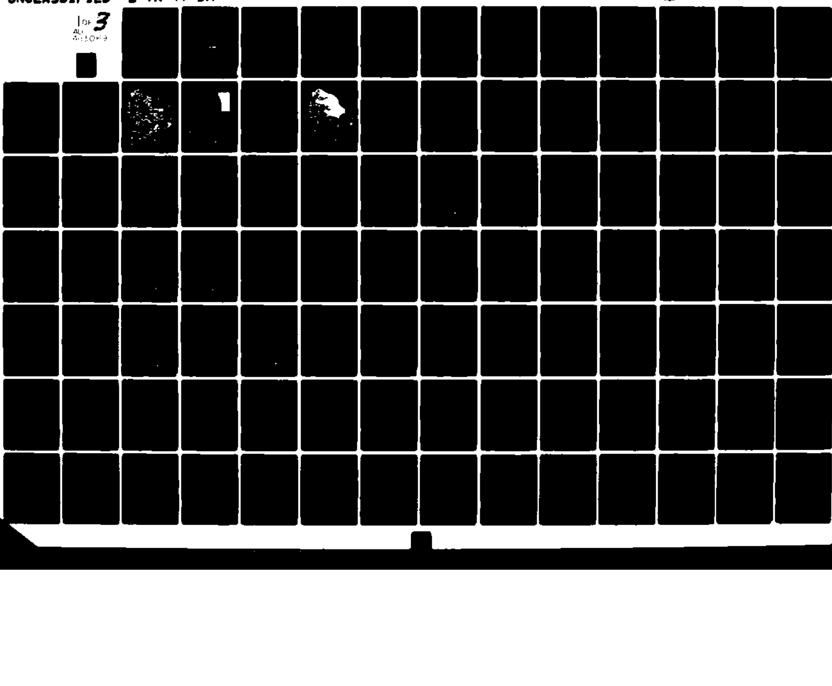
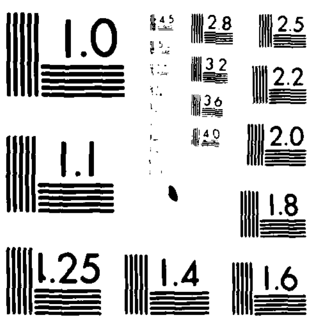
AD-A113 069 ERTEC WESTERN INC LONG BEACH CA F/G 8/7
MX SITING INVESTIGATION. GEOTECHNICAL EVALUATION. DETAILED AGGR--ETC(U)
MAY 81 F04704-80-C-0006
UNCLASSIFIED E-TR-47-DM NL

1 OF 3
AD
A113069



11306



MICROCOPY RESOLUTION TEST CHART

PHOTOGRAPH THIS SHEET

DTIC ACCESSION NUMBER: AD-A113 069

LEVEL: II

INVENTORY: 1

E-TR-47-DM

DOCUMENT IDENTIFICATION

This document has been approved for public release and sale; its distribution is unlimited.

DISTRIBUTION STATEMENT

ACCESSION FOR		
NTIS	GRA&I	☒
DTIC	TAB	☐
UNANNOUNCED		☐
JUSTIFICATION		
BY		
DISTRIBUTION /		
AVAILABILITY CODES		
DIST	AVAIL AND/OR SPECIAL	
A		

DTIC COPY INSPECTED 2

DISTRIBUTION STAMP

DTIC
APR 0 7 1982
E

DATE ACCESSIONED

"Original contains color plates: All DTIC reproductions will be in black and white"

8 2 ... 0 ...

DATE RECEIVED IN DTIC

PHOTOGRAPH THIS SHEET AND RETURN TO DTIC-DDA-2

DTIC FORM OCT 79 70A

DOCUMENT PROCESSING SHEET

Ertec

The Earth Technology Corporation

E-TR-47-DM

MX SITING INVESTIGATION
GEOTECHNICAL EVALUATION

DETAILED AGGREGATE RESOURCES STUDY

DELAMAR VALLEY, NEVADA

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

29 May 1981

SECURITY CLASSIFICATION OF THIS PAGE (*When Data Entered*)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: E-TR-47-DM

2. GOVT ACCESSION NO.:

3. RECIPIENT'S CATALOG NUMBER:

4. TITLE (and Subtitle): Detailed Aggregate Resources Study Delamar Valley, Nevada

5. TYPE OF REPORT & PERIOD COVERED: Final

6. PERFORMING ORG. REPORT NUMBER: E-TR-47-DM

7. AUTHOR(s): Ertec Western, Inc.

8. CONTRACT OR GRANT NUMBER(s): F04704-80-C-0006

9. PERFORMING ORGANIZATION NAME AND ADDRESS: Ertec Western Inc. (formerly Fugro National) P.O. Box [illegible] [illegible]

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: 64312 F

11. CONTROLLING OFFICE NAME AND ADDRESS: [illegible]

12. REPORT DATE: 29 May 81

13. NUMBER OF PAGES: 65

14. MONITORING AGENCY NAME & ADDRESS (*if different from Controlling Office*):

15. SECURITY CLASS. (*of this report*):

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE:

16. DISTRIBUTION STATEMENT (*of this Report*): Distribution Unlimited

DISTRIBUTION STATEMENT A
Approved for public release;
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*): Geology, ~~Siting~~, ~~Road Base~~ Aggregates, ~~Concrete aggregates~~ grain size, trench logs, sieve analysis, alluvium, basin Fill

20. ABSTRACT (*Continue on reverse side if necessary and identify by block number*):

Detailed aggregate resources study, Delmar Valley, Nevada. Report contains analysis, evaluation and quantity of aggregate found in the Delmar Valley, Classes RBIa, RBIb and RBII for Road-base and Classes CA1, CA2, CB, CC1 and CC2 for concrete.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

SECURITY CLASSIFICATION OF THIS PAGE (*When Data Entered*)

FOREWORD

This report is one of a series prepared for the Department of the Air Force, Ballistic Missile Office (BMO), in compliance with Contract No. F04704-80-C-0006, CDRL Item No. 004A2. These reports present the results of Detailed Aggregate Resources Studies within and adjacent to selected areas in Nevada and Utah that are under consideration for siting the MX missile system.

This volume contains the results of the aggregate resources evaluation for Delamar Valley. Results of this report are presented as text, appendices, and three drawings. This report has been prepared and submitted on the assumption that the reader is familiar with previous aggregate resources reports.

TABLE OF CONTENTS

	Page
FOREWORD	i
EXECUTIVE SUMMARY	v
1.0 INTRODUCTION	1
1.1 Study Area	1
1.2 Background	1
1.3 Objectives	6
1.4 Scope	7
2.0 GEOLOGIC SETTING	8
2.1 Physiography	8
2.2 Location and Description of Geologic Units	8
2.2.1 Rock Units	9
2.2.2 Basin-Fill Units	9
3.0 ROAD-BASE AGGREGATES EVALUATION	12
3.1 Study Approach	12
3.1.1 Requirements for Road-Base Aggregates	12
3.1.2 Data Acquisition and Analysis	13
3.1.3 Presentation of Results	14
3.1.4 Classification of Road-Base Aggregates	17
3.2 Sources of Road-Base Aggregates	19
3.2.1 Basin-Fill Sources	19
4.0 CONCRETE AGGREGATES EVALUATION	25
4.1 Study Approach	25
4.1.1 Requirements for Concrete Aggregates	25
4.1.2 Data Acquisition and Analysis	27
4.1.3 Presentation of Results	34
4.1.4 Classification of Concrete Aggregates	35
4.2 Sources of Concrete Aggregates	38
4.2.1 Basin-Fill Sources	38
5.0 CONCLUSIONS	48
5.1 Road-Base Aggregates	49
5.1.1 Class RBIa Sources	49
5.1.2 Class RBIb Sources	49
5.1.3 Class RBII Sources	50

TABLE OF CONTENTS (cont'd)

	Page
5.2 Concrete Aggregates	50
5.2.1 Class CA1 Sources	50
5.2.2 Class CB Sources	51
5.2.3 Class CC1 Sources	51
5.2.4 Class CC2 Sources	52
6.0 RECOMMENDATIONS FOR FUTURE STUDIES	53
6.1 Sources of Road-Base Aggregates	53
6.2 Sources of Concrete Aggregates	53
7.0 BIBLIOGRAPHY	55

LIST OF APPENDICES

Appendix		
A	Summary of Field and Laboratory Test Data, Delamar Valley, Nevada	A-1
B	Summary of Field Petrographic and Grain-size Analyses Data, Delamar Valley, Nevada	B-1
C	Trench Logs	C-1
D-1	Flow Diagram, Road-Base Aggregates Testing	D-1
D-2	Flow Diagram, Concrete Trial Mix Design and Testing	D-2
E-1	Chemical Analyses of Cement, Fly Ash, and Water used in Concrete Trial Mix Designs	E-1
F-1	Unified Soil Classification System	F-1
F-2	Summary of Caliche Development	F-2
F-3	Ertec Western Geologic Unit Cross Reference	F-3
G	Cross Reference from Map Number to Verification Activity, Delamar Valley, Nevada	G-1

LIST OF TABLES

Table Number		
1	Aggregate and Trial Mix Tests, Concrete Aggregates Evaluation, Delamar Valley, Nevada	30
2	Concrete Trial Mix Design Criteria, Delamar Valley, Nevada	31
3	Concrete Trial Mix Test Results, DM-A-(16-20) Delamar Valley, Nevada	43

TABLE OF CONTENTS (Cont'd)

LIST OF FIGURES

Figure Number		Page
1	Detailed Aggregate Resources Study Delamar Valley, Nevada	2
2	Utah-Nevada Regional Aggregate Studies	3
3	Valley-Specific Aggregate Resources Study Areas, Nevada-Utah	5
4	Grain-Size Distribution Envelopes, Road-Base Aggregates, Class RBIa, Delamar Valley, Nevada	21
5	Grain-Size Distribution Envelopes, Concrete Aggregates, DM-A-(16-20), Delamar Valley, Nevada	41
6	Grain-Size Distribution Envelopes, Concrete Aggregates, Class CB, Delamar Valley, Nevada	45

TABLE OF CONTENTS (Cont'd)

LIST OF DRAWINGS

Drawing Number		
1	Field Station and Selected Existing Data Site Locations, Detailed Aggregate Resources Study, Delamar Valley, Nevada	In Pockets at End of Report
2	Road-Base Aggregate Resources Map, Detailed Aggregate Resources Study, Delamar Valley, Nevada	
3	Concrete Aggregate Resources Map, Detailed Aggregate Resources Study, Delamar Valley, Nevada	

EXECUTIVE SUMMARY

This report contains the Detailed Aggregate Resources Study (DARS) evaluation for Delamar Valley, Nevada. It is the first in a series of reports that contain detailed aggregate information on the location and quality of basin-fill and rock sources of road-base and concrete aggregates. Field reconnaissance, laboratory testing, and existing data from other Ertec Western, Inc. (formerly Fugro National, Inc.) investigations and the Nevada Department of Highways provide the basis for the findings presented in this report.

ROAD-BASE AGGREGATES

Potential road-base aggregate sources were classified as follows:

Class RBIa - Basin-fill or rock sources containing materials suitable for use as road-base aggregates; based on acceptable laboratory aggregate test results.

Class RBIb - Basin-fill sources containing materials suitable for use as road-base aggregates; based on correlation with Class RBIa source areas.

Class RBII - Potential basin-fill sources of materials suitable for use as road-base aggregates; based on photogeologic interpretations, field observations, and limited or inconclusive sieve analysis and/or abrasion data.

Assignment of an aggregate source to one of the above three classes was determined from laboratory test results (gradation, abrasion and, to a lesser extent, soundness) and geomorphological and compositional correlations.

Results of this evaluation are presented on a 1:62,500 scale aggregate resources map (Drawing 2) and are summarized as follows:

<u>Class RBIa Sources</u>: Seven basin-fill sources consisting of good to high quality aggregates acceptable for use as road-base construction materials have been located on the east side of the valley. The deposits are all alluvial fans (Aaf).

<u>Class RBIb Sources</u>: Seven basin-fill deposits within the study area are defined as potential sources of good to high quality, road-base aggregates. Geomorphological and compositional similarities were used to correlate these units to tested RBIa deposits. Six of the deposits are alluvial fans (Aaf) and one is a stream-channel deposit (Aal). All are confined to the east side of the valley.

<u>Class RBII Sources</u>: Several potential basin-fill aggregate sources are located throughout the study area. All of these sources are alluvial fans that have been classified on the basis of limited field and laboratory data.

CONCRETE AGGREGATES

A classification system consisting of five classes was developed for the concrete aggregates evaluation to present potential basin-fill and crushed-rock sources. Although most rock sources will supply coarse concrete aggregates, their delineation was not an objective of this study. Assignment of an aggregate source to one of the five classes was determined from laboratory test results (trial concrete mixes and gradation, abrasion, and soundness of aggregates) and geomorphological and compositional correlations. The emphasis of this study was the evaluation of the concrete-making properties (especially 28-day compressive strengths) of potential aggregates when used in trial concrete mixes.

Class CA1	Basin-fill or rock sources containing aggregates that produced trial mix concrete with 28-day compressive strengths equal to or greater than 6500 psi.
Class CA2	Basin-fill or rock sources containing aggregates that produced trial mix concrete with 28-day compressive strengths less than 6500 psi.
Class CB	Basin-fill or rock sources containing aggregates potentially suitable for use in concrete; based on acceptable laboratory aggregate test results.
Class CC1	Basin-fill or rock sources containing aggregates potentially suitable for use in concrete; based on correlation with Class CA1 and CA2 source areas.
Class CC2	Basin-fill sources containing aggregates potentially suitable for use in concrete; based on correlation with Class CB source areas.

The following three trial mixes were used to obtain a range of compressive strength values; however, only Mix 3 results were used to classify sources. In all three trial mixes, fly ash, as a pozzolan, replaced 20 percent of the cement by weight.

- Mix 1 - 7.5 sacks of cement per cubic yard of concrete and 1.5-inches maximum aggregate size;
- Mix 2 - 8.5 sacks of cement per cubic yard of concrete and 1.5-inches maximum aggregate size; and
- Mix 3 - 8.5 sacks of cement per cubic yard of concrete, 0.75-inch maximum aggregate size, and a superplasticizer.

Results of this evaluation are presented on a 1:62,500 scale aggregate resources map (Drawing 3) and summarized as follows:

Class CA1 Sources: One basin-fill deposit in the area contained aggregates that, when used in Mix 3, produced 28-day compressive strengths greater than 6500 psi. The source is an alluvial fan (Aaf) and is located on the east side of the valley.

Class CB Sources: Five basin-fill deposits consisting of good to high quality aggregates, potentially acceptable for use as concrete construction materials, were delineated on the east side of the valley. All of these deposits are alluvial fans.

Class CC1 Sources: One alluvial fan in the study area is classified as a potential source of concrete aggregates. It is correlated to the Class CA1 source on geomorphological and compositional similarities.

Class CC2 Sources: Alluvial units located along the eastern side of the valley are potential sources of aggregates suitable for use in concrete. They are correlated to Class CB units on the basis of geomorphological and compositional similarities.

CONCLUSIONS

Sufficient quantities of coarse and fine aggregates suitable for use as road-base and/or concrete construction material are available in Delamar Valley. Laboratory test results indicate that the quality of the coarse aggregates ranges from good to excellent, and the quality of the fine aggregates ranges from poor to satisfactory. Most of the aggregate sources are confined to the east side of the valley.

RECOMMENDATIONS

Additional aggregate field investigations and laboratory testing will be required to further refine the physical and chemical characteristics of road-base and concrete aggregate sources as borrow areas prior to the initiation of construction.

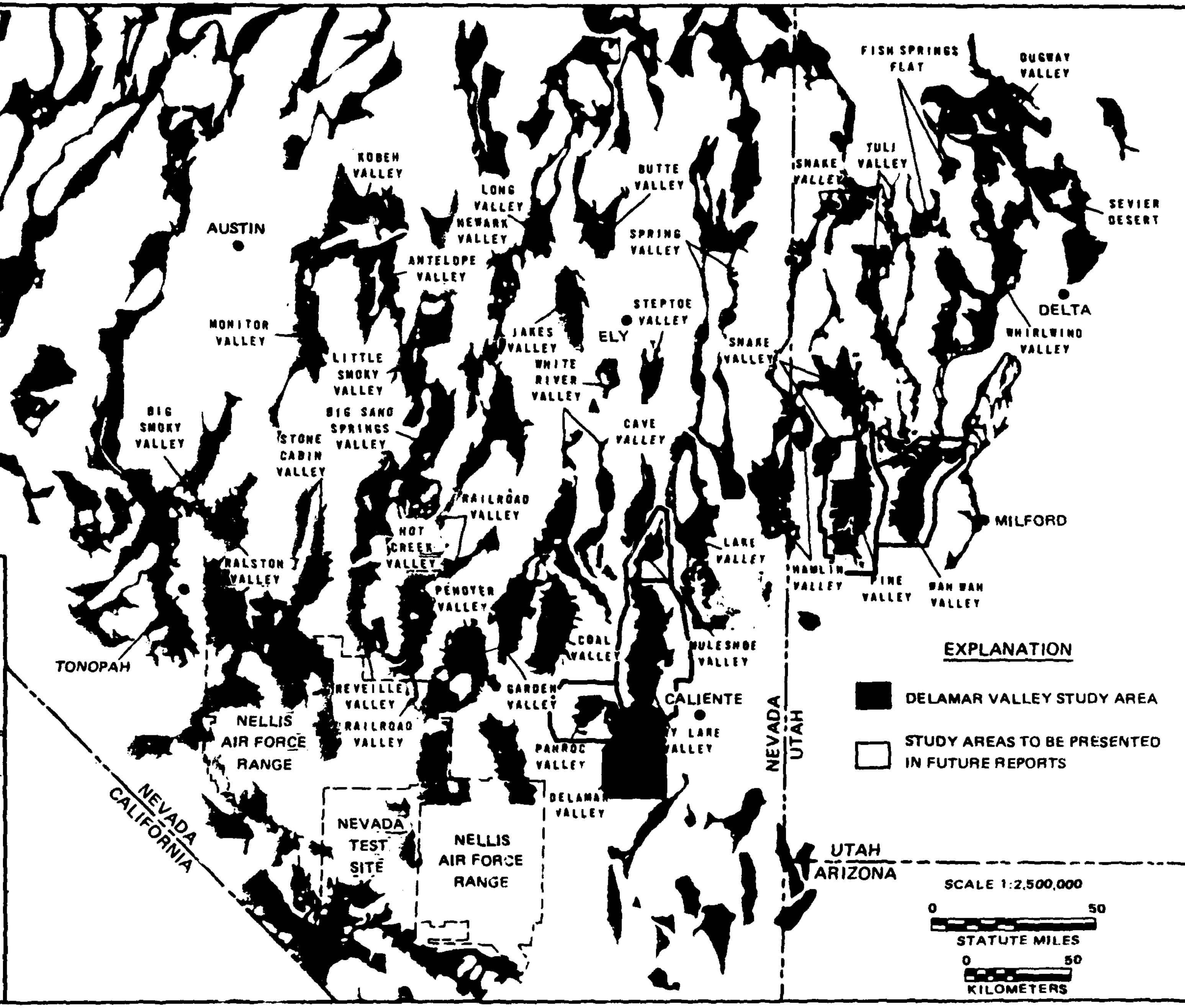
1.0 INTRODUCTION

1.1 STUDY AREA

This report presents the results of the Detailed Aggregate Resource Study (DARS) for Delamar Valley (Figure 1). Delamar Valley is located in south-central Lincoln County, Nevada. The valley is bounded on the west by the South Pahroc Range, on the east and south by the Delamar Mountains, and on the northeast by the southern extent of the Burnt Springs Range. U.S. Highway 93 is the northern boundary of the study area and the only paved road in the vicinity. A network of graded roads and four-wheel-drive trails provide access to most of the study area. Delamar Valley is mainly undeveloped desert rangeland administered by the Bureau of Land Management (BLM). Several active and inactive mining operations are located in the Delamar Mountains. The nearest town is Caliente, Nevada, located approximately 15 miles (24 km) east of Delamar Valley on U.S. Highway 93.

1.2 BACKGROUND

Aggregate resources studies for the MX program were introduced in 1977 with the investigation of Department of Defense (DoD) and BLM lands in California, Nevada, Arizona, New Mexico, and Texas (FN-TR-20D). Refinement of the MX siting area added portions of Utah and Nevada that were not evaluated in this initial Aggregate Resources Evaluation Investigation (AREI). This additional area, defined as the Utah-Nevada aggregate resources study area, was examined in the fall of 1979, and a second general aggregate resources report was submitted on 3 March 1980 (Figure 2).



