Procedures for verifying the efficiency of the control devices are described in Section 3.0 of Volume 4.

### 5.5.10 Decommissioning

Reclamation of the tailings impoundment area, including surety arrangements, is discussed in detail in Section 9.0 of the Environmental Report.

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5.5.11 Tailings Management and Reclamation

Direct Gamma Radiation. The tailings impoundment, containing radium-226, is large enough so that for purposes of calculating the gamma-ray exposures at the surface of the impoundment near its center, it may be treated as a radiation-emitting slab of infinite area. Every disintegration of an atom of radium-226 eventually results in the production, through decay of its daughter products, of an average of 2.18 photons. These photons have a mean energy of 0.824 MeV. More that 95 percent of this gamma energy is from radon daughters. The total gamma-ray flux at the surface of the impoundment is made up of unscattered primary gamma rays and secondary gamma rays that have been scattered by material inside the impoundment but still reach the surface. The primary gamma-ray flux is a function of the gamma-ray emission rate and energies, the linear attenuation coefficient of the tailings, and the thickness of the tailings. The secondary or scattered gamma-ray flux may be described by a buildup factor which is a function of the linear attenuation coefficient, the energy of the primary gamma rays, and the thickness of the slab (USEPA, 1976).

Schiager* has performed some theoretical calculations for uranium mill tailings piles and has reduced them to the following:

$$x\ (\mu R/hr) = 2.5\ C_{Ra}\ (pCi/g)$$

This simple formula allows the estimation of the exposure rate (x) above a tailings pile if the concentration of the radium in the tailings is known. Schiager assumed that the density of the tailings pile was

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*Schiager, K.J. 1974. Analysis of Radiation Exposures on or Near Uranium Mill Tailings Piles, Radiation Data and Reports. U.S. Environmental Protection Agency, Volume 15, Number 7, July.



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1.6 g/cm$^3$ and that the linear attenuation coefficient was 0.11 cm$^{-1}$. The buildup factor increases only slowly after one to two feet of tailings. Thus, the formula, which includes buildup, does not have to be corrected unless the depth of the tailings is less than about one foot, in which case the exposure at the surface of the pile will be smaller than predicted by this equation (USEPA, 1976).

The Mt. Taylor tailings have been estimated to contain approximately 1230 pCi/g. Using Schiager's formula then gives an estimate of the gamma-ray exposure rate at the surface of the uncovered tailings of about 3100 $\mu$R/hr or 27R/yr. The earth cover placed over the tailings during reclamation will attenuate gamma rays. In theory, each foot of packed earth (1.6 g/cm$^3$) covering the tailings* will reduce this exposure rate by a factor of approximately 10 or more (USEPA, 1976). Therefore, the 10-foot cover planned for the Mt. Taylor tailings would give an attenuation of $10^{10}$ or greater. In practice, diffusion and decay of radon-222 in the soil will produce gamma-ray emissions in the upper layers of the cover, reducing very slightly the effective attenuation of the gamma-ray field. The cover is expected to reduce the gamma ray field to essentially background levels.

Radon Emanation Rate. The average radium-226 content of six soil samples in the project area is 3.76 pCi/g. Based upon this value, it was calculated that the current background flux of radon-222 is 6.0 pCi/m$^2$-sec. Therefore, the performance objective of the tailings cover is to reduce the radon-222 flux to 12.0 pCi/m$^2$-sec.

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*Swift, J.J., J.M. Hardin, and H.W. Calley. 1976. Potential Radiological Impact of Airborne Release and Direct Gamma Radiation to Individuals Living Near Inactive Uranium Mill Tailings Piles. U.S. Environmental Protection Agency. EPA-520/1-76-001, July.

It has been calculated that the radon flux from the surface of the compacted, non-reclaimed tailings would be 590 pCi/m$^2$-sec. Applying appropriate factors for the reduction of radon-222 through varying thicknesses of clay and earth, it is calculated that the tailings impoundment will have to be covered with a one-foot thick clay cap, overlain with a nine-foot thick cover of earth materials. Applying the reduction due to the above-described cover, the radon flux at the surface of the reclaimed tailings has been estimated at 9.4 pCi/m$^2$-sec.

Calculations regarding the radon attenuation capacity of the proposed cover material is presented in Appendix F.

Monitoring and Maintenance. Implementation of the reclamation and restoration program described in Section 9.0 of the Environmental Report should eliminate the need for an ongoing monitoring and maintenance program. Briefly, the program calls for the placement of ten feet of clay and earth on top of the tails, followed by approximately six inches of topsoil. The topsoil will be seeded and fertilized as necessary to establish vegetation. In addition, permanent erosion control and surface drainage facilities for the covered tailings deposit will consist of the following:

- rock-lined ditches extending from natural drainageways at the edge of the deposit to a common low point near the left abutment of the dam

- an extension of the retention dam to provide five feet of freeboard above the top of the reclaimed pond for added flood protection

- an open-cut drainageway in rock on the left abutment of the dam to pass storm water

- an 18-inch layer of rock on the downstream face of the dam.

