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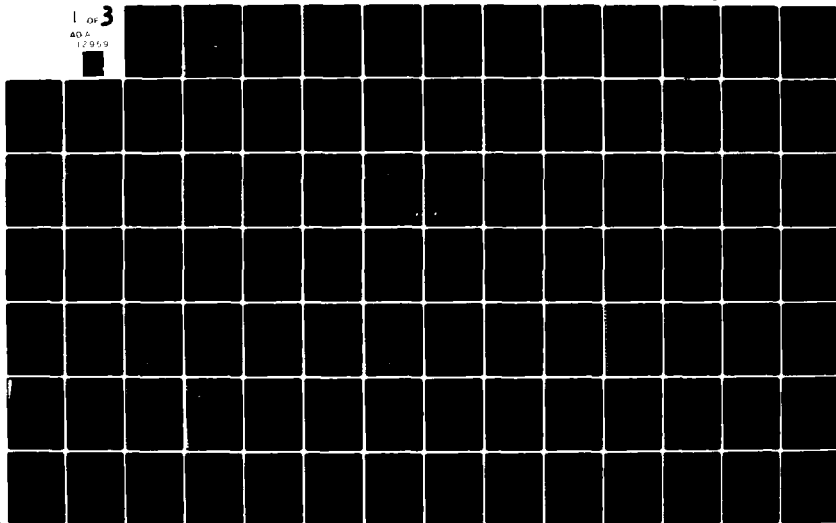
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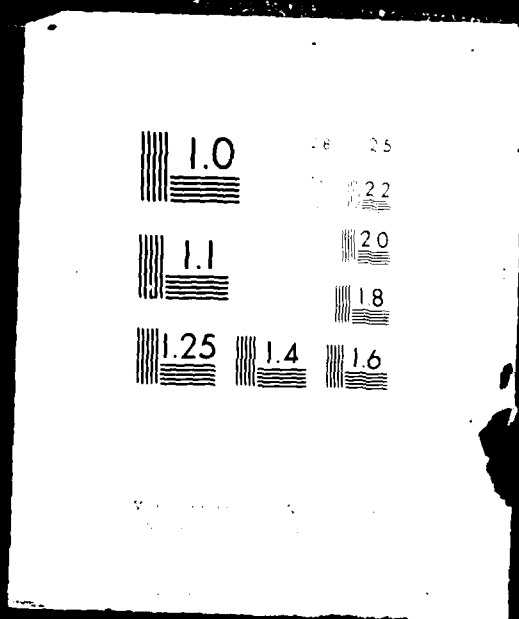
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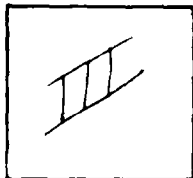
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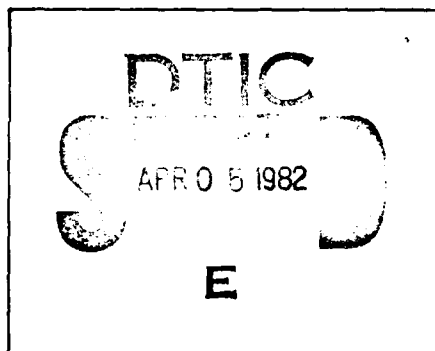
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MX SITING INVESTIGATION
WATER RESOURCES PROGRAM
REVIEW DRAFT
WATER APPROPRIATIONS HEARING
PRESENTATION AND SUPPORT
DOCUMENTATION

DRY LAKE VALLEY, NEVADA

VOLUME II

Prepared for:

U.S. Department of the Air Force
Ballistic Missile Office
Norton Air Force Base, California 92409

Prepared by:

Ertec Western, Inc.
3777 Long Beach Boulevard
Long Beach, California 90807

30 September 1981

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER E-TR-53-II	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Water Resources Program Review Draft Water Appropriations Hearing Presentation & Support Documentation Dry Lake Valley, NV Vol. II		5. TYPE OF REPORT & PERIOD COVERED Draft
7. AUTHOR(s) Ertec		6. PERFORMING ORG. REPORT NUMBER E-TR-53-II
9. PERFORMING ORGANIZATION NAME AND ADDRESS Ertec Western Inc. (formerly Fugro National) P.O. Box 7765 Long Beach Ca 90807		8. CONTRACT OR GRANT NUMBER(s) FC4704-80-C-0006
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Department of the Air Force Space and Missile Systems Organization Wright AFB PA 19240-9 (SAMSO)		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 64312 F
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE 30 Sep 81
		13. NUMBER OF PAGES 62
		15. SECURITY CLASS. (of this report)
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Distribution Unlimited		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) Distribution Unlimited		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Well logs, Well design, Gravity surveys,		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report represents integration of two years of intensive MX Water Resources Program activities in NV-UT siting area		

LIST OF APPENDICES

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- A1.0 Dry Lake Valley Section: MX Siting Investigation,
Water Management Report
- B1.0 Numerical Modeling Studies, Dry Lake Valley,
October 1981
- C1.0 Results of Aquifer Testing, Dry Lake Valley,
October 1981
- D1.0 Dry Lake Valley Section: MX Siting Investigation,
Technical Summary Report (In Progress)
- E1.0 Dry Lake/Delamar Valleys Section: MX Siting
Investigation, Water Resources Program, Summary
for Draft Environmental Impact Statement,
FN-TR-38, revised 1 August 1980
- F1.0 MX Siting Investigation, Gravity Survey - Dry
Lake Valley, Nevada, FN-TR-33-DL, 17 March 1980
- G1.0 Eakin, Thomas E., 1963, Ground-Water Appraisal
of Dry Lake and Delamar Valleys, Lincoln
County, Nevada: State of Nevada, Department of
Conservation and Natural Resources, Ground-Water
Resources-Reconnaissance Series Report 16, 26 p.
- H1.0 Miscellaneous Working Documents
- H1.1 Well Logs and Reports to the State Engineer of
Nevada
- H1.2 Dry Lake Valley Well Log and Well Design
(Valley-Fill)
- H1.3 Dry Lake Valley Well Log and Well Design
(Carbonate)

A1.0

DRY LAKE VALLEY SECTION: MX SITING
INVESTIGATION, WATER MANAGEMENT REPORT

4.5 DRY LAKE VALLEY

4.5.1 Hydrologic Summary

Dry Lake Valley is a topographically open basin in Lincoln County, Nevada. Of the approximately 700 mi² (1813 km²) of valley area, 310 mi² (802.9 km²) are suitable for MX deployment (Table 4-10).

Dry Lake Valley is hydrologically connected with Muleshoe Valley, and the two valleys are considered as a single hydrographic unit by the Nevada State Engineer. Ground water in Dry Lake and Muleshoe valleys is essentially undeveloped, however, there are 20 acre-ft/yr (0.02 hm³/yr) of pending applications and 19 acre-ft/yr (0.02 hm³/yr) of certificated or permitted rights (Woodburn and others, 1981) for ground-water withdrawal. In addition, there is 21 acre-ft/yr (0.02 hm³/yr) of surface water use (DRI, 1980) in the valley.

The perennial yield is estimated at 3000 acre-ft/yr (3.70 hm³/yr) for the Dry Lake-Muleshoe basin (State of Nevada, 1971). The combined peak-year MX water requirements in the two valleys, 3373 acre-ft/yr (4.16 hm³/yr) for Dry Lake and 968 acre-ft/yr (1.19 hm³/yr) for Muleshoe, in 1984 would exceed the Dry Lake-Muleshoe basin perennial yield by 1341 acre-feet (1.65 hm³). However, the combined total ground water in storage within the upper 100 feet (30 m) of saturated sediments in Dry Lake and Muleshoe valleys is estimated at 2.8 million acre-feet (3452.4 hm³) (State of Nevada, 1971). This suggests that the ground-water basin could sustain the peak MX water demand if temporary overdraft is allowed by the Nevada State Engineer.

GENERAL PHYSIOGRAPHY

Valley Area	Valley Length	Avg. Valley Width	Suitable Area	Avg. Valley Floor Elevation
700 sq mi	38 mi	18 mi	310 sq mi	4800 ft

GENERAL HYDROLOGY

Aquifer	Depth to Water	Potentiometric Elevation Range	Transmissivity	Storativity	
Valley-fill Carbonate	300-800 ft 850 ft	4200-5000 ft —	3300 sq ft/day 13,000 sq ft/day	0.06 —	
Perennial Yield	Ground-Water Recharge (ppt)	Interbasin Recharge	Interbasin Discharge	ET	Surface Discharge
3000	2700	2100	5000	minor	—

WATER QUALITY

Total Samples	Suitable for Consumption	Exceeds (1) Standards	Suitable for Construction	Exceeds * Standards
6	5	1	6	0

WATER USE AND APPROPRIATIONS (2)

Source	Current Use	Applications	Certificates/ Proofs/Permits	Availability (3)
Ground Water	0	20	19	3000/2981
Surface Water	21	2596	-	-

MX WATER REQUIREMENTS

	1982	1983	1984	1985	1986	1987	1988	1989	1990
Construction	196	414	3373	2458	2014	225	0	0	0
Operation									

- (1): Well near Bristol Silver Mine - exceeds state primary standard for nitrate
 (2): Dry Lake and Muleshoe valleys combined
 (3): Perennial Yield - Current Use /
 Perennial Yield - Certificated Use
 * : Portland Cement Association
 recommendations (1966).

Note: All units are in acre-feet per year unless otherwise noted.



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 DEPARTMENT OF THE AIR FORCE
 BMO/AFRC-MX

HYDROLOGIC SUMMARY DRY LAKE VALLEY, NEVADA

28 SEPT 81

TABLE 4-10

Surface water supplies are limited to ephemeral streamflow and springs. The springs are located mostly in the mountains, are generally inaccessible, and have low discharge (less than 2 gpm [0.13 l/s]).

A 10-day aquifer pump test conducted by Ertec in the southern part of the valley (3S-64E-12ca) (number 40433) indicates a generally unconfined valley-fill aquifer having an average transmissivity of 3300 ft²/day (306.6 m²/day) and a storativity of 0.06. Confined or semiconfined conditions are, however, expected in other portions of the valley due to the complex nature of the valley fill which was found to be composed of variable thicknesses of clay, silt, sand, and gravel.

The regional carbonate aquifer underlying and adjacent to the valley fill is considered to have a high potential for development. Data from an aquifer test performed by Ertec in the northern part of the valley (3N-63E-27cc) indicate a transmissivity in the carbonate aquifer of 13,000 ft²/day (1208 m²/day). The test well was pumped at a sustained rate of 106 gpm (7 l/s) with a drawdown of only 2 feet (0.6 m). The hydrostratigraphic unit (Guilmette Formation and Simonson Dolomite) penetrated at the test site is considered to be a high-yield aquifer based on these investigations.

Water-chemistry tests on water samples collected by Ertec from both the valley-fill and carbonate aquifers show that all but one well, 3N-65E-21dba, meet primary and secondary drinking

water standards for the State of Nevada (Appendix D). This well, located in the northeastern part of Dry Lake Valley was found to have a nitrate concentration of 32 mg/l, which exceeds the 10 mg/l standard for nitrate. This well was, however, used for mining operations by the Bristol Silver Mine and is thought to be contaminated by mining-related activity.

4.5.2 Water-Supply Sources

Development of the valley-fill aquifer is the preferred source for the MX water supply in Dry Lake Valley (Table 4-11). Development of the valley-fill aquifer is projected to have the least potential impact on local water users and the environment, the highest physical development potential, and to be the least costly and the most timely to develop of the four water-supply options. The legal availability of ground water from the valley-fill aquifer was ranked second to importation because the estimated perennial yield of the hydrographic basin can supply only about 70 percent of the peak-year requirements. The quantity of ground water presently available for development, based on certificated and permitted water rights, is 2981 acre-ft/yr ($3.68 \text{ hm}^3/\text{yr}$). The estimated combined peak-year water requirement for Dry Lake and Muleshoe valleys is 4341 acre-feet (5.35 hm^3) during 1984. However, there is essentially no ground-water use in Dry Lake Valley, and the State Engineer need not limit his decisions on the approval of ground-water applications to a comparison of approved water rights versus the perennial yield of the basin. Quantity, distribution, and type and length of

Criteria	Weight	Valley-fill Aquifer		Carbonate Aquifer		Lease/Purchase		Importation	
		Score	Wt. Score	Score	Wt. Score	Score	Wt. Score	Score	Wt. Score
Legal Water Availability	10	7	70	7	70	0	0	8	80
Impacts on Man or Environment	10	9	90	8	80	7	70	6	60
Development Potential (Physical Availability)	10	10	100	8	80	7	70	10	100
Cost	4	10	40	3	12	5	20	0	0
Timeliness	6	10	60	2	12	7	42	1	6
Water Quality	2	10	20	10	20	10	20	10	20
Final Weighted Score		380		274		222		266	

* Recommended source of water supply
 + First alternative source of water supply



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WATER-SUPPLY SOURCE MATRIX DRY LAKE VALLEY, NEVADA

28 SEPT 81

TABLE 4.11

current and proposed ground-water use is considered as well as the quantity of water in storage in the aquifer.

The development of the carbonate aquifer in Dry Lake Valley is considered a much more feasible alternative source of water supply than importation of water, even though it ranked only slightly higher than importation in the matrix evaluation. The results of a carbonate aquifer test conducted by Ertec near the northwest margin of the valley indicate that the carbonate aquifer has a high potential for development; however, development of the carbonate aquifer would be about three times more costly than the valley-fill aquifer and would require four times more time to construct the supply wells. The relatively high yield potential indicated by the existing carbonate test well suggests that some combination of pumping from the valley-fill and the carbonate aquifers may be viable.

Importation of water is ranked third among the four options, although it compares favorably with development of the carbonate aquifer. Importation ranked high because of the legal and physical water availability in the source valley, which would be Spring Valley. The matrix evaluation is weighted more toward legal and environmental considerations of water use and less toward MX water-supply system construction. However, importation of water from the nearest valley where it is plentiful is estimated to cost as much as 40 times development of the valley-fill aquifer and 14 times development of the carbonate aquifer.

Lease or purchase of existing water rights is presently not recommended because there are only 19 acre-ft/yr ($0.02 \text{ hm}^3/\text{yr}$) of approved ground-water rights (Woodburn and others, 1981) and 21 acre-ft/yr ($0.03 \text{ hm}^3/\text{yr}$) of surface-water rights (DRI, 1980). These total less than one percent of the MX peak-water requirement for Dry Lake and Muleshoe valleys combined in 1984.

4.5.3 Suitable Areas for Water-Supply Well Locations

Two large areas in Dry Lake Valley have been identified as primary areas for development of the valley-fill aquifer (Drawing 4-5). In the northern part of the valley, there is an extensive primary area in the central valley and flanking alluvial fans. In the central and southern part of the valley, a 0.25- to 3-mile (0.4- to 5-km) wide strip of primary areas occurs between the lacustrine sediments in the valley floor and the edge of the valley. In Township 3S, these strips coalesce into one and extend southward into Delamar Valley.

The primary area for development of the valley-fill aquifer in Dry Lake Valley is extensive and is capable of providing well locations for the construction and operation of the MX missile system.

Due to the extensive deposition of lacustrine deposits in central and southern Dry Lake Valley, a large area is classified as secondary. This area extends from the north-central part of Township 1N to the central part of Township 3S and is 5 to 6 miles (8 to 10 km) wide.

Additional small secondary areas have been delineated on the western flank of the valley in Township 1S and on the southwest flank of the mountains in Township 3S. These areas are classified as secondary on the basis of geophysical and water-level data which indicate that only thin saturated thicknesses of valley-fill sediments occur. There is only one Air Force water-appropriation application point of diversion in the valley, and it lies in a secondary water-supply well development area at 3S-64E-12ac (number 40433).

There is only one cultural exclusion within the valley-floor area in Dry Lake Valley which is located in Township 1S near the east side of the valley. There are, however, four water-appropriation exclusions in the northern part of the valley floor and two water-appropriation exclusions in the central portion of the valley floor. These exclusions include the area within 1 mile (1.6 km) of an existing ground-water or surface-water appropriation. Other water-appropriation exclusions are found in the mountains adjacent to the valley. A possible regional spring occurs in Dry Lake Valley at 3N-65E-31cc.

4.5.4 Water-Supply System Alternatives

Based upon the available hydrologic data and the matrix analyses conducted as part of this investigation, there are three feasible MX water-supply alternatives for Dry Lake Valley. The alternative which can be ultimately used is largely dependent upon the decision of the State Engineer regarding temporary overdraft of the Dry Lake Valley ground-water basin. The three

alternatives, listed in order of priority from a technical standpoint, are discussed below.

4.5.4.1 Alternative I

The first alternative involves splitting the pending Air Force water-appropriation point of diversion at the existing Air Force test well at 3S-64E-12ca (number 40433) into multiple points of diversion, use of the existing test well at 3S-64E-12ca and the carbonate test well at 3N-63E-27cc, and the construction of two additional water-supply wells in the valley-fill aquifer. This approach will require the amendment of the pending application. This process should be initiated early in FY 82 to ensure that there is available water for the initial MX construction activities scheduled to begin in mid-1982.

The proposed LSC, presumed to be located in 3S-64E, will require from 230 to 1050 acre-ft/yr (0.28 to 1.29 hm³/yr) with the peak requirement in 1986. Based upon an estimated well yield of 750 gpm (47 l/s), only one water-supply well will be required to deliver the 651 gpm (41 l/s) needed for peak water use at the LSC. The existing Air Force test well at 3S-64E-12ca has been pumped at a maximum rate of 750 gpm (47 l/s) and, if a sustained yield of 651 gpm (41 l/s) is possible, no additional MX water-supply wells will be required. During the period from 1983 to 1985, and during 1987, surplus water from the existing well could be utilized for DTN and cluster construction in the southern end of the valley.

The development of MX water-supply wells for DTN and cluster construction, operation, and reclamation will require the use of the existing Air Force valley-fill well at 3S-64E-12ca, the use of the existing carbonate exploration well at 3N-63E-27cc, and the construction of two additional MX water-supply wells.

In 1982 and 1983, the entire MX water requirement in Dry Lake Valley can be met through the operation of the existing Air Force valley-fill well. In 1984, however, the existing Air Force carbonate exploration well located at 3N-63E-27cc and three additional wells will be required to deliver the 3373 acre-feet (4.16 hm^3) which will be required. It is recommended that one additional valley-fill well be constructed in the primary area in the southern part of the valley and one valley-fill well be constructed in the primary area in the northern part of the valley. Assuming well yields of 650 gpm (41 l/s) or 1047 acre-ft/yr ($1.29 \text{ hm}^3/\text{yr}$) if pumped continuously, these wells should be capable of supplying more than the MX water requirement (3373 acre-feet [4.16 hm^3]) during the peak-construction year. For the period from 1985 to 1986, the MX water requirements for nondomestic purposes decrease and a reduction in the pumping rates of the water-supply wells can occur.

4.5.4.2 Alternative II

If the State Engineer restricts MX ground-water withdrawal from the valley-fill aquifers of Dry Lake hydrographic basin (Dry Lake and Muleshoe valleys) to the perennial yield of 3000

acre-ft/yr ($3.70 \text{ hm}^3/\text{yr}$) but allows additional water to be withdrawn from the carbonate aquifer, as much as 1341 acre-feet (1.65 hm^3) may have to be withdrawn from the carbonate aquifer in 1984. This alternative would then involve splitting the pending Air Force water-appropriation point of diversion at the existing Air Force test well at 3S-64E-12ca (number 40433) into multiple points of diversion, use of the existing valley-fill aquifer test well at 3S-64E-12ca, increasing the diameter of the carbonate aquifer test well at 3N-63E-27cc, and the construction of an additional valley-fill and carbonate aquifer well.

Although the carbonate test well at 3N-63E-27cc had a sustained yield of 106 gpm (7 l/s), the drawdown in the well was only 2 feet (0.6 m). Discharge from the well was limited by the greater than 800 feet (244 m) water depth and by small well diameter. A larger capacity pump, necessitating a larger diameter well, can be expected to increase the well yield to at least 450 gpm (28 l/s) or 725 acre-ft/yr ($0.89 \text{ hm}^3/\text{yr}$) pumped continuously.

The entire MX water requirement in Dry Lake Valley can be met through the operation of the existing Air Force test well at 3S-64E-12ca in 1982, 1983, and 1987. In 1984, however, two carbonate wells, including the existing carbonate well at 3N-63E-27cc with an increased diameter, and one additional well in the valley-fill aquifer would be used to supply the required water. In 1985, most of the required water can be supplied by two wells tapping the valley-fill aquifer and only minimal water will be needed from a well in the carbonate aquifer. No water will be required from the carbonate aquifer in 1986.

4.5.4.3 General Well Characteristics

An Air Force well constructed in the valley-fill aquifer at 3S-64E-12ca (number 40433) was pumped at a constant discharge rate of 500 gpm (32 l/s), and results suggest that a higher sustained yield is possible. The valley-fill well was constructed with a 16-inch (41-cm) borehole and a 10-inch (25-cm) ID casing to a total depth of 1012 feet (308 m). Larger diameter wells may be capable of greater sustained yields if the same favorable aquifer is penetrated. Although the depth to water ranges from about 800 feet (244 m) below land surface in the northern part of the valley to over 300 feet (91 m) in the southernmost part of the valley, the depth to productive aquifer may be substantially greater. Therefore, it is recommended that MX water-supply wells be constructed to depths of at least 1200 feet (366 m). Due to the lack of hydrologic data for aquifer characteristics and well yields for much of Dry Lake Valley, it is recommended that exploratory drilling be conducted to verify the proposed locations of other MX water-supply wells.

4.5.5 Additional Investigations

Suggested possible sites for additional drilling and testing prior to operational development of the water-supply system are identified in Drawing 4-5.

An application was filed for only one point of diversion in Dry Lake Valley at 3S-64E-12ca (number 40433). The request for water at this point of diversion was sufficient to meet the peak MX water requirement for construction in the valley.

Two additional drilling sites have been identified beyond the application point of diversion in Dry Lake Valley. These sites were selected along existing roads in primary water-supply areas delineated in Drawing 4-5.

The drilling site located at 3N-64E-2ac in the northern part of the valley is the first priority. The site is located 3 miles (5 km) south of the proposed construction camp at the northern end of Dry Lake Valley. A well at this location could provide data on water quantity and quality, both of which will be necessary for planning domestic water supply at the construction camp. This site is also strategically located with respect to clusters and is approximately 1 mile (1.6 km) from the DTN in an area where little or no aquifer performance data exist.

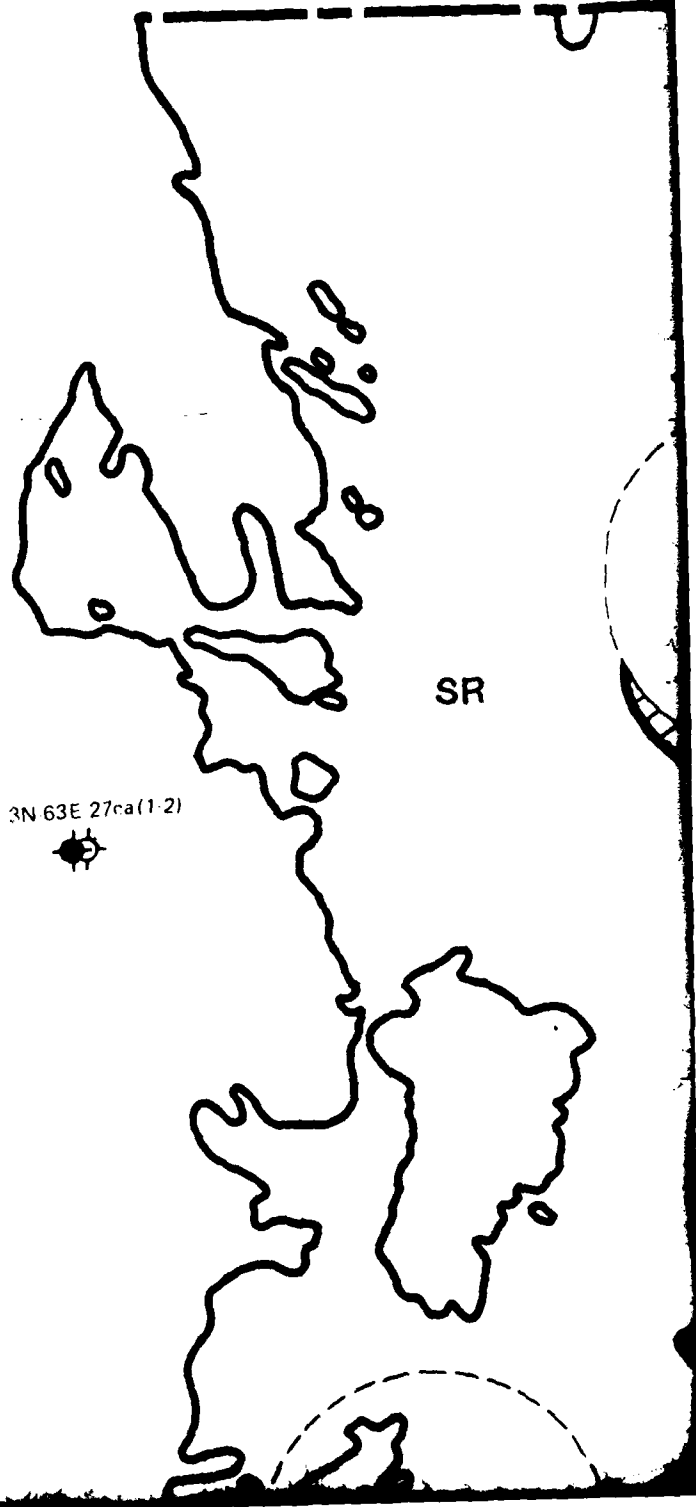
The drilling site at 2N-64E-36cc is centrally located with respect to the DTN and the clusters. The site at 2N-64E-36cc in north-central Dry Lake Valley is approximately 12 miles (19 km) south of a proposed construction camp. Aquifer data within a 5-mile (8-km) radius are limited to one stock well.

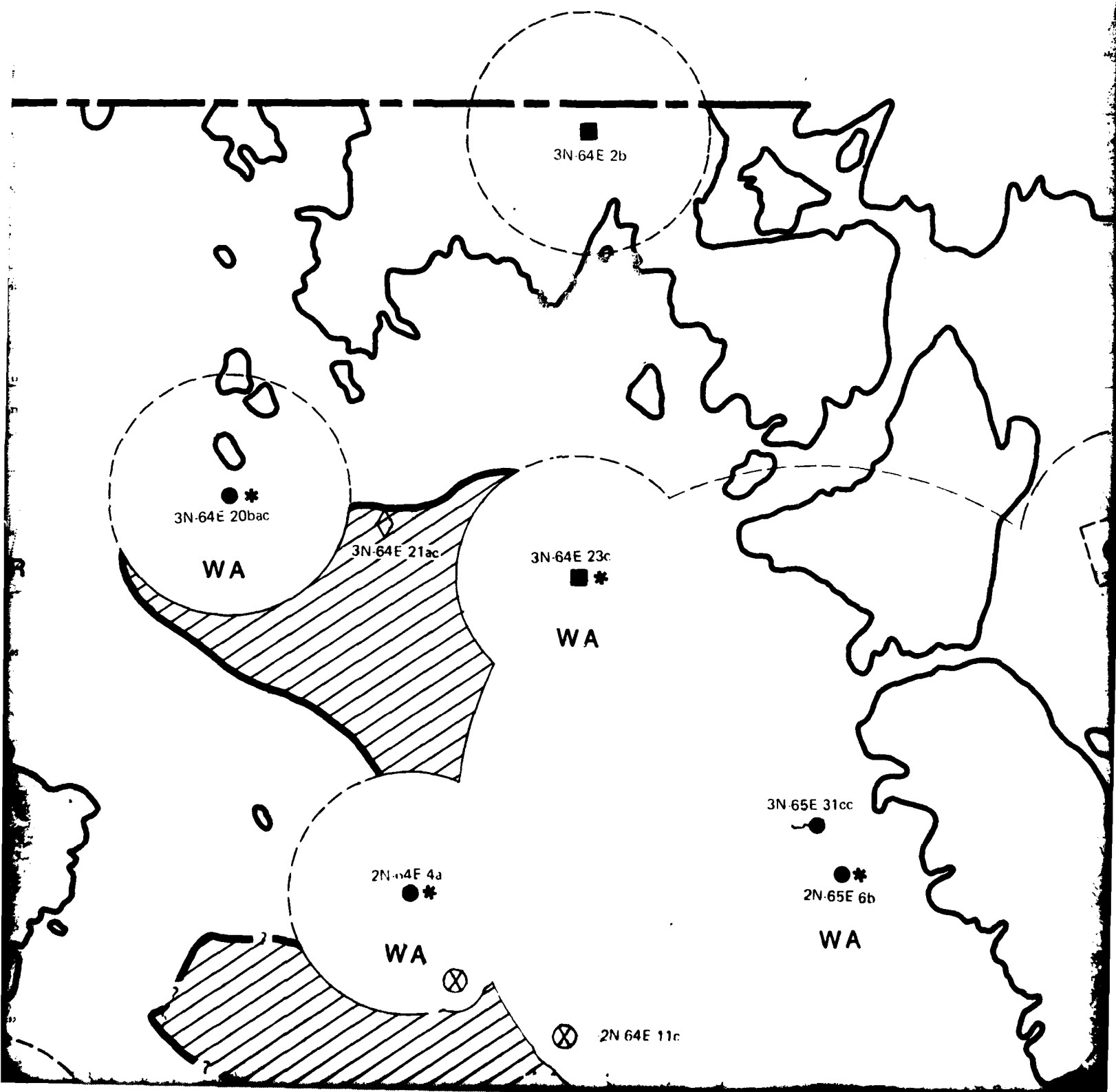
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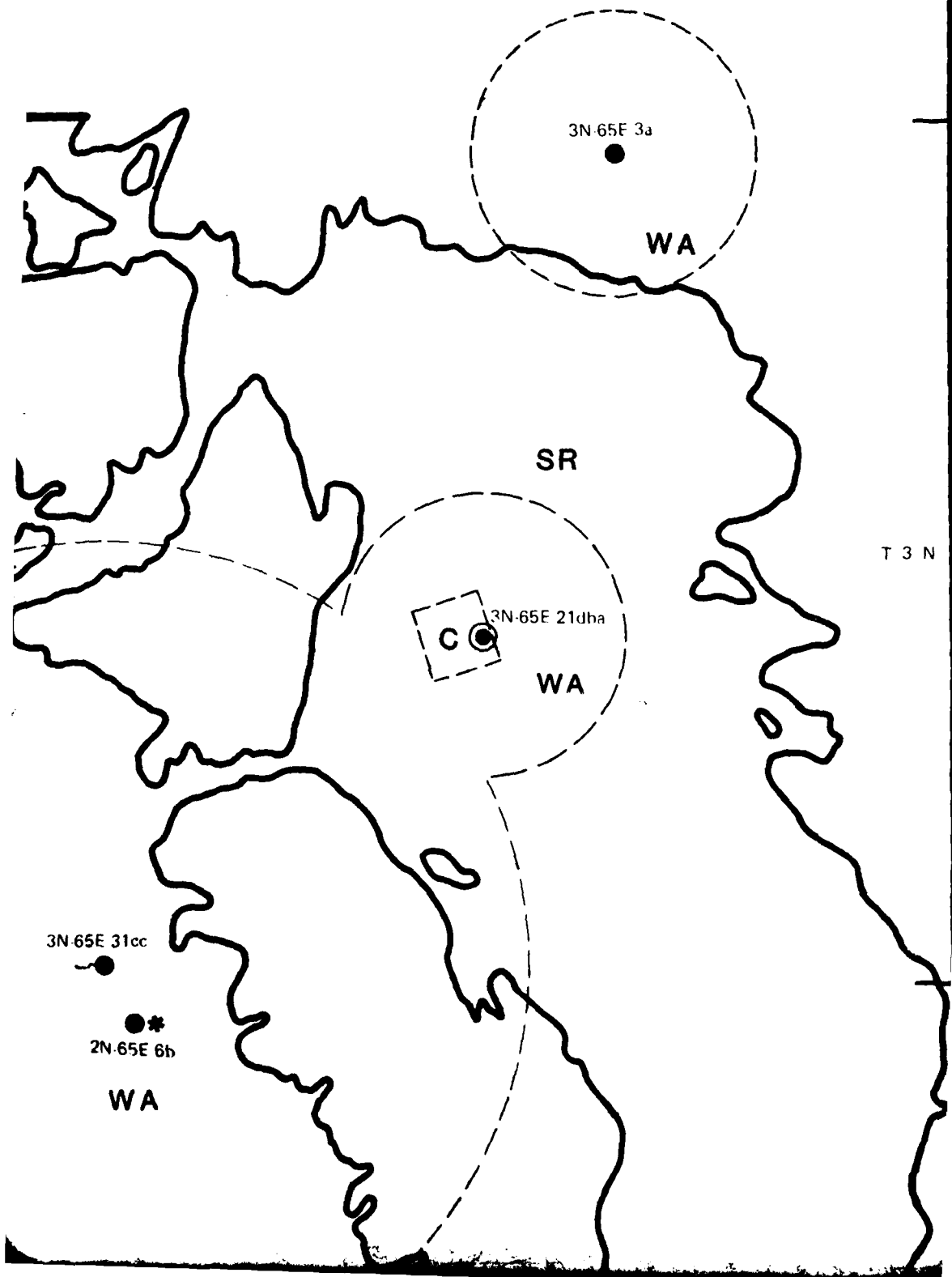
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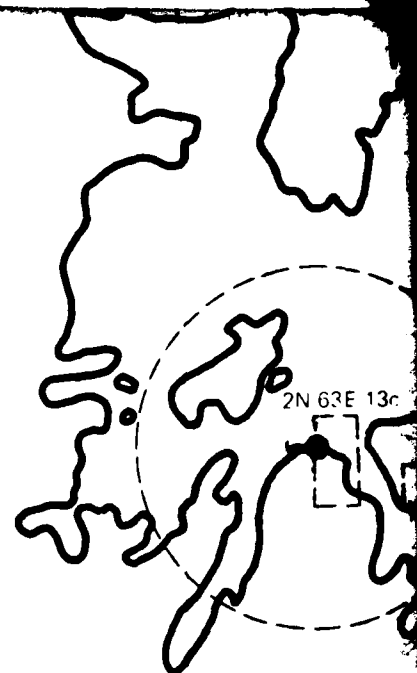




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T 2 N



2N-63E 34c



T 1 N

1N-63F 23b



1N-63E 21d



1N-63E 28c



2N-64E 4a



2N-65E 6b

WA

WA



2N 64E 11c

2N-63E 13c



2N-65E 30L



2N 64E 36cc



1N-64E 24a1



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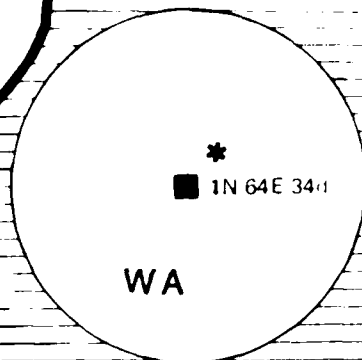
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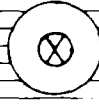
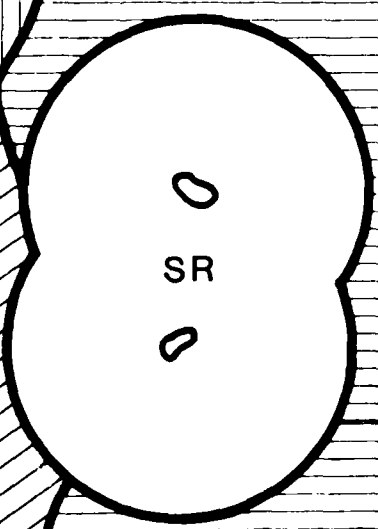
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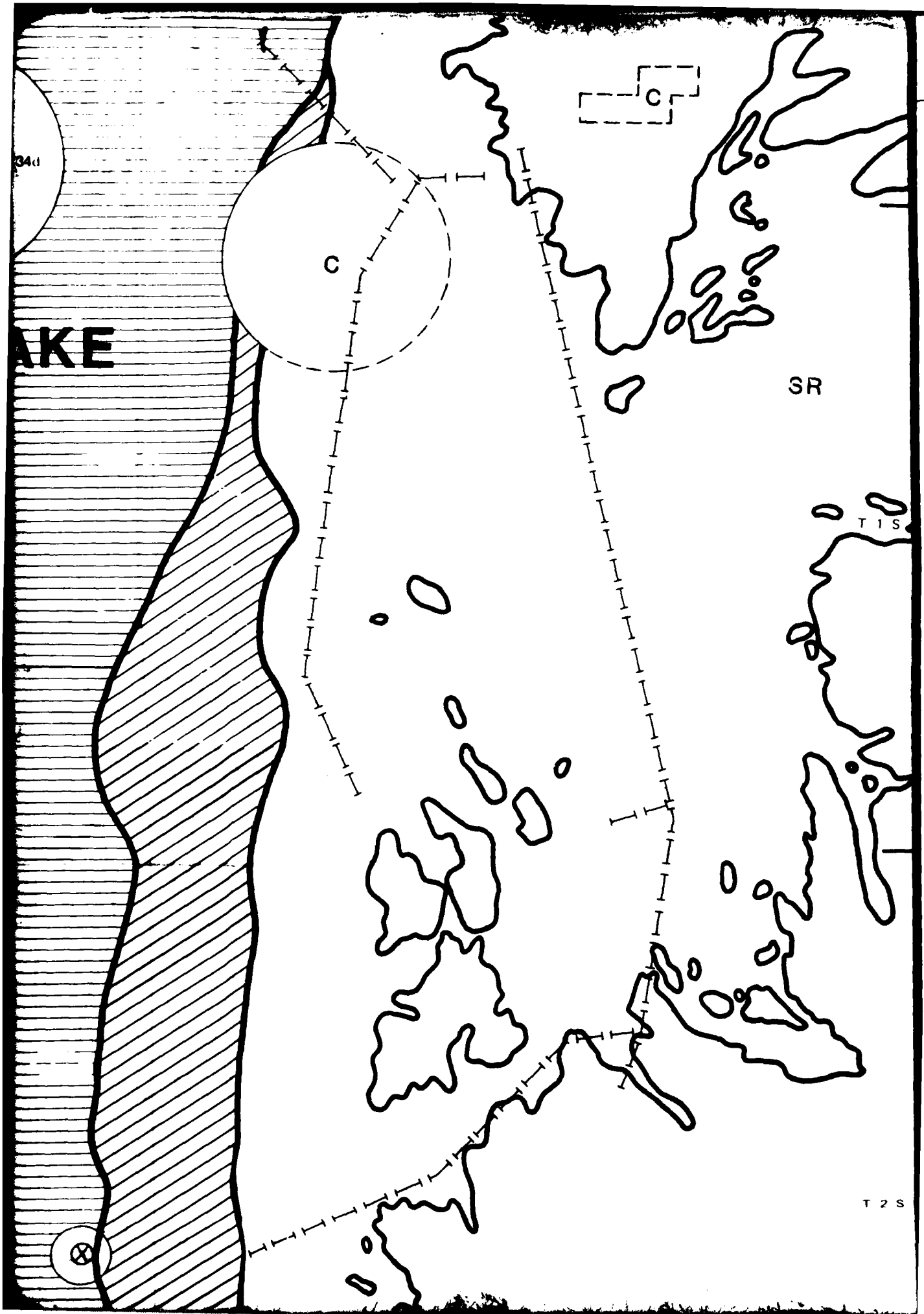


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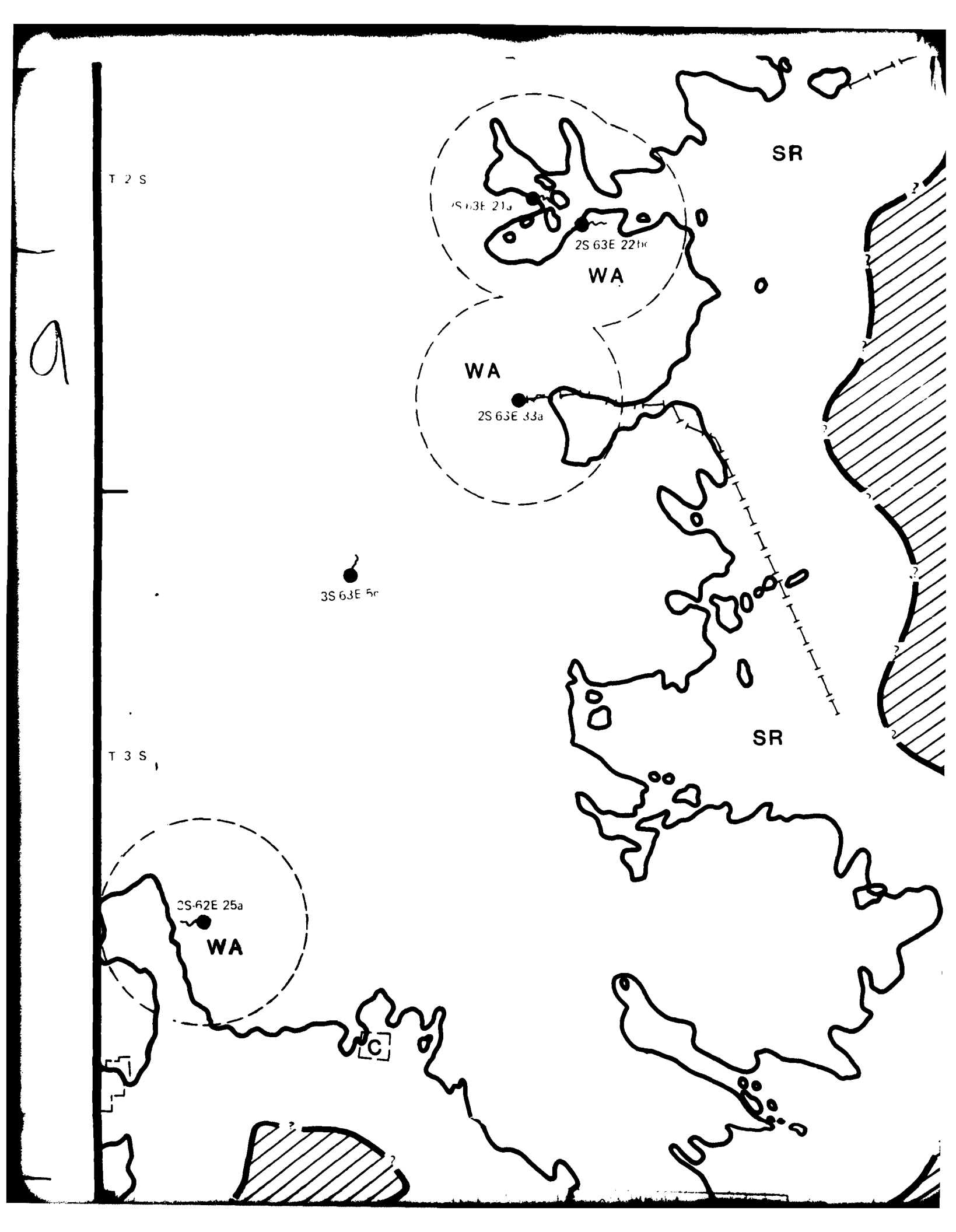
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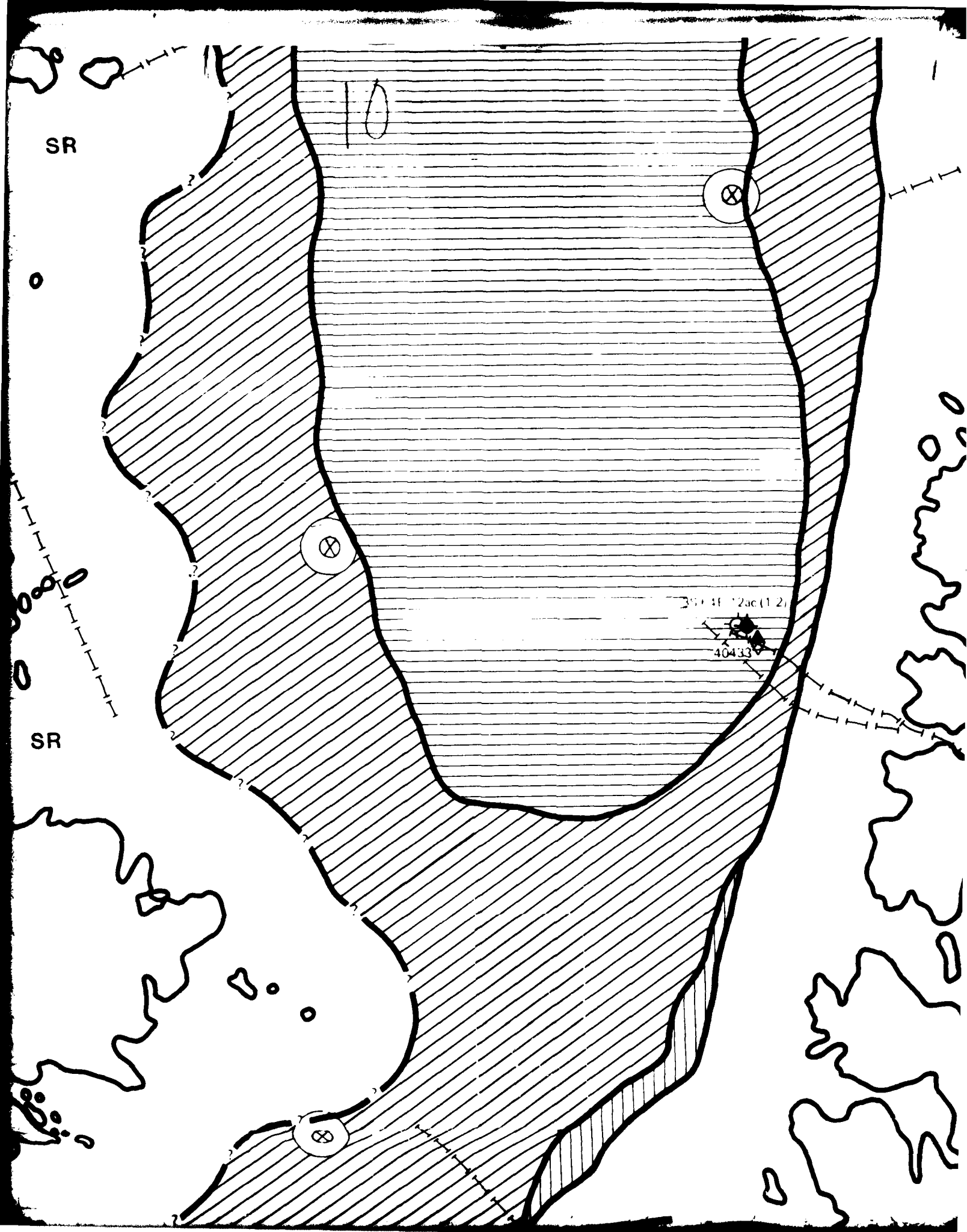
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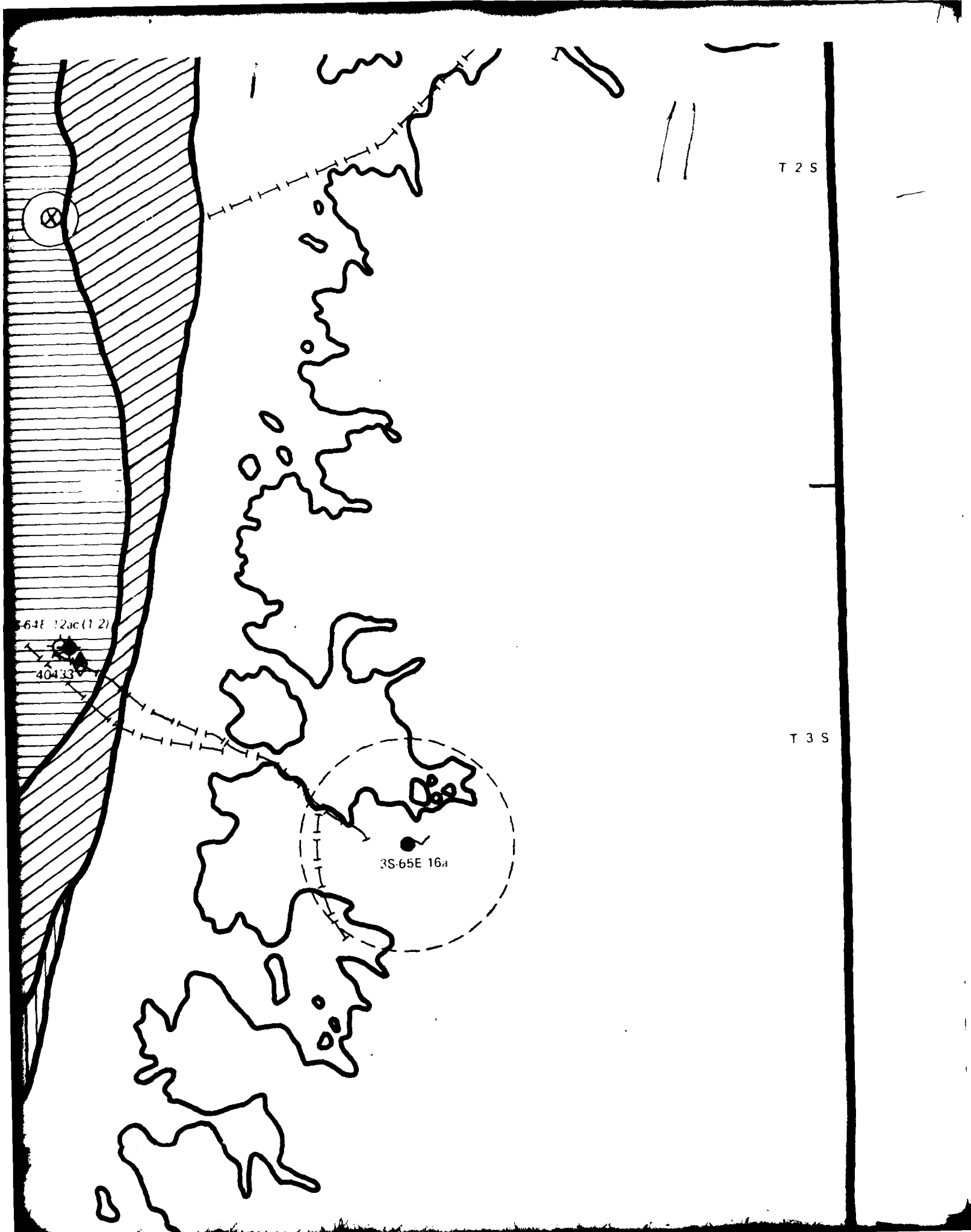


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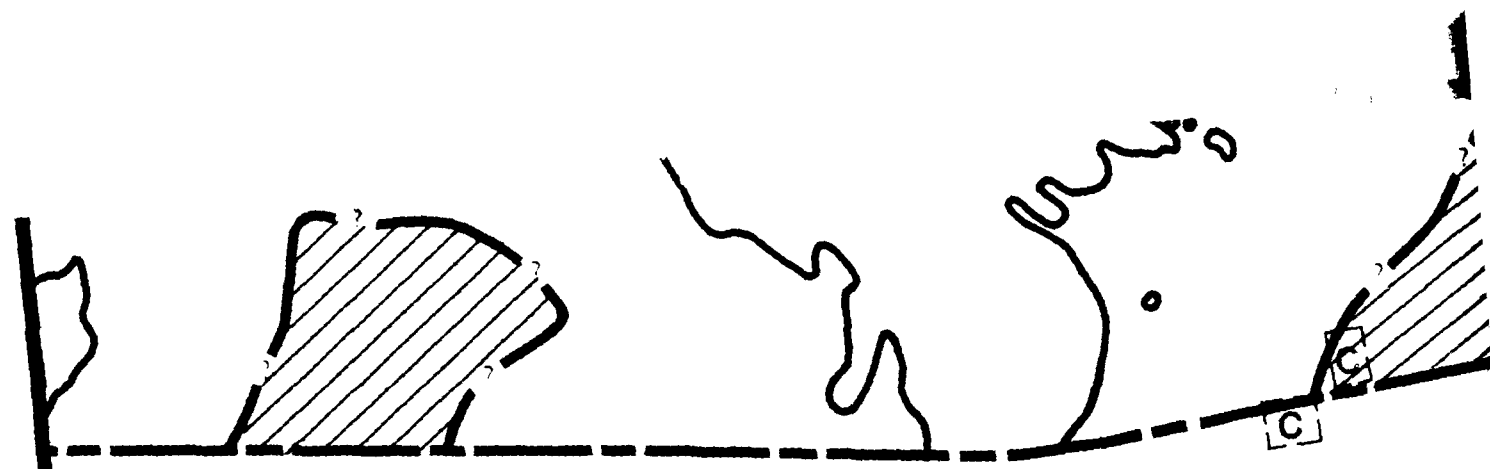
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EXPLANATION

SYMBOLS

----- POWERLINE(S)
 ----- TELEPHONE/TELEGRAPH
 |||| PIPELINE

----- DRAINAGE DIVIDE

----- VALLEY BOUNDARY

----- ROCK-VALLEY-FILL CONTACT

---?---?--- PREFERRED AREA BOUNDARY:
 QUERIED WHERE GEOPHYSICAL AND/OR
 WATER LEVEL DATA IS SUBJECT TO
 GREATER MARGIN OF ERROR

----- CULTURAL OR WATER APPROPRIATION
 EXCLUSION BOUNDARY, DASHED IN
 AREAS OF OTHER EXCLUSIONS

41222 ◆ AIR FORCE WATER APPROPRIATION
 (APPLICATION NUMBER SHOWN)

41221 ◆ AIR FORCE WATER APPROPRIATION: ADDITIONAL
 DRILLING/TESTING RECOMMENDED
 (APPLICATION NUMBER SHOWN)

◆ ADDITIONAL DRILLING/TESTING
 RECOMMENDED LOCATION

⊙ AIR FORCE OBS. WELL

◆ AIR FORCE TEST WELL

● DOMESTIC/STOCK WELL

⊙ MUNICIPAL/IRRIGATION WELL

■ UNDESIGNATED WELL

□ ABANDONED WELL

● SPRING

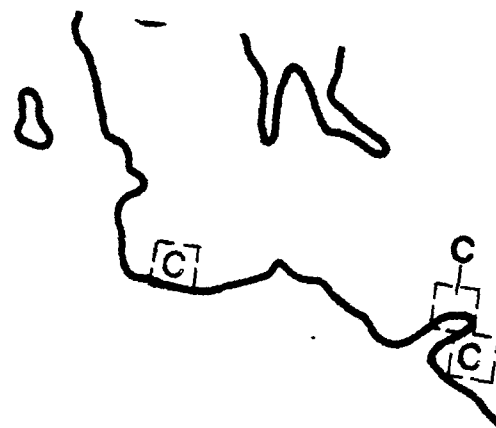
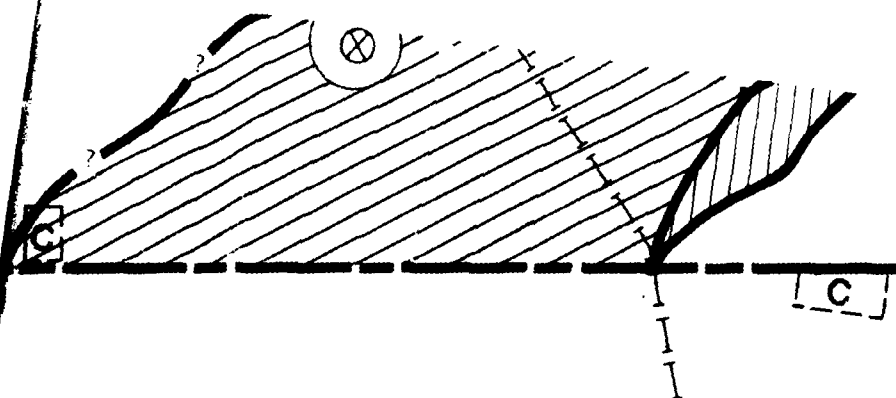
▲ STREAM APPROPRIATION

△ UNDESIGNATED APPROPRIATION

⊗ RESERVOIR

* POSSIBLE EXISTING WELL, UNVERIFIED
 WATER APPROPRIATION

12



PREFERRED AREAS

-  PRIMARY
-  SECONDARY: LACUSTRINE
-  SECONDARY: LIMITED SATURATED THICKNESS

AREAS OF EXCLUSION

- WA** : WATER APPROPRIATION
- C** : CULTURAL
- SR** : SHALLOW ROCK

REFERENCE

Desert Research Institute, 1980, Water rights in Nevada and Utah: an inventory within the MX area, Water Resources Center, University of Nevada System, unpublished report.

Ertec Western, Inc., 1981, MX water resources, potentiometric map - Dry Lake Valley, Nevada, unpublished map, 1: 62,500 scale.

Fugro National, Inc., 1980, MX siting investigation, gravity survey - Dry Lake Valley, Nevada, FN-TR-33-DL, unpublished report, 30 January 1980

1980, MX siting investigation, non-geotechnical map - Dry Lake Valley, Nevada, unpublished map, 1: 62,500 scale, July 1980

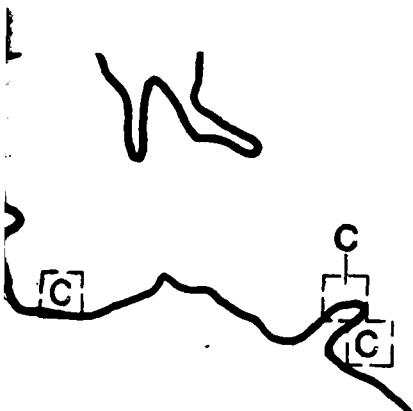
1980, verification study, Dry Lake Valley, Nevada, FN-TR-27-DL V. I, V. II

Ertec
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28 SEPT 81

13



Water rights in Nevada
in the MX area, Water
of Nevada System, un-

Water resources,
Lake Valley, Nevada,
scale.

Siting investigation,
Lake Valley, Nevada,
Report, 30 January 1980.

Siting investigation,
Lake Valley, Nevada,
scale, July 1980.

Investigation study, Dry
7-DL V. I, V. II.



SCALE 1:62,500



STATUTE MILES



KILOMETERS



The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

DRY LAKE VALLEY, NEVADA
PREFERRED AREAS FOR MX
WATER-SUPPLY WELLS

28 SEPT 81

DRAWING 4-5

14

B1.0

NUMERICAL MODELING STUDIES,
DRY LAKE VALLEY

C1.0

RESULTS OF AQUIFER TESTING,
DRY LAKE VALLEY

D1.0

DRY LAKE VALLEY SECTION: MX SITING
INVESTIGATION, TECHNICAL SUMMARY REPORT

2.8 DRY LAKE VALLEY

2.8.1 GENERAL PHYSIOGRAPHY AND HYDROLOGY

Dry Lake Valley is a north-trending basin in Lincoln County, Nevada. The valley is topographically open to Muleshoe Valley to the north and is separated from Delamar Valley to the south by a low alluvial divide. Dry Lake and Muleshoe valleys are considered one hydrologic basin by the Nevada State Engineer. Dry Lake Valley is 38 miles (61 km) long, 21 miles (34 km) across at its widest point, and encompasses 700 mi² (1812 km²), of which 310 mi² (803 km²) are suitable for MX deployment. The average valley floor elevation is 4800 feet (1463 m). The valley is bordered by the North Pahroc Range on the west and the Burnt Springs, Highland and Bristol ranges on the east. The mountain crests range in elevation from about 7000 feet (2134 m) to over 9000 feet (2743 m).

Perennial streamflow is absent in Dry Lake Valley there is some ephemeral surface-water inflow from Muleshoe Valley, however, total runoff from the mountains at the apex of the alluvial fans is estimated to be 9000 acre-ft/yr (11.1 hm³/yr) (Nevada State Engineer, 1971). This estimate is for the combined Dry Lake, Muleshoe, and Delamar valleys hydrographic areas. Small springs in or near the base of the mountains surrounding Dry Lake Valley issue from the clastic rocks of Paleozoic age and the volcanic and clastic rocks of Tertiary age. Four springs discharged from 0.5 to 2 gpm (0.03 to 0.1 l/s), when measured in May 1980 by Ertec personnel.

Ground-water recharge is from the infiltration of precipitation in stream channels and surface runoff on the alluvial fans. The average annual recharge for Dry Lake/Muleshoe valleys is estimated to be 4800 acre-ft/yr ($5.9 \text{ hm}^3/\text{yr}$) (Eakin, 1963). Of this amount, approximately 2100 acre-ft/yr ($2.6 \text{ hm}^3/\text{yr}$) is derived from precipitation in the mountains around Muleshoe Valley with the remainder from sources within Dry Lake. Evapotranspiration and water discharged by wells is less than 100 acre-ft/yr ($0.1 \text{ hm}^3/\text{yr}$). Evapotranspiration only occurs in limited areas near small springs.

The Dry Lake Valley basin is a hydrologically open system with underflow to the south or southwest and possibly to the west through the carbonates of Paleozoic age. Total discharge by underflow is estimated to be 5000 acre-ft/yr ($6.2 \text{ hm}^3/\text{yr}$) (Nevada State Engineer, 1971). This is considered in agreement with Eakin's (1963) estimate of 4800 acre-ft/yr ($5.9 \text{ hm}^3/\text{yr}$) recharge because the State Engineer's figure is rounded to the nearest thousand acre-foot. The hydraulic gradient in the valley fill aquifer is southward at 16 ft/mi (3 m/km) from central Dry Lake Valley to central Delamar Valley (Figure B1.8). The potentiometric surface ranges in elevation from 5000 feet in the north to 4200 feet in the south (1524 to 1280 m) based on the regional potentiometric map. The depth to ground water in Dry Lake Valley is in excess of 300 feet (91 m), thus, there is no evapotranspiration of ground water by phreatophytes. The valley-fill aquifer in Dry Lake Valley is probably over

10,000 feet (3048 m) thick in the central part of the valley and is composed of alluvial fan, fluvial, playa, and lacustrine deposits (FN-TR-33DL, FN-TR-26E). Eakin (1963 describes the valley-fill sediments as clay, silt, sand, and gravel of Tertiary to Quaternary age deposited under subaerial and lacustrine conditions.

Carbonate rocks of Paleozoic age are exposed in the mountains and are believed to partially underlie the valley-fill sediments. The mountains bordering Dry Lake Valley to the west contain ash flow tuffs of Tertiary age with some carbonate rocks of Paleozoic age. The mountains to the east contain carbonates of Paleozoic age with minor amounts of ash flow tuffs of Tertiary age (Stewart and Carlson, 1978).

2.8.2 MX WATER REQUIREMENTS

The peak annual demand for ground water in Dry Lake Valley during the construction phase is expected to be 3411 acre-ft (4.2 hm^3) in 1984 according to preliminary figures from the U.S. Army Corps of Engineers (1981) as revised by Ertec (1981). Construction should begin in 1982 and conclude in 1987. Water demand for the operational phase of the MX project is expected to be less than 300 acre-ft/yr ($0.4 \text{ hm}^3/\text{yr}$) for the 30 year life of the project.

The Air Force has requested 3810 acre-ft/yr ($4.7 \text{ hm}^3/\text{yr}$) for appropriation in Dry Lake Valley. It should be noted that the amount of water needed in Dry Lake Valley for construction and operation is expected to be less than this because the applicat-

ions were filed before the latest cluster layouts and water requirements were determined.

2.8.3 WATER SUPPLY LIMITATIONS

2.8.3.1 Perennial Yield, Use, and Appropriations

The combined perennial yield for Dry Lake/Muleshoe valleys is estimated to be 3000 acre-ft/yr ($3.7 \text{ hm}^3/\text{yr}$) (Nevada State Engineer, 1971). This was apparently based on Eakin's (1963) estimate of 6000 acre-ft/yr ($7.4 \text{ hm}^3/\text{yr}$) discharge for the combined Muleshoe, Dry Lake, and Delamar valleys. The discharge was divided, and a combined perennial yield of 3000 acre-ft/yr ($3.7 \text{ hm}^3/\text{yr}$) was assigned to Dry Lake/Muleshoe valleys.

Surface-water use, primarily for stock watering, is estimated to be 21 acre-ft/yr ($0.03 \text{ hm}^3/\text{yr}$) in Dry Lake Valley. Surface-water appropriations in the appropriation and permit phase total 2596 acre-ft/yr ($3.2 \text{ hm}^3/\text{yr}$) (DRI, 1980). At the present time, ground-water use is minor in Dry Lake Valley. Current ground-water permits total 8 acre-ft/yr ($0.01 \text{ hm}^3/\text{yr}$), certifies total 11 acre-ft/yr ($0.01 \text{ hm}^3/\text{yr}$), and there are a total of 20 acre-ft/yr ($0.03 \text{ hm}^3/\text{yr}$) of pending applications for ground-water rights in the valley (Woodburn, et al, 1981).