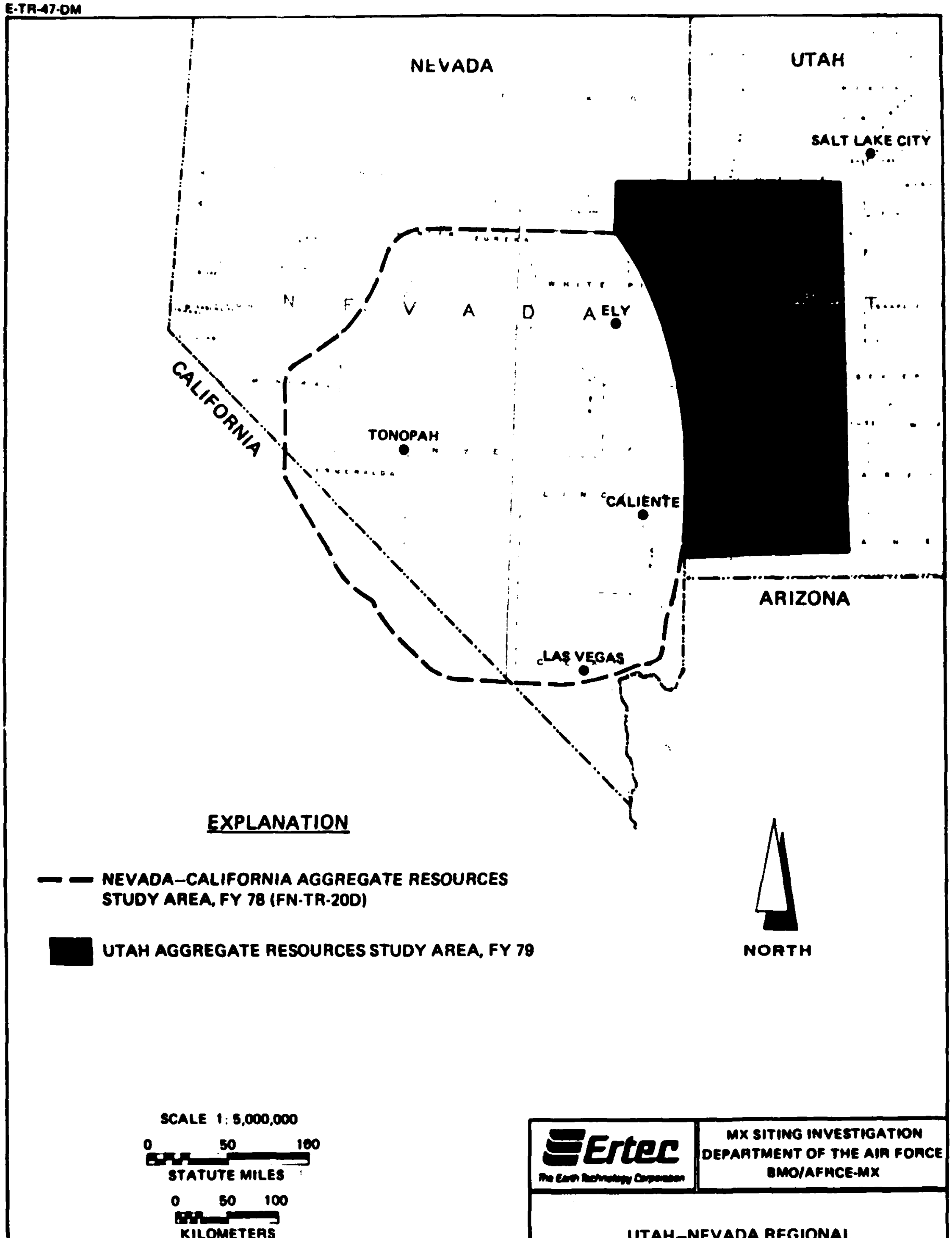
Ertec
The Earth Technology Corporation

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

DETAILED AGGREGATE RESOURCES STUDY
DELAMAR VALLEY, NEVADA

29 MAY 81

FIGURE 1



Ertec
The Earth Technology Corporation

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

UTAH–NEVADA REGIONAL
AGGREGATE STUDIES

29 MAY 81

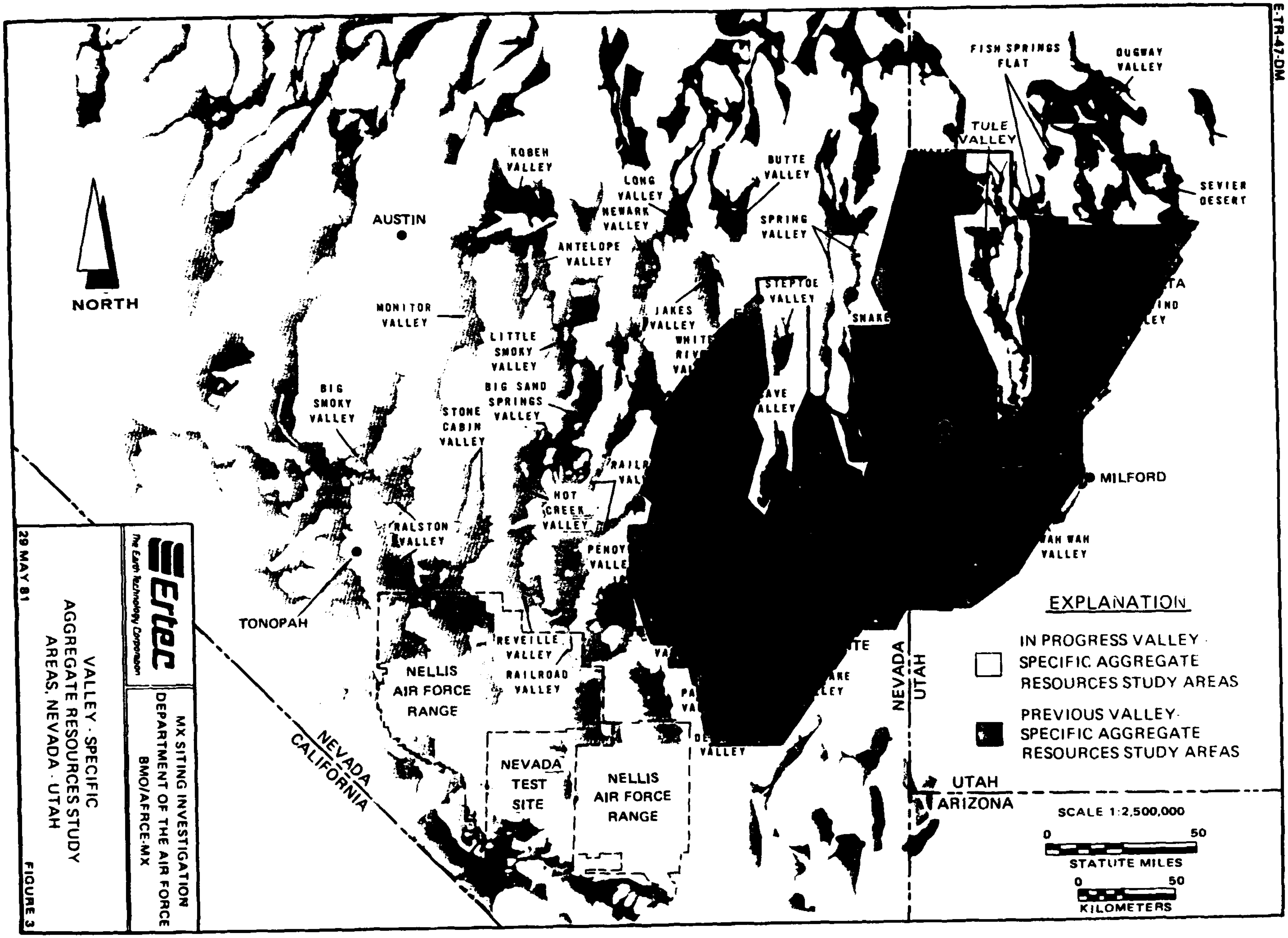
FIGURE 2

Both regional aggregate investigations consisted of the compilation and evaluation of existing data with limited field reconnaissance, sample collection, and laboratory aggregate testing. Only general information on the location, quality, and quantity of aggregates was provided.

Subsequent to the regional studies, Valley-Specific Aggregate Resources Studies (VSARS) were developed in FY 79. The primary objective of these continuing studies is to provide additional information on potential aggregate sources in specified valleys and in the immediate surrounding areas. Existing exposures of potential basin-fill and rock aggregate sources are sampled and subjected to a suite of laboratory aggregate tests. Results of these tests are used to classify coarse and fine basin-fill and crushed-rock aggregates for suitability as concrete and road-base construction materials.

The aggregate sources presented in VSARS are to be used as a guide for preliminary construction planning and the selection of areas for more detailed-aggregate evaluations. To date, field investigations have been completed for 16 valley areas with final reports submitted for 11 (Figure 3). Field investigations for remaining valleys in the designated deployment area are planned in FY 81 and FY 82.

The DARS were initiated in FY 81 to further analyze and refine potential sources of coarse and fine basin-fill and crushed-rock aggregates identified during the VSARS. These studies consist of both road-base (Section 3.0) and concrete (Section 4.0)



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

VALLEY - SPECIFIC
AGGREGATE RESOURCES STUDY
AREAS, NEVADA - UTAH

29 MAY 81

FIGURE 3

aggregate evaluations. The major consideration was to further evaluate basin-fill deposits as potential sources of road-base and concrete aggregates. Limited new data were developed on crushed-rock sources.

1.3 OBJECTIVES

The objectives of the Detailed Aggregate Resources Study are as follows:

Road-Base Aggregates Evaluation

- o Refine potential basin-fill and rock sources (initially identified in VSARS) for road-base aggregates; and
- o Provide additional laboratory test data on the general quality of basin-fill aggregates for use as road-base material.

Concrete Aggregates Evaluation

- o Refine the areal extent of the most acceptable VSARS basin-fill and rock, concrete aggregate sources; and
- o Provide additional laboratory testing information on the quality and the concrete-making properties of potential coarse and fine basin-fill and crushed-rock aggregates.

1.4 SCOPE

The scope of the two evaluations required office and field studies and included the following:

a. Compilation and analysis of appropriate existing data on the quality and quantity of potential road-base and concrete aggregates. Major sources of data were other Ertec investigations for the siting of the MX system and the Nevada Department of Highways.

b. Initial and final basin-fill deposit differentiation based on geomorphology, grain-size, lithology, and aerial photography and topographic map interpretation. Initial and final rock unit divisions based on evaluations of aerial photography and published geologic maps.

c. Staking and permitting on selected BLM lands. Appropriate basin-fill trench locations for samples of road-base and concrete aggregates were determined from items a and b and a brief field reconnaissance.

d. Backhoe excavation of staked and permitted basin-fill locations, sampling when gravel percentage exceeded 30 percent, or when suitable fine aggregates for concrete mixes were present. Selection and sampling of acceptable crushed-rock sources of coarse aggregates for concrete mixes.

e. Valley-wide field reconnaissance utilizing aerial photography and petrographic and grain-size analyses to determine lateral extent and acceptability of basin-fill deposits.

f. Laboratory tests to supplement available existing data for the determination of the suitability of specific basin-fill and rock units as sources of road-base or concrete aggregates. Trial (check) concrete mixes were made to evaluate the basic concrete-making properties of selected concrete aggregate sources as well as engineering properties of hardened concrete.

g. Development and application of road-base and concrete materials classification systems that textually and graphically depict the locations of the most suitable aggregate sources in the study area. The depiction and discussion of areas that are unsuitable or have a low probability for use were not done.

2.0 GEOLOGICAL SETTING

2.1 PHYSIOGRAPHY

Delamar Valley lies within the Basin and Range Physiographic Province. The primary physiographic features of the study area are uplifted mountains and a down-dropped, intervening alluvium-filled basin. These north-south trending features are controlled by block-faulting and are typical of the Basin and Range Province. Elevations range from about 5600 feet (1707 m) in the east-central part of the valley to about 4540 feet (1384 m) on the playa in the southern part of the valley.

Mountain ranges flanking the basin are the South Pahroc Range on the west, Burnt Springs Range on the northeast, and the Delamar Mountains on the east and south. Delamar Valley is open to Dry Lake Valley to the north. Topographic relief between mountain ridges and the basin ranges from about 975 feet (297 m) to about 2400 feet (732 m) along the western side of the study area and from approximately 1400 to 1800 feet (427 to 549 m) along the eastern side of the study area. Delamar Valley is a closed-drainage system with a large playa in the southern portion of the study area.

2.2 LOCATION AND DESCRIPTION OF GEOLOGICAL UNITS

Paleozoic, Mesozoic, and Cenozoic rocks are found in bedrock outliers within the valley fill and in the mountains within and adjacent to the study area. The Paleozoic rocks consist predominantly of limestone, dolomite, and quartzite with interbedded sandstone and shale. These units crop out across the entire eastern study area margin and, where not exposed, underlie younger geologic units. Unconformably overlying the Paleozoic rocks are Mesozoic rocks consisting predominantly of undifferentiated volcanic and intravolcanic sedimentary rocks. Cenozoic rocks unconformably overlie Paleozoic and Mesozoic units and consist of Tertiary intrusives and volcanics. Unconsolidated Cenozoic deposits lie unconformably above all older units and consist primarily of alluvial, lacustrine, and stream-channel and terrace deposits.

Additional geologic information is presented in previous Ertec reports (FN-TR-27-DM-I and II; FN-TR-37-a).

2.2.1 Rock Units

Geologic rock units, previously classified as potential sources of crushed-rock aggregates during the VSARS program, are unclassified in this report. No specific rocks from the study area were sampled or tested during the DARS program. Rocks classified during the more general VSARS program as good sources were extrapolated from test results in adjoining valleys. These results could not be confidently correlated into the study area for the more selective DARS evaluation.

2.2.2 Basin-Fill Units

The basin-fill geologic units within the study area that are potential sources of coarse and fine aggregates are alluvial fan deposits (Aaf) and stream-channel and terrace deposits (Aal). The grouping of the units was based on similarities in physical and chemical characteristics and map-scale limitations. All other basin-fill units may locally supply aggregates but are not considered major sources and will not be discussed in this report.

2.2.2.1 Alluvial Fan Deposits - Aaf

Alluvial fan deposits (Aaf) are the most extensive potential sources of basin-fill aggregates within the study area. They occur in a fairly narrow band along most of the east side of the valley and in scattered locations on the west side of the valley. Alluvial fan deposits are typically heterogeneous to poorly stratified mixtures of boulders, cobbles, gravel, sand, silt, and clay. Large quantities of boulder- and cobble-sized material exist along the east side of the valley adjacent to the mountain fronts. On the east side of the valley, alluvial fan deposits consist predominantly of sandy gravel. Alluvial fan deposits on the west side are predominantly gravelly sand.

Most alluvial fan deposits have developed soil horizons consisting of silty, clayey sand that are a few inches (centimeters) to 1 foot (0.3 m) in thickness overlying a zone of carbonate accumulation (caliche). The caliche horizon generally ranges in thickness from 1 to 2 feet (0.3 to 0.6 m) and exhibits Stage I to III development with Stage II and III being most common (Appendix F).

2.2.2.2 Stream-Channel and Terrace Deposits - Aal

Stream-channel and terrace deposits (Aal) in the study area are associated with ephemeral streams within the valley. They range in composition from sandy gravel and gravelly sand near the mountain fronts to sandy silts near the valley axis. Caliche development within the stream-channel deposits ranges from absent to minor Stage I, occurring as thin lenses and layers or as coatings on the underside of coarse-grained clastic material. One stream-channel deposit has been delineated in the study area on the northeast side of the valley near U.S. Highway 93. No major terrace deposits were mapped in the study area.

3.0 ROAD-BASE AGGREGATES EVALUATION

3.1 STUDY APPROACH

The primary objective of the road-base aggregates study was to evaluate the suitability of basin-fill and rock aggregates for use as road base. Two important considerations were applied to basin-fill aggregate sources identified as potentially suitable in VSARS; refinement of source boundaries and additional laboratory tests to further evaluate physical and chemical characteristics. Sources of crushed-rock aggregates were refined using only existing data, published geologic maps, and limited photogeologic interpretations. Information on potential rock sources for use as road-base aggregates was not specifically collected for this evaluation. Only existing VSARS data and data developed from the concrete aggregates evaluation (Section 4.0) were assessed.

The study approach for the road-base aggregates evaluation required a review of previous Ertec Verification (FN-TR-27-DM-I and II) and aggregate reports (FN-TR-20D and FN-TR-37-a) for Delamar Valley. This data base helped define the scope of the road-base materials investigation which included office and field photogeologic and topographic interpretations, field reconnaissance, and collection and laboratory testing of basin-fill samples.

3.1.1 Requirements for Road-Base Aggregates

For the purpose of this report, road-base aggregates are defined using the Nevada Department of Highways (1976) classification of

Type I Class A aggregate base. The requirements for aggregates suitable for such a base are as follows:

Gradation:

Sieve Size	Percent Passing by Weight
1.5 inches	100
1.0 inch	80-100
No. 4	30- 65
No. 16	15- 40
No. 200	2- 12

Fractured Faces	35 percent, minimum
Plasticity Index	3-15 percent
Liquid Limit	35 maximum
Resistance (R value)	70 minimum
Percent Wear (500 Rev.)	45 percent, maximum

During the road-base aggregate studies, gradation and percent wear were the two primary criteria used to evaluate potential source areas. Magnesium sulfate ($MgSO_4$) soundness tests were performed on selected aggregate samples to gain additional information related to the effects of weathering on aggregates. Soundness losses exceeding 18 percent were considered potentially unacceptable (American Society of Testing and Materials, 1978). The remaining requirements were not evaluated during this study.

3.1.2 Data Acquisition and Analysis

Office studies for the road-base aggregates evaluation required preliminary basin-fill and rock-unit differentiation based on photogeologic interpretations and published topographic and geologic maps. All available data on basin-fill grain-size gradations were compiled to estimate gravel content for the defined basin-fill units.

The field program involved backhoe excavation of 31 trenches selected during office studies and initial field reconnaissance. Trenches were excavated and sampled in groups of three, 0.1 to 0.2 mile (0.2 to 0.3 km) apart, to characterize individual basin-fill units. Completion depths ranged from 12 to 15 feet (3.7 to 4.6 m) and, where collected, representative samples averaged 100 pounds (45 kg) per trench.

Due to gradation variability in basin-fill deposits, field limits of 30 percent or more gravel and 20 percent or less silt and clay were established as basic aggregate grain-size distribution requirements. Gravel is defined as coarse aggregates which pass the 3.0-inch (75-mm) sieve and are predominantly retained on a No. 4 (4.75-mm) sieve. Aggregates larger than 3.0 inches (cobbles and boulders) were generally present in the materials investigated but were not included in the laboratory samples because of sample-size limitations. Silt and clay particles are defined as material passing through a No. 200 sieve (0.0029-inch [0.075-mm]).

Field studies also included 37 petrographic and grain-size data field stops and valley-wide photogeologic field reconnaissance. These analyses were performed to supplement and confirm office studies and to provide a data base for lithologic and gradation correlations of basin-fill units.

Laboratory testing that included 28 sieve analyses, six abrasion tests, and four $MgSO_4$ soundness tests was performed to broaden the existing data base during the road-base aggregates evaluation. Confirmation test data (gradation, abrasion, and soundness tests) from the concrete aggregates evaluation (Section 4.0) were also used to supplement test data for the road-base aggregates evaluation.

The scope of the study did not allow sample collection and laboratory testing of all potential road-base aggregate sources. Existing data and field petrographic and grain-size analyses were used to correlate lithologic and gradation properties to basin-fill units which were not sampled. An important element of this correlation procedure was the use of aerial photography to help delineate the lateral extent of basin-fill deposits. Photogeologic and field observations ascertained geomorphological and topographical relationships of basin-fill units and the source rock lithology and distribution of predominantly gravelly materials.

3.1.3 Presentation of Results

Results of the road-base aggregates evaluation are presented in the form of text, figures, 1:62,500 scale drawings, and appendices. Drawing 1 shows the locations of all the data points used in the Detailed Aggregate Resources Study. The data points are grouped by study type and assigned categorized map numbers. VSARS data points are designated by map numbers 1 to 199 and correspond to map numbers in the appendix table of the Delamar area VSARS report (FN-TR-37-a). DARS data points are assigned map number groups 200 to 299 for trench locations and 300 to 399 for petrographic and grain-size data stop locations. Verification data points are assigned the map number group 400 to 599. Appendix Table G-1 converts map number to Delamar Verification Report (FN-TR-27-DM-I and II) activity type and number for direct reference.