# 6.0
# ACCIDENTS

The potential for accidents related to the operation of the Mt. Taylor Project will be minimized through conservative design, construction, and operation, as well as a quality assurance program designed to monitor and maintain safe operations. Notwithstanding these safeguards, the consequences of any potential release of radiological materials to the environment have been evaluated according to three degrees of severity ranging from trivial through large. Analyses of potential accidents are given in Section 7.0 of the Environmental Report and will therefore not be repeated here.

In any case where an accidental release of radioactive materials did occur, Gulf would immediately survey the affected area with appropriate monitoring equipment, determine what, if any, mitigating measures were warranted, and then assume responsibility for restoring the environment to background conditions. The Nuclear Regulatory Commission will be notified of any unanticipated release of radioactive material to the environment from the tailings disposal system.

# 7.0
# QUALITY ASSURANCE

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Applicant's quality assurance program will cover mill and tailings disposal system design, construction, and operation to assure safety, reliability, and economy of operation. The Project Manager will be responsible for ensuring that the requirements of the quality assurance program are met.

## 7.1 DESIGN

During design, the Project Manager will be responsible for:

- determining that design criteria meet applicable building standards, pressure vessel codes, seismic and meteorological consideration
- ensuring that design criteria are reviewed and approved by qualified personnel
- ensuring that design documents are reviewed for conformance with design criteria
- ensuring that only approved design documents are issued for construction
- preparing procedures and material specifications
- reviewing and approving specifications for conformance to design criteria
- reviewing and approving procurement documents that conform to specifications

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## 7.2 CONSTRUCTION

During construction, the Project Manager or his delegate will be responsible for:

- ensuring that the installation is constructed in conformance with approved drawings and specifications
- reviewing, approving, and documenting construction design changes
- implementing a receiving inspection system to assure that materials and components are inspected for conformance to specifications and that nonconforming items are identified and controlled to prevent inadvertent use
- implementing a program of testing of materials and components to ensure conformance with specifications

7.3 ACCEPTANCE TESTS

Prior to operation, the Mill Manager will verify that all systems meet performance standards.

Prior to operation, the Radiation Safety Officer will verify:

- operability of radiation monitors
- readiness of emergency equipment
- proper installation of safety items



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7.4 OPERATION

The Mill Manager will be responsible for operation and maintenance and will:

- implement a training program for operating and maintenance personnel in accordance with applicable standards
- annually review training documentation to verify adequacy of course content and training records
- establish a procedures system that will prevent exposure of plant personnel or the environs to radioactive materials in excess of established limits
- approve, issue, and maintain a master file of operating procedures and their revisions
- develop and implement a preventive maintenance program

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## 7.5 RADIATION PROTECTION AND ENVIRONMENTAL MONITORING

The Radiation Safety Officer will be responsible for radiation protection and environmental monitoring and will:

- develop and implement a radiation protection orientation and training program for all employees
- establish a program for training the radiation safety technician(s)
- perform annual reviews of training documentation to verify the adequacy of course content and training records
- review and approve sampling and surveying procedures for safety, radiation protection, and environmental impact considerations
- review and approve procurement of radiation protection and environmental monitoring instruments and calibration standards
- perform monthly reviews of survey records to insure completeness, detection of abnormal conditions, and adequacy of followup actions
- review the radiation instrument calibration records and procedures
- establish and maintain a program utilizing independent laboratories to verify sample analysis accuracy
- perform and document quarterly audits of jobs which are hazardous or critical to the safety of plant personnel to assure compliance with the adequacy of radiation rules and safety procedures
- annually review safety, radiation exposure, and radiation survey records for adherence to ALARA philosophy

Recommendations will be discussed with personnel responsible for the work involved and a date for the institution of corrective action will be established. A followup audit will verify compliance.

8.0

# EVALUATION OF ALTERNATIVES

Alternative locations for the mill and tailings impoundment were identified at the outset of the planning process. As discussed in Section 10.0 of the Environmental Report, three sites were considered for mill construction. One was rejected because of its proximity to the town of San Mateo, and one was rejected because of excessive capital and operating costs and interference with the selected tailings impoundment area. The site selected, Section 1, T13N, R8W, provides an isolated location topographically suited for the operation of a mill in an environmentally sound and economically feasible manner.

Eight potential sites for the tailings impoundment were identified. The original evaluation was conducted on the basis of a conventional surface impoundment, and La Polvadera Canyon site was selected based upon favorable geologic conditions and minimum risk of ground water contamination, population exposure, and surface erosion.

As a result of the recent emphasis by NRC on below-grade burial of tailings, the potential sites are being reevaluated for below-grade burial.

Section 10.0 of the Environmental Report discusses tailings impoundment alternatives in more detail.