The quantity of ground water available for MX use is approximately 3000 acre-ft/yr ($3.7 \text{ hm}^3/\text{yr}$) when considering existing use. The water availability is 2981 acre-ft/yr ($3.7 \text{ hm}^3/\text{yr}$) when considering approved appropriations and 2961 acre-ft/yr (3.7

hm³/yr) when considering both existing and pending applications. The peak MX demand of 3411 acre-ft/yr (4.2 hm³/yr) for ground water will exceed the reported perennial yield by 411 acre-ft/yr (0.5 hm³/yr). When considering existing appropriations, the perennial yield will be exceeded by 430 acre-ft/yr (0.5 hm³/yr). Because the State Engineer considers Muleshoe Valley as part of Dry Lake Valley for perennial yield estimates, its ground-water demand must also be considered. Peak year MX demand for Muleshoe Valley is 968 acre-ft (1.2 hm³) in 1984. Therefore, the combined peak construction water demand in 1984 and the existing appropriations will exceed the perennial yield by 1398 acre-ft/yr (1.7 hm³/yr). However, if Dry Lake/Muleshoe valleys are hydrologically connected with Delamar Valley as previously discussed, and the perennial yield of Delamar Valley (3000 acre-ft/yr, 3.7 hm³/yr) and its peak MX demand (679 acre-ft/yr; 0.8 hm³/yr) is considered, the total peak year demand for construction water in 1984 is 5058 acre-ft (6.2 hm³/yr) compared to a combined perennial yield of 7000 acre-ft/yr (7.4 hm³/yr). The combined existing appropriations for the three valleys totals 35 acre-ft/yr (0.04 hm³/yr), therefore sufficient water would be available from the combined basins to meet peak year MX requirements. It should also be noted that the construction period in the three valleys is from 1982 to 1987, and that the quantity of water needed for the operational phase after that period will be considerably less than that required during construction.

2.8.3.2 Source Capabilities

Surface water is limited to ephemeral streamflow and spring discharges in Dry Lake Valley. The springs in Dry Lake Valley are not believed to be a dependable source of water for the MX project because they are generally in the mountains above the valley floor, are relatively inaccessible, and have low discharge (less than 2 gpm; 0.1 l/s).

Data from an aquifer test performed by Ertec in the southern part of the valley (3S/64E-12ac) indicate a transmissivity and storativity for the valley-fill aquifer of about $3100 \text{ ft}^2/\text{day}$ ($287 \text{ m}^2/\text{day}$) and 0.04, respectively. These aquifer characteristics indicate that, in this area of the valley, the valley-fill aquifer is capable of yielding water in sufficient quantities and rates required to meet MX needs.

A carbonate aquifer test conducted by Ertec Western in the northern part of the valley (3N/63E-27ca) indicated a transmissivity in the carbonate aquifer of about $13,500 \text{ ft}^2/\text{day}$ ($1250 \text{ m}^2/\text{day}$) and a specific capacity of 50 gpm/ft.

2.8.3.3 Water Quality

Water quality data for Dry Lake Valley is shown in Appendix Fl.8. Chemical analyses of water samples from the two test wells drilled by Ertec Western, one which penetrates the valley-fill aquifer and one which penetrates the carbonate aquifer, one existing well, and six springs indicate that, for the constituents analyzed, water quality are within criteria

for construction water (Appendix El.1). The chemical analyses of samples from six springs and three wells indicate that all but one well, at 3N/65E-21dba, meet Primary and Secondary Drinking Water Standards for the State of Nevada (Appendix El.2). This well, located in the northeastern portion of the valley was found to have a nitrate concentration of 32 mg/l, which exceeds the 10 mg/l Primary Drinking Water Standards for nitrate. This well was used when the Bristol Silver Mine was in operation and could be contaminated from surface sources. Although the valleywide water quality cannot be accurately predicted from the limited data available, it is expected that the ground water should be suitable for construction and drinking water purposes.

2.8.4 PRIMARY WATER SUPPLY ALTERNATIVES

2.8.4.1 Lease or Purchase of Existing Water Rights

It will not be possible to obtain MX water supplies through the lease or purchase of water rights in Dry Lake Valley because approved and pending ground-water appropriations total only 39 acre-ft/yr ($0.05 \text{ hm}^3/\text{yr}$). Because of the limited current use, substantial water is available for appropriation.

2.8.4.2 Valley-Fill Aquifer

The valley-fill aquifer represents a satisfactory source of water for MX construction and operation because: a) little ground water in Dry Lake Valley has been appropriated; and b) the aquifer tests and studies performed indicate that it is

capable of supplying water at the rate necessary and insufficient quantity and quality to meet MX requirements.

2.8.4.3 Carbonate Aquifer

The aquifer test mentioned previously indicates that the carbonate aquifer has a high potential for development in Dry Lake Valley. However, it is considered only as alternative for development because the valley-fill aquifer appears adequate for MX water requirements.

2.8.4.4 Interbasin Transfer

Interbasin transfer will not be necessary in Dry Lake Valley because the valley-fill aquifer is capable of meeting MX requirements. However, the transfer of water from Dry Lake Valley to Muleshoe and/or Delamar valleys is being considered.

2.8.5 IMPACTS OF DEVELOPMENT

2.8.5.1 Intrabasin Effects

Computer simulation of a well field in Dry Lake/Muleshoe withdrawing water for six years at rates estimated by the U.S. Army Corps of Engineers (1981) for both valleys was performed. A transmissivity of $1300 \text{ ft}^2/\text{day}$ ($120 \text{ m}^2/\text{day}$) and storativity of 0.05 were used in the simulation. Those values were found to be representative of the average aquifer characteristics of all types of sediments in the valley. Pumping rates were varied according to annual MX needs and reached a maximum of one well pumping in Muleshoe at 600 gpm (38 l/s) and five wells in Dry Lake pumping at 420 gpm (26 l/s). Maximum drawdown effects occurred after five years and averaged about 4.1 feet

(1.2 m) at a distance of one mile (2 km) from the wells in Dry Lake Valley. Because of the lack of vertical recharge on the valley floor and the absence of recharge from underlying sediments, complete recovery after cessation of pumping will occur after at least 30 years.

At the present time ground-water use in Dry Lake Valley consist of widely separated stock watering wells, so MX ground-water withdrawals should be able to avoid significant impacts to these users. The lowered water levels will have no effect on vegetation because the ground water is more than 300 feet (91 m) below the land surface and well beyond all root systems.

There should be little effect on spring discharge in Dry Lake Valley because the majority of the springs are in the hills and mountains and probably discontinuous with the valley-fill aquifer. There is a spring in Dry Lake Valley, (3N/65E-31cc) that may be considered a regional spring connected with the regional flow regime through carbonate rocks. MX wells will be located at appropriate distances from this spring to avoid any impacts.

2.8.5.2 Interbasin Effects

Water levels and spring discharge could be affected in Pahranaagat and Delamar valleys because they are downgradient from Dry Lake Valley and receive underflow through the carbonate aquifer. The regional springs which could be affected include Ash, Crystal, and Hiko springs in Pahranaagat Valley. However, there is not enough

data available to quantify what, if any, the effects will be. Because of the great distances from the pumped wells, ~~however~~ the effects will probably be undetectable.

2.8.6 MITIGATING MEASURES

A well field design was modeled for Dry Lake Valley which consisted of two simulations, one with a single pumping well and one with five pumping wells. Results from modeling indicate that MX ground-water withdrawals will probably require five or more wells to obtain water in sufficient quantity with the least amount of drawdown. Additional wells in Dry Lake Valley may be required to meet MX water requirements for Delamar and Muleshoe valleys.

The primary suitable for MX production wells is about 96 mi² (249 km²) along the margin of the valley. The criteria used in determining this area includes consideration of land status, environmentally sensitive areas, existing water appropriations, areas containing Tertiary sediments (which are generally fine grained), and low transmissivity zones.

Pumping schedules could be adjusted to avoid MX construction withdrawals exceeding the perennial yield of Dry Lake Valley. early storage of ground water in reservoirs prior to the construction period is a practical alternative. Another option would be to extend the construction period (reduce the rate of construction), which would reduce the peak year quantity of water required.

There are an additional 71 m² (184 km²) that are considered secondarily suitable in the center of the valley. This area is considered secondary because of the presence of generally low transmissivity lacustrine deposits and/or less than 200 feet of thickness.

24 SEP 81 14:03:23

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PAGE 1

DISCHARGE MEASUREMENTS, DRY LAKE VALLEY

ID. TOWNSHIP NO. RANGE-SECTION	SOURCE	STATION NAME	MC/YEAR MEASURED	DISCHARGE (GPM)	LAND ELEV (FT)	REMARKS	DATA SOURCE
1 3N/65E-31CC	SP		8/1979	3.0	5100		ERTEC 79
2 2N/65E-13C8A	SP	COYOTE SPRING	8/1979	1.0	5100	ERTEC 79	
3 2S/63E-22SC	SP	WHEATGRASS SPR.	5/1980	2.0	5400		ERTEC 80
4 4S/66E-24SA	SP	SEVEN OAK SPR.	5/1980	0.5	5730		ERTEC 80
5 4S/64E-25DD	SP	RED ROCK SPR.	5/1980	1.0	6100	DISCHARGE <1GPM	ERTEC 80

25 SEP 91 14:52:36

EPTC WESTERN, INC.

PAGE 1A

SELECTED WATER QUALITY DATA FOR DRY LAKE VALLEY

TOWNSHIP RANGE-SECT	SPE	MO YR	STATION NAME	TEMP DEG C	SP. COND	PH	DISS. SOLIDS	SILICA (SiO2)	CALCIUM (CA)	MAGNESIUM (MG)	SODIUM (NA)
1 3N/63E-27CA	WE	12-30	USAF TEST WELL	--	550	7.3	366	24	76	30	15
2 3N/63E-21DBA	WE	-15	BRISTOL WELL	--	ND	--	--	49	76	33	37
3 3N/65E-31CC	SP	8-79		24.0	470	6.8	--	43	40	10.0	21
4 2N/63E-13CBA	SP	8-79	COYOTE SPRING	20.0	550	6.8	--	79	82	13	49
5 2S/63E-22BC	SP	5-80	WHEATGRASS SPR.	13.0	415	7.0	--	--	--	--	--
6 3S/64E-25CB	SP	5-79		26.0	443	6.9	--	44	83	10.0	53
7 3S/61E-5CB	SP	5-80	LITTLE SHOULDER SPR.	13.0	250	6.8	--	19	25	7.9	12
8 3S/64E-12AC	WE	4-80	USAF TEST WELL	--	480	7.9	292	1.4	20	10	76
9 4S/64E-24BA	SP	5-80	SEVEN OAK SPR.	8.0	815	7.6	--	--	--	--	--

25 SEP 61 14:52:36

ERTEC WESTERN, INC.

PAGE 19

SELECTED WATER QUALITY DATA FOR DRY LAKE VALLEY

ID.	POTASSIUM (K)	CARBONATE (CO3)	BICARB. (HCO3)	CHLORIDE (CL)	SULFATE (SO4)	FLUORIDE (F)	NITRATE (N)	BORON (B)	IRON (FE)	MANGANESE (MN)	REMARKS	REFERENCE
2	6.5	0	404	5.0	20	.6	ND	--	--	--		ERTEC 70
3	6.0	0	1:7	110	71	--	32	--	--	--	*5	EAKIN 43
	2.5	0	214	17	21	.2	.4	--	--	--	*1	ERTEC 79
	7.6	0	232	25	25	.5	ND	--	--	--		ERTEC 79
	--	0	351	--	--	--	--	--	--	--		ERTEC 80
	7.1	0	320	30	54	.4	1.4	--	--	--	*1	ERTEC 79
	3.0	0	137	2.0	15	.1	.2	--	--	--	*1	ERTEC 80
2	5.2	1	213	21	44	--	6.7	--	--	--	*1,4	ERTEC 80
9	--	0	303	--	--	--	--	--	--	--		ERTEC 80

NO : SAMPLES FOR WATER QUALITY ANALYSIS COLLECTED BY ERTec EXCEPT WHERE NOTED. ALL ANALYSIS REPORTED IN MG/L EXCEPT AS NOTED BELOW.
ERTec ANALYSES FOR DISSOLVED SOLIDS DETERMINED BY RESIDUE -ON- EVAPORATION AT 180 DEGREE C METHOD.
METHODS: NEVADA LOCATIONS BASED ON MT. DIABLO BASELINE. UTAH LOCATIONS BASED ON SALT LAKE BASELINE AND MERIDIAN.

THE FOLLOWING CONSTITUENTS ARE REPORTED IN MICROGRAMS/LITER:
BORON IRON MANGANESE

FOOT: *1 NITRATE REPORTED AS N.
NOTES: *2 NITRATE REPORTED AS NO3
*3 NITRITE + NITRATE REPORTED AS N
*4 DISSOLVED SOLIDS BY SUM OF DETERMINED CONSTITUENTS
*5 NA+K AS NA
*6 HCO3+CO3 AS HCO3
ND = NOT DETECTED

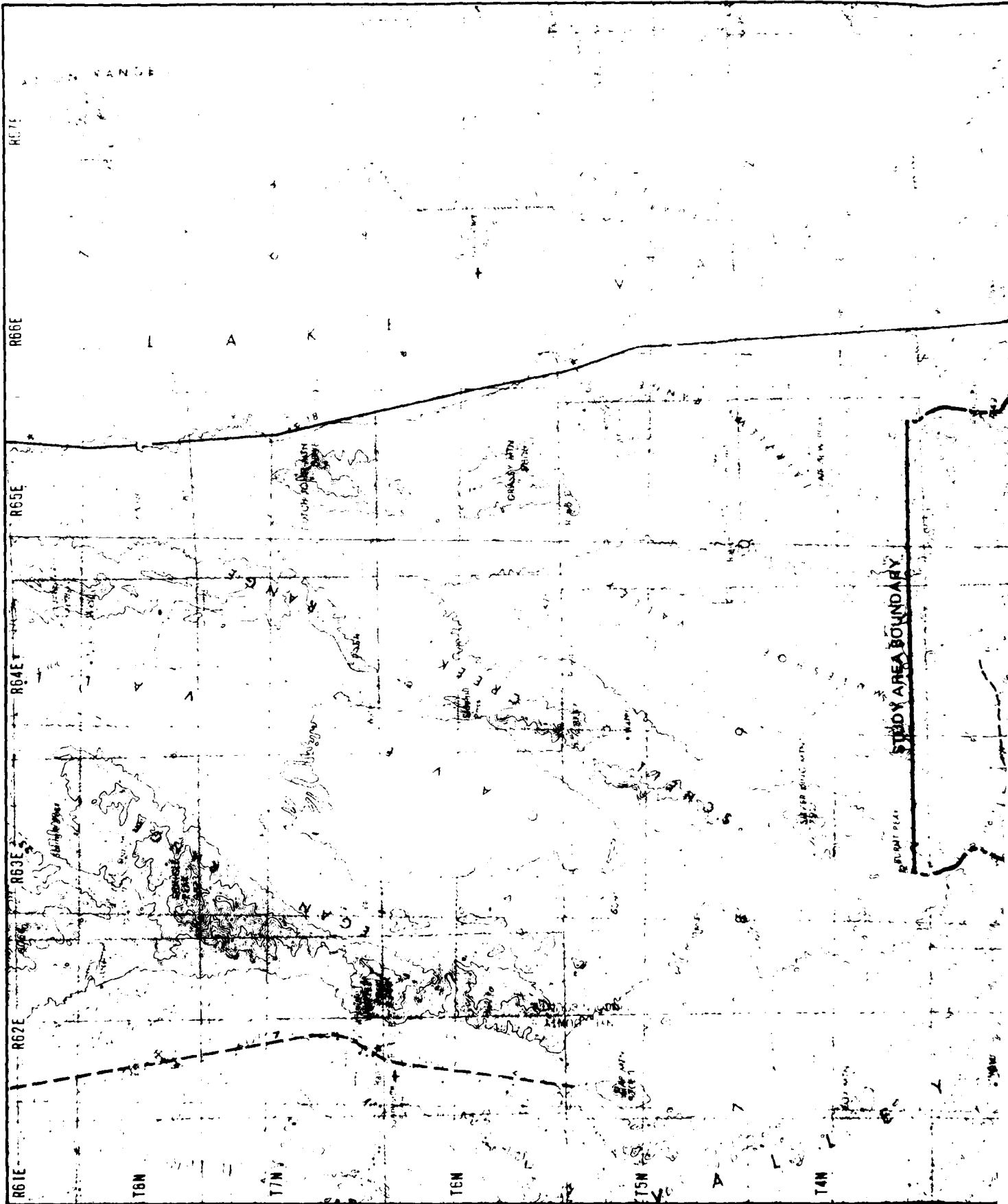
ACTIVITY	82	83	84	85	86	87	88	89	90
1 DOMESTIC									
2 LIFT SUPPORT CAMPS		200	593	1179	1000				
3 INDEPENDENT WORKERS		1	2	4	4				
4 REVEGETATION		115	695	520	753	250			
5 LANDSCAPING		21	93	125	106				
6 DUST CONTROL									
7 ROADWAYS	37	50	311	311	156				
8 WORK SITES		40	278	60	40				
9 IN CAMPS									
						INCLUDED ABOVE			
10 ROAD CONSTRUCTION									
11 RECOMPACTION	125		1120						
12 CONSTRUCTION ROADS	34		17						
13 REGRADING				125					
14 SHELTER EXCAVATION				140	70				
15 CONCRETE FOR DDA			1	23	2				
16 CONCRETE FOR MOB. ADD.									
17 DAA COSTS									
18 CONCRETE AGGREGATE WASH			1	26	2				
TOTALS (ACRE-FEET / YEAR)	196	427	3411	2533	2133	250			

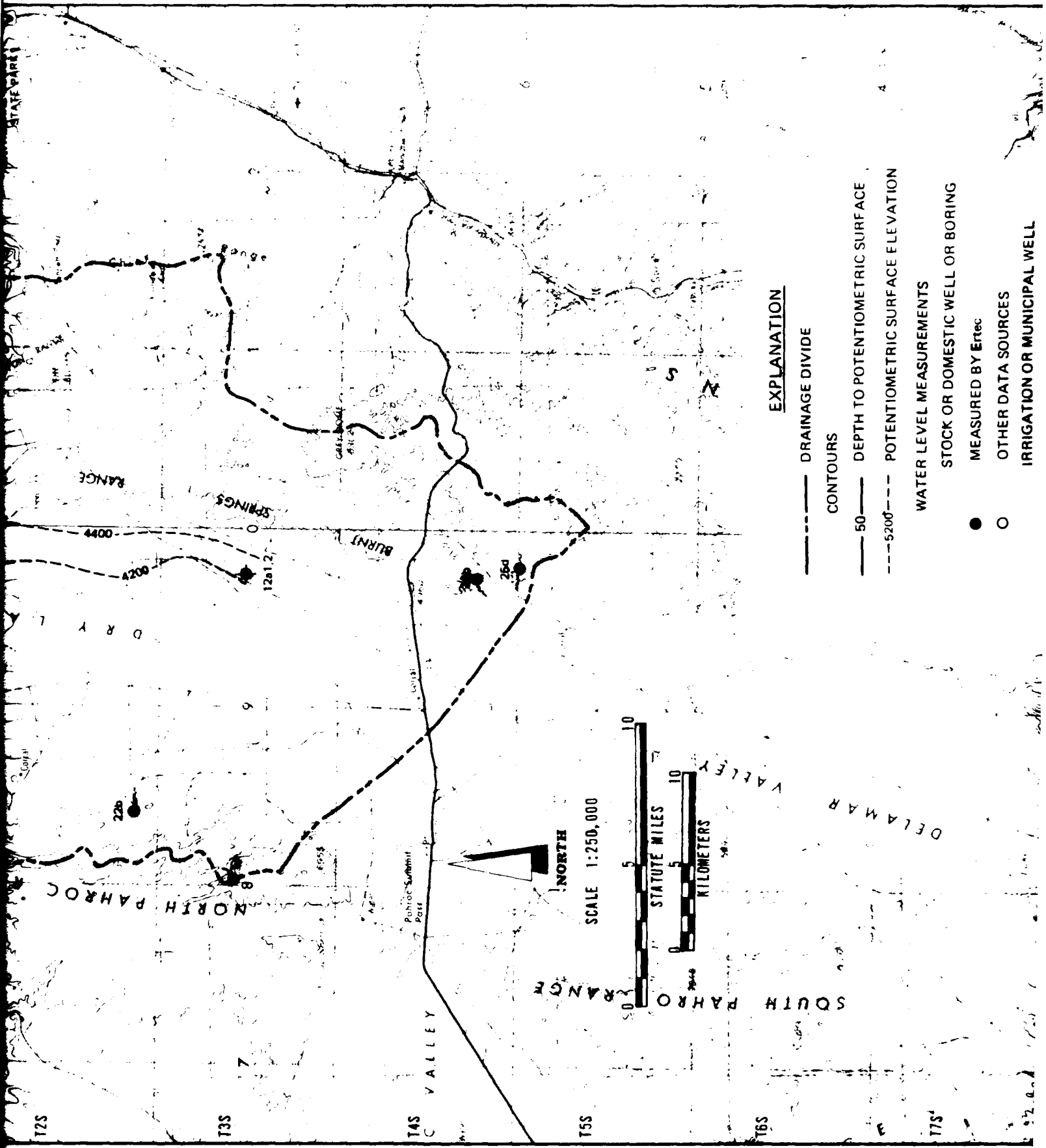
* These figures are a little higher than those in Table 4 - 13 due to difference in calculations within the COE MX water requirement document. 17 March 1981

MX WATER USE
ESTIMATES
DRY LAKE VALLEY, NEVADA
SEPTEMBER 81 TABLE

24 SEP 81 13:33:05
 EPTC WESTERN, INC.
 WELL AND WATER LEVEL DATA IN DRY LAKE VALLEY

ID. TOWNSHIP NO. RANGE-SECTION	WELL DESCRIPTION			WATER LEVEL MEASUREMENTS			REMARKS	DATA SOURCE
	WELL OWNER	YEAR DRILLED	WELL DEPTH (FT)	CASING ID (IN)	LAND ELEV (FT)	MO/YEAR DEPTH-BELOW SURFACE (FT)		
1 3N/63E-27CA	U.S. AIR FORCE	1980	2395	10	5390	2/1981	4339 CARR. TEST WELL	EPTC
2 3N/64E-20BAC	9LM	1960	380	6	5067	7/1960	4360	EAKIN 63
3 3N/65E-21DBA	DELHUE	1962	51		5451	7/1962	45	USGS 79
4 2N/65E-681			376		5075		3406 DRY	EAKIN 63
5 1N/64E-24A1	LYTLE & OTHERS	1959	515	5	4700	1/1959	4302	EAKIN 63
6 1N/65E-24AC			12	48	5660		5650 DUG WELL	EAKIN 63
7 3S/64E-12AC1	U.S. AIR FORCE	1980	1305	2	4645	2/1981	4262 OBSERVATION WELL	EPTC
8 3S/64E-12AC2	U.S. AIR FORCE	1980	1012	10	4645	2/1981	4250 TEST WELL	EPTC





PRELIMINARY



MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRC-MX

POTENTIOMETRIC LEVELS
DRY LAKE VALLEY, NEVADA

50 ——— DEPTH TO POTENTIOMETRIC SURFACE

5200 --- POTENTIOMETRIC SURFACE ELEVATION

WATER LEVEL MEASUREMENTS

STOCK OR DOMESTIC WELL OR BORING

MEASURED BY Ertec

OTHER DATA SOURCES

IRRIGATION OR MUNICIPAL WELL

MEASURED BY Ertec

OTHER DATA SOURCES

DISCHARGE MEASUREMENTS

STREAMS

MEASURED BY Ertec

OTHER DATA SOURCES

SPRINGS

MEASURED BY Ertec

OTHER DATA SOURCES

AQUIFER TEST

Ertec VERIFICATION BORING

Ertec WATER RESOURCES WELL
NO AQUIFER TEST PERFORMED

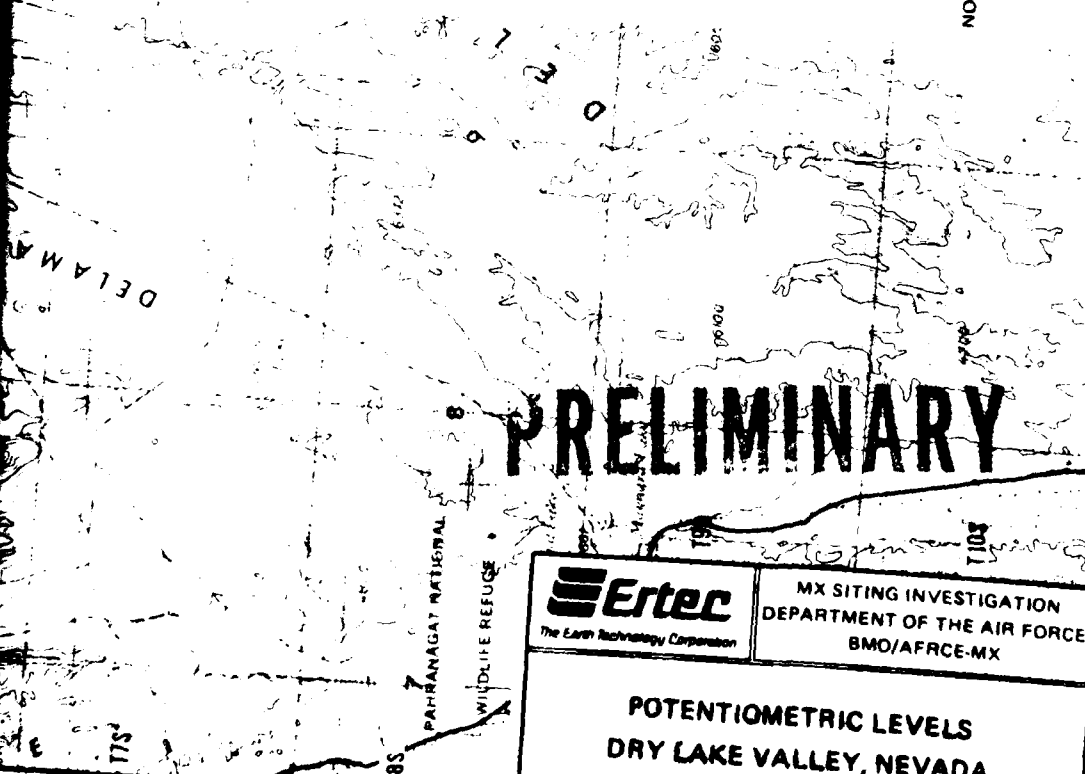
7b

SECTION LOCATION NUMBER

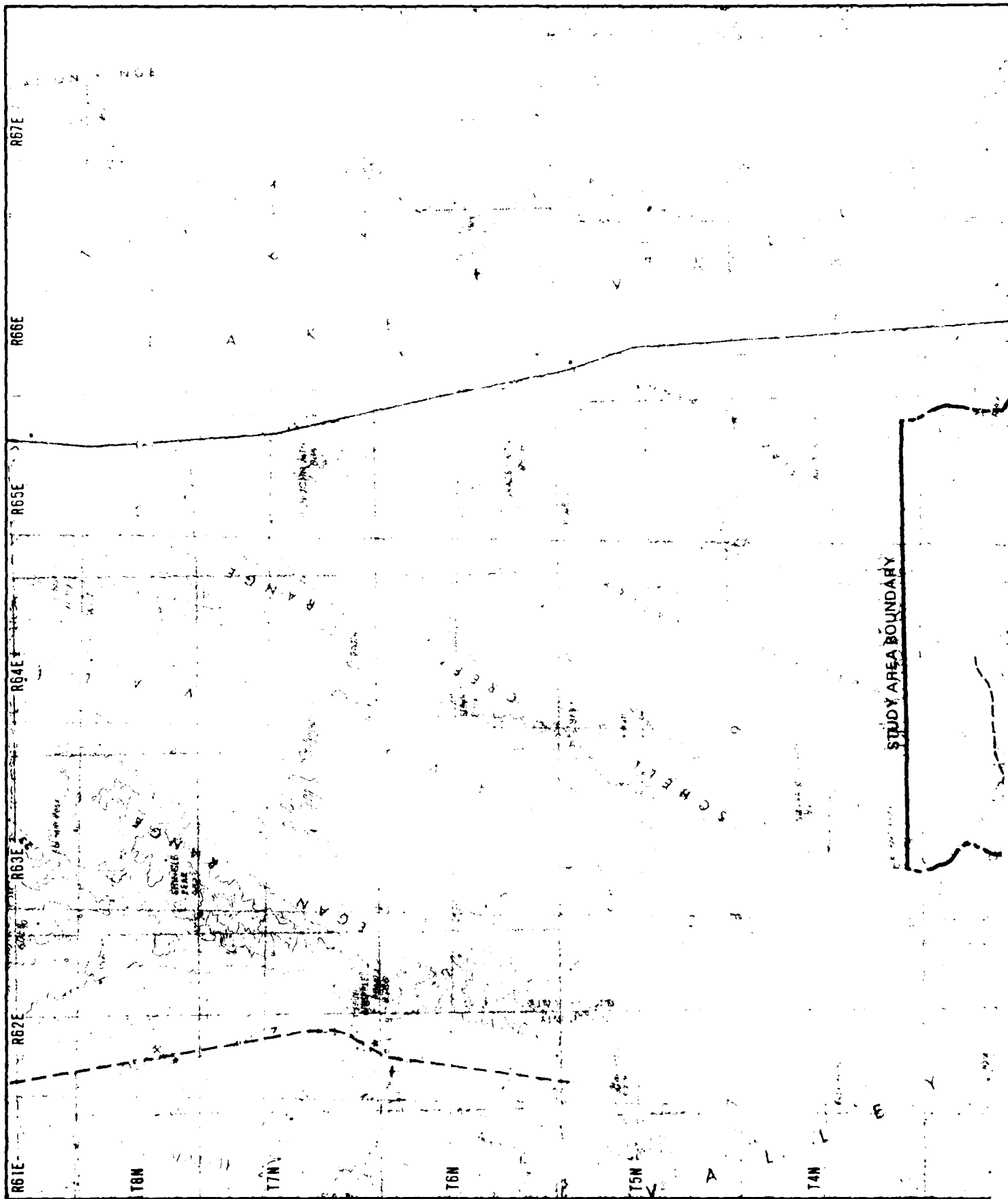
DATES OF WATER LEVEL MEASUREMENTS SHOWN IN TABLE C1.8
DATES OF DISCHARGE MEASUREMENTS SHOWN IN TABLE D1.8

NOTES (1) THE POTENTIOMETRIC SURFACE AND DEPTH TO WATER CONTOUR MAPS WERE
CONSTRUCTED FROM 1:62,500 SCALE BASE MAPS AND REPRESENT TRUE ELEVATIONS AND DEPTHS.

(2) AGE OF WATER LEVEL MEASUREMENT DATA, ESPECIALLY IN AREAS OF EXTENSIVE
WATER USE, HAS BEEN CONSIDERED IN DEVELOPMENT OF THIS MAP. THEREFORE,
OLDER DATA POINTS MAY NOT, IN ALL CASES, MATCH POTENTIOMETRIC OR
DEPTH TO WATER CONTOURS SHOWN.



4



STUDY AREA BOUNDARY

4000

20b

27c

13c

31c

21d

24b

4600

4200

4400

22b

NORTH PARROT RANGE

BRISTOL RANGE

RANGE

WINGS

T4N

T3N

T2N

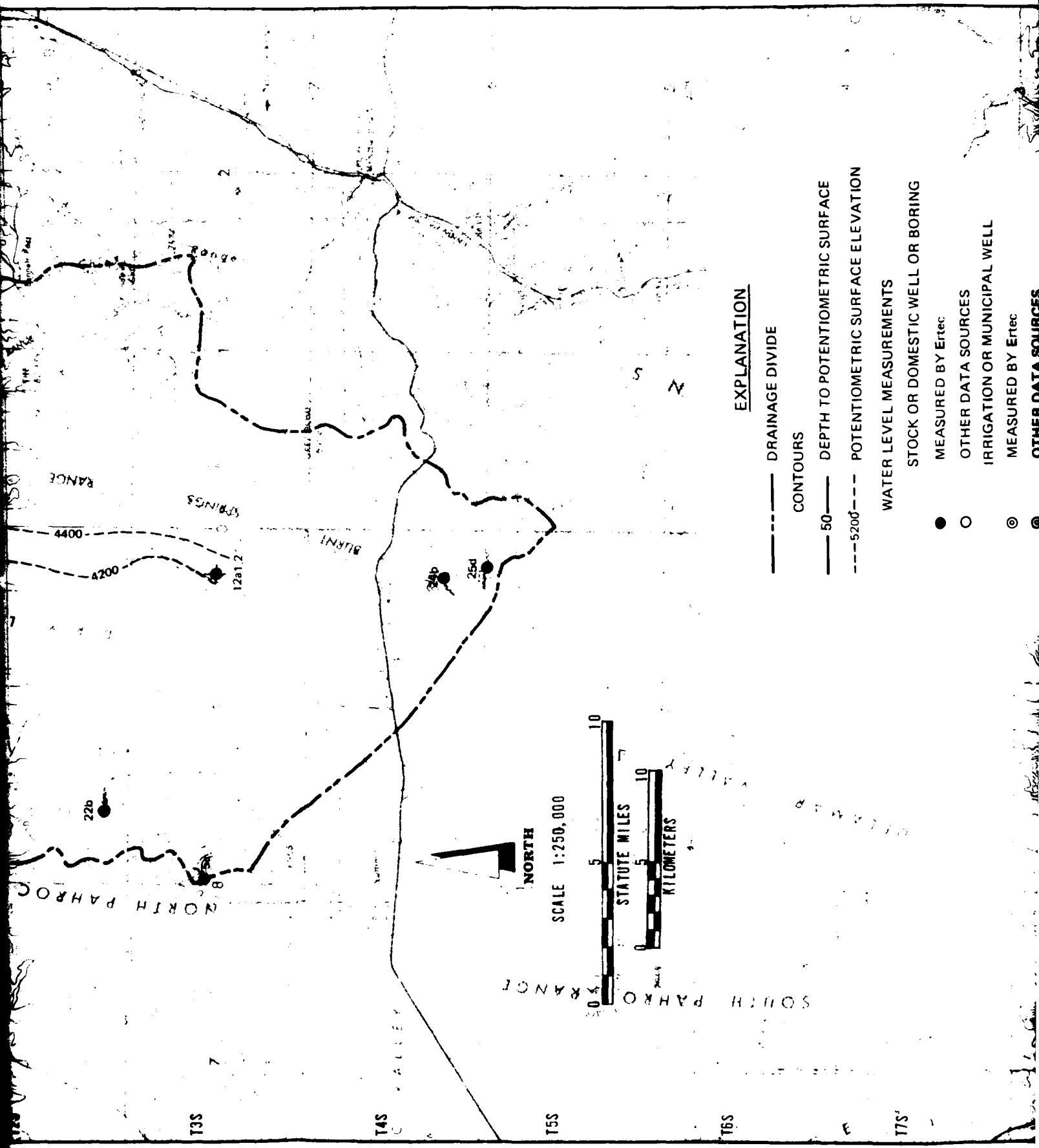
T1N

T1S

T2S

T3S

12



13

--- DRAINAGE DIVIDE

CONTOURS

- 50 --- DEPTH TO POTENTIOMETRIC SURFACE
- 5200 --- POTENTIOMETRIC SURFACE ELEVATION

WATER LEVEL MEASUREMENTS

STOCK OR DOMESTIC WELL OR BORING

- MEASURED BY Ertec
- OTHER DATA SOURCES
- ⊙ IRRIGATION OR MUNICIPAL WELL
- ⊙ MEASURED BY Ertec
- ⊙ OTHER DATA SOURCES

DISCHARGE MEASUREMENTS

STREAMS

- ▲ MEASURED BY Ertec
- △ OTHER DATA SOURCES

SPRINGS

- MEASURED BY Ertec
- OTHER DATA SOURCES
- ◆ AQUIFER TEST

Ertec VERIFICATION BORING

- Ertec WATER RESOURCES WELL
- NO AQUIFER TEST PERFORMED

SECTION LOCATION NUMBER

DATES OF WATER LEVEL MEASUREMENTS SHOWN IN TABLE C1.8
 DATES OF DISCHARGE MEASUREMENTS SHOWN IN TABLE D1.8.

- NOTES (1) THE POTENTIOMETRIC SURFACE AND DEPTH TO WATER CONTOUR MAPS WERE CONSTRUCTED FROM 1:62,500 SCALE BASE MAPS AND REPRESENT TRUE ELEVATIONS AND DEPTHS.
- (2) AGE OF WATER LEVEL MEASUREMENT DATA, ESPECIALLY IN AREAS OF EXTENSIVE WATER USE, HAS BEEN CONSIDERED IN DEVELOPMENT OF THIS MAP. THEREFORE, OLDER DATA POINTS MAY NOT, IN ALL CASES, MATCH POTENTIOMETRIC OR DEPTH TO WATER CONTOURS SHOWN.



MX SITING INVESTIGATION
 DEPARTMENT OF THE AIR FORCE
 BMO/AFRC-MX

POTENTIOMETRIC LEVELS DRY LAKE VALLEY, NEVADA

E1.0

DRY LAKE/DELAMAR VALLEYS SECTION: MX SITING
INVESTIGATION, WATER RESOURCES PROGRAM,
SUMMARY FOR DRAFT ENVIRONMENTAL IMPACT STATEMENT

north of township 6 with total dissolved solids concentrations ranging from about 130 to about 280 mg/l. Two springs (7N/64E-33cc; 6N/63E-19da), analyzed by the BLM have moderately high bicarbonate concentrations (more than 250 mg/l). This condition is probably due to the solution of carbonate rocks by the ground water.

Cave Valley Spring located at 9N/64E-16bdb also originates from the carbonates but has low bicarbonate concentration (80 mg/l) and low total dissolved solid concentrations (127 mg/l). This is probably due to a short resident time of the ground water with the rocks which suggests that it is related to precipitation and snowmelt. Thus it is not connected to the regional carbonate aquifer. The discharge in Cave Spring ranges from a few hundred gallons per minute to less than 10 gallons per minute. Table C1-3 lists the chemical analysis of the water samples and Drawing D1-2 shows the area of good water quality. As can be seen on the Drawing, all of the valley is estimated to contain ground water of good quality.

3.3 DRY LAKE/DELAMAR VALLEYS

3.3.1 Physiography and Geology

Dry Lake and Delamar valleys are believed to be hydrologically connected through valley-fill aquifers and are treated essentially as the same ground-water basin in the ensuing discussions. The Dry Lake/Delamar drainage basin lies within central Lincoln County in east-central Nevada (Figure 1). The basin is approximately 82 miles (132 km) long and 20 miles (32 km) wide at the

widest point, and encompasses an area of 1300 mi² (3367 km²). Of that area, 497 mi² (1287 km²) are suitable for MX siting including 315 mi² (815 km²) in Dry Lake Valley and 182 mi² (417 km²) in Delamar Valley.

The valley-fill deposits are up to 10,000 feet (3 km) thick along the axis of the valleys and thin toward the margins. Based on detailed gravity maps constructed by Fugro National, (FN-TR-33-DL), the volume of valley-fill in Dry Lake Valley is estimated to be 635,000,000 acre-ft (732,955 hm³). The estimated volume of valley-fill in Delamar Valley is 200,000,000 acre-ft (246,600 hm³). These substantial potential aquifer volumes provide tremendous storage capacity for ground water.

Mountain crests bounding the valleys range in elevation from about 7000 feet (2134 m) to over 9000 feet (2743 m). Highland Peak, on the east side of Dry Lake Valley, has an elevation of 9395 feet (2864 m), and is the highest point in the basin. The playa, in the extreme south end of Delamar Valley, has an elevation of less than 4400 feet (1341 m) and is the lowest point in the basin. The two valleys are separated by a low, broad alluvial fan that extends across the basin just south of Dry Lake playa.

Dry Lake and Delamar valleys exhibit typical Basin and Range structure, consisting of high angle, north-south trending, normal basement faults that border the Pahroc ranges on the west and the Bristol, Highland, Chief, and Delamar ranges on the east. The area between the ranges is faulted downward. A

north-south trending fault on the eastern side of the basin displaces surface alluvium and forms a prominent scarp. Additionally, Shawe (1965) shows east-west trending faults that transect the basin and displace deep valley-fill deposits. This interpretation is supported also by gravity surveys (Fugro National, FN-TR-26E).

The mountains on the western side of the valley are predominantly composed of ash flow tuffs of Tertiary age with some carbonate rocks of Paleozoic age. Conversely, the eastern mountains are composed primarily of carbonate rocks of Paleozoic age with minor amounts of ash flow tuffs of Tertiary age (Stewart and Carlson, 1978).

Coarse-grained alluvial and fine-grained lacustrine deposits make up the majority of sediments in the valleys. Although playa deposits cover only a small percentage of the valley surface, they are thought to be of great thickness and inter-finger with alluvial deposits in the subsurface (Fugro National, FN-TR-27). These playa deposits are located in the south-central portions of the valleys. From the central part of the valleys, the grain size and grading of alluvial deposits progressively increase towards the mountains.

3.3.2 General Hydrology

Dry Lake and Delamar valleys form closed surface drainage basins. There are no perennial streams in the valleys, and streamflow only occurs in the mountain ravines and alluvial fans after high-intensity rains and as snowmelt runoff.

Springs in the Dry Lake and Delamar valley area occur in volcanic rocks composed predominantly of tuffs along the basin margins. The springs are recharged by meteoric waters (precipitation and snowmelt) and are not associated with the deep regional carbonate aquifer. They generally have low yields (less than 20 gpm) and are used primarily to supply stock ponds in the area.

The ground-water table in the basin aquifer occurs at considerable depths (Drawings B1-3 and B1-4). In Dry Lake Valley, ground-water levels are about 400 feet (122 m) below ground surface, and in Delamar Valley, levels are generally greater than 800 feet (244 m) below ground surface. Some water wells in the northern and western part of Dry Lake Valley tap perched aquifers with water levels significantly higher than the underlying basin aquifer. Water use in the valleys is limited to a few isolated stock ponds fed by infrequent surface runoff and nearby springs with waters of meteoric origin.

Ground-water recharge to the basin is primarily from precipitation occurring in the mountains along the northwest and east flanks of the valleys (Eakin, 1963). From these areas, ground water moves laterally and downward toward the central part of the valleys as indicated on the ground-water level contour map (Drawing B1-3 and B1-4). Generally, the ground water moves from Dry Lake Valley toward Delamar Valley. An annual (recharge based on a percentage of average annual precipitation) of about 6000 acre-ft (7.4 hm^3) for the valleys has been estimated by

Eakin (1963). Discharge occurs primarily as deep underflow to the south through carbonate rocks. Alluvial ground-water gradients between Dry Lake Valley and Delamar Valley closely resemble the carbonate aquifer gradient between White River Valley and Pahranaagat Valley. This suggests that the valley-fill aquifers of the basin and the regional carbonate aquifers are hydraulically connected (Eakin, 1963).

3.3.3 Aquifer Characterisitics

The considerable depth to ground water (Drawing B1-3 and B1-4) has precluded much development in these valleys and, therefore, very little has been published about specific aquifer characteristics. However, all wells in the basin tap valley-fill aquifers with little indication of confinement. Existing wells produce less than 100 acre-ft of water annually for use by livestock. During Furgo National's field investigations in 1979, none of the wells were found to be suitable for aquifer testing because of pumping limitations. In 1980, two intermediate depth test wells (3S/64E-12ca and 6S/63E-12ad) were drilled in Dry Lake/ Delamar valleys (lithologic and geophysical logs are presented in Appendices H1-3 and H1-34). At each site, observation and test wells were constructed.

Aquifer tests in Dry Lake Valley were conducted for ten days at 500 gpm (31.5 l/s) followed by an aquifer recovery test. The maximum well yield during development was approximately 750 gpm (47.3 l/s). Maximum drawdown at the pumping well during the pump test was about 50 feet (15 m). These tests indicated an

aquifer transmissivity of about 45,000 gpd/ft ($155 \text{ cm}^2/\text{sec}$) and a storage coefficient of 3×10^{-4} . Because the well only partly penetrated the aquifer, the transmissivity of the total thickness of the aquifer is probably much higher. The unusually low storage coefficient in the valley-fill aquifer is probably due to the tremendous thickness of the aquifer.

Aquifer tests in Delamar Valley were conducted for ten days at 85 gpm (5.3 l/s) followed by an aquifer recovery test. Maximum drawdown during the test was 85 feet (26 m). Transmissivity was calculated at 5000 gpd/ft ($7 \text{ cm}^2/\text{sec}$) with a storage coefficient of 4.0×10^{-4} .

Potential well yields in Dry Lake Valley are expected to be high in the unconsolidated valley-fill deposits around the valley periphery. However, a significant portion of the basin is probably composed of fine-grained lacustrine deposits near the central valley areas. These areas probably have relatively low hydraulic conductivities. The extent and depth of the low yield deposits are not fully known. However, there appears to be sufficient water for development of the MX system within the basin.

Because of the great depths to water in Delamar Valley [870 ft (265 m) in test well 6S/63E-12ad], well yields are expected to be less than 100 gpm (6.3 l/s). Well yields may increase slightly away from the central valley axis, but any yield increase due to higher aquifer permeability will probably be offset by the corresponding increase in pumping lift.

3.3.4 Water Quality Limitations

Because there are very few wells in Dry Lake Valley, only four ground-water quality analyses are available. The well and spring sample locations are shown in Drawing D1-3. Four of these samples were collected by Fugro National in 1979 and 1980 and one sample was collected by Carpenter (1915) and reported by Eakin in 1963.

Based on the water quality critieria listed in Appendix C1-1, all of the water analyzed is of good quality and is acceptable for drinking. All ground-water samples contained moderately high bicarbonate levels ranging from 187 to 320 mg/l, which result in hardness levels of about 100 mg/l. Calcium concentrations range from about 40 to 83 mg/l and were generally in the poor range. In addition, the sample collected at 3N/65E-21dbd and analyzed by Carpenter also contained relatively high chloride (110 mg/l) and nitrate (32 mg/l) concentrations.

Ground water in the northern part of Dry Lake Valley is of the calcium-magnesium/chloride-bicarbonate type. As the ground water migrates from the fans toward the central valley area, the concentrations of calcium and chloride increase slightly and sodium concentrations decrease, yielding water of the sodium-calcium/bicarbonate type. The higher calcium and chloride concentrations in the central valley area may be related to the soil chemistry of the playa deposits.

The only ground-water samples for chemical quality testing from Delamar Valley was from the Fugro National test well. However,

the analyses were not completed at the time of publication of this report.

3.4 DUGWAY VALLEY

3.4.1 Physiography and Geology

Dugway Valley is located in Tooele and Juab counties in west-central Utah (Figure 1) and has a total area of 890 mi² (2300 km²). Of the total area only 182 mi² (471 km²) are suitable for MX siting.

Dugway Valley trends north-south and is approximately 30 miles (48 km) long and varies in width from 1 to 8 miles (2 to 13 km). The valley is bordered on the west by the Dugway Mountains and the Thomas Range, on the south by the Drum Mountains, and on the east and northeast by Keg Mountain and Slow Elk Hills. The northern boundary of the valley is the Great Salt Lake Desert. Valley floor elevations range from 4480 feet (1365 m) at the north end to 5080 feet (1548 m) in the central-southern portion of the valley. The valley is bounded by peaks on the northwest that reach elevations of nearly 9000 feet (2700 m). Most of the area below about 4600 feet (1400 m) is nearly flat as a result of planation and deposition by ancient Lake Bonneville (Stephens and Sumsion, 1978).

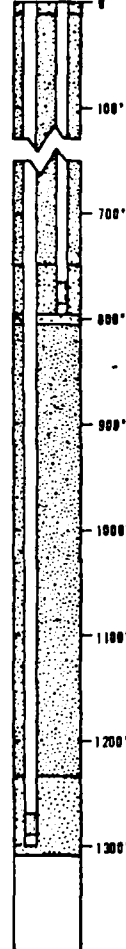
Valley-fill deposits consist mainly of alluvial fan deposits along the margins of the valley which interfinger with lake and playa deposits in and near the center of the valley. These deposits consist mainly of clay, silt, sand, and minor amounts



WELL NO. 00-2 SHEET 1 OF 1
 LOGGED BY JFW, SC AND LG PROJECT NO. 70-200-45
 DATE (S) JAN 2-22, 1980 PROJECT NAME MX
 VALLEY DRY LAKE

ELEVATION
 GROUND LEVEL 4043'
 TOP OF CASING 4043'

WELL SKETCH



LOCATION OR COORDINATES 35.84E-12E

DRILLING SUMMARY

TOTAL DEPTH DRILLED 1300'
 ROTARY REVERSE CORE
 DRILLING CONTRACTOR DEYLINE
 BIT (S) USED BUCKET ADOBE 0' TO 40'
40' TO 10' REVERSE ROTARY
 SIZE (S) AND TYPE (S) OF BIT(S) 18 5/8"
DRAB AND CLUSTER BITS
 DRILLING FLUID WATER AND 4 SACKS POLYMER

SAMPLING METHOD COLLECTED FROM DISCHARGE PIPE

SURFACE CASING 0' TO 40' 22" DIA
 COMMENTS (PROBLEMS, SHUTDOWNS, ETC)

DESIGN

BASIS DRILLER'S LOG
 GEOLOGIC LOG ☒
 GEOPHYSICAL LOG ☒
 COPIES ATTACHED YES NO

STEEL CASING STRING 1

FROM 0' TO 1270' BLANK
 FROM 1270' TO 1280' PERF
 FROM 1280' TO 1300' BLANK
 FROM TO
 FROM TO

STEEL CASING STRING 2

FROM 0' TO 765' BLANK
 FROM 765' TO 785' PERF
 FROM 785' TO 795' BLANK
 FROM TO
 FROM TO

CASING STEEL PVC
 DIMENSIONS 2" I.D.
 SCREEN
 DIMENSIONS 2" I.D.
 SLOT SIZE 3/4" MACHINE SLOTS

PACKERS

CENTRALIZERS

PEA GRAVEL 0'-750' 805'-1230'

WELL PACK 750'-785' 1230'-1305'

CEMENT (BOX) DEPTH (S) 0' - 10'

785'-805'

BENTONITE

PELLETS

SLURRY

DEVELOPMENT METHOD (S)

AIR LIFT 15 HOURS

TIME LOG

	START	FINISH	ELAPSED TIME	% OF TOTAL
DRILLING				
LOGGING				
CASING				
GRAVEL PACKING				
CEMENTING				
BENTONITE PELLETS				
SLURRY				
DEVELOPMENT				

MISCELLANEOUS

A 22" DIAMETER STEEL CONDUCTOR CASING
WAS INSTALLED TO 40' BELOW THE GROUND SURFACE

F-0-3 2-21-79

EXPLANATION

- ☐ BLANK CASING
- ☒ PERFORATED CASING
- ☒ CEMENT
- ☒ GRAVEL PACK
- ☒ SAND PACK

WELL CONSTRUCTION LOG
 OBSERVATION WELL
 DRY LAKE VALLEY, NEVADA

MX SITING INVESTIGATION
 DEPARTMENT OF THE AIR FORCE - DMU

FIGURE
 H1.4-3

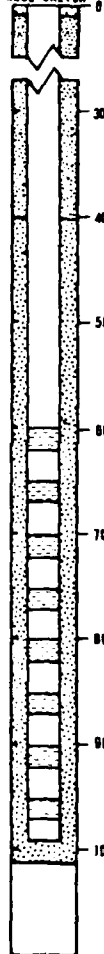
FUGRO NATIONAL, INC.



WELL NO. TP-1 SHEET 1 OF 1
 LOGGED BY JFH, LG PROJECT NO. 70-200-45
 DATE (S) 1 JAN 20 FEB 12 1982 PROJECT NAME MX
 VALLEY DRY LAKE

ELEVATION
 GROUND LEVEL 4845'
 TOP OF CASING 4848'

WELL SKETCH



LOCATION AND COORDINATES 35°45'-1200

DRILLING SUMMARY

TOTAL DEPTH DRILLED 1010'
 ROTARY REVERSE CODE _____
 DRILLING CONTRACTOR WELLS
 RIG (S) USED REVERSE ROTARY 9'-10'
REVERSE ROTARY 40'-70'
 SIZE (S) AND TYPE (S) OF BIT(S) 18 5/8" DRILL
TRACONE A SLIMMER BITS
 DRILLING FLUID POLYMER (5 BAGS) AND WATER
 SAMPLING METHOD COLLECTED FROM DISCHARGE
PIPE
 SURFACE CASING 8'-40" 22" DIAMETER
 COMMENTS (PROBLEMS, SHUTDOWNS, ETC)

DESIGN

BASIS DRILLER'S LOG _____
 GEOLGIC LOG ☒
 GEOPHYSICAL LOG ☒
 COPIES ATTACHED YES NO
 STEEL CASING SCREEN
 FROM 800' TO 820'
 FROM 850' TO 870'
 FROM 700' TO 720'
 FROM 750' TO 770'
 FROM 800' TO 820'
 FROM 850' TO 870'
 FROM 800' TO 820'
 FROM 850' TO 870'
 FROM _____ TO _____
 FROM _____ TO _____
 CASING STEEL PVC
 DIMENSIONS 10" I.D.
 SCREEN
 DIMENSIONS 10" I.D.
 SLOT SIZE 80

PACKERS

CENTRALIZERS EVERY 100'

PEA GRAVEL 10'-400'

WELL PACK 400'-1010'

CEMENT (BIS) _____ DEPTH (S) 0'-10'

BENTONITE _____

PELLETS _____

SLURRY _____

DEVELOPMENT METHOD (S)

SHARRING AND BAILING, 32 HOURS

PUMP SURGING FOR 12 HOURS

TIME LOG

	START	FINISH	ELAPSED TIME	% OF TOTAL
DRILLING				
LOGGING				
CASING				
GRAVEL PACKING				
CEMENTING				
BENTONITE PELLETS				
SLURRY				
DEVELOP- MENT				

MISCELLANEOUS

10" I.D. BLANK CASING INSTALLED ABOVE AND
BELOW EACH SCREENED INTERVAL, A 22" DIAMETER
STEEL CONSTRUCTION CASING WAS INSTALLED AND
GRUBBED TO 40' BELOW THE GROUND SURFACE

F-0-2 2-81-70

EXPLANATION

- ☐ BLANK CASING
- ☒ PERFORATED CASING
- ☒ CEMENT
- ☒ GRAVEL PACK
- ☒ SAND PACK

WELL CONSTRUCTION LOG
 TEST WELL
 DRY LAKE VALLEY, NEVADA

MX SITING INVESTIGATION
 DEPARTMENT OF THE AIR FORCE - WMO

FIGURE
 H1.4-4

FUGRO NATIONAL, INC.

SCRO NATIONAL, INC.
DRILL CUTTINGS LOG

PAGE 1 OF 13

FIELD LOG OF WELL NUMBER OW-2

PROJECT NUMBER 79-290- 45

VALLEY NAME Dry Lake

PROJECT NAME MX SITING INVESTIGATION

LOCATION NUMBER T3S, R64E, Sect. 12^{ac}

EQUIPMENT USED 0-40' Bucket Auger/
90-1300' Reverse Rotary

LOGGED BY JM & SC DATE 1-8-80

COMPANY Beylik

CHECKED BY JAG DATE 4-10-80

OPERATOR Jim Clyde

TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
0	<u>Silt</u> : Tan silt with occasional gravel to 1½".
10	<u>Silt</u> : Tan Silt
20	<u>Silt & Sand with Gravel</u> : Tan silt with ± 25% med colored, fine to coarse poorly sorted, subrounded to subangular sand, with ± 10% med colored subrounded to angular gravel to 1½".
30	<u>Gravel with Cobbles</u> - Med to dark colored, subrounded to subangular ½" gravel up to cobbles to 4".
40	<u>Fine Gravel with Sand</u> : Brown color, well sorted, subrounded gravel with less than 25% coarse sand, gravel up to ¾".
50	<u>Gravel with Coarse Sand</u> : Brown color, subangular, well sorted gravel up to ¾" with coarse, angular sand (less than 25%).
60	<u>Gravel with Sand</u> : Brown color, well sorted, subrounded gravel up to 1½" with less than 25% coarse sand.
70	<u>Gravel with Sand</u> : Same as above (60').
80	<u>Coarse Sand with Gravel</u> : Dark color, well sorted, subrounded sand with less than 25% gravel up to ½".
90	<u>Fine to Medium Gravel with Sand</u> : Brown color, well sorted, subrounded gravel with less than 10% coarse sand.
100	<u>Gravel with Sand</u> : Dark color, well sorted, subangular gravel up to ¾" with less than 30% coarse sand.