Drawing 2 presents the locations of all potential road-base aggregate sources, DARS trenches, and field petrographic and grain-size data stops in the study area. Geologic unit symbols used in Drawing 2 relate to standard geologic nomenclature whenever possible. A conversion table relating these symbols to the geologic unit nomenclature used in other Ertec reports is contained in Appendix Table F-3.

A solid contact line separates basin-fill and rock units in Drawing 2 to differentiate these two basic material types. Basin-fill contacts are derived from photogeological mapping with limited field reconnaissance and are dashed.

Classifications of potential sources of basin-fill road-base aggregates are distinguished by different patterns and are emphasized by a dark background tone.

The appendices contain tables that summarize the basic field data collected during the course of the study and the subsequent laboratory test procedures and results. Appendices A and B include DARS trench data and petrographic and grain-size analysis data, respectively. Appendix C contains representative trench logs. Appendix Table D-1 presents a laboratory testing flow diagram for the road-base aggregates evaluation. Appendix F includes three tables describing soil classification, caliche development, and geologic unit cross reference.

3.1.4 Classification of Road-Base Aggregates

A classification system was designed to present the most likely potential sources of basin-fill and crushed-rock road-base aggregates. It was developed from an evaluation as well as from an extrapolation of all available data.

This classification system is primarily based on laboratory test results (gradation and abrasion and, to a lesser extent, soundness) and geomorphological and compositional correlations. The classification is presented in hierarchy form; classification of the highest potential source areas is described first and classification of the lowest potential source areas is described last.

Class	Explanation
RBIa	Basin-fill or rock sources containing materials suitable for use as road-base aggregates; based on acceptable laboratory aggregate test results.

Class RBIa includes those source areas where the potential for suitable road-base aggregates is the highest. Each delineated area has been sampled and tested. In order to assign Class RBIa to a basin-fill deposit, the source must satisfy the overall requirements outlined in Section 3.1.1.

Class	Explanation
RBIb	Basin-fill sources containing materials suitable for use as road-base aggregates; based on correlation with Class RBIa source areas.

Class RBIb basin-fill deposits are correlated to tested RBIa deposits on the basis of limited laboratory sieve analysis data and field observations. Field observations included petrographic and grain-size analyses which provided data on lithology of adjacent source rock and general amounts and lithologies of gravel present in the basin-fill units. Photogeologic interpretations were also used to correlate Class RBIb deposits to RBIa deposits. Specific geomorphological parameters included surface texture, drainage patterns, relative relief, and topographic profiles.

Class	Explanation
RBII	Potential basin-fill sources of materials suitable for use as road-base aggregates; based on photogeologic interpretations, field observations, and limited or inconclusive sieve analysis and/or abrasion data.

Class RBII includes poorly defined, basin-fill aggregate sources. Field observations and inconclusive field and laboratory data indicate these deposits may be potentially acceptable for use as road-base aggregate sources.

All classifications are based on limited data. Additional field reconnaissance, testing, and case history studies are needed to confirm adequacy, delimit exact areal boundaries, and refine chemical and physical characteristics.

3.2 SOURCES OF ROAD-BASE AGGREGATES

Only basin-fill units have been delineated as potential sources of road-base aggregates in the Delamar Valley study area (Drawing 2). The study approach in the evaluation of road-base aggregates emphasized the analysis of basin-fill deposits and dictated that only previously tested, crushed-rock sources be discussed and classified. Although there are no previously tested, acceptable rock sources delineated in Delamar Valley, untested rock units may be suitable as sources of crushed-rock aggregates.

3.2.1 Basin-Fill Sources

All three classes of road-base aggregates, Class RBIa, RBIb, and RBII, are present in the basin-fill deposits of Delamar Valley (Drawing 2).

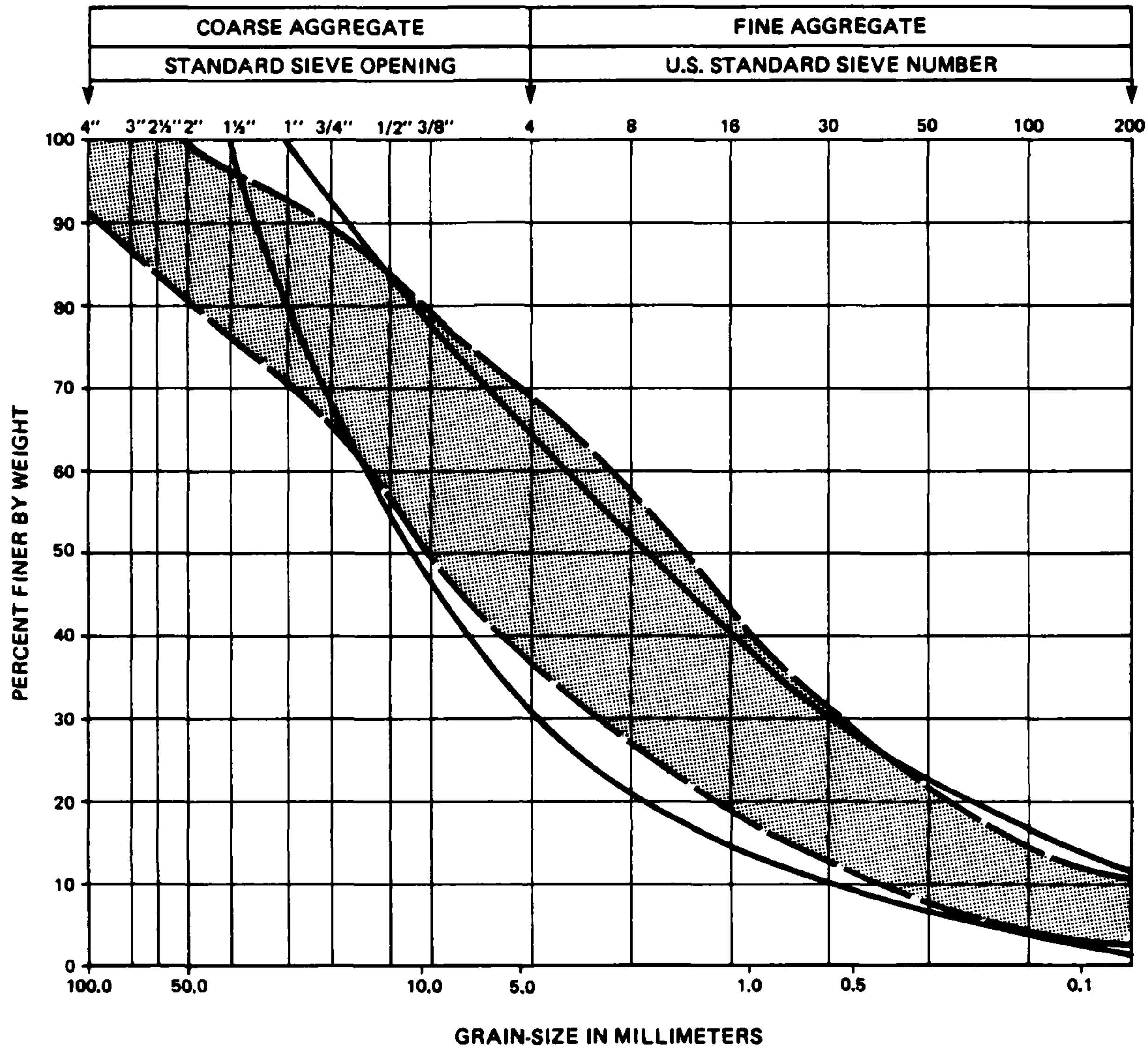
3.2.1.1 Class RBIa

All Class RBIa deposits within the study area are located along the eastern margin of the valley adjacent to the Delamar Mountains and the southern extent of the Burnt Springs Range. The Class RBIa deposit located against the northern boundary by the Burnt Springs Range extends north into Dry Lake Valley (E-TR-47-DL).

There are seven Class RBIa basin-fill deposits within the study area, all of which are alluvial fan units (Aaf). These basin-fill deposits generally consist of poor- to well-graded, sub-angular to subrounded sandy gravel. The gravel content of these deposits ranges from a low of 31 percent to a high of 71 percent but is generally 40 to 60 percent. Sand content ranges from 23 to 57 percent. Silt and clay content (below the overburden layer) ranges from a low of three percent to a high of 16 percent, but is generally between five to eight percent. Class RBIa basin-fill sources commonly consist of 25 to 94 percent carbonate clasts, 60 to 84 percent volcanic clasts, and 43 to 92 percent quartzite clasts. Carbonate and quartzite clasts are concentrated in Class RBIa deposits in the east-central part of the valley adjacent to the Delamar Mountains and in the deposit that lies adjacent to the Burnt Springs Range near U.S. Highway 93. Volcanic clasts are abundant in the northern and southern parts of the valley.

It has been observed that variations in grain-size gradations occur within a deposit depending on sample location. In general, gradations within a deposit are finer near the valley axis and coarser near mountain fronts. Due to access restrictions, samples were generally collected at distal and medial locations within each deposit.

The gradation of Class RBIa deposits approximates the grain-size distribution requirements stated in Section 3.1.1 (Figure 4). The different RBIa deposits generally share the same gradation



REQUIRED GRAIN-SIZE DISTRIBUTION ENVELOPE FOR TYPE I CLASS A, ROAD-BASE AGGREGATES (NEVADA STATE DEPARTMENT OF HIGHWAYS, 1976).

GRAIN-SIZE DISTRIBUTION ENVELOPE OF BASIN—FILL AGGREGATES POTENTIALLY SUITABLE FOR ROAD BASE.

Ertec — The Earth Technology Corporation	MX SITING INVESTIGATION DEPARTMENT OF THE AIR FORCE BMO/AFRCE-MX

GRAIN-SIZE DISTRIBUTION ENVELOPES ROAD-BASE AGGREGATES, CLASS RBIa DELAMAR VALLEY, NEVADA

29 MAY 81 FIGURE 4

characteristics; some cobbles and coarse gravel (oversized material) are present, gravel passing the 1.5-inches sieve is deficient, and fine gravel and sand passing 1-inch to No. 4 sieves are within design gradation requirements. There are two exceptions to the RBIa gradation trends. The deposit sampled in the north at locations 206 through 208 has a slight excess of sand passing the No. 4 and No. 8 sieves. The RBIa deposit at locations 226 through 228 (east-central portion of the valley) is deficient in gravels passing the 1-inch to 0.75-inch sieves. Material greater than 2 inches can be crushed and used to produce additional aggregates of all sizes. Additional minor processing of all RBIa deposits will be necessary to conform to the gradation requirements.

Laboratory abrasion tests performed on samples from all Class RBIa deposits show a narrow range of 26.3 to 31.8 percent wear. Laboratory $MgSO_4$ soundness tests performed on a selected group of coarse Class RBIa deposits yielded results ranging from 5.1 to 20.8 percent loss. Except for the one high soundness test loss of 20.8 percent, these test results are within acceptable values for abrasion and soundness.

The areal extent of the Class RBIa deposits ranges from approximately 0.5 to 2.0 mi^2 (1.3 to 5.2 km^2). The thickness of these Class RBIa deposits has been estimated to be at least 25 feet (7.6 m). Generally, 60 to 90 percent of the material in these deposits will be suitable for use as road base aggregates.

3.2.1.2 Class RBIb

Class RBIb basin-fill sources consist of alluvial and stream-channel deposits that have been correlated to Class RBIa deposits and, therefore, are considered to contain material acceptable for use as road-base aggregates. These deposits occur only on the east side of the valley adjacent to the Delamar Mountains and the Burnt Springs Range. Class RBIb basin-fill deposits include six alluvial fan deposits (Aaf) and one stream-channel deposit (Aal). The deposits of this class are generally all adjacent to Class RBIa deposits.

Since Class RBIb basin-fill deposits are correlated to Class RBIa deposits, they possess the same general characteristics as the RBIa deposits. These characteristics are poorly to well-graded, subangular to subrounded sandy gravel and gravelly sand which consist of predominantly carbonate and volcanic clasts with minor amounts of quartzite clasts.

Although variations in grain-size gradations will occur, depending on sample location within the deposit and the proximity of the deposit to its source area, Class RBIb deposits are interpreted to have gradation distributions similar to RBIa deposits.

The Class RBIb deposits vary in surface area from approximately 0.2 to 3.3 mi^2 (0.5 to 8.5 km^2). It is estimated that the material sampled from these deposits and described above extends to a depth of at least 25 feet (7.6 m). Generally, 60 to 90 percent of the material will be suitable for use as road-base aggregates.

3.2.1.3 Class RBII

Class RBII basin-fill aggregate sources are alluvial units that are potentially acceptable for use as road base. These deposits have been classified on the basis of limited field and laboratory data collected during this and other Ertec studies.

Class RBII deposits are eight widely spaced deposits located along the southeastern portion of the valley adjacent to the Delamar Mountains; in the west-central portion of the valley, adjacent to the South Pahroc Range; and in the northeastern portion of the valley, adjacent to the Burnt Springs Range. All of the Class RBII deposits are alluvial fan units (Aaf).

Limited laboratory and field data used to define the Class RBII deposits in the southeastern portion of the valley indicate that they consist of sandy gravel and gravelly sand and are composed predominantly of volcanic clasts with minor amounts of carbonate and quartzite clasts. However, there may be considerable variations from this general description within individual deposits.

The Class RBII deposits on the west side of the valley are known, on the basis of limited field data, to be composed of gravelly sand with abundant volcanic clasts. The total areal extent of the RBII deposits is approximately 25 mi^2 (64.6 km^2).

4.0 CONCRETE AGGREGATES EVALUATION

4.1 STUDY APPROACH

The purpose of the concrete aggregates evaluation is to determine the suitability of aggregates within Delamar Valley for use in concrete. To accomplish this, two objectives have been established:

1. Evaluate the basic physical and chemical characteristics of the aggregates; and
2. Determine the concrete making properties of the aggregates.

The study approach required to achieve these objectives included a review of previous Ertec Verification (FN-TR-27-DM-I and II) and aggregate reports (FN-TR-20D and FN-TR-37-a) for Delamar Valley. This data base helped define the scope of the concrete aggregates investigation and included office and field photogeologic and topographic interpretations, field reconnaissance, and collection and laboratory testing of basin-fill samples.

4.1.1 Requirements for Concrete Aggregates

The following requirements for aggregates and concrete (made using these aggregates) were established using criteria from the American Society of Testing and Materials (1979), the "Concrete Manual" prepared by the United States Department of the Interior (1975) and Milos Polivka (1981, personal communication).

1. Aggregates
   - Gradation - The aggregate gradation specifications used by the American Society of Testing and Materials (1979; C 33) were selected for evaluating the samples tested. These grading specifications follow.

Coarse Aggregates

Sieve Size	Percent Passing by Weight	Sieve Size	Percent Passing by Weight
2 inches	100	1 inch	100
1.5 inches	95-100	0.75 inch	90-100
1 inch	---	0.5 inch	---
0.75 inch	35-70	0.375 inch	20-55
0.50 inch	---	No.4	0-10
0.375 inch	10-30	No.8	0-5
No.4	0-5		

Fine Aggregates

Sieve Size	Percent Passing by Weight
0.375 inch	100
No.4	95-100
No.8	80-100
No.16	50-85
No.30	25-60
No.50	10-30
No.100	2-10
No.200	

- Abrasion - Los Angeles Machine abrasion losses for coarse aggregates are not to exceed 50 percent.

- Soundness - Five-cycle magnesium sulfate ($MgSO_4$) soundness losses are not to exceed 18 percent and 15 percent for coarse and fine aggregates, respectively. Although not a requirement for the evaluation, five-cycle sodium sulfate ($NaSO_4$) soundness tests are performed on samples that failed $MgSO_4$ testing. Resultant losses are not to exceed 12 percent and 10 percent for coarse and fine aggregates, respectively.

- Reactivity - Aggregates are to be nonreactive to alkali-silica and alkali-carbonate rock tests. Results are incomplete and will be submitted as an addendum to this report.

2. Concrete

- Compressive Strength - The primary concrete requirement is a 28-day compressive strength equal to or greater than 6500 psi.

- o Static Modulus of Elasticity - Values of 3 to 6 million psi at 28 days required.
- o Splitting Tensile Strength - Values of 10 percent or less of the compressive strength at 28 days required.
- o Ultimate Drying Shrinkage - Values of 0.03 to 0.10 percent (300 to 1000 millionths) required.

4.1.2 Data Acquisition and Analysis

4.1.2.1 Office Studies

Office studies for the concrete aggregates evaluation required preliminary basin-fill and rock unit differentiation based upon photogeologic interpretations and published topographic and geologic maps. All available data on basin-fill, grain-size gradations were compiled to estimate gravel content for the defined basin-fill units. All available test data on the aggregate properties of basin-fill and rock units were compiled to select sample locations in units previously tested and found preliminarily acceptable for use as concrete aggregate sources.

4.1.2.2 Field Studies

The field program involved backhoe excavation of five trenches selected during office studies and initial field reconnaissance; all the trenches were excavated to obtain samples of coarse and fine aggregates (gravel and sand).

Due to gradation variability in basin-fill deposits, field limits of 30 percent or more gravel and 15 percent or less silt and clay were established as basic aggregate grain-size distribution requirements. Gravel is defined as coarse aggregates which pass the 3.0-inch (75-mm) sieve and are predominantly retained on a No. 4 (4.75-mm) sieve. Silt and clay particles are defined as material passing through a No. 200 sieve (0.0029-inch [0.075-mm]).

The five trenches excavated to collect basin-fill samples for the evaluation of concrete aggregates were grouped into a set 150 feet apart (46 m) to characterize an individual basin-fill unit. Trenches were excavated to depths ranging from 12 to 15 feet (3.7 to 4.6 m). Bulk representative samples averaged 400 pounds (182 kg) per trench.

Field studies also included 37 petrographic and grain-size data field stops and valley-wide photogeologic field reconnaissance. These analyses were performed to supplement and confirm the office studies and to provide a broader data base for lithologic and gradation correlations of basin-fill units.

4.1.2.3 Laboratory Testing

The laboratory aggregate testing program was performed in two phases. The first phase consisted of standard tests for determining the basic properties of the aggregates and included the following:

- o Unit Weights and Voids in Aggregates;
- o Standard Specifications for Concrete Aggregates;
- o Soundness of Aggregates, Magnesium Sulfate ($MgSO_4$) and Sodium Sulfate ($NaSO_4$);
- o Sieve Analysis by Washing, less than No. 200 fraction;
- o Fineness Modulus;

- Specific Gravity and Absorption, Coarse and Fine Aggregates;
- Resistance to Abrasion, Los Angeles Machine;
- Sieve Analysis, Coarse and Fine Aggregates; and
- Petrographic Examination of Aggregates for Concrete.

Generally, these tests were performed on aggregates from different locations within the same sources previously tested and identified as the most promising in the VSARS program. This repetitive testing was done to confirm the suitability of aggregates for concrete (see Section 4.1.1, Requirements for Concrete Aggregates). Table 1 lists the number of tests completed in Delamar Valley.

The second phase of the testing consisted of an evaluation of the concrete-making properties of the aggregates when used in the following three trial (check) concrete mixes:

Mix 1 - 7.5 sacks (94 pounds per sack) of cement per cubic yard of concrete with 1.5-inches maximum aggregate size;

Mix 2 - 8.5 sacks (94 pounds per sack) of cement per cubic yard of concrete with 1.5-inches maximum aggregate size; and

Mix 3 - 8.5 sacks (94 pounds per sack) of cement per cubic yard of concrete with 0.75-inch maximum aggregate size and a superplasticizer.