CORD NATIONAL, INC.
DRILL CUTTINGS LOG

PAGE 2 OF 13

FIELD LOG OF WELL NUMBER OW-2

PROJECT NUMBER 79-290- 45
 PROJECT NAME MX SITING INVESTIGATION
 EQUIPMENT USED Reverse Circulation
 COMPANY Beylik
 OPERATOR J. Clyde

VALLEY NAME Dry Lake
 LOCATION NUMBER T35, R64E, Sect. 12^{2C}_{2a}
 LOGGED BY SC & JM DATE 1-8-80
 CHECKED BY JAG DATE 4-10-80
 TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
100	<u>Gravel with Coarse Sand:</u> Dark color, well sorted, subangular, max gravel 1" with less than 25% coarse sand.
110	<u>Gravel with Coarse Sand:</u> Same as above (100'-110'). <u>Max size for gravel 1 1/2".</u>
120	<u>Gravel with Coarse Sand:</u> Same as above (100'-120'). <u>Max gravel 1 1/2".</u>
130	<u>Gravel with Coarse Sand:</u> Less than 25% sand. Max gravel 1 1/2". Most less than 1".
140	<u>Gravel with Coarse Sand:</u> Less than 10% sand. Same as above (130-140').
150	<u>Gravel with Coarse Sand:</u> Dark, subrounded, well sorted max size 1" gravel with less than 40% very coarse, subangular sand.
160	<u>Gravel with Coarse Sand:</u> Brown, subrounded, well sorted gravel with less than 25% coarse sand. Max size 3/4".
170	<u>Gravel with Coarse Sand:</u> Brown, subangular, well sorted gravel with less than 25% coarse sand. Max size 3/4".
180	<u>Gravel with Coarse Sand:</u> Much coarser than 170-180', 33% of sample greater than 1" size. Brown subrounded, subangular, well sorted with less than 10% sand.
190	<u>Very Coarse Gravel with Coarse Sand:</u> Dark, well sorted subangular. Greater than 2" sized gravel. Less than 5% coarse sand.
200	

CORD NATIONAL, INC. **DRILL CUTTINGS LOG**

PAGE 3 OF 13

FIELD LOG OF WELL NUMBER OW-2

PROJECT NUMBER 79-290- 45
 PROJECT NAME MX SITING INVESTIGATION
 EQUIPMENT USED Reverse Circulation
 COMPANY Beylik
 OPERATOR J. Clyde

VALLEY NAME Dry Lake
 LOCATION NUMBER T3S, R64E, Sect. 12^{ee}
 LOGGED BY JM & SC DATE 1-8-80
 CHECKED BY JAG DATE 4-10-80
 TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
200	<u>Gravel with Coarse Sand:</u> Brown, well sorted, subangular gravel. Max size 1" with less than 40% subangular, coarse sand.
210	<u>Gravel with Coarse Sand:</u> Gray, subangular, well sorted. Max size 1 1/2". Less than 10% subangular, coarse sand.
220	<u>Gravel with Coarse Sand:</u> Gray-black, subangular, well sorted. Max size 2 1/2". Less than 10% coarse, subangular sand.
230	<u>Gravel with Coarse Sand:</u> Gray-black, subangular, well sorted. Max size 1". Less than 40% subrounded, coarse sand.
240	<u>Gravel with Sand and Some Clay:</u> Subangular, poorly sorted, max gravel size 3/4". Less than 10% sand. Less than 20% silt and clay.
250	<u>Gravel with Coarse Sand:</u> Gray-brown, subangular, well sorted, max size 1". Less than 20% coarse sand.
260	<u>Gravel with Coarse Sand:</u> Gray, subangular, well sorted. Max size 2 1/2" gravel. Less than 20% coarse, subangular sand.
270	<u>Gravel with Sand and Silt:</u> Gray color, subangular, poor to medium sorted, max 1/2" gravel. Less than 25% fine-to coarse-grained sand. Less than 5% silt.
280	<u>Gravel with Coarse Sand:</u> Gray color, subangular, well sorted. Max 3/4" gravel. Less than 20% coarse, subangular sand,
290	<u>Gravel with Coarse Sand:</u> Gray, subangular, well sorted, max size gravel 1". Less than 20% subangular coarse sand.
300	

TECHNOLOGICAL NATIONAL, INC. **DRILL CUTTINGS LOG**

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FIELD LOG OF WELL NUMBER OW-2

PROJECT NUMBER 79-290- 45
 PROJECT NAME MX SITING INVESTIGATION
 EQUIPMENT USED Reverse Circulation
 COMPANY Beylik
 OPERATOR J. Clyde

VALLEY NAME Dry Lake
 LOCATION NUMBER T3S, R64E, Sect. 12 ⁰⁶
 LOGGED BY JM & SC DATE 1/8/80
 CHECKED BY JAG DATE 4/10/80
 TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
300	<u>Fine Gravel with Coarse Sand:</u> Gray-brown, subrounded, well sorted, max size $\frac{1}{2}$ ". Less than 40% coarse, subrounded sand.
310	
320	<u>Gravel with Coarse Sand:</u> Gray-brown, subrounded, well sorted, max size $\frac{1}{2}$ " gravel, less than 40% coarse, subrounded sand. <u>Gravel with Coarse Sand:</u> Well sorted, brown gray, subrounded, max $\frac{1}{2}$ " gravel with less than 30% coarse, subrounded sand.
330	
340	<u>Gravel with Sand, Silt & Clay:</u> Poorly sorted, gray-black, subangular to subrounded, less than 40% sand. Less than 10% silt and clay, $\frac{1}{2}$ " gravel.
350	<u>Gravel with Sand, Silt & Clay:</u> Poorly sorted, brown subangular-subrounded. 40% sand, 10% silt and clay, $\frac{1}{2}$ " gravel.
360	<u>Gravel with Trace Sand, Silt & Clay:</u> Less than 20% sub-gravel size, gray-black, subangular, poorly sorted $\frac{1}{2}$ " gravel.
370	<u>Gravel with Medium to Coarse Sand:</u> Brown-black, subrounded-subangular well sorted less than 30% sand.
380	<u>Gravel:</u> Poorly sorted, $\frac{1}{2}$ " gravel, subangular, less than 20% coarse sand.
390	<u>Gravel:</u> Medium sorted, gray-black-brown, subangular, less than 10% sand, $\frac{1}{2}$ " gravel.
400	

WORLD NATIONAL, INC. **DRILL CUTTINGS LOG**

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FIELD LOG OF WELL NUMBER OW-2

PROJECT NUMBER 79-290- 45
 PROJECT NAME MX SITING INVESTIGATION
 EQUIPMENT USED Reverse Circulation
 COMPANY Beylik
 OPERATOR J. Clyde

VALLEY NAME Dry Lake
 LOCATION NUMBER T3S, R64E, Sect. 12^{ac}_{ea}
 LOGGED BY JM & SC DATE 1/14/80
 CHECKED BY JAG DATE 4/10/80
 TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
400	<u>Gravel with Sand, Silt & Clay:</u> Poorly sorted, gray-black, subangular-subrounded, less than 30% sand, 20% silt and clay, 1/2" gravel.
410	<u>Gravel with Sand, Silt & Clay:</u> Poorly sorted, subangular to subrounded, gray-black, less than 20% sand, less than 10% silt and clay.
420	<u>Gravel with Sand, Silt & Clay:</u> Poorly sorted, subangular, brown-gray, less than 40% sand, less than 10% silt and clay, 2 1/2" gravel.
430	<u>Gravel with Sand, Silt & Clay:</u> Poorly sorted, brown-black, subangular, 3/4" gravel, less than 20% sand, less than 10% silt and clay.
440	<u>Gravel with Sand, Silt & Clay:</u> Poorly sorted, blue-black, subangular, 3/4" gravel, less than 15% sand, less than 10% silt and clay.
450	<u>Gravel with Sand, Silt & Clay:</u> Poorly sorted, subangular, gray-black, 1/2" gravel, less than 40% sand, less than 10% silt and clay.
460	<u>Gravel with Sand, Silt, & Clay:</u> Poorly sorted, subangular, gray-brown, 1/2" gravel, less than 40% sand, 10% silt and clay.
470	<u>Gravel with Sand, Silt and Clay:</u> Brown-gray poorly sorted subrounded, max 2" gravel, less than 20% sand, less than 10% silt and clay.
480	<u>Gravel with Sand and Clay:</u> Gray-black colored, poorly sorted subangular gravel with less than 30% coarse to fine-grained sand with less than 10% silty clay. Max grain size 3/4".
490	<u>Gravel with Sand:</u> White, gray-black colored moderately sorted subangular gravel with less than 20% coarse subangular sand grains. Maximum grain size 1".
500	

TERRA NATIONAL, INC.
DRILL CUTTINGS LOG

PAGE 6 OF 13

FIELD LOG OF WELL NUMBER OW-2

PROJECT NUMBER 79-290- 45
 PROJECT NAME MX SITING INVESTIGATION
 EQUIPMENT USED Reverse Circulation
 COMPANY Beylik
 OPERATOR J. Clyde

VALLEY NAME Dry Lake
 LOCATION NUMBER T3S, R64E, Sect. 12^{ac}
 LOGGED BY JM & SC DATE 1-14-80
 CHECKED BY JAG DATE 4-10-80
 TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
500	<u>Gravel with Sand:</u> Gray, black colored moderately sorted subrounded to subangular gravel with less than 15% coarse subangular sand. Maximum gravel size approximately 2"
510	<u>Gravel with Trace Coarse Sand:</u> Brown, subangular, well sorted, gravel to 1 1/4", less than 10% sand.
520	<u>Gravel with Trace Sand and Silt:</u> Same as 510' with less than 10% sand and silt.
530	<u>Gravel with Trace Coarse Sand:</u> Same as 510'.
540	
550	<u>Gravel with Sand and Silt:</u> Brown-gray, subangular, moderate sorting. Less than 25% sand and silt.
560	<u>Gravel with Trace Coarse Sand:</u> Same as 510'.
570	
580	
590	
600	

GENCO NATIONAL, INC.
DRILL CUTTINGS LOG

PAGE 7 OF 13

FIELD LOG OF WELL NUMBER OW-2

PROJECT NUMBER 79-290- 45

VALLEY NAME Dry Lake

PROJECT NAME MX SITING INVESTIGATION

LOCATION NUMBER T3S, R64E, Sect. 12^{3C}_{ea}

EQUIPMENT USED Reverse Mud Rotary

LOGGED BY SC & JM DATE 1/15/80

COMPANY Beylik

CHECKED BY JAG DATE 4/10/80

OPERATOR J. Clyde

TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
600	
610	<u>Gravel with Trace Coarse Sand:</u> Brown, subangular, well sorted, gravel to 1½", less than 10% sand.
620	
630	<u>Gravel with Trace Coarse Sand:</u> Same as 610', but max size ½".
640	<u>Gravel with Sand and Silt:</u> Brown, subangular, poorly sorted, less than 30% sand, less than 10% silt, gravel size to ½".
650	
660	
670	
680	
690	
700	

3000 NATIONAL, INC. **DRILL CUTTINGS LOG**

PAGE 8 OF 13

FIELD LOG OF WELL NUMBER OW2

PROJECT NUMBER 79-290- 45
 PROJECT NAME MX SITING INVESTIGATION
 EQUIPMENT USED Reverse Mud Rotary
 COMPANY Beylik
 OPERATOR J. Clyde

VALLEY NAME Dry Lake
 LOCATION NUMBER T3S, R64E, Sect. 12 ⁹_{ea}
 LOGGED BY SC DATE 1/17/80
 CHECKED BY JAG DATE 4/10/80
 TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
700	<u>Gravel with Some Coarse Sand:</u> Brown, subangular, well sorted gravel size to 3/4", less than 20% sand.
710	<u>Gravel with Some Coarse Sand:</u> Same as 700' but with gravel to 2".
720	<u>Gravel with Some Coarse Sand:</u> Same as 700'.
730	<u>Gravel with Sand, Silt, & Clay:</u> Brown, subangular gravel to 1/2" size with 20% sand, 20% silt & clay.
740	<u>Gravel with Some Coarse Sand:</u> Same as 700'.
750	<u>Gravel with Trace Coarse Sand:</u> Same as 700' but less than 10% sand, & gravel to 3".
760	<u>Gravel with Trace Coarse Sand:</u> Same as 750'.
770	<u>Gravel with Some Coarse Sand:</u> Same as 700'.
780	
790	
800	

TEGRO NATIONAL, INC.
DRILL CUTTINGS LOG

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FIELD LOG OF WELL NUMBER OW2

PROJECT NUMBER 79-290- 45
 PROJECT NAME MX SITING INVESTIGATION
 EQUIPMENT USED Reverse Rotary
 COMPANY Beylik
 OPERATOR J. Clyde

VALLEY NAME Dry Lake
 LOCATION NUMBER T3S, R64E, Sect. 12^a 6a
 LOGGED BY SC & JM DATE 1-18-80
 CHECKED BY JAG DATE 4-10-80
 TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
800	<u>Coarse Sand Trace Gravel & Silt:</u> Brown subangular, well sorted, coarse sand, less than 10% gravel, less than 10% silt.
810	<u>Gravel with Some Coarse Sand:</u> Brown, subangular, well sorted, gravel size to 1", 20% sand.
820	
830	
840	
850	
860	
870	
880	
890	
900	

JORO NATIONAL, INC. **DRILL CUTTINGS LOG**

PAGE 10 OF 13

FIELD LOG OF WELL NUMBER OW2

PROJECT NUMBER 79-290- 45

VALLEY NAME Dry Lake

PROJECT NAME MX SITING INVESTIGATION

LOCATION NUMBER T3S, R64E, Sect. 12 ²⁰

EQUIPMENT USED Reverse Rotary

LOGGED BY JM & SC DATE 1-19-80

COMPANY Beylik

CHECKED BY JAG DATE 4-10-80

OPERATOR J. Clyde

TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
900	<u>Sand with Some Gravel & Silt:</u> Brown subangular, poorly sorted, sand with 10% silt & clay, 20% gravel.
910	
920	
930	
940	<u>Gravel with Trace Coarse Sand:</u> Brown subangular, well sorted, gravel to 3/4", 10% sand.
950	
960	
970	
980	
990	
1000	

WORLD NATIONAL, INC. **DRILL CUTTINGS LOG**

PAGE 11 OF 13

FIELD LOG OF WELL NUMBER OW2

PROJECT NUMBER 79-290- 45

VALLEY NAME Dry Lake

PROJECT NAME MX SITING INVESTIGATION

LOCATION NUMBER T3S, R64E, Sect. 12 ^{2C}

EQUIPMENT USED Reverse Rotary

LOGGED BY JM & SC DATE 1-20-80

COMPANY Beylik

CHECKED BY JAG DATE 4-10-80

OPERATOR J. Clyde

TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
1000	
1010	<u>Gravel with Cobbles:</u> Dark colored, poorly sorted subangular to angular (predominantly angular) gravel with less than 5% broken cobbles up to 3".
1020	<u>Gravel with Cobbles:</u> As above (1010'), more darker rocks, medium to dark color.
1030	<u>Gravel with Sand:</u> Medium color, poorly sorted, subangular to angular gravel up to 1", with less than 20% fine-to coarse-grained, angular to subangular sand.
1040	<u>Gravel:</u> Medium color, poorly sorted, subangular to angular gravel with 20% cobbles up to 2½", with 20% medium to coarse, subangular to angular sand.
1050	<u>Gravel:</u> Light to dark colored, poorly sorted, subrounded to angular gravel up to 1½".
1060	<u>Gravel with Sand:</u> Light to dark color, medium sorted, subangular to angular gravel up to ¾".
1070	<u>Gravel:</u> Medium to dark color, well sorted, angular to subangular fine-grained gravel up to ½".
1080	<u>Gravel with Sand:</u> Medium to dark color, poorly sorted, subangular to angular gravel up to 1" with less than 25% coarse-to medium-grained, subangular to angular sand.
90	
10	<u>Gravel:</u> as above (1080'), but medium sorted.

WILSON NATIONAL, INC.
DRILL CUTTINGS LOG

PAGE 12 OF 13

FIELD LOG OF WELL NUMBER OW2

PROJECT NUMBER 79-290- 45
 PROJECT NAME MX SITING INVESTIGATION
 EQUIPMENT USED Reverse Rotary
 COMPANY Beylik
 OPERATOR J. Clyde

VALLEY NAME Dry Lake Valley
 LOCATION NUMBER T3S, R64E, Sect. 12^{ac}
 LOGGED BY JM & LB DATE 1-21-80
 CHECKED BY JAG DATE 4-10-80
 TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
1100	
1110	<u>Gravel</u> : Dark colored, well sorted, angular gravel up to 3/8".
1120	<u>Gravel</u> : Medium color, poorly sorted, subrounded to angular gravel up to 1/2" with less than 20% sand.
1130	<u>Gravel with Sand</u> : Light to dark color, poorly sorted, subrounded to rounded gravel up to 1" with 20% coarse to fine sand.
1140	<u>Gravel with Sand</u> : As above (1130') with occassional broken cobbles up to 4".
1150	<u>Gravel with Sand</u> : Medium to dark color, medium sorted subangular to angular gravel up to 1" with less than 20% medium to coarse sand.
1160	<u>Gravel with Sand</u> : Light to dark color, well sorted angular to subangular, fine gravel with 20% coarse sand.
1170	<u>Gravel</u> : Medium color, poorly sorted, subangular to angular, fine to 1 1/2" gravel.
1180	
1190	<u>Gravel</u> : Dark colored, poorly sorted, angular to subangular fine up to 2" gravel.
1200	

GENCO NATIONAL, INC.
DRILL CUTTINGS LOG

PAGE 13 OF 13

FIELD LOG OF WELL NUMBER OW2

PROJECT NUMBER 79-290- 45
 PROJECT NAME MX SITING INVESTIGATION
 EQUIPMENT USED Reverse Rotary
 COMPANY Beylik
 OPERATOR J. Clyde

VALLEY NAME Dry Lake
 LOCATION NUMBER T3S, R64E, Sect. 12^{ac}
 LOGGED BY JM & LB DATE 1-22-80
 CHECKED BY JAG DATE 4-10-80
 TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
1200	
1210	<u>Gravel</u> : Medium to dark color, poorly sorted angular to subangular, fine up to 1½" gravel.
1220	<u>Gravel</u> : Medium to dark color, medium sorted, subrounded to subangular, fine to ½" gravel.
1230	
1240	<u>Sand with Gravel</u> : Light to medium color, medium sorted, subrounded to subangular, medium to coarse sand with less than 10% gravel up to ½".
1250	<u>Sand and Gravel</u> : Light to dark color, well sorted, angular to subangular, fine gravel with 50% coarse sand.
1260	<u>Gravel with Sand</u> : Light to medium colored medium sorted, subangular to angular gravel with less than 25% coarse sand.
1270	<u>Gravel</u> : Light to dark colored, well sorted, angular to subangular gravel up to 3/8".
1280	<u>Sand & Gravel</u> : Light to dark colored, well sorted, angular to subangular, fine gravel with - 50% coarse sand.
1290	<u>Gravel with Sand</u> : Medium to dark colored, poorly sorted, angular to subangular gravel up to 3/4" with - 25% coarse sand.
1300	

UGRO NATIONAL, INC.
DRILL CUTTINGS LOG

Well PAGE 1 OF 11
 FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45
 PROJECT NAME MX SITING INVESTIGATION
 EQUIPMENT USED Bucket Auger 0'-40' Reverse Rotary
 COMPANY Beylik 40' - TD
 OPERATOR J. Clyde

VALLEY NAME Dry Lake
 LOCATION NUMBER T6S, R63E, Sec. 12
 LOGGED BY JM DATE 2-6-80
 CHECKED BY JAG DATE 4/10/80
 TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
0	<u>Silt</u> : Tan silt with occasional gravel up to 1 1/4".
10	<u>Silt</u> : Tan silt.
20	<u>Silt</u> : Tan silt with less than 25% medium colored, fine- to coarse-grained, poorly sorted, subrounded to subangular sand with less than 10% gravel up to 1 1/4".
30	<u>Gravel with Cobbles</u> : Medium to dark colored, subrounded to subangular, medium gravel with cobbles up to 4".
40	<u>Gravel</u> : Medium colored, moderately sorted, angular to subrounded, fine to coarse gravel up to 1 1/4".
50	- - Gravel up to 1".
60	<u>Gravel</u> : Medium colored, moderately sorted, subangular to subrounded, fine to coarse gravel up to 1 1/4" with less than 5% coarse-grained sand.
70	- - Gravel up to 3/4".
80	
90	- - Gravel up to 1 1/4".
100	

BERO NATIONAL, INC.
DRILL CUTTINGS LOG

PAGE 2 OF 11

FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45
 PROJECT NAME MX SITING INVESTIGATION
 EQUIPMENT USED Reverse Rotary
 COMPANY Beylik
 OPERATOR J. Clyde

VALLEY NAME Dry Lake
 LOCATION NUMBER T6S, R63E, Sect. 12
 LOGGED BY JFM DATE 2-6-80
 CHECKED BY JAG DATE 4/11/80
 TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
100	<u>Gravel</u> : Dark brown colored, well sorted, subangular to subrounded, gravel up to $\frac{1}{2}$ ".
110	- - - Very well sorted gravel up to $\frac{1}{2}$ ".
120	- - - Gravel up to $\frac{3}{4}$ ".
130	
140	<u>Gravel</u> : Light to dark colored, very well sorted, subangular to subrounded gravel up to $\frac{1}{2}$ ".
150	<u>Gravel</u> : Light to dark colored, poorly sorted, subangular to subrounded gravel with occasional cobbles up to 2". Less than 20% medium- to coarse-grained sand.
160	<u>Gravel</u> : Light to dark colored, well sorted, subangular to subrounded, fine to medium gravel, occasionally up to 1", with less than 10% coarse-grained sand.
170	<u>Gravel with Cobbles</u> : Light to dark colored, poorly sorted, angular to subrounded, fine to coarse gravel, with cobbles up to 3" and less than 5% coarse-grained sand.
180	
190	<u>Gravel</u> : Light to dark colored, moderately sorted, subangular to subrounded, fine to coarse gravel, with occasional cobbles up to $1\frac{1}{2}$ " and less than 5% coarse sand.
200	- - - Cobbles up to 2".

TUBRO NATIONAL INC.
DRILL CUTTINGS LOG

PAGE 3 OF 11

FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45
 PROJECT NAME MX SITING INVESTIGATION
 EQUIPMENT USED Reverse Rotary
 COMPANY Beylik
 OPERATOR J. Clyde

VALLEY NAME Dry Lake
 LOCATION NUMBER T6S. R63E. Sec. 12d. 4c
 LOGGED BY JFM DATE 2-06-80
 CHECKED BY JAG DATE 4-10-80
 TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
200	<u>Gravel:</u> Light to dark colored, poorly sorted, angular to subangular, fine to coarse gravel with less than 20% cobbles up to 2½" and less than 5% coarse-grained sand.
210	<u>Gravel:</u> Light to dark colored, moderately sorted, angular to subangular, fine to coarse gravel, with occasional cobbles up to 4" and less than 5% medium- to coarse-grained sand.
220	<u>Gravel:</u> Light to dark colored, well sorted, subangular to subrounded, fine to coarse gravel up to 2½", with less than 10% medium- to coarse-grained sand.
230	<u>Gravel:</u> Light to dark colored, moderately sorted, subangular to subrounded, fine to coarse gravel up to 1", with less than 10% medium- to coarse-grained sand.
240	- - - Gravel up to 2".
250	
260	<u>Sand:</u> Medium colored, well sorted, fine-grained sand, with less than 25% medium-grained sand to coarse gravel up to 2".
270	<u>Gravel:</u> Medium to dark colored, medium sorted, subangular to subrounded, fine to coarse gravel up to 2½", with less than 10% coarse-grained sand.
280	<u>Gravel with Sand:</u> Medium to dark colored, poorly sorted, subrounded to angular, fine to coarse gravel up to 1½", and approximately 25% medium colored, fine- to coarse-grained sand.
290	<u>Gravel:</u> Medium to dark colored, moderately sorted, subrounded to subangular, fine to medium gravel up to ½", with approximately 10% fine- to coarse-grained sand.
300	

UGRO NATIONAL, INC.
DRILL CUTTINGS LOG

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FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45
 PROJECT NAME MX SITING INVESTIGATION
 EQUIPMENT USED Reverse Rotary
 COMPANY Beylik
 OPERATOR J. Clyde

VALLEY NAME Dry Lake
 LOCATION NUMBER T6S, R63E, Sec. 12A/C
 LOGGED BY LB DATE 2-07-80
 CHECKED BY JAG DATE 4-10-80
 TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
300	<u>Gravel</u> : Medium to dark colored, moderately sorted, subrounded to angular, fine to medium gravel up to 1/3", with approximately 10% fine- to coarse-grained sand.
310	<u>Gravel</u> : Medium to dark colored, poorly sorted, subangular to angular, fine to 2 1/4" gravel.
320	<u>Gravel</u> : Dark colored, poorly sorted, subrounded to angular, fine to 2" gravel (less than 10% sand).
330	<u>Gravel</u> : Dark colored, poorly sorted, subrounded to angular, fine to 2 1/4" gravel (less than 5% sand).
340	<u>Gravel with Sand</u> : Dark colored, poorly sorted, subangular to angular, fine to 2" gravel, with less than 20% medium colored, medium-to coarse-grained sand.
350	<u>Gravel</u> : Dark colored, poorly sorted, subangular to angular, fine to 3/4" gravel with less than 10% sand.
360	<u>Gravel</u> : Dark colored, moderately sorted, subangular to angular, fine to 1/2" gravel.
370	<u>Gravel</u> : Dark colored, poorly sorted, subangular to angular (predominantly angular), fine to 1" gravel.
380	<u>Gravel</u> : Dark colored, poorly sorted, subangular, fine to 1/2" gravel (with less than 10% sand).
390	<u>Gravel</u> : Medium to dark colored, poorly sorted, subangular to angular, 1/3"-diameter gravel with less than 15% sand.
400	

TUCERO NATIONAL, INC.
DRILL CUTTINGS LOG

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FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45

VALLEY NAME Dry Lake

PROJECT NAME MX SITING INVESTIGATION

LOCATION NUMBER T6S, R63E, Sec. 12A20

EQUIPMENT USED Reverse Rotary

LOGGED BY LB, JM DATE 2-07-80

COMPANY Beylik

CHECKED BY JAG DATE 4-10-80

OPERATOR J. Clyde

TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
400	Gravel: Light to dark color, medium sorted, subangular to subrounded gravel up to $\frac{1}{4}$ " with less than 15% medium- to coarse-grained sand.
410	Gravel with Sand & Clay: Medium colored, poorly sorted, subangular to subrounded gravel up to $\frac{3}{8}$ ", with less than 50% fine- to coarse-grained sand and clay.
420	
430	Gravel: Medium to dark colored, well sorted, subangular to subrounded gravel up to $\frac{1}{2}$ ", with less than 20% coarse-grained sand.
440	- - - Gravel up to 1".
450	- - - Less than 10% coarse sand.
460	Gravel with Sand: Light to dark colored, poorly sorted, subangular to subrounded, fine to coarse gravel up to 1", with less than 30% fine to coarse-grained sand.
470	Gravel with Sand: Medium to dark colored, poorly sorted, subrounded to subangular, fine to 1" gravel with less than 25% medium- to coarse-grained sand.
480	
490	- - - Gravel up to $\frac{3}{4}$ ".
500	

TUCRO NATIONAL, INC.
DRILL CUTTINGS LOG

PAGE 6 OF 11

FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45
 PROJECT NAME MX SITING INVESTIGATION
 EQUIPMENT USED Reverse Rotary
 COMPANY Beylik
 OPERATOR J. Clyde

VALLEY NAME Dry Lake
 LOCATION NUMBER T6S, R63E, Sec. 1249C
 LOGGED BY LB, JFM DATE 2/08/80
 CHECKED BY JAG DATE 4/10/80
 TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
500	<u>Gravel with Sandy Silt</u> : Medium to dark colored, poorly sorted, subrounded to angular, fine to 1" gravel with less than 30% tan colored, coarse-grained sand to silt.
510	<u>Gravel</u> : Medium to dark colored, moderately sorted, angular, fine to 1½" gravel.
520	- - - 5% fine- to coarse-grained sand.
530	
540	<u>Gravel</u> : Light to dark colored, poorly sorted, angular to subangular, fine to 2½" gravel with less than 10% sand.
550	<u>Gravel</u> : Medium to dark colored, poorly sorted, angular to subangular, fine to 1" gravel with less than 25% medium colored, fine- to coarse-grained sand.
560	<u>Gravel and Sand</u> : Medium to dark colored, poorly sorted, angular to subangular, fine to ½" gravel with less than 40% medium to dark colored sand.
570	<u>Gravel</u> : Medium to dark colored, poorly sorted, angular to subangular, fine to 1" gravel with less than 20% fine- to coarse-grained sand.
580	<u>Gravel</u> : Dark colored, moderately sorted, subrounded to subangular gravel with less than 10% sand.
590	- - - Sand content up to about 25%.
600	

GEED NATIONAL, INC.
DRILL CUTTINGS LOG

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FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45

VALLEY NAME Dry Lake

PROJECT NAME MX SITING INVESTIGATION

LOCATION NUMBER T6S, R63E, Sec. 12

EQUIPMENT USED Reverse Rotary

LOGGED BY LB DATE 2-08-80

COMPANY Beylik

CHECKED BY JAG DATE 4-10-80

OPERATOR J. Clyde

TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
600	<u>Sand and Gravel with Silt:</u> Dark colored, moderately sorted, fine-grained to $\frac{1}{4}$ " sand and gravel with less than 50% tan silt.
610	<u>Gravel:</u> Dark colored, moderately sorted, subangular to angular, fine to 1" gravel.
620	<u>Gravel:</u> Dark colored, moderately sorted, subrounded to subangular, fine to 2" gravel with less than 10% sand.
630	<u>Gravel:</u> Dark colored, moderately sorted, subangular to angular, fine to 1" gravel with less than 5% coarse-grained sand.
640	<u>Gravel:</u> Dark colored, poorly sorted, subangular to angular (predominantly angular), fine to 2" gravel.
650	<u>Gravel:</u> Medium to dark colored, well sorted, subangular to angular, fine to $\frac{1}{3}$ " gravel.
660	<u>Gravel:</u> Medium to dark colored, poorly sorted, subangular to angular (predominantly angular), fine to $\frac{1}{4}$ " gravel, with less than 10% sand.
670	<u>Gravel:</u> Medium to dark colored, moderately sorted, subangular to angular, fine to $\frac{1}{3}$ " gravel.
680	- - - Increasing fine-grained gravel.
690	<u>Gravel:</u> Medium to dark colored, well sorted, subrounded to angular, fine to $\frac{1}{4}$ " gravel.
700	

USCO NATIONAL, INC. **DRILL CUTTINGS LOG**

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FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45

VALLEY NAME Dry Lake

PROJECT NAME MX SITING INVESTIGATION

LOCATION NUMBER T6S, R63E, Sec. 12A.20

EQUIPMENT USED Reverse Rotary

LOGGED BY LB, JFM DATE 2/09/80

COMPANY Beylik

CHECKED BY JAG DATE 4/10/80

OPERATOR J. Clyde

TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
700	
710	<u>Gravel</u> : Dark colored, well sorted, subangular to angular, fine to 1 1/4" gravel.
720	<u>Gravel</u> : Dark colored, well sorted, subangular to angular (predominantly angular), fine to 1" gravel.
730	<u>Gravel</u> : Dark colored, poorly sorted, subangular, fine to medium gravel up to 1/2" with less than 25% fine- to coarse-grained sand.
740	<u>Gravel</u> : Dark colored, poorly sorted, angular to subangular, fine to medium gravel up to 1" with less than 10% fine- to coarse-grained sand.
750	<u>Gravel</u> : Medium to dark colored, poorly sorted, angular to subangular, fine to medium gravel, occasionally up to 1 1/4", with less than 10% fine- to coarse-grained sand.
760	<u>Gravel</u> : Medium to dark colored, moderately sorted, angular to subangular, fine to medium gravel up to 3/4" (predominantly fine gravel), with less than 10% medium- to coarse-grained sand.
770	<u>Gravel with Sand</u> : Medium to dark colored, poorly sorted, angular to subangular, fine to medium gravel up to 3/4" with less than 35% fine- to coarse-grained sand.
780	<u>Gravel</u> : Medium to dark colored, moderately sorted, angular to subangular, fine to medium gravel up to 1/2" with less than 10% medium- to coarse-grained sand.
790	<u>Gravel</u> : Medium to dark colored, moderately sorted, angular to subangular, fine to medium gravel up to 1" (predominantly 1/8" to 1/4").
800	

TERRA NATIONAL, INC.
DRILL CUTTINGS LOG

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FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45
 PROJECT NAME MX SITING INVESTIGATION
 EQUIPMENT USED Reverse Rotary
 COMPANY Beylik
 OPERATOR J. Clyde

VALLEY NAME Dry Lake
 LOCATION NUMBER T6S, R63E, Sec. 12, 1/4
 LOGGED BY JFM DATE 2-10-80
 CHECKED BY JAG DATE 4-10-80
 TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
800	Gravel: Light to dark colored, moderately sorted, angular to subangular, fine to medium gravel up to 1".
810	Gravel: Medium to dark color, poorly sorted, angular to subangular, fine to medium gravel (predominantly less than 1/2" and up to 3/4"), with less than 10% coarse-grained sand.
820	Gravel: Medium to dark color, well sorted, angular to subangular, fine to medium gravel (predominantly fine, occasionally up to 1/2"), with less than 10% coarse-grained sand.
830	Gravel: Dark colored, moderately sorted, angular to subangular, fine to medium with occasional coarse gravel up to 2-3/4", with less than 5% coarse-grained sand.
840	Gravel: Medium to dark colored, poorly sorted, angular to subangular, fine to medium, occasionally up to 1".
850	
860	- - - Gravel up to 1 1/4", with less than 5% coarse sand.
870	Gravel: Medium to dark colored, moderately sorted, angular to subangular, fine to medium gravel up to 1" with less than 5% coarse-grained sand.
880	Gravel: Medium to dark colored, moderately sorted, angular, fine to medium gravel up to 1 1/4".
890	Gravel: Medium to dark colored, moderately to well sorted, angular to subangular, fine to medium gravel up to 3/4".
900	

NEED NATIONAL, INC. **DRILL CUTTINGS LOG**

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FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45
 PROJECT NAME MX SITING INVESTIGATION
 EQUIPMENT USED Reverse Rotary
 COMPANY Beylik
 OPERATOR J. Clyde

VALLEY NAME Dry Lake (DL)
 LOCATION NUMBER T6S, R63E, Sec. 12A^{2c}
 LOGGED BY JFM, LB DATE 2/10/80
 CHECKED BY JAG DATE 4/10/80
 TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
900	<u>Gravel:</u> Medium to dark colored, well sorted, angular to subangular, fine gravel up to $\frac{1}{4}$ ", with less than 5% coarse-grained sand.
910	<u>Gravel:</u> Medium to dark colored, well sorted, angular to subangular, fine to medium gravel, occasionally up to 1", with less than 5% coarse-grained sand.
920	<u>Gravel:</u> Medium to dark colored, moderately well sorted, angular to subangular, fine to medium gravel up to $\frac{3}{8}$ ", with less than 5% coarse-grained sand.
930	
940	<u>Gravel and Sand:</u> Dark colored, well sorted, subangular to angular, fine gravel and coarse-grained sand.
950	<u>Gravel:</u> Dark colored, poorly sorted, subangular to angular, fine to 2" gravel, with less than 10% medium- to coarse-grained sand.
960	
970	<u>Gravel:</u> Dark colored, well sorted, subrounded to subangular, fine to $\frac{1}{3}$ " gravel, with less than 20% fine- to coarse-grained sand.
980	<u>Gravel:</u> Dark colored, poorly sorted, subrounded to angular, fine to 3" gravel, with less than 10% sand.
990	<u>Gravel:</u> Dark colored, moderately well sorted, subangular to angular, fine to $\frac{1}{4}$ " gravel, with less than 5% sand.
1000	

TECRO NATIONAL, INC. **DRILL CUTTINGS LOG**

PAGE 11 OF 11

FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45

VALLEY NAME Dry Lake

PROJECT NAME MX SITING INVESTIGATION

LOCATION NUMBER T6S, R63E, Sec. 12 AC

EQUIPMENT USED Reverse Rotary

LOGGED BY JFM, LB DATE 2-10-80

COMPANY Beylik

CHECKED BY JAG DATE 4-10-80

OPERATOR J. Clyde

TOTAL WELL DEPTH: 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
1000	<u>Gravel and Cobbles:</u> Medium to dark colored, poorly sorted, subangular to angular gravel to 3". Broken cobbles to 6".
1010	
	T.D.: 1010'
20	
30	
40	
50	
60	
70	
80	
90	
00	

AD-A112 959

ERTEC WESTERN INC LONG BEACH CA

F/8 13/2

MX SITING INVESTIGATION. WATER RESOURCES PROGRAM. VOLUME II. RE-ETC(U)

SEP 81

F04704-80-C-0006

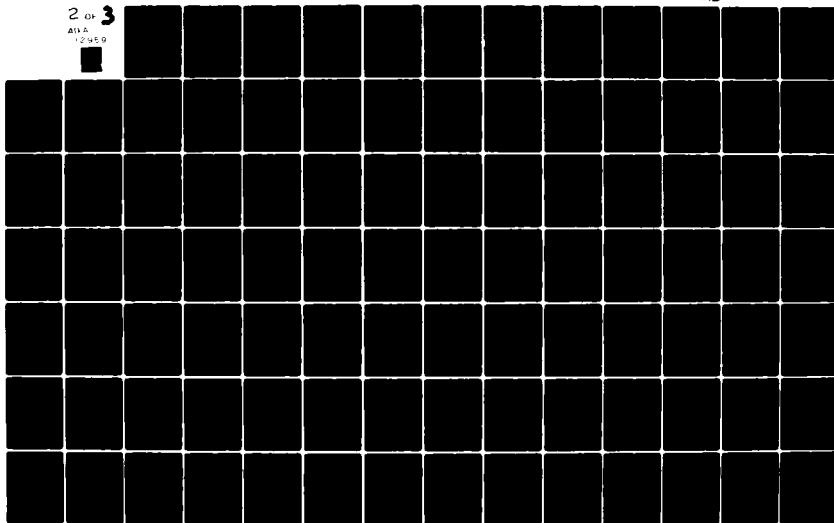
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E-TR-53-2

NL

2 OF 3

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2959



1.0

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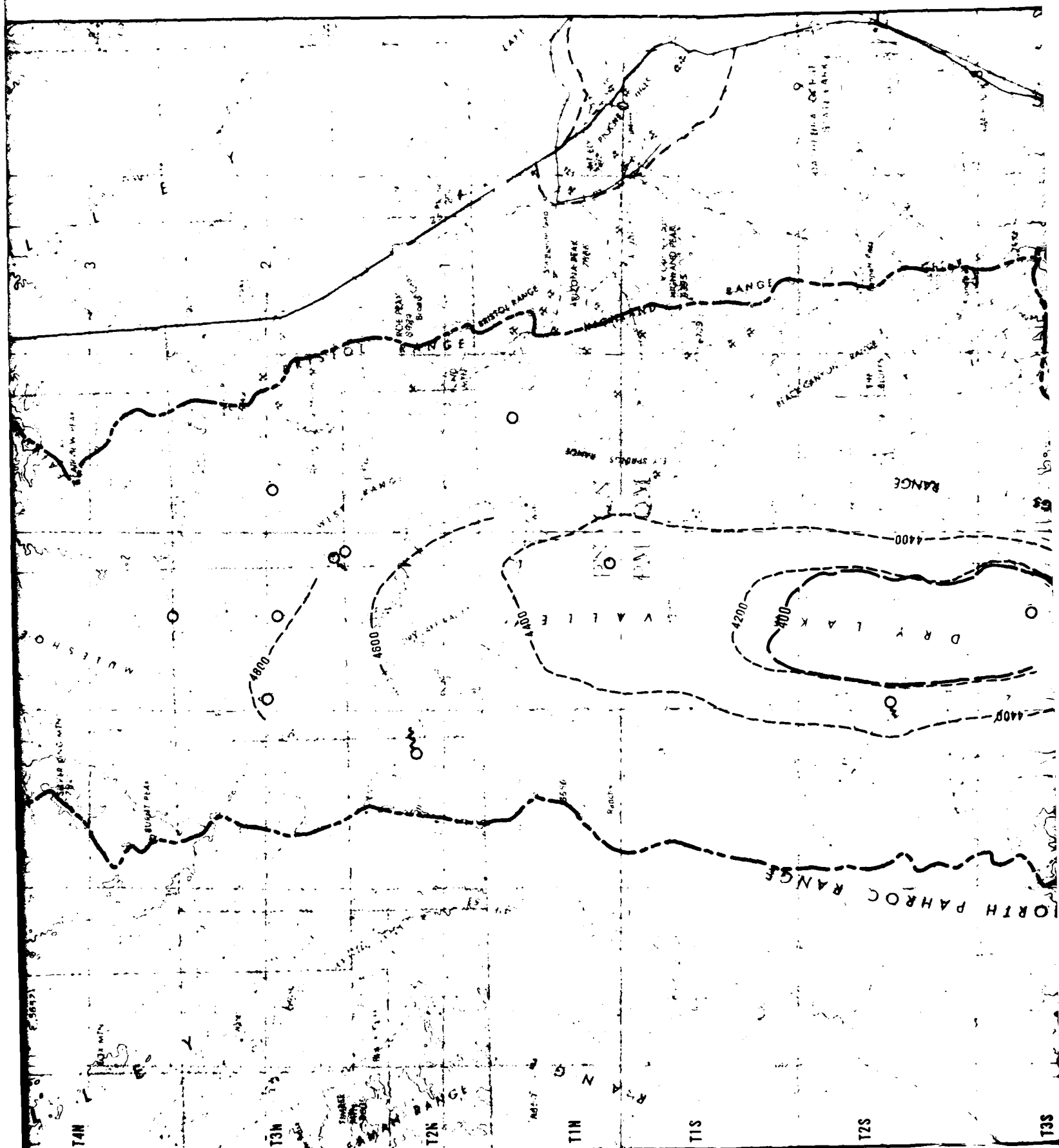
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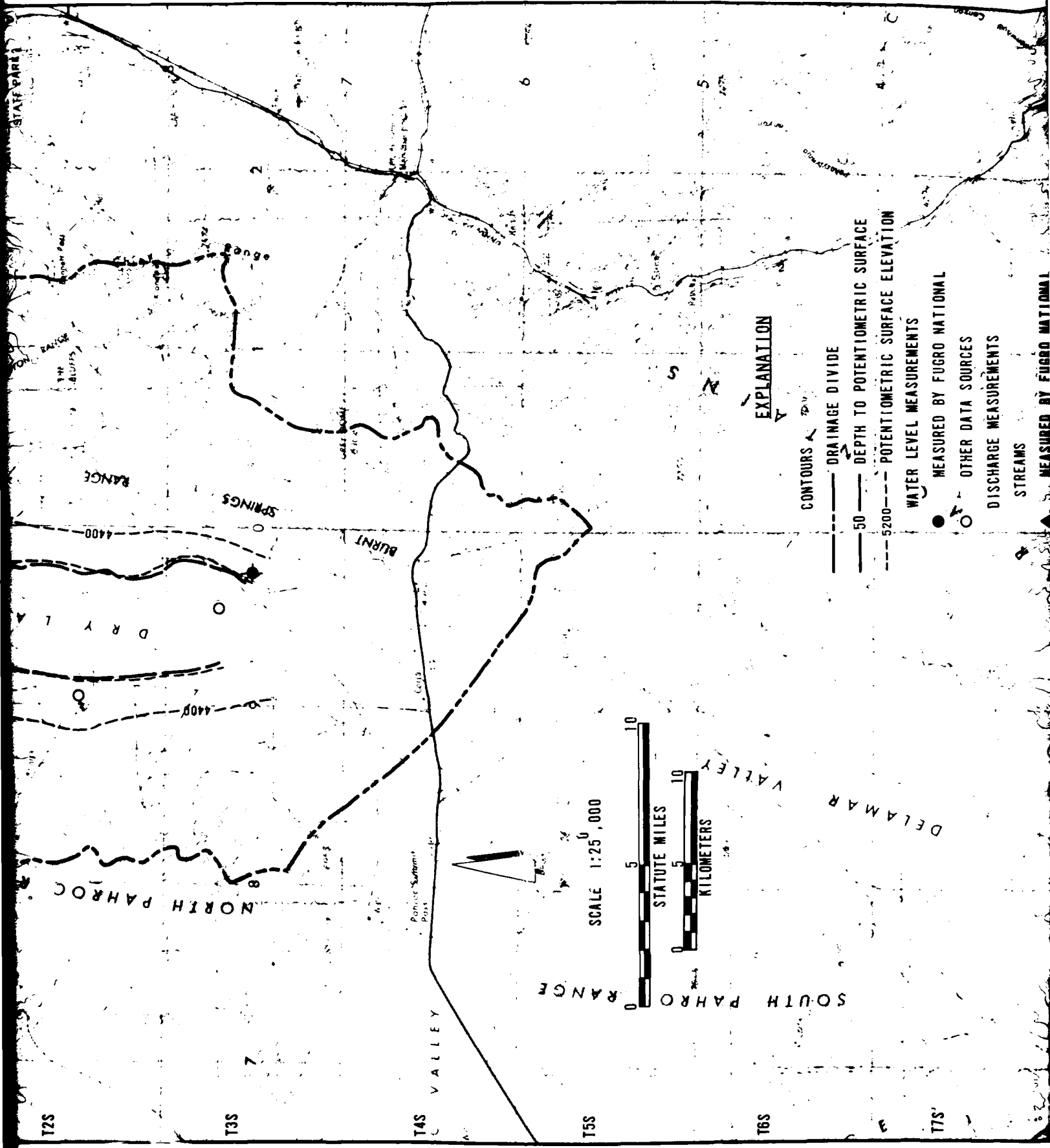
1.6







3



EXPLANATION

- CONTOURS
- DRAINAGE DIVIDE
- 50 --- DEPTH TO POTENTIOMETRIC SURFACE
- 5200 --- POTENTIOMETRIC SURFACE ELEVATION
- WATER LEVEL MEASUREMENTS
 - MEASURED BY FUGRO NATIONAL
 - OTHER DATA SOURCES
- DISCHARGE MEASUREMENTS
- STREAMS
- MEASURED BY FUGRO NATIONAL
- OTHER DATA SOURCES
- SPRINGS
- MEASURED BY FUGRO NATIONAL
- OTHER DATA SOURCES
- AQUIFER TEST
- WATER TABLE MONITORING BORINGS
- AREA OF HIGH EVAPOTRANSPIRATION

NOTES: (1) POTENTIOMETRIC AND DEPTH TO WATER CONTOURS WERE CONSTRUCTED FROM 1:62,500 SCALE BASE MAP AND REPRESENT TRUE ELEVATIONS AND DEPTHS. THESE HYDROLOGIC DATA WERE REDUCED AND TRANSFERRED TO THIS 1:250,000 SCALE BASE MAP WHICH MAY HAVE RESULTED IN SOME APPARENT DISCREPANCY WITH TOPOGRAPHIC CONTOURS.

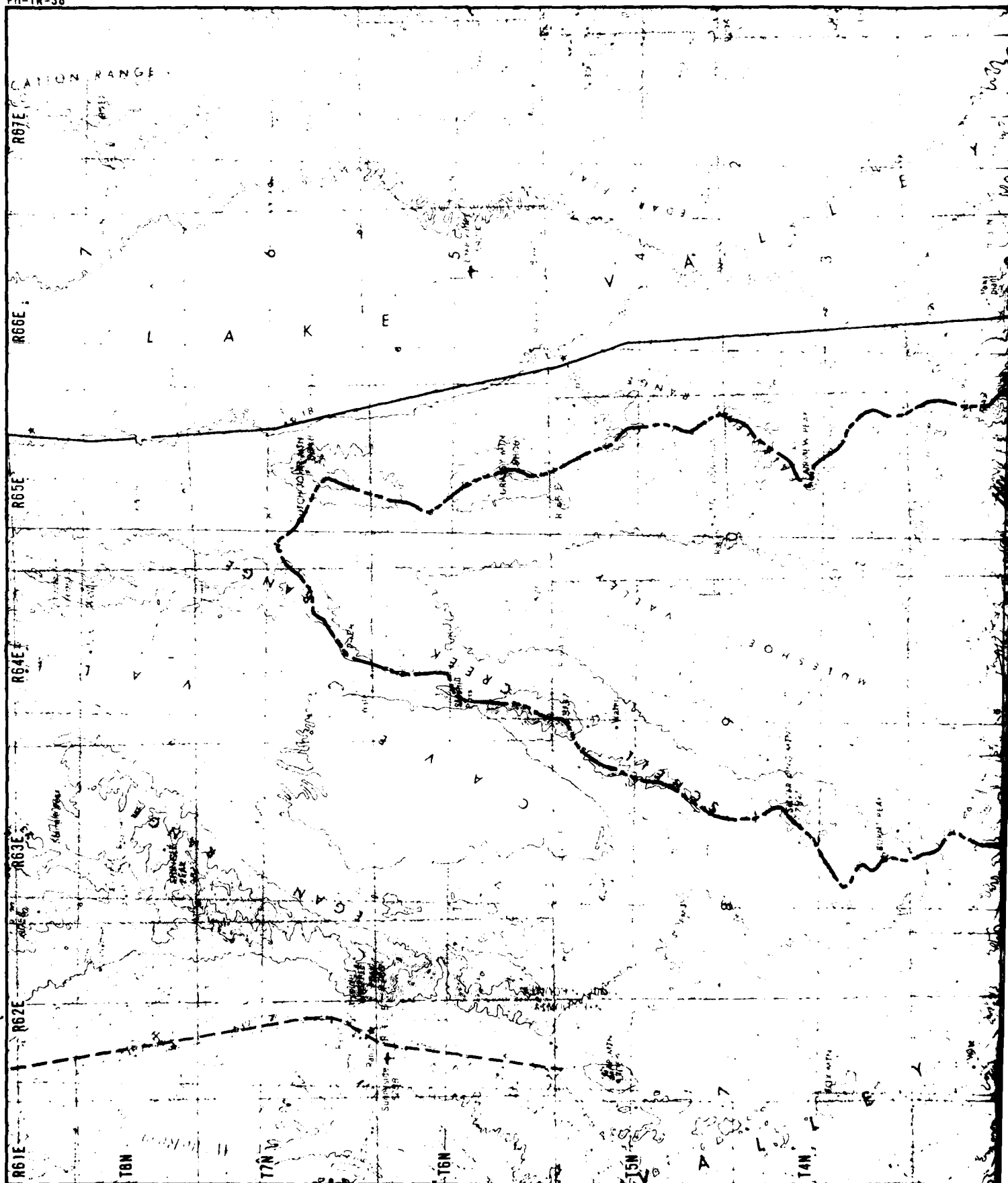
(2) CONTOUR MAPS COMPILED DURING THIS INVESTIGATION ARE BASED ON THE LIMITED DATA AVAILABLE, AND AS NEW DATA BECOMES AVAILABLE, MAPS WILL BE UPDATED AND REFINED.

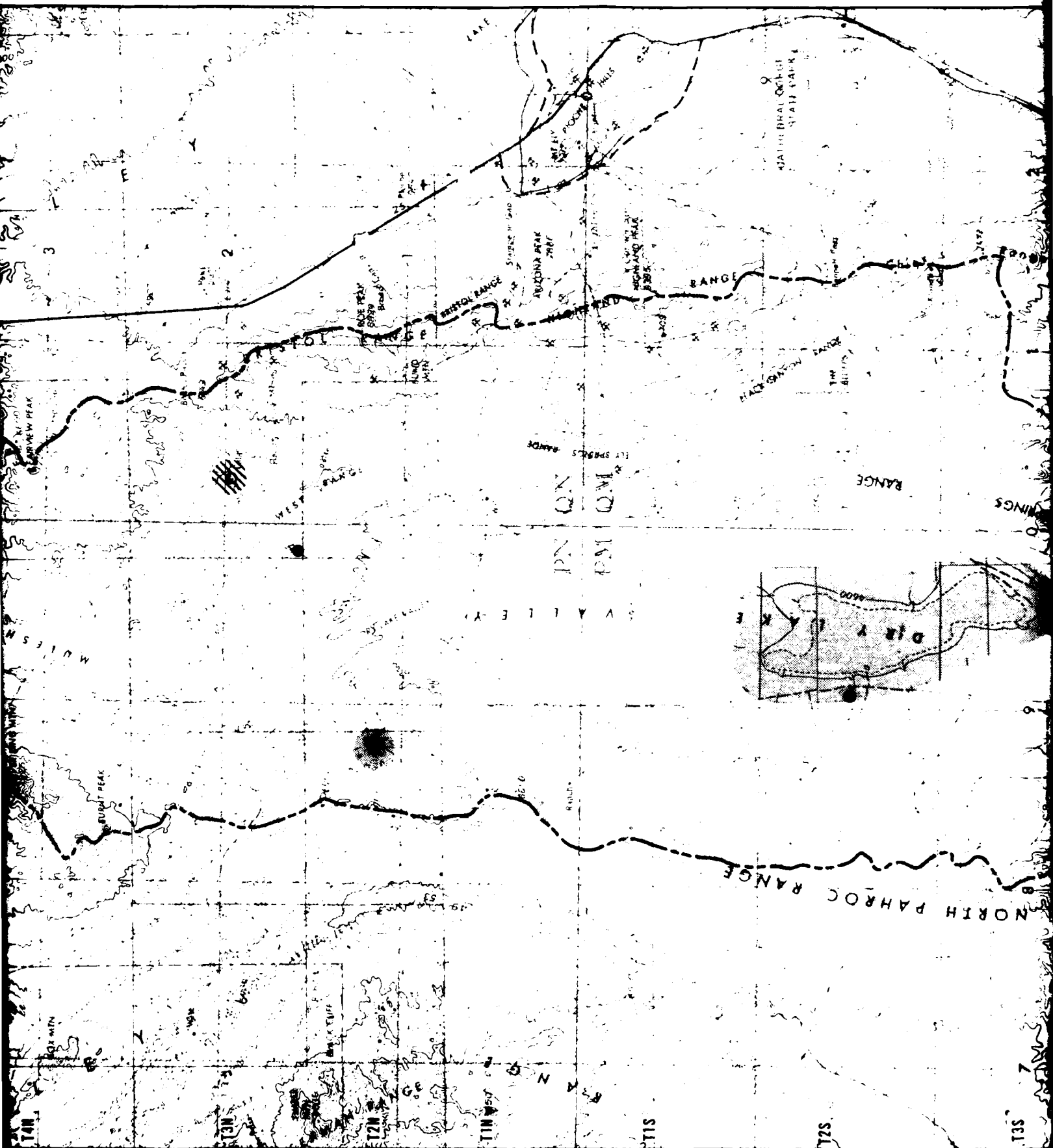
POTENTIOMETRIC LEVELS
DRY LAKE VALLEY, NEVADA

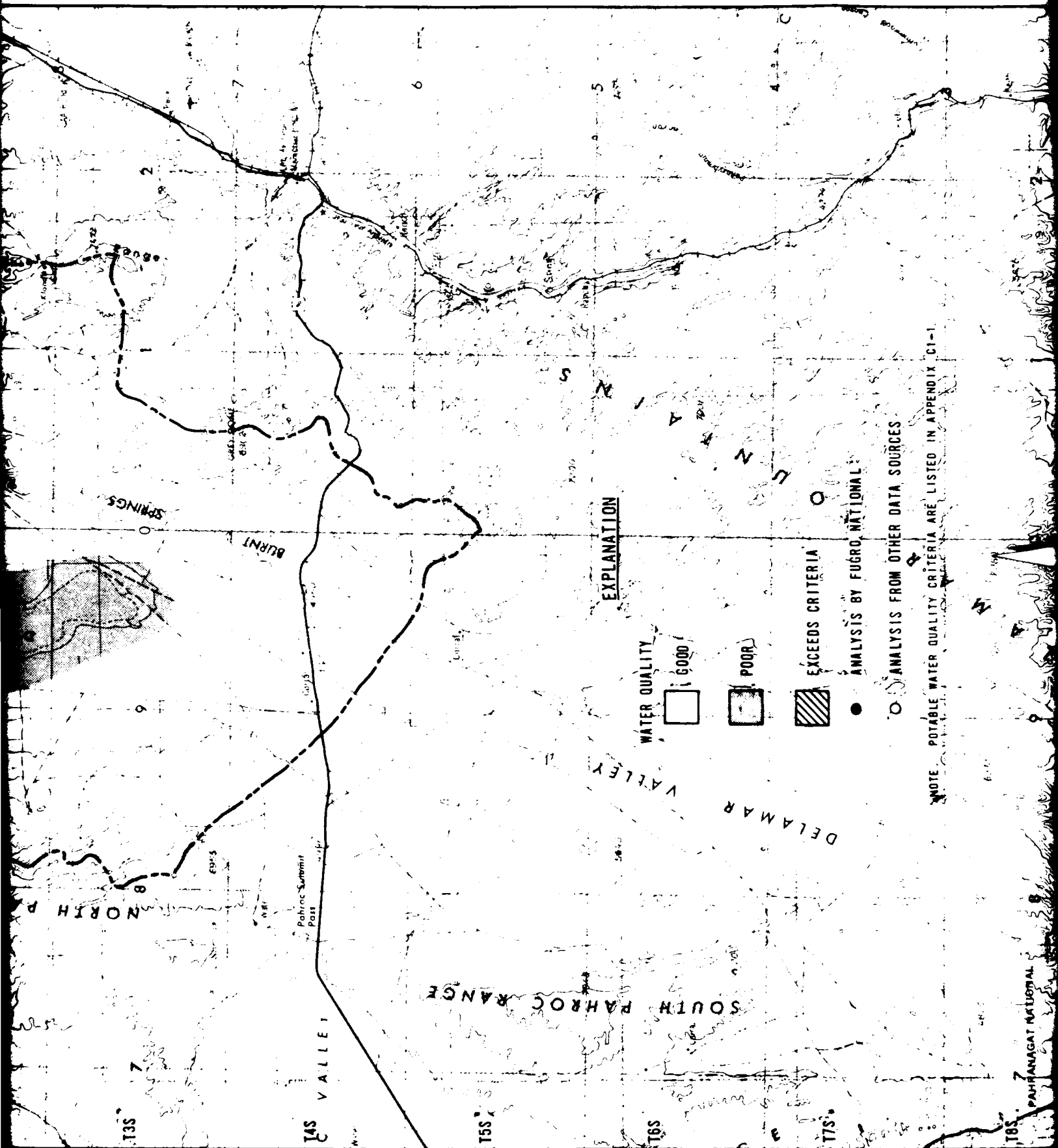
MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

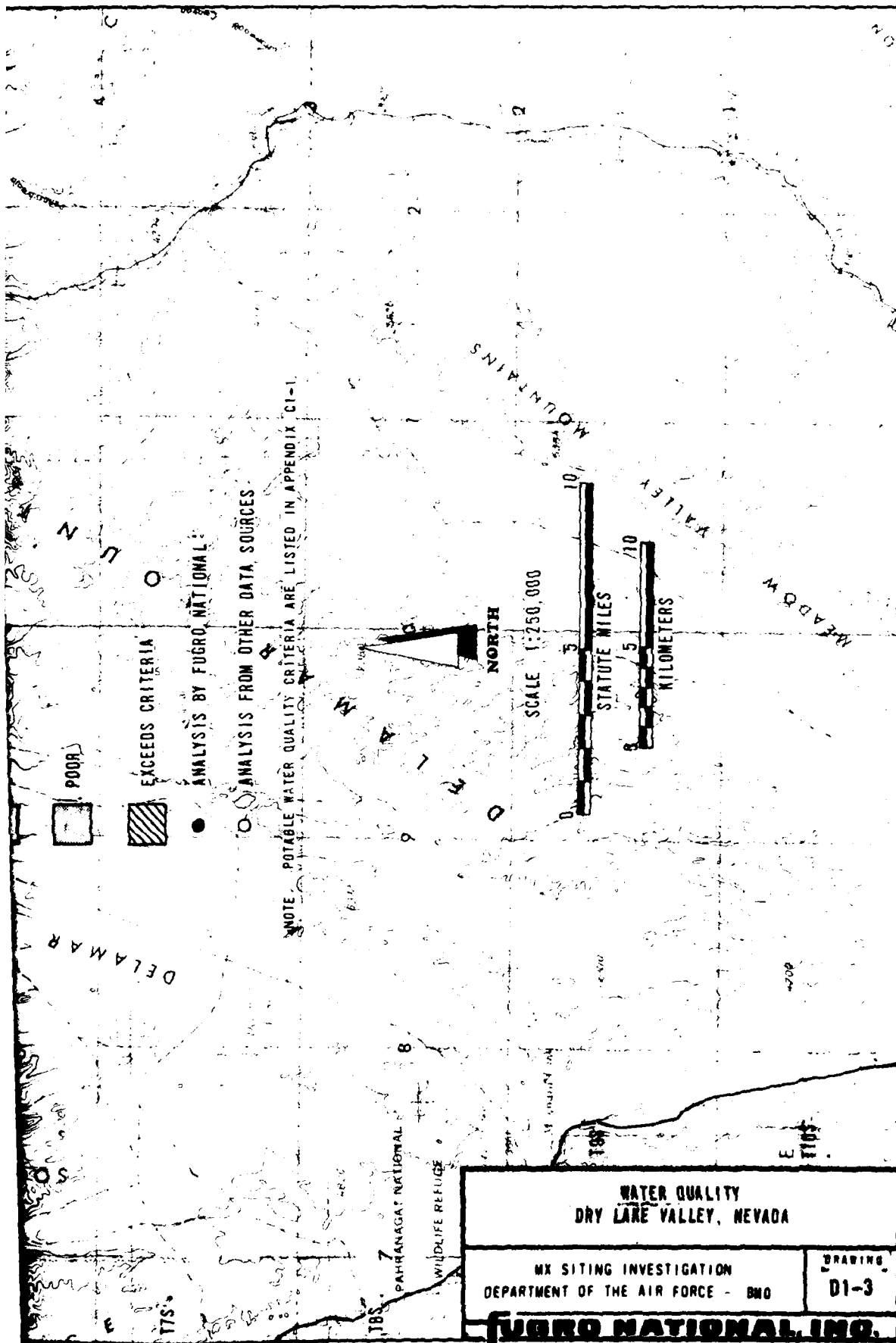
DRAWING
B1-4

FUGRO NATIONAL INC.









F1.0

MX SITING INVESTIGATION, GRAVITY
SURVEY-DRY LAKE VALLEY, NEVADA

FN--TR-33-DL

MX SITING INVESTIGATION

GRAVITY SURVEY - DRY LAKE VALLEY

NEVADA

Prepared for:

U.S. Department of the Air Force
Ballistic Missile Office (BMO)
Norton Air Force Base, California 92409

Prepared by:

Fugro National, Inc.
3777 Long Beach Boulevard
Long Beach, California 90807

17 March 1980

FOREWORD

Methodology and Characterization Studies during fiscal years 1977 and 1978 included gravity surveys in ten valleys in Arizona (five), Nevada (two), New Mexico (two), and California (one). The gravity data were obtained for the purpose of estimating the gross structure and shape of the basins and the thickness of the valley fill. There was also the possibility of detecting shallow rock in areas between boring locations. Generalized interpretations from these surveys were included in Fugro National's Characterization Reports (FN-TR-26a through e).

During the FY 77 surveys, the measurements were made to form an approximate one-mile grid over the study areas, and contour maps showing interpreted depth to bedrock were made. In FY 79, the decision was made to concentrate the available funds on the basic Verification Program to verify and refine suitable area boundaries. This decision resulted in a reduction in the gravity program. Instead of obtaining gravity data on a grid, the reduced program consisted of obtaining gravity measurements along profiles across the valleys where Verification Studies were also performed.

The Defense Mapping Agency (DMA), St. Louis, was also requested to provide gravity data from their library to supplement the gravity profiles. For Big Smoky, Reveille, and Railroad valleys, a sufficient density of library data is available to permit construction of interpreted contour maps instead of two-dimensional cross sections.

In late summer of FY 79, supplementary funds became available to begin data reduction. At this time, inner zone terrain corrections began on the library data and the profiles from Big Smoky Valley, Nevada, and Butler and La Posa valleys, Arizona. The profile data from Whirlwind, Hamlin, Snake East, White River and Garden Coal valleys, Nevada were available from the field in early October, 1979.

A continuation of gravity interpretations has been incorporated into the FY 80 contract and the results are being summarized in a series of valley reports. The reports covering Nevada-Utah gravity studies will be numbered, "FN-TR-33-", followed by the abbreviation for the subject valley. In addition, more detailed reports of the results of FY 77 surveys in Dry Lake and Ralston valleys, Nevada are being prepared. Verification Studies are continuing in FY 80 and gravity studies are included in the program. DMA will continue to obtain the field measurements and it is planned to return to the grid pattern. The interpretation of the grid data will allow the production of contour maps which will be valuable in the deep basin structural analysis needed for computer modeling in the Water Resources Program. The gravity interpretations will also be useful in the Nuclear Hardness and Survivability (NH&S) evaluations.

The basic decisions governing the gravity program are made by BMO following consultation with TRW Inc., Fugro National and the (DMA). Conduct of the gravity studies is a joint effort between DMA and Fugro National. The field work, including planning, logistics, surveying, and meter operation is done by the Defense Mapping Agency Hydrographic/Topographic Center (DMAHTC), headquartered in Cheyenne, Wyoming. DMAHTC reduces the data to Simple Bouguer Anomaly (see Section A1.4, Appendix A1.0). The Defense Mapping Agency Aerospace Center (DMAAC), St. Louis, calculates outer zone terrain corrections.

Fugro National provides DMA with schedules showing the valleys with the highest priorities. Fugro National also recommended locations for the profiles in the FY 79 studies within the constraints that they should follow existing roads or trails. Any required inner zone terrain corrections are calculated by Fugro National prior to making geologic interpretations.

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1.0 INTRODUCTION

1.1 OBJECTIVES

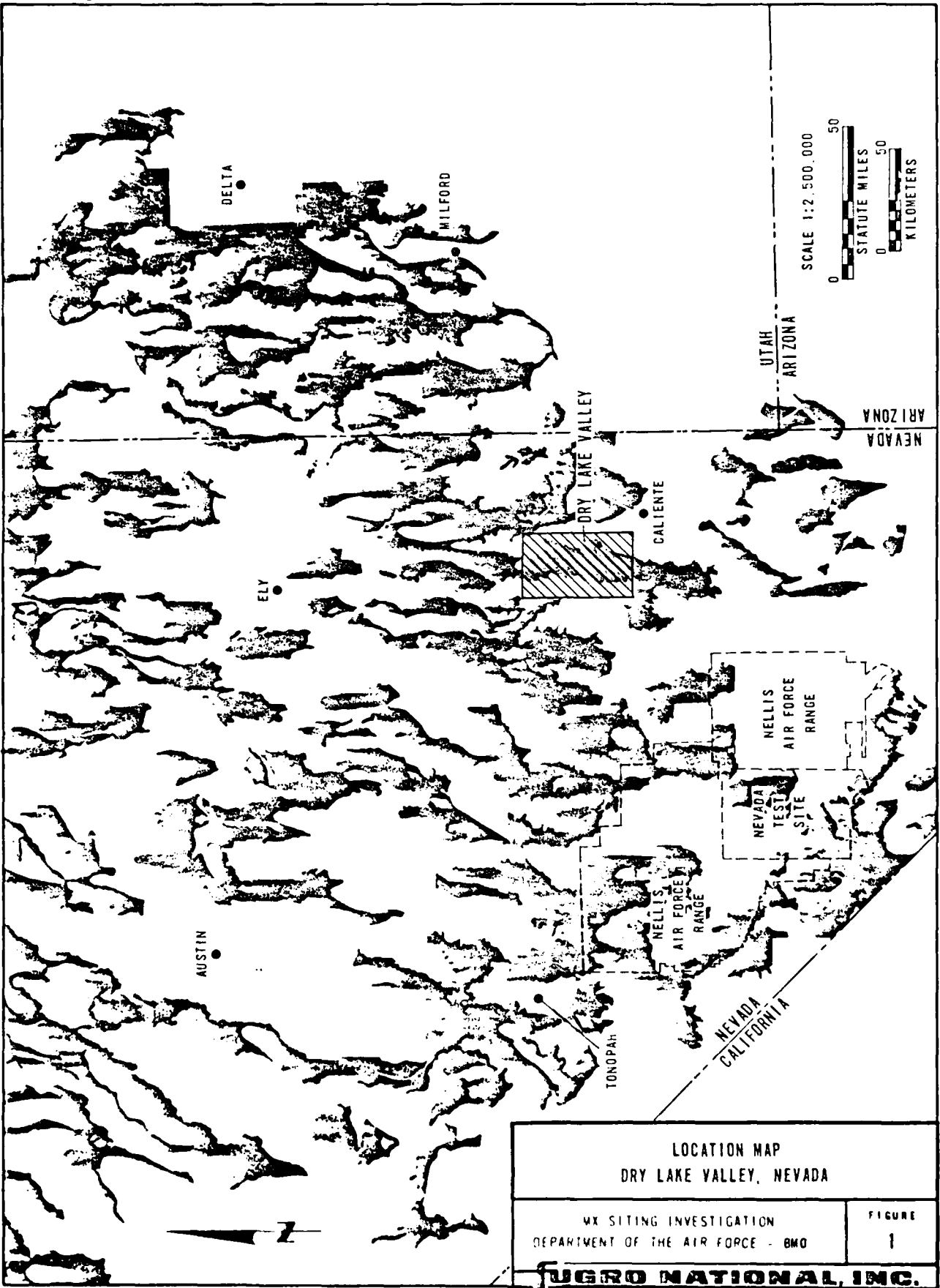
Measurements of the gravitational field were made in Dry Lake Valley for the purpose of estimating the overall shape of the structural basin and the thickness of alluvial fill in the basin. These estimates are expected to be useful to the Nuclear Survivability and Hardness (NH&S) community in modeling dynamic response to nuclear detonations and to geohydrologists in evaluating ground water regimes.

1.2 LOCATION

Dry Lake Valley is located in central Lincoln County, Nevada, approximately 106 miles (170 km) NNE of Las Vegas (see Figure 1). The portion of Dry Lake Valley included in this study is approximately 40 miles (65 km) long and 13 miles (22 km) wide, comprising an area of approximately 520 square miles (1347 km²). As shown in Figure 2, Dry Lake Valley is bounded by mountain ranges on three sides and is open to Delamar Valley on the south. U.S. Highway 93, which is the only paved road in the vicinity, crosses the southern end of the valley.