In all three trial mixes, fly ash, as a pozzolan, replaced 20 percent of the cement by weight. All concrete trial mix design criteria are presented in Table 2. Samples were collected for one basin-fill (coarse and fine aggregates) trial mix. Material greater than 1.5 inches was crushed to conform to gradation

	ASTM STANDARD TEST	AGGREGATE AND CONCRETE TEST DESCRIPTIONS [1]	TOTAL NUMBER OF TESTS*			
			BASIN-FILL		ROCK	
			CA	FA	ROCK	FA
AGGREGATES	C29	UNIT WEIGHT AND VOIDS IN AGGREGATE	1		–	
	C33	STANDARD SPECIFICATIONS FOR CONCRETE AGGREGATE	1		–	
	C88	SOUNDNESS OF AGGREGATE; Mg SO_4/$NaSO_4$	1/–	1/1	–	–
	C117	SIEVE ANALYSIS BY WASHING, < # 200 FRACTION	2		–	–
	C125	FINENESS MODULUS	–	1	–	–
	C127	SPECIFIC GRAVITY/ABSORPTION, COARSE AGGREGATE	6/2	–/–	–	–
	C128	SPECIFIC GRAVITY/ABSORPTION, FINE AGGREGATE	–/–	3/1	–	–
	C131	RESISTANCE TO ABRASION, LOS ANGELES MACHINE	1	–	–	–
	C136	SIEVE ANALYSIS, COARSE AND FINE AGGREGATE	7	6	–	–
	C295	PETROGRAPHIC EXAM. OF AGGREGATES FOR CONCRETE	1	1	–	–
CONCRETE	C39	COMPRESSIVE STRENGTH OF CYLINDRICAL CONCRETE SPECIMENS	24		–	
	C138	UNIT WEIGHT, YIELD, AIR CONTENT OF CONCRETE	3		–	
	C143	SLUMP OF PORTLAND CEMENT CONCRETE	4		–	
	C157	LENGTH CHANGE OF HARDENED CEMENT MORTAR AND CONCRETE	30		–	
	C173	AIR CONTENT OF CONCRETE, VOLUMETRIC METHOD	3		–	
	C192	MAKING AND CURING CONCRETE SPECIMENS	3		–	
	C227	POTENTIAL ALKALI-SILICA REACTIVITY, MORTAR-BAR METHOD	1 (IP)	1 (IP)	–	–
	C469	STATIC MODULUS OF ELASTICITY, POISSONS RATIO OF CONCRETE IN COMPRESSION	24		–	
	C496	SPLITTING TENSILE STRENGTH OF CYLINDRICAL CONCRETE SPECIMENS	6		–	
	C684	MAKING AND TESTING ACCELERATED CURE CONCRETE COMPRESSION TEST SPECIMENS	6		–	
	222-1-77 [2]	SELECTING PROPORTIONS FOR NORMAL AND HEAVY WEIGHT CONCRETE	3		–	
	PROP. [3]	POTENTIAL ALKALI-CARBONATE ROCK REACTIVITY, LENGTH CHANGE METHOD	1 (IP)		–	
	C39-65 [4]	COEFFICIENT OF LINEAR THERMAL EXPANSION OF CONCRETE	6 (IP)		–	

1. AMERICAN SOCIETY FOR TESTING AND MATERIALS (1978)
2. AMERICAN CONCRETE INSTITUTE (1977)
3. MIELENZ (1980) PROPOSED ASTM STANDARD TEST
4. UNITED STATES ARMY CORPS OF ENGINEERS (1977)

(IP) - TEST IN PROGRESS

* BASIN-FILL SOURCES SUPPLIED BOTH COARSE AND FINE AGGREGATES FOR CONCRETE MIX. LEDGE-ROCK SOURCES SUPPLIED COARSE AGGREGATES; LOCAL SAND SOURCES (GENERALLY COLLECTED WITHIN A FEW MILES OF CORRESPONDING LEDGE-ROCK SOURCES) SUPPLIED FINE AGGREGATES FOR CONCRETE MIX.

Ertec
The Earth Technology Corporation

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

AGGREGATE AND TRIAL MIX TESTS
CONCRETE AGGREGATES EVALUATION
DELAMAR VALLEY, NEVADA

29 MAY 81 TABLE 1

CONCRETE CONSTITUENTS AND PROPERTIES	CONCRETE TRIAL MIX DESIGN CRITERIA					
	MIX 1 7.5/1.5 IN.[1]		MIX 2 8.5/1.5 IN.[1]		MIX 3 8.5/0.75 IN.; SUPER.[1]	
	VOLUME	WEIGHT	VOLUME	WEIGHT	VOLUME	WEIGHT
CEMENT, NEVADA TYPE II (LOW ALKALI; FT^3, LBS)	2.87	564	3.25	639	3.25	6.39
FLY ASH, WESTERN (REPLACES 20% OF CEMENT BY WEIGHT; FT^3, LBS)	0.99	141	1.12	160	1.12	160
SUPERPLASTICIZER (WRDA 19; OZ/CWT)[2]	—	—	—	—	15	—
WATER REDUCER (WRDA 79; OZ/CWT)	5	—	5	—	5	—
AIR ENTRAINMENT ADMIXTURE (DARAVAIR: OZ/CWT [FT^3])	2.25 [1.08]	—	1.25 [1.08]	—	1.75 [1.08]	—

	MIX 1	MIX 2	MIX 3
SLUMP, MAXIMUM (INCHES)	3 - 4	3 - 4	0 - 1[3]
AIR CONTENT, RANGE (PERCENT)	4 - 6	4 - 6	4 - 6
WATER/CEMENT RATIO (BY WEIGHT)	0.36	0.32	0.33
CEMENT FACTOR (SCY)[4]	7.5	8.5	8.5

1. SACKS OF CEMENT PER CYD / MAXIMUM AGGREGATE SIZE
2. OZ/CWT = OUNCES/100 POUNDS OF CEMENT AND FLY ASH
3. SLUMP BEFORE ADDITION OF SUPERPLASTICIZER
4. SCY = SACKS OF CEMENT/CUBIC YARD OF CONCRETE

Ertec
The Earth Technology Corporation

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

CONCRETE TRIAL MIX DESIGN CRITERIA
DELAMAR VALLEY, NEVADA

29 MAY 81

TABLE 2

requirements. If necessary, coarse and fine aggregates were processed to conform to gradation requirements.

The following tests were performed to evaluate fresh and hardened properties of concrete made from Delamar Valley aggregates:

Fresh Properties

- Unit Weight, Yield and Air Content of Concrete;
- Slump of Portland Cement Concrete;
- Air Content of Concrete, Volumetric Method;
- Making and Curing Concrete Specimens;
- Making and Testing Accelerated Cure Concrete Compression Test Specimens; and
- Selecting Proportions for Normal and Heavyweight Concrete.

Hardened Properties

- Compressive Strength of Cylindrical Concrete Specimens;
- Length Change of Hardened Cement Mortar and Concrete;
- Potential Alkali-Silica Reactivity, Mortar-Bar Method;
- Static Modulus of Elasticity of Concrete in Compression;
- Splitting Tensile Strength of Cylindrical Concrete Specimens;
- Potential Alkali-Carbonate Rock Reactivity, Length Change Method; and
- Coefficient of Linear Thermal Expansion of Concrete.

The results of all tests summarized in Table 1 are important to the concrete aggregates evaluation, but hardened concrete properties are considered the most significant (see Section 4.1.1, Requirements for Concrete Aggregates). Although the primary requirement for concrete is a 28-day compressive strength of

6500 psi, one-day (accelerated), seven-day, and 90-day tests were done to determine the range of compressive strength values. In order to compare different aggregate sources, 28-day compressive strengths of Mix 3 were always used.

Occasionally, fresh concrete properties varied from design concrete specifications and may have affected hardened concrete test results. If known or significant, the causative factor and its effect on test results are mentioned in the discussions on sources of concrete aggregates (Section 4.2.1).

The scope of the study did not allow sample collection and laboratory testing of all potential basin-fill and rock concrete aggregate sources. Existing data and field petrographic and grain-size analyses were used to correlate lithologic and gradation properties to basin-fill units which were not sampled. An important element of this correlation procedure was the use of aerial photography to help delineate the lateral extent of basin-fill deposits. Photogeologic field observations ascertained geomorphological and topographical relationships of basin-fill units and the source rock lithology and distribution of predominantly gravelly materials.

No rock sources were examined in Delamar Valley, and limited laboratory and field data prevented confident correlations of tested sources outside the study area.

4.1.3 Presentation of Results

Results of the concrete aggregates evaluation are presented in the form of text, tables, figures, 1:62,500 scale drawings, and appendices. Drawing 1 is a location map showing the position in the study area of all data points used in the Detailed Aggregate Resources Study. All data points are grouped by study type and assigned categorized map numbers (see Section 3.1.3).

Drawing 3 presents the locations of the potential basin-fill concrete aggregate sources, DARS trenches, and field petrographic and grain-size data stops in the study area. Geologic unit symbols used in Drawing 3 relate to standard geologic nomenclature whenever possible. A conversion table relating these symbols to the geologic unit nomenclature used in other Ertec reports is contained in Appendix Table F-3.

A solid contact line separates basin-fill and rock units in Drawing 3 to differentiate these two basic material types. Basin-fill contacts are derived from photogeological mapping with limited field reconnaissance and are also dashed. Rock contacts were not delineated because of a lack of or limited laboratory and field data.

Classifications of potential basin-fill concrete aggregate sources are distinguished by different patterns and are emphasized by a dark background tone.

The appendices contain tables that summarize the basic field data collected during the course of the study and the subsequent laboratory test procedures and results. Appendices A and B contain DARS trench data and petrographic and grain-size data, respectively. Appendix C contains representative trench logs. Appendix Table D-2 presents a laboratory testing flow diagram for the concrete aggregates evaluation. Appendix E presents the chemical analyses of cement, fly ash, and water used in making all concrete trial mixes. Appendix F includes three tables describing soil classification, caliche development, and geologic unit cross reference.

4.1.4 Classification of Concrete Aggregates

A classification system was designed to present the most likely basin-fill and crushed-rock concrete aggregate sources. It was developed from an evaluation as well as from an extrapolation of all available data. Data include laboratory test results (compressive strength of concrete and grain-size, abrasion, and soundness of aggregates) and geomorphological and compositional correlations.

The classification system groups potential aggregate sources into three categories:

1. Aggregate sources which were used in concrete mixes - Class CA1 and Class CA2;
2. Aggregate sources which were subjected to basic aggregate tests - Class CB; and
3. Untested aggregate sources which were correlated to Classes CA1, CA2, or CB - Class CC1 and Class CC2.

The classification is presented in hierarchy form; classification of the highest potential source areas is described first, and classification of the lowest potential source areas is described last.

Class	Explanation
CA1	Basin-fill or rock sources containing aggregates that produced trial mix concrete with 28-day compressive strengths equal to or greater than 6500 psi using Mix 3 (Section 4.1.2).
CA2	Basin-fill or rock sources containing aggregates that produced trial mix concrete with 28-day compressive strengths less than 6500 psi using Mix 3 (Section 4.1.2).

The Classes CA1 and CA2 describe those specific sources where basin-fill or crushed-rock aggregates have been collected and used in making trial mix batches of concrete. Following appropriate ASTM standards, concrete cylinders containing the collected aggregates were made, cured, and tested for various hardened concrete properties. The class is divided into two categories by 28-day compressive strength test results.

Generally, aggregates from each potential source area have been tested previously during the VSARS program. Confirmation testing that includes gradation, abrasion, and soundness tests was performed when applicable to ensure the continued acceptability of a sample for use in concrete. Abrasion and $MgSO_4$ soundness values do not exceed coarse aggregate requirements specified in Section 4.1.1. Tested samples of fine aggregates used in the concrete trial mixes consistently have $MgSO_4$ soundness losses exceeding the required 15 percent maximum, however, $NaSO_4$ soundness losses generally do not exceed 10 percent.

Class	Explanation
CB	Basin-fill or rock sources containing aggregates potentially suitable for use in concrete; based on acceptable laboratory aggregate test results.

The Class CB describes those source areas that have been sampled and tested only for grain-size gradation, abrasion, and magnesium sulfate soundness. Trial concrete mixes were not made. Gradation, abrasion, and soundness values specified in Section 4.1.1 were used to assign this classification to an aggregate source.

Class	Explanation
CC1	Basin-fill or rock sources containing aggregates potentially suitable for use in concrete; based on correlation with Class CA1 or CA2 areas.
CC2	Basin-fill sources of aggregates potentially suitable for use in concrete; based on correlation with Class CB areas.

Untested Class CC deposits are correlated to tested Class CA or CB deposits on the basis of field observations and limited field and laboratory test results. Class CC basin-fill deposits consist of units of the same apparent relative age as Class CA and CB deposits.

Field observations and petrographic and grain-size analyses provided correlative data on lithology of adjacent source rock and lithology and general amounts of gravel present in the basin-fill units. Photogeologic interpretations were also used to correlate Class CC basin-fill deposits to Class CA or CB basin-fill deposits. Specific geomorphological parameters correlated during the procedure included surface texture, drainage patterns, relative relief, and topographic profiles.

All classifications are based on limited data. Additional field reconnaissance, testing, and case history studies are needed to confirm adequacy, delimit exact areal boundaries, and refine chemical and physical properties.

4.2 SOURCES OF CONCRETE AGGREGATES

Only basin-fill deposits have been classified as potential sources of concrete aggregates in Delamar Valley. The study approach in the evaluation of concrete aggregates emphasized the analysis of basin-fill deposits and dictated that only previously tested, acceptable crushed-rock sources be sampled and/or evaluated. Although there are no previously tested, acceptable rock sources delineated in Delamar Valley, untested rock units may be suitable as sources of crushed-rock aggregates.

4.2.1 Basin-Fill Sources

Basin-fill sources of concrete aggregates are grouped into four classes. Deposits defined on the basis of laboratory test data are included in Class CA1 and Class CB. Untested basin-fill deposits correlated to deposits with test data are in Classes CC1 and CC2.

4.2.1.1 Class CA1

There is one Class CA1 basin-fill concrete materials source identified within the study area. This deposit is located on the east side of the valley adjacent to the Delamar Mountains.

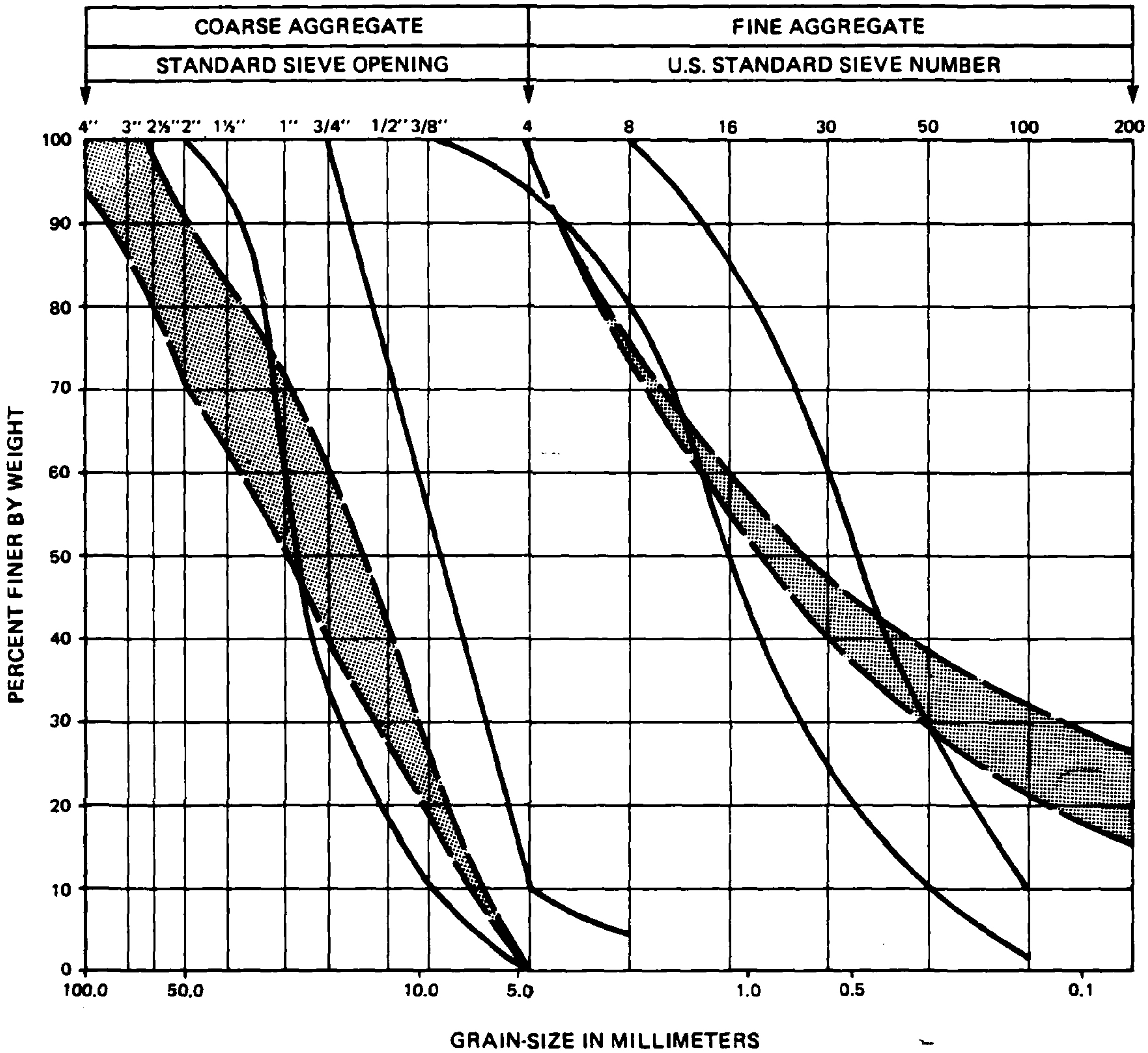
1. The Class CA1 basin-fill source is an alluvial fan deposit (Aaf) located adjacent to the Delamar Mountains between latitudes 37°15'N and 37°30'N (Drawing 3). This deposit consists mainly of poorly graded, sandy gravel. The gravel ranges from 58 to 71 percent of the deposit (excluding cobbles and boulders), and the sand ranges from 23 to 35 percent. Cobbles and boulders comprise about seven percent of the total material within the deposit. Silt and clay comprise from six to nine percent of the deposit.

The gravel clasts sampled from the Class CA1 deposit are typically subangular to subrounded in shape. Approximately 61 percent of the gravel clasts are of satisfactory physical quality; 30 percent are porous, weak, and internally fractured and are of fair physical quality; and about nine percent are soft or highly porous and are of poor quality. The collected gravel sample is composed of approximately 66 percent dolomite, 11 percent limestone and dolomitic limestone, five percent quartzite and quartzose sandstone, and 16 percent coating material, volcanic, chert, and tuffaceous material. About 57 percent of the gravel clasts are partially or completely coated by calcareous material. The dolomite and dolomitic limestone clasts may be susceptible to a deleterious degree to the alkali-carbonate reaction. Volcanic, chert, and tuffaceous materials are susceptible to the alkali-silica reaction.

The sand particles from the sampled Class CA1 deposit are typically angular to subrounded in shape and are generally similar in composition, but not quality, to the gravel clasts within the deposits. Approximately 38 percent of the sampled sand particles are satisfactory in physical quality; 49 percent are porous, weak, or internally fractured and are of fair physical quality; and about 13 percent are soft, highly porous particles and are of poor quality. All the sand is considered to be marginally susceptible to a deleterious degree to the alkali-carbonate reaction and susceptible to the alkali-silica reaction.

The percentages of coarse aggregates passing the 1-inch to No. 4 sieves within the Class CA1 deposit conform to the design gradation requirements (Figure 5). The percentages of coarse aggregates passing the 2- to 1.5-inch sieves are deficient, and oversize clasts are available for crushing. The percentages of fine aggregates do not conform to design gradation requirements. There is a deficiency of coarse sand passing the No. 8 sieve and an excess of fine sand passing the No. 50 to No. 200 sieves. Processing will be necessary to bring the deposit within gradation requirements. Variations in grain-size gradations will occur within the deposit depending on proximity to the source area. In general, this source is relatively fine grained near the valley axis and coarse grained adjacent to the mountain fronts.

A coarse aggregate sample from this Class CA1 deposit was subjected to laboratory abrasion and $MgSO_4$ soundness tests and yielded losses of 29.1 and 5.1 percent, respectively. These values for abrasion and soundness are well within acceptable



REQUIRED GRAIN-SIZE DISTRIBUTION ENVELOPES FOR COARSE AND FINE AGGREGATES USED IN CONCRETE (AMERICAN SOCIETY FOR TESTING AND MATERIALS, 1978, C 33; THE RECOMMENDED GRADATIONS FOR AGGREGATES WITH 1.5 AND 0.75 INCH MAXIMUM SIZE ARE COMBINED INTO ONE ENVELOPE).

GRAIN-SIZE DISTRIBUTION ENVELOPES OF BASIN—FILL COARSE AND FINE AGGREGATES POTENTIALLY SUITABLE FOR CONCRETE.