1.3 SCOPE OF STUDY

The Defense Mapping Agency Hydrographic-Topographic Center/Geodetic Survey Squadron (DMAHTC/GSS) obtained gravitational field measurements at 1069 stations in and around Dry Lake Valley during June and July, 1977. Approximately one-half of these stations were distributed throughout the valley with about 1 mile (1.6 km) between stations. The rest of the stations were

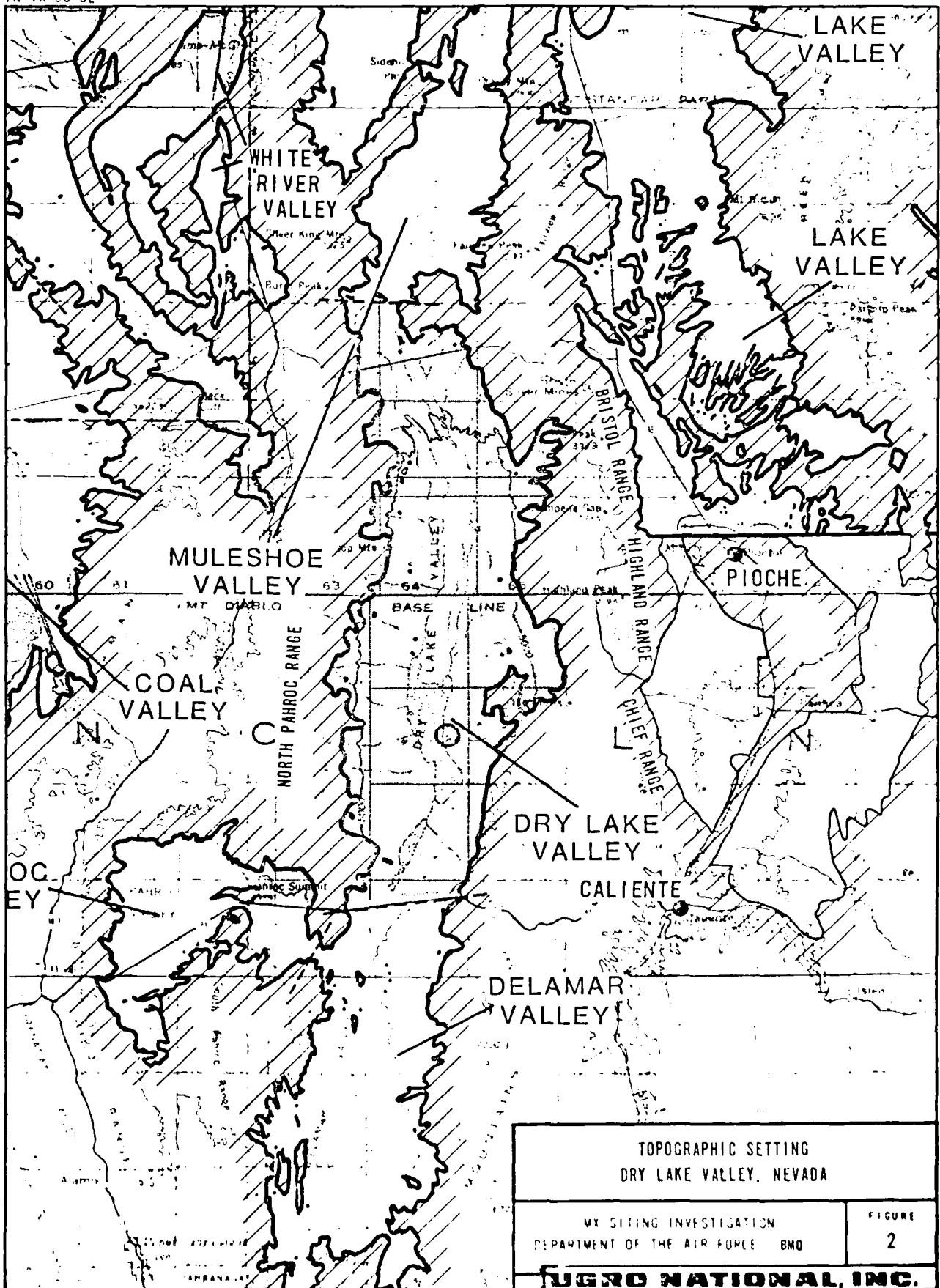


LOCATION MAP
DRY LAKE VALLEY, NEVADA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

FIGURE
1

UGRO NATIONAL, INC.



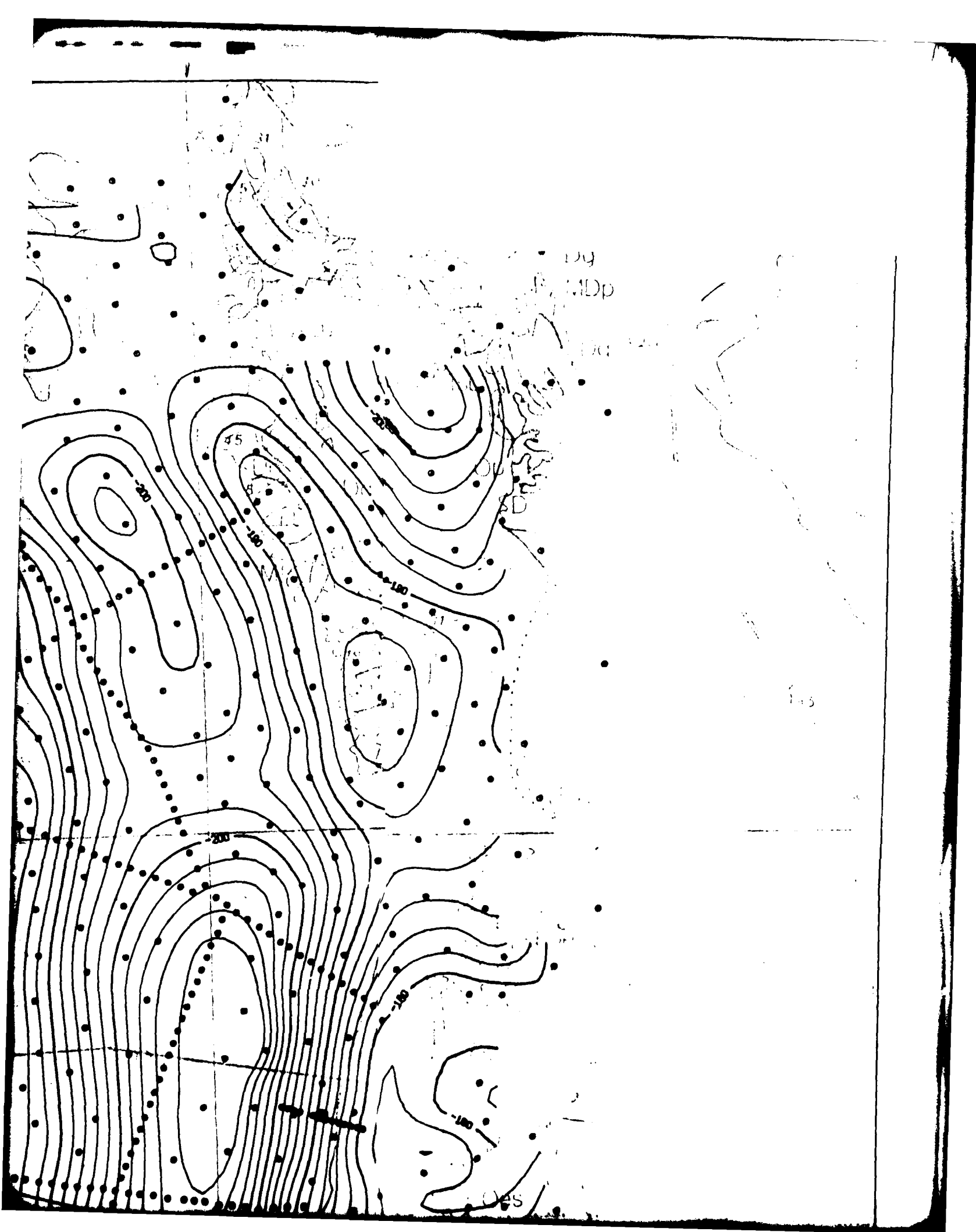
placed either at 1/4-mile (0.4 km) intervals along roads and trails or around the perimeter of the valley on rock outcrops. The station locations are shown on Figures 3 and 6. Station elevations were determined within a tolerance of 5 feet (1.5 m). With this elevation tolerance, the gravity precision is no smaller than 0.3 milligals. The principal facts for all stations are listed in Appendix A2.0.

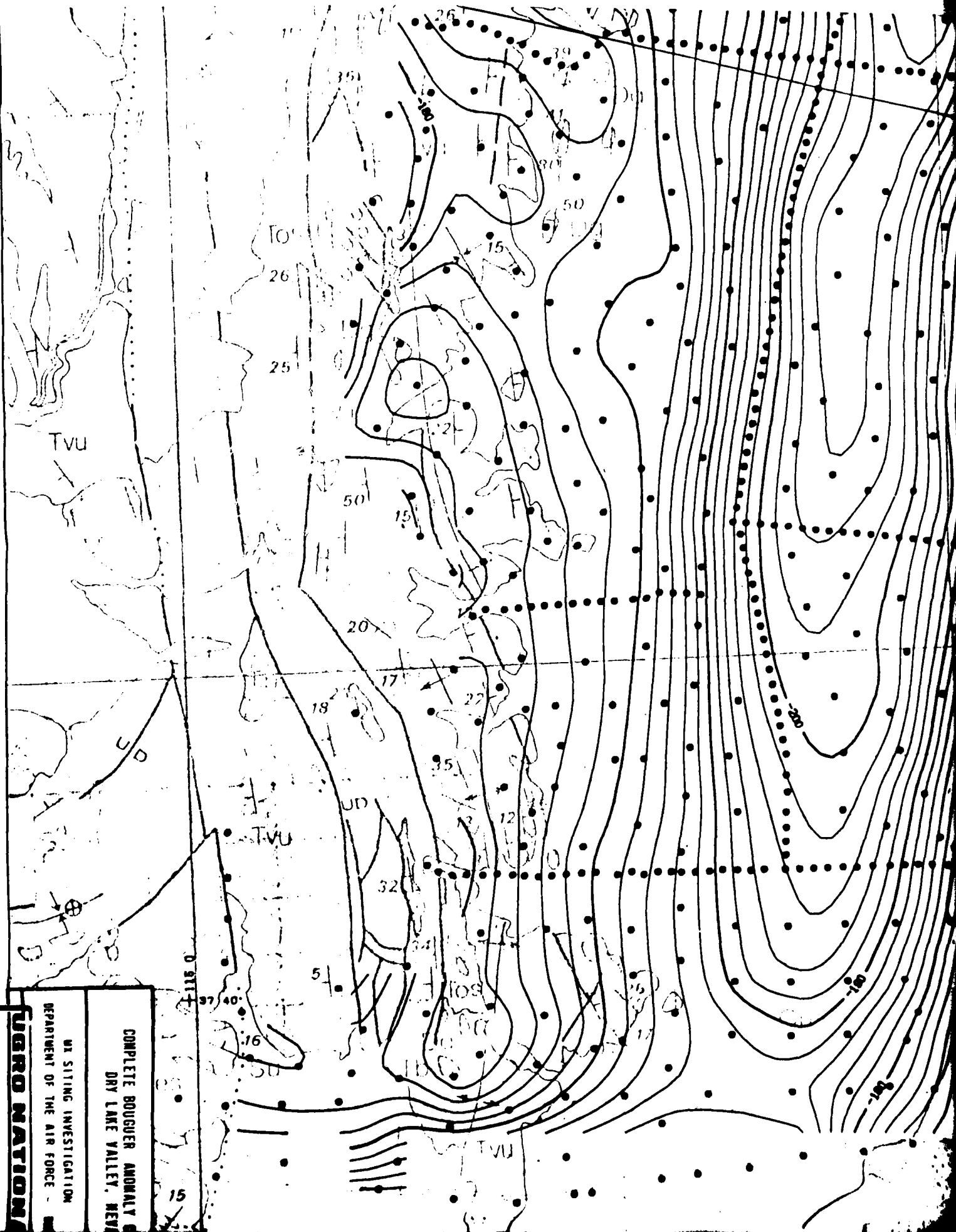
In addition to the gravity data in Dry Lake Valley, information from two relatively long seismic refraction lines in the northern part of the valley was available. These seismic lines were recorded during Characterization studies by Fugro National in June, 1977 (FN-TR-26e).

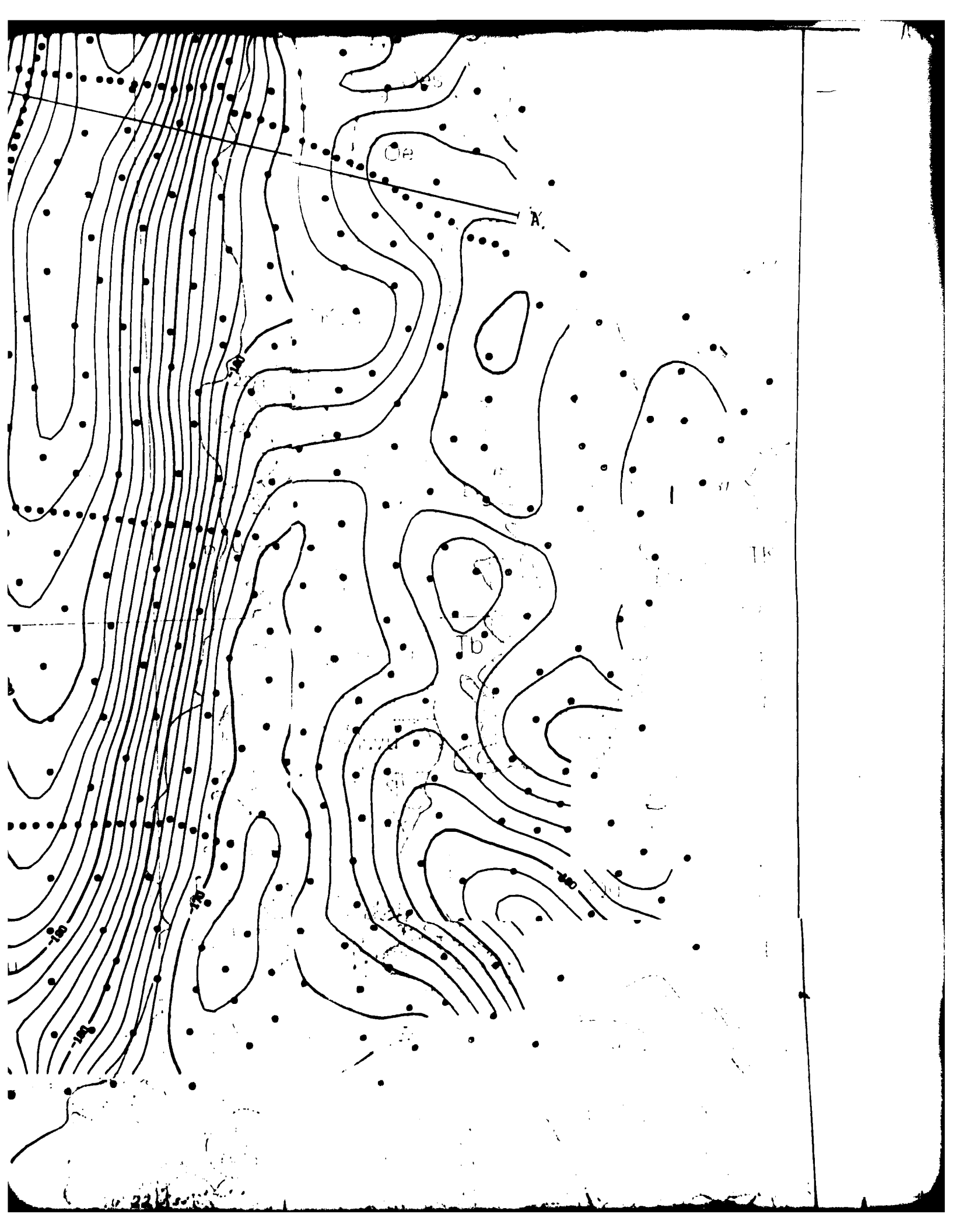
2.0 GRAVITY DATA REDUCTION

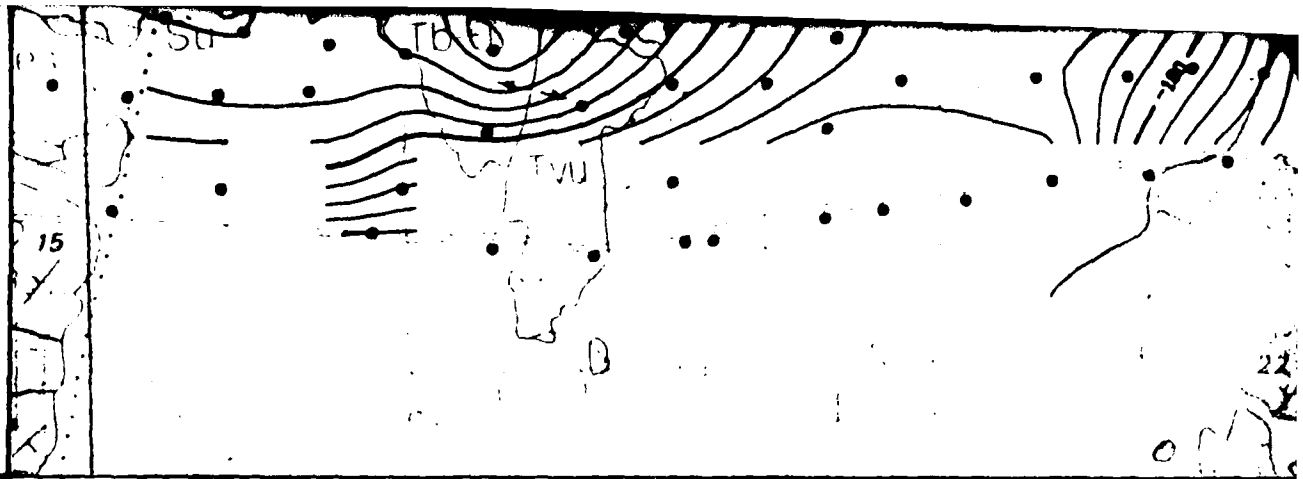
DMAHTC/GSS obtained the basic observations and reduced them to simple Bouguer Anomalies (SBA) for each station as described in Appendix A1.0. Up to three levels of terrain corrections were applied to convert the SBA to the complete Bouguer Anomaly (CBA). First, the Defense Mapping Agency Aerospace Center (DMAAC), St. Louis, used its library of digitized terrain data and a computer program to calculate corrections for all stations to account for terrain to 104 miles (167 km) from the station. The second level of terrain corrections was necessary because the computer program has limitations in accounting for terrain effects near the stations. This made it necessary, for some stations, to use a ring template to calculate the effect of terrain within approximately 3000 feet of these stations. The third level of terrain corrections was applied to those stations where 10 feet or more of relief was observed within 130 feet of the station. For these stations, elevation differences were measured in the field at a distance of 130 feet along six directions from the stations. These data were used to calculate the effect of the very near relief. Figure 3 is a contour map of the CBA which also shows the locations of the gravity stations and approximate rock outcrop line at the edges of the valley.

100







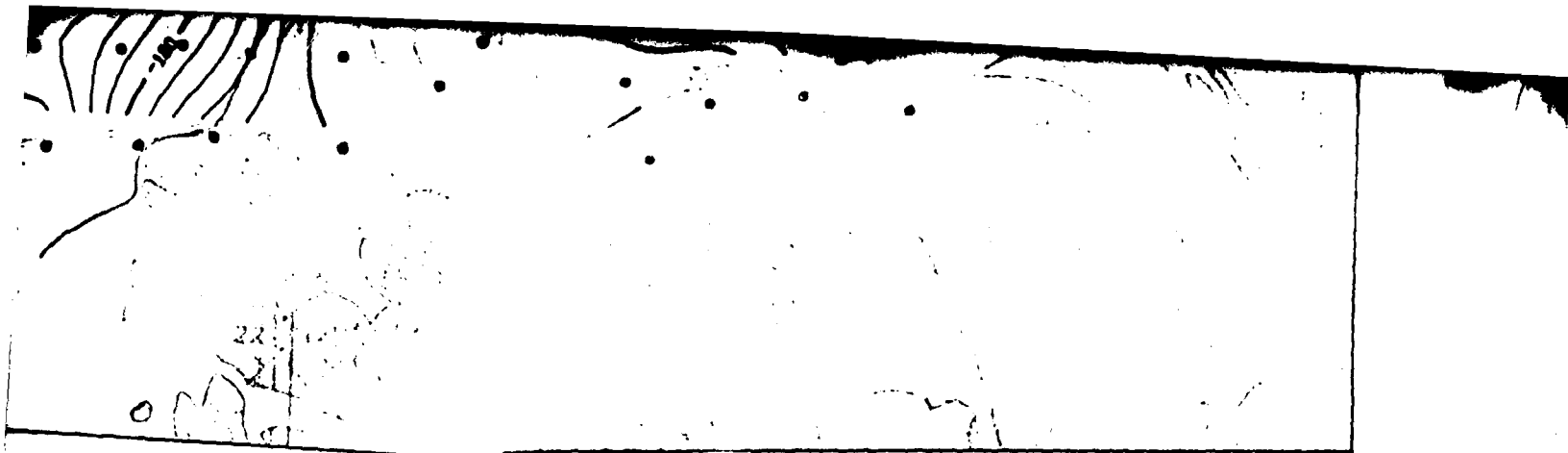


BOUGUER ANOMALY CONTOURS
DRY LAKE VALLEY, NEVADA

1. SITING INVESTIGATION
UNIT OF THE AIR FORCE - BMD

FIGURE
3

PRO NATIONAL, INC.



6

3.0 GEOLOGIC SUMMARY

The structural geologic setting, major rock types, and depositional regime of the valley-fill material are important considerations in the interpretation of the gravitational field data. Dry Lake Valley exhibits typical basin and range structure; high angle, normal basement faults, oriented north-south, probably border the North Pahroc Range on the west, and the Bristol, Highland, and Chief ranges on the east. The area between was faulted downward. Stewart, and Carlson (1978) indicate that a north-south trending fault on the eastern side of the valley cuts through the surface alluvium. This is further substantiated by Shawe (1965) and Fugro National, Inc. (1978, FN-TR-26E). Shawe (1965) also mentions transverse faults, near the Dry Lake area, occurring at large angles to the major north-south structural trends.

The outcrops in the mountains on the western side of the valley are predominantly Tertiary ash flow tuffs with some Paleozoic carbonate rocks. Conversely, the eastern mountains are composed primarily of Paleozoic carbonates with minor amounts of Tertiary ash flow tuffs (Stewart, and Carlson, 1978). The Paleozoic carbonate rocks in Nevada are generally reported to be relatively high density, on the order of 2.8 g/cm^3 . The volcanic rocks in Nevada are highly variable in density. In general, their density ranges fall between 2.2 and 2.5 g/cm^3 .

At the surface, the total valley fill is composed of young and intermediate age alluvial fan deposits (72 percent of surface

area), fluvial and stream terrace deposits (16 percent), playa and older lacustrine deposits (six percent), and undifferentiated fluvial, alluvial, and lacustrine deposits (six percent), (Fugro National, Inc. 1978, FN-TR-26e). Except for younger stream channel and playa deposits, the valley fill is late Tertiary and early Quaternary in age. Eakin (1963) describes, the valley fill as consisting of unconsolidated to partly consolidated silt, sand, and gravel derived from adjacent highlands, and including some rocks of volcanic origin.

4.0 INTERPRETATION

The gravitational effect of the light weight material filling the Dry Lake structural basin dominates the CBA map in Figure 3. The CBA values become increasingly negative toward the center of the valley.

4.1 REGIONAL-RESIDUAL SEPARATION

A fundamental step in gravity interpretation is evaluation of the portion of the CBA which represents the geologic feature of interest, in this case, the relatively low density valley fill. The part of the gravity field which is of interest is called the "residual" anomaly. The magnitude of the residual anomaly is a product of: 1) the thickness of alluvial fill; and 2) the contrast in density between the fill and bedrock.

The residual anomaly was isolated by first estimating the way the CBA field would have appeared if there had been no valley fill present. This estimated field is called the "regional" gravity. For this study, the regional field was calculated by fitting (by least squares) a second-order polynomial surface to the CBA values at the bedrock stations around the valley. The regional field was then subtracted from the CBA. The remainder was the residual anomaly.

4.2 DENSITY SELECTION

To calculate the thickness of alluvium which caused the residual anomaly, it is necessary to know the density contrast between the alluvial fill and the bedrock. Only very generalized

information on densities is available, and, for calculation, they were treated as if they are constant throughout the valley. Upon consideration of these factors, it becomes clear that the thickness of alluvium (or depth to rock) interpretation is a coarse approximation.

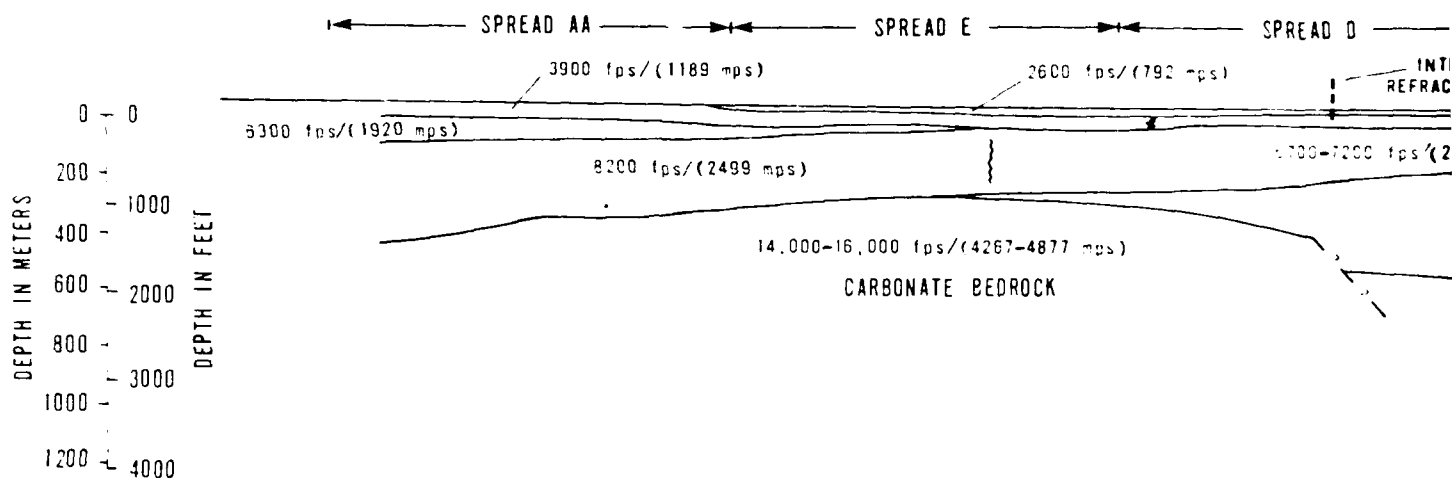
Interpretations from the two seismic refraction lines in the northern end of the valley were used to constrain the selection of the density contrast. These interpretations are shown in Figures 4 and 5. The highest velocities in the profiles are on the order of 15,000 fps (4572 mps). These were interpreted to represent carbonate bedrock. By "trial and error" calculations, it was found that use of a density contrast of 0.45 g/cm^3 caused the depth calculated from the gravity to approximately agree with the seismic interpretation.

The density measured for samples of alluvial fill obtained from shallow borings in Dry Lake Valley range from 2.1 g/cm^3 to 2.4 g/cm^3 . Published values for carbonate rocks typically range between 2.6 and 2.8 g/cm^3 . The contrast of 0.45 g/cm^3 appears to be reasonable in light of these typical values. This contrast should be considered a maximum, because the average density of the alluvial materials will become greater as the depth of burial increases.

4.3 MODELING

For computation and contouring, values for surface elevations and CBA were interpolated at the nodes of a regular 1 mile (1.6 km) grid over the valley. Portions of the grid, where

VELOC
SEISMIC REFRAC



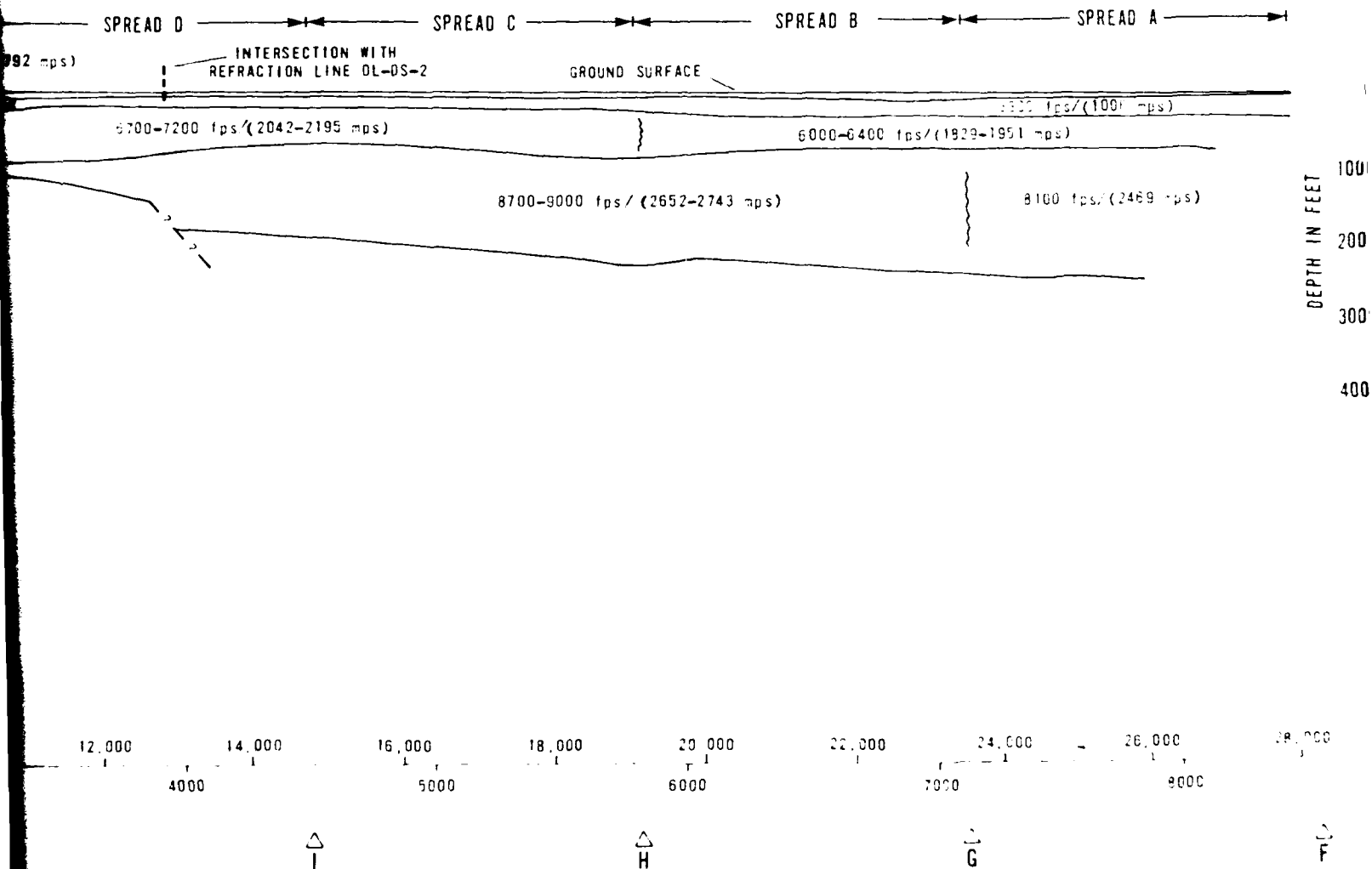
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DISTANCE IN METERS 0 1000 2000 3000 4000

SP POINT LOCATIONS Δ M Δ L Δ K Δ J

VELOCITY PROFILE SEISMIC REFRACTION LINE DL-DS-1

S 28 E



VELOCITY PROFILE
SEISMIC REFRACTION LINE
DRY LAKE VALLEY MI

WE SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE

FUGRO NATION

SPREAD A →

3300 fps/(1006 mps)

1951 mps)

8100 fps/(2469 mps)

0 + 0
- 200
1000 - 400
2000 - 600
3000 - 800
- 1000
4000 - 1200

DEPTH IN FEET

DEPTH IN METERS

26,000 28,000
8000

Δ
F

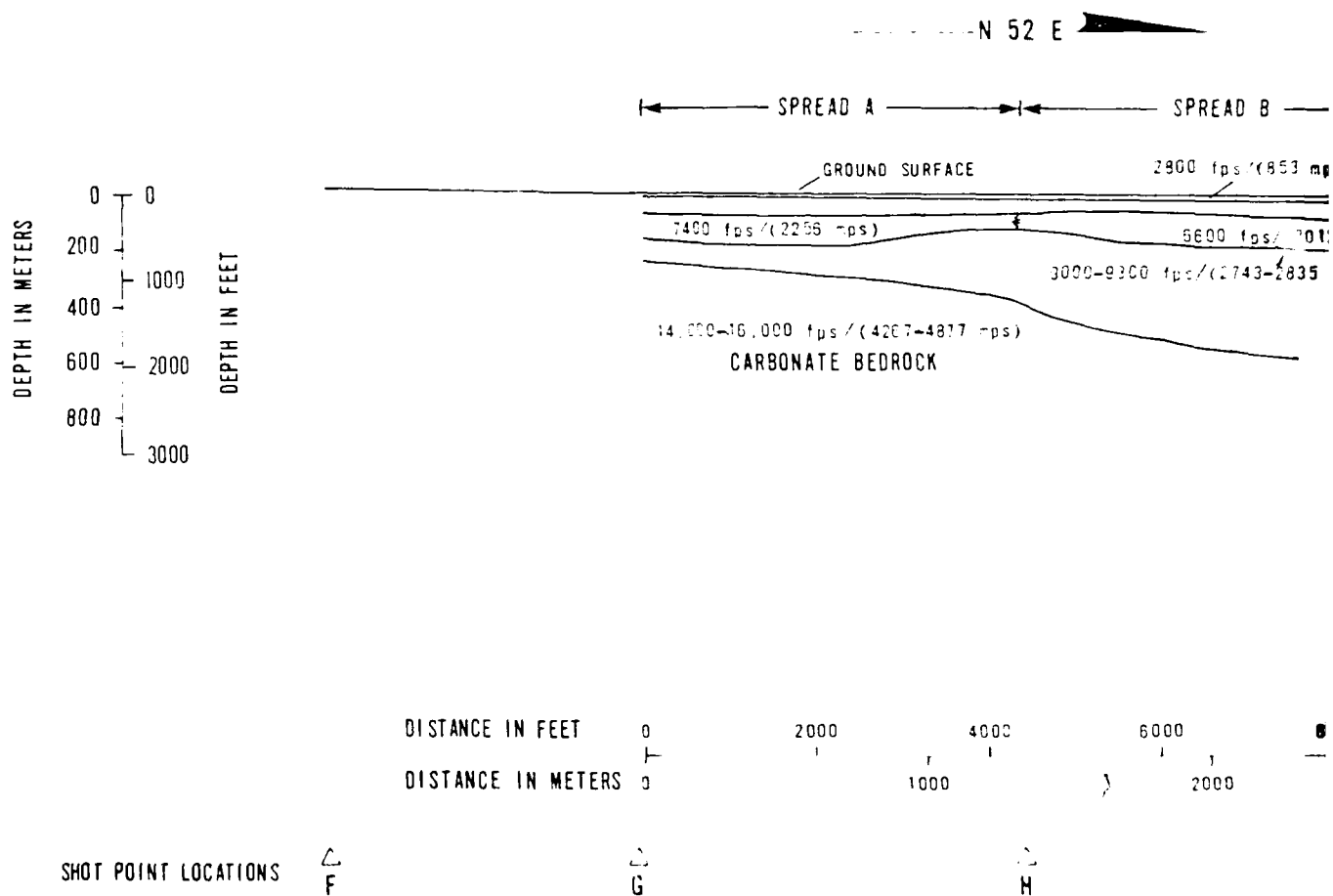
VELOCITY PROFILE
SEISMIC REFRACTION LINE DL-DS-1
DRY LAKE VALLEY NEVADA

WE SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE BMD

FIGURE
4

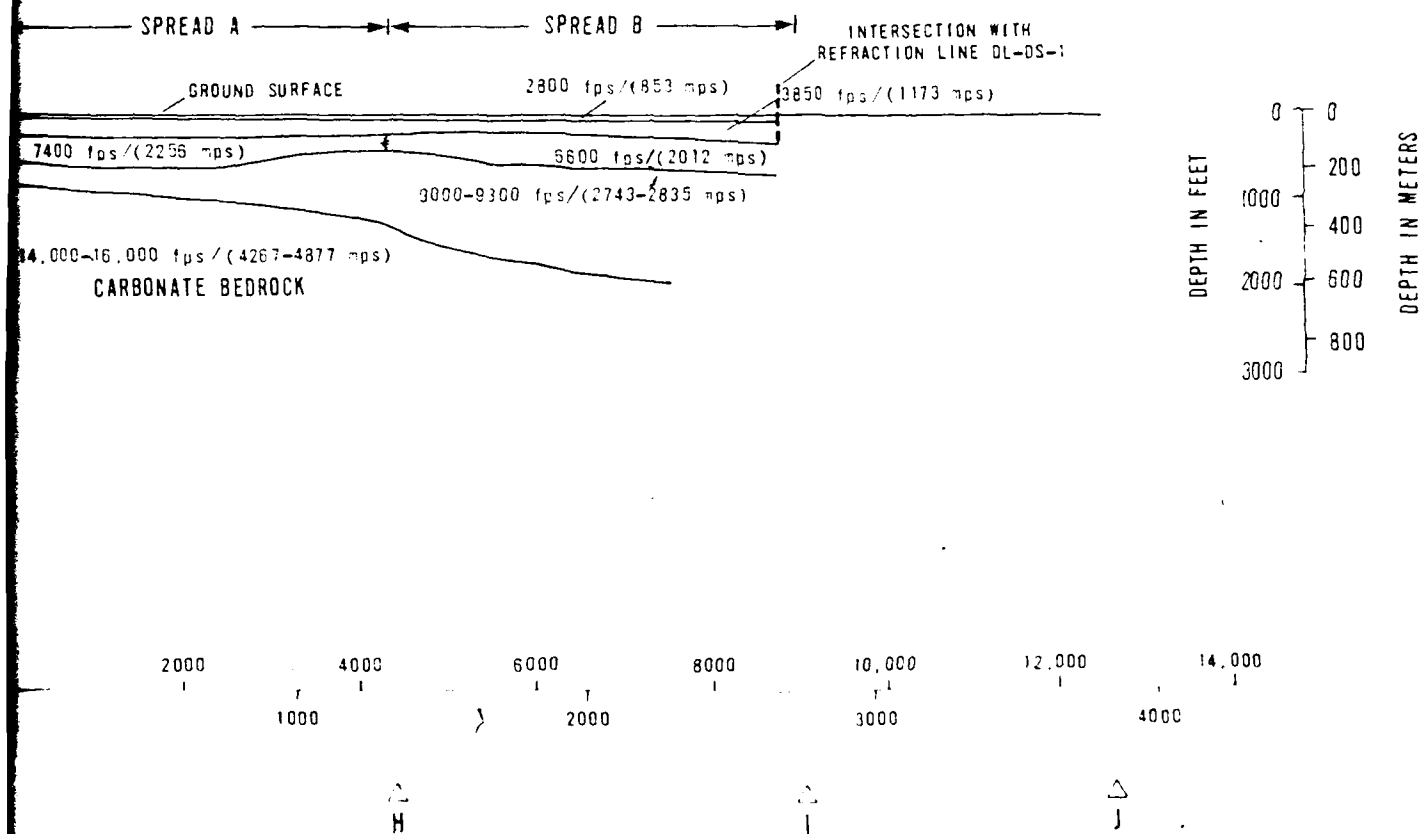
FUGRO NATIONAL, INC.

VELOCITY PROFILE SEISMIC REFRACTION LINE DL-DS-2



VELOCITY PROFILE
SEISMIC REFRACTION LINE DL-DS-2

N 52 E



VELOCITY PROFILE
SEISMIC REFRACTION LINE DL-DS-2
DRY LAKE VALLEY, NEVADA

GEOTECHNICAL INVESTIGATION
DEPARTMENT OF THE AIR FORCE - CAMB.

FIGURE
5

FUGRO NATIONAL, INC.

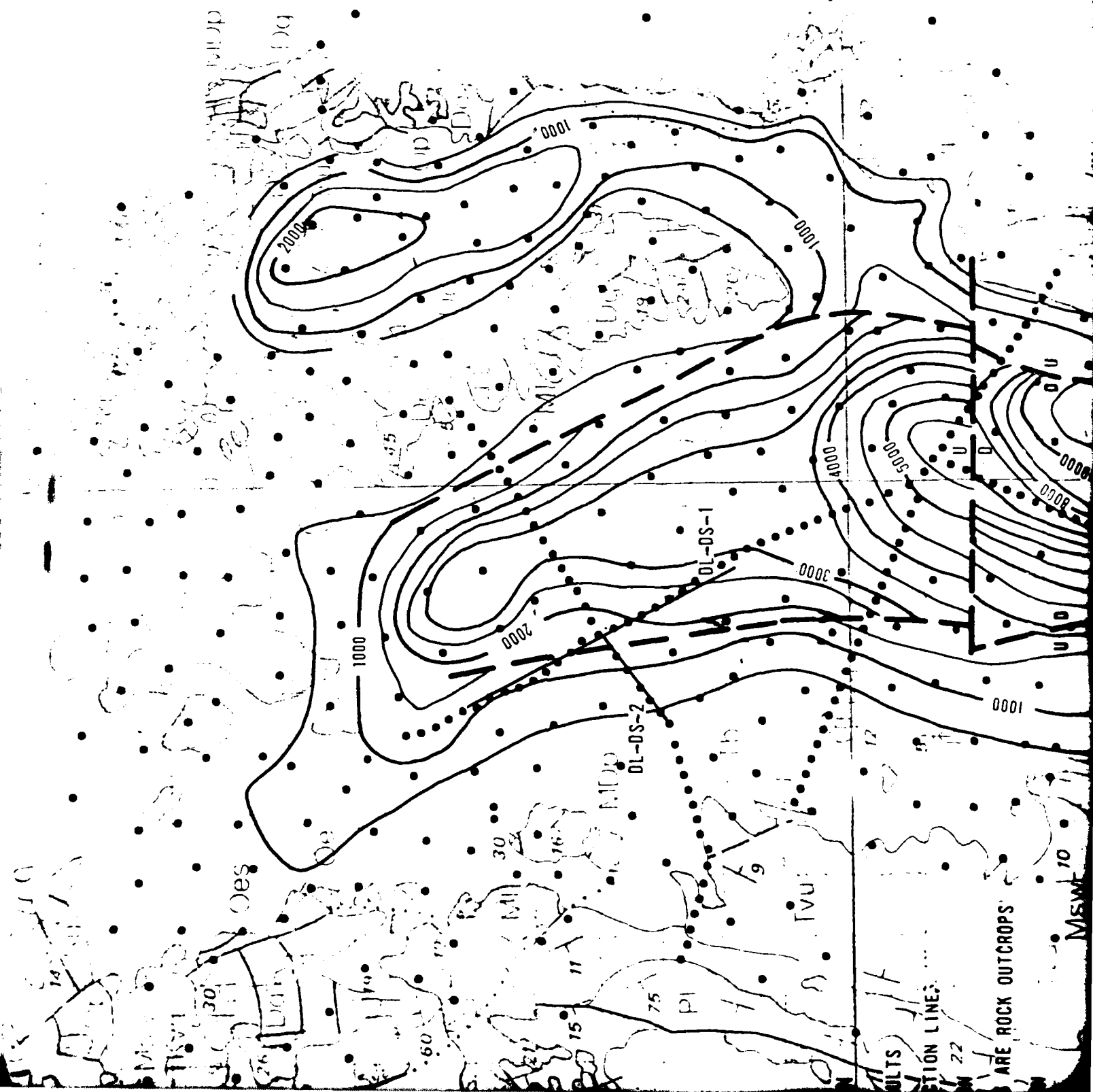
there were insufficient station data to establish reliable nodal values, were masked out.

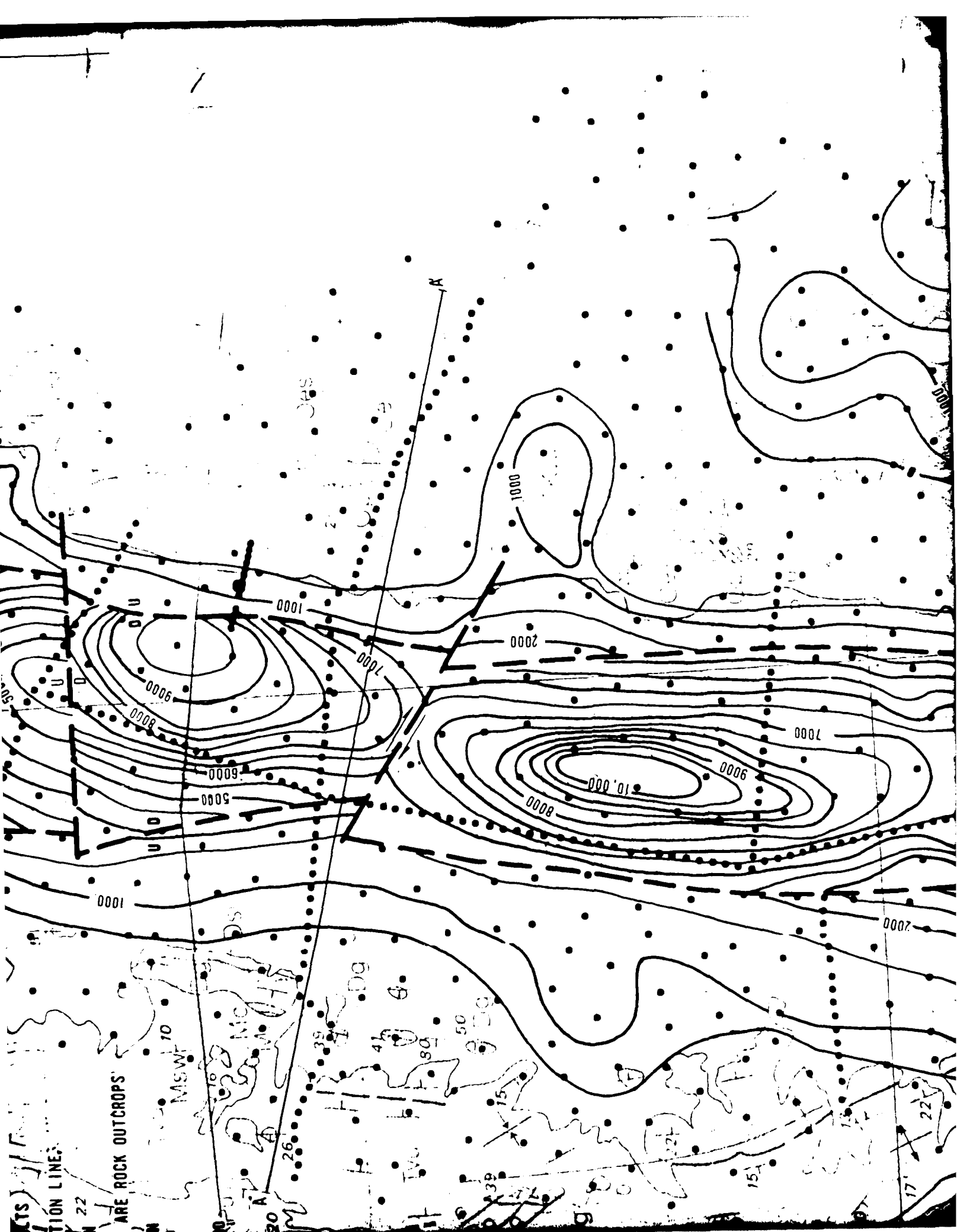
Bedrock depths at each node were computed by iterative computer programs that considered the gravity effect from the model at the other nodes as well as beneath the node in question. Contours showing the interpreted depth to bedrock are displayed in Figure 6. The CBA contours in Figure 3 show linear gradients along both sides of the valley. These gradients range from 10 to 14 milligals per mile. These gradients are thought to be produced by large, steep bedrock faults. The second vertical derivative of the CBA field was calculated to guide the placement of the faults shown in Figure 6. Since the zero contour of the second vertical derivative marks the steepest part of the input CBA field, the faults were placed along the zero contour. This places the trace of the eastern boundary fault slightly more than 1 mile (1.6 km) west of surface cracks in the alluvium mapped as a fault along the eastern boundary of Dry Lake Valley.

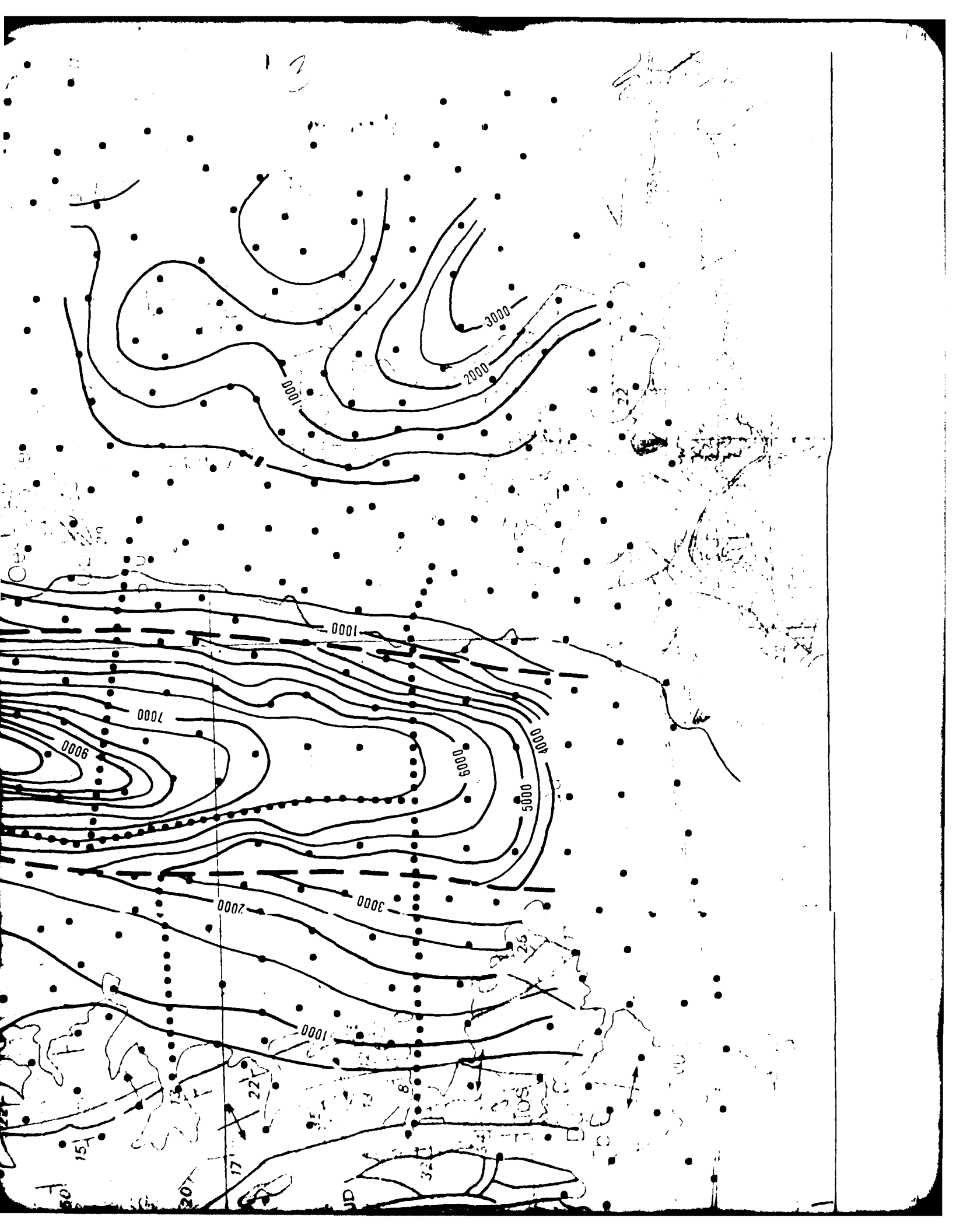
The two faults interpreted to cross the valley are not so clearly defined as the boundary faults. They are positioned where changes in strike of the major gravity gradients and the axis of the valley occur. There is significant change in bedrock elevation associated with the northern transverse fault, but little, if any vertical change across the southern fault.

A cross-section view across the central part of the valley (Section AA', Figures 3 and 6) is shown in Figure 7. The top

part of the figure shows the shape of the CBA profile along this section. The lower part shows the surface profile and the interpreted bedrock profile.









EXPLANATION

INTERPRETED FAULTS

SEISMIC REFRACTION LINES

LINE OF SECTION 22

DARKENED AREAS ARE ROCK OUTCROPS

GRAVITY STATION

CI=500 FT.

EXPLANATION

INTERPRETED FAULTS

SEISMIC REFRACTION LINES

LINE OF SECTION 22

DARKENED AREAS ARE ROCK OUTCROPS

GRAVITY STATION

CI=500 FT.

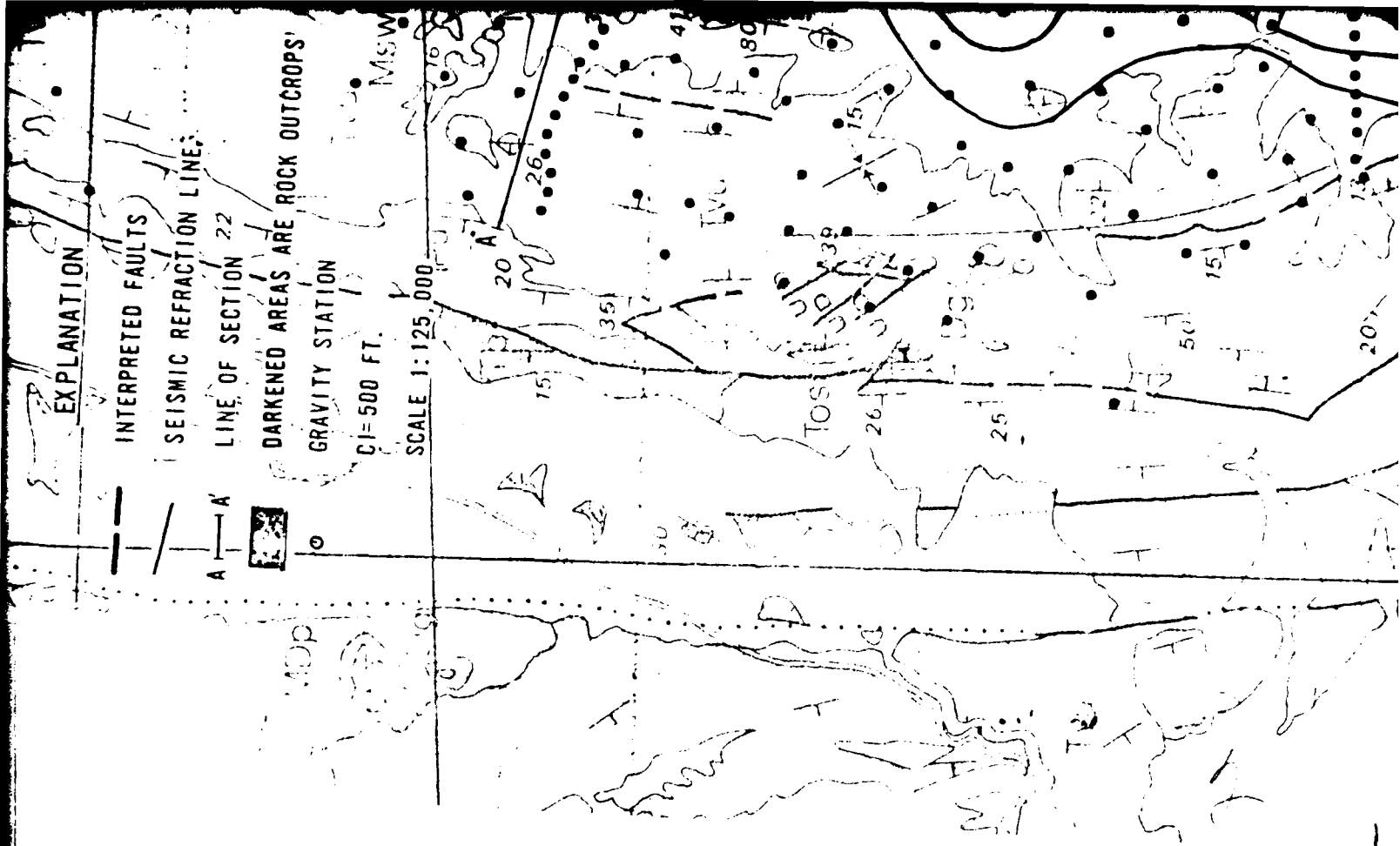
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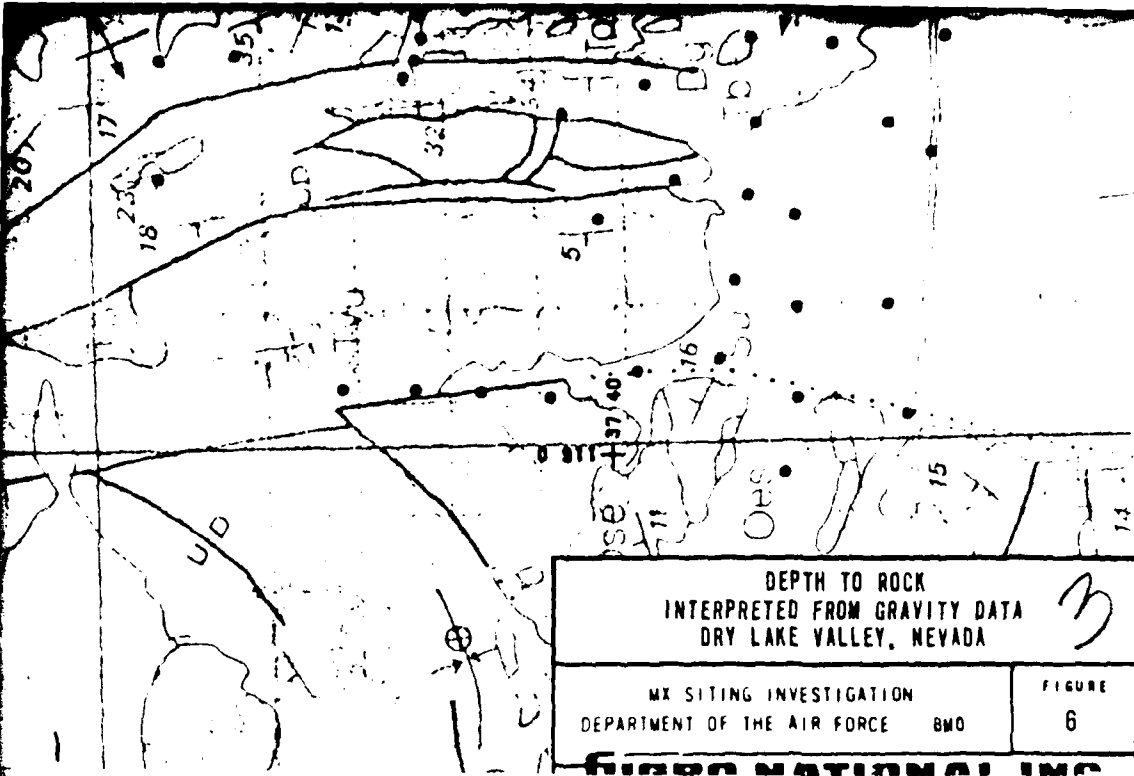
MSW

A—A'

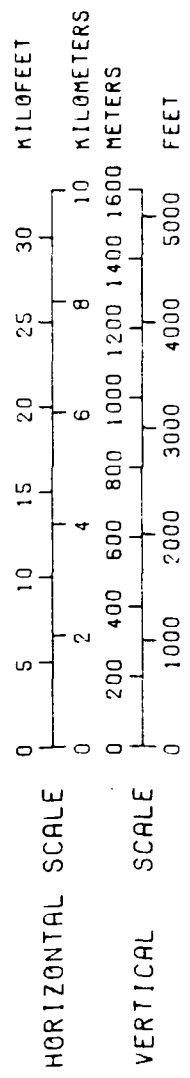
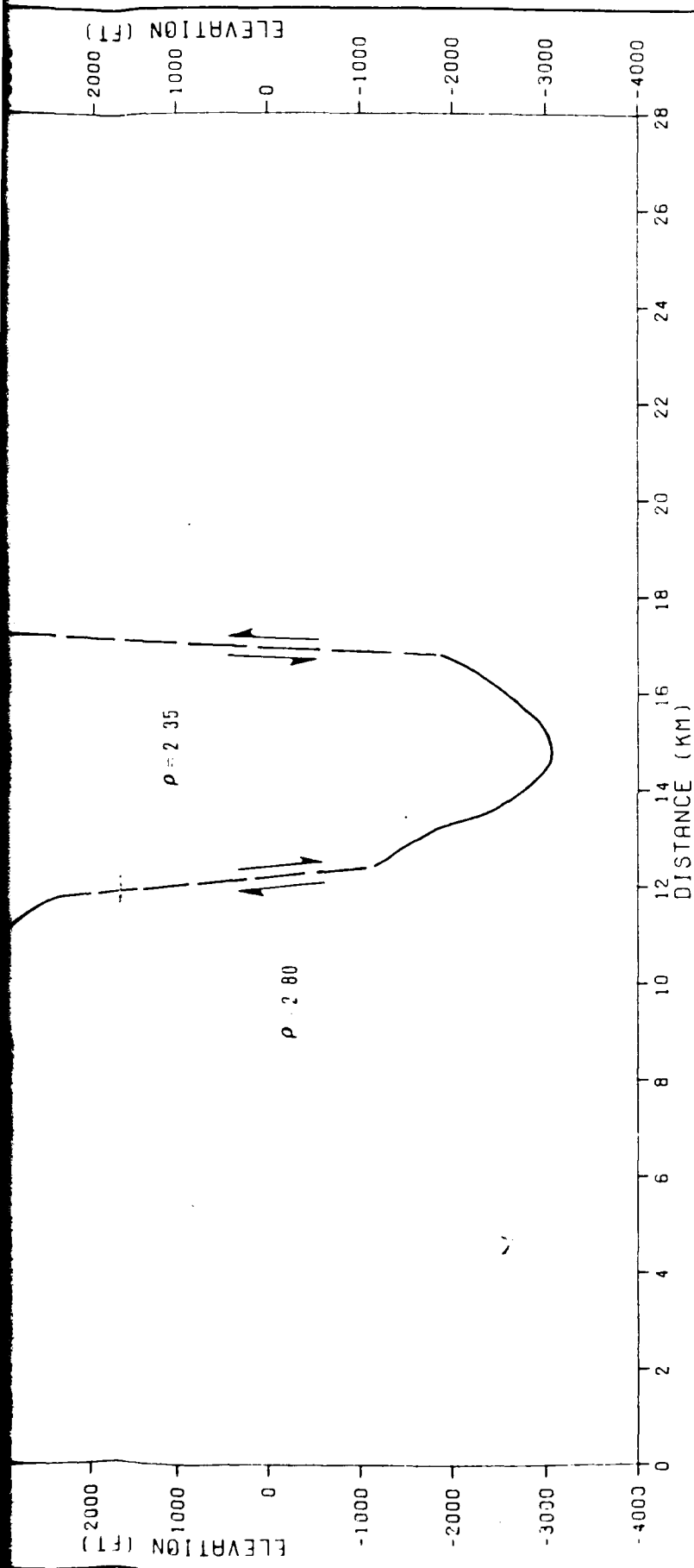


○









EXPLANATION

- TOP: COMPLETE BOUGUER ANOMALY (INTERPOLATED) (—)
- BOTTOM: ELEVATION: INTERPOLATED SURFACE ELEVATIONS (---)
- MODEL OF BEDROCK SURFACE (---)
- DENSITY VALUES (ρ 2.3) g cm³
- DISTANCE SCALE 1:125,000

CROSS-SECTIONAL VIEW, PROFILE AA'
DRY LAKE VALLEY, NEVADA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE DMO

FIGURE
7

JUGRO NATIONAL, INC.

5.0 CONCLUSIONS

The interpretation of the gravity survey of Dry Lake Valley indicates that there are major range bounding normal faults on both sides of the valley. The graben between the boundary faults is calculated to be on the order of 10,000 feet deep. The northern third of the valley is substantially shallower than the southern part.

There is a large, well defined negative gravity anomaly associated with Dry Lake Valley. An average density contrast of 0.45 g/cm^3 between the alluvium and bedrock was used to calculate the thickness of alluvium which would create such an anomaly. If a smaller contrast had been used, the calculated thickness would have been greater. Conversely, if a larger contrast had been used, the calculated thickness would have been smaller.

Additional modeling with other density contrasts was not justified because so little is known about the actual density distribution in and around the valley.

If future studies acquire better density data or actual thicknesses of alluvium in relatively deep parts of the basin, the gravity interpretation can be refined and made more accurate.

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APPENDIX A1.0

GENERAL PRINCIPLES OF THE
GRAVITY EXPLORATION METHOD

A1.0 GENERAL PRINCIPLES OF THE GRAVITY
EXPLORATION METHOD

A1.1 GENERAL

A gravity survey involves measurement of differences in the gravitational field between various points on the earth's surface. The gravitational field values being measured are the same as those influencing all objects on the surface of the earth. They are generally associated with the force which causes a 1 gm mass to be accelerated at 980 cm/sec^2 . This force is normally referred to as a 1 g force.

Even though in many applications the gravitational field at the earth's surface is assumed to be constant, small but distinguishable differences in gravity occur from point to point. In a gravity survey, the variations are measured in terms of milligals. A milligal is equal to $0.001 \text{ cm/second}^2$ or 0.00000102 g . The differences in gravity are caused by geometrical effects, such as differences in elevation and latitude, and by lateral variations in density within the earth. The lateral density variations are a result of changes in geologic conditions. For measurements at the surface of the earth, the largest factor influencing the pull of gravity is the density of all materials between the center of the earth and the point of measurement.

To detect changes produced by differing geological conditions, it is necessary to detect differences in the gravitational field as small as a few milligals. To recognize changes due to

geological conditions, the measurements are "corrected" to account for changes due to differences in elevation and latitude.

Given this background, the basic concept of the gravitational exploration method, the anomaly, can be introduced. If, instead of being an oblate spheroid characterized by complex density variations, the earth were made up of concentric, homogeneous shells, the gravitational field would be the same at all points on the surface of the earth. The complexities in the earth's shape and material distribution are the reason that the pull of gravity is not the same from place to place. A difference in gravity between two points which is not caused by the effects of known geometrical differences, such as in elevation, latitude, and surrounding terrain, is referred to as an "anomaly."

An anomaly reflects lateral differences in material densities. The gravitational attraction is smaller at a place underlain by relatively low density material than it is at a place underlain by a relatively high density material. The term "negative gravity anomaly" describes a situation in which the pull of gravity within a prescribed area is small compared to the area surrounding it. Low-density alluvial deposits in basins such as those in the Nevada-Utah region produce negative gravity anomalies in relation to the gravity values in the surrounding mountains which are formed by more dense rocks.

The objective of gravity exploration is to deduce the variations in geologic conditions that produce the gravity anomalies identified during a gravity survey.

A1.2 INSTRUMENTS

The sensing element of a LaCoste and Romberg gravimeter is a mass suspended by a zero-length spring. Deflections of the mass from a null position are proportional to changes in gravitational attraction. These instruments are sealed and compensated for atmospheric pressure changes. They are maintained at a constant temperature by an internal heater element and thermostat. The absolute value of gravity is not measured directly by a gravimeter. It measures relative values of gravity between one point and the next. Gravitational differences as small as 0.01 milligal can be measured.

A1.3 FIELD PROCEDURES

The gravimeter readings were calibrated in terms of absolute gravity by taking readings twice daily at nearby USGS gravity base stations. Gravimeter readings fluctuate because of small time-related deviations due to the effect of earth tides and instrument drift. Field readings were corrected to account for these deviations. The magnitude of the tidal correction was calculated using an equation suggested by Goguel (1954):

$$C = P + N \cos \phi (\cos \phi + \sin \phi) + S \cos \phi (\cos \phi - \sin \phi)$$

where C is the tidal correction factor, P, N, and S are time-related variables, and ϕ is the latitude of the observation point. Tables giving the values of P, N, and S are published annually by the European Association of Exploration Geophysicists.

The meter drift correction was based on readings taken at a designated base station at the start and end of each day. Any difference between these two readings after they were corrected for tidal effects was considered to have been the result of instrumental drift. It was assumed that this drift occurred at a uniform rate between the two readings. Corrections for drift were typically only a few hundredths of a milligal. Readings corrected for tidal effects and instrumental drift represented the observed gravity at each station. The observed gravity values represent the total gravitational pull of the entire earth at the measurement stations.

A1.4 DATA REDUCTION

Several corrections or reductions are made to the observed gravity to isolate the portion of the gravitational pull which is due to the crustal and near-surface materials. The gravity remaining after these reductions is called the "Bouguer Anomaly." Bouguer Anomaly values are the basis for geologic interpretation. To obtain the Bouguer Anomaly, the observed gravity is adjusted to the value it would have had if it had been measured at the geoid, a theoretically defined surface which approximates the surface of mean sea level. The difference between the "adjusted" observed gravity and the gravity at the geoid calculated for a theoretically homogeneous earth is the Bouguer Anomaly.

Four separate reductions, to account for four geometrical effects, are made to the observed gravity at each station to arrive at its Bouguer Anomaly value.

a. Free-Air Effect: Gravitational attraction varies inversely as the square of the distance from the center of the earth. Thus corrections must be applied for elevation. Observed gravity levels are corrected for elevation using the normal vertical gradient of:

$$FA = -0.09406 \text{ mg/ft } (-0.3086 \text{ milligals/meter})$$

where FA is the free-air effect (the rate of change of gravity with distance from the center of the earth). The free-air correction is positive in sign since the correction is opposite the effect.

b. Bouguer Effect: Like the free-air effect, the Bouguer effect is a function of the elevation of the station, but it considers the influence of a slab of earth materials between the observation point on the surface of the earth and the corresponding point on the geoid (sea level). Normal practice, which is to assume that the density of the slab is 2.67 grams per cubic centimeter was followed in these studies. The Bouguer correction (B_C), which is opposite in sign to the free-air correction, was defined according to the following formula.

$$B_C = 0.01276 (2.67) h_f \text{ (milligals per foot)}$$

$$B_C = 0.04185 (2.67) h_m \text{ (milligals per meter)}$$

where h_f is the height above sea level in feet and h_m is the height in meters.

c. Latitude Effect: Points at different latitudes will have different "gravities" for two reasons. The earth (and the geoid) is spheroidal, or flattened at the poles. Since points at higher latitudes are closer to the center of the earth than points near the equator, the gravity at the higher latitudes is larger. As the earth spins, the centrifugal acceleration causes a slight decrease in gravity. At the higher latitudes where the earth's radii are smaller, the centrifugal acceleration diminishes. The gravity formula for the Geodetic Reference System, 1967, gives the theoretical value of gravity at the geoid as a function of latitude. It is:

$$g = 978.0381 (1 + 0.0053204 \sin^2 \phi - 0.0000058 \sin^2 2\phi) \text{ gals}$$
where g is the theoretical acceleration of gravity and ϕ is the latitude in degrees. The positive term accounts for the spheroidal shape of the earth. The negative term adjusts for the centrifugal acceleration.

The previous two corrections (free air and Bouguer) have adjusted the observed gravity to the value it would have had at the geoid (sea level). The theoretical value at the geoid for the latitude of the station is then subtracted from the adjusted observed gravity. The remainder is called the Simple Bouguer Anomaly (SBA). Most of this gravity represents the effect of material beneath the station, but part of it may be due to irregularities in terrain (upper part of the Bouguer slab) away from the station.

d. Terrain Effect: Topographic relief around the station has a negative effect on the gravitational force at the station. A nearby hill has upward gravitational pull and a nearby valley contributes less downward attraction than a nearby material would have. Therefore, the corrections are always positive. Corrections are made to the SBA when the terrain effects were 0.1 milligal or larger. Terrain corrected Bouguer values are called the Complete Bouguer Anomaly (CBA). When the CBA is obtained, the reduction of gravity at individual measurement points (stations) is complete.

A1.5 INTERPRETATION

The first step in interpretation is to separate the portion of the CBA that might be caused by the lightweight, basin-fill material overlying the heavier bedrock material which forms the surrounding mountains and presumably the basin floor. Since the valley-fill sediments are absent at the stations read in the mountains, the CBA values at these bedrock stations are used as the basis for constructing a regional field over the valley. A regional field is an estimation of the values the CBA would have had if the light weight sediments (the anomaly) had not been there.

The difference between the CBA and the regional field is called the "residual" field or residual anomaly. The residual field is the interpreter's estimation of the gravitational effect of the geologic anomaly. The zero value of the residual anomaly is not exactly at the rock outcrop line but at some

distance on the "rock" side of the contact. The reason for this is found in the explanation of the terrain effect. There is a component of gravitational attraction from material which is not directly beneath a point.

If the "regional" is well chosen, the magnitude of the residual anomaly is a function of the thickness of the anomalous (fill) material and the density contrast. The density contrast is the difference in density between the alluvial and bedrock material. If this contrast were known, an accurate calculation of the thickness could be made. In most cases, the densities are not well known and they also vary within the study area. In these cases, it is necessary to use typical densities for materials similar to those in the study area.

If the selected average density contrast is smaller than the actual density contrast, the computed depth to bedrock will be greater than the actual depth and vice-versa. The computed depth is inversely proportional to the density contrast. A ten percent error in density contrast produces a ten percent error in computed depth. An iterative computer program is used to calculate a subsurface model which will yield a gravitational field to match (approximately) the residual gravity anomaly.

APPENDIX A2.0

LISTS OF GRAVITY DATA

DRY LAKE VALLEY GRAVITY STATIONS

STATION IDENT.	LAT. DEG MIN	LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM	ORSV GRAV	INRC GRAV	FAA	CSA +1000
DL1	+38	767	+1145234	5377Y	0	127422193	68649148289200331	98562	80349	
DL2	+38	771	+1145117	5225Y	0	107422204	68620149343200338	98179	80465	
DL3	+38	793	+114501551591T		0	103422249	68966149601200370	97963	80490	
DL4	+38	833	+114490751509T		0	119422323	68493149894200428	97943	80493	
DL5	+38	808	+1144852	5634Y	0	194422282	69206147022200391	99654	80636	
DL6	+38	807	+1144744	5279R	0	111422284	69364149231200390	98522	80628	
DL7	+38	798	+1144630	5342R	0	114422271	69530148685200377	98583	80477	
DL8	+38	751	+1144505	5548Y	0	114422189	69715147527200308	99434	80625	
DL9	+38	861	+1144550	5665Y	0	115422391	69645146910200469	99757	80551	
DL10	+38	880	+1144672	5600C	0	112422421	69465147333200497	99540	80552	
DL11	+38	892	+1144773	5584Y	0	111422440	69317147360200515	99394	80465	
DL12	+38	899	+1144668	5251C	0	106422449	69135149690200525	98584	80780	
DL13	+38	914	+114499951860T		0	133422473	68986149923200547	98182	80627	
DL14	+38	869	+1145115	5304Y	0	110422386	68614148775200480	98212	80231	
DL15	+38	846	+1145109	5365C	0	110422344	68697149051200450	99286	81023	
DL16	+38	929	+1145105	5438Y	0	122422494	68699148263200569	98673	80447	
DL17	+38	955	+1145116	5354Y	0	126422545	68614148625200607	98406	80271	
DL18	+38	939	+1144934	5565Y	60	152422521	69080147270200584	99253	80423	
DL19	+38	966	+1144837	5409Y	0	94422575	69221148317200623	99165	80606	
DL20	+38	940	+1144869	5826Y	0	131422540	694671459312005911	10172	80432	
DL21	+38	936	+1144558	5934Y	0	175422547	696291451992005941	100454	80390	
DL22	+38	991	+1144572	5847Y	0	119422630	696071459112006591	100281	80457	
DL23	+38	1024	+1144658	5628Y	0	97422688	69480147027200708	99287	80186	
DL24	+38	1013	+1144752	5449Y	0	128422665	69343148410200691	99001	80544	
DL25	+38	1034	+1144876	5632Y	47	112422699	69161146677200723	99159	80108	
DL26	+38	1003	+1144982	5225Y	0	124422638	69067149752200677	98249	80557	
DL27	+38	1011	+1145128	5424Y	0	123422648	68794148377200689	98735	80359	
DL28	+38	1012	+1145223	5580Y	0	137422647	68655147612200690	99637	80743	
DL30	+38	1104	+1145069	5445Y	0	128422622	68876148536200625	98958	80514	
DL31	+38	1090	+1144957	5271Y	0	126422600	69040149015200605	97618	79966	
DL32	+38	1074	+1144762	5697Y	0	114422777	69325146461200781	99297	79961	
DL33	+38	1084	+1144672	5534Y	0	101422799	69456147530200795	99117	80573	
DL34	+38	1079	+1144570	5711Y	0	104422793	69636147210200785	100171	80796	
DL36	+38	55	+1145100	5153Y	0	158420681	68676149419199290	99124	81707	
DL38	+38	80	+1145084	5163C	0	113420928	68896149925199327	99188	81691	
DL39	+38	71	+1145059	5090C	0	163420912	68935150360199313	98949	81748	
DL40	+38	63	+1145033	5043C	0	124420698	68973150501199302	98659	81533	
DL41	+38	55	+1145006	5000C	0	116420684	69013150512199290	98277	81339	
DL42	+38	46	+1144980	4962C	0	113420668	69052150360199277	98205	81475	
DL43	+38	38	+1144954	4922C	0	108420654	69090151582199265	98036	81556	
DL44	+38	30	+1144928	4925Y	0	105420640	69126151714199253	98110	82117	
DL45	+38	21	+1144902	4853Y	0	103420625	69167152018199240	98496	82035	
DL46	+38	13	+1144876	4848Y	0	111420611	69202151697199228	98293	81569	
DL47	+38	4	+1144850	4842Y	0	103420795	69244151647199216	98000	81543	
DL48	+38	63	+1144883	4870Y	0	104420903	69193151345199302	98412	81593	
DL49	+38	125	+1144937	4942C	0	98421016	69111151345199392	98502	81744	
DL50	+38	134	+1145032	5134Y	0	99421029	68972150019199405	98660	81546	
DL51	+38	169	+1145109	5192Y	0	113421091	68658150059199456	98065	81971	
DL52	+38	211	+1145229	5257Y	0	119421165	68680149377199510	99531	81723	
DL53	+38	205	+1145198	5229Y	0	115421155	68726149625199509	99529	81610	
DL54	+38	203	+1145166	5203Y	0	119421152	68770150090199506	99540	81913	
DL55	+38	215	+1145141	5178Y	0	106421175	68869150394199523	99552	81497	
DL56	+38	219	+1145114	5147Y	0	121421184	68846150510199530	99419	81985	
DL57	+38	225	+1145068	5122Y	0	112421196	68626150608199538	99273	81935	

STATION IDENT.	LAT. DEG MIN	LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM	GRSV GRAV	THEO GRAV	CAA	CBA +1000
DL59	+38	237+1145034	5072H	0	98421220	68964150581199556	98758	81556		
DL60	+38	243+1145007	5050H	0	95421232	69004150646199565	98607	81476		
DL61	+38	249+1144979	5026H	0	96421244	69044150676199573	98403	81356		
DL62	+38	257+1144942	5002Y	0	92421260	69098150725199585	98214	81245		
DL63	+38	195+1145003	5050H	0	100421143	69012150607199495	98636	81514		
DL64	+38	214+1144897	4957Y	0	93421182	69166151136199523	98264	81450		
DL65	+38	166+1144857	4912Y	0	99421094	69226151595199452	98370	81715		
DL66	+38	113+1144796	4865S	0	99420998	69318151073199375	97670	81106		
DL67	+38	23+1144730	4846S	0	95420833	69345150793199243	97155	80723		
DL68	+38	9+1144672	4834S	0	97420610	69504150257199223	96527	80137		
DL69	+38	90+1144719	4865S	0	97420959	69432150340199341	96783	80287		
DL70	+38	1+1144558	4823S	0	107420600	69671150326199211	96504	80151		
DL71	+38	21+1144567	4828S	0	110420636	69657150394199240	96590	80233		
DL72	+38	42+1144577	4835S	0	106420675	6964215044199271	96666	80296		
DL73	+38	62+1144587	4842S	0	103420911	69626150450199300	96721	80310		
DL74	+38	83+1144597	4847S	0	104421950	69610150463199330	96747	80319		
DL75	+38	103+1144607	4855S	0	101420987	69595150422199360	96752	80297		
DL76	+38	124+1144617	4867S	0	107421025	69579150336199391	96749	80256		
DL77	+38	144+1144626	4878S	0	106421062	69562150223199420	96733	80194		
DL78	+38	163+1144643	4887S	0	103421096	69540150166199450	96703	80141		
DL79	+38	181+1144657	4897S	0	102421129	69518150116199474	96728	80127		
DL80	+38	200+1144672	4904S	0	99421164	69496150096199512	96744	80121		
DL81	+38	219+1144686	49110	0	95421196	69474150124199530	96741	80136		
DL82	+38	237+1144705	4922S	0	96421231	69446150154199556	96716	80227		
DL83	+38	256+1144719	4930S	0	96421266	69424150156199584	97101	80282		
DL84	+38	275+1144732	4937S	0	94421300	69404150210199612	97306	80316		
DL85	+38	294+1144747	4945S	0	95421335	69382150259199639	97152	80386		
DL86	+38	313+1144760	4957S	0	92421370	69362150334199667	97293	80476		
DL87	+38	334+1144771	4968S	0	90421408	69346150355199696	97357	80540		
DL88	+38	355+1144782	49720	0	91421447	69323150421199729	97480	80613		
DL89	+38	330+1144621	4968Y	0	90421399	69272150588199692	97519	80795		
DL90	+38	315+1144646	4966S	0	91421376	69236150705199670	97771	80923		
DL91	+38	297+1144677	49580	0	91421336	69191151002199606	98020	81154		
DL92	+38	284+1144690	4972S	0	92421311	69150151056199525	98211	81335		
DL93	+38	270+1144622	4980C	0	93421284	69127150964199604	98212	81289		
DL94	+38	174+1144758	4961S	0	94421113	69371150668199464	97317	80694		
DL95	+38	251+1144814	4937S	0	94421253	69266150796199517	97582	80937		
DL96	+38	93+1144621	4844S	0	114420971	69721150616199345	96757	80359		
DL97	+38	164+1144625	4859Y	0	115421102	69712150452199449	96624	80383		
DL98	+38	239+1144694	4900Y	0	109421239	69696150393199559	96646	80644		
DL99	+38	308+1144657	4935Y	0	102421364	69513150046199660	96632	80602		
DL100	+38	349+1144561	4978C	0	113421443	69651150966199720	96946	80722		
DL101	+38	365+1144756	4952S	0	97421466	69385150448199743	97306	80515		
DL102	+38	374+1144730	4971S	0	96421483	69403150179199756	97206	80376		
DL103	+38	385+1144702	49670	0	98421505	69446150095199773	97468	80226		
DL104	+38	396+1144682	4970S	0	101421526	69472150029199786	97013	80156		
DL105	+38	406+1144661	4982Y	0	100421545	69503149944199803	97026	80134		
DL106	+38	414+1144635	4994S	0	106421570	69540149821199822	96997	80076		
DL107	+38	432+1144611	5009S	0	103421595	69574149711199841	97010	80034		
DL108	+38	445+1144584	5023S	0	109421620	69613149604199860	97116	79993		
DL109	+38	455+1144558	5037C	0	113421639	69651149500199875	97089	80026		
DL110	+38	467+1144532	5050C	0	110421662	69686149407199892	97262	80096		
DL111	+38	481+1144504	5092C	0	123421689	69729149464199913	97473	80226		
DL112	+38	379+1144672	4982S	0	91421491	69312150485199764	97617	80706		
DL113	+38	394+1144613	4988S	0	92421518	69281150570199786	97726	80805		
DL114	+38	413+1144630	5000S	0	93421552	69255150649199813	97790	80927		
DL115	+38	434+1144608	5010S	0	95421587	69238150736199840	97896	81049		

DRY LAKE VALLEY GRAVITY STATIONS

A2-3

STATION IDENT.	LAT. DEG MIN	LONG. DEG MIN	ELEV. +CODE	TEMP. IN/OUT	NORTH UTM	EAST UTM	ORSV GRAV	THEO GRAV	FAA +1000	CHA +1000
DL116	+38 448	+114 466	5020S	0	91421616	69204150615199865	97993	80962		
DL117	+38 468	+114 467	5027S	0	94421652	69185150481199804	97896	80845		
DL118	+38 488	+114 483	5033S	0	92421689	69174150286199923	97729	80655		
DL119	+38 510	+114 489	5041S	0	90421729	69159150142199955	97628	80524		
DL120	+38 528	+114 491	5051S	0	90421762	69132150049199982	97602	80465		
DL121	+38 548	+114 491	5060S	0	91421799	69121149979200011	97588	80421		
DL122	+38 568	+114 493	5063S	0	95421835	69099149920200040	97528	80354		
DL123	+38 586	+114 494	5075S	0	92421868	69077149851200066	97546	80329		
DL124	+38 607	+114 495	5090S	0	92421907	69061149870200096	97576	80407		
DL125	+38 629	+114 496	5101U	0	94421947	69053149922200130	97798	80494		
DL126	+38 700	+114 523	5300Y	0	125422069	68653149396200234	99042	81091		
DL127	+38 676	+114 513	5160Y	0	106422028	68799149778200196	98141	80646		
DL128	+38 603	+114 524	5243Y	0	125421890	68646150020200091	99272	81514		
DL129	+38 601	+114 515	5170Y	0	103421889	68778150065200088	98635	81104		
DL130	+38 537	+114 516	5174Y	0	120421770	68756150257199995	98948	81421		
DL131	+38 473	+114 521	5278Y	0	116421650	68694149893199902	98664	81779		
DL132	+38 504	+114 511	5124Y	0	133421711	68839150577199947	98653	81509		
DL133	+38 443	+114 514	5732Y	0	242421597	68799146975199857	101065	81757		
DL134	+38 415	+114 521	5297Y	0	120421543	68696149921199816	99956	82009		
DL135	+38 342	+114 523	5248Y	0	126421407	68663150165199709	99845	82072		
DL136	+38 263	+114 519	5166Y	0	124421262	68734150350199594	99563	81999		
DL137	+38 310	+114 510	5120B	0	125421352	68654150770199663	99292	81954		
DL138	+38 325	+114 501	5038C	0	101421383	68984150452199684	98681	81596		
DL139	+38 350	+114 491	4965S	0	93421433	69141151036199721	98231	81321		
DL140	+38 420	+114 494	5008Y	0	97421561	69090151205199823	98511	81527		
DL141	+38 444	+114 502	5032C	0	112421563	68974151110199859	98607	81556		
DL142	+38 495	+114 495	5037S	0	97421599	69067150666199934	98136	81053		
DL143	+38 531	+114 502	5070S	0	98421764	68963150334199986	98062	80666		
DL144	+38 619	+114 503	5087U	0	106421926	68946150251200115	98010	80766		
DL145	+38 716	+114 505	50751401T	0	105422105	68910149837200257	97953	80527		
DL146	+38 685	+114 503	5113Y	0	102422049	68990150026200212	97934	80597		
DL147	+38 738	+114 490	5191Y	0	94422151	69126149720200289	98264	80673		
DL148	+38 575	+114 481	5038S	0	90421652	69274149741200051	97291	80134		
DL150	+38 494	+114 476	5018S	0	97421704	69341149750199932	97943	80625		
DL151	+38 445	+114 472	4993S	0	97421615	69415149801199860	96936	79997		
DL152	+38 517	+114 466	5057C	0	98421750	69449149377199966	97003	79853		
DL153	+38 597	+114 470	5092B	0	101421697	69434149325200083	97164	79897		
DL154	+38 675	+114 467	5091T	0	102422042	69470149210200197	97782	80197		
DL155	+38 735	+114 463	5248B	0	104422153	69485149172200284	98277	80482		
DL156	+38 721	+114 476	5171Y	0	106422124	69344149720200264	98121	80590		
DL157	+38 658	+114 478	51161T	0	96422007	69313149705200172	97679	80326		
DL158	+38 692	+114 456	51529T	0	108422078	69636149314200222	98534	80725		
DL159	+38 606	+114 459	5167B	0	101421917	69595149195200096	97727	80206		
DL160	+38 526	+114 455	5115C	0	106421771	69655149352199979	97511	80171		
DL161	+37 450	+114 369	5537S	0	137418059	7101014636719702210	1492	82737		
DL163	+37 457	+114 370	5485S	0	123418191	7095614651419712710	1009	82424		
DL165	+37 461	+114 363	5495Y	0	149418273	7108314674719718910	1274	82681		
DL166	+37 467	+114 367	5416Y	0	164418387	7102814771019728610	1404	83094		
DL167	+37 467	+114 357	5558Y	0	152418387	7117914615419727710	1185	82581		
DL168	+37 466	+114 349	5759S	0	165418370	7136414551919725910	1377	82936		
DL169	+37 459	+114 347	6071S	0	220418232	7146914345419715010	1343	82937		
DL170	+37 451	+114 343	5962S	13	176418096	7135514375419704410	12624	82676		
DL171	+37 474	+114 345	5784Y	0	154418508	7134214546319736910	12533	82952		
DL172	+37 474	+114 351	5722Y	0	141418515	7125114572519737610	12205	82632		
DL174	+37 474	+114 356	5641S	0	155418581	7118714563119743610	1491	82406		
DL176	+37 474	+114 327	5507S	0	176418600	7160814709119753610	1493	82677		
DL178	+37 474	+114 327	5507S	0	176418600	7160814709119753610	1493	82677		

STATION IDENT.	LAT. DEG MIN	LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM	GRSV GRAY	THEO GRAY	DIFF	CHG
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DL179	+374819	+1143351	5657S	0	193418656	714951462981	97484102055	62953		
DL180	+374823	+1143422	5763S	0	178418663	713911456241	97490102379	62642		
DL181	+374880	+1143174	5433S	0	184418778	717521465311	97573100090	81743		
DL182	+374901	+1143356	5918Y	0	235418809	714841447061	97604102797	82649		
DL183	+374899	+1143476	5947Y	0	211418801	713081442861	97601102657	82545		
DL184	+374860	+1143576	5631Y	0	184418725	711601449551	97544102290	82557		
DL187	+374939	+1143289	5787Y	0	284418882	715801454741	97559102284	82426		
DL190	+374983	+1143524	6228S	0	290418955	712331426481	97723103728	82776		
DL191	+375013	+1143646	6067S	0	259419006	710531440021	97767103336	82902		
DL193	+375062	+1143555	6473S	34	346419100	711841414491	97639104535	82838		
DL199	+375099	+1143712	5904Y	0	297419162	709521451181	97893102792	82952		
DL200	+375114	+1143734	5827Y	0	297419189	709191450461	97915102572	82975		
DL202	+375214	+1143616	6513S	0	504419378	710871411311	98061104372	82662		
DL205	+38 9	+1144375	4830S	0	127420821	699391502441	99223 96477	80136		
DL206	+38 48	+1144470	4830S	0	117420690	697931504151	99280 96591	80234		
DL207	+38 78	+1144380	46442T	0	144420948	699281505451	99323 96812	80435		
DL208	+38 123	+1144454	4861Y	0	128421029	698161504131	99389 96770	80318		
DL209	+38 86	+1144286	4940C	0	137420967	700651502681	99335 97423	80711		
DL210	+38 41	+1144177	5160Y	0	152420887	702271494861	99270 98713	81470		
DL211	+38 19	+1143951	5582Y	0	229420855	705591466211	99238 99919	81109		
DL212	+38 57	+1143794	6296Y	0	433420931	707871426321	99293102797	81756		
DL213	+38 90	+1143900	5758Y	0	275420988	706301453091	99341102360	80996		
DL214	+38 108	+1144005	5445Y	0	207421017	704761476181	99367 99495	81131		
DL215	+38 81	+1144090	5249Y	0	177420964	703521469541	99328 99025	81299		
DL216	+38 81	+1144200	5075Y	0	155420960	701921500491	99328 98482	81326		
DL218	+38 148	+1143827	6150Y	0	414421098	707341431271	99426101583	81022		
DL219	+38 150	+1143918	5734S	0	262421098	706011456561	99429101193	80698		
DL220	+38 169	+1144090	5370Y	0	186421127	703461485901	99456 99672	81542		
DL221	+38 169	+1144200	5098Y	0	212421123	701871502271	99456 98750	81575		
DL222	+38 167	+1144310	4861Y	0	170421115	700271506161	99454 97697	80619		
DL223	+38 172	+1144386	46871T	0	133421122	699121501641	99461 96694	80159		
DL225	+38 199	+1144460	4905C	0	117421169	698061500291	994501 96689	80077		
DL226	+38 260	+1144366	49459T	0	129421284	696971499791	99450 96936	80196		
DL227	+38 279	+1144408	4947C	0	119421316	697871496561	99417 96805	80651		
DL228	+38 237	+1144273	4971Y	0	185421246	700781506501	99456 97876	81107		
DL229	+38 218	+1144127	5836Y	0	275421216	702921455981	99426100495	81365		
DL230	+38 199	+1144018	55020T	0	199421185	704521470641	994501 99945	81373		
DL231	+38 213	+1143936	5756Y	0	237421214	705721456281	99452110280	80665		
DL232	+38 240	+1143667	6008C	0	22421267	706711441821	99450101168	80968		
DL234	+38 302	+1143692	5976Y	0	244421380	706321444331	994651101986	80943		
DL235	+38 289	+1144000	5600Y	2	187421352	704751466091	99432100446	81330		
DL236	+38 273	+1144074	5715Y	0	163421320	703671465781	99409101754	81425		
DL237	+38 276	+1144181	5655Y	0	327421322	702101464601	99413103569	81608		
DL238	+38 297	+1144306	5024Y	0	167421356	706271503701	99444 98018	81139		
DL239	+38 351	+1144403	56200T	0	131421452	696821498541	99473 97358	80367		
DL240	+38 399	+1144475	5655C	0	111421539	697751495371	994793 97317	80187		
DL241	+38 444	+1144410	51010T	0	130421624	695681497701	99459 97913	80541		
DL242	+38 416	+1144307	5451Y	0	175421576	700201483861	99418 99669	81152		
DL243	+38 350	+1144242	5453Y	0	193421456	701101483741	994721 99973	81367		
DL244	+38 345	+1144159	6216Y	0	168421450	702391433351	994714102126	81347		
DL245	+38 340	+1144253	5826C	0	164421448	705411453201	99470101145	81368		
DL246	+38 366	+1144023	5733Y	0	150421494	704371463131	994715110327	81152		
DL247	+38 377	+1144061	5809Y	0	163421512	703521453581	994761110022	81190		
DL248	+38 420	+1144123	5560C	9	142421590	702891474091	9947623 99951	81124		
DL249	+38 355	+1144055	6114Y	0	253421480	706641436871	994729101562	80902		
DL251	+38 408	+1143967	5853C	0	173421574	705171449321	994606100272	80187		

STATION IDENT.	LAT. DEG MIN	LONG. DEG MIN	ELEV. +CODE	TEMP. IN/OUT	COR. UTM	NORTH UTM	EAST UTM	ORSV GRAV	TEMP GRAV	PA +1000	CP +1000
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DL253	+38	412	1140195	6055Y	0	345421573	70184144000	199812101	176	80869	
DL254	+38	475	1144152	5465C	0	146421691	70244147824	199904	99353	80859	
DL255	+38	497	1144228	5454Y	0	122421729	70132148358	199937	99751	81271	
DL256	+38	491	1144335	5501Y	0	129421714	69976148152	199927	100004	81363	
DL257	+38	465	1143790	6443Y	0	305421686	70773142023	199890	102775	81105	
DL258	+38	448	1143900	6050Y	0	208421650	70613143952	199865	101028	80801	
DL259	+38	468	1143975	5855Y	0	173421684	70503144932	199894	100143	80846	
DL260	+38	515	1143875	6169Y	17	217421775	70647143565	199963	101663	80856	
DL261	+38	538	1144004	5748Y	0	154421813	70457145595	199996	99696	80245	
DL262	+38	520	1144074	5589Y	0	138421777	70356146721	199970	99351	80427	
DL263	+38	531	11440142	5463Y	0	133421795	70256147021	199986	99049	80550	
DL265	+38	582	1143844	6343Y	0	281421900	70689142445	200061	1102087	80734	
DL266	+38	575	1143929	5856Y	0	187421884	70565145157	200051	1100231	80445	
DL269	+38	663	1143923	5892Y	0	174422047	70570144449	200179	99723	79801	
DL270	+38	740	114352459911		0	184422193	70711144442	200292	100938	80636	
DL271	+38	730	114391858281		0	150422171	70574145069	200277	99642	79916	
DL272	+38	692	1144026	5604Y	0	141422097	70416146056	200222	98576	79633	
DL273	+38	664	114392050660		0	149422006	70472145723	200180	98866	79632	
DL274	+38	627	114406255600		0	135421975	70366146718	200127	98921	80092	
DL275	+38	593	1144025	5628Y	0	145421914	70424146315	200077	99204	80154	
DL276	+38	711	1144121	5622Y	0	121422128	70276146543	200249	99214	80196	
DL278	+38	602	114417554062		0	129421925	70204147917	200096	98793	80394	
DL282	+38	564	114427452840		0	136421851	70661149565	200034	99295	81395	
DL285	+38	562	1144356	52548	20	124421844	69941149759	200031	99207	81418	
DL286	+38	546	1144382	52218	0	153421814	69904149983	200008	99110	81456	
DL287	+38	531	1144405	51708	0	128421785	69871150032	199986	98892	81316	
DL288	+38	516	1144435	51619	0	122421756	69826149722	199964	98329	80648	
DL289	+38	504	1144458	51408	0	116421733	69795149613	199947	98040	80625	
DL290	+38	492	1144482	51168	0	116421710	69760149465	199929	97683	80350	
DL291	+38	560	1144455	51718	0	138421837	69797149462	200029	98599	81100	
DL292	+38	613	1144491	5602Y	0	113421941	70034147047	200106	99664	80670	
DL293	+38	628	1144481	5736Y	94	146421966	69902146579	200126	100435	81111	
DL294	+38	623	1144491	5250C	0	121421952	69741149622	200121	98914	81129	
DL295	+38	705	114443353930		0	124422106	69622146396	200241	99110	80541	
DL296	+38	710	114432055230		0	130422119	69727147465	200248	99216	80509	
DL297	+38	687	114423755000		1	122422080	70110147258	200214	98806	80170	
DL298	+373818	1144437	56938		157	260416767	69946144533	196024	102089	83089	
DL299	+373793	1144314	58458		81	262416725	70126143463	195986	102439	82696	
DL300	+373808	1144186	61475		106	354416757	70316141894	196041	103740	83235	
DL301	+373802	1144078	62208		0	252416750	70475141455	196001	104081	83687	
DL302	+373778	1143971	5965Y		0	171416709	70633143122	195966	102732	82753	
DL303	+373781	1143849	59235		0	166416719	70613143241	195970	101036	83021	
DL304	+373818	1143796	58748		0	164416790	70666143153	196024	102413	82542	
DL305	+373904	1143769	58258		0	151416949	70695143114	196126	101766	82076	
DL306	+373849	1143900	5920Y		0	164416843	70731143518	196070	101325	83193	
DL307	+373846	1143978	60725		0	199416835	70620142357	196065	101342	82901	
DL308	+373838	1144259	57673		0	204416810	70207144673	196053	102332	83371	
DL309	+373888	1144422	59285		0	276416897	69965142646	196127	102526	83363	
DL310	+373869	1144343	56188		0	298416866	70082145346	196094	102126	83256	
DL311	+373921	1144359	5180Y		0	169416960	70156148371	196174	102923	83176	
DL312	+373959	1144406	5970Y		0	159417028	69982148872	196231	100363	83226	
DL313	+373982	1144312	52625		0	159417074	70122146157	196263	100851	83231	
DL314	+373916	1144264	55948		0	210416954	70196145464	196167	101436	83306	
DL315	+373900	1144190	56908		0	285416927	70306143554	196144	102845	83341	
DL316	+373884	1144077	64985		0	570416902	70472146721	196120	104772	82836	
DL317	+373917	1144015	69048		0	103116965	70562146527	196169	105337	82820	
DL318	+373927	1144006	6053Y		0	103116988	70716146010	196180	105337	82820	

STATION IDENT.	LAT. DEG MIN	LONG. DEG MIN	ELEV. +CODE	TEMP. IN/OUT	NORTH UTM	EAST UTM	ORSV GRAV	THEO GRAV	FAA	CBA +1000
DL319	+373984	+1143763	5744Y	0	141417098	709301431	196266100960	81510		
DL320	+374000	+1143840	5801S	5	144417125	708071431	196290101482	81346		
DL321	+374020	+1143955	5902S	0	160417158	706461430	196319102261	82311		
DL322	+373993	+1144034	6207S	0	283417105	705311415	196280103729	82841		
DL323	+373962	+1144101	6376S	0	384417045	704341405	196234104306	82944		
DL324	+373994	+1144188	6352S	174	541417101	703041399	196280103492	82542		
DL325	+374036	+1144395	5418S	0	251417171	699961465	196342101211	82933		
DL326	+374059	+1144246	5278Y	0	172417219	702161477	196370101086	83256		
DL327	+374078	+1144160	5600S	0	223417257	703421452	196403102103	83022		
DL328	+374038	+1144066	6138S	0	293417187	704821417	196345103169	82527		
DL329	+374071	+1143644	5798S	0	135417256	708061433	196393101486	81345		
DL330	+374102	+1143930	5801Y	0	142417310	706791434	196438101566	81922		
DL331	+374166	+1143755	5725S	0	129417435	709331443	196531101682	82284		
DL332	+374180	+1143888	5778S	0	134417456	707371437	196552101537	81964		
DL333	+374110	+1144073	6026S	0	293417320	704661425	196450102779	82519		
DL334	+374114	+1144253	5221S	0	150417321	702031481	196455100663	83205		
DL335	+374095	+1144359	5559S	0	431417282	700461455	196426101472	82942		
DL336	+374169	+1144493	4773Y	0	121417414	698481498	196536	98221	82062	
DL337	+374176	+1144471	4800S	0	121417427	698801499	196540	98527	82276	
DL338	+374165	+1144447	4849Y	0	122417408	699161499	196530	99029	82612	
DL339	+374156	+1144422	4898Y	0	134417392	699531499	196517	99487	82915	
DL340	+374147	+1144307	4942Y	0	134417376	699901497	196504	99750	83028	
DL341	+374137	+1144374	4985Y	0	139417359	700241494	196489	99917	83054	
DL342	+374132	+1144345	5035S	0	138417351	700671492	196482100147	83112		
DL343	+374181	+1144278	5138S	0	138417444	701631486	196553100613	83227		
DL344	+374154	+1144161	5388Y	0	148417398	703371471	196514101348	83139		
DL345	+374202	+1144126	5551Y	0	178417488	703831462	196584101665	83110		
DL346	+374180	+1144053	6103S	0	395417450	704941416	196552102727	82306		
DL347	+374172	+1143999	5889S	0	172417437	705741432	196541102178	82264		
DL348	+374242	+1143708	5764Y	0	131417574	706661442	196642101865	82336		
DL349	+374242	+1143895	5710S	0	132417570	707241445	196642101816	82271		
DL350	+374256	+1144432	4802S	0	135417577	699341502	196663	98782	82539	
DL351	+374237	+1144376	4959S	0	141417544	700171497	196635	99816	83041	
DL352	+374228	+1144217	5650S	0	247417533	702511455	196622102138	83115		
DL353	+374265	+1144224	6014S	0	656417601	702391427	196676102677	82821		
DL354	+374265	+1144136	6298S	0	736417604	703661408	196676103423	82679		
DL355	+374251	+1144063	6001S	59	234417581	704761426	196655102696	82524		
DL356	+374256	+1143998	5970S	39	205417592	705721428	196663102327	82209		
DL357	+374301	+1143933	5798S	0	164417678	706651412	196726101966	82555		
DL358	+374307	+1143826	5776S	0	148417693	708221445	196738102114	82543		
DL359	+374381	+1143759	5695S	0	131417832	709171456	196745101761	82600		
DL360	+374473	+1143779	5456Y	0	126418002	708831463	19679100750	82267		
DL361	+374441	+1143832	5431Y	0	134417941	708071466	196833100817	82427		
DL362	+374376	+1143909	5673S	0	138417807	706971449	196829101554	82543		
DL363	+374458	+1143955	5691S	0	139417968	706251466	196857102412	83113		
DL364	+374415	+1143944	5565S	0	125417887	705851466	196895101460	82624		
DL365	+374325	+1143972	5700S	0	138417721	706071449	196763101819	82516		
DL366	+374325	+1144061	5999S	70	272417718	704761426	196763102498	82579		
DL367	+374370	+1144064	5785S	82	224417809	704841445	196835102243	82774		
DL368	+374442	+1144099	5457S	0	132417933	706151471	196834101468	82976		
DL369	+374491	+1144131	5966S	0	521418022	703651431	196905102338	82508		
DL370	+374401	+1144170	5219Y	0	150417854	703121466	196874100650	83119		
DL371	+374323	+1144168	6110S	0	574417719	703191422	196760103042	82676		
DL372	+374324	+1144267	6208S	0	154417708	701731464	196762100703	83190		
DL373	+374289	+1144319	5879S	158	649417642	700981434	196711102062	82628		
DL374	+374345	+1144389	4771Y	0	112417743	699931504	196792	99996	82586	
DL375	+374351	+1144371	6012S	0	110417711	701111511	196833	99677	82586	

STATION IDENT.	LAT. DEG MIN	LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM	ORSV GRAV	THEO GRAV	FAA +1000	GBA +1000
DL376	+374345	+1144497	4609S	0	112417739	69834150650	196792	97232	81624	
DL378	+374459	+1144446	4650S	0	109417952	69401150970	196959	97772	82021	
DL379	+374437	+1144341	4855S	2	129417915	70059150558	196927	99322	82494	
DL380	+374480	+1144255	5500S	0	286417997	70184146464	196990	101236	82765	
DL381	+374401	+1144259	5025Y	0	168417351	70181149689	196874	100106	83135	
DL384	+373763	+1143716	5700S	0	155416671	71009143382	195944	101084	81796	
DL385	+373871	+1143654	5728S	0	161416893	71095142694	196102	100702	81327	
DL386	+374002	+1143635	5681Y	0	132417134	71043143440	196292	100611	81367	
DL387	+374007	+1143574	5355S	0	131417148	71206145924	196300	100022	81414	
DL388	+373966	+1143486	5223S	0	176417054	71335146738	196231	99661	82022	
DL389	+373904	+1143370	5256S	0	132416965	71511146591	196149	99651	82076	
DL393	+373984	+1143357	5494S	0	156417113	71527145176	196266	100619	82036	
DL394	+374027	+1143428	55770	0	155417190	71420144724	196329	100681	82014	
DL395	+374073	+1143516	5642Y	0	156417272	71289145390	196396	102094	83096	
DL396	+374108	+1143463	5843S	0	186417339	71365143598	196447	102143	82400	
DL397	+374068	+1143634	5560S	0	134417258	71115144907	196388	100646	82016	
DL398	+374083	+1143736	5703S	0	128417282	70965143746	196410	101010	81657	
DL399	+374149	+1143681	5687H	0	135417406	71012144419	196507	101436	82174	
DL400	+374148	+1143618	5667H	0	137417407	71135144575	196505	101468	82226	
DL401	+374214	+1143698	5767H	0	138417526	71014144744	196602	102419	82686	
DL402	+374267	+1143729	5784S	0	136417623	70966144583	196679	102341	82749	
DL403	+374245	+1143620	5670S	0	150417586	71127144492	196647	103092	83236	
DL404	+374236	+1143561	5055S	12	198417572	71215143047	196634	103402	82960	
DL406	+374095	+1143373	5820S	0	204417318	71498143767	196428	102135	82486	
DL411	+374157	+1143529	5836H	0	179417427	71265143874	196519	102283	82557	
DL412	+374191	+1143632	5602S	0	155417486	71112144632	196568	102069	82435	
DL413	+374332	+1143674	5883S	0	174417745	71037144510	196773	103105	83216	
DL414	+374361	+1143605	5853S	0	161417801	71144144406	196816	102676	82676	
DL415	+374410	+1143668	6039S	0	264417889	71049143376	196886	102330	82997	
DL416	+374406	+1143587	5838S	0	156417959	71166144437	196940	102443	82687	
DL417	+374491	+1143499	5885S	0	183418046	71294143945	197005	102378	82468	
DL418	+374402	+1143521	6122S	0	225417680	71265142507	196876	103251	82596	
DL422	+373729	+1144435	6062S	11	366416602	69253142418	195895	103013	83019	
DL423	+373717	+1144117	5885S	0	195416590	70377143357	195677	102676	83001	
DL424	+373724	+1144049	6026Y	0	179416607	70521142354	195688	103213	82839	
DL425	+375280	+1145506	5829S	0	227419434	66314145235	198157	101938	82284	
DL426	+375257	+1145305	5422S	0	172419398	66609147134	198123	100059	81736	
DL427	+375296	+1145382	6061S	0	622419468	66495142715	198180	101569	81514	
DL428	+375345	+1145284	5113S	0	142419561	68639119725	198252	99594	82297	
DL429	+375384	+1145392	5712S	0	224419630	68676145965	198309	101415	82157	
DL430	+375401	+1145298	5094Y	0	161419665	68613149956	198334	99572	82354	
DL431	+375324	+1145483	5835S	0	270419516	68338145415	198221	102110	82475	
DL432	+375382	+1145477	5915S	0	263419620	68352144772	198306	102136	82225	
DL437	+375436	+1145272	5060Y	0	116419733	68650151079	198385	99501	82281	
DL438	+375451	+1145296	5134Y	0	121419757	68614149761	198407	99671	82261	
DL435	+375458	+1145320	5175Y	0	118419769	68679149571	198417	99856	82321	
DL436	+375468	+1145344	5193Y	0	123419787	68643149575	198432	100015	82426	
DL437	+375477	+1145370	5224Y	0	144419803	68505109506	198445	100227	82553	
DL438	+375485	+1145396	5257Y	0	123419817	68466149369	198457	100348	82586	
DL439	+375487	+1145421	5299Y	0	114419819	68425149106	198459	100477	82547	
DL440	+375486	+1145456	5355Y	0	140419806	68387148604	198441	100631	82507	
DL441	+375483	+1145477	5421Y	0	153419816	68348148147	198454	100713	82476	
DL442	+375491	+1145503	5423Y	0	144419822	68369148101	198464	100675	82523	
DL443	+375514	+1145349	5102Y	0	125419886	68547150084	198505	99971	82558	
DL444	+375600	+1145321	5245S	0	123420032	68671149492	198625	100229	82463	
DL445	+375580	+1145411	5536S	0	125419892	68440147596	198595	101104	82357	
DL446	+375514	+1145406	5337S	0	113419897	68371147101	198551	100300	82300	

STATION LAT. LONG. ELEV. TFR-COR. NORTH EAST CORN. TIME PAI. PAA
 IDENT. DEG MIN DEG MIN +CODE IN/OUT UTM UTM GRAV GRAV +1000

DL453	+375312	+1145229	51730	50	115419502	68718149609198204100089	62611
DL454	+375295	+1145110	47960	0	109419475	68693151795196179	62562
DL455	+375303	+1145144	48770	0	108419599	68641151361194276	62474
DL456	+375303	+1145024	47540	0	95419493	69019151309198191	61736
DL457	+375350	+1144925	47205	0	87419583	69162151104198259	61342
DL458	+375262	+1144923	46755	0	88419420	69169151469198131	61496
DL459	+375313	+1144836	46478	0	88419517	69294150943198205	61750
DL460	+375260	+1144805	46248	0	90419425	69547149753198126	79459
DL461	+375308	+1144800	46360	0	95419516	69632149735198196	79449
DL462	+375310	+1144515	46330	0	110419523	69764149606198201	79513
DL463	+375388	+1145023	48110	0	95419650	69017150947198315	61594
DL464	+375426	+1145250	50388	1	116419712	68683150422198370	62396
DL465	+375419	+1145223	49938	0	116419700	68723150916198360	62631
DL466	+375415	+1145197	49630	0	111419696	68761151190198356	62719
DL467	+375432	+1145174	49548	0	111419726	68794151136198379	62593
DL468	+375447	+1145151	49398	0	108419755	68627151217198401	62559
DL469	+375464	+1145135	49530	0	108419787	68650151239198426	62649
DL470	+375464	+1145097	48968	0	110419788	68905151501198426	62562
DL471	+375455	+1145068	48608	0	103419772	68946151479198413	62331
DL472	+375452	+1145040	48368	0	105419768	68989151174198409	61907
DL473	+375446	+1145012	48120	0	98419757	69031151150198400	61625
DL474	+375445	+1144986	47848	0	95419756	69069151097198396	61496
DL475	+375441	+1144956	47588	0	92419750	69113151225198392	61474
DL476	+375438	+1144929	47425	0	90419745	69153151290198388	61445
DL477	+375435	+1144906	47200	0	89419741	69186151331198384	61405
DL478	+375431	+1144878	47115	0	88419734	69226151314198376	61291
DL479	+375428	+1144851	46975	0	88419730	69267151235198373	61132
DL480	+375424	+1144824	46768	0	89419723	69307151144198367	60922
DL481	+375422	+1144796	46601	0	89419720	69345151034198365	60743
DL482	+375419	+1144770	46558	0	90419716	69386150960198360	60520
DL483	+375414	+1144718	46489	0	91419708	69463150348198353	79964
DL484	+375409	+1144690	46455	0	95419703	69504150140198345	79760
DL485	+375407	+1144666	46445	0	93419697	69539149976198343	79590
DL486	+375404	+1144638	46485	0	95419693	69581149776198338	79426
DL487	+375399	+1144606	46490	0	96419684	69625149652198331	79316
DL488	+375396	+1144574	46508	0	102419680	69675149562198327	79237
DL489	+375394	+1144553	46495	0	102419677	69706149541198323	79215
DL490	+375392	+1144530	46498	0	104419676	69739149543198321	79221
DL491	+375386	+1144501	46489	0	113419664	69782149577198312	79272
DL492	+375378	+1144500	46480	0	110419649	69775149596198300	79256
DL493	+375455	+1144526	46608	0	105419657	69735149416198545	79660
DL494	+375461	+1144594	46630	0	98419660	69642149426198422	79681
DL495	+375266	+1144762	46218	0	88419433	69465151163198137	79661
DL496	+375288	+1144755	46238	0	89419470	69414151213198189	79672
DL497	+375307	+1144749	46258	0	89419509	69426151254198197	79697
DL498	+375329	+1144743	46308	0	89419550	69430151292198229	79733
DL499	+375350	+1144736	46348	0	90419589	69439151315198259	79750
DL500	+375372	+1144730	46403	0	90419630	69447151336198291	79774
DL501	+375392	+1144724	46455	0	90419667	69455151364198321	79737
DL502	+375430	+1144705	46528	0	92419746	69481151276198352	79846
DL503	+375453	+1144695	46543	0	91419781	69495151306198410	79869
DL504	+375473	+1144684	46585	0	94419819	695101513107198439	79871
DL505	+375493	+1144673	46605	0	96419856	695251513062198469	79888
DL506	+375512	+1144663	46695	0	93419892	69539151304198496	79915
DL507	+375531	+1144652	46743	0	90419927	69554149961198524	79976
DL508	+375553	+1144641	46795	0	96419966	69576149992198556	79999
DL509	+375571	+1144630	46843	0	97419999	69598149999198588	80022

STATION IDENT	LAT. DEG MIN	LONG. DEG MIN	ELEV. +0000	TER- TYP/OUT	CRK. UTM	NORTH UTM	EAST UTM	ORSV GRAV	TRAC GRAV	PA- +1000	CSA +1000
DL510	+375593	+1144620	4690S	0	99420043	6959914979	1198615	95314	79417		
DL511	+375612	+1144610	4699S	0	98420078	6961214978	1198642	95287	79356		
DL512	+375633	+1144599	4705S	0	98420118	6962814964	1198673	95255	79305		
DL513	+375652	+1144589	4710S	0	99420153	6964114956	1198701	95187	79221		
DL514	+375672	+1144579	4715S	0	101420190	6965514953	1198730	95176	79196		
DL515	+375692	+1144568	4717S	0	103420228	6967014952	1198759	95161	79175		
DL516	+375711	+1144558	4720S	0	105420263	6968414950	1198787	95141	79146		
DL517	+375731	+1144547	4732S	0	103420301	6969914946	1198816	95182	79146		
DL518	+375752	+1144536	4742S	0	104420340	6971514941	1198847	95195	79125		
DL519	+375771	+1144526	4741S	0	106420375	6972814940	1198875	95191	79127		
DL520	+375791	+1144515	4745S	0	108420413	6974414936	1198904	95220	79144		
DL521	+375811	+1144505	4753S	0	109420450	6975714934	1198933	95272	79170		
DL522	+375912	+1144516	4785S	0	109420637	6973714989	1199080	95846	79632		
DL523	+375941	+1144530	4798S	0	107420690	6971515006	1199123	96095	79838		
DL524	+375965	+1144547	4810S	0	107420739	6968915020	1199163	96309	80010		
DL525	+375901	+1144542	4790S	0	104420615	6969914972	1199085	95906	79672		
DL527	+375918	+1144594	4801S	0	106420645	6962215015	1199090	96249	79974		
DL528	+375910	+1144568	4795S	0	102420631	6966115002	1199076	96073	79821		
DL529	+375927	+1144620	4804S	0	100420661	6958615023	1199102	96344	80059		
DL530	+375936	+1144646	4808S	0	102420676	6959615027	1199116	96403	80106		
DL531	+375945	+1144672	4813S	0	97420692	6950715027	1199124	96441	80122		
DL532	+375952	+1144696	4816S	0	97420704	6947115032	1199139	96506	80177		
DL533	+375961	+1144723	4822S	0	96420720	6943115036	1199152	96614	80264		
DL534	+375969	+1144748	4824S	0	102420734	6939515039	1199164	96758	80409		
DL535	+375979	+1144774	4831S	0	97420751	6935615074	1199179	97030	80650		
DL536	+375987	+1144799	4835S	0	100420765	6931915115	1199191	97356	80975		
DL537	+375996	+1144826	4839S	0	108420781	6927915137	1199204	97706	81311		
DL538	+375940	+1144879	4824S	0	105420676	6920415160	1199122	96082	81733		
DL539	+375932	+1144770	4815S	0	98420665	6936415059	1199116	96600	80476		
DL540	+375878	+1144873	4805S	0	103420561	6921015155	1199031	97746	81461		
DL541	+375846	+1144779	4786S	0	93420505	6935515052	1198984	96584	81354		
DL542	+375806	+1144688	4793S	0	95420571	6948615029	1199034	96365	81112		
DL543	+375820	+1144617	4771S	0	96420463	6959314969	1198946	95846	79676		
DL544	+375795	+1144685	4762S	0	93420414	6949415014	1198909	95649	79901		
DL545	+375772	+1144767	4760S	0	92420369	6937515034	1198876	96404	80261		
DL546	+375801	+1144869	4762S	0	98420419	6922515137	1198914	97056	81241		
DL547	+375727	+1144879	4771S	0	96420282	6921315127	1198810	97386	81209		
DL548	+375724	+1144813	4733S	0	95420294	6955914966	1198806	95597	79755		
DL549	+375681	+1144775	4732S	0	92420200	6936815071	1198743	96494	80452		
DL550	+375642	+1144871	4729S	0	98420125	6922915130	1198646	97320	81289		
DL551	+375636	+1144693	4711S	0	93420120	6950415016	1198677	95618	79843		
DL552	+375609	+1144809	4711S	0	92420066	6932115109	1198636	96720	80814		
DL553	+375586	+1144908	4711S	0	101420020	6917715159	1198604	97326	81361		
DL554	+375531	+1144757	4687S	0	90419923	6940115003	1198534	96416	80520		
DL555	+375526	+1144886	4707S	0	89419916	6921515140	1198516	97564	81462		
DL556	+375476	+1144794	4673S	0	91419024	6934415124	1198446	96796	80936		
DL557	+375502	+1145005	4738S	0	107419861	6913415140	1198481	97981	81758		
DL558	+375562	+1144993	4734S	0	136419973	6905315180	1198570	97782	81772		
DL559	+375621	+1144985	4758S	0	138420082	6906315181	1198655	97937	81816		
DL560	+375702	+1144929	4859S	0	127420232	6905315186	1198773	98422	81477		
DL561	+375746	+1144965	4862S	0	112420313	6905715131	1198838	98618	81579		
DL562	+375981	+1145030	5019S	0	113420746	6898115048	1199181	98544	81534		
DL563	+375906	+1144977	4909S	0	109420609	6906215119	1199072	98321	81685		
DL564	+375818	+1144974	4881S	0	109420447	6906415151	1198943	98498	81959		
DL566	+375970	+1145162	5332S	0	153420721	6878914994	1199168	99459	81926		
DL567	+375997	+1145090	5363S	0	127420607	6869715039	1199073	99029	81667		
DL568	+375964	+1145263	5383S	0	128420521	6873315081	1199011	99111	81711		

DRY LAKE VALLEY GRAVITY STATIONS

A2-10

STATION IDENT.	LAT. DEG MIN	LONG. DEG MIN	FLV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM	GRSV GRAV	THEO GRAV	FAA	OMA +1000
DL569	+375820	+1145097	50640	0	120420446	66890150108198946	99008	61788		
DL570	+375778	+1145189	52458	0	132420345	68757149356198885	99833	62076		
DL571	+375760	+1145088	50500	0	115420336	68906150291198859	98959	61649		
DL572	+375704	+1145047	54380	0	241420233	68968147919198777	100302	62003		
DL573	+375722	+1145231	52718	0	163020260	68696149196198603	100001	62184		
DL574	+375686	+1145132	52510	0	112420197	68645149034198750	99702	61904		
DL575	+375650	+1145249	52105	11	121420127	68675149723198698	100057	62422		
DL576	+375620	+1145090	58120	228	563420077	68924145114198654	101161	62129		
DL577	+375600	+1145164	56950	0	287420037	68801145966198625	100940	61603		
DL578	+375542	+1145244	50785	0	130419927	68687150235198540	99485	62295		
DL579	+375529	+1145196	52540	0	108419905	68757148439198521	99365	61553		
DL580	+375525	+1145076	50790	0	132419901	68933149701198515	98985	61794		
DL582	+374570	+1144778	45800	0	85418145	69412149339197121	95319	79783		
DL583	+374578	+1144596	46010	0	88418166	69679149595197133	95762	80157		
DL584	+374616	+1144698	45825	0	85418233	69527149513197188	95446	79903		
DL585	+374653	+1144804	45790	0	85418298	69370149301197242	95151	79618		
DL586	+374500	+1144661	45805	0	92418013	69293149458197019	95555	80026		
DL587	+374522	+1144665	45805	0	91418054	69286149511197051	95561	80031		
DL588	+374543	+1144670	45805	0	92418092	69278149541197081	95561	80032		
DL589	+374563	+1144874	45815	0	90418129	69271149556197111	95556	80022		
DL590	+374535	+1144879	45805	0	89418170	69263149616197143	95574	80042		
DL591	+374609	+1144882	45805	0	89418214	69257149657197177	95561	80049		
DL592	+374627	+1144889	45805	0	90418247	69246149721197204	95619	80088		
DL593	+374646	+1144894	45805	0	89418286	69238149808197234	95675	80143		
DL594	+374669	+1144898	45805	0	89418324	69231149885197265	95723	80191		
DL595	+374691	+1144902	45805	0	89418365	69224149889197298	95693	80161		
DL596	+374712	+1144917	45815	0	91418403	69202150171197326	95999	80665		
DL597	+374734	+1144910	45815	0	90418444	69211150163197360	95914	80381		
DL598	+374755	+1144904	45838	0	89418463	69219150157197391	95896	80354		
DL599	+374775	+1144899	45838	0	88418520	69225150159197420	95869	80325		
DL600	+374797	+1144903	45828	0	88418561	69233150147197452	95815	80275		
DL601	+374818	+1144887	45835	0	87418600	69241150179197483	95821	80277		
DL602	+374841	+1144881	45845	0	87418643	69249150205197516	95828	80280		
DL603	+374861	+1144875	45855	0	87418680	69257150226197545	95834	80282		
DL604	+374883	+1144869	45885	0	86418721	69265150208197577	95808	80245		
DL605	+374907	+1144869	45865	0	87418765	69264150366197613	95911	80357		
DL606	+374933	+1144856	45875	0	86418814	69281150235197651	95752	80193		
DL607	+374954	+1144850	45875	0	86418855	69289150168197683	95645	80086		
DL608	+374976	+1144844	45873	0	86418894	69297150236197713	95692	80133		
DL609	+374998	+1144836	45895	0	87418935	69305150227197745	95668	80103		
DL610	+375019	+1144832	45935	0	89418974	69313150285197776	95734	80152		
DL611	+375046	+1144826	45965	0	89419024	69321150196197816	95833	80241		
DL612	+375068	+1144820	45985	0	89419065	69328150094197848	95817	79921		
DL613	+375089	+1144813	46015	0	85419104	69336149955197876	95876	79766		
DL614	+375111	+1144809	46035	0	85419145	69343149915197910	95822	79706		
DL615	+375133	+1144802	46055	0	85419186	69352149926197942	95814	79692		
DL616	+375157	+1144798	46085	0	86419230	69363149946197977	95835	79704		
DL617	+375178	+1144789	46115	0	86419269	69369149979198009	95864	79723		
DL618	+375200	+1144783	46145	0	86419310	69377150035198041	95816	79765		
DL619	+375222	+1144775	46175	0	86419351	69386150073198073	95845	79789		
DL620	+375246	+1144769	46165	0	87419396	69395150121198106	95871	79805		
DL621	+375231	+1144831	46265	0	100419376	697451497471198066	95836	79751		
DL622	+375204	+1144835	46260	0	92419324	69636149717198046	95848	79783		
DL623	+375175	+1144806	46140	0	87419369	69506149556198005	94966	79316		
DL624	+375003	+1144754	45960	0	83818947	69434149439197752	94938	79345		
DL625	+374989	+1144669	45970	0	87419925	69543149433197732	94962	79371		
DL626	+374966	+1144655	45970	0	87419933	69573149433197732	94962	79371		

DRY LAKE VALLEY GRAVITY STATIONS

A2-11

STATION IDENT.	LAT. DEG MIN	LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM	GRSV GRAV	TLL GRAV	FAA	CSA +1000
DL627	+375063	+1144591	4606S	0	90419064	69665149512197841	95317	79696		
DL628	+375080	+1144702	4606S	0	85419091	69501149379197865	94060	79236		
DL629	+375133	+1144604	4613U	0	90419193	69642149724197942	95194	79550		
DL630	+374946	+1144789	4591S	0	85418840	69379149379197670	95115	79541		
DL631	+374908	+1144629	4591S	0	87418776	69616149433197614	95024	79452		
DL632	+374914	+1144522	4612S	0	93418791	69772150201197623	95921	80343		
DL633	+374891	+1144736	4593U	0	84418740	69459149186197589	94820	79239		
DL634	+374827	+1144792	4562S	0	84418620	69380149387197496	95012	79266		
DL635	+374778	+1144722	4562S	0	84418532	69485149210197424	94906	79362		
DL636	+374760	+1144813	4560U	0	85418496	69352149427197398	95131	79594		
DL637	+374751	+1144654	4564S	0	86418484	69586149406197385	95158	79609		
DL638	+374829	+1144637	4566S	0	86418629	69607149400197498	95059	79503		
DL639	+374829	+1144524	4605S	0	92418633	69773150000197498	95838	80224		
DL640	+374747	+1144565	4602S	0	89418480	69717149617197379	95546	79939		
DL641	+374709	+1144691	4580S	0	88418379	69240149396197323	95076	79141		
DL642	+374706	+1144863	4580S	0	87418394	69281149442197320	95425	79691		
DL643	+374703	+1144836	4580S	0	85418389	69321149417197315	95206	79670		
DL644	+374700	+1144809	4580S	0	85418385	69361149305197310	95096	79560		
DL645	+374696	+1144781	4580S	0	84418378	69402149279197305	95076	79539		
DL646	+374693	+1144755	4580S	0	84418374	69440149310197300	95113	79576		
DL647	+374690	+1144729	4580S	0	85418369	69478149341197296	95147	79611		
DL648	+374687	+1144702	4582U	0	85418364	69516149346197291	95227	79684		
DL649	+374684	+1144675	4583S	0	85418360	69558149453197288	95295	79749		
DL650	+374681	+1144648	4585S	0	86418355	69598149519197283	95365	79833		
DL651	+374678	+1144620	4590S	0	86418351	69639149568197278	95485	79916		
DL652	+374674	+1144593	4597S	0	87418344	69679149627197273	95616	80024		
DL653	+374671	+1144566	4605S	0	88418340	69719149676197268	95746	80126		
DL654	+374668	+1144539	4613S	0	89418335	69758149771197264	95919	80274		
DL655	+374664	+1144512	4633S	0	90418328	69798149826197258	96169	80457		
DL656	+374648	+1144991	4654U	0	97418097	69100150213197089	96922	81146		
DL657	+374640	+1144980	4628U	0	94418268	69112150615197223	96946	81255		
DL658	+374727	+1144968	4610U	0	93418429	69126150775197350	96608	81177		
DL659	+374813	+1144972	4616U	0	92418588	69116151026197475	96491	81339		
DL660	+374899	+1144983	4640U	0	92418747	69097151452197601	97517	81784		
DL661	+374986	+1144995	4662U	0	92418907	69075151539197728	97680	81875		
DL662	+375072	+1145007	4663U	0	92419066	69054151728197853	97945	82065		
DL663	+375130	+1145014	4691U	0	94419173	69041151742197936	97950	82045		
DL664	+375215	+1145018	4707U	0	95419330	69032151539198063	97792	81826		
DL665	+375199	+1144895	4665S	0	87418305	69213151656198039	97321	81565		
DL666	+375130	+1144916	4635U	0	88419176	69155151496197938	97179	81559		
DL667	+375064	+1144911	4622U	0	87419054	69195151394197841	97049	81572		
DL668	+374978	+1144910	4603S	0	88418895	69200151192197716	96794	81162		
DL669	+374919	+1145093	4760S	0	103018040	68951150520197646	96069	81937		
DL670	+374906	+1145151	4833U	0	104418170	68863150129197150	96357	81902		
DL671	+374839	+1145051	4691U	0	104418264	69008150903197221	97526	81932		
DL672	+374872	+1145107	4748S	0	108418323	68924150685197270	96281	82195		
DL673	+374883	+1145219	5072U	0	137419339	68759148525197286	99372	82210		
DL674	+374735	+1145168	4765S	0	125418437	68832150554197362	98435	82308		
DL675	+374782	+1145217	4835S	0	131418524	68756150632197430	98364	81944		
DL676	+374864	+1145236	4841U	0	131418574	68727151391197559	98674	82320		
DL677	+374800	+1145092	4712U	0	106418560	68941151491197456	98634	82103		
DL678	+374754	+1145075	4679U	0	108418475	68966151132197389	97626	81976		
DL679	+374885	+1145049	4678U	0	106418719	69014151295197580	97738	81663		
DL680	+374875	+1145164	4805U	5	110418696	68932150706197566	98358	82064		
DL682	+374953	+1145104	4762S	0	101418643	68917150780197680	97915	81775		
DL683	+374980	+1145216	4845S	0	109418889	68760150149197720	98497	81910		