Ertec
The Earth Technology Corporation

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

GRAIN-SIZE DISTRIBUTION ENVELOPES
CONCRETE AGGREGATES, DM-A- (16-20)
DELAMAR VALLEY, NEVADA

29 MAY 81 FIGURE 5

ranges for coarse concrete-construction-material use. The fine aggregate sample from this Class CA1 deposit was subjected to both $MgSO_4$ and $NaSO_4$ soundness tests. The sample failed the $MgSO_4$ soundness test with a 23.3 percent loss but passed the $NaSO_4$ soundness test with a 3.3 percent loss.

Concrete (Mix 3) made using the aggregates from the Class CA1 deposit had a 28-day compressive strength of 7690 psi and a 90-day compressive strength of 8785 psi. Concrete trial Mixes 1 and 2 yielded 28-day compressive strengths of 4545 psi and 5525 psi, respectively (Table 3). The air content of Mix 1 (9.0 percent) was higher than the maximum air content as specified by the mix design (6.0 percent) and may have caused a lowering of the compressive strengths of this mix. Fresh concrete properties and hardened concrete test results (chord modulus of elasticity, splitting tensile strength, drying shrinkage) are also included in Table 3. All test results for hardened concrete except for Mix 1 are within or exceed the requirements mentioned in Section 4.1.1.

The areal extent of the Class CA1 deposit is approximately 0.7 mi^2 (1.8 km^2). It is estimated that the material sampled from this deposit and described above extends to a depth of at least 25 feet (7.6 m). It is also estimated that this deposit has a yield of 75 to 80 percent after gradation deficiencies, handling, poor-quality constituents, and silt and clay losses.

AGGREGATE SOURCE[1]	FIELD STATION	CONCRETE MIX DESIGN CRITERIA[2] SACKS OF CEMENT/CYD / MAX. AGG. SIZE	FRESH CONCRETE PROPERTIES SLUMP[3] (IN.)	AIR CONTENT (%)	UNIT WEIGHT (PCF)	WATER/CEMENT RATIO	CEMENT FACTOR (SCY)	ASTM STANDARD
BASIN – FILL	DM-A-(16-20)	MIX 1 7.5/1.5 IN.	5	9.0	142.8	0.34	7.35	COMPRESSIVE STRENG (PSI)
								CHORD MODULUS OF ELAST (PSI x 10^6)
								SPLITTING TENSILE STREN (PSI)
								DRYING SHRINKAGE, (PERCENT
	DM-A-(16-20)	MIX 2 8.5/1.5 IN.	4	3.5	146.1	0.36	8.42	COMPRESSIVE STRENG (PSI)
								CHORD MODULUS OF ELAST (PSI x 10^6)
								SPLITTING TENSILE STREN (PSI)
								DRYING SHRINKAGE, (PERCENT
	DM-A-(16-20)	MIX 3 8.5/0.75 IN., SUPER-PLASTICIZER	0 BEF. 3.5 AFT.	4.0	149.6	0.27	8.84	COMPRESSIVE STRENG (PSI)
								CHORD MODULUS OF ELAST (PSI x 10^6)
								SPLITTING TENSILE STREN (PSI)
								DRYING SHRINKAGE, (PERCENT

1. BASIN-FILL SOURCES SUPPLIED BOTH COARSE AND FINE AGGREGATES FOR CONCRETE MIX. LEDGE-ROCK SOURCES SUPPLIED COARSE AGGREGATES; LOCAL SAND SOURCES (GENERALLY COLLECTED WITHIN A FEW MILES OF CORRESPONDING LEDGE-ROCK SOURCES) SUPPLIED FINE AGGREGATES FOR CONCRETE MIX.
2. ASTM AND ACI SPECIFICATIONS AND PROCEDURES WERE FOLLOWED IN THE MIX DESIGN AND BATCHING OF THE CONCRETE TRIAL MIXES. THE CONCRETE MIXES CONSISTED OF COARSE AND FINE AGGREGATES, LOW ALKALI CEMENT, FLY ASH (20% BY WEIGHT REPLACEMENT OF CEMENT), SUPERPLASTICIZER, AIR-ENTRAINING ADMIXTURE, AND WATER REDUCER.
3. BEF. – SLUMP BEFORE ADDITION OF SUPERPLASTICIZER.
   AFT. – SLUMP AFTER ADDITION OF SUPERPLASTICIZER.
4. COMPRESSIVE AND TENSILE CYLINDERS. DRYING SHRIN MENS; TIMETABLE INCLUDE

HARDENED CONCRETE TEST RESULTS

ASTM STANDARD TEST [4]	TIMETABLE			
	1 DAY (ACCELERATED)	7 DAYS	28 DAYS	90 DAYS
PRESSIVE STRENGTH, ASTM C 39 (PSI)	1675	3375	4545	6020
ODULUS OF ELASTICITY, ASTM C 469 (PSI x 10^6)	1.00	3.16	3.40	3.80
IG TENSILE STRENGTH, ASTM C 496 (PSI)	—	—	505	—

YING SHRINKAGE, ASTM C 157 (PERCENT)	7 DAYS	14 DAYS	21 DAYS	28 DAYS	35 DAYS
	0.0	0.030	0.041	0.048	0.057

PRESSIVE STRENGTH, ASTM C 39 (PSI)	2625	4595	5525	6915
ODULUS OF ELASTICITY, ASTM C 469 (PSI x 10^6)	2.30	3.20	3.90	4.28
IG TENSILE STRENGTH, ASTM C 496 (PSI)			505	

YING SHRINKAGE, ASTM C 157 (PERCENT)	7 DAYS	14 DAYS	21 DAYS	28 DAYS	35 DAYS
	0.0	0.027	0.040	0.048	0.055

PRESSIVE STRENGTH, ASTM C 39 (PSI)	3510	6285	7690	8785
ODULUS OF ELASTICITY, ASTM C 469 (PSI x 10^6)	3.14	3.54	4.33	4.30
IG TENSILE STRENGTH, ASTM C 496 (PSI)			640	

YING SHRINKAGE, ASTM C 157 (PERCENT)	7 DAYS	14 DAYS	21 DAYS	28 DAYS	35 DAYS
	0.0	0.030	0.044	0.053	0.060

IVE AND TENSILE STRENGTH VALUES ARE AVERAGES OBTAINED FROM TWO TESTED
NS. DRYING SHRINKAGE VALUES ARE AVERAGES OBTAINED FROM TWO TESTED SPECI-
ETABLE INCLUDES A SEVEN DAY MOIST CURE.

Ertec
The Earth Technology Corporation

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

CONCRETE TRIAL MIX TEST RESULTS
DM-A-(16-20)
DELAMAR VALLEY, NEVADA

29 MAY 81 | TABLE 3 | 1 OF 1

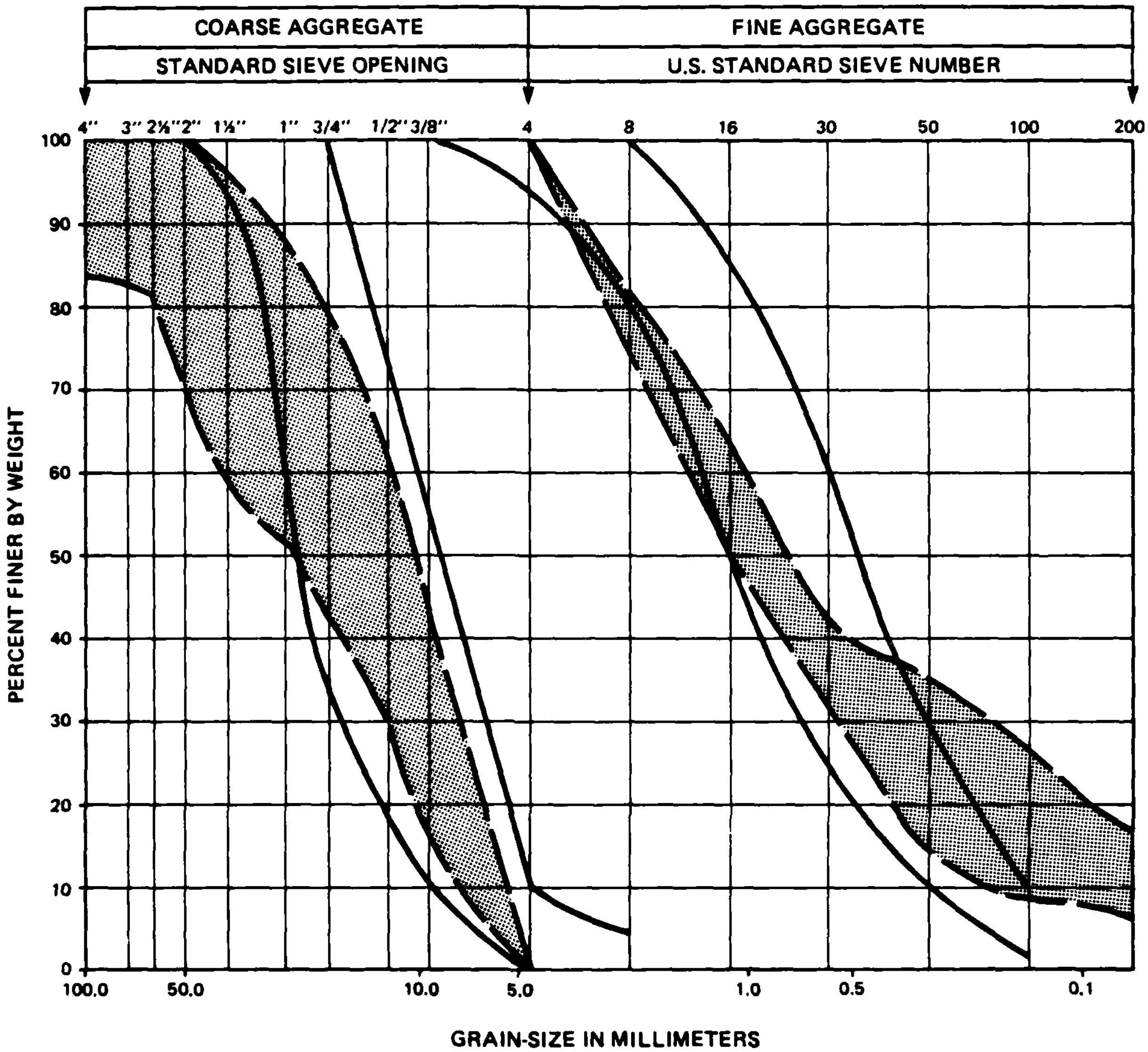
4.2.1.2 Class CB

Class CB basin-fill aggregate sources are alluvial deposits that have been sampled and laboratory tested and, on the basis of test results, are considered to be potential sources of concrete aggregates. Class CB deposits have not been used in concrete trial mixes. Test results show that these deposits contain at least 30 percent gravel clasts of all sizes (No. 4 sieve size to 3-inches), have less than 50 percent abrasion wear, and where applicable, have less than 18 percent loss when subjected to a $MgSO_4$ soundness test.

There are five Class CB sources along the east side of the study area, and all are alluvial fan (Aaf) deposits. Four are located adjacent to the Delamar Mountains, and one is located near U.S. Highway 93 adjacent to the Burnt Springs Range.

Class CB basin-fill deposits generally consist of poorly to well-graded, subangular to subrounded gravelly sand and sandy gravel. The gravel content of most Class CB deposits ranges from about 30 to 60 percent, and the silt content ranges from four to 16 percent. Most deposits are composed of a few to 69 percent carbonate and quartzite clasts and eight to 84 percent volcanic clasts.

The percentages of coarse aggregates passing the 1-inch to No. 4 sieves within the Class CB deposit conform to design gradation requirements (Figure 6). The percentages of coarse aggregates passing the 2- to 1.5-inches sieves are slightly deficient, and



REQUIRED GRAIN-SIZE DISTRIBUTION ENVELOPES FOR COARSE AND FINE AGGREGATES USED IN CONCRETE (AMERICAN SOCIETY FOR TESTING AND MATERIALS, 1978, C 33; THE RECOMMENDED GRADATIONS FOR AGGREGATES WITH 1.5 AND 0.75 INCH MAXIMUM SIZE ARE COMBINED INTO ONE ENVELOPE).

GRAIN-SIZE DISTRIBUTION ENVELOPES OF BASIN–FILL COARSE AND FINE AGGREGATES POTENTIALLY SUITABLE FOR CONCRETE.

Ertec
The Earth Technology Corporation

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

GRAIN-SIZE DISTRIBUTION ENVELOPES
CONCRETE AGGREGATES, CLASS CB
DELAMAR VALLEY, NEVADA

29 MAY 81

FIGURE 6

oversize material is available for crushing. Although the percentage of coarse sand generally meets designs requirements, the percentage of fine sand passing the No. 50 to No. 100 sieves is excessive. Variations in grain-size gradations will occur within the deposit depending on proximity to the source area. In general, the deposits are relatively finer-grained near the valley axis and coarser-grained near the mountain fronts.

Laboratory abrasion tests performed on samples from all Class CB deposits resulted in fairly low percent wear values ranging from 26.3 to 31.8 percent. $MgSO_4$ soundness tests performed on the coarse aggregates from two of the Class CB samples resulted in values of 12.7 and 17.4 percent loss.

The areal extent of Class CB deposits ranges from 0.6 to 1.1 mi^2 (1.6 to 2.8 km^2). It is estimated that the material sampled from these deposits extends to a depth of at least 25 feet (7.6 m) and will have a yield of 60 to 80 percent.

4.2.1.3 Class CC1

The Class CC1 deposit within the study area is located on the east side of the valley adjacent to the Delamar Mountains. It is an alluvial fan unit that has been correlated to the Class CA1 deposit on the basis of geomorphological and compositional similarities.

The Class CC1 deposit is therefore considered to be a potential source of concrete aggregate consisting of poorly graded, subangular to angular sandy gravel of generally satisfactory physical quality. The lithology of the deposit is predominantly quartzite, limestone, and dolomite with trace amounts of other rock types. The areal extent of the Class CC1 deposit is 1.3 mi^2 (3.4 km^2).

4.2.1.4 Class CC2

Class CC2 basin-fill aggregate sources are alluvial deposits that have been correlated to Class CB concrete aggregate sources on the basis of geomorphological and compositional similarities. These deposits are therefore assumed to contain material similar in size and composition to Class CB deposits. Class CC2 deposits are located along the east side of the valley adjacent to the Delamar Mountains and have an areal extent ranging from 0.2 to 3.3 mi^2 (0.5 to 8.5 km^2).

5.0 CONCLUSIONS

Results of the Detailed Aggregate Resources Study indicate that there are sufficient quantities of aggregates available for the construction of the MX missile system in the Delamar Valley study area.

Good to high quality basin-fill coarse aggregates are present along the east side of the valley. Sufficient quantities of poor to satisfactory quality, fine aggregates are present in basin-fill deposits in the valley. After shelter layouts are finalized, potential borrow areas can be delineated based on the results of this study.

Although most rock will supply acceptable coarse aggregates, no sources are delineated in this study. Sufficient quantities of basin-fill aggregates within the valley will probably make processing of crushed-rock aggregates unnecessary.

As discussed in the report, field studies placed an arbitrary cut-off limit of a minimum of 30 percent gravel for the source to be considered for road-base or concrete aggregates. Nevertheless, basin-fill deposits with less than 30 percent gravel are also probably potentially suitable for use as aggregates. However, yield from such sources will be low and extensive processing and/or blending will be required to satisfy the gradation requirements.

5.1 ROAD-BASE AGGREGATES

5.1.1 Class RBIa Sources

Seven basin-fill deposits consisting of good- to high-quality coarse aggregates acceptable for road base have been located within the study area. They are confined to the east side of the valley and have an areal extent of approximately 6.8 mi^2 (17.6 km^2).

Gradation analyses indicate that, where sampled, the deposits approximate ASTM standards and DARS requirements. Sand and fine gravel sizes are within design gradation requirements. Gravels passing the 1.5- to 1-inch sieves is deficient. Crushing and blending the coarse gravels and cobbles should bring individual deposits within design gradation requirements. In addition, grain-size variations will occur depending on sample location within the deposit. Generally, finer grained material can be obtained nearer the valley axis, and coarser grained material can be obtained near mountain front source areas.

Abrasion and soundness results on tested samples are also within ASTM standards and DARS requirements.

5.1.2 Class RBIb Sources

Seven basin-fill deposits within the study area are defined as potential sources of good- to high-quality coarse aggregates for use as road-base construction material. Geomorphological and compositional similarities were used to correlate these units to tested RBIa deposits. The units include alluvial fan deposits (Aaf) and one stream channel deposit (Aal). All are confined to the east side of the valley. Their total areal extent is approximately 12 mi^2 (31.1 km^2).

5.1.3 Class RBII Sources

Eight potential road-base aggregate sources defined by limited field and laboratory data are present throughout the study area. All deposits are alluvial fans, consist predominantly of sandy gravel or gravelly sand, and are compositionally similar to Class RBIa and RBIb deposits. These deposits have a total areal extent of approximately 25 mi^2 (64.8 km^2).

5.2 CONCRETE AGGREGATES

5.2.1 Class CA1 Sources

One alluvial fan basin-fill deposit consisting of good- to high-quality aggregates that produced concrete with 28-day compressive strengths equal to or greater than 6500 psi has been delineated within the study area. Chord modulus of elasticity, splitting tensile strength, and drying shrinkage results generally conform to the standard concrete requirements.

Gradation results indicate that, where sampled, the deposit approximates ASTM standards and DARS requirements. Typically, percentages of medium and fine gravel (1-inch to No. 4 sieves) conform to gradation specifications, but there is a lack of coarse gravel passing the 2- to 1.5-inch sieves. The fine aggregate samples generally contain a deficiency of coarse sand passing the No. 8 sieve and an excess of fine sand passing the No. 50 to No. 200 sieves. Processing of basin-fill deposits will be necessary to bring gradations within design requirements. Crushing of over-sized materials will produce more aggregates of all sizes. Wasting will remove excess fine sand. In addition, variations in grain-size gradation will occur within the deposit depending on proximity to the source area. Aggregates are relatively finer grained near the valley axis and coarser grained near the mountain fronts.

Results of abrasion and soundness tests performed on coarse aggregates from the Class CA1 deposit are also within specified ASTM and DARS requirements. The fine aggregates within the deposit are generally of lower quality (high $MgSO_4$ soundness losses) but results are inconclusive regarding their use as concrete construction material. The Class CA1 deposit is located on the east side of the valley and has a total areal extent is approximately 0.7 mi^2 (1.8 km^2).

5.2.2 <u>Class CB Sources</u>

Five basin-fill deposits consisting of good- to high-quality coarse aggregates potentially acceptable for use as concrete construction material were delineated within the study area. These deposits are all alluvial fan units (Aaf) and are confined to the east side of the valley. Their total areal extent is approximately 4 mi^2 (10.4 km^2). No concrete trial mixes were made, but gradation, abrasion, and soundness test results on samples from these deposits were generally within acceptable ranges as specified by ASTM standards and DARS requirements.

5.2.3 Class CC1 Sources

One basin-fill alluvial fan unit in the study area is classified as a potential source of concrete aggregates. The unit is correlated to the Class CA1 source based on geomorphological and compositional similarities. This deposit has a total areal extent of approximately 1.3 mi^2 (3.4 km^2).

5.2.4 Class CC2 Sources

Several alluvial units located along the east side of the valley are classified as potential sources of concrete aggregates. Units were correlated to Class CB sources on the basis of geomorphological and compositional similarities. They have a total areal extent of approximately 7 mi^2 (18.1 km^2).

6.0 RECOMMENDATIONS FOR FUTURE STUDIES

The conclusions of this Detailed Aggregate Resources Study of Delamar Valley, as enumerated in Section 5.0, are based on limited field and laboratory test results. However, the results presented in this report provide sufficient data for selecting potential borrow areas. After selection of the borrow areas, more extensive studies are required to further determine the characteristics of the aggregates.

6.1 SOURCES OF ROAD-BASE AGGREGATES

It is recommended that additional field exploration (backhoe or drilling) and detailed laboratory testing be performed. The laboratory tests should consist of sieve analysis, resistance to abrasion, CBR, and other appropriate tests as deemed necessary by the designers.

6.2 SOURCES OF CONCRETE AGGREGATES

It is recommended that additional field investigations (backhoe or drilling) and detailed laboratory testing be performed. The aggregate samples should be subjected to the following tests:

- Sieve Analysis;
- Resistance to Abrasion;
- Soundness;
- Specific Gravity and Absorption; and
- Petrographic Examination of Aggregates for Concrete.

In addition, the following detailed tests using concrete made from these aggregates should be performed:

- Compressive Strength;
- Splitting Tensile Strength;
- Flexural Strength;
- Shrinkage;

- o Thermal Expansion;
- o Modulus of Elasticity;
- o Potential Alkali-Silica Reactivity;
- o Potential Alkali-Carbonate Rock Reactivity; and
- o Resistance of Concrete to Rapid Freezing and Thawing.

It is recommended that concrete trial mixes with different size aggregates and admixtures be made in order to assess the variation in compressive strength, durability, shrinkage, and thermal properties of concrete.

Limited testing performed during the Delamar Verification studies (FN-TR-27-DM-I and II) indicate that the potential for sulfate attack of soils on concrete is "negligible." However, it is recommended that additional studies be made to further evaluate the potential for sulfate attack of soils on concrete and determine the type of cement to be used in concrete.

7.0 BIBLIOGRAPHY

American Concrete Association, 1975, Durability of concrete: American Concrete Institute Publication, SP-47, 385 p.

American Concrete Institute, 1977, Recommended practice for selecting proportions for normal and heavyweight concrete: American Concrete Institute, 20 p.

__________, 1978, Cement and concrete terminology: American Concrete Institute Publication, SP19, 50 p.

American Public Works Association, 1970, Standard specifications for public works construction: Part 2 - Construction Materials, Sec. 200 Rock Materials, p. 62-70.

American Society for Testing and Materials, 1975, Significance of tests and properties of concrete and concrete-making materials: American Society for Testing and Materials, Special Technical Publication No. 169-A, 571 p.

__________, 1978, Annual book of ASTM standards, Part 14; concrete and mineral aggregates: American Society for Testing and Materials, Part 14, 814 p.

__________, 1979, Annual book of ASTM standards, Concrete and Mineral Aggregates, American Society of Testing and Materials, Part 14, 826 p.

Bates, R. L., 1969, Geology of the industrial rocks and minerals: Dover Publications, Inc., New York, 459 p.

Blanks, R., and Kennedy, H., 1955, The technology of cement and concrete, v. 1: John Wiley & Sons, Inc., 422 p.

Borup, H. J., and Bagley, D. G., 1976, Soil survey of Meadow Valley area, Nevada-Utah, parts of Lincoln County, Nevada, and Iron County, Utah: U.S. Department of Agriculture, Soil Conservation Service, 174 p.

Brown, L., 1959, Petrography of cement and concrete: Portland Cement Research Department, Bulletin 111.

Carr, W. J., 1966, Geology and test potential of Timber Mountain Caldera area, Nevada: U.S. Geological Survey, Technical Letter NTS-174.

Erlin, B., 1966, Methods used in petrographic studies of concrete: Portland Cement Association, Research Department Bulletin 193, 17 p.

Freedman, S., 1971, High strength concrete: Portland Cement Association, Concrete Information Reprint, 17 p.

Fugro National, Inc., 1978, Aggregate resources report, Department of Defense and Bureau of Land Mangement lands, southwestern United States: Cons. Report for SAMSO, (FN-TR-20-D) 85 p.

_______________, Inc., 1980, Aggregate resources studies, Dry Lake Valley, Muleshoe Valley, Delamar Valley, Pahroc Valley, Nevada: Cons. Report for BMO, (FN-TR-37-a) 45 p.

_______________, Inc., 1981, Verification study, Delamar Val ley, Nevada: Cons. Report for BMO, v. I and II, (FN-TR-27-DM) 80 p. and 98 p.

Gile, L. H., 1961, A classification of Ca horizons in soils in a desert region, Dona Ana County, New Mexico: Soil Science Society America Procedures, v. 25, No. 1, p. 52-61.

Gile, L. H., Peterson, F. F., and Grossman, R. B., 1965, The K horizon of carbonate accumulation: Soil Science Society v. 99, p. 74-82.

Hadley, D. W., 1961, Alkali reactivity of carbonate rocks-expansion and dedolomitization: Research and Development Laboratories of the Portland Cement Association, Bulletin 139, p. 462-474.

_______________, 1964, Alkali reactivity of dolomitic carbonate rocks: Research and Development Laboratories of the Portland Cement Association, Bull. 176, 19 p.

_______________, 1968, Field and laboratory studies on the reactivity of sand-gravel aggregates: Research and Development Laboratories of the Portland Cement Association, Bulletin 221, p. 17-33.

Hose, R. K., Blake, M. C., Jr., and Smith, R., 1976, Geology and mineral resources of White Pine County, Nevada: Nevada Bureau of Mines and Geology, Bulletin 85, 105 p.

Howard, E. L., compiler, 1978, Geologic map of the eastern Great Basin, Nevada and Utah: Terra Scan Group LTD., 3 sheets.

Ketner, K. B., 1976, Map showing high-purity quartzite in California, Nevada, Utah, Idaho, and Montana: U.S. Geological Survey Map, MF-821.

Lerch, W., 1959, A cement-aggregate reaction that occurs with certain sand-gravel aggregates: Research and Development Laboratories of the Portland Cement Association, Bulletin 122, p. 42-50.

McKee, E. D., and Weir, G. W., 1953, Terminology for stratification and cross-stratification in sedimentary rocks: Geological Society America Bulletin, v. 64, p. 381-389.

Mielenz, R. C., 1980, Proposed test method for length-change of concrete due to alkali-carbonate rock reaction: Richard C. Mielenz, P. E., Inc., Materials and Petrography, Gates Mills, Ohio.

National Ready Mixed Concrete Association, 1961, Selection and use of aggregate for concrete: National Ready Mixed Concrete Association, Publication No. 101, p. 513 - 542.

National Sand & Gravel Association, 1977, Compilation of ASTM standards relating to sand, gravel and concrete: NSGA Circular No. 113, NRMCA Publication No. 137.

Nevada State Department of Highways, 1976, Standard specifications for road and bridge construction: State of Nevada Department of Highways, Section 704, p 819-822.

__________, No date, Materials and research laboratory, aggregate test data: Unpublished.

Office of State Inspector of Mines, 1977, Directory of Nevada mine operations active during calander year 1976: Nevada Industrial Commission, 59 p.

Papke, G. K., 1973, Industrial mineral deposits of Nevada: Nevada Bureau of Mines and Geology, map 46.

Pickett, G., 1956, Effect of aggregate on shrinkage of concrete and hypothesis concerning shrinkage: Portland Cement Association, Research Department, Bulletin 66, 5 p.

Steinour, H. H., 1960, Concrete mix water-how impure can it be? Research and Development Laboratories of the Portland Cement Association, Bulletin 119, p. 33-50.

Stewart, H., and Carlson, J. E., 1978, Geologic Map of Nevada: U.S. Geological Survey, scale 1:500,000.

Travis, R. B., 1955, Classification of rocks: Quarterly of the Colorado School of Mines, v. 50, No. 1, 98 p.

Tschantz, C. M., and Pampeyan, E. H., 1970, Geology and mineral deposits of Lincoln County, Nevada: Nevada Bureau of Mines, MacKay School of Mines, University of Nevada, Bulletin 73, 188 p.

U. S. Army Corps of Engineers, 1953, Test data, concrete aggregate in continental U.S.: U. S. Army Corps of Engineers v. 1, areas 2 and 3.

U. S. Army Corps of Engineers, 1977, Handbook for concrete and cement, method of test for coefficient of linear thermal expansion of concrete: Waterways Experiment Station, Vicksburg, Mississippi and U. S. Army Corps of Engineers, CRD-C39-55, Part I, 2 p.

U. S. Department of the Interior, 1966, Concrete Manual; A Manual for the Control of Concrete Construction: U. S. Department of the Interior, Bureau of Reclamation, 642 p.

__________, 1974a, The mineral industry of Nevada: U.S. Department of the Interior, Bureau of Mines.

__________, 1974b, Earth Manual: U. S. Department of the Interior, Bureau of Reclamation, 810 p.

__________, 1975a, Concrete Manual: Water Resources Technical Publication, 627 p.

__________, 1975b, Concrete Manual: U. S. Department of the Interior, Bureau of Reclamation, 627 p.

__________, Lower Colorado Regional Office, Nevada Aggregate Data, Unpublished.

U. S. Geological Survey, 1964, Mineral and water resources of Nevada: U. S. Government Printing Office, Washington, D.C., 314 p.

Voskuil, W. H., 1966, Selected readings in mineral economics: Nevada Bureau of Mines, Report 12, 18 p.

Waddell, J., 1976, Concrete inspection manual: International Conference of Building Officials, 332 p.

Womack, J. C., et al., 1963, Materials manual: California Highway Transporation Agency, v. I and II.

Personal Communication

Polivka, Milos, 1981, Consutling Civil Engineer, Berkely, California.

APPENDIX A

SUMMARY OF FIELD AND LABORATORY TEST DATA

FIELD AND LABORATORY TEST DATA

Field observations and laboratory test data on samples collected at selected stations are presented in Table A-1. Field stations were established at various locations throughout the study area where detailed descriptions of potential basin-fill and fine aggregate sources were recorded. Detailed explanations for the column headings of Table A-1 are as follows:

COLUMN HEADING	EXPLANATION
MAP NUMBER	Map numbers are sequentially arranged identifiers of field stations occupied during the course of the aggregate study.
FIELD STATION	These designations are internal DARS identifiers of all field stations. Each one consists of a two-letter valley abbreviation followed by the letter A (aggregate trench).
LOCATION	The location column lists the geographic portion of the valley in which the field station is located (e.g., NE-northeast).
GEOLOGIC UNIT	The geologic unit listed is a term used to differentiate basin-fill deposits based on geomorphology. A geologic unit cross reference, outlining all units used, is included as Table F-3.
MATERIAL DESCRIPTION	Material descriptions are based on either field or laboratory USCS classifications using appropriate ASTM standards for basin-fill deposits. Coarse and fine aggregate gradations used in concrete trial mix designs are included at the end of each concrete aggregate trench group.
USCS SYMBOL	Appropriate field or laboratory ASTM standards are used to classify sampled

material. The Unified Soil Classification System is used in this study. Table F-1 contains detailed information on the USCS.

FIELD OBSERVATIONS

Boulders and/or Cobbles — The estimated occurrence of boulders and cobbles is based on an appraisal of the entire deposit. Cobbles have an intermediate diameter of 3 to 12 inches (8 to 30 cm); boulders have an intermediate diameter of 12 inches (30 cm) or more. Because of sample-size limitations, boulders were not generally sampled. Cobbles were representatively sampled for concrete aggregate evaluations but only generally sampled for road-base aggregate evaluations. Field observations of boulders and cobbles are important considerations for in-situ gradations only. Number percentages are equated to the following equivalent dry weight terms:

Rare	-	1 - 4 percent
Few	-	5 - 20 percent
Some	-	> 20 percent

Gravel — Coarse aggregate particles that pass a 3-inch (76-mm) sieve but are predominantly retained on a No. 4 (4.75 mm) sieve.

Sand — Fine aggregate particles that almost entirely pass a No. 4 sieve but are predominantly retained on a No. 200 (0.075 mm) sieve.

Fines — Soil particles that pass a No. 200 sieve (silt and clay).

Overburden Thickness (Feet) — Surficial soil overlying a usable aggregate deposit. Material generally consists of silt and sand with low concentrations of gravel. Numbers presented indicate thickness of deposit in feet.

Total Trench Depth (Feet) — Depth, in feet, of trench excavation used to collect aggregate samples. Depth followed by the letter R indicates that depth below which soil strength exceeded excavation capability. The common conditions for refusal (R) are calcium carbonate accumulation (caliche) and/or presence of oversized material.

Deleterious Materials (Material/Depth/ Stage)	Deleterious materials are substances that are potentially detrimental to concrete in service. Substances that may be present include: organic impurities, low density materials (ash, vesicle , pumice, cinders), amorphous silica (opal, chert, chalcedony), volcanic glass, caliche and clay coatings, mica, gypsum, pyrite, chlorite, friable materials, and aggregates that may react chemically or be affected chemically by other external influences. The most common deleterious material is calcium carbonate accumulation (caliche). When it is abundant, the interval(s) at which it occurs and the stage of development (Table F-2) are listed. Caliche can occur disseminated throughout a deposit, as lenses, and as discrete layers. The depth space is left blank when caliche is present throughout the deposit.
Plasticity (Index)	Plasticity index (PI) is the range of water content, expressed as a percentage of the weight of the oven-dried soil (less than No. 40 sieve material), through which a soil behaves plastically . It is defined as the liquid limit minus the plastic limit. Field terms used to approximate plasticity index range include the following.

Plasticity	PI	Wet Consistency
Slight	(4-15)	Slightly sticky; after pressure, soil adheres to both thumb and finger but comes off cleanly. Does not appreciably stretch.
Medium	(15-30)	Sticky; after pressure, soil adheres to both thumb and finger and tends to stretch somewhat before pulling apart from either digit.
High	(>30)	Very sticky; after pressure, soil adheres strongly to both digits and is markedly stretched when digits are separated.

Hardness	Hardness determination is a field test used to identify materials that are soft or poorly bonded by estimating their resistance to crushing by impact with a

rock hammer. Classification terms used include:

Soft	Hammer point indents deeply with firm blow.
Moderately Hard	Hammer point indents only shallowly with firm blow.
Hard	Hammer breaks hand-held sample with one firm blow.
Very Hard	Hammer breaks intact sample with many blows.

Weathering — Weathering is defined as any changes in color, texture, strength, chemical composition, or other properties of rock due to the effects of various atmospheric conditions. Field terms used to classify degree of weathering include: fresh, slight(ly), moderate(ly), or very weathered.

LABORATORY TEST DATA

Sieve Analysis (ASTM C 136) — A sieve analysis is the determination of the proportions of particles existing within certain size ranges in granular material by separation on sieves of different size openings, expressed as a weight percent of the total sample. Numbers presented represent the percent of the sample passing through the stated sieve size. Sieve sizes include: 3-inch (75-mm), 2 1/2-inch (63-mm), 2-inch (50-mm), 1 1/2-inch (38.1-mm), 1-inch (25-mm), 3/4-inch (19-mm), 1/2-inch (12.5-mm), 3/8-inch (9.5-mm), No. 4 (4.75-mm), No. 8 (2.36-mm) No. 16 (1.18-mm) No. 30 (0.6-mm), No. 50 (0.3-mm), No. 100 (0.15-mm), No. 200 (0.075-mm).

Specific Gravity and Absorption (ASTM C 127 and 128) — In general, specific gravity is defined as the ratio of the weight in air of a unit volume of material to the weight in air of an equal volume of water. Absorption is the process by which a liquid is drawn into and tends to fill permeable pores in a porous solid body, also, the increase in weight of a porous solid body resulting from the penetration of a liquid into its permeable pores. Specific definitions of bulk, bulk saturate-surface-dry (SSD), and apparent specific gravity, as well as absorption are contained in ASTM-E 12-70 and C 125, respectively.

Fineness Modulus — Fineness modulus is an empirical factor obtained by adding the total percentages of a sample of aggregate, retained on each of a specified series of sieves, and dividing the sum by 100.

Unit Weight — Unit weight is the weight of a unit volume of dry, rodded aggregate, commonly expressed as pounds per cubic foot (pcf).

Abrasion Test (ASTM C 131) — The abrasion test is a method for testing resistance to wearing away by rubbing and friction, by placing a specified quantity of aggregates in a steel drum (the Los Angeles testing machine), rotating the drum 500 times, and determining the percent of material worn away.

Soundness Test (ASTM C 88) — Soundness tests are used to determine resistance to large or permanent volume changes of aggregates by placing samples in saturated solutions of magnesium or sodium sulfate. The test furnishes information useful in studying resistance to weathering action, particularly when adequate service records of the material tested are not available. For concrete aggregate tests, magnesium sulfate soundness tests are run first. If the material fails this test, sodium sulfate soundness tests are performed.

Petrographic Examination (ASTM C 295) — A petrographic examination is a procedure used to identify the physical and chemical properties of aggregates that have a bearing on the quality of the material in consideration of its intended use. Typical properties analyzed include: description and classification of constituents, relative amounts of constituents, particle coatings, rock type, particle condition and particle shape, texture and structure, color, mineral composition and heterogeneities, and presence of constituents known to cause deleterious chemical reactions in concrete.

Alkali Reactivity

Alkali-Silica ASTM C 227 — A potential alkali-silica reactivity test evaluates the susceptibility of cement-aggregate combinations to expansive reactions involving the alkalies sodium and potassium by measurement of the increase (or decrease) in length of mortar bars containing the combination during storage under prescribed conditions of test.

Alkali-Carbonate ASTM Proposed Standard — A potential alkali-carbonate reactivity test evaluates the susceptibility of cement-aggregate combinations to expansive reactions involving the carbonates of dolomite (in certain calcitic dolomites and dolomitic limestones) by measurement of the increase (or decrease) in length of concrete specimens (prisms) containing the combination during storage under prescribed conditions of test. This test is a proposed ASTM standard and has not been formally approved by the American Society of Testing and Materials.

AGGREGATE USE CLASSIFICATION

Road Base Aggregates

RBIa — Basin-fill or rock sources containing materials suitable for use as road-base aggregates; based on acceptable laboratory aggregate test results.

RBIb — Basin-fill sources containing materials suitable for use as road-base aggregates; based on correlation with Class RBIa areas.

RB II — Potential basin-fill sources of materials suitable for use as road-base aggregates; based on photogeologic interpretations, field observations, and limited or inconclusive sieve analysis and/or abrasion data.

<u>Concrete Aggregates</u>	CA1	Basin-fill or rock sources containing aggregates that produced trial mix concrete with 28-day compressive strengths equal to or greater than 6500 psi.
	CA2	Basin-fill or rock sources containing aggregates that produced trial mix concrete with 28-day compressive strengths less than 6500 psi.
	CB	Basin-fill or rock sources containing aggregates potentially suitable for use in concrete; based on acceptable laboratory aggregate test results.
	CC1	Basin-fill or rock sources containing aggregates potentially suitable for use in concrete; based on correlation with Class CA1 or CA2 source areas.
	CC2	Basin-fill sources containing aggregates potentially suitable for use in concrete; based on correlation with Class CB source areas.
	FA	Basin-fill sources containing fine aggregates used with crushed-rock samples for certain concrete trial mixes.