STATION IDENT.	LAT. DEG MIN	LONG. DEG MIN	ELEV. +CODE	TEMP. IN/OUT	DEPTH UTM	EAST UTM	GRSV GRAV	TEMP GRAV	DATA	DATA
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DL685	+375050	+1145147	4817S	0	102419020	68850150550197821	98061	81733		
DL686	+375139	+1145165	4848S	0	108419184	68819150729197952	98462	81975		
DL687	+375207	+1145116	4802S	0	109419312	68888151221198051	98362	82093		
DL688	+375245	+1145199	4910S	0	117419379	68765150765198106	98667	82237		
DL690	+375260	+1144454	4623Y	0	116419444	69856150439198137	95509	80157		
DL691	+375250	+1144334	4740C	0	116419419	70133150736198113	97457	81399		
DL692	+375319	+1144407	4657C	0	120419544	69923150536198214	98148	80384		
DL693	+375385	+1144474	4647C	0	113419663	69822149656198311	95077	79346		
DL694	+375381	+1144455	4647C	0	120419657	69864149826198305	95248	79516		
DL695	+375376	+1144419	46519T	0	125419649	69903150497198298	95579	79636		
DL696	+375379	+1144387	4682C	0	123419655	69950150466198302	96220	80374		
DL697	+375380	+1144357	4710C	0	124419658	69993150771198303	96793	80652		
DL698	+375380	+1144322	47401T	0	128419659	70045151003198303	97364	81304		
DL699	+375361	+1144303	4772C	0	128419625	70073151042198276	97575	81526		
DL700	+375335	+1144293	4789Y	0	127419577	70089151059198236	97890	81663		
DL701	+375331	+1144266	4834Y	0	132419571	70129151013198232	98274	81913		
DL702	+375323	+1144240	4873Y	0	136419557	70166150771198220	98411	81928		
DL703	+375313	+1144215	4921Y	0	140419539	70205150461198205	98587	82043		
DL704	+375305	+1144188	4974Y	0	147419528	70245150364198194	98681	81653		
DL705	+375299	+1144162	5024Y	0	151419515	70283149629198185	98925	81941		
DL706	+375292	+1144135	5075Y	0	160419503	70323149565198175	99173	82026		
DL707	+375284	+1144109	5126Y	0	165419490	70361149435198163	99514	82195		
DL708	+375274	+1144083	5177Y	0	175419472	70400149313198148	99887	82406		
DL709	+375264	+1144063	5219Y	9	162419454	70430149236198134	100220	82590		
DL710	+375255	+1144037	5265C	0	167419439	70468149064198121	100394	82603		
DL711	+375244	+1143942	5462C	0	210419496	7060614777419816310101	82626			
DL712	+375313	+1143836	5769Y	0	272419553	70757145713198205101991	82516			
DL713	+375270	+1143768	5972Y	0	327419476	70862144475198143102540	82196			
DL714	+375372	+1143767	6107Y	0	350419665	70859143913198291103100	82620			
DL715	+375381	+1143958	5590Y	0	216419675	70576146552198305101156	82306			
DL716	+375381	+1143880	5806Y	0	254419677	70693145446198305101785	82237			
DL719	+375347	+1144134	5040Y	0	192419605	70522150175198255	99351	82353		
DL720	+375404	+1144146	5063Y	0	197419710	70502150048198336	99358	82287		
DL721	+375370	+1144217	4890Y	0	153419645	70194150652198289	98383	81658		
DL722	+375440	+1144052	5315C	36	216419780	70436148344198391100274	82396			
DL723	+375462	+1143939	5829Y	0	227419625	70602145247198423101664	82033			
DL725	+375496	+1143816	6216Y	0	286419692	70781143047198473103076	82163			
DL726	+375523	+1143916	6174Y	0	296419739	70830142606198513102405	81643			
DL735	+375730	+1143681	5722Y	0	269420323	7067514066519861511064	82396			
DL736	+375732	+1143953	5560C	0	253420324	70569147631198618106591	81660			
DL739	+375776	+1143766	6059C	0	314420412	70641144431198682102175	81623			
DL740	+375795	+1143776	6775Y	0	240420411	70679145491198694101935	81476			
DL741	+375807	+1143909	5442Y	0	217420461	70496147613198927101103	81949			
DL742	+375775	+1144131	5220Y	0	197420398	70350149324198880	99571	81363		
DL743	+375834	+1144109	5879Y	0	621420507	70350144422198966100234	81355			
DL744	+375881	+1144123	5160Y	0	181420593	70313149263199035	98613	81334		
DL745	+375896	+1144041	5308Y	0	184420624	70433149137199057	99335	81414		
DL746	+375915	+1143945	5584C	0	229420663	70575146613199085100062	81265			
DL747	+375874	+1143916	5856T	0	243420588	70617146535199025100014	81237			
DL749	+375964	+1143841	5972Y	0	287420757	70722144299199157101378	81269			
DL750	+375991	+1143856	5269	0	135420799	704091466151992196	98785	81031		
DL751	+375946	+1144113	5101Y	0	159420713	702411493781492130	98253	81114		
DL752	+375994	+1144239	4963Y	0	162420728	70136149932199201	97409	80624		
DL753	+375954	+1144240	4962Y	0	139420724	70132149932199142	97356	80523		
DL754	+375908	+1144311	4868Y	0	131420636	70037149666199075	96404	79431		
DL755	+375933	+1144370	4815Y	0	131420681	69979149932199112	96131	79440		
DL756	+375901	+1144356	4815Y	0	129420671	69941149932199013	96001	79440		

STATION IDENT.	LAT. DEG MIN	LONG. DEG MIN	ELEV. +CODE	TEMP. IN/OUT	COR. NORTH UTM	EAST UTM	GRSV GRAY	THEO GRAY	FAA	CPA
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DL757	+375891	+1144493	4777S	0	109420598	69771149738199050			95640	79460
DL758	+375878	+1144470	47720	0	111420575	69696149674199031			95551	79366
DL759	+375853	+1144481	4764S	0	109420529	69791149559198995			95398	79258
DL760	+375831	+1144490	4756S	0	109420488	69776149505198963			95301	79166
DL761	+375859	+1144360	47989T	0	127420544	69967149635199003			95792	79553
DL762	+375864	+1144230	4961Y	0	142420558	70149149720199011			97397	80618
DL763	+375805	+1144339	48031T	0	132420445	70001149654198924			96125	79875
DL764	+375787	+1144422	4746S	0	119420409	69660149553198896			95316	79250
DL765	+375701	+1144439	4720S	0	121420249	69659149457198773			95114	79126
DL766	+375727	+1144333	47940T	0	133420301	70013150660198810			96366	80188
DL767	+375789	+1144224	4986S	0	150420419	70170149435198901			97657	81401
DL768	+375727	+1144204	4963Y	0	170420306	70202150196198810			98281	81455
DL769	+375653	+1144219	4909Y	0	166420168	70183150730198702			98226	81669
DL770	+375648	+1144303	47641T	0	149420156	70060150769198695			96907	80607
DL771	+375636	+1144302	4698Y	0	131420130	69931149717198677			95263	79562
DL772	+375625	+1144481	4711Y	0	108420107	69631149329198681			95093	79043
DL773	+375542	+1144420	4677S	0	121419956	69694149576198540			95053	79225
DL774	+375528	+1144337	4670S	0	151419933	70016150289198520			95710	79441
DL775	+375579	+1144276	47310T	0	177420029	70103151205198594			97133	81174
DL776	+375491	+1144254	47549T	0	186419967	70139151122198466			97710	81676
DL777	+375472	+1144461	4664S	0	113419824	69646149441198438			96694	79101
DL778	+375458	+1144374	4667S	0	142419802	69665150258198417			95762	79956
DL779	+375420	+1144303	47461T	0	138419734	70071151088198362			97390	81341
DL780	+38 762	+1144385	5618Y	0	108422213	69690147006200324			99556	80502
DL781	+38 761	+1144303	5775Y	0	126422214	700101466642003231			99693	81122
DL782	+38 771	+1144225	5627Y	0	124422236	70123146358200336			99976	79911
DL783	+38 815	+1144274	5687Y	0	126422315	70050146385200402			99566	80235
DL784	+38 807	+1144421	5856Y	0	148422295	69635145479200390			100204	80375
DL785	+38 819	+1144491	5702Y	0	122422315	69733146537200406			99794	80466
DL786	+38 873	+1144352	5747Y	10	122422420	69933146349200487			99947	80477
DL787	+38 922	+1144445	5665Y	0	136422507	69795146689200559			99635	80581
DL788	+38 755	+1144039	5712S	0	128422213	70396145450200314			93694	79540
DL789	+38 794	+1144118	5781S	0	139422282	70279145386200371			96233	79714
DL790	+38 794	+1143968	5762Y	0	106422285	70498145681200371			99738	80231
DL793	+38 834	+1143876	5847Y	0	202422365	70627146112200436			100712	80972
DL795	+38 930	+1143983	6030Y	0	155422339	70476143360200570			102142	80796
DL800	+38 892	+1144276	6034Y	0	149422458	70043144713200515			100449	80558
DL801	+381022	+1144485	5749Y	0	117422691	69735146295200705			99687	80215
DL803	+38 997	+1144400	6073Y	0	150422607	69657144794200580			101204	80720
DL804	+38 963	+1144323	6117Y	0	164422557	699711447962006191			101061	80960
DL805	+381005	+1144263	6058Y	0	306422657	70157141123200680			103139	80787
DL811	+38 957	+1143793	6153Y	0	124422596	70746144353200691			101466	80672
DL819	+381068	+1144025	5953Y	0	125422772	69616145734200772			100989	80614
DL820	+381149	+1144439	6168Y	79	181422527	69794143736200782			110957	80181
DL826	+381213	+1144420	5872Y	0	125423006	69610145702200984			100180	80281
DL829	+375334	+1147674	6509S	0	504419607	70965141423197244			104443	82740
DL839	+374176	+1145261	5031Y	0	121417400	68719148412196516			99203	82205
DL840	+374174	+1145289	5073Y	0	127417396	68674146285196543			99405	82309
DL841	+374173	+1145315	5111Y	0	133417393	68640146166196541			99727	82426
DL842	+374175	+1145342	5157Y	0	141417395	68601467956196545			99905	825
DL843	+374177	+1145365	5191Y	0	159417329	685551467661965461			101174	82625
DL844	+374180	+1145395	5233Y	0	142417303	685221477481965521			100463	82517
DL845	+374179	+1145423	5265Y	0	196417400	684811477391965511			100749	83028
DL846	+374181	+1145453	5330Y	0	220417403	684351475161965531			101125	83166
DL847	+374180	+1145482	5372Y	0	232417400	683941475321965521			101332	83267
DL848	+374186	+1145509	5412Y	0	223417411	683561471231965511			101497	83267
DL849	+374192	+1145537	5454Y	0	233417412	683191471231965511			101652	83267

STATION IDENT.	LAT. DEG MIN	LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM	GRSV GRAV	THED GRAV	FAA	CRA +1000
DL850	+374090	+1145431	5504S	0	167417236	68473146010196421101390				62784
DL851	+374093	+1145303	5055Y	0	145417235	68661146457196425	99666			62509
DL855	+373952	+1145313	5120Y	0	115416984	68652147895196220	99861			62513
DL856	+373971	+1145418	5310S	0	143417016	68497146609196247150536				62508
DL857	+373960	+1145542	5599S	0	196416992	68315145330196231101794				62693
DL858	+373872	+1145328	5050Y	0	118416636	68633148235196103	99622			62516
DL859	+373891	+1145439	5268S	0	121416867	68469147650196130101309				63462
DL860	+373936	+1145665	5638S	45	280416943	68135146346196196101215				62310
DL861	+373820	+1145273	4974S	0	101416742	68716146657196027	98541			61977
DL862	+373802	+1145383	5059Y	0	105416705	68555147479196001	99080			61939
DL863	+373857	+1145469	5211S	0	120416803	68397147808196081100769				63116
DL864	+373779	+1145408	5113Y	0	110416658	68387147635195967	99187			61456
DL865	+373856	+1145596	5268S	0	141416797	68240145610196080100299				62472
DL866	+373866	+1145586	5247S	0	186416613	68104147055196095100363				62653
DL867	+373821	+1145714	5155S	0	141416729	68066147227196029	99713			62272
DL868	+373880	+1145791	5219S	0	192416836	67952147424196115100433				62631
DL869	+373820	+1145624	5072S	0	138416724	67906147779196027	99466			62312
DL870	+373896	+1145686	5162S	0	209416662	67612147574196136100626				62629
DL871	+373820	+1145934	5058S	0	123416720	67744147787196027	99362			62233
DL874	+374043	+1145577	6018S	0	332417144	68260142135196352102723				62536
DL878	+374221	+1145343	5304S	0	147417481	68597147023196012100329				62366
DL881	+374316	+1145272	5012S	0	150417648	68686148063196741	99476			62526
DL882	+374313	+1145376	5308S	12	156417650	68544147224196746105433				62497
DL883	+374373	+1145265	4980	0	145417764	68705149277196034	99311			62476
DL886	+374434	+1145272	5034S	0	132417677	68692149080196423	99333			62495
DL887	+374430	+1145330	5132S	0	152417868	68607148504196416	99926			62574
DL888	+374414	+1145423	5294S	0	207417835	68471147729196893100656				62606
DL889	+374432	+1145514	5614S	0	197417865	68337146130196920102047				63096
DL890	+374465	+1145379	5202S	0	164417931	68534148175196966100165				62557
DL891	+374495	+1145467	5399Y	0	228417983	68403147306197012101106				62920
DL892	+373819	+1144535	48040	0	108416755	69364146472196026	97664			61387
DL893	+373957	+1144634	47200	0	103416917	69356146742196154	97607			61312
DL894	+373996	+1144635	46680	0	101417082	69353148677196284	96523			60703
DL895	+374083	+1144634	46390	0	96417243	69351148975196410	96220			60494
DL896	+374170	+1144835	46170	0	94417404	69346149154196536	96067			60415
DL897	+374193	+1144834	4612S	0	95417446	69346149203196571	96035			60400
DL898	+374211	+1144833	46090	0	93417485	69346149235196602	96068			60381
DL899	+374235	+1144832	4602S	0	91417524	69347149258196632	95934			60332
DL900	+374259	+1144831	45960	0	90417568	69347149280196667	95869			60286
DL901	+374289	+1144828	45930	0	93417624	69351149289196711	95800			60228
DL902	+374315	+1144829	4590S	0	94417672	69348149295196746	95742			60180
DL903	+374347	+1144829	45870	0	92417731	69347149316196795	95688			60135
DL904	+374369	+1144834	4586S	0	93417772	69338149320196827	95651			60102
DL905	+374391	+1144839	4584S	0	93417812	69336149359196859	95639			60097
DL906	+374411	+1144842	4584S	0	92417849	69325149381196889	95631			60089
DL907	+374432	+1144846	4584S	0	92417886	69315149414196920	95634			60091
DL908	+374454	+1144851	4581S	0	93417928	69310149411196952	95576			60045
DL909	+374476	+1144856	4580S	0	93417969	69301149430196984	95548			60020
DL911	+374167	+1144517	4735S	0	111417409	69013149035196533	97663			61424
DL912	+374169	+1144508	4660S	0	109417412	69767149351196536	97457			61405
DL913	+374170	+1144576	4646S	0	106417413	69726149920196536	97165			61365
DL914	+374179	+1144602	4630S	0	104417412	69688149711196536	96746			61055
DL915	+374179	+1144631	4615S	0	102417411	69645149492196535	96366			60747
DL916	+374179	+1144665	4610S	0	99417410	69595149235196535	96081			60457
DL917	+374169	+1144696	4607S	0	97417407	69550149133196535	95953			60336
DL918	+374171	+1144723	46070	0	96417409	69510149091196539	95908			60296
DL919	+374171	+1144767	4608S	0	96417409	69510149091196539	95908			60296

STATION IDENT.	LAT. DEG MIN	LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM	GRSV GRAV	THEO GRAV	DIFF	CHG +1960
DL920	+374171	+1144780	4609S	0	94417407	69426149	116196539	95953	86327	
DL921	+374171	+1144807	4612S	0	95417406	69386149	134196539	95998	86352	
DL922	+374172	+1144876	4628S	0	95417406	69285149	157196541	96171	86481	
DL923	+374171	+1144902	4644S	0	94417403	69247149	154196539	96319	86574	
DL924	+374173	+1144926	4650S	0	96417406	69209149	165196541	96478	86680	
DL925	+374174	+1144957	4662S	0	94417407	69166149	221196543	96739	86855	
DL926	+374172	+1144983	4702S	0	95417402	69128149	307196541	97017	87075	
DL927	+374172	+1145011	4729S	0	95417401	69086149	349196541	97313	87280	
DL928	+374172	+1145037	47540	0	94417400	69046149	340196541	97546	87423	
DL929	+374173	+1145057	47780	0	100417402	69019149	255196541	97849	87693	
DL930	+374174	+1145083	4798S	0	101417403	68981149	232196543	97842	87579	
DL931	+374171	+1145110	48300	0	104417396	68941149	125196539	98042	87672	
DL932	+374176	+1145134	4854S	0	105417405	68906149	055196546	98190	87740	
DL933	+374172	+1145162	48900	0	106417396	68865148	082196541	98364	87797	
DL934	+374177	+1145204	49290	0	112417404	68803148	042196546	98670	87902	
DL935	+374177	+1145231	49646	0	113417403	68763148	0567196546	98924	88043	
DL936	+373819	+1144556	50380	0	147416764	69771148	214196026	99602	82566	
DL937	+373825	+1144643	49270	0	124416772	69643148	259196034	98592	81911	
DL938	+373819	+1144722	48500	0	117416758	69527148	0570196026	98188	81763	
DL939	+373825	+1144609	4863S	0	122416903	69696148	730196137	98359	81695	
DL940	+373907	+1144502	49600	0	162416929	69646149	080196154	99793	82976	
DL941	+373907	+1144724	47540	0	109416921	69526148	091196154	97477	81371	
DL942	+373939	+1144588	48270	0	120416985	69719149	092196201	98318	81974	
DL943	+373994	+1144502	48920	0	127417090	69843149	349196280	99107	82549	
DL944	+373994	+1144614	47520	0	112417086	69676149	147196280	97587	81491	
DL945	+373995	+1144724	46700	0	106417084	69516148	089196282	96740	80807	
DL946	+374081	+1144516	4772S	0	114417256	69615149	794196408	98295	82133	
DL947	+374082	+1144625	4668S	0	105417248	69656149	302196409	96623	81607	
DL948	+374083	+1144723	46340	0	100417247	69514149	052196410	96251	80546	
DL949	+374211	+1144533	4675S	0	108417490	69787150	232196597	97631	81793	
DL950	+374232	+1144637	45660	0	100417525	69634149	410196628	95971	80429	
DL951	+374259	+1144721	45840	0	94417572	69509149	179196667	95652	80111	
DL952	+374278	+1144561	4598S	0	104417613	69743150	306196695	96882	81303	
DL954	+374346	+1144607	45800	0	97417737	69673149	475196794	95734	80260	
DL955	+374346	+1144717	45600	0	92417733	69511149	217196794	95525	79996	
DL956	+374405	+1144625	45790	0	94417846	69644149	423196880	96635	80111	
DL957	+374436	+1144521	4595S	0	102417895	69795150	159196916	96485	80015	
DL958	+374432	+1144731	4580S	0	89417892	69687149	245196920	95427	79493	
DL959	+374495	+1144785	4560S	0	89418906	69405149	399197012	95399	79667	
DL960	+374495	+1144588	4567S	0	93418613	69694149	021197012	95777	80225	
DL961	+374499	+1145212	4612S	0	124417999	68777149	764197017	98974	82345	
DL962	+374457	+1145003	46699	0	100417929	69086150	176196956	97163	81335	
DL963	+374432	+1144918	4610S	0	96417885	69212149	013196920	96077	80651	
DL964	+374432	+1145062	47310	0	105417880	69001150	0284196920	97668	81357	
DL965	+374432	+1145142	4854S	0	113417877	68850149	305196920	96426	81964	
DL966	+374346	+1144910	46380	0	96417729	69183149	47196797	95398	80675	
DL967	+374363	+1145015	46890	0	101417754	69073149	416196814	97226	81334	
DL968	+374348	+1145105	47760	0	111417724	68941149	067196797	96018	81339	
DL969	+374346	+1145161	48350	0	118417722	68459149	065196797	94374	82101	
DL970	+374289	+1145025	47119	0	100417617	69061149	784196711	97417	81436	
DL971	+374252	+1144926	4650S	0	95417571	69208149	303196672	96592	80627	
DL972	+374218	+1145120	4813S	0	111417538	68923149	05196651	98166	81653	
DL973	+374218	+1145227	49490	0	124417479	68767148	783196607	96751	81996	
DL974	+374116	+1145044	47201	0	94417300	69045149	126196662	97574	81395	
DL975	+374087	+1144936	4672S	0	100417247	69201149	111966416	96563	80723	
DL976	+374001	+1144943	4660S	0	100417087	69194149	084196291	96636	80974	
DL977	+374001	+1144943	4660S	0	100417087	69194149	084196291	96636	80974	

STATION IDENT.	LAT. DEG MIN	LONG. DEG MIN	ELEV. +CODE	TER-FOR. IN/OUT	NORTH UTM	EAST UTM	GRSV GRAV	THEO GRAV	FAA	CSA +1000
DL978	+374087	+1145139	4868S	0	110417240	68902148741196416	98137	81644		
DL979	+374105	+1145222	4964S	0	122417270	68779148556196443	98636	82021		
DL980	+374017	+1145140	49210	0	126417110	68904148339196314	98365	81697		
DL982	+373912	+1144949	4712S	0	102416923	69189149219196161	97402	81433		
DL983	+373949	+1145060	47539T	0	130416987	69024149099196215	97624	81539		
DL984	+373907	+1145162	49600	0	115416906	68476148019196154	98544	81742		
DL985	+373896	+1145217	4990S	0	110416884	68796148154196138	98978	82068		
DL986	+373862	+1145073	48041T	0	102416826	69009148589196086	97711	81428		
DL987	+373820	+1144996	4755S	0	104416751	69124148725196027	97447	81333		
DL988	+373820	+1145158	48820	0	101416745	6885148213196027	98130	81580		
DL989	+373776	+1145086	48100T	0	101416666	68993148030195963	97333	81029		
DL990	+373674	+1145225	48629T	0	100416473	68793147425195814	97366	80893		
DL991	+373692	+1145089	48090T	0	114416511	68992147649195841	97066	80776		
DL992	+373699	+1145019	48461T	0	105416526	69095147567195851	97322	80898		
DL993	+373706	+1144918	49671T	0	108416543	69243147276195861	97595	80955		
DL994	+373722	+1144814	49459T	0	117416576	69396147407195844	98070	81317		
DL995	+373726	+1144696	4995Y	0	139416587	69569148045195890	99166	82268		
DL996	+373735	+1144600	51191T	0	159416609	69710147787195905	100059	82759		
DL997	+373714	+1145955	49710	0	99416523	67717147950195873	98866	82005		
DL998	+373732	+1145822	50900		109416561	67912147197195899	99201	81646		
DL999	+373687	+1145600	49961T		96416484	68182147027195834	98212	81172		
DL1000	+373728	+1145602	5052S		101416561	68236148462195893	98614	81363		
DL1001	+373676	+1145494	4942S		95416457	68397147100195809	98271	81245		
DL1002	+373661	+1145371	4942S	0	99416444	68579147127195795	97641	81064		
DL1003	+373672	+1145259	48810	0	99416468	68783147415195812	97539	80990		
DL1004	+373729	+1145273	49200	0	97416573	68726147414195895	97822	81139		
DL1006	+38 776	+1145748	5537Y	0	102422193	67896148446200345	98714	79931		
DL1007	+38 864	+1145749	5678Y	0	114422356	67893148588200473	99553	80301		
DL1008	+38 952	+1145749	5615Y	0	126422518	67889148600200602100325	99616	80616		
DL1009	+381023	+1145715	6371Y	0	265422651	67936148697200706102354	80689	80689		
DL1010	+38 928	+1145655	5891Y	0	139422477	68026148696200567106773	80619	80619		
DL1011	+38 853	+1145693	5788Y	0	114422337	67975148654200457100270	80643	80643		
DL1013	+38 874	+1145574	5903Y	0	138422386	681441485816200486100885	80889	80889		
DL1014	+38 803	+1145520	5722Y	0	125422250	682301486974200384100442	81 51	81 51		
DL1015	+381001	+1145578	6144Y	0	173422615	68137149679200674101631	81049	81049		
DL1016	+38 942	+1145520	6150Y	0	152422507	682201494122005588101707	80663	80663		
DL1020	+38 805	+1145289	5407Y	0	132422262	68567148051200387 99300	80722	80722		
DL1021	+38 864	+1145310	5560Y	0	163422379	68534147620200473 99482	80661	80661		
DL1022	+38 906	+1145362	5852Y	0	136422446	68457148056200535100606	80776	80776		
DL1023	+38 951	+1145308	5659Y	0	160422531	68533148679200601 99337	80196	80196		
DL1024	+38 998	+1145408	6039Y	0	173422615	68585147735200670100992	80660	80660		
DL1027	+381048	+1145307	5823Y	0	179422710	68531148657200743100717	81036	81036		
DL1029	+38 36	+1145359	5616Y	0	130420537	68497148696199262100589	81504	81504		
DL1030	+38 87	+1145266	5413Y	0	120420734	686261486292199337 99695	81557	81557		
DL1031	+38 128	+1145400	5563Y	0	133421906	68434147309199397100456	81547	81547		
DL1033	+38 173	+1145297	5354Y	0	137421092	68582148766199463 99693	81569	81569		
DL1034	+38 217	+1145255	52900	0	123421175	68640149299199527 99557	81638	81638		
DL1035	+38 224	+1145283	53426	0	124421187	68601148939199537 99727	81631	81631		
DL1036	+38 232	+1145311	53956	2	117421197	68559148639199546 99667	81585	81585		
DL1037	+38 234	+1145330	59760	0	129421204	68520148177199552100162	81615	81615		
DL1038	+38 244	+1145364	55766	0	146421221	68481147643199586100555	81603	81603		
DL1042	+38 402	+1145201	5300Y	0	128421516	68561147242199790100077	81656	81656		
DL1043	+38 439	+1145333	5446Y	2	99421583	6851914870019925610103	81624	81624		
DL1046	+38 563	+1145335	5359T	1	111421512	68510149135200033 99331	81290	81290		
DL1047	+38 563	+1145437	5465T	2	93421609	68361148264200033 99673	81125	81125		
DL1048	+38 614	+1145399	5516Y	0	96421965	68415148625200106 99650	81125	81125		
DL1051	+38 681	+1145399	5633Y	0	100420966	68491148635100102 99671	81125	81125		

STATION IDENT.	LAT. DEG MIN	LONG. DEG MIN	ELEV. +CODE	TOP-COR. IN/OUT	NORTH UTM	EAST UTM	IRSV GRAV	PREC GRAV	FWA	CSA +1000
DL1052	+38 743	+114 545	55080	0	130422141	68325147955200296100044				81199
DL1053	+38 715	+114 554	55820	0	101422087	68204147772200255	99862			80993
DL1054	+374509	+114 383	5393Y	0	120418066	70796146766197032100492				82215
DL1055	+374504	+114 398	5815Y	0	309418051	70573144606197024102312				82788
DL1056	+374540	+114 428	4935Y	0	148418107	70136150419197077	99785			83101
DL1057	+374515	+114 440	4676Y	0	112418057	69968151361197041	98346			82509
DL1058	+374527	+114 449	46400	0	97418076	69835150108197056	96716			80987
DL1059	+374586	+114 448	46500	0	94418185	69835149916197144	96533			80767
DL1060	+374590	+114 444	4697Y	0	102418195	69945150762197150	97519			81901
DL1061	+374601	+114 432	4761Y	0	116418219	70083151409197166	99048			82928
DL1062	+374563	+114 415	5621Y	0	253418154	70321146090197111101882				82963
DL1063	+374576	+114 407	5441Y	0	128418181	70441147012197130101090				82661
DL1064	+374592	+114 396	5466Y	0	129418215	70607147055197153101345				82831
DL1065	+374568	+114 388	5301Y	0	125418173	70719147447197116100218				82263
DL1066	+374576	+114 372	5421Y	0	118418192	70659146593197130100482				82111
DL1067	+374619	+114 363	5258Y	0	132418269	70768147716197192100008				82207
DL1068	+374696	+114 376	5416Y	0	142418415	70896147649197305101316				82986
DL1069	+374713	+114 388	5273Y	0	167418442	70724148141197330100437				82626
DL1070	+374694	+114 398	5231Y	0	123418403	70576148126197302100520				82631
DL1071	+374665	+114 407	5121Y	0	128418346	70446149455197259100396				83052
DL1072	+374625	+114 413	5575Y	0	243418270	70347148479197201101767				82975
DL1073	+374620	+114 423	4928Y	0	140418257	70205150541197194	99724			83155
DL1074	+374637	+114 427	48370	0	122418287	70141151196197219	99216			82943
DL1075	+374642	+114 431	47950	0	109418295	70084151088197226	98988			82743
DL1076	+374646	+114 434	47730	0	105418301	70044151058197232	98745			82571
DL1077	+374648	+114 432	47440	0	107418304	70094150926197234	98337			82263
DL1078	+374652	+114 430	47230	0	98418310	69966150706197241	97913			81902
DL1079	+374660	+114 424	4694Y	0	98418324	69928150457197252	97360			81468
DL1080	+374660	+114 445	46710	0	93418323	69876150111197252	96817			80979
DL1081	+374661	+114 448	46510	0	92418324	69838149933197254	96449			80678
DL1082	+374699	+114 417	4937Y	0	137418405	70297150442197309	99595			82894
DL1083	+374729	+114 421	5424Y	0	513418458	70193146902197353100596				82609
DL1084	+374735	+114 434	47440	0	101418465	70027150954197362	98238			82158
DL1085	+374745	+114 439	4673Y	0	93418481	69902150123197376	96696			80861
DL1086	+374749	+114 407	5031Y	0	118418501	70430149686197382	99851			82810
DL1087	+374789	+114 415	4964Y	0	107418572	70315150026197441	99296			82472
DL1088	+374782	+114 374	5490Y	0	174418574	70691147392197430101632				83041
DL1089	+374798	+114 388	6369Y	0	862418601	70796141098197453103590				82729
DL1090	+374861	+114 375	5870Y	0	195418720	70963145106197545102601				82975
DL1091	+374871	+114 384	5942Y	232	330418735	70766144069197560102435				82730
DL1092	+374789	+114 395	5130Y	0	153418540	70607149275197441100114				82773
DL1093	+374859	+114 394	5196Y	0	155418709	70616149973147542100336				82769
DL1094	+374810	+114 407	4967Y	0	119418614	70431150022197471	99484			82594
DL1095	+374833	+114 407	4967Y	0	122418749	70435149796197577	99150			82262
DL1096	+374931	+114 375	5642Y	38	254418850	70903146005197646102057				83116
DL1097	+374950	+114 385	5617Y	0	212418881	70754147687197675101196				82927
DL1100	+375120	+114 376	5772Y	0	290419199	70681145909197923102310				82913
DL1101	+375126	+114 378	5728Y	4	255419239	70644146125197932102108				82831
DL1102	+375152	+114 382	5642S	0	255419256	70785146573197970101702				82718
DL1103	+375219	+114 385	5615Y	0	241419379	70737146774198066101554				82645
DL1104	+375165	+114 385	5577Y	0	231419279	70741147620197989101518				82726
DL1105	+375181	+114 389	5694Y	0	218419307	70684147436198013101131				82611
DL1106	+375195	+114 392	5644Y	0	204419332	70641147642198033101044				82680
DL1107	+375208	+114 394	5617Y	0	210419355	70607148678198052100913				82641
DL1108	+375224	+114 395	5373Y	0	197419384	70575148379198076100871				82742
DL1109	+375234	+114 397	5321Y	0	191419401	70535148665198091100655				82656

STATION IDENT.	LAT. DEG MIN	LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM	GRSV GRAV	TRC GRAV	SEA +1000
DL1111	+375131	+1143870	5527Y	0	222419215	70719147233197940101310			82681
DL1112	+375120	+1143951	5343Y	0	185419192	70601146249197923100610			82571
DL1113	+375167	+1143989	5280B	0	181419278	70543148790197992100490			82562
DL1114	+375195	+1144088	5106Y	0	150419326	70396149253198033	99273		82008
DL1115	+375138	+1144059	5136Y	0	147419221	70441149406197950	99754		82424
DL1116	+375083	+1144054	5104Y	0	144419120	70451149233197870	99402		82138
DL1117	+375012	+1144033	5072Y	0	140418989	70485149034197766	99008		81849
DL1118	+374910	+1144002	5096Y	0	139418802	70535149033197617	99375		82133
DL1119	+374981	+1143922	5257Y	0	183418936	70650148230197720	99976		82229
DL1120	+375052	+1143951	5259Y	0	181419066	70604148281197824	99950		82194
DL1121	+375229	+1144227	4919B	0	127419384	70191150510198083	98720		82070
DL1123	+375200	+1144428	4638S	0	112419323	69697150904198041	96511		80304
DL1124	+375194	+1144326	4752Y	0	112419315	70047150916198031	97605		81510
DL1125	+375143	+1144215	4697B	0	122419225	70212150486197957	98617		82037
DL1126	+375068	+1144177	4901Y	0	123419088	70271150318197848	98593		82006
DL1127	+374963	+1144164	4829Y	0	123419094	70295150450197895	98201		81654
DL1128	+374874	+1144170	4925Y	0	111418729	70291150267197564	99049		82363
DL1129	+374949	+1144227	4849Y	0	109418666	70204150626197874	98586		82156
DL1130	+375026	+1144235	4821Y	0	112419012	70186150789197789	98376		82039
DL1131	+375041	+1144230	4945Y	0	124419110	70193150117197866	98788		82046
DL1132	+375108	+1144316	47510T	0	108419157	70066150865197906	97678		81582
DL1133	+375137	+1144391	4666Y	0	108419208	69955151152197946	97115		81306
DL1134	+375147	+1144494	4617S	0	105419222	69803150403197963	95890		80247
DL1135	+375050	+1144392	4674Y	0	101419047	69957151024197821	97189		81346
DL1136	+375059	+1144493	4625C	0	98419060	69608150427197834	96117		80441
DL1137	+374975	+1144446	4652C	0	96418906	69681150626197712	96696		80926
DL1138	+374995	+1144333	4727Y	0	101418947	70045150946197741	97690		81006
DL1139	+374952	+1144335	4736Y	0	100418067	70045150876197678	97769		81716
DL1140	+374875	+1144280	4806Y	21	104418727	70129150423197566	98840		82360
DL1141	+374875	+1144391	4696Y	1	96418723	69966150576197566	97593		81583
DL1142	+374824	+1144403	4696Y	0	95418628	69951150769197491	97471		81559
DL1143	+374917	+1144447	4648C	0	95418799	69982150646197627	96769		81602
DL1144	+374805	+1144291	4834Y	0	105418597	701161504950197464	98979		82597
DL1145	+374508	+1145335	5111Y	0	167418012	68596148952197030100622			82757
DL1146	+374575	+1145427	5305Y	0	218418133	68459147646197126100645			82769
DL1147	+374587	+1145287	5071B	0	135418160	68664149240197145	99618		82655
DL1148	+374636	+1145347	5158B	0	169418208	68574148923197217100249			82825
DL1149	+374662	+1145403	5501B	0	184418290	68490148543197255101060			82461
DL1150	+374644	+1145463	5810B	0	231418259	68403143913197229101366			81759
DL1151	+374691	+1145277	5128B	0	136418352	68674148676197290	99841		82487
DL1152	+374741	+1145368	5048B	0	207418444	68626149625197370	99762		82752
DL1153	+374745	+1145427	5916B	0	330418447	68452144722197370103625			83176
DL1154	+374706	+1145524	6286B	0	395418372	68311141655197320103259			82455
DL1155	+374771	+1145539	6708B	0	644418492	6828613819731974101	9922		81667
DL1156	+374831	+1145486	5735B	0	211418604	68361145396197500101668			82518
DL1157	+374819	+1145366	5345B	0	150418586	68531447623197484100545			82577
DL1158	+374871	+1145317	5010B	0	145418684	68606149694197560	99487		82545
DL1159	+374904	+1145126	5214B	0	171418741	68426148938197630100472			82796
DL1160	+374936	+1145521	5366B	0	160418797	68366148213197655101059			82923
DL1161	+374675	+1145601	5692B	2	202418682	68191146390197566101757			82694
DL1163	+375000	+1145552	5561B	51	180418915	68258148956197746101565			82617
DL1164	+374971	+1145425	5190B	0	154418665	68425149176197726100310			82766
DL1165	+375023	+1145397	5171Y	0	133418462	68484149664197782	99918		82444
DL1166	+375038	+1145328	5075Y	0	121418492	68585149482197804	99444		82262
DL1167	+375055	+1145259	4952B	0	115419026	68585150330197829	99387		82516
DL1168	+375053	+1145483	5741B	0	187419015	68357145551197826101651			82423
DL1169	+375073	+1145483	5741B	0	187419015	68357145551197826101651			82423

STATION IDENT.	LAT. DEG MIN	LONG. DEG MIN	ELEV. +CODE	TEMP. IN/OUT	EAST UTM	GRSV UTM	TIME GRAV	FAV GRAV	Q13 +1000
DL1170	+375109	+1145457	5478S	0	149419119	68392147464	197908101112	62577	
DL1171	+375104	+1145322	5464S	0	201419115	68591147148	197900100107	61676	
DL1172	+375160	+1145371	5422S	0	144419216	68516147446	197982100495	62146	
DL1173	+375169	+1145262	5069S	0	117419237	68676150126	197995 99836	62664	
DL1174	+375220	+1145342	5169S	0	153419328	68556146992	198070 99767	62222	
DL1175	+375199	+1145444	5617S	0	162419286	68408146577	198039101403	62407	
DL1176	+375212	+1145522	5622S	0	226419308	68293145542	198058102278	62647	
DL1177	+375147	+1145521	5668S	0	200419187	68297145575	197963100957	61625	
DL1178	+375217	+1145597	6917S	0	207419314	68183136461	198065103501	61116	
DL1179	+375119	+1145627	6502S	236	554419132	68143139624	197922103099	61712	
DL1180	+375033	+1145642	6498S	0	691418973	68124139627	197797103190	61716	
DL1181	+374949	+1145312	5029S	1	121418828	68612149787	197674 99443	62413	
DL1913	+38 505	+1145090	5141S	0	111421713	68671115094	199946 99383	61959	
DL1914	+38 640	+11448925	6951T	0	92021970	69155149937	200145 97741	80455	
DL1918	+375417	+1144743	4652S	0	90419713	69426150632	198337 96054	80277	
DL1919	+374203	+1145037	47520T	0	95417458	69047149399	196545 97535	61425	
DL1961	+374525	+1144684	45600	0	87418065	69552149522	197055 95568	60034	
DL2000	+374595	+1144984	46400	0	94418185	69106150362	197157 96909	61163	
DL2001	+374598	+1145011	4666Y	0	97418189	69066150496	197162 97245	61426	
DL2002	+374599	+1145038	4684Y	0	101418190	69029150603	197163 97521	61646	
DL2003	+374601	+1145064	4715Y	0	100418193	68990150621	197166 97627	61646	
DL2004	+374593	+1145089	4774Y	0	100418177	68954150561	197155 98334	62151	
DL2005	+374592	+1145115	4776Y	0	112413175	68916150389	197153 98163	62005	
DL2006	+374590	+1145178	4873Y	0	121418169	68824149805	197150 98515	62016	
DL2007	+374590	+1145204	4918Y	0	115418168	68785149626	197150 98762	62103	
DL2008	+374589	+1145232	4962Y	0	126418165	68744149501	197146 99050	62252	
DL2009	+374588	+1145260	5010Y	0	125418162	68703149432	197147 99435	62472	
DL2010	+374586	+1145313	5118Y	0	137418157	68626149013	197144100035	62716	
DL2011	+374585	+1145338	5163Y	0	149418154	68589148685	197143100132	62672	
DL2012	+374583	+1145365	5211Y	0	179418150	68549148376	197140100260	62686	
DL2013	+374585	+1145402	5266S	0	175418152	68495147989	197143100594	62740	
DL2060	+373975	+1145699	5260Y	0	283417008	67789147053	196253100303	62646	
DL2061	+374060	+1145430	5552S	0	347417164	67791145373	196377101249	62659	
DL2062	+374127	+1145921	5683S	0	248417288	67751144702	196475101713	62576	
DL2063	+374190	+1145916	5549S	0	240417405	67753145026	196566101499	62613	
DL2064	+374360	+1145506	5545Y	0	230417732	68349146629	196614101601	62916	
DL2065	+374272	+1145324	50870	0	158417576	68622148691	196686 99676	62683	
DL2066	+375864	+1144950	4734S	0	115420550	69835149646	199211 95476	72337	
DL2067	+375852	+1144427	4766S	0	117420529	69676149614	198993 95473	79335	
DL2068	+375839	+1144402	4773S	0	121420506	69407149603	198974 95547	79389	
DL2069	+375827	+1144381	4775S	0	126420484	69436149662	198956 95643	79483	
DL2070	+375813	+1144357	4790C	0	127420459	69470149767	198936 95910	79699	
DL2071	+375770	+1144316	4832C	0	136420418	70035149962	198902 96533	80189	
DL2072	+375779	+1144294	4866C	0	136420398	70066149967	198886 96675	80214	
DL2073	+375766	+1144272	4900C	0	141420375	70106149971	198867 97217	80646	
DL2074	+375754	+1144250	4932C	1	146420354	70135150017	198850 97577	80902	
DL2075	+375742	+1144229	4962C	0	154420332	70165150068	198832 97911	81141	
DL2076	+375716	+1144182	5020C	0	184420286	70235150072	198795 98721	81784	
DL2077	+375704	+1144160	5073C	0	201420265	70267150082	198777 99048	81947	
DL2078	+375691	+1144137	5161C	0	227420241	70302149616	198756 99458	82172	
DL2222	+36 741	+1143770	6368Y	0	228422197	70790149219	200094102027	80467	
DL3001	+373951	+1143216	5301S	1	153417058	71133146503	196216100739	62608	
DL3002	+374312	+1143457	6724S	161	471417716	71364138675	196745105219	62920	
DL3003	+374715	+1143314	6037S	251	234416467	71556143627	197332103114	63512	
DL3004	+374996	+1143344	6778S	7	581416974	71497139620	197734105062	62553	
DL3006	+375587	+1143934	6464Y	5	541420056	70604141126	198605103171	61762	
DL3007	+375671	+1143934	6517Y	0	541420056	70604141126	198605103171	61762	

STATION IDENT	LAT. DEG MIN	LONG. DEG MIN	ELEV. +CODE	TEMP-COR. IN/OUT	NORTH UTM	EAST UTM	ORSV GRAV	THEO GRAV	FAA	SEA +1000
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DL3008	+38 277	+114 3657	7778S	2	971421343	70777133257199615106856	81301			
DL3009	+38 691	+114 3650	6155S	1	201422109	70967143+39200220101149	80354			
DL3010	+38 741	+114 3706	6048S	0	154422199	70683144452200294111081	60407			
DL3011	+381026	+1144003	6872Y	8	446422715	70436139183200711103154	80169			
DL3014	+38 704	+1145796	5377Y	0	96422058	67631147777200239 98143	79899			
DL3015	+38 409	+1145464	5773Y	8	129421523	68326146289199606100815	81262			
DL3016	+375996	+1145497	6059S	115	318420758	68297144156199204101980	81747			
DL3017	+375701	+1145334	5702S	16	174420218	68546146371198773101263	82005			
DL3018	+375612	+1145657	5262S	1	128420043	68079146694198642 99574	81755			
DL3019	+375350	+1145561	6660S	313	709419562	68230138747198259103172	81479			
DL3021	+374846	+1145751	5808S	7	164418623	67972144615197523101755	82116			
DL3022	+374434	+1145661	6590S	413	579417864	68121138318196923103422	81937			
DL3023	+374011	+1145712	6955S	2821	1130417080	68063135029196305104187	81877			
DL3024	+374260	+1145916	5533S	249	169417534	67753145620196669101272	82601			
DL3025	+373833	+115 25	4988Y	0	122416741	67610146314196046 99207	82316			
DL3500	+375522	+1144277	47078	0	178419924	70104151366198511 97166	81291			
DL3501	+375522	+1144277	47078	0	178419924	70104151389198511 97178	81301			
DL3502	+375522	+1144277	47078	0	178419924	70104151399198511 97189	81311			
DL3503	+375522	+1144276	47088	0	178419924	70106151405198511 97201	81321			
DL3504	+375522	+1144276	47098	0	178419924	70106151406198511 97209	81337			
DL3505	+375522	+1144275	47098	0	179419924	70107151411198511 97220	8133			
DL3506	+375522	+1144275	47108	0	179419924	70107151415198511 97232	81345			
DL3507	+375521	+1144275	47116	0	179419922	70107151417198509 97242	81353			
DL3508	+375521	+1144274	47128	0	180419922	70109151422198509 97255	81365			
DL3509	+375521	+1144274	47138	0	180419922	70109151422198509 97264	81370			
DL3510	+375521	+1144273	47133	0	180419922	70110151426198509 97274	81379			
DL3511	+375521	+1144273	47146	0	179419922	70110151429198509 97283	81384			
DL3512	+375521	+1144273	47156	0	179419922	70110151431198509 97293	81392			
DL3513	+375521	+1144272	47158	0	181419922	70112151437198509 97302	81401			
DL3514	+375521	+1144272	47168	0	181419922	70112151439198509 97310	81406			
DL3515	+375521	+1144271	47178	0	180419922	70113151436198509 97320	81412			
DL3516	+375521	+1144271	47188	0	180419922	70113151441198509 97332	81420			
DL3517	+375520	+1144271	47198	0	179419920	70113151440198508 97343	81426			
DL3518	+375517	+1144257	47518	0	189419915	70134151396198503 97603	81585			
DL3519	+375514	+1144244	47928	0	182419910	70153151277198499 97879	81713			
DL3520	+375511	+1144231	48318	0	188419905	70172151165198495 98134	81845			
DL3521	+375508	+1144218	48678	0	190419900	701911511033198491 98343	81943			
DL3522	+375505	+1144205	49068	0	215419895	70211150675198486 98564	82044			
DL3523	+375502	+1144192	49558	0	234419890	70230150659198481 98810	82144			
DL3524	+375522	+1144276	47068	0	177419924	70103151386198511 97161	81285			
DL3525	+375522	+1144278	47060	0	177419924	70103151373198511 97136	81275			
DL3526	+375522	+1144279	47050	0	177419924	70101151366198511 97136	81266			
DL3527	+375522	+1144279	47056	0	177419924	70101151360198511 97126	81256			
DL3528	+375523	+1144279	47046	0	178419925	70101151353198513 97119	81246			
DL3529	+375523	+1144280	47046	0	178419925	70100151349198513 97105	81237			
DL3530	+375523	+1144280	47038	0	176419925	70100151338198513 97089	81223			
DL3531	+375523	+1144281	47036	0	175419925	70095151331198513 97079	81213			
DL3532	+375523	+1144281	47034	0	175419925	70096151323198513 97068	81202			
DL3533	+375523	+1144281	47028	0	175419925	70098151317198513 97056	81193			
DL3534	+375523	+1144282	47026	0	175419925	70097151305198513 97040	81177			
DL3535	+375523	+1144282	47014	0	175419925	70097151296198513 97026	81170			
DL3536	+375523	+1144283	47010	0	174419925	70095151281198513 97019	81159			
DL3537	+375523	+1144283	47008	0	174419925	70095151264198513 97008	81150			
DL3538	+375521	+1144283	47006	0	174419927	70095151277198513 96995	81139			
DL3539	+375521	+1144284	46996	0	174419927	70094151271198513 96984	81129			
DL3540	+375521	+1144284	46996	0	174419927	70094151266198513 96975	81121			

STATION IDENT.	LAT. DEG MIN	LONG. DEG MIN	ELEV. +CODE	TEMP-COR. IN/OUT	NORTH UTM	EAST UTM	OBSV GRAV	THEO GRAV	FAA	CBA +1000
DL3542	+375530	+1144210	46768	0	346419941	70202150681	198523	96363	80762	
DL3543	+375533	+1144324	46726	0	162419942	70000050644	198527	96081	80310	
DL3544	+375536	+1144337	46711	0	152419947	70000050417	198531	95842	80064	
DL3545	+375539	+1144350	46728	0	145419953	69997150226	198536	95657	79866	
DL3546	+375542	+1144363	46738	0	142419958	69977150063	198540	95502	79705	
DL3547	+375530	+1144276	47078	0	179419939	70105151377	198523	97153	81277	
DL3548	+375530	+1144276	47088	0	179419939	70105151381	198523	97167	81287	
DL3549	+375529	+1144275	47098	0	180419937	70107151334	198521	97181	81299	
DL3550	+375529	+1144275	47108	0	180419937	70107151337	198521	97191	81306	
DL3551	+375529	+1144275	47118	0	180419937	70107151391	198521	97203	81316	
DL3552	+375529	+1144274	47118	0	182419937	70108151397	198521	97214	81327	
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DL3567	+375531	+1144280	47028	0	178419940	70097151314	198524	97037	81179	

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GROUND-WATER APPRAISAL OF DRY
LAKE AND DELAMAR VALLEYS,
LINCOLN COUNTY, NEVADA

GROUND-WATER RESOURCES - RECONNAISSANCE SERIES

Report 16

GROUND-WATER APPRAISAL OF DRY LAKE AND DELAMAR VALLEYS,

Lincoln County, Nevada

by

Thomas E. Eakin

Prepared cooperatively by the

Geological Survey

U. S. Department of the Interior

May

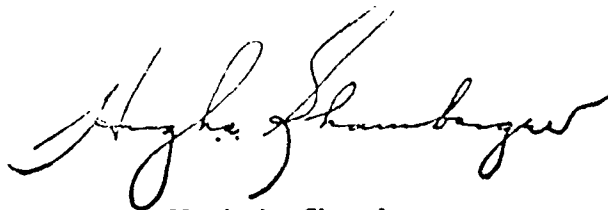
1963

FOREWORD

This is the 16th report in the series of reconnaissance ground-water studies which were initiated by action of the Legislature in 1960. In these sixteen reports, the ground-water resources of some nineteen valleys have been appraised and described.

The present appraisal of the ground-water resources of Dry Lake and Delamar Valleys in Lincoln County, Nevada, was made by Thomas E. Eakin, geologist, U. S. Geological Survey.

These reconnaissance ground-water resources studies make available pertinent information of great value to many State and Federal agencies. As development takes place in any area, demands for more detailed information will arise and studies to supply such information will be undertaken. In the meantime these reconnaissance type studies are timely and adequately meet the immediate needs for information on the ground-water resources of the areas on which reports are prepared.



Hugh A. Shamberger
Director

Department of Conservation
and Natural Resources

May, 1963

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GROUND-WATER APPRAISAL OF DRY LAKE AND DELAMAR VALLEYS,
LINCOLN COUNTY, NEVADA

by
Thomas E. Eakin

SUMMARY

The results of this reconnaissance of Dry Lake and Delamar Valleys suggest that average annual ground-water recharge from precipitation may be on the order of 6,000 acre-feet. Ground water is discharged largely by underflow through bedrock from the valleys, most probably to the southwest or south toward Pahrnagat Valley.

The substantial depth to water, in excess of 300 feet in the topographically lower parts of the valleys, precludes low-cost development of substantial supplies of ground water. However, this apparently adverse feature for usual water-supply purposes may be desirable from the standpoint of possible special testing purposes required in modern technology.

The area roughly including Tps. 1 S. to 2 N., R. 64 E. may be most favorable for eventual interception of most of the recharge which is principally supplied from the mountains to the east and north. Here, perennial yield might closely approach the average annual recharge. It should be pointed out, however, that the depth to water, ranging from about 400 feet to 700 feet or more, probably precludes development of substantial water supplies for most purposes because of the high cost of pumping.

INTRODUCTION

Ground-water development in Nevada has shown a substantial increase in recent years. Part of the increased development is due to the effort to bring new land into cultivation, part is due to the effort to supplement surface-water supplies, and part is due to the general increased demands for water. In any case, as efforts to develop ground water increase, there is a corresponding increase in demand for information on the ground-water resources throughout the State.

Recognizing this need, the State Legislature enacted special legislation (Chapt. 181, Stats. 1960) for beginning a series of reconnaissance studies of the ground-water resources of Nevada. As provided in the legislation, these studies are being made by the U. S. Geological Survey in cooperation with the Nevada Department of Conservation and Natural Resources.

Interest in ground-water resources currently includes many areas and is extending to additional areas almost continuously. Thus, the emphasis of the reconnaissance studies is to provide as quickly as possible a general appraisal of the ground-water resources in particular valleys or areas where information is urgently needed. Ultimately, ground-water information will be available for practically all valleys of the State, at least at a reconnaissance level. For this reason each study is limited severely in time, field work for each area generally averaging about two weeks.

The Department of Conservation and Natural Resources has established a special report series to expedite publication of the results of the reconnaissance studies. Figure 1 shows the areas for which reports have been published in this series. A list of the titles of previous reports published in the series is given at the end of this report. This report is the sixteenth in the Reconnaissance Series.

The purpose of the Reconnaissance Series is to provide a general appraisal of the ground-water resources of virtually all valleys of the State for public information, and to provide a preliminary estimate of the amount of ground-water development that the areas might sustain on a perennial basis as an initial guide to possible requirements for administration of the areas under the State ground-water law.

The scope of this report is limited to a general description of the physical conditions of Dry Lake and Delamar Valleys, including observations of the interrelation of climate, geology, and hydrology as they affect ground-water resources; and possible movement of ground water between valleys is discussed. The report also includes a preliminary estimate of the average annual recharge to and discharge from the ground-water reservoir.

Location and General Features:

Dry Lake and Delamar Valleys are in central Lincoln County and lie within an area bounded by lat $37^{\circ} 15'$ and $38^{\circ} 28' N.$, and long $114^{\circ} 33'$ and $115^{\circ} W.$ The two valleys occupy a north-trending trough which is about 82 miles long and a maximum of about 20 miles wide between drainage divides. The combined area of the two valleys is nearly 1,300 square miles.

U. S. Highway 93 crosses the area in an eastward alignment about at the divide between Dry Lake Valley on the north and Delamar Valley on the south (fig. 2). Caliente lies along the highway about 20 miles east of the area.

A gravel road extends southward from U.S. Highway 93 to the former mining town of Delamar. State Highway 83 and improved roads connect formerly active mines on the western side of the Bristol Range with U.S. Highway 93 to the east in the vicinity of Pioche. Trails provide limited access to the lower parts of the valleys during fair weather.

The valleys are used principally for livestock range, although full use of the area may be somewhat limited by inadequate distribution of permanent watering points.

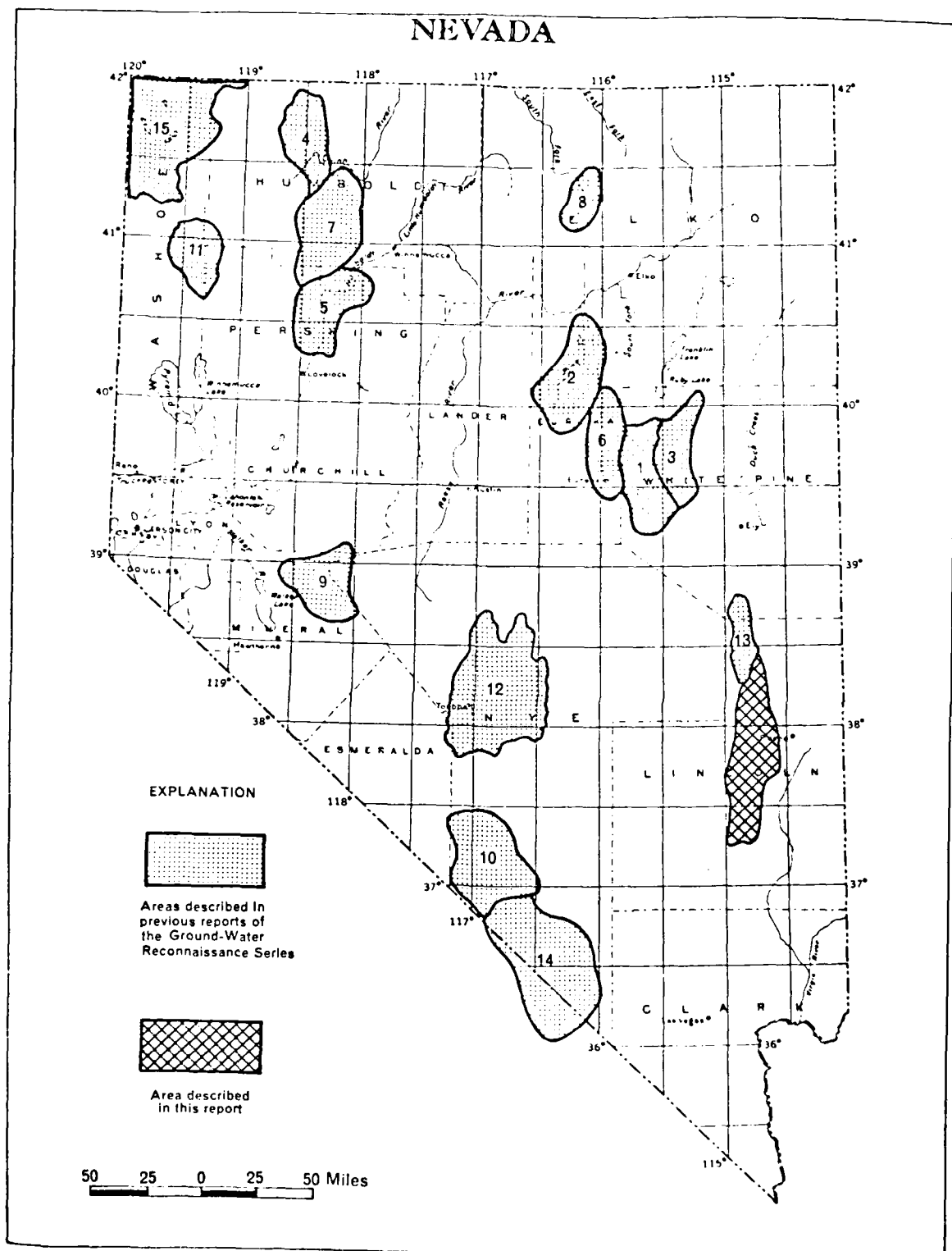


FIGURE 1. MAP OF NEVADA SHOWING AREAS DESCRIBED IN PREVIOUS REPORTS OF THE RECONNAISSANCE SERIES AND IN THIS REPORT.

Climate:

The climate of Dry Lake and Delamar Valleys is semi-arid. Precipitation and humidity generally are low, and summer temperatures and evaporation rates are high. Precipitation is irregularly distributed but generally is least on the valley floor and greatest in the mountains. Snow is common during the winter months and localized thundershowers provide much of the summer precipitation. The daily and seasonal temperature range is relatively large.

Records of precipitation are not available for Dry Lake and Delamar Valleys. However, the magnitude and distribution of precipitation in parts of the valleys probably are reasonably represented by the records for Alamo in Pahrnagat Valley west of Delamar, and for Caliente and Pioche to the east (fig. 2). Table 1 lists the annual and the average monthly and average annual precipitation at Alamo, Caliente, and Pioche.

Maximum annual precipitation, in inches, during the period 1931-60 for Alamo, Caliente, and Pioche was 14.91 (1941), 18.73 (1941) and 22.38 (1941), respectively. Maximum monthly precipitation, in inches, for the same period was 6.15 (August 1945), 4.29 (October 1946), and 5.01 (August 1945), respectively. Minimum annual precipitation, in inches, for the respective stations was 1.23 (1956), 2.92 (1950), and 3.81 (1956). Minimum monthly precipitation has been zero a number of times at each of the stations.

Table 2 lists average monthly and annual temperature for the period 1931-60 at Alamo and Caliente and for the period 1939-60 at Pioche. Maximum and minimum temperatures recorded are: at Alamo, 115° F. on August 11, 1940, and -9°F. on January 21, 1937; at Caliente, 109°F. on June 22, 1948, and -31°F. on January 9, 1937; and at Pioche, 102°F. on June 22, 1954 and -5°F. on January 4, 1949.