MAP NUMBER	FIELD STATION	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION	USCS SYMBOL	BOULDERS AND/ OR COBBLES	DISTRIBUTIO MATERIAL F THAN COBB (PERCENT) GRAVEL	SAND
201	DM-A-1	Delamar Valley, N	Aaf	Gravelly Sand	SP-SM	-/Rare	20	68
202	DM-A-2	Delamar Valley, N	Aaf	Gravelly Sand	SM	-/Rare	22	65
203	DM-A-3	Delamar Valley, N	Aaf	Sandy Gravel	GW-GM	-/Few		
204	DM-A-4	Delamar Valley, N	Aaf	Sandy Gravel	GP	-/Few		
205	DM-A-5	Delamar Valley, N	Aaf	Gravelly Sand	SP-SM	-/Few		
	DM-A(3, 4, 5)		Aaf	Sandy Gravel	GW-GM	- / -		
206	DM-A-6	Delamar Valley, C	Aaf	Gravelly Sand	SP	-/Rare		
207	DM-A-7	Delamar Valley, C	Aaf	Gravelly Sand	SP	-/Rare		
208	DM-A-8	Delamar Valley, C	Aaf	Gravelly Sand	SP	-/Few		
	DM-A-(6, 7, 8)		Aaf	Gravelly Sand	SP	- / -		
209	DM-A-9	Delamar Valley, E	Aaf	Gravelly Sand	SP-SM	- / -	28	64
210	DM-A-10	Delamar Valley, E	Aaf	Gravelly Sand	SP-SM	- / -	27	63
211	DM-A-11	Delamar Valley, C						

FIELD OBSERVATIONS												
BOULDERS AND/ OR COBBLES	DISTRIBUTION OF MATERIAL FINER THAN COBBLES (PERCENT)			OVERBURDEN THICKNESS (FEET)	TOTAL TRENCH DEPTH (FEET; R= REFUSAL DEPTH)	DELETERIOUS MATERIALS (MATERIAL/DEPTHS/ STAGE)	PLASTICITY	HARDNESS	WEATHERING			
	GRAVEL	SAND	FINES							3 IN.	2½ IN.	2 IN
/Rare	20	68	12	1.5	10.0(R)	Caliche/2-5/III	Slight					
/Rare	22	65	13	1.0	10.0(R)	Caliche/3.5-7.5/III	None					
/Few				0.0	13.5	Caliche/7-9/II	None			100	95.7	94.
/Few				0.0	13.0	Caliche/3-4.2, 7.5-9, 11-12/II	None			100	93.2	89.
/Few				0.0	9.0(R)	Caliche/ - /I, II	Slight			97.2	97.2	97.
/ -										100	97.8	95.
/Rare				1.0	14.0	Caliche/1-3.4/ II					100	97.
/Rare				1.0	13.0	Caliche/1-4.5/ II					100	98.
/Few				1.0	13.0	Caliche/1-4/ II				96.8	96.8	93.
/ -										100	98.7	97.
/ -	28	64	8	3.0	11.5	Caliche/3-7/ III						
/ -	27	63	10	1.5	10.5	Caliche/1.5-5.5/ III						
				1.0	2.5(R)	Caliche/1.5-2.5/ IV						

LABORATORY TE

SIEVE ANALYSIS, ASTM C 136 (PERCENT PASSING)													SPECIFIC GRAVITY AND ASTM C 127 AND				
													COARSE AGGREGATE				
													SPECIFIC GRAVITY			ABSORP. (PERCENT)	SPE
2 IN.	1½ IN.	1 IN.	¾ IN.	½ IN.	⅜ IN.	NO. 4	NO. 8	NO. 16	NO. 30	NO. 50	NO. 100	NO. 200	BULK	BULK SSD	APPARENT		BUL
94.1	91.0	82.1	76.2	69.0	63.4	50.1	39.1	29.0	21.2	15.2	10.9	7.8					
89.2	83.7	75.1	68.4	57.4	48.9	35.0	26.3	18.7	13.1	8.6	5.6	3.5					
97.2	95.2	91.1	86.9	78.9	73.6	56.9	44.3	32.9	24.7	18.4	13.8	10.5					
95.6	94.2	87.7	82.1	74.	67.9	53.5	39.9	29.4	21.8	15.9	11.6	8.2					
97.0	94.6	94.2	90.0	83.2	77.2	64.7	52.7	38.4	24.4	13.4	7.8	5.0					
98.8	97.9	93.7	89.2	83.8	78.7	66.8	54.0	35.9	19.8	10.0	5.9	4.2					
93.4	92.3	83.2	77.0	71.7	66.4	58.0	48.4	33.1	18.3	8.9	5.0	3.2					
97.1	96.7	93.2	89.7	83.5	77.2	64.5	52.0	34.9	19.5	9.8	5.6	3.8					

LABORATORY TEST DATA

SPECIFIC GRAVITY AND ABSORPTION, ASTM C 127 AND C 128 — E AGGREGATE — GRAVITY — LK D	APPARENT	ABSORP. (PERCENT)	FINE AGGREGATE — SPECIFIC GRAVITY — BULK	BULK SSD	APPARENT	ABSORP. (PERCENT)	FINENESS MODULUS (PERCENT)	UNIT WEIGHT (PCF)	ABRASION TEST ASTM C 131 (PERCENT WEAR)	SOUNDNESS TEST, ASTM C 88 (PERCENT LOSS) — COARSE AGGREGATE — $MgSO_4$	COARSE AGGREGATE — $NaSO_4$	FINE AGGREGATE — $MgSO_4$	FINE AGGREGATE — $NaSO_4$	PETRO… EXAM… ASTM…
									27.8	17.4		41.4		
									29.6					

T WEIGHT (PCF)	ABRASION TEST ASTM C 131 (PERCENT WEAR)	SOUNDNESS TEST, ASTM C 88 (PERCENT LOSS)				PETROGRAPHIC EXAMINATION ASTM C 295	ALKALI REACTIVITY		AGGREGATE USE CLASSIFICATION
		COARSE AGGREGATE		FINE AGGREGATE			SILICA METHOD, ASTM C 227 (LENGTH CHANGE, PERCENT)	CARBONATE METHOD, PROP. ASTM (LENGTH CHANGE, PERCENT)	
		$MgSO_4$	$NaSO_4$	$MgSO_4$	$NaSO_4$				
									RBIb,-
									RBIb,-
									RBIa,CB
									RBIa,CB
									RBIa,CB
	27.8	17.4		41.4					RBIa,CB
									RBIa,CB
									RBIa,CB
									RBIa,CB
	29.6								
									RBIa,CB

Ertec
The Earth Technology Corporation

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

SUMMARY OF FIELD AND LABORATORY TEST DATA
DELAMAR VALLEY, NEVADA

MAP NUMBER	FIELD STATION	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION	USCS SYMBOL	BOULDERS AND/ OR COBBLES	DISTRIBUTION MATERIAL FIN THAN COBBL (PERCENT)	
							GRAVEL	SAND
212	DM-A-12	Delamar Valley, C	Aaf					
213	DM-A-13	Delamar Valley, C	Aaf					
214	DM-A-14	Delamar Valley, C	Aaf					
215	DM-A-15	Delamar Valley, C						
216	DM-A-16	Delamar Valley, C	Aaf	Sandy Gravel	GP-GM	Some/ Some		
217	DM-A-17	Delamar Valley, C	Aaf	Sandy Gravel	GW-GM	-/Rare		
218	DM-A-18	Delamar Valley, C	Aaf	Sandy Gravel	GW-GM	-/Few		
219	DM-A-19	Delamar Valley, C	Aaf	Sandy Gravel	GP-GM	Few/ Few		
220	DM-A-20	Delamar Valley, C	Aaf	Sandy Gravel	GP-GM	Rare/ Few		
	DM-A-(16, 17,18,19,20)			1.5in-0.75				
	DM-A-(16, 17,18,19,20)			0.75in-No.4				
	DM-A-(16, 17,18,19,20)			Blend(1.5in-No.4)				
	DM-A-(16, 17,18,19,20)			No.4-No.200				

FIELD OBSERVATIONS													
OR COBBLES	DISTRIBUTION OF MATERIAL FINER THAN COBBLES (PERCENT)			OVERBURDEN THICKNESS (FEET)	TOTAL TRENCH DEPTH (FEET; R= REFUSAL DEPTH)	DELETERIOUS MATERIALS (MATERIAL/DEPTHS/ STAGE)	PLASTICITY	HARDNESS	WEATHERING				
	GRAVEL	SAND	FINES							3 IN.	2½ IN.	2 IN.	
				1.0	2.5(R)	Caliche/1.5-2.5/IV							
				1.0	2.5(R)	Caliche/1.5-2.5/IV							
				1.0	2.5(R)	Caliche/1.5-2.5/IV							
				0.0	4.0(R)	Caliche/3-4/IV							
e/ e				0.0	13.0	Caliche/ - /I	Slight			97.1	94.0	92.1	
are				3.0	12.5	Caliche/ - /I	Slight			95.2	88.9	88.9	
ew				1.5	13.0	Caliche/9-10/II	None				100	95.1	
/				1.0	14.0	Caliche/11-14/II	Slight			97.0	96.4	91.2	
e/				1.0	11.0(R)	Caliche/10-11/III	Slight			92.7	87.0	81.2	
												100	
												100	

LABORAT

SIEVE ANALYSIS, ASTM C 136 (PERCENT PASSING)															SPECIFIC GRAV ASTM C			
															COARSE AGGREGATE			
															SPECIFIC GRAVITY			ABSORP. (PERCENT)
3 IN.	2½ IN.	2 IN.	1½ IN.	1 IN.	¾ IN.	½ IN.	⅜ IN.	NO. 4	NO. 8	NO. 16	NO. 30	NO. 50	NO. 100	NO. 200	BULK	BULK SSD	APPARENT	
97.1	94.0	92.1	88.9	80.5	72.4	61.3	53.0	37.4	27.6	20.5	15.5	11.7	9.0	6.6				
95.2	88.9	88.9	83.7	75.4	69.6	60.1	54.9	42.3	31.3	23.1	17.6	13.2	10.2	7.4				
	100	95.1	90.4	83.3	76.9	65.7	58.6	41.9	31.0	22.9	17.4	13.1	10.1	7.4				
97.0	96.4	91.2	80.6	65.5	56.0	44.9	39.0	29.3	22.6	16.3	13.1	10.3	8.2	5.8				
92.7	87.0	81.2	76.2	68.5	60.9	54.1	49.2	37.4	28.8	22.3	18.0	14.5	12.1	6.0				
		100	98.5	55.2	4.9	1.0	0.8	0.6							2.69	2.70	2.73	0.
				100	98.3	74.1	53.1	7.0	0.6						2.61	2.65	2.73	1.
		100	99	78	52	38	27	4										
								100	83.6	56.5	36.0	20.8	10.9	3.9				

LABORATORY TEST DATA

SPECIFIC GRAVITY AND ABSORPTION, ASTM C 127 AND C 128							FINENESS MODULUS (PERCENT)	UNIT WEIGHT (PCF)	ABRASION TEST ASTM C 131 (PERCENT WEAR)	SOUNDNESS TEST, ASTM C 88 (PERCENT LOSS)				PET EX A
RSE AGGREGATE			FINE AGGREGATE							COARSE AGGREGATE		FINE AGGREGATE		
IC GRAVITY		ABSORP. (PERCENT)	SPECIFIC GRAVITY			ABSORP. (PERCENT)								
BULK SSD	APPAR-ENT		BULK	BULK SSD	APPAR-ENT					$MgSO_4$	$NaSO_4$	$MgSO_4$	$NaSO_4$	
2.70	2.73	0.6												Pe
2.65	2.73	1.7						98.6						Pe
								102.7	29.1			5.07		
			2.57	2.64	2.75	2.5	2.92					23.3	3.0	Pe

IGHT F)	ABRASION TEST ASTM C 131 (PERCENT WEAR)	SOUNDNESS TEST, ASTM C 88 (PERCENT LOSS)				PETROGRAPHIC EXAMINATION ASTM C 295	ALKALI REACTIVITY		AGGREGATE USE CLASSIFICATION
		COARSE AGGREGATE		FINE AGGREGATE			SILICA METHOD, ASTM C 227 (LENGTH CHANGE, PERCENT)	CARBONATE METHOD, PROP. ASTM (LENGTH CHANGE, PERCENT)	
		$MgSO_4$	$NaSO_4$	$MgSO_4$	$NaSO_4$				
									RBIa,CB
									RBIa,CB
									RBIa,CB
									RBIa,CB
									RBIa,CA1
									RBIa,CA1
									RBIa,CA1
									RBIa,CA1
									RBIa,CA1
						Performed			
6						Performed			
7	29.1			5.07			In Progress	In Progress	
				23.3	3.0	Performed		In Progress	

Ertec *The Earth Technology Corporation*

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

SUMMARY OF FIELD AND LABORATORY TEST DATA DELAMAR VALLEY, NEVADA

MAP NUMBER	FIELD STATION	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION	USCS SYMBOL	BOULDERS AND/ OR COBBLES	DISTRIBUTION OF MATERIAL FINER THAN COBBLES (PERCENT)		
							GRAVEL	SAND	FINES
221	DM-A-21	Delamar Valley, S	Aaf	Gravelly Sand	SW-SM	-/Rare			
222	DM-A-22	Delamar Valley, S	Aaf	Gravelly Sand	SP-SM	-/Rare			
223	DM-A-23	Delamar Valley, S	Aaf	Gravelly Sand	SW-SM	-/Rare			
	DM-A-(21, 22, 23)		Aaf	Gravelly Sand	SW-SM				
224	DM-A-24	Delamar Valley, S	Aaf	Gravelly Sand	SM	Few/ Some	35	50	15
225	DM-A-25	Delamar Valley, S	Aaf	Sandy Gravel	GP-GM	-/Few	50	40	10
226	DM-A-26	Delamar Valley, C	Aaf	Sandy Gravel	GP-GM	Few/ Some			
227	DM-A-27	Delamar Valley, C	Aaf	Sandy Gravel	GW-GM	Few/ Some			
228	DM-A-28	Delamar Valley, C	Aaf	Sandy Gravel	GP-GM	Rare/ Some			
	DM-A-(26, 27, 28)		Aaf	Sandy Gravel	GW-GM				
229	DM-A-29	Delamar Valley, NE	Aaf	Sandy Gravel	GW-GM	-/Few			
230	DM-A-30	Delamar Valley, NE	Aaf	Gravelly Sand	SW-SM	-/Rare			

FIELD OBSERVATIONS												
BOULDERS AND/OR COBBLES	DISTRIBUTION OF MATERIAL FINER THAN COBBLES (PERCENT)			OVERBURDEN THICKNESS (FEET)	TOTAL TRENCH DEPTH (FEET; R= REFUSAL DEPTH)	DELETERIOUS MATERIALS (MATERIAL/DEPTHS/ STAGE)	PLASTICITY	HARDNESS	WEATHERING			
	GRAVEL	SAND	FINES							3 IN.	2½ IN.	2 IN.
-/Rare				1.0	13.0	Caliche/12+ /II	Slight			97.7	96.5	96
-/Rare				1.0	13.0	Caliche/1-2.5/II	Slight			100	96.2	94
-/Rare				1.0	12.0	Caliche/ - /II,III	Slight				100	98
										100	97.0	94
Few/ Some	35	50	15	2.0	9.0	Caliche/2-4, 7-8/III	Slight					
-/Few	50	40	10	0.5	7.5	Caliche/0.5-3/II,III	Slight					
Few/ Some				1.0	13.0	Caliche/1-3/II				90.7	88.8	84
Few/ Some				2.0	13.0	Caliche/1-2/II				84.5	84.5	81
Rare/ Some				1.0	13.0	Caliche/1-2.5/II				95.9	94.2	91
										90.2	86.2	84
-/Few				0.0	13.0	Caliche/ - /I, II				96.9	96.9	92
-/Rare				0.0	13.0	Caliche/ - /I, II						100

LABOR

SIEVE ANALYSIS, ASTM C 136 (PERCENT PASSING)															SPECIFIC GR ASTM		
															COARSE AGGREGAT		
															SPECIFIC GRAVITY		
3 IN.	2½ IN.	2 IN.	1½ IN.	1 IN.	¾ IN.	½ IN.	⅜ IN.	NO. 4	NO. 8	NO. 16	NO. 30	NO. 50	NO. 100	NO. 200	BULK	BULK SSD	APPARENT
97.7	96.5	96.0	94.7	90.7	88.4	83.6	80.3	68.9	56.5	43.0	30.7	20.7	15.2	11.7			
100	96.2	94.1	93.4	91.4	89.1	84.8	76.4	64.1	51.2	36.1	22.9	13.4	8.5	5.6			
	100	98.0	93.4	88.7	86.9	82.3	77.8	62.4	48.5	33.4	20.8	11.9	7.7	5.7			
100	97.0	94.8	91.6	89.3	85.3	80.0	75.0	59.6	45.9	30.9	19.5	12.0	8.3	6.3			
90.7	88.8	84.2	78.1	72.6	67.3	60.5	54.7	42.2	31.6	21.3	13.9	8.1	4.9	3.2			
84.5	84.5	81.9	77.3	70.3	65.6	59.2	54.2	44.7	36.3	28.4	21.1	13.8	8.9	6.2			
95.9	94.2	91.7	86.7	77.3	70.5	62.9	57.2	47.3	39.0	29.9	21.3	13.3	8.2	5.7			
90.2	86.2	84.7	79.3	72.0	67.0	58.1	52.5	40.9	33.8	25.7	18.7	12.1	8.0	5.7			
96.9	96.9	92.5	89.7	80.5	75.0	66.6	60.2	46.5	37.9	30.1	23.3	17.0	12.3	8.2			
		100	98.6	96.1	93.0	87.2	79.6	64.3	48.2	32.3	20.4	12.9	8.8	6.2			

4 3

LABORATORY TEST DATA

SPECIFIC GRAVITY AND ABSORPTION, ASTM C 127 AND C 128							FINENESS MODULUS (PERCENT)	UNIT WEIGHT (PCF)	ABRASION TEST ASTM C 131 (PERCENT WEAR)	SOUNDNESS TEST, ASTM C 88 (PERCENT LOSS)				PETROG EXAMIN ASTM
AGGREGATE			FINE AGGREGATE							COARSE AGGREGATE		FINE AGGREGATE		
RAVITY		ABSORP. (PERCENT)	SPECIFIC GRAVITY			ABSORP. (PERCENT)								
K	APPARENT		BULK	BULK SSD	APPARENT					$MgSO_4$	$NaSO_4$	$MgSO_4$	$NaSO_4$	
									31.6	20.8		19.9		
									26.3	12.7		26.0		

EIGHT (F)	ABRASION TEST ASTM C 131 (PERCENT WEAR)	SOUNDNESS TEST, ASTM C 88 (PERCENT LOSS)				PETROGRAPHIC EXAMINATION ASTM C 295	ALKALI REACTIVITY		AGGREGATE USE CLASSIFICATION
		COARSE AGGREGATE		FINE AGGREGATE			SILICA METHOD, ASTM C 227 (LENGTH CHANGE, PERCENT)	CARBONATE METHOD, PROP. ASTM (LENGTH CHANGE, PERCENT)	
		$MgSO_4$	$NaSO_4$	$MgSO_4$	$NaSO_4$				
									RBIa,-
									RBIa,-
									RBIa,-
	31.6	20.8		19.9					
									RBII,-
									RBII,-
									RBIa,CB
									RBIa,CB
									RBIa,CB
	26.3	12.7		26.0					
									RBIa,CB
									RBIa,CB

Ertec
The Earth Technology Corporation

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

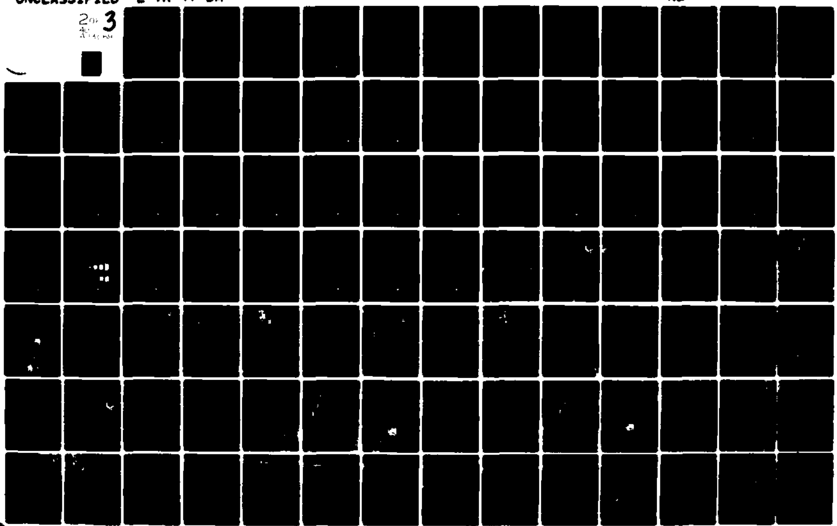
SUMMARY OF FIELD AND LABORATORY TEST DATA
DELAMAR VALLEY, NEVADA

29 MAY 81 TABLE A-1

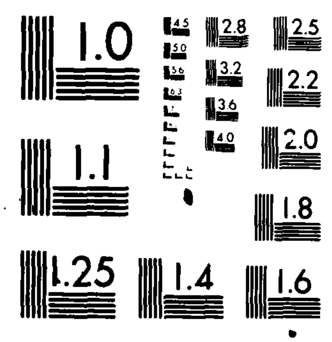
MAP NUMBER	FIELD STATION	LOCATION	GEOLOGIC UNIT	MATERIAL DESCRIPTION	USCS SYMBOL	BOULDERS AND/ OR COBBLES	DISTRIBUTIO[N OF] MATERIAL F[INER] THAN COBB[LES] (PERCEN[T])	
							GRAVEL	SAND
231	DM-A-31	Delamar Valley, NE	Aaf	Gravelly Sand	SW-SM	-/Rare		
	DM-A-(29, 30, 31)		Aaf	Sandy Gravel	GM			

AD-A113 069 ERTEC WESTERN INC LONG BEACH CA F/G 8/7
MX SITING INVESTIGATION. GEOTECHNICAL EVALUATION. DETAILED AGGR--ETC(U)
MAY 81 F04704-80-C-0006
UNCLASSIFIED E-TR-47-DM NL

2 OF 3



A11306



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

FIELD OBSERVATIONS								
(DI)STRIBUTION OF (M)ATERIAL FINER (T)HAN COBBLES (PERCENT)			OVERBURDEN THICKNESS (FEET)	TOTAL TRENCH DEPTH (FEET; R= REFUSAL DEPTH)	DELETERIOUS MATERIALS (MATERIAL/DEPTHS/ STAGE)	PLASTICITY	HARDNESS	WEATHERING
GRAVEL	SAND	FINES						
			0.0	13.0	Caliche/ - /I,II			