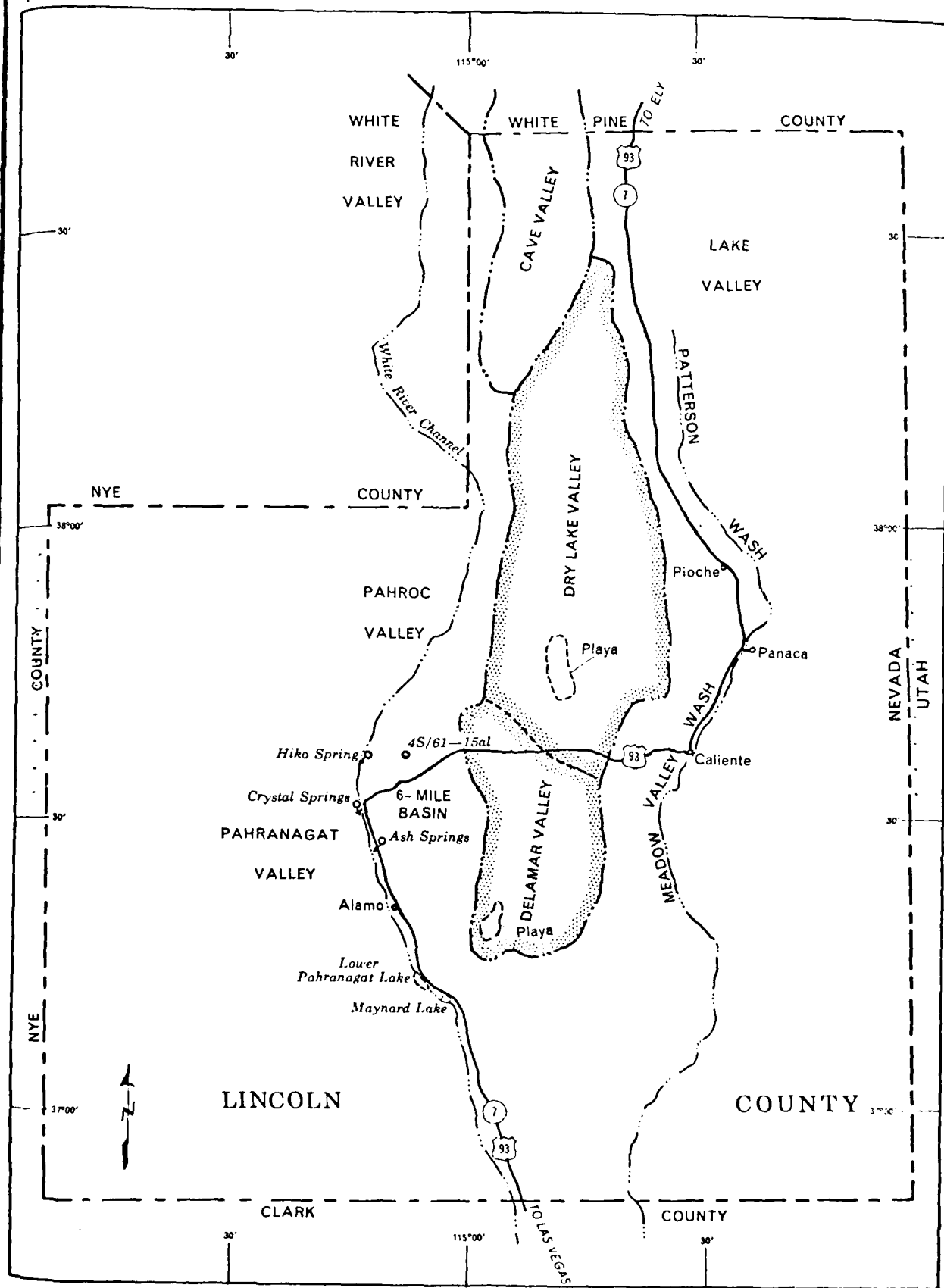


FIGURE 2. Sketch map showing relation of Dry Lake and Delamar Valleys to adjacent areas

Table 1.--Summary of precipitation at Alamo, Caliente, and Pioche, Nev.
(from published records of the U.S. Weather Bureau)

Average monthly and annual precipitation, in inches, (1931-60)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Alamo	.70	.68	.68	.57	.45	.15	.73	.77	.32	.43	.43	.60	6.60
Caliente	.83	.79	.85	.70	.56	.39	.76	.92	.49	.89	.75	.86	8.79
Pioche ^{1/}	1.55	1.26	1.46	1.19	.83	.33	.87	1.12	.69	1.18	.96	1.36	12.80

Average for 1939-60.

Annual precipitation, in inches, (1931-61)

Year	Alamo	Caliente	Pioche	Year	Alamo	Caliente	Pioche
1931	9.60	9.49	--	1947	--	7.47	10.70
1932	9.68	11.61	--	1948	2.75	5.23	8.39
1933	7.29	8.16	--	1949	6.09	10.03	15.36
1934	3.01	7.14	--	1950	5.32	2.92	7.14
1935	5.58	9.43	--	1951	4.89	10.15	13.98
1936	8.97	11.60	--	1952	6.88	11.52	16.32
1937	6.30	6.84	--	1953	1.98	4.66	7.26
1938	11.15	--	--	1954	5.96	9.31	13.28
1939	7.42	9.41	10.05	1955	5.65	7.13	14.09
1940	6.16	7.49	13.48	1956	1.23	4.78	3.81
1941	14.91	18.73	22.38	1957	7.43	10.88	17.14
1942	2.94	6.63	7.18	1958	6.47	8.13	15.51
1943	--	11.70	16.08	1959	4.42	4.83	10.41
1944	--	7.96	11.59	1960	6.02	9.77	12.85
1945	10.65	11.60	20.60	1961	3.63	8.80	9.62
1946	--	12.36	14.04				

Table 2. -- Average monthly and annual temperature, in degrees Fahrenheit,
at Alamo, Caliente, and Pioche, Nev. for the period 1931-60

(from published records of the U.S. Weather Bureau)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Alamo	36.6	41.1	47.2	56.1	62.9	71.9	79.2	76.9	69.7	58.6	46.8	39.3	57.1
Caliente	30.4	36.0	43.7	52.2	60.2	68.5	75.9	73.9	65.9	54.1	41.5	33.5	52.9
Pioche ^{1/}	29.5	33.6	39.3	48.6	57.0	66.3	73.9	71.7	64.8	52.8	40.3	34.0	51.0

Average for 1939-60.

Low humidity and high temperatures are favorable for high rates of evaporation. Pan evaporation recorded at Caliente since 1956 is listed in table 3. Evaporation from May through September accounts for most of the annual total and averages about 50 inches for the 6-year period of record.

The average growing season in Dry Lake and Delamar Valleys has not been determined. An approximation of the probable growing season may be obtained by reference to the nearby Upper Meadow Valley Wash, which is 20 miles east of this area. Houston (1950, p. 19) lists an average growing season of 157 days (May 2 to October 6), based on records at Caliente. Killing temperatures vary according to type of crop. In recent years Weather Bureau records list freeze data rather than killing frosts; the dates are listed for the occurrence of the last spring minimum and the first fall minimum for temperatures of 32°F. or below, 28°F. or below, and 16°F. or below. From these data the number of days between the last spring minimum and the first fall minimum occurrence for the respective temperature groups are given. The following tabulation lists the number of days for the three temperature groups recorded for the period 1952-61 at Alamo, Caliente, and Pioche.

Number of days between temperatures of:
(from published records of the U.S. Weather Bureau)

Year	32°F or below			28°F or below			24°F or below		
	Alamo	Caliente	Pioche	Alamo	Caliente	Pioche	Alamo	Caliente	Pioche
1952	177	183	173	212	208	210	227	227	232
1953	117	122	143	150	144	161	208	191	166
1954	219	151	136	230	206	176	257	210	177
1955	141	137	143	178	178	170	208	186	197
1956	134	151	152	183	--	163	202	204	204
1957	163	138	134	169	162	190	238	227	227
1958	173	134	178	176	152	179	222	191	224
1959	151	135	131	184	150	178	228	200	209
1960	144	141	144	164	189	164	198	205	204
1961	129	136	148	156	179	165	188	183	188
Average	154	142	148	180	174	175	217	202	180

Table 3. -- Total evaporation at Caliente, Nev. (1956-61)

(from published records of the U.S. Weather Bureau)

	March	April	May	June	July	August	September	October	November
1956			7.42	^b 12.55	11.10	10.86	8.07	^b 4.65	2.05
1957	3.97	6.76	6.33	10.66	11.45	^b 11.60	7.54		
1958		^b 6.39	9.35	11.99	12.39	11.73	7.56	5.00	
1959		7.56	9.59	11.89	11.71	10.10	7.18		
1960			9.78	10.94	11.16	10.87	7.34	4.06	
1961		7.19	9.40	12.07	11.06	7.90	6.68	^b 4.07	
Average			8.64	11.67	11.48	10.51	7.39		

^{b/} Adjusted to full month by Weather Bureau.

Physiography and Drainage:

Dry Lake and Delamar Valleys occupy a surficially closed trough in the Great Basin section of the Basin and Range physiographic province of Fenneman (1931, p. 328). The north-trending trough is bounded on the east successively from the north by the Ely, Bristol, Highland Peak, and Delamar Ranges. A southwest-trending spur of the Ely Range forms the northwest boundary of Dry Lake Valley. The Pahroc (also Pahrock) Range bounds the central part of the trough on the west. On the southwest unnamed ranges, commonly with poorly defined drainage divides, comprise the boundary. The south end of Delamar Valley is separated from Pahrnagat Valley by a low alluvial divide.

The highest point in the mountains enclosing Dry Lake and Delamar Valleys is Highland Peak with an altitude of about 9,500 feet. The crest of the Bristol and Highland Peak Ranges is more than 8,000 feet above sea level for a distance of about 12 miles. The crest of the mountains along the northwest and east sides has an altitude of more than 7,000 feet for a combined distance of about 42 miles. Elsewhere the crests are less than 6,000 feet above sea level, except for short segments whose altitudes are somewhat above 7,000 feet.

The lowest part of the trough of Dry Lake and Delamar Valleys is the playa or dry lake, in the southern part of Delamar Valley (see inside cover photograph) which has an altitude of slightly less than 4,400 feet. The altitude of the playa in Dry Lake Valley is somewhat less than 4,600 feet. Dry Lake and Delamar Valleys are separated by an alluvial divide whose saddle altitude is about 4,875 feet.

The trough of Dry Lake and Delamar Valleys is higher than those of White River and Pahrnagat Valleys on the west and Meadow Valley Wash on the east, which are tributary to the Colorado River (fig. 2). In Dry Lake and Delamar Valleys the altitude decreases irregularly from about 5,400 feet at the altitude of Fairview Peak in the north to about 4,400 feet at the north end of the Delamar playa in a distance of about 55 miles, or an average decrease of 18 feet per mile. In the White River and Pahrnagat Valleys to the west the altitude of the floor of the channel decreases from about 5,100 feet to 3,600 feet in the same distance, giving an average gradient of about 27 feet per mile. Similarly, in Meadow Valley Wash and in Lake Valley to the east, the altitude decreases from 5,900 feet to 3,900 feet in the same distance, giving an average gradient of about 26 feet per mile. Thus, the steeper gradients in the adjacent valleys result in the land surface altitude of the channels being substantially lower than the land surface altitude in the southern part of the trough of Dry Lake and Delamar Valleys. In fact, the playa in Delamar Valley is nearly 1,200 feet higher than the floor of Pahrnagat Valley in the vicinity of Maynard Lake. The topographic positions and geology of these valleys largely control the occurrence and movement of ground water in the region. There are no perennial streams in Dry Lake and Delamar Valleys, and the gross physiographic features of most of the stream channels and washes probably were formed during periods of greater precipitation--probably in Pleistocene time. Present-day streamflow occurs for short periods only after high-intensity rains and from snowmelt runoff. Only runoff

from high-intensity rains can provide large volumes of flow to cause local erosion and substantial transport of sediments in sufficient quantity to modify stream channels and washes.

The main channel along the axis of the northern part of Dry Lake Valley is contained between relatively steep banks about 25 feet below the general level of the valley. The floor of the channel is covered with white sage, and the soil is fine-grained as it is in adjacent parts of the valley floor. This feature suggests that flash-flood erosion in this channel is most uncommon. Farther south, channels draining the Highland Peak and Delamar ranges have somewhat steeper gradients. In this area flood flows occasionally transport relatively coarse gravel to the lower part of the alluvial apron. One example of this was noted along a wash crossing the trail about in sec. 22, T. 1 N., R. 65 E.

During Pleistocene time, lakes occupied the playa areas of Delamar and Dry Lake Valleys. Tschanz and Pampeyan (1961) mapped about 16 miles of beach or strand line along the west, south, and southeast sides of the Dry Lake playa, and about 14 miles along the equivalent segments of the Delamar playa. These represent the highest shore lines identified in these valleys.

Maximum depths of the Pleistocene lakes were on the order of 75 feet in Dry Lake Valley and perhaps 50 feet in Delamar Valley, according to Carpenter (1915, p. 65, 66). The surface areas of the lakes in Dry Lake and Delamar Valleys were about 30 and 16 square miles, respectively.

GENERAL GEOLOGY

The following discussion of geology is based largely on the reconnaissance geologic maps of Tschanz and Pampeyan (1961) and Tschanz (1960). Other reports that relate to the geology in and adjacent to Dry Lake and Delamar Valleys include those prepared by Westgate and Knopf (1932), Callaghan (1936, 1937), Reso and Croneis (1959), and Kellog (1960).

For the purposes of this report the rocks of Dry Lake and Delamar Valleys are divided into two general groups and further subdivided into four major units. The distribution of these four units is shown on plate 1. One group primarily represents bedrock in the mountains. It is divided into a Paleozoic carbonate unit and a Paleozoic clastic and Tertiary volcanic and clastic rock unit.

Tschanz (1960, p. 198) indicates that the total thickness of Paleozoic rocks exposed in northern Lincoln County is between 30,000 and 33,000 feet. As described, one may infer that carbonate rocks (limestone and dolomite) probably constitute about 60 percent of the total section. This is somewhat less than the 80 percent of carbonate rocks in a total section of about 30,000 feet noted by Kellog (1960, p. 189) in his study of the southern Egan Range, which is 10 to 15 miles northwest of the area. The second unit of the bedrock group includes Paleozoic shale, sandstone or quartzite, and conglomerate and Tertiary volcanic rocks, chiefly tuff and intravolcanic sedimentary rocks. Because of

their importance to the ground-water hydrology of the region, the Paleozoic carbonate rocks are distinguished from Paleozoic clastic and Tertiary volcanic rocks on plate 1 as discussed subsequently in this report.

The second group is designated the valley fill and is divided into older and younger valley fill. The older deposit consists of unconsolidated to partly consolidated silt, sand, and gravel derived from adjacent highland areas, but also includes some rocks of volcanic origin. This unit was deposited largely under subaerial and lacustrine environments. Although data are not available, the maximum thickness of this unit probably is at least several hundred feet. X

The younger valley fill includes clay, silt, sand, and gravel of Quaternary age and is largely restricted to stream channels and playa areas. As defined, this unit is relatively thin and probably is no more than a few tens of feet thick. The valley fill is underlain by bedrock, presumably similar in character to that exposed in the mountains.

Water-Bearing Properties of the Rocks:

The rocks of Paleozoic age generally have had their primary permeability, that is, permeability at the time of deposition, considerably reduced by consolidation, cementation, or other alteration. However, because they subsequently have been fractured repeatedly by folding and faulting, secondary openings have developed through which some ground water is transmitted. Further, fractures or joints in Paleozoic carbonate rocks locally have been enlarged by solution as water moves through them. Solution openings develop near sources of recharge where carbon dioxide carried by rain water penetrates the ground, where organic acids derived from decaying vegetation, or where otherwise derived acids may be carried by the water into contact with the carbonate rocks. Solution openings need not be restricted to the vicinity of present day recharge areas and outcrops of these rocks. Rather, they may occur wherever the requisite conditions have occurred anytime since the deposition of the carbonate rocks. The principal significance of solution openings is that they further facilitate movement of ground water through carbonate rocks.

Whether existing fractures or solution openings have extensive hydraulic connection or not is related to the overall geologic history of the rocks. In the absence of detailed information, ground-water movement through carbonate rocks in this region is assumed to occur both through fractures and solution openings. Certainly, the large quantity of ground water issuing from fractures and solution openings, such as those at Crystal and Ash Springs in Pahrangat Valley, is a dramatic demonstration that ground-water movement through Paleozoic carbonate rocks occurs in this region of Nevada. N/

The Paleozoic clastic rocks and the Tertiary volcanic and clastic rocks exposed in the mountains generally have little primary permeability. Secondary fractures probably are the principal means by which limited amounts of ground water are transmitted through them. Favorably disposed fractures in these rocks probably provide the network of openings through which water

moves and is discharged at small springs in the mountains and which yield a few gallons per minute to wells penetrating these rocks. Under extremely favorable conditions the distribution of fracture openings in welded tuff, lava flows, or Paleozoic clastic rocks may permit the development of moderate yields of water from wells. However, these occurrences are likely to be so localized that the odds of a well encountering them are very small indeed.

The unconsolidated sand and gravel of the valley fill in Dry Lake and Delamar Valleys is capable of transmitting ground water freely. However, most of the valley fill probably is composed of deposits of fine sand and silt. Grains of this size generally have relatively low permeability and, where saturated, transmit water much more slowly than coarse sand and gravel. Deposits of silty clay and clay may transmit water so slowly to wells that they will not yield supplies adequate for stockwatering purposes. Various parts of the valley fill probably are moderately consolidated or cemented and this further reduces the capacity of these deposits to transmit useful supplies of water to wells.

GROUND-WATER APPRAISAL

Occurrence of Ground Water:

[Ground-water recharge in Dry Lake and Delamar Valleys is derived principally from precipitation within the surficial drainage area of the valleys. In a general way, ground water moves from recharge areas in and bordering the mountains toward the central parts of the valleys, thence southward or southwestward to discharge through rock formations.] This is in contrast with hydrologically closed valleys commonly found in the Basin and Range province. Carpenter (1915, p. 67) indicated that ground water in Bristol (Dry Lake) and Delamar Valleys probably finds an outlet in Pahranaagat Valley. Snyder (1963, p. 400) refers to Dry Lake Valley as being a drained valley; that is, ground water moves out of the valley to discharge elsewhere. *

In typical hydrologically closed valleys in the Great Basin, ground water is recharged from precipitation largely in the mountains enclosing the valley. Ground water moves from areas of recharge toward the ground-water reservoir in the valley fill underlying the central part of the valley. In or adjacent to the topographically lowest part of the valley, the water table, or upper surface of the zone of saturation, is within a few feet of land surface. Where the water table is close to land surface, ground water is discharged naturally by evaporation from the soil or from free-water surfaces and is transpired by plants (phreatophytes) which obtain most of their water from the zone of saturation or overlying capillary fringe.

Under long-term conditions in a hydrologically closed ground-water system, average annual recharge to the ground-water reservoir equals the average annual natural discharge. However, if a ground-water system in a topographically closed valley is hydrologically open, recharge from precipitation in the valley may be greater or less than the discharge within the valley. Where recharge from precipitation within the valley is greater than discharge in the valley, ground water must be discharging by underflow from the valley to an area

areas of lower hydraulic head. Where the recharge from precipitation within the valley is less than discharge in the valley, recharge in part must be entering the valley from an area or areas beyond the topographic divide having a higher hydraulic head.

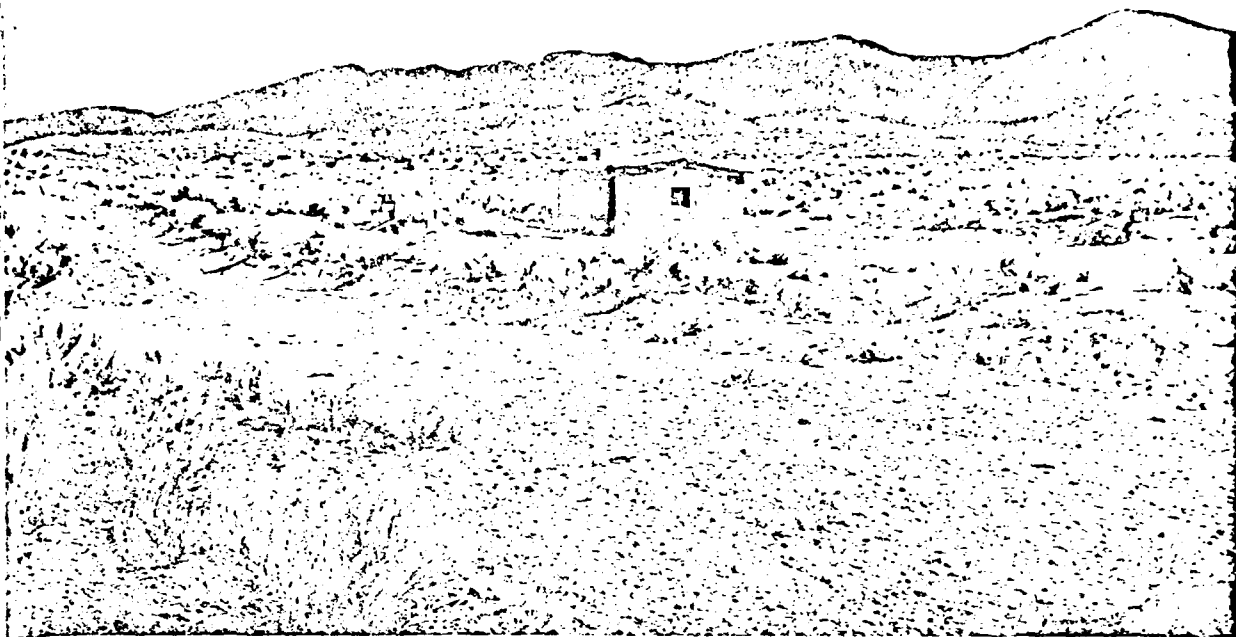
In addition to hydraulic controls, the water-bearing character of the rocks and their structure are important factors in the movement, or impedance to movement, of ground water. Where bedrock formations in the enclosing mountains are relatively impermeable, ground water normally is part of a closed hydrologic system in a topographically closed valley. Where the bedrock formations are at least locally permeable, the ground-water system may be hydrologically open. Winograd (1962, p. 110) has referred to this relationship in the vicinity of Yucca Flat in southern Nevada.

The chemical quality of the ground water is another factor that may be of aid in evaluating the nature of a ground-water system. Ordinarily, the concentration of chemical constituents shows considerable variation in different parts of a ground-water system. Generally, the concentration is least in areas of recharge and tends to be greatest in areas of natural discharge. Despite the normal variations that may be expected in the chemical constituents in ground water in a given system, the character and concentration of one or more constituents may aid in identifying whether or not a given system is closed.

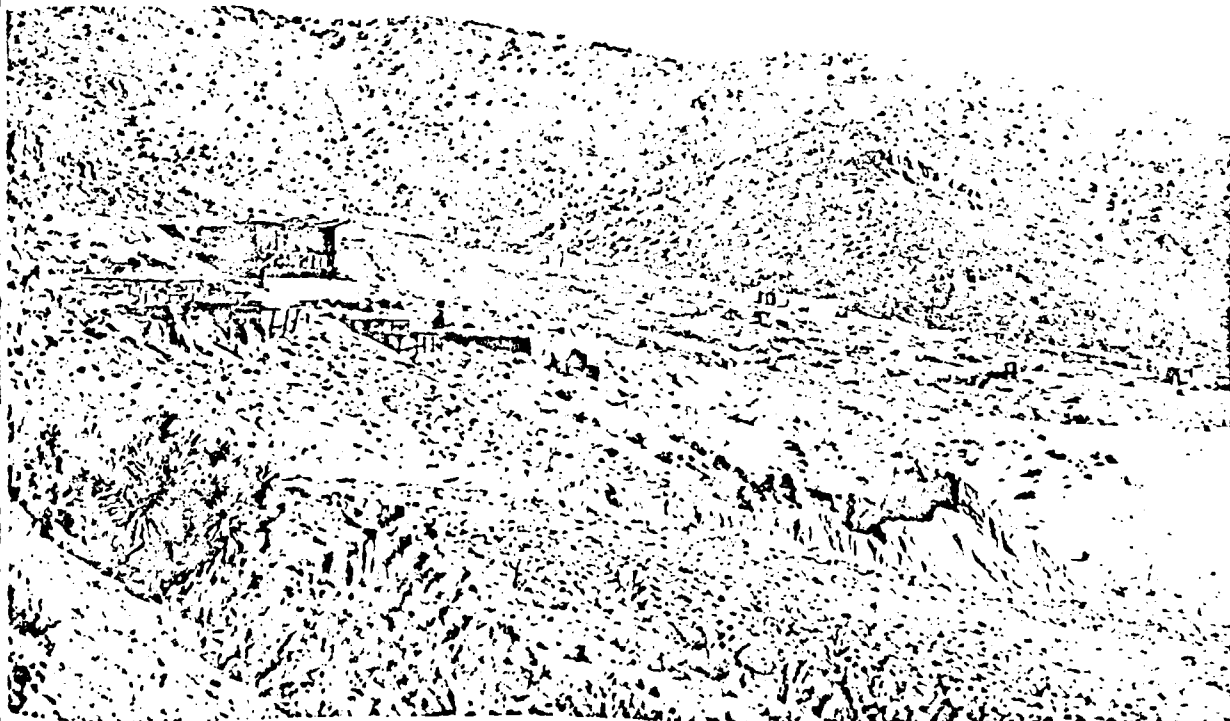
In summary, closed or open ground-water systems may be identified by the relationship of recharge to discharge within the valley, by potential hydraulic gradients between the reference valley and adjacent valleys, by the water-bearing character of geologic formations, including modifications by structural deformation, and by the chemical quality of the ground water with respect to that in adjacent areas.

In Dry Lake and Delamar Valleys, the principal areas of recharge are centered in the mountains along the northwest, northeast, and east sides of Dry Lake Valley. From the areas of recharge, ground water moves toward the central part of the valley. Along at least some of the stream canyons or washes ground water is not far below land surface, such as at Bristol wells (3N/65-21d3) (See cover photograph and photograph 3) and well 1N/65-2a1 where the depth to water is about 45 feet and 10 feet, respectively. Near the centers of the valleys the depths to water generally are substantial. For example, well 5N/64-14a1 is dry at a depth of about 240 feet, an altitude of roughly 5,385 feet; the depth to water in well 3N/64-20b1 is about 318 feet, altitude of about 4,820 feet; the depth to water in well 2N/64-3b1 is about 664 feet, altitude about 4,350 feet; and the depth to water in well 1N/64-24a1 is about 398 feet, altitude on the order of 4,300 feet.

In Delamar Valley, water for the mines and town of Delamar (photograph 4) was obtained from small springs and wells in the volcanic rocks in a nearby wash according to Callaghan (1937, p. 35). Callaghan further states that this supply was inadequate and that a well was drilled 900 feet deep in the alluvium of Delamar Valley which was dry throughout. The approximate well site is shown



Photograph 3. View east of stone cabin at Bristol Wells. Well 3N/65-21d2 is a short distance to the left of the cabin. The north end of the Bristol Range forms the skyline. Bristol Wells was an early water supply point for stock and travelers, it supported a small smelter operation and at least part of the water requirements of the Bristol Silver mine about 4 miles to the southeast, beyond the right side of the picture.



Photograph 4. View southeast of Delamar. Structure to left is remains of mill. Light colored band extending to right edge of picture is part of tailings. Wind action has heavily sculptured and removed a considerable volume of the tailings. In middle distance stone walls mark the principal area of Delamar townsite. Principal mining was in hill to left of left side of picture, although numerous prospect pits mark hill in background. Most of water supply for Delamar was brought in by pipeline from Meadow Valley Wash, 10 to 12 miles to the east.

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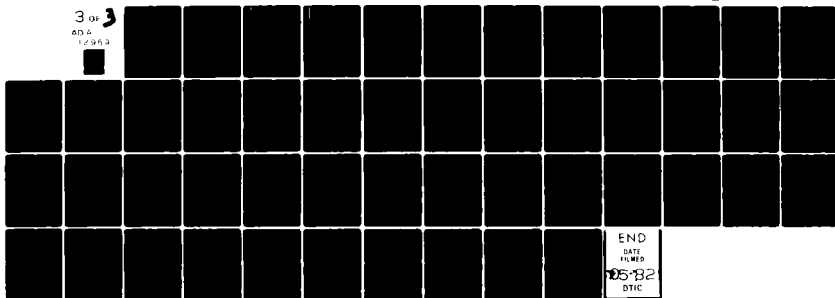
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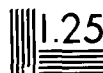
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6S/63-12a1 on plate 1. However, the details of drilling are not known. If the well literally did not encounter water throughout the full 900 feet, the water-level altitude in this area may be below about 3,700 feet, subject of course to the accuracy of land-surface altitude and the location of the well site.

The great depth to water below the playa areas of Dry Lake and Delamar Valleys precludes evapotranspiration losses from the ground-water reservoir in these valleys, except for extremely small amounts adjacent to scattered springs in the mountains. Inasmuch as the average annual ground-water recharge to Dry Lake and Delamar Valleys is estimated to be several thousand acre-feet per year (p. 34-37), and as no equivalent ground-water discharge by evapotranspiration occurs in the valleys, virtually all the ground water is discharged from the Valleys by underflow through bedrock.

That ground water is discharged outside these valleys is further confirmed by the hydraulic gradients between Dry Lake and Delamar Valleys and adjacent valleys. As noted previously the altitude of the ground-water levels in Dry Lake and Delamar Valleys decreases southward along the axial part of the valleys. Available control points do not precisely define the altitude of the ground-water levels in the valleys. However, an apparent gradient is indicated by the water-level altitudes at the several drilling sites; that is, less than about 5,385 feet in Sec. 14, T. 5 N., R. 64 E., about 4,820 feet at well 3N/64-20b1, about 4,350 feet at well 2N/64-3a1, and somewhat below about 3,700 feet at well 6S/63-12a1 in Delamar Valley. Thus, the hydraulic gradient is southward at more than 35 feet per mile in the northern part of Dry Lake Valley, and southward at somewhat more than 18 feet per mile from the north-central part of Dry Lake Valley to the central part of Delamar Valley.

Valleys to the east and west of Dry Lake and Delamar Valleys superficially drain to the Colorado River. Along the White River channel in Pahrangat Valley, Hiko Spring issues from about the alluvial-carbonate bedrock contact at an altitude of about 3,890 feet. About 5 miles south of Hiko Spring, Crystal Springs issue from limestone and alluvium at an altitude of about 3,815 feet. About 5 miles farther south in Pahrangat Valley, Ash Springs issue from limestone at the alluvial-bedrock contact at an altitude of about 3,610 feet. About 30 miles farther south in the vicinity of Lower Pahrangat and Maynard Lakes, at the south end of Pahrangat Valley, ground water in the alluvium is near land surface and is at an altitude of about 3,150 feet. Additionally, the depth to water in well 4S/61-15a1, about 6 miles east of Hiko Spring, is about 678 feet or an altitude of about 3,700 feet. Land surface along the White River channel and known water-level altitudes south of Maynard Lake along the White River channel are lower still. Maynard Lake is only about 10 miles southwest of the playa in Delamar Valley. Thus, ground water from Dry Lake and Delamar Valleys could discharge to Pahrangat Valley by underflow to the west, south, or southwest, based in terms of the potential hydraulic gradient.

Along Meadow Valley Wash to the east, land-surface altitude in the wash is above 4,000 feet northward from a point about 10 miles south of Caliente. The depth to water in the wash is generally within a few tens of feet below land surface;

therefore, the water-level altitude in Meadow Valley Wash probably is equal to or higher than that in Dry Lake and Delamar Valleys at equivalent latitudes throughout most of their lengths. For most of the same distance, the mountain area probably provides sufficient recharge to maintain a hydraulic divide between the two areas. Thus, a major transfer of ground water between the two areas does not seem likely.

In further considering ground-water discharge by underflow from Dry Lake and Delamar Valleys, the Paleozoic carbonate rocks appear to be the most favorable rocks to transmit ground water. The springs in Pahrangat Valley demonstrate that ground water moves through solution openings and fracture systems in some quantity, at least locally. Ground-water movement through similar Paleozoic rocks in Cave Valley, northwest of Dry Lake Valley, has been described in a previous report (Eakin, 1962). Drilling at the Nevada Test Site, about 75 miles southwest of this area, has shown that the Paleozoic carbonate rocks transmit ground water more readily than do the Paleozoic clastic rocks and Tertiary tuff (Winograd, 1962, p. 110). Thus, the Paleozoic carbonate rocks probably afford the best opportunity for ground-water movement between valleys in this area.

Plate 1 shows the surficial distribution of Paleozoic carbonate rocks in Dry Lake and Delamar Valleys. They are exposed most extensively along the east and northwest sides of Dry Lake Valley. Along the west and south sides of Delamar Valley, younger volcanic rocks crop out. However, Paleozoic carbonate rocks undoubtedly underlie the volcanic rocks in this area and, further, are exposed along White River channel in Pahrangat Valley and southward (Tschanz and Pampeyan 1961, and Bowyer, Pampeyan, and Longwell, 1958). Accordingly, the distribution of Paleozoic carbonate rocks in this area is favorable to the movement of ground water southward or southwestward from Dry Lake and Delamar Valleys to Pahrangat Valley.

If the Paleozoic carbonate rocks are capable of transmitting ground water by underflow from Dry Lake and Delamar, the converse may be true; that is, ground water may move into Dry Lake and Delamar Valleys from the north through carbonate rocks from valleys upgradient from Dry Lake and Delamar Valleys. This may be evaluated roughly as follows: In the northern part of Dry Lake Valley the lowest known water-level altitude is about 4,820 feet at well 3N/64-20b1. Higher water-level altitudes occur in White River Valley to the west and northwest; in Cave Valley to the northwest, and in Lake Valley to the north and east. However, the mountains enclosing the northern part of Dry Lake Valley are areas favorable to recharge from precipitation. Because they are areas of recharge, the water levels, in these mountain blocks also must be assumed to be areas of relatively high water levels. Thus, although actual water levels are not available in these areas, it is strongly inferred that ground-water divides occur beneath the mountains and thus provide hydraulic barriers to ground-water movement from adjacent valleys into the northern part of Dry Lake Valley. Similarly, it is inferred that a hydraulic divide exists in the Bristol and Highland Peak Ranges on the east side of Dry

Lake Valley and provides a hydraulic barrier to ground-water movement between Dry Lake Valley and Meadow Valley Wash. The same condition probably occurs in the Delamar Range on the east and southeast sides of Delamar Valley, although this range probably receives less recharge from precipitation than do the ranges to the north.

The mountains bordering the west side of Dry Lake and Delamar Valleys apparently provide only meager recharge from precipitation. The amount probably is not sufficient in magnitude or time to maintain a hydraulic barrier between Dry Lake and Delamar Valleys and White River and Pahranaagat Valleys.

In summary, most, if not all, of the ground-water recharged to Dry Lake and Delamar Valleys is believed to be derived from precipitation within their surficial drainage areas. Ground water moves from the areas of recharge toward the central part of the valleys, thence generally southward or southwestward. Ground water is discharged from the trough of Dry Lake and Delamar Valleys by underflow through Paleozoic carbonate rocks to areas downgradient from the trough; that is, most probably into Pahranaagat Valley, southwest of Delamar.

The depth to water in the central part of the trough of Dry Lake and Delamar Valleys is deep--probably too deep for economic recovery of ground water for the usual uses in this region, except possibly for stock purposes. Depths to water in the lower parts of the valleys decrease from somewhat more than 300 feet in T. 3 N., R. 64 E., to about 400 feet in the south part of T. 1 N., R. 64 E., to possibly more than 1,000 feet beneath the playa area of Delamar Valley. Perched or semiperched ground water in the mountains and upper parts of the alluvial apron locally supply water to small springs and locally is at a sufficiently shallow depth to permit the development of small water supplies by wells, such as at Bristol wells and well 1N/65-2a1.

Estimated Average Annual Recharge:

The average annual recharge to the ground-water reservoir may be estimated as a percentage of the average annual precipitation within the valley (Eakin and others, 1951, p. 79-81). A brief description of the method follows: Zones in which the average precipitation ranges between specified limits are delineated on a map, and a percentage of the precipitation is assigned to each zone which represents the probable average recharge from the average precipitation for that zone. The degree of reliability of the estimate so obtained, of course, depends on the degree to which the values approximate actual precipitation in the several zones, and the degree to which the assigned percentages represent the actual proportion of recharge to ground water. Neither of these factors is known precisely enough to assume a high degree of reliability of the recharge estimate for any one valley. However, the method has proved useful for reconnaissance estimates and experience suggests that in many areas the estimates probably are relatively close to the actual long-term average annual recharge.

The precipitation map of Nevada (Hardman and Mason, 1949, p. 10) has been adjusted (Hardman, oral communication, 1962) to the improved topographic base maps (scale 1:250,000) now available for the whole State. The base map for plate 1 of this report was prepared from the same series of topographic maps. The several zones of precipitation applicable to Dry Lake and Delamar Valleys are as follows: the boundary between the zones of less than 8 inches and 8 to 12 inches of precipitation was delineated at the 6,000-foot contour; between 8 to 12 inches and 12 to 15 inches, at the 7,000-foot contour; between 12 to 15 inches and 15 to 20 inches, at the 8,000-foot contour; between 15 to 20 inches and more than 20 inches at the 9,000-foot contour.

The average precipitation used for the respective zones, beginning with the zone of 8 to 12 inches of precipitation, is 10 inches (0.83 foot), 13.5 inches (1.12 feet), 17.5 inches (1.46 feet), and 21 inches (1.75 feet).

The percentages of the average precipitation assumed to represent recharge for each zone are: less than 8 inches, 0; 8 to 12 inches, 3 percent; 12 to 15 inches, 7 percent; 15 to 20 inches, 15 percent; and more than 20 inches, 25 percent.

Table 4 summarizes the computation of recharge for Dry Lake and Delamar Valleys. The recharge (column 5) for each zone is obtained by multiplying the figures in columns 2, 3, and 4. Thus, for the zone of 12 to 15 inches of precipitation in Dry Lake Valley the computed recharge is 16,000 (acres) times 1.12 (feet) times .25 (25 percent) = about 1,300 acre-feet. The estimated total average annual recharge to ground water in Dry Lake and Delamar Valleys is about 6,000 acre-feet.

Table 4. --Estimated average annual ground-water recharge from precipitation in Dry Lake and Delamar Valleys, Nev.

(1) Precipitation zone (in inches)	Dry Lake Valley			Delamar Valley				
	(2) Approximate area of zone (acres)	(3) Average annual precipitation (feet)	(4) Percent recharged	(5) Estimated recharge (acre-feet) (2x3x4)	(2) Approximate area of zone (feet)	(3) Average annual precipitation (feet)	(4) Percent recharged	(5) Estimated recharge (ac.-ft) (2x3x4)
20+	200	1.75	25	100	0	- -	- -	- -
15-20	3,200	1.46	15	700	0	- -	- -	- -
12-15	16,000	1.12	7	1,300	4,000	1.12	7	300
8-12	114,000	.83	3	2,700	35,000	.83	3	900
8 -	442,000	- -	0	- -	208,000	- -	0	- -
	575,400 about 900 sq. mi.	Estimated average annual recharge (rounded)		5,000	247,000 about 385 sq. mi.	Estimated average annual recharge (rounded)		1,000

Estimated Average Annual Discharge:

Only a very small amount of ground water is discharged from Dry Lake and Delamar Valleys by evaporation and transpiration. Areas where ground water evaporates from soil or from free-water surfaces or is transpired by vegetation are restricted to isolated areas adjacent to the few small springs. The largest of these occurs near the spring at the Meloy Ranch in the southern part of T. 5 N., R. 65 E. Discharge was estimated to be about 20 gpm in March 1963. The few wells in the valley are used largely to provide water for stock, and the total withdrawals are very small. In the past, Bristol wells have been used in part to supply water requirements for mine camps and travelers. Similarly, wells and springs in Cedar Wash were used for water supply at Delamar. However, neither of these supplies were adequate.

Because of the great depth to water, no large areas of evapotranspiration from ground water occur in the lower parts of Dry Lake and Delamar Valley. Most of the ground water apparently is discharged by underflow through bed-rock from Dry Lake and Delamar Valleys, but the amount cannot be directly determined. However, to the extent that the estimate of ground-water recharge is correct, and because over a long period of time recharge equals discharge, ground-water discharge by underflow is about 6,000 acre-feet per year minus the small amount, probably less than a few hundred acre-feet discharged by wells and by evapotranspiration adjacent to spring areas.

Perennial Yield:

The perennial yield of a ground-water system is the amount of natural discharge that can be salvaged for beneficial use from the ground-water system. It is the upper limit of the amount of water that can be withdrawn economically from the system for an indefinite period of time without causing a permanent and continuing depletion of ground water in storage and without causing a deterioration of the quality of water. The average recharge from precipitation and streams, discharge by evapotranspiration, discharge to streams, and underflow from a valley are measures of the natural inflow and outflow from the ground-water system.

In an estimate of perennial yield, consideration should be given to the effects that ground-water development of wells may have on the natural circulation in the ground-water system. Development by wells may or may not induce recharge in addition to that received under natural conditions. Part of the water discharged by wells may re-enter the ground-water reservoir by downward percolation, especially if the water is used for irrigation. Ground water discharged from wells theoretically is offset eventually by a reduction of the natural discharge. In practice, however, it is difficult to offset fully the discharge from wells by a decrease in the natural discharge, except when the water table has been lowered to a level that eliminates both underflow and evapotranspiration in the area of natural discharge. The numerous pertinent factors are so complex that, in effect, specific determination of perennial yield of a valley requires a very extensive investigation, based in part on data

that can be obtained economically only after there has been substantial development of ground water for several years.

The ground-water system in Dry Lake and Delamar Valleys, as presently understood, is such that economics probably is the controlling factor in the determination of perennial yield. The great depth to water in most of the valley more or less precludes large-scale withdrawals for most uses. Hydrologically, the saturated zone, or reservoir, underlying the floor of the valleys is the most likely area in which to develop substantial water supplies. At the depth of water indicated, the ground-water reservoir probably occurs largely in Tertiary rocks or in underlying Paleozoic carbonate rocks beneath the floor of the valleys.

Whether development occurs in the Tertiary or younger rocks of the valley fill or in the Paleozoic carbonate rocks, withdrawals for a long time would have to come largely from ground water in storage. The amount of stored ground water to be removed is many times the average annual recharge and undoubtedly would require many years of pumping. Pumping from storage would result in a lowering of water levels extending outward from the area of pumping farther and farther until the area of influence eventually would divert virtually all the water from areas of recharge to the area of pumping. After this was accomplished, pumping levels would tend to stabilize, providing that the average annual net withdrawals from pumping were equal to the recharge to the pumped area. The net withdrawals at that time would be equal to perennial yield. Thus, the perennial yield would be limited to the amount of inflow that could be diverted from the areas of recharge to the area of pumping influence.

Whether the magnitude of perennial yield ultimately equals total recharge to the valley depends upon the relative location of the area of pumping with respect to the several areas of recharge to the valley, the relation of the area of pumping with respect to the principal area of ground-water discharge or underflow from the valley, and the altitude of economic pumping levels with respect to altitude of natural discharge or underflow. In Dry Lake and Delamar Valleys, the costs of pumping relatively large quantities of ground water to modify appreciably the natural ground-water regimen to salvage all the natural discharge undoubtedly would be prohibitive for all but the most exceptional water requirements. However, to the extent that such development might occur, the area in and adjacent to Tps. 1 S. and 1 N., R. 64 E., is located favorably with respect to ground-water storage, and sufficient development might result ultimately in salvaging much of the discharge from Dry Lake Valley. However, it is conceivable that to salvage a large part of the estimated 6,000 acre-feet of average annual discharge from the valley, water levels might have to be drawn down as much as 1,500 feet below land surface.

Ground-Water in Storage:

The amount of ground water stored in the valley fill and underlying bed-rock in Dry Lake and Delamar Valleys is substantial. It is many times the average annual recharge to and discharge from the ground-water reservoir in these valleys. To the extent that ground water may be developed, the volume of ground water in storage provides a reserve for maintaining an adequate supply for pumping during protracted periods of drought or for temporary periods of high demand under emergency conditions. This reserve, in effect, increases the reliability of ground water as a dependable source of supply and is an important asset in semiarid regions where surface-water supplies vary widely from year to year.

Chemical Quality:

The chemical quality of the water in most ground-water systems in Nevada varies considerably from place to place. In the areas of recharge the chemical concentration of the water normally is very low. However, as the ground water moves through the system to the areas of discharge, it is in contact with rock materials which have different solubilities. The extent to which the water dissolved chemical constituents from the rock materials is governed in large part by the solubility, volume, and distribution of the rock materials, by the time the water is in contact with the rocks, and by the temperature and pressure in the ground-water system.

The following analysis of water from Bristol well was reported by Carpenter (1915, p. 30). Constituents are listed in parts per million.

Silica	(SiO ₂)	49	Carbonate	(CO ₃)	0.0
Iron	(Fe)	.7	Bicarbonate	(HCO ₃)	187
Calcium	(Ca)	76	Sulfate	(SO ₄)	71
Magnesium	(Mg)	33	Nitrate	(NO ₃)	32
Sodium plus			Chloride	(Cl)	110
Potassium (Na + K)		37			

Total hardness as CaCO ₃		325			
Total solids		509			

The analysis probably does not represent the typical chemical quality of ground water in Dry Lake Valley. However, it is somewhat suggestive of a mixed-water type found in the region. In some areas, ground water in Paleozoic carbonate rocks will contain a relatively high proportion of calcium magnesium, and bicarbonate due to solution of the carbonate rocks. As that water moves into Tertiary volcanic rocks or deposits derived from such rocks the proportion of sodium will increase partly by base exchange and partly by addition to the dissolved solids in the water until the water becomes a sodium-bicarbonate type. The relatively high chloride and nitrate in the analysis suggests local contamination, a condition that might well be expected from the local concentration of people and stock of the watering point when Bristol wells supplied water to the nearby mines and was the site of a small settlement and a smelter.

If it can be assumed that the analysis may be more or less representative of ground water in the lower part of Dry Lake Valley, with the exception of the high concentration of chloride and nitrate, the water would be suitable for domestic and stock purposes.

Development:

Small amounts of ground water from springs and wells are used to water livestock feeding on the range in Dry Lake Valley. Carpenter (1915, p. 66) reported that Bristol well (3N/65-21d1) formerly furnished the water supply for a smelter. He reported too, that several wells were dug in the vicinity and a small town sprung up around them. However, when Carpenter visited the area in 1912, only one well remained. This well had been in use to supply water to the traveling public and for miners at the Bristol mine a few miles east. The well could be pumped dry at that time during the filling of water tanks used to supply water at the mine. In October 1912 the well was 51 feet deep and water level was 43 feet below land surface. Seemingly the well has since been destroyed. There are three drilled wells in that area that are used to water stock. Reportedly, however, all three do not provide a sufficient supply to meet the needs.

Near Delamar, Carpenter (1915, p. 67) noted that water was piped from several springs, reported to be small seepages in the limestone and granite. Callaghan (1937, p. 35) also refers to the water supply of Delamar but refers to the earlier used springs and wells in a nearby wash as being developed in volcanic rocks. Carpenter also reported that well 6S/63-12a1, drilled 900 feet deep at the foot of the alluvial slope below Delamar, was dry. He further states that when the mine at Delamar was active, water supply was obtained from Meadow Valley Wash, which was pumped over the Meadow Valley Range (Delamar Range) through two 3 1/2-inch pipe lines.

Presently, ground water from wells and springs probably supplies less than 100 acre-feet per year and is used principally for watering stock in Dry Lake and Delamar Valleys. Development of ground water for irrigation probably would be prohibitive because of high pumping costs. Limited amounts of

ground water could be developed, if the need were great enough.

The very substantial depths to water in the central parts of Dry Lake and Delamar Valleys, which makes the cost of development of ground water too high for usual purposes, may make the area attractive for some types of special testing or operation required in modern day technology. In turn, ground water probably could be developed to meet limited water requirements of such activities.

DESIGNATION OF WELLS

In this report the number assigned to a well is both an identification number and a location number. It is referenced to the Mount Diablo base line and meridian established by the General Land Office.

A typical number consists of three units. The first unit designates the township; "N" after the number identifies the township as north of the Mount Diablo base line; "S" after the number identifies the township as south of the Mount Diablo base line. The second unit, a number separated by a slant line from the first, is the range east of the Mount Diablo meridian. The third unit, separated from the second by a dash, is the number of the section in the township. The section number is followed by a lower case letter, which designates the quarter section, and finally, a number designating the order in which the well was recorded in the quarter section. The letters a, b, c, and d, designate, respectively, the northeast, northwest, southwest, and southeast quarters of the section.

Thus, well number 3N/64-20b1 indicates that this well was the first well recorded in the northwest quarter of sec. 20, T. 3 N., R. 64 E.

Wells on plate 1 are identified only by the section number, quarter section letter, and serial number. The township in which the well is located can be ascertained by the township and range numbers shown on the margin of plate 1. For example, well 3N/64-20b1 is shown on plate 1 as 20b1 and is within the rectangle designated as T. 3 N., R. 64 E.

Table 5.--Records of selected wells in Dry Lake and
Delamar Valleys, Lincoln County, Nev.

1N/64-24a1. Owners R. Lytle, S. A. Hollinger, and A. Delmue.
Drilled stock well; depth 515 feet, casing diameter 5 inches. Reported depth
to water below land surface 398 feet, January 17, 1959. This well caved
between 428 feet and 515 feet. Driller's log:

Material	Thickness (feet)	Depth (feet)
Clay	3	3
Gravel, sandy	12	15
Clay	45	60
Sand and gravel, stratified	29-	350
Sand, fine	70	420
Lime, cemented	8	428
Clay	87	515
Total depth		515

1N/65-2a1. Owner not determined. Dug well; depth 12 feet, diameter
48 inches. Reported depth to water 10 feet.

2N/64-3b1. Coyote well. Owner, Bureau of Land Management.
Drilled stock well; depth 742 feet; diameter, 6 inches; casing perforated 702 to
742 feet with torch-cut 1/4- x 8-inch slots, 6 to the round. Equipped with
pump jack and gasoline pump. Reported depth to water, 664 feet, March, 1963.

2N/65-6b1. Owner not determined. Abandoned drilled well; depth 376
feet. Dry.

3N/64-20b1. Owner Bureau of Land Management. Unused, drilled
stock well; depth 380 feet, casing diameter 6 inches. Depth to water below land
surface 304 feet, when drilled; measured depth to water 316.54 feet, Mar. 11, 196

3N/65-21d1. Bristol well. Destroyed dug stock and domestic well.
Reported depth, 51 feet. Reported depth to water 43 feet.

3N/65-21d2. Bristol well. Drilled stock well; casing diameter, 8
inches. Equipped with pump jack. Reported depth to water about 45 feet.

3N/65-21d3. Bristol well. Drilled stock well; casing diameter,
6 inches. Equipped with windmill and cylinder pump. Reported depth to water,
45 feet.

3N/65-21d4. Bristol well. Drilled stock well; casing diameter, 5 inches.
Equipped with pump jack and engine. Reported depth to water, 45 feet.

5N/64-14a1. Owner not determined. Drilled well; depth 239.5 feet. Dry.

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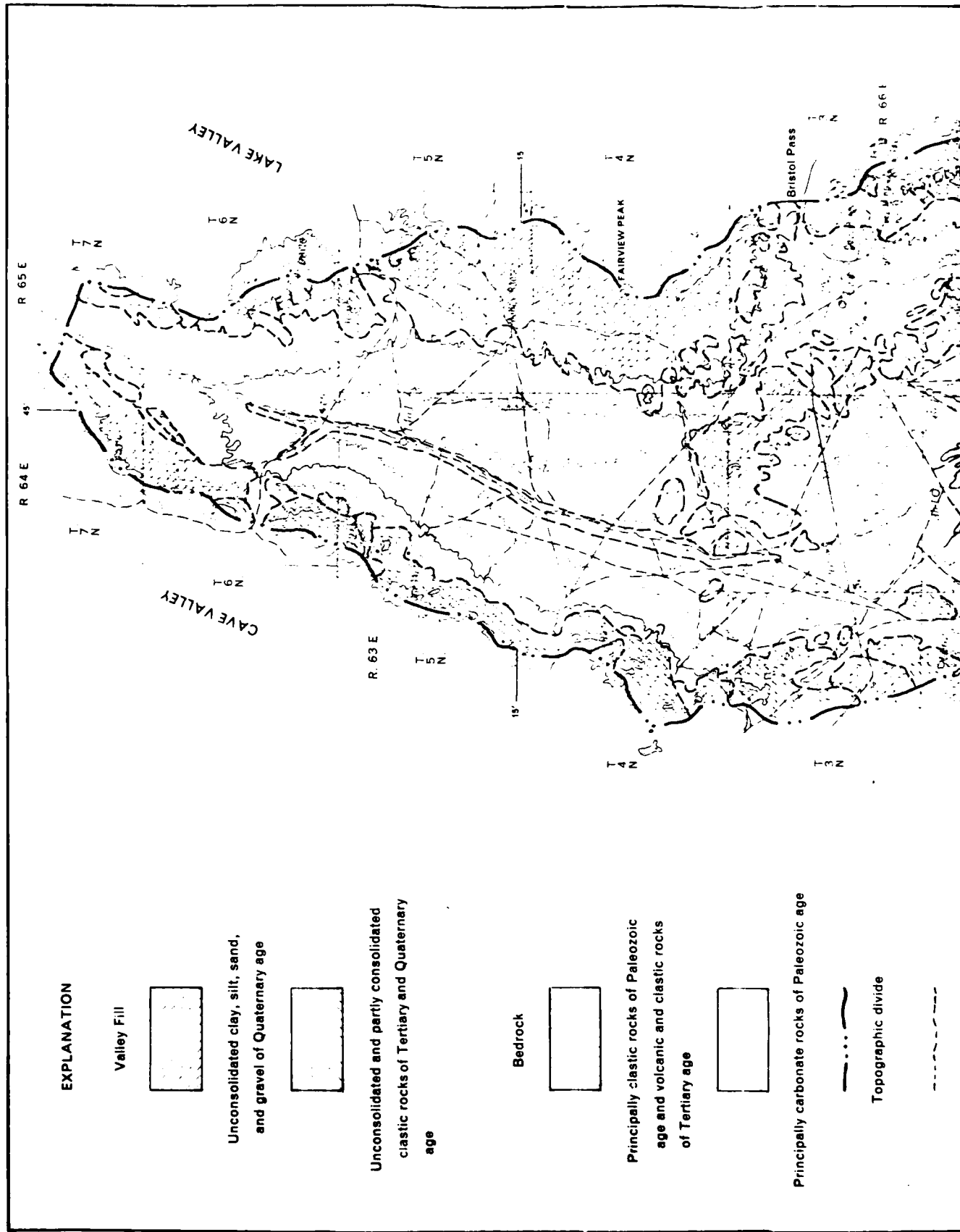
PREVIOUSLY PUBLISHED REPORTS OF THE
GROUND-WATER RESOURCES RECONNAISSANCE SERIES

Rep. No.

- 1 Ground-Water Appraisal of Newark Valley, White Pine County, Nevada.
Dec. 1960, by Thomas E. Eakin.
- 2 Ground-Water Appraisal of Pine Valley, Eureka and Elko Counties,
Nevada, Jan. 1961, by Thomas E. Eakin.
- 3 Ground-Water Appraisal of Long Valley, White Pine and Elko Counties,
Nevada, June 1961, by Thomas E. Eakin.
- 4 Ground-Water Resources of Pine Forest Valley, Humboldt County,
Nevada, Jan. 1962, by William C. Sinclair.
- 5 Ground-Water Appraisal of the Imlay Area, Humboldt River Basin,
Pershing County, Nevada, Feb. 1962, by Thomas E. Eakin
6. Ground-Water Appraisal of Diamond Valley, Eureka and Elko Counties,
Nevada, Feb. 1962, by Thomas E. Eakin.
- 7 Ground-Water Resources of Desert Valley, Humboldt County, Nevada,
April 1962, by William C. Sinclair,
- 8 Ground-Water Appraisal of Independence Valley, Western Elko County,
Nevada, May 1962, by Thomas E. Eakin.
- 9 Ground-Water Appraisal of Gabbs Valley, Mineral and Nye Counties,
Nevada, June 1962, by Thomas E. Eakin.
- 10 Ground-Water Appraisal of Sarcobatus Flat and Oasis Valley, Nye County,
Nevada, Oct. 1962, by Glenn T. Malmberg and Thomas E. Eakin.
- 11 Ground-Water Resources of Hualapai Flat, Washoe, Pershing, and
Humboldt Counties, Nevada, Oct. 1962, by William C. Sinclair.
- 12 Ground-Water Appraisal of Ralston and Stonecabin Valleys, Nye County,
Nevada, Oct. 1962, by Thomas E. Eakin.
- 13 Ground-Water Appraisal of Cave Valley in Lincoln and White Pine
Counties, Nevada, Dec. 1962, by Thomas E. Eakin.
- 14 Ground-Water Resources of Amargosa Desert, Nevada - California,
March 1963, by George E. Walker and Thomas E. Eakin.
- 15 Ground-Water Appraisal of the Long Valley-Massacre Lake Region,
Washoe County, Nevada, by William C. Sinclair; also including a
section on The Soils of Long Valley by Richard L. Malchow.

UNITED STATES DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY

STATE OF NEVADA
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES



Principally carbonate rocks of Paleozoic age

Topographic divide

Approximate geologic contact

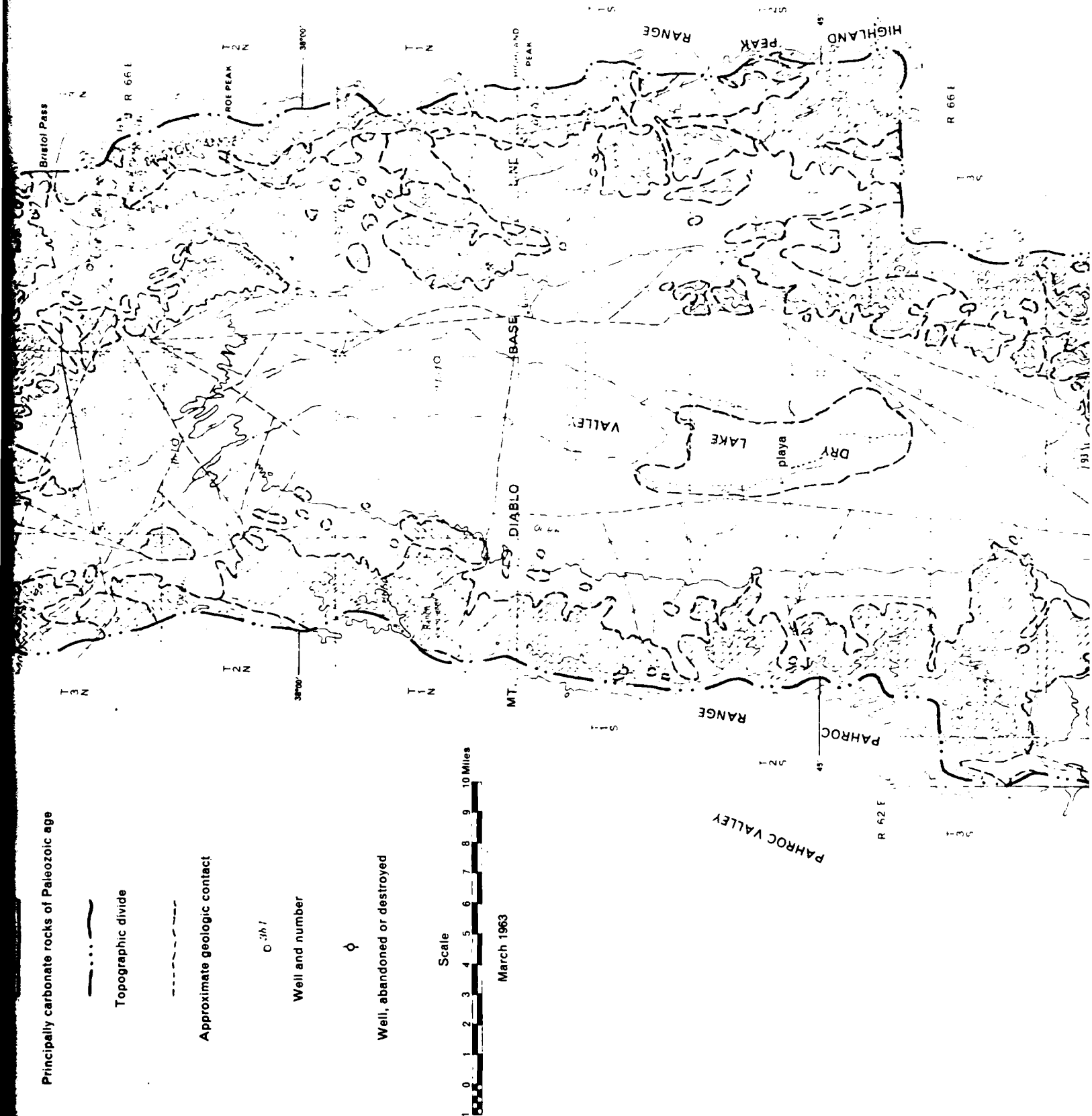
Well and number

Well, abandoned or destroyed

Scale



March 1963



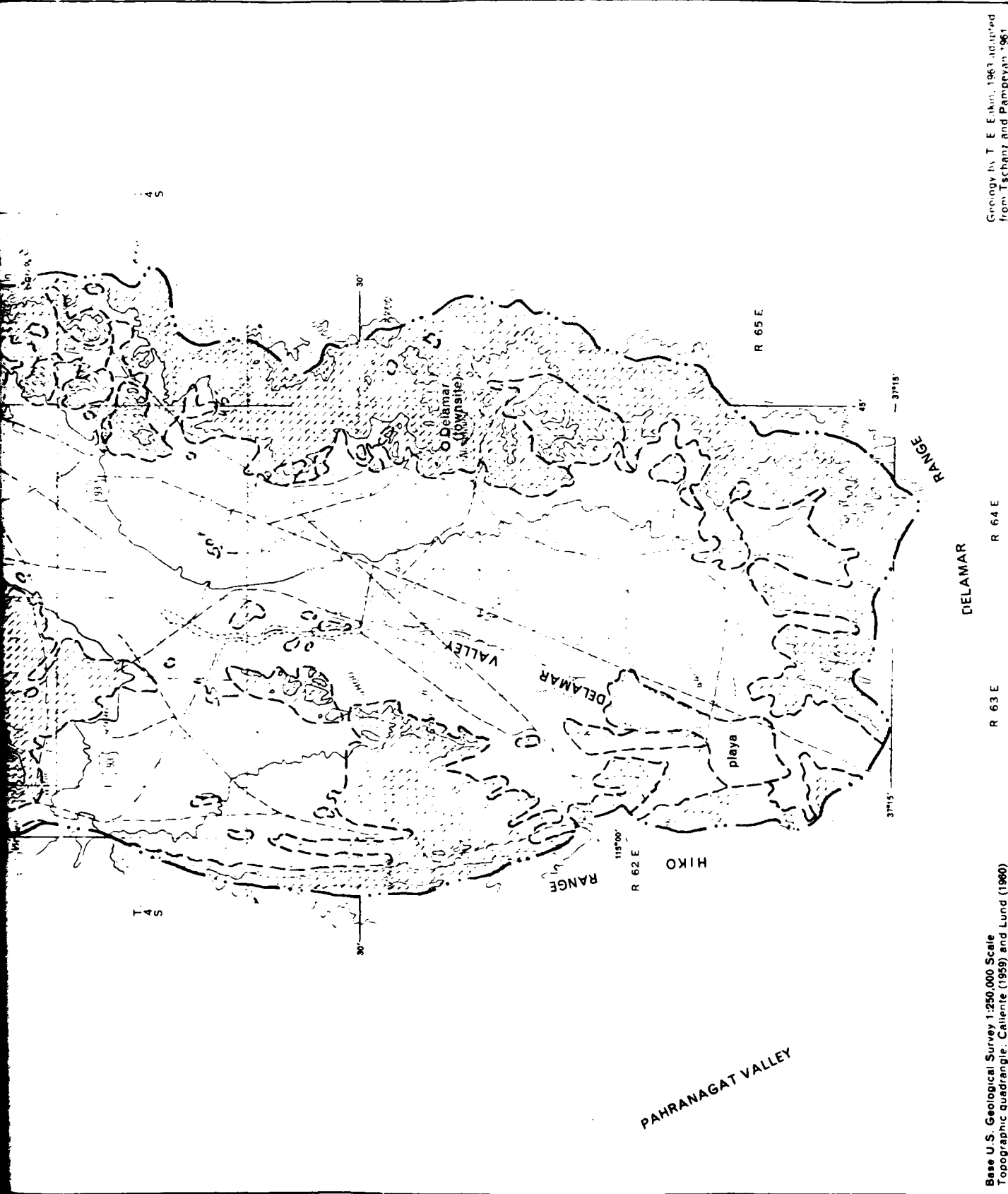


PLATE 1.—MAP OF THE DRY LAKE AND DELAMAR VALLEYS: LINCOLN COUNTY, NEVADA
 SHOWING AREAS OF BEDROCK, VALLEY FILL, AND LOCATION OF WELLS

H1.0

MISCELLANEOUS WORKING DOCUMENTS

H1.1

WELL LOGS AND REPORTS TO THE
STATE ENGINEER OF NEVADA

Dry Lake 30/65-21

WELL LOG AND REPORT TO THE STATE ENGINEER OF NEVADA

(5)

PLEASE COMPLETE THIS FORM IN ITS ENTIRETY

Log No. 6894 X ✓
 Rec. Dec 4 1962
 Well No. _____
 Permit No. _____

Do not fill in

Owner White Side Co. Inc. Driller W. C. Little

Address 3000 E. 1st St. Las Vegas, Nev. Address 2700 E. 1st St. Las Vegas, Nev. Lic. No. 35

Location of well: 1/4 Sec 21, T. 3 N. R. 6 E. in Lincoln County

or Artificial well

Water will be used for Stock Total depth of well 120'

Size of drilled hole 8" Weight of casing per linear foot _____

Thickness of casing 10 gauge Temp. of water _____

Diameter and length of casing 5" 50'
 (Casing 12" in diameter and under give inside diameter; casing 12" in diameter give outside diameter.)

If flowing well give flow in c.f.s. or g.p.m. and pressure _____

If nonflowing well give depth of standing water from surface 17'

If flowing well describe control works _____
 (Type and size of valve, etc.)

Date of commencement of well December 28, 1962 Date of completion of well January 1, 1963

Type of well rig Hand Drilled

LOG OF FORMATIONS

From feet	To feet	Thickness feet	Type of material	Water-bearing Formation, Casing Perforations, Etc.
0	60	60	sand-gravel-boulders	Chief aquifer (water-bearing formation)
60	120	60	cemented gravel	from <u>17'</u> to <u>77'</u> ft.
				Other aquifers _____

				First water at <u>17</u> feet.
				Casing perforated
				from <u>20'</u> to <u>80'</u> ft.
				Size of perforations
				<u>1/8 x 1/2</u>

WELL LOG AND REPORT TO THE STATE ENGINEER OF NEVADA

PLEASE COMPLETE THIS FORM IN ITS ENTIRETY

Log No. 100-100
Rec. Dec. 10 1962
Well No. 02
Permit No. _____
Do not put in

Owner 100-100 Driller 100-100
Address 100-100 Address 100-100 Lic. No. 100-100
Location of well: 1/4 Sec. 21, T. 3. N. 1/2, R. 6. E., in 100-100 Cou
or 100-100 100-100
Water will be used for 100-100 Total depth of well 80'
Size of drilled hole 8" Weight of casing per linear foot 100-100
Thickness of casing 1/4" Temp. of water 100-100
Diameter and length of casing 12" 60'
(Casing 12" in diameter and under give inside diameter; casing 12" in diameter give outside diameter)
If flowing well give flow in c.f.s. or g.p.m. and pressure 100-100
If nonflowing well give depth of standing water from surface 100-100
If flowing well describe control works 100-100
Date of commencement of well 100-100 completion of well 100-100
Type of well rig 100-100

LOG OF FORMATIONS

From feet	To feet	Thickness feet	Type of material
0	45	45	sand-gravel - boulders
45	50	5	sandy clay
50	80	30	cemented gravel

Water-bearing Formation, Casing Perforations, Etc.

Chief aquifer (water-bearing formation)

from 15' to 50'

Other aquifers

First water at 15' feet.

Casing perforated

from 20' to 60'

Size of perforations

1/2" x 12"

WELL LOG AND REPORT TO THE STATE ENGINEER OF NEVADA

PLEASE COMPLETE THIS FORM IN ITS ENTIRETY

Log No. 2000
Rec. Dec 4 1962
Well No. 30,65-21
Permit No. 4
Do not fill in

Owner W. L. Little, Co. Valley, Nev. Driller W. L. Little

Address W. L. Little, Co. Valley, Nev. Address W. L. Little, Co. Valley, Nev. Lic. No. 3

Location of well: 1/4 Sec 21, T. 3 N, R. 65 E, in Elko Co.

or Section 20, T. 3 N, R. 65 E, in Elko Co.

Water will be used for Stock Total depth of well 120'

Size of drilled hole 8" Weight of casing per linear foot

Thickness of casing 10 gauge Temp. of water

Diameter and length of casing 5" 50'

(Casing 12" in diameter and under give inside diameter; casing 12" in diameter give outside diameter)

If flowing well give flow in c.f.s. or g.p.m. and pressure

If nonflowing well give depth of standing water from surface 17'

If flowing well describe control works

(Type and size of valve, etc.)

Date of commencement of well December 28, 1962 Date of completion of well January 1, 1963

Type of well rig W. L. Little

LOG OF FORMATIONS

From feet	To feet	Thickness feet	Type of material
0	60	60	sand-gravel boulders
60	120	60	consolidated gravel

Water-bearing Formation, Casing Perforations, Etc.

Chief aquifer (water-bearing formation)

from 17' to 77'

Other aquifers

First water at 17' feet.

Casing perforated

from 20' to 50'

Size of perforations

2 1/2" x 1/2"

ENGINEER OF NEVADA 30/65-21

Do not

Type of well ris. Leaky well

212

(U) 5N/65-22.
WELL LOG AND REPORT TO THE STATE
ENGINEER OF NEVADA *Dry Lake*

PLEASE COMPLETE THIS FORM IN ITS ENTIRETY

Log No. 10702X
Rec. 19
Well No. 23978
Permit No. 23978
Do not fill in BASIN

Owner Charles Sidleys Driller Wick M. Camp

Address Baker Hill Address Baker Hill Lic. No. 1

Location of well 2 1/4 Sec 29, T. 3 N/S, R. 3 E, in Luna Lake Co.
or

Water will be used for Irrigation Total depth of well 9.40

Size of drilled hole 2.4" Weight of casing per linear foot

Thickness of casing 1/4" Temp. of water

Diameter and length of casing 1 1/2" 2.40'
(Casing 12" in diameter and under give inside diameter; casing 12" in diameter give outside diameter)

If flowing well give flow in c.f.s. or g.p.m. and pressure

If nonflowing well give depth of standing water from surface 3'

If flowing well describe control works
(Type and size of valve, etc.)

Date of commencement of well 11/1/66 Date of completion of well 2/1/66

Type of well rig Rotary

LOG OF FORMATIONS

From feet	To feet	Thickness feet	Type of material	Water-bearing Formation, Casing Perforations, Etc.
0	15	15	Surf	
15	25	10	Gravel Sand	Chief aquifer (water-bearing formation)
25	30	5	Gravel	from 60 to 74.0 ft
30	32	2	Clay	Other aquifers
32	36	4	Gravel Sand	
36	45	9	Clay	
45	50	5	Gravel Sand	
50	54	4	Clay	
54	60	6	Gravel	
60	63	3	Clay	
63	69	6	Gravel	First water at 18 feet
69	74	5	Clay	
74	78	4	Gravel	Casing perforated
78	81	3	Clay	from 60 to 74.0 ft
81	85	4	Gravel	
85	89	4	Clay	
89	93	4	Gravel	
93	97	4	Clay	
97	101	4	Gravel	
101	105	4	Clay	
105	109	4	Gravel	
109	113	4	Clay	
113	117	4	Gravel	
117	121	4	Clay	
121	125	4	Gravel	
125	129	4	Clay	
129	133	4	Gravel	
133	137	4	Clay	
137	141	4	Gravel	
141	145	4	Clay	
145	149	4	Gravel	
149	153	4	Clay	
153	157	4	Gravel	
157	161	4	Clay	
161	165	4	Gravel	
165	169	4	Clay	
169	173	4	Gravel	
173	177	4	Clay	
177	181	4	Gravel	
181	185	4	Clay	
185	189	4	Gravel	
189	193	4	Clay	
193	197	4	Gravel	
197	201	4	Clay	
201	205	4	Gravel	
205	209	4	Clay	
209	213	4	Gravel	
213	217	4	Clay	
217	221	4	Gravel	
221	225	4	Clay	
225	229	4	Gravel	
229	233	4	Clay	
233	237	4	Gravel	
237	241	4	Clay	
241	245	4	Gravel	
245	249	4	Clay	
249	253	4	Gravel	
253	257	4	Clay	
257	261	4	Gravel	
261	265	4	Clay	
265	269	4	Gravel	
269	273	4	Clay	
273	277	4	Gravel	
277	281	4	Clay	
281	285	4	Gravel	
285	289	4	Clay	
289	293	4	Gravel	
293	297	4	Clay	
297	301	4	Gravel	
301	305	4	Clay	
305	309	4	Gravel	
309	313	4	Clay	
313	317	4	Gravel	
317	321	4	Clay	
321	325	4	Gravel	
325	329	4	Clay	
329	333	4	Gravel	
333	337	4	Clay	
337	341	4	Gravel	
341	345	4	Clay	
345	349	4	Gravel	
349	353	4	Clay	
353	357	4	Gravel	
357	361	4	Clay	
361	365	4	Gravel	
365	369	4	Clay	
369	373	4	Gravel	
373	377	4	Clay	
377	381	4	Gravel	
381	385	4	Clay	
385	389	4	Gravel	
389	393	4	Clay	
393	397	4	Gravel	
397	401	4	Clay	
401	405	4	Gravel	
405	409	4	Clay	
409	413	4	Gravel	
413	417	4	Clay	
417	421	4	Gravel	
421	425	4	Clay	
425	429	4	Gravel	
429	433	4	Clay	
433	437	4	Gravel	
437	441	4	Clay	
441	445	4	Gravel	
445	449	4	Clay	
449	453	4	Gravel	
453	457	4	Clay	
457	461	4	Gravel	
461	465	4	Clay	
465	469	4	Gravel	
469	473	4	Clay	
473	477	4	Gravel	
477	481	4	Clay	
481	485	4	Gravel	
485	489	4	Clay	
489	493	4	Gravel	
493	497	4	Clay	
497	501	4	Gravel	
501	505	4	Clay	
505	509	4	Gravel	
509	513	4	Clay	
513	517	4	Gravel	
517	521	4	Clay	
521	525	4	Gravel	
525	529	4	Clay	
529	533	4	Gravel	
533	537	4	Clay	
537	541	4	Gravel	
541	545	4	Clay	
545	549	4	Gravel	
549	553	4	Clay	
553	557	4	Gravel	
557	561	4	Clay	
561	565	4	Gravel	
565	569	4	Clay	
569	573	4	Gravel	
573	577	4	Clay	
577	581	4	Gravel	
581	585	4	Clay	
585	589	4	Gravel	
589	593	4	Clay	
593	597	4	Gravel	
597	601	4	Clay	
601	605	4	Gravel	
605	609	4	Clay	
609	613	4	Gravel	
613	617	4	Clay	
617	621	4	Gravel	
621	625	4	Clay	
625	629	4	Gravel	
629	633	4	Clay	
633	637	4	Gravel	
637	641	4	Clay	
641	645	4	Gravel	
645	649	4	Clay	
649	653	4	Gravel	
653	657	4	Clay	
657	661	4	Gravel	
661	665	4	Clay	
665	669	4	Gravel	
669	673	4	Clay	
673	677	4	Gravel	
677	681	4	Clay	
681	685	4	Gravel	
685	689	4	Clay	
689	693	4	Gravel	
693	697	4	Clay	
697	701	4	Gravel	
701	705	4	Clay	
705	709	4	Gravel	
709	713	4	Clay	
713	717	4	Gravel	
717	721	4	Clay	
721	725	4	Gravel	
725	729	4	Clay	
729	733	4	Gravel	
733	737	4	Clay	
737	741	4	Gravel	
741	745	4	Clay	
745	749	4	Gravel	
749	753	4	Clay	
753	757	4	Gravel	
757	761	4	Clay	
761	765	4	Gravel	
765	769	4	Clay	
769	773	4	Gravel	
773	777	4	Clay	
777	781	4	Gravel	
781	785	4	Clay	
785	789	4	Gravel	
789	793	4	Clay	
793	797	4	Gravel	
797	801	4	Clay	
801	805	4	Gravel	
805	809	4	Clay	
809	813	4	Gravel	
813	817	4	Clay	
817	821	4	Gravel	
821	825	4	Clay	
825	829	4	Gravel	
829	833	4	Clay	
833	837	4	Gravel	
837	841	4	Clay	
841	845	4	Gravel	
845	849	4	Clay	
849	853	4	Gravel	
853	857	4	Clay	
857	861	4	Gravel	
861	865	4	Clay	
865	869	4	Gravel	
869	873	4	Clay	
873	877	4	Gravel	
877	881	4	Clay	
881	885	4	Gravel	
885	889	4	Clay	
889	893	4	Gravel	
893	897	4	Clay	
897	901	4	Gravel	
901	905	4	Clay	
905	909	4	Gravel	
909	913	4	Clay	
913	917	4	Gravel	
917	921	4	Clay	
921	925	4	Gravel	
925	929	4	Clay	
929	933	4	Gravel	
933	937	4	Clay	
937	941	4	Gravel	
941	945	4	Clay	
945	949	4	Gravel	
949	953	4	Clay	
953	957	4	Gravel	
957	961	4	Clay	
961	965	4	Gravel	
965	969	4	Clay	
969	973	4	Gravel	
973	977	4	Clay	
977	981	4	Gravel	
981	985	4	Clay	
985	989	4	Gravel	
989	993	4	Clay	
993	997	4	Gravel	
997	1001	4	Clay	

#5

1N/64E-39

Day: Feb 11
 Date: Feb 11
 Week: Feb 11
 Period: 1077-53
 Do not put in

Overcupped Hollings - Palmer Box - Black Tree
Miss Piache, Nevada *Miss Box - Piache, Nevada No 30*

Location of well: Section 39, T1N, R64E, Lincoln Co.
in Simpson formation area

Water will be used for 21 B Total amount of water 515

Size of fertilized seeds 7 1/4 Weight of seedling from chosen seeds _____

Division of 3 11

Diameter and length of casing 5" 515' 00000000

11. Do you have any other information that you wish to provide?

If sandoring will give depth of sandoring water from surface 398' TO WATER.

If drawing well describe several words

Date of commencement of well No. 15, 1958 Date of completion of well No. 17, 1959

Type of soil is Loam 10/2/20

Feet Down	To Sect	Distance Feet	Type of material
0	3	3	clay
3	15	12	sandy gravel
15	60	45	clay
60	350	290	stratified sand & gravel
350	420	70	fine sand
420	428	8	cemented lime
428	515	87	clay

END OF LOG

Water-bearing formation, casing
penetrated, etc.

CASE ADVISOR WATER BEARING
Casing section (water-bearing
formation)

From 428 to 515 ft.

Casing section _____

FIRST WATER AT 428 feet.
Initial water at 412 ft. end

Casing perforated.
Casing cemented.

From 400 to 515 ft.

Size of perforations _____
1/8 x 10" 1/8 x 10" slot size

WELL

(32) 35/63-22db
 AT TO THE STATE ENGINEER
 NEVADA

Log No. 10864
 Rec. 11-26-69 19
 Well No.
 Permit No. 22477
 Do not fill in.

THIS FORM ON ITS ENTIRETY

Owner CHE Driller VICK McCAHILL
 Address NEVADA Address BEAVER Lic. No. 7381
 Location of well T.3.3/4S, R.43.E, in LINCOLN Co.
 Permit No. 251 22477
 Water will be used for IRRIGATION Total depth of well
 Size of drilled hole Weight of casing per linear foot
 Thickness of casing 3/8" Temp. of water
 Diameter and length of 120"
 (Casing 12" in diameter and under give inside diameter; casing 12" in diameter give outside diameter.)
 If flowing well give flow 3' 4"
 If nonflowing well give d
 If flowing well describe c
 (Type and size of valve, etc.)
 Date of commencement 1/3/66 Date of completion of well 3/2/66
 Type of well rig

FORMATIONS

From feet	To feet	Type of material
0	8	GREY CLAY
8	12	BLUE CLAY
12	125	GREY CLAY
125	152	GRAVEL
132	138	CLAY
138	155	GRAVEL
155	168	CLAY
168	174	GRAVEL
174	175	CLAY
177	190	SANDY CLAY
190	205	GRAVEL
205	207	SAND
207	222	SAND + GRAVEL
222	230	CLAY

Water-bearing Formation, Casing Perforations, etc.

Chief aquifer (water-bearing formation)

from 125 to 230

Other aquifers

First water at 8 feet

Casing perforated

from 60 to 230

Size of perforations

3/8"

Log No. _____
Permit No. _____
Basin _____

WELL DRILLERS REPORT

Please complete this form in its entirety

1. OWNER U.S. DEPT OF THE AIR FORCE
Ballistics Missile Office

ADDRESS Norton AFB, Calif. 92409

2. LOCATION NE 1/4 Sw 14 Sec. 12 T. 3 N/S R. 64 E. Nye County
PERMIT NO. none req. Exploratory well

3. TYPE OF WORK
New Well ☒ Recondition ☐
Deepen ☐ Other ☐
4. PROPOSED USE
Domestic ☐ Irrigation ☐ Test ☒
Municipal ☐ Industrial ☐ Stock ☐
5. TYPE WELL
Cable ☐ Reverse Rotary ☒
Other ☐

6. LITHOLOGIC LOG

Material	Water Strata	From	To	Thickness
fine sand, some small rock		0	50 ft.	
sand and gravel		50	185	
gravel, coarse sand		185	240	
gravel, coarse sand, some clay		240	275	
gravel, sand, some silt		275	340	
coarse sand, gravel, traces of silt and clay		340	370	
gravel with sand and silt and 1/2" rock		370	420	
sand, gravel, trace of silt & clay, rock from 1/2" to 3"		420	510	
gravel and coarse sand		510	610	
gravel, sand, small rock 1/2" to 2" and silt		610	1010	
sand, gravel streaks with rocks up to 6" size		1010	1300	

8. WELL CONSTRUCTION

Diameter hole 18-5/8" inches Total depth 1300 feet
Casing record _____
Weight per foot _____ Thickness _____
Diameter From To
2 inches 0 feet 1300 feet
2 inches 0 feet 798 feet
_____ inches _____ feet _____ feet
_____ inches _____ feet _____ feet
_____ inches _____ feet _____ feet
_____ inches _____ feet _____ feet
Surface seal Yes ☒ No ☐ Type grout
Depth of seal 40 ft. feet
Gravel packed: Yes ☒ No ☐
Gravel packed from 0 feet to 1300 feet

Perforations:

Type perforation mill slot
Size perforation _____
From 1270 feet to 1290 feet
From 768 feet to 788 feet
From _____ feet to _____ feet
From _____ feet to _____ feet
From _____ feet to _____ feet

9. WATER LEVEL

Static water level 383 feet below land surface
Flow _____ G.P.M.
Water temperature cold ° F. Quality _____

10. DRILLERS CERTIFICATION

This well was drilled under my supervision and the report is true to the best of my knowledge.

Name BEYLIK DRILLING, INC. (James L. Clyde Driller)

Address 591 S. Walnut Street-1a Habra, Ca. 9063

Nevada contractor's license number 007055A

Nevada driller's license number 1169

Signed John A. Beylik

Date Feb. 12, 1980

7. WELL TEST DATA

Pump RPM	G.P.M.	Draw Down	After Hours Pump
air lift	15 +		4

not applicable BAILER TEST

G.P.M. Draw down feet hours
G.P.M. Draw down feet hours
G.P.M. Draw down feet hours

Log No. _____
Permit No. _____
Basin. _____

WELL DRILLERS REPORT

Please complete this form in its entirety

1. OWNER U. S. DEPT. OF THE AIRFORCE ADDRESS Norton AFB, Calif. 92409
Ballistic Missile Dept.
(Well is: Dry Lake Valley Test Well No. TW-1)
2. LOCATION NE 1/4 SW 1/4 Sec. 12 T. 3S N/S R. 64E E in Lincoln County
PERMIT NO. none required - Exploratory hole

3. TYPE OF WORK
New Well ☒ Recondition ☐
Deepen ☐ Other ☐
4. PROPOSED USE
Domestic ☐ Irrigation ☐ Test ☒
Municipal ☐ Industrial ☐ Stock ☐
5. TYPE WELL
Cable ☐ Rotary ☐
Other ☒ Reverse

6. LITHOLOGIC LOG				
Material	Water Strata	From	To	Thick-ness
gravel, clay, small rock		0	140	
gravel, small rock		140	150	
large rocks, 2" dia. gravel		150	190	
and fine sand				
large rocks, 2" dia. gravel		190	260	
gravel & small 1" dia. rocks		260	370	
fine sand & few small rocks		370	400	
gravel & small rocks/clay		400	440	
brown clay, small amt. gravel		440	520	
gravel and small rocks		520	600	
gravel, very little clay		600	630	
brown clay, small rocks		630	710	
gravel		710	760	
brown clay and gravel		760	780	
gravel and fine sand		780	800	
gravel, very little clay		800	830	
gravel & small rocks		830	850	
gravel, some small rocks		850	880	
small 1" dia. rocks, gravel		880	900	
rocks & gravel		900	1000	
gravel		1000	1005	
hard rock and some gravel		1005	1010	

8. WELL CONSTRUCTION
Diameter hole 18-1/2 inches Total depth 1,000 feet
Casing record _____
Weight per foot _____ Thickness 5/16"
Diameter 22" x 1/4" wall From 0 To 40
10" x 5/16" inches + 2 feet 1000 feet
inches _____ feet _____ feet
inches _____ feet _____ feet
inches _____ feet _____ feet
inches _____ feet _____ feet
Surface seal: Yes ☒ No ☐ Type grout
Depth of seal 40 ft. _____ feet
Gravel packed: Yes ☒ No ☐
Gravel packed from 10 feet to 1000 feet

Perforations: Johnson
Type perforation wire screen
Size perforation .050
From 970 feet to 990 feet
From 920 feet to 950 feet
From 870 feet to 810 feet
From 830 feet to 750 feet
From 770 feet to 750 feet
From 720 feet to 680 feet
From 620 feet to 600 feet

9. WATER LEVEL
Static water level .422 Feet below land surface
Flow _____ G.P.M.
Water temperature 82.5 °F. Quality slightly cloudy

Date started Feb. 6th 19 80
Date completed April 20th 19 80

7. WELL TEST DATA			
Pump RPM	G.P.M.	Draw Down	After Hours Pump
1800	500	41	70

None None BAILER TEST
G.P.M. _____ Draw down _____ feet _____ hours
G.P.M. _____ Draw down _____ feet _____ hours
G.P.M. _____ Draw down _____ feet _____ hours

10. DRILLERS CERTIFICATION
This well was drilled under my supervision and the report is true to the best of my knowledge.

Name BEYLIK DRILLING, INC.
Address 591 S. Walnut Street
La Habra, Calif. 90631
Nevada contractor's license number 007055A
Nevada driller's license number 1168 and 1169
Signed James Clyde (James Clyde) Driller
Date April 21, 1980

WELL LOG AND REPORT TO THE STATE ENGINEER OF NEVADA

PLEASE COMPLETE THIS FORM IN ITS ENTIRETY

Log No. 44-112
 Rec. 11-1-21 19
 Well No. _____
 Permit No. 22559
 Do not fill in.

Owner E. L. 211 Driller Paul L. 211
 Address 350 State Route, Pahrump, Nye Co., Nevada Address Pahrump, Nye Co., Nevada Lic. No. 30
 Location of well: SE 1/4, SE 1/4 Sec. 23, T. 4 N/S, R. 63 E, in Pahrump, Nye Co., Nevada
 Permit No. 22559
 Water will be used for Irrigation Total depth of well 41'
 Size of drilled hole 1 1/2" Weight of casing per linear foot _____
 Thickness of casing 2 1/2" casing Temp. of water _____
 Diameter and length of casing _____
(Casing 12" in diameter and under give inside diameter; casing 12" in diameter give outside diameter.)
 If flowing well give flow in c.f.s. or g.p.m. and pressure _____
 If nonflowing well give depth of standing water from surface _____
 If flowing well describe control works _____
(Type and size of valve, etc.)
 Date of commencement of well November 17, 1966 Date of completion of well November 19, 1966
 Type of well rig Cable Tool

LOG OF FORMATIONS

From feet	To feet	Thickness feet	Type of material	Water-bearing Formation, Casing Perforations, etc.
0	5	5	soil	Chief aquifer (water-bearing formation)
5	12	7	sand	from _____ to _____
12	51	39	cemented gravel	Other aquifers _____
51	61	10	gravel in boulders	_____

				First water at _____ f.
				Casing perforated
				from _____ to _____
				Size of perforations _____

(39) 45163-2100

WELL LOG AND REPORT TO THE STATE ENGINEER
OF NEVADA

Log No. 9636
 Rec. Aug 6
 Well No. _____
 Permit No. 22853
 Do not fill in.

PLEASE COMPLETE THIS FORM IN ITS ENTIRETY

Owner Artistic Enterprises Driller W. L. F.
 Address 3500 S. Main St. Rm. 212 Las Vegas, Nev. Address Phoenix 7/10/67 Lic. No. 30
 Location of well: S.E. 1/4, S. 21 1/4 Sec. 24, T. 4 N/S, R. 6 E, in Lincoln Co.
 Permit No. Don't Ent.
 Water will be used for test hole Total depth of well 360'
 Size of drilled hole 7 1/4" Weight of casing per linear foot _____
 Thickness of casing 2.25" casing Temp. of water _____
 Diameter and length of casing _____
 (Casing 12" in diameter and under give inside diameter; casing 12" in diameter give outside diameter.)
 If flowing well give flow in c.f.s. or g.p.m. and pressure _____
 If nonflowing well give depth of standing water from surface no water
 If flowing well describe control works _____
 (Type and size of valve, etc.)
 Date of commencement of well July 24, 1967 Date of completion of well July 29, 1967
 Type of well rig Cable Tool

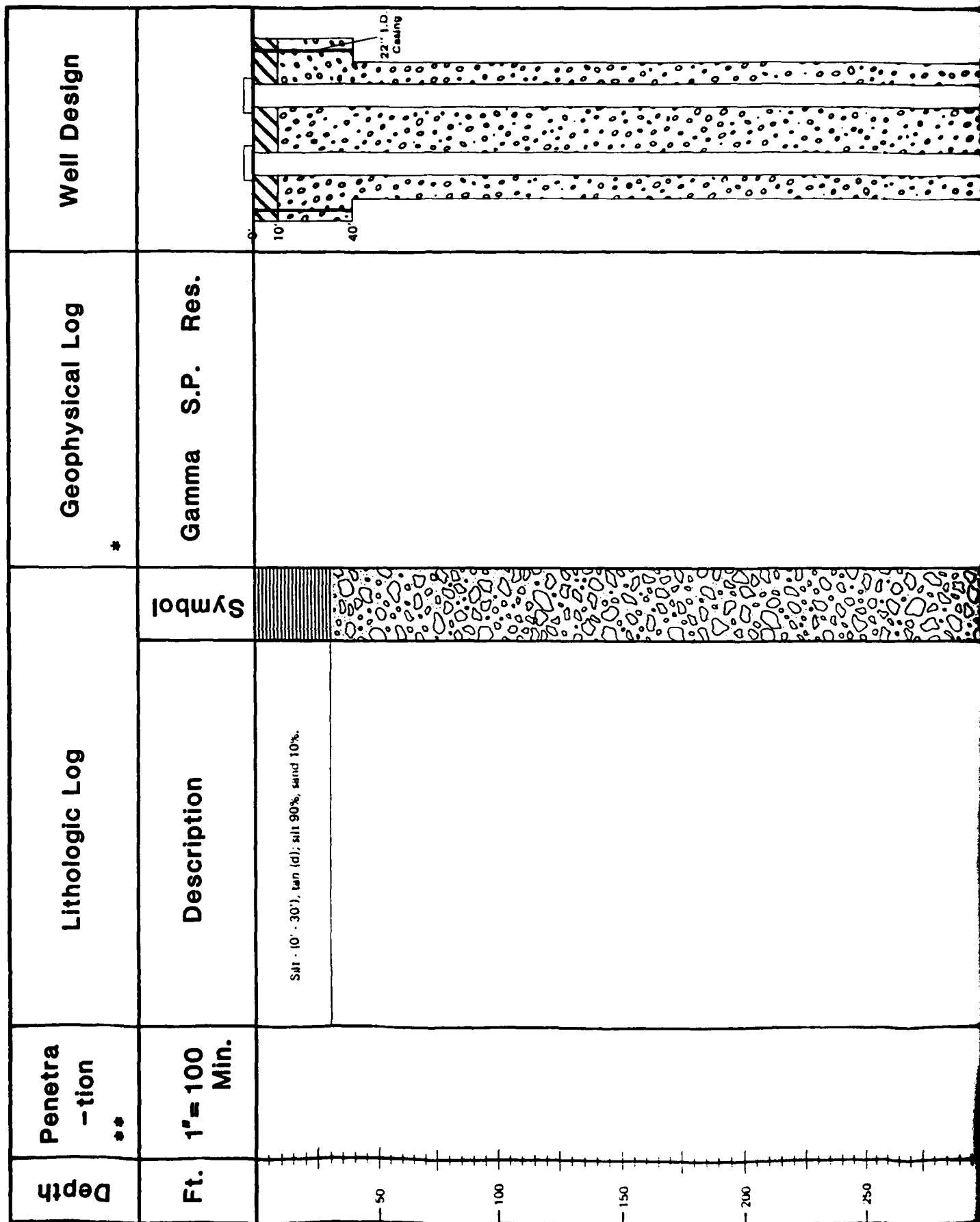
LOG OF FORMATIONS

From feet	To feet	Thickness feet	Type of material	Water-bearing Formation, Casing Perforations, etc.
~~0~~	~~65~~	~~65~~	~~drill hole 4700.1966~~	Chief aquifer (water-bearing formation) from _____ to _____
65	226	161	Cemented sand	Other aquifers _____
226	228	2	clay	
228	236	8	Cemented sand	
236	238	2	clay	
238	240	2	Cemented sand	
240	250	10	clay with layers of sand	
250	252	2	Cemented sand	
252	296	44	layers of cemented sand in sand	First water at _____ feet
296	297	1	clay	
297	326	29	layers of cemented sand in sand	Casing perforated from _____ to _____
326	327	1	clay	
327	360	33	sand	Size of perforations _____

H1.2

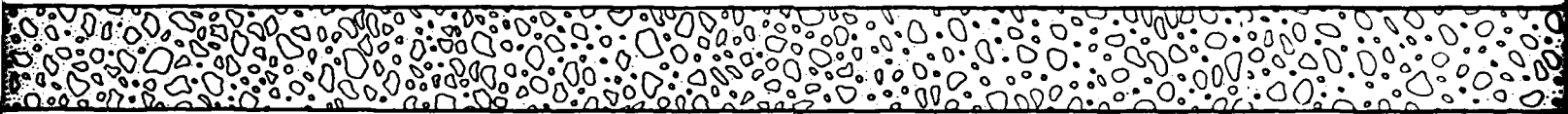
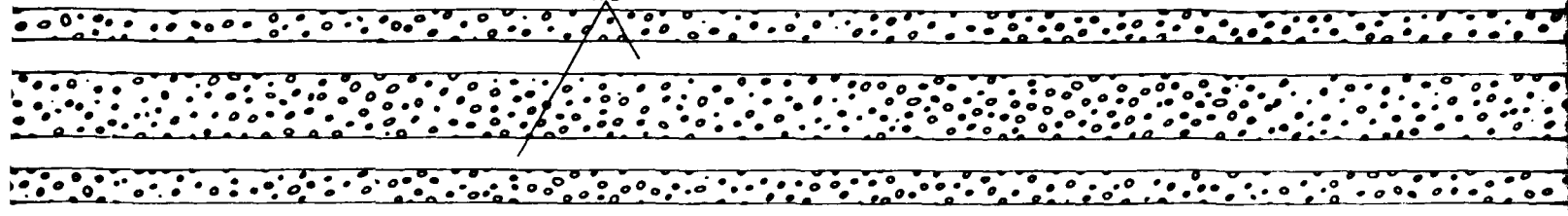
DRY LAKE VALLEY WELL LOG
AND WELL DESIGN (VALLEY-FILL)

DRY LAKE VALLEY OBSERVATION WELL (DL-I-O-1) 3S/64E-12da



1 2

2" I.D.
Casing



Gravel With Some Sand - (30' - 900'); brown (w/;
sand 15%, gravel 85%, sand % decreases to trace from
(510' - 760').

250

300

350

400

450

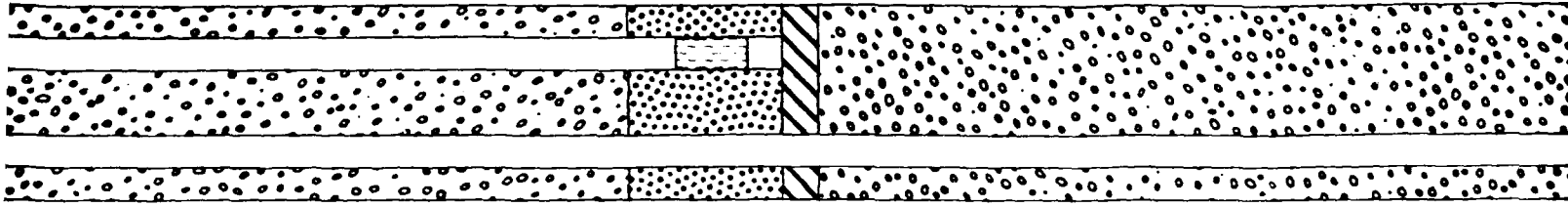
500

550

600

650

13

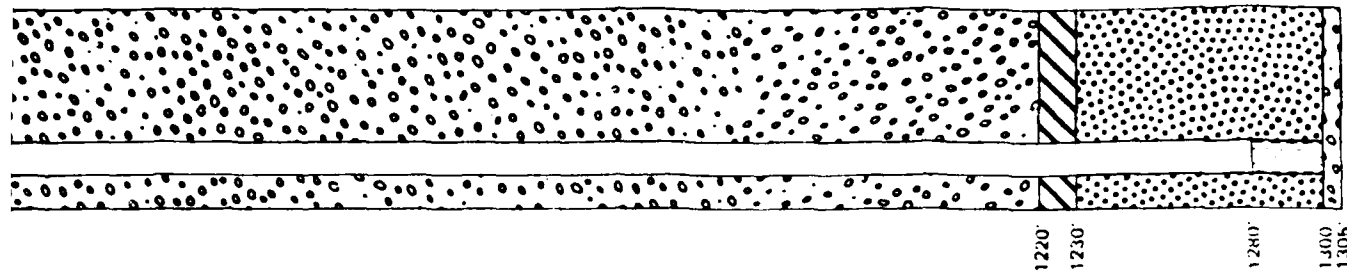


760' 765' 785' 795' 805'

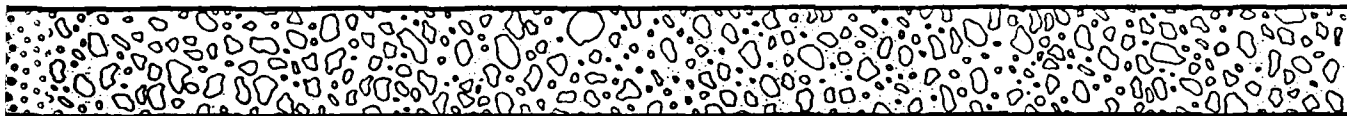


Sand With Some Gravel And Silt - (800' - 940').
brown (w), sand 70%, gravel 20%, silt 10%.

600 650 700 750 800 850 900 950 1000



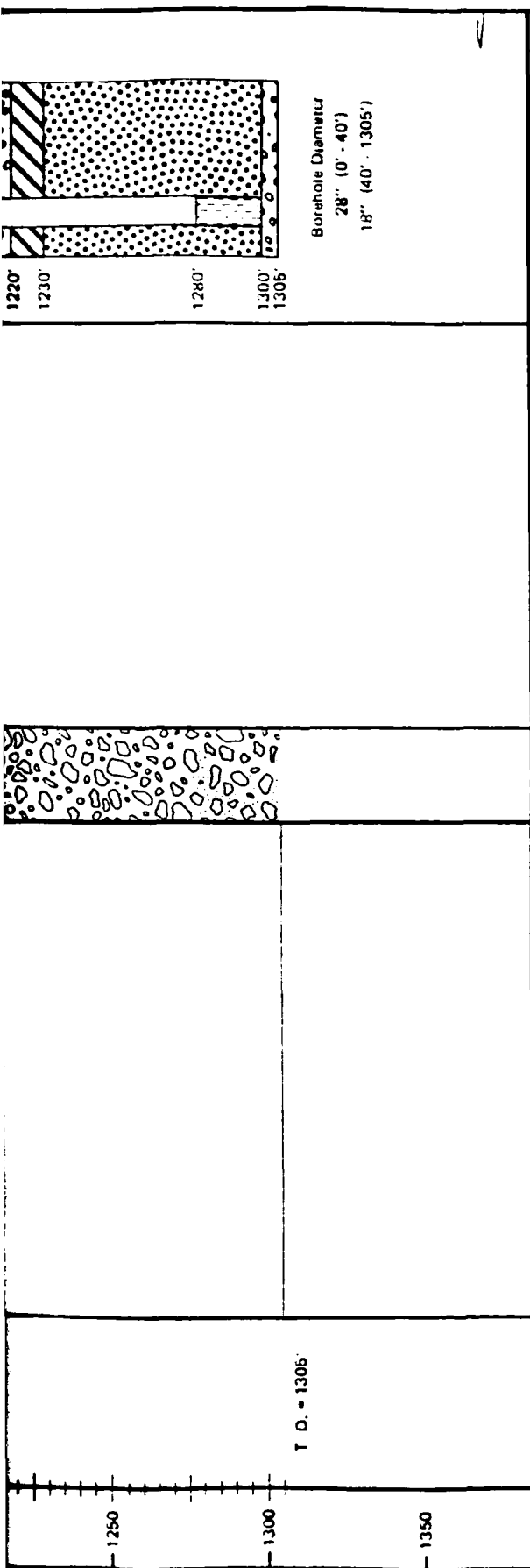
Borehole Diameter
28" (0' - 40')
18" (40' - 1305')



Gravel With Some Sand - (940' - 1305'); brown (wl),
sand 15%, gravel 85%.

T.D. = 1305





LITHOLOGIC SYMBOLS

	Clay Clay Silt Silt Silt And Clay (May also include modifiers of: with some gravel, and with very little gravel).
	Sand With Gravel Silt And Sand With Gravel Silty Sand With Gravel (May also include the modifier: and gravel).
	Gravel With Sand Gravel With Clay Sand Gravel With Silty Clay Sand Gravel With Silty Sand Gravel With Clay And Sand Gravel With Silt And Sand (May also include modifiers of: with some, and with very little).

WELL DESIGN

	Cement
	Pee Gravel
	Well Pack
	Slotted Pipe

* Geophysical logs not applicable for this format.

** Penetration rates were not recorded.

FIGURE

Depth	Penetration **	Lithologic Log		Geophysical Log	Well Design
Ft.	1" = 100 Min.	Description	Symbol	Gamma S.P. Res.	
0		Silt (0' - 30'); tan (w); silt 100%, trace gravel.			
50					
100					
150					
200					
250					

1 2

Sound-
ing
Tube

400'

540'

600'

620'

650'

670'

Gravel With Very Little Sand - (30' - 1010'), brown
(w), sand 5%, gravel 95%.

250

300

350

400

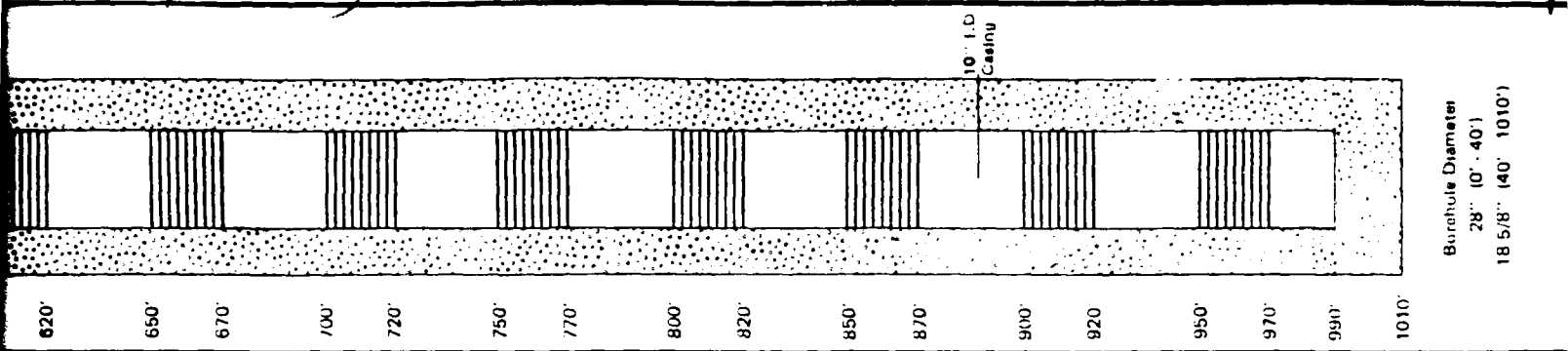
450

500

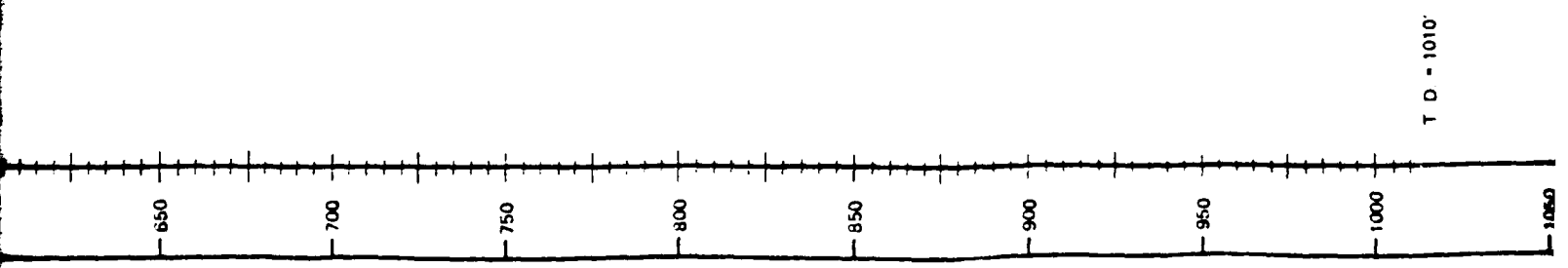
550

600

650



Borehole Diameter
28" (0' - 40')
18 5/8" (40' - 1010')



T D = 1010'

4

950
970
990
1010

Borehole Diameter
28" (0' - 40')
18 5/8" (40' - 1010')

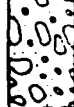
T. D. = 1010'

950
1000
1050

WELL DESIGN

- Cement 
- 8 - 12 Sand 
- Pea Gravel 
- Screen 

LITHOLOGIC SYMBOLS

- Clay 
- Clay Silt
- Silt And clay (May also include modifiers of, with some gravel, and with very little gravel).
- Gravel With Sand 
- Gravel With Clay Sand
- Gravel With Silty Clay Sand
- Gravel With Silty Sand
- Gravel With Clay And Sand
- Gravel With Silt And Sand (May also include modifiers of, with some, and with very little).

- * Geophysical logs not applicable for this format.
- ** Penetration rates were not recorded

DRY LAKE VALLEY
(DL-I-T-1)

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE (DMO)

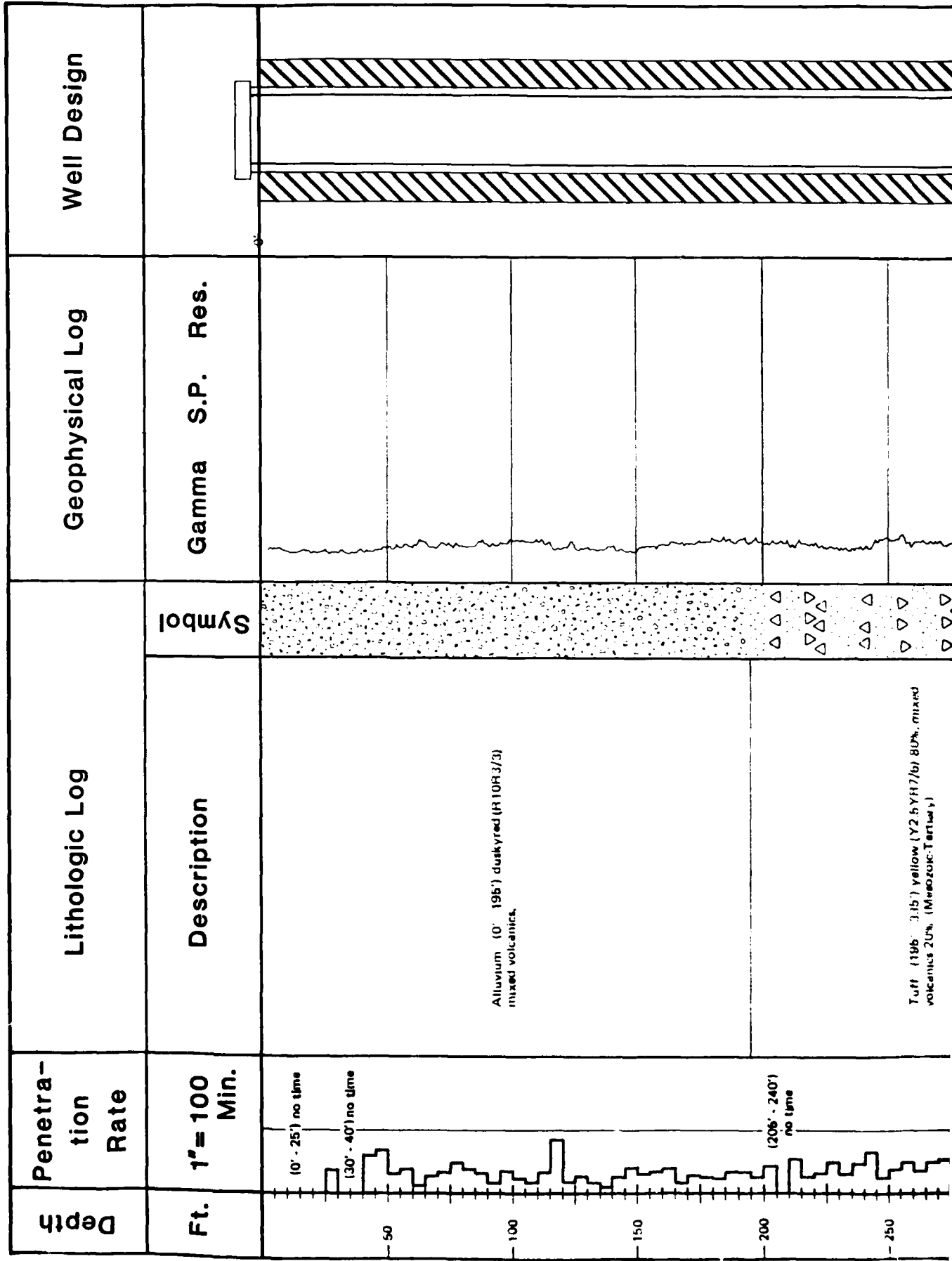
FIGURE

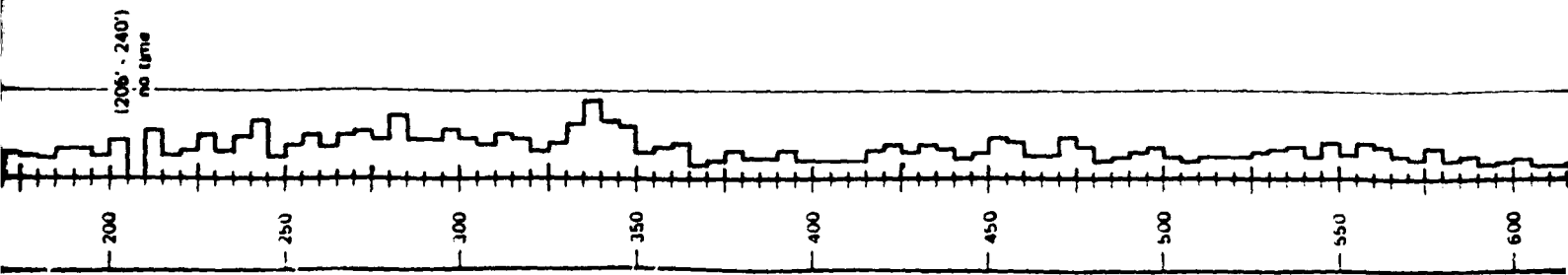
LOGRO NATIONAL, INC.

H1.3

DRY LAKE VALLEY WELL LOG
AND WELL DESIGN (CARBONATE)

14 DRY LAKE VALLEY TEST WELL 3N/63E-27ca





Tuff (186' - 335') yellow (Y2.5YR7/6) 80% mixed volcanic 20% (Mesozoic-Tertiary)

Sandstone And Limestone - (335' - 360') weak red (R10R5/4), interbedded.

Limestone (360' - 410'), weak red (R10R4/3), tuff and calcite present (Guilmette Formation (?), Devonian)

Dolomite (410' - 680') reddish gray (R5YH5/2), 95% calcite present, 5% (Guilmette Formation (?), Devonian)

34.7'

10" I.D.
casing grout
ed in place

8 I.D.
casing
casing
casing

8" I.D.
Casing
Casing
welded
in hole

Static
water
level
853'
Nov. 1980

▽

775'

935'

Dolomite (680' - 780') light reddish brown (R5YR6/3),
100% (Guilmette Formation (7), Devonian)

Dolomite (780' - 930') pinkish gray (R5YR6/2), 95%
5% calcite (Guilmette Formation (7), Devonian)

(670' - 675')
no time

(970' - 975')
no time

550

600

650

700

750

800

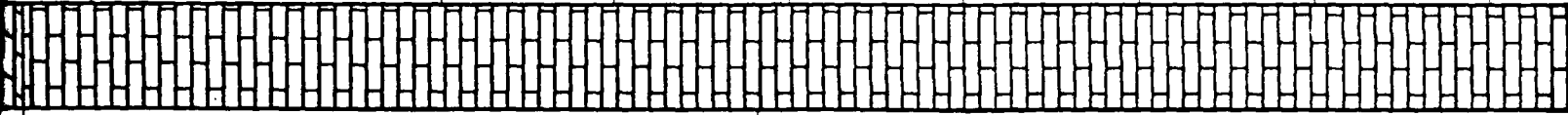
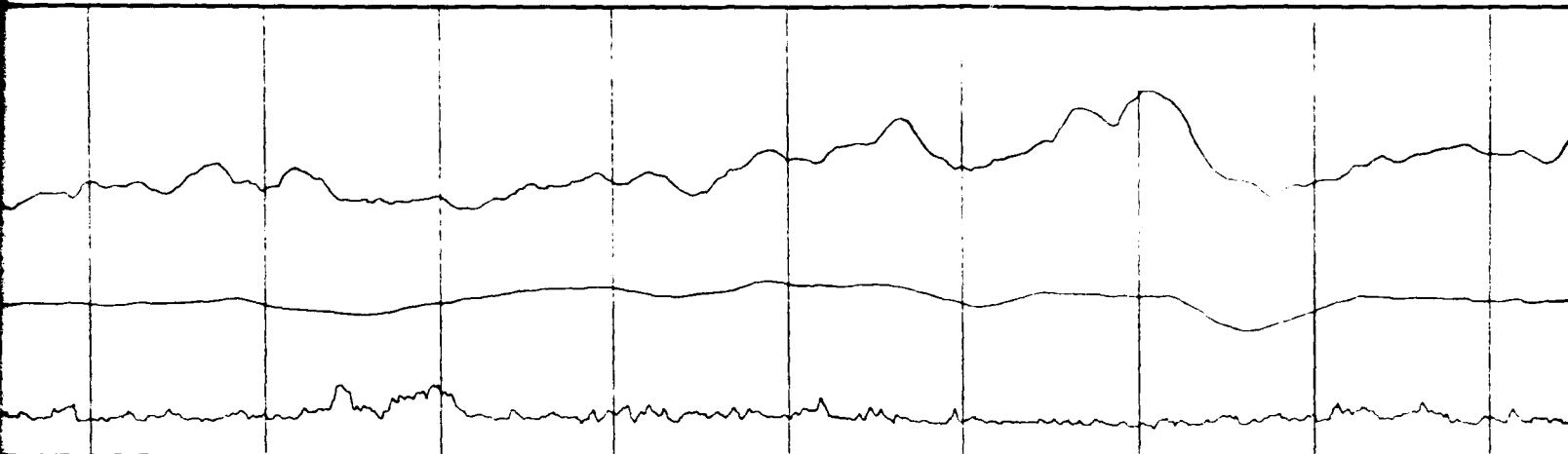
850

900

950

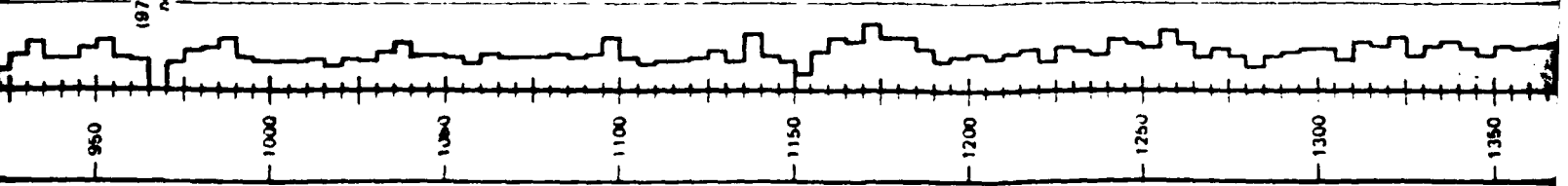
4

935'

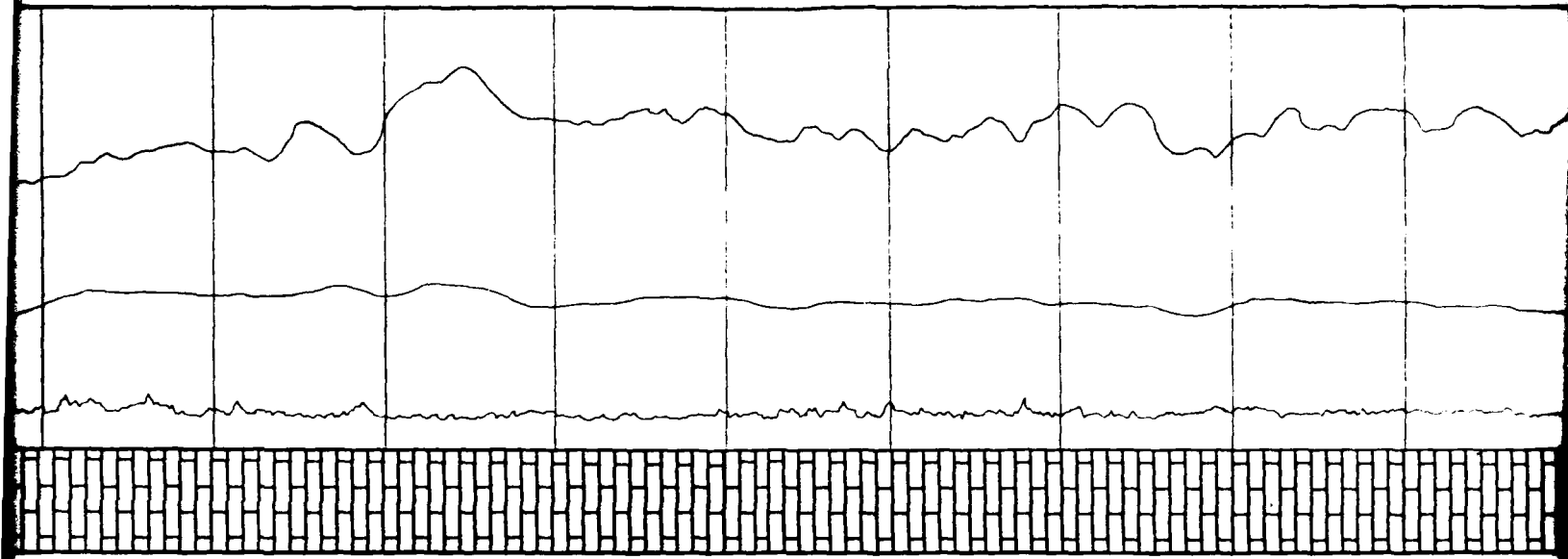


Altered Limestone - (930' - 1140') pinkish white
(WSYR8/2), 60%, limestone, dark reddish gray
(R5YR4/2), 40%. (Gullimette Formation (?), Devonian).

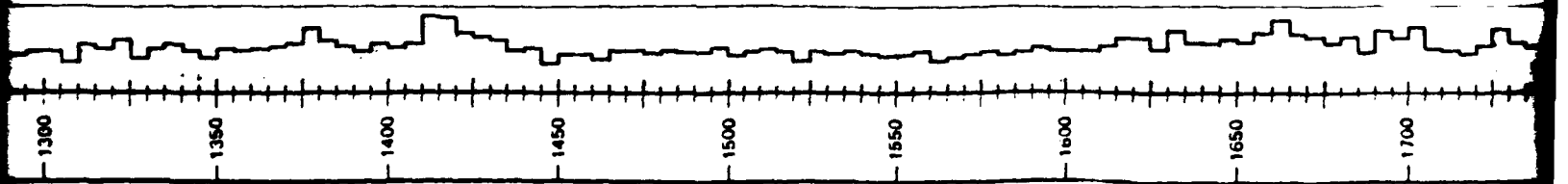
(970' - 975')
no line



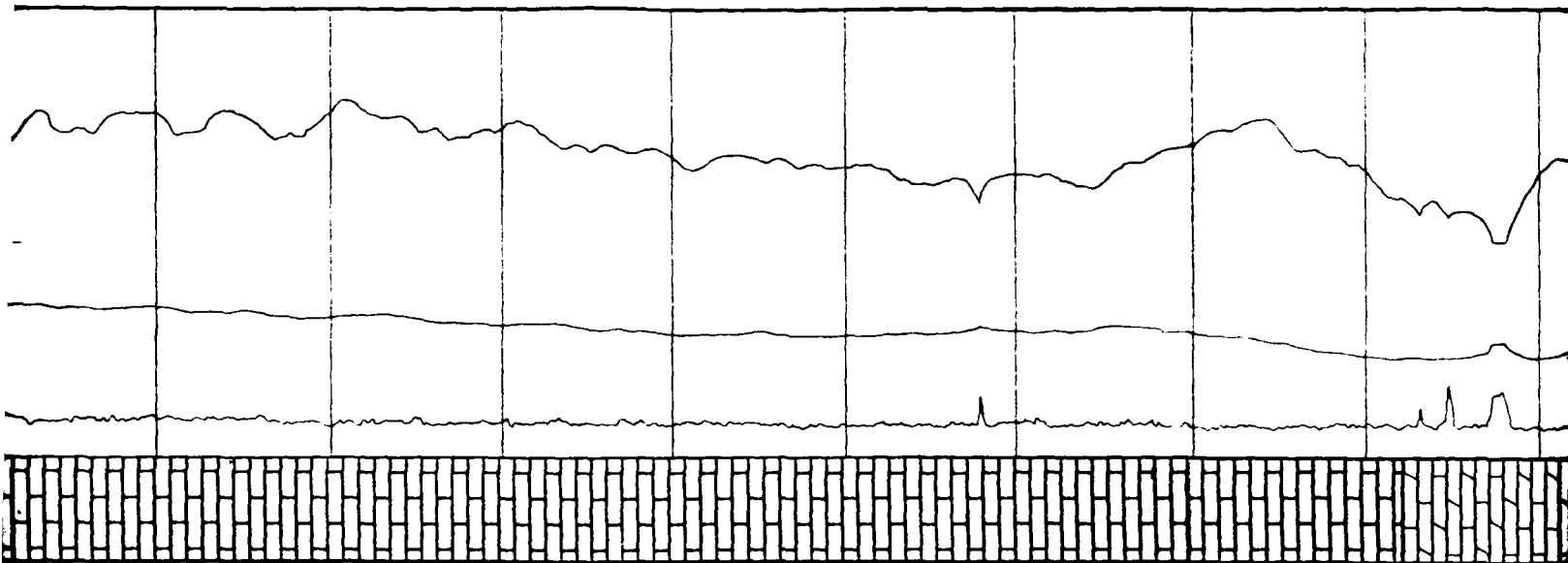
15



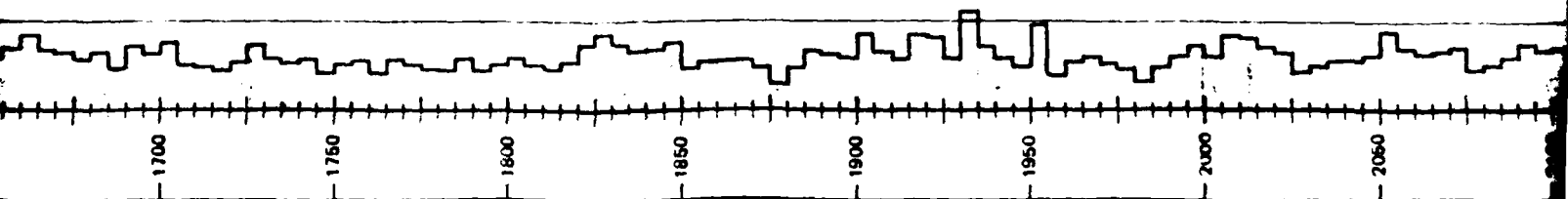
Altered Limestone - (1140' - 2060') pinkish white
(W5YH8/2), 60%, limestone, dark reddish gray
(K5YH4/2) and yellowish red (R5YH6/6), 40%.
(Guilmette Formation (?) Devonian).



6



Altered Dolomite Ark/Ol Limestone (2060' - 2100')
pinkish gray (R7.5YR7/2), 60% dark gray
(W7.5YR4/10), 30%, (Simmons Formation 17)
Devonian.



1700

1750

1800

1850

1900

1950

2000

2050

Altered Dolomite And/Or Limestone (2060' - 2100')
pinkish gray (R7.5YR7/2), 60% dark gray
(W7.5YR4/10), 30%, (Simonsen Formation (?)
Devonian).

Altered Dolomite And/Or Limestone (2100' - 2395')
dark gray (W7.5YR4/0), 70% dark gray (W7.5YR4/0),
30% (Simonsen Formation (?) Devonian).

Borehole Diameter
13 3/4" (0' - 347')
9 7/8" (347' - 935')
7 7/8" (935' - 2395')

2395'

Gamma - CPS

S.P. MV

Res OHMS

T.D. = 2395'

2060

2100

2150

2200

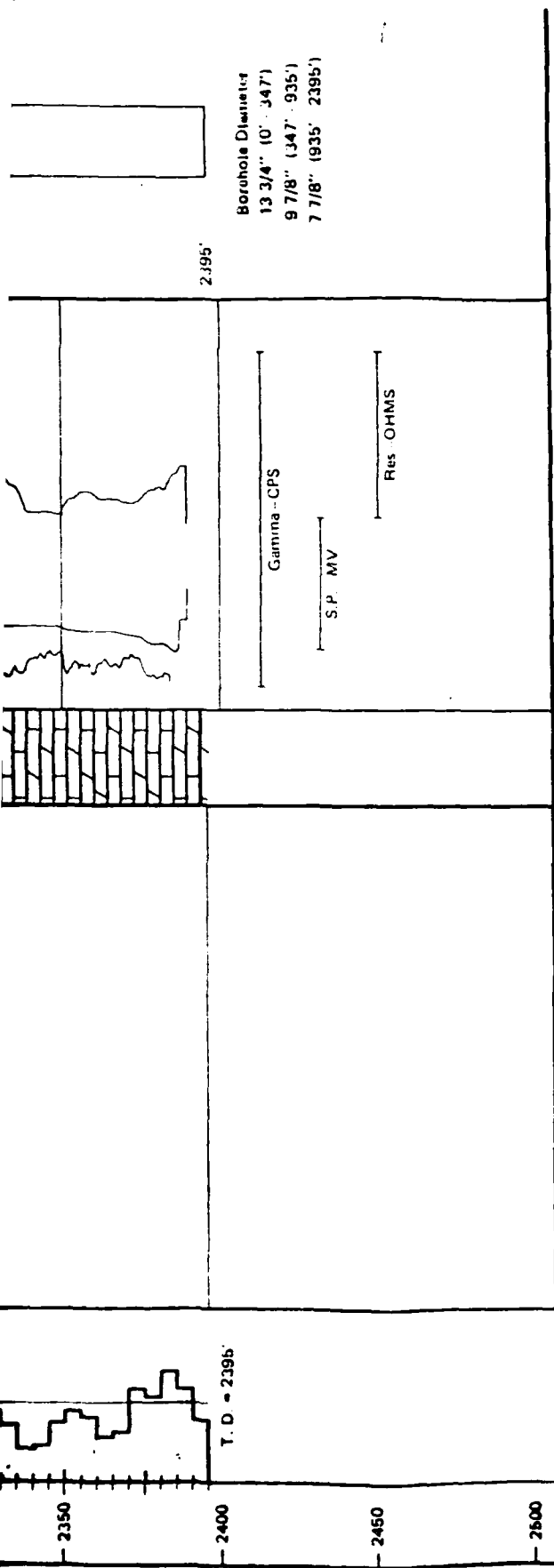
2250

2300

2350

2400

2450



WELL DESIGN

Cement



LITHOLOGIC SYMBOLS

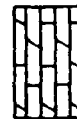
Alluvium



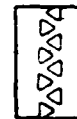
Dolomite



Altered Dolomite
And/Or Limestone



Tuff



Sandstone And
Limestone



Limestone With Tuff
And Calcite Present



Altered Limestone



INVESTIGATIVE
DEPARTMENT OF THE AIR FORCE
BIO/AIRCE MX

LITHOLOGIC LOG AND COMPLETION SUMMARY - D-1 VALLEY-CARBONATE TEST

FILMED

05-8