LABORATORY TE

	SIEVE ANALYSIS, ASTM C 136 (PERCENT PASSING)													SPECIFIC GRAVITY AND ASTM C 127 AND				
														COARSE AGGREGATE				
														SPECIFIC GRAVITY			ABSORP. (PERCENT)	SPE
	2 IN.	1½ IN.	1 IN.	¾ IN.	½ IN.	⅜ IN.	NO. 4	NO. 8	NO. 16	NO. 30	NO. 50	NO. 100	NO. 200	BULK	BULK SSD	APPAR-ENT		BULK
	100	98.2	93.0	86.9	80.2	72.0	57.2	42.8	29.6	20.3	13.8	9.7	6.8					
	98.6	96.5	92.3	87.6	80.3	73.0	57.4	49.8	39.7	30.9	23.7	19.2	15.8					

LABORATORY TEST DATA

SPECIFIC GRAVITY AND ABSORPTION, ASTM C 127 AND C 128							FINENESS MODULUS (PERCENT)	UNIT WEIGHT (PCF)	ABRASION TEST ASTM C 131 (PERCENT WEAR)	SOUNDNESS TEST, ASTM C 88 (PERCENT LOSS)				PE EX
SE AGGREGATE			FINE AGGREGATE							COARSE AGGREGATE		FINE AGGREGATE		
C GRAVITY		ABSORP. (PERCENT)	SPECIFIC GRAVITY			ABSORP. (PERCENT)								
ULK SSD	APPAR-ENT		BULK	BULK SSD	APPAR-ENT					$MgSO_4$	$NaSO_4$	$MgSO_4$	$NaSO_4$	
									31.8					

T	ABRASION TEST ASTM C 131 (PERCENT WEAR)	SOUNDNESS TEST, ASTM C 88 (PERCENT LOSS)				PETROGRAPHIC EXAMINATION ASTM C 295	ALKALI REACTIVITY		AGGREGATE USE CLASSIFICATION
		COARSE AGGREGATE		FINE AGGREGATE			SILICA METHOD, ASTM C 227 (LENGTH CHANGE, PERCENT)	CARBONATE METHOD, PROP. ASTM (LENGTH CHANGE, PERCENT)	
		$MgSO_4$	$NaSO_4$	$MgSO_4$	$NaSO_4$				
									RBIa,CB
	31.8								

Ertec *The Earth Technology Corporation*

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

SUMMARY OF FIELD AND LABORATORY TEST DATA
DELAMAR VALLEY, NEVADA

APPENDIX B

SUMMARY OF FIELD PETROGRAPHIC AND GRAIN-SIZE ANALYSES

FIELD PETROGRAPHIC AND GRAIN-SIZE ANALYSES

Field petrographic observations are presented in Table B-1. Field stations were established at various locations throughout the study area where detailed petrographic descriptions of potential basin-fill sources of aggregates were recorded. Detailed explanations for the column headings of Table B-1 are as follows:

COLUMN HEADING	EXPLANATION
MAP NUMBER	Map numbers are sequentially arranged identifiers of field petrographic stations occupied during the course of the aggregate study.
FIELD STATION	These designations are internal DARS identifiers of field petrographic designations.
LOCATION	The location column lists the geographic portion of the valley in which the field station is located (e.g., NE-northeast).
GEOLOGIC UNIT	The geologic unit listed is a term used to differentiate basin-fill deposits based on geomorphology. A geologic unit cross reference, outlining all units used, is included as Table F-3.
FIELD OBSERVATIONS	
Clast Count	Clast or petrographic counts are the main data collected during the field petrographic analysis. Data collected include lithology and percent present by size. Categorization by lithology is done to determine general percentages of nondeleterious and deleterious materials.
Other Deleterious Clasts Present	This column is reserved for recording additional types of materials present that are of poor quality for use as aggregate. Items mentioned include samples of rock types not sieved, counted, and described under clast count, such as: amorphous silica

	(chert, opal, chalcedony), volcanic glass, mica, chlorite, friable materials, low density clasts (ash, vesicles, pumice, cinders), gypsum, pyrite, organic material, and coatings (clay and caliche).
<u>Size Distribution</u>	The estimated occurrence of boulders and cobbles is based on the appraisal of an entire deposit only if the materials are observed in the banks of prominent stream channels. Size distribution information for gravel was generally recorded only at trench locations. Any gravel values given are expressed as a percent of the total amount of less than 3.0-inch material present. The numeral zero is used to indicate a size fraction not observed, and the letter R is used to indicate the rare occurrence of a size fraction (one to four percent).
<u>Gradation</u>	Gradation information was recorded at trench locations only.
<u>Maximum Particle Size</u>	Maximum particle size is defined as the intermediate diameter length of the most frequently occurring clast present in a deposit (in centimeters). Erratic oversized materials (boulders, large cobbles) are generally not represented as the maximum particle size.
<u>Particle Shape</u>	Shape of clasts are classified into the following six categories.
Angular (ANG)	Particles have sharp edges and relatively plane sides with unpolished surfaces.
Sub-angular (SA)	Particles are similar to angular but have somewhat rounded edges.
Sub-rounded (SR)	Particles exhibit nearly plane sides but have well-rounded corners and edges.
Rounded (R)	Particles have smoothly curved sides and no edges.
Platey (P)	Particles are thin and flat with either rounded or nonrounded corners and edges.
Elongate (E)	Particles are several times longer than they are wide with rounded corners and edges.

Remarks

This column is used to describe the general site location of petrographic field stations; location terms used include: surface, shallow wash, stream channel bank or bottom, borrow pit, and road cut. Surface indicates analysis was performed on top of the stated geologic unit. Shallow wash indicates analysis was performed on top of the unit but at the bottom of a small swale. Stream channel bank or bottom indicates analysis was performed in an exposed section (incision) or within a minor stream channel deposit, respectively.

MAP NUMBER	FIELD STATION	LOCATION	GEOLOGIC UNIT	CLAST COUNT, > 1 IN. TO ≤ 3 IN. DIAME							
				NON-DELETERIOUS							
				Qtz	Ls	Do	Gr	Vu	Vb	CALI-CHE	C
301	DM-1	Delamar Valley, N	Aaf					68	18		
302	DM-2	Delamar Valley, N	Aaf		10	40	48				
303	DM-3	Delamar Valley, N	Aaf		20	54		6			
304	DM-4	Delamar Valley, N	Aaf		2			44	46		
305	DM-5	Delamar Valley, C	Aaf					66	14	2	
306	DM-6	Delamar Valley, C	Aaf		6	16		12	24		
307	DM-7	Delamar Valley, N	Aaf					74	22		
308	DM-8	Delamar Valley, N	Aaf	12	18	34		16	10		
309	DM-9	Delamar Valley, N	Aaf	10	40	30		8	4		
310	DM-10	Delamar Valley, C	Aaf	2				82	4		
311	DM-11	Delamar Valley, C	Aaf								
312	DM-12	Delamar Valley, C	Aaf								

FIELD OBSERVATIONS

TO ≤ 3 IN. DIAMETER (PERCENT)						CLAST COUNT, > ½ IN. TO ≤ 1 IN. DIAMETER (PERCENT)											
	DELETERIOUS					NON-DELETERIOUS						DELETERIOUS					D
Vb	CALICHE	CHERT	TUFF	GLASS	OTHER	Qtz	Ls	Do	Gr	Vu	Vb	CALICHE	CHERT	TUFF	GLASS	OTHER	CL
18			14						4	44	22			30			Ch Vo
			2				18	30		36				12		4	
					20		42	30		12						16	Ca
46			8				2			44	54						Ca
14	2		16		2					62	22		2	14			
24			42				20	18		36	10	2		14			Ca
22			4							74	16			10			Fr De
10					10	2	52	28		10	2					6	
4			4		4	6	44	24		4	6			10		6	
4			12							66	14			20			Vo Pu
						2	8	4		58	12	2		14			
						2	6			66	10			16			Ca

S	OTHER	OTHER DELETERIOUS CLASTS PRESENT	SIZE DISTRIBUTION: PERCENT OF TOTAL: BOULDERS	SIZE DISTRIBUTION: PERCENT OF TOTAL: COBBLES	SIZE DISTRIBUTION: < 3" %: GRAVEL	GRADATION	MAXIMUM PARTICLE SIZE (CM)	PARTICLE SHAPE	REMARKS
		Chert, Volc. Glass	0	R			11	SA,SR	Shallow Wash
	4						14	SA	Shallow Wash
	16	Caliche					8	SA,SR,PL	Stream Channel
		Caliche					15	SA	
			0	R			11	SA,SR	
		Caliche					9	SA,SR,R	Shallow Wash
		Friable Low Density Mat'l					8	A,SA,SR,PL	
	6						7	SA,PL	Shallow Wash
	6						5	SA,SR,PL	Shallow Wash
		Volc. Glass, Pumice					4	SA,SR,R	
		Caliche					2	SA,SR	

Ertec
The Earth Technology Corporation

MX SITING INVES
DEPARTMENT OF TH
BMO/AFRC

SUMMARY OF FIELD PETROGRA
AND GRAIN-SIZE ANALYSE
DELAMAR VALLEY, NEVAD

29 MAY 81 TABLE B-1

...ER ...RIOUS ...RESENT	SIZE DISTRIBUTION: PERCENT OF TOTAL: BOULDERS	SIZE DISTRIBUTION: PERCENT OF TOTAL: COBBLES	SIZE DISTRIBUTION: < 3" %: GRAVEL	GRADATION	MAXIMUM PARTICLE SIZE (CM)	PARTICLE SHAPE	REMARKS
...ass	0	R			11	SA,SR	Shallow Wash
					14	SA	Shallow Wash
					8	SA,SR,PL	Stream Channel
					15	SA	
	0	R			11	SA,SR	
					9	SA,SR,R	Shallow Wash
Low Mat'l					8	A,SA,SR,PL	
					7	SA,PL	Shallow Wash
					5	SA,SR,PL	Shallow Wash
...lass,					4	SA,SR,R	
					2	SA,SR	

MAP NUMBER	FIELD STATION	LOCATION	GEOLOGIC UNIT	CLAST COUNT, $>$ 1 IN. TO $\leq$ 3 IN. DIAME							
				NON-DELETERIOUS							
				Qtz	Ls	Do	Gr	Vu	Vb	CALI-CHE	CH
313	DM-13	Delamar Valley, E	Aaf								
314	DM-14	Delamar Valley, C	Aaf								
315	DM-15	Delamar Valley, E	Aaf	64				10	18	4	
316	DM-16	Delamar Valley, C	Aaf	90					10		
317	DM-17	Delamar Valley, C	Aaf	40	4			42	10		
318	DM-18	Delamar Valley, C	Aaf		10	28			44	18	
319	DM-19	Delamar Valley, C	Aaf	40	4			20	34	2	
320	DM-20	Delamar Valley, C	Aaf	40	6	4		22	20	8	
321	DM-21	Delamar Valley, C	Aaf	92					2	6	
322	DM-22	Delamar Valley, C	Aaf	22	56	18		4			
323	DM-23	Delamar Valley, C	Aaf	22	62	12				4	
324	DM-24	Delamar Valley, C	Aaf	24	56	12				2	
325	DM-25	Delamar Valley, C	Aaf		18	4		68	2		

FIELD OBSERVATIONS

≤ 3 IN. DIAMETER (PERCENT)						CLAST COUNT, > ½ IN. TO ≤ 1 IN. DIAMETER (PERCENT)											OT DELE CLASTS
	DELETERIOUS					NON-DELETERIOUS						DELETERIOUS					
Vb	CALI-CHE	CHERT	TUFF	GLASS	OTHER	Qtz	Ls	Do	Gr	Vu	Vb	CALI-CHE	CHERT	TUFF	GLASS	OTHER	
										62	16			22			
						8	26			40	16			10			Calich
18	4		4			38				36	22			2		2	Calich
10						94					6						
10					4	42				28	18	2		10			Calich
44	18					12	46	8		14	18			2			Calich
34	2					52	12			8	20	8					Calich
20	8					50	2	2		28	8	10					Calich
2	6					100											Calich
						44	44	4		8							Calich
	4					40	32	14		2		12					Calic
	2				6	40	42	2		10		4				2	Calich
2			8			4	40	6		40	10						Calich

ER	OTHER DELETERIOUS CLASTS PRESENT	SIZE DISTRIBUTION: PERCENT OF TOTAL		< 3" %	GRADATION	MAXIMUM PARTICLE SIZE (CM)	PARTICLE SHAPE	REMARKS
		BOULDERS	COBBLES	GRAVEL				
						3	SA,SR	
	Caliche					3	SA,SR	
	Caliche					40	SA,SR	
						20	SA,SR	Surface
	Caliche					8	SA,SR	Stream Channel, Bank
	Caliche					10	SA,SR	
	Caliche					7	A,SA	Surface
	Caliche					10	SA	Stream Channel, Bank
	Caliche					11	A,SA	Stream Channel, Bank
	Caliche					11	A,SA	Stream Channel, Bank
	Caliche					8	SA,SR	Stream Channel, Bank
	Caliche					7	A,SA	Stream Channel
	Caliche					14	SA,SR	Shallow Wash

Ertec
The Earth Technology Corporation

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

SUMMARY OF FIELD PETROGRAPHIC
AND GRAIN-SIZE ANALYSES
DELAMAR VALLEY, NEVADA

MAP NUMBER	FIELD STATION	LOCATION	GEOLOGIC UNIT	CLAST COUNT, > 1 IN. TO ≤ 3 IN. DIAM						
				NON-DELETERIOUS						
				Qtz	Ls	Do	Gr	Vu	Vb	CALICHE
326	DM-26	Delamar Valley, C	Aaf	2	74	24				
327	DM-27	Delamar Valley, S	Aaf		32	6		60		
328	DM-28	Delamar Valley, S	Aaf			2		70	12	
329	DM-29	Delamar Valley, S	Aaf			2		98		
330	DM-30	Delamar Valley, S	Aaf	2	26	4		66	2	
331	DM-31	Delamar Valley, S	Aaf		10			82	4	
332	DM-32	Delamar Valley, S	Aaf		30	8		44	6	
333	DM-33	Delamar Valley, S	Aaf	18	4			66	8	
334	DM-34	Delamar Valley, C	Aaf	22	48	18		8	2	
335	DM-35	Delamar Valley	Aaf	86	2			6	6	
336	DM-36	Delamar Valley, N	Aaf		28			68	4	
337	DM-37	Delamar Valley, NE	Aaf					98	2	

FIELD OBSERVATIONS

1 IN. TO ≤ 3 IN. DIAMETER (PERCENT)							CLAST COUNT, > ½ IN. TO ≤ 1 IN. DIAMETER (PERCENT)										
US		DELETERIOUS					NON-DELETERIOUS						DELETERIOUS				
Vu	Vb	CALICHE	CHERT	TUFF	GLASS	OTHER	Qtz	Ls	Do	Gr	Vu	Vb	CALICHE	CHERT	TUFF	GLASS	OTHER
							4	82	8				6				
60				2			2	28	12		58						
70	12			16				2			80	4			14		
98											98				2		
66	2						20	14	6		46	4			10		
82	4			4			6				80				14		
44	6			12			2	16	6		72				4		
66	8			4				20	8		72						
8	2		2				6	66	6		22						
6	6						52				28	10			10		
68	4							16			82	2					
98	2										98		2				

ATIONS

RCENT) ERIOUS F	GLASS	OTHER	OTHER DELETERIOUS CLASTS PRESENT	SIZE DISTRIBUTION PERCENT OF TOTAL BOULDERS	COBBLES	<3" % GRAVEL	GRADATION	MAXIMUM PARTICLE SIZE (CM)	PARTICLE SHAPE	REMARKS
			Caliche					19	A,SA	Stream Channel,Bank
			Caliche					18	SA,SR	Stream Channel,Botto
			Caliche					5	SA,SR	Stream Channel,Botto
			Caliche					4	SA,SR	Stream Channel,Botto
			Caliche					4	SA,SR	Stream Channel,Bank
			Caliche					7		Shallow Wash
			Caliche					5	SA,SR	Stream Channel,Bank
			Caliche					10	A,SA	Stream Channel
			Caliche					10		Stream Channel,Bank
			Caliche					12	SR	Shallow Wash
			Caliche					7	SA,SR	Shallow Wash
			Caliche					7		Shallow Wash

Ertec
The Earth Technology Corporation

MX SITI
DEPARTM

SUMMARY OF FIELD PE
AND GRAIN-SIZE A
DELAMAR VALLEY,

29 MAY 81 TABLE B-1

OTHER LETERIOUS STS PRESENT	SIZE DISTRIBUTION			GRADATION	MAXIMUM PARTICLE SIZE (CM)	PARTICLE SHAPE	REMARKS
	PERCENT OF TOTAL		< 3" %				
	BOUL-DERS	COB-BLES	GRA-VEL				
iche					19	A,SA	Stream Channel,Bank
iche					18	SA,SR	Stream Channel,Bottom
iche					5	SA,SR	Stream Channel,Bottom
iche					4	SA,SR	Stream Channel,Bottom
iche					4	SA,SR	Stream Channel,Bank
iche					7		Shallow Wash
iche					5	SA,SR	Stream Channel,Bank
che					10	A,SA	Stream Channel
che					10		Stream Channel,Bank
che					12	SR	Shallow Wash
che					7	SA,SR	Shallow Wash
che					7		Shallow Wash

Ertec
The Earth Technology Corporation

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

SUMMARY OF FIELD PETROGRAPHIC
AND GRAIN-SIZE ANALYSES
DELAMAR VALLEY, NEVADA

29 MAY 81 TABLE B-1

APPENDIX C

TRENCH LOGS

Ertec

EXPLANATION OF TRENCH LOGS

Trench logs were completed for excavated trenches. Each log presented in this appendix is chosen from a group of trench logs so that it represents the general aggregate conditions and properties of that entire group. Occasionally, the full compliment of trenches in a group was not excavated due to low gravel percentages and/or advanced caliche development found in the first one or two trenches of that group. Detailed explanations of the trench logs headings are as follows:

COLUMN HEADING		EXPLANATION
BULK SAMPLE		Representative samples were obtained by channel sampling a trench wall. Overburden and, in some trenches, dense caliche layers were avoided during the sampling procedure.
	II -	100 lb. sample (2 bags) for road-base aggregate testing.
	III -	400 lb. sample (55 gallon barrel) for concrete aggregate testing.
DEPTH		Depth corresponds to depth below ground surface in meters and feet.
LITHOLOGY		Graphic representation of soil types present in excavation.
USCS		Unified Soil Classification System symbols. For detailed information see Table F-1.
CONSISTENCY		The consistency of the in-situ deposit was estimated by visual observation of the soil in the trench walls, ease (or difficulty) of excavation of the trench, and trench-wall stability. Consistency descriptions of coarse-grained soils (GW, GP, GM, GC, SW, SP, SM, SC) are as follows:
		DESCRIPTION
Very Loose (VL)		Will not hold vertical cut (when dry).

<u>Loose (L)</u> — Will hold vertical cut, but caves if disturbed.

<u>Medium Dense (MD)</u> — Holds vertical cut, even when disturbed; easily excavated.

<u>Dense (D)</u> — Holds vertical cut, difficult to excavate.

<u>Very Dense (VD)</u> — Very difficult to impossible to excavate.

SOIL DESCRIPTION — Except in cases where samples were classified based on laboratory data, the descriptions are based on visual classification. The procedures outlined in ASTM D 2487-69, Classification of Soils for Engineering Purposes and D 2488-69, Description of Soils (Visual-Manual Procedure) were followed. Solid lines across the column indicate known changes in the strata at the depth shown.

Definitions of some of the terms and criteria used to describe soils and conditions encountered during the excavation follow:

<u>Descriptive Name</u> — Name of soil, as determined by USCS, preceded by an adjective indicating the size range of the most abundant secondary material present.

<u>Particle Size</u> — For coarse-grained soils (sands and gravels) the size range of the particles visible to the unaided eye was estimated as fine, medium, coarse, or a combined range (e.g., fine to medium). These terms approximately correspond to the following sieve sizes:

Gravel	Fine	No. 4 to 0.75-inch sieve
	Coarse	0.75-inch to 3-inch sieve
Sand	Fine	No. 200 to No. 40 sieve
	Medium	No. 40 to No. 10 sieve
	Coarse	No. 10 to No. 4 sieve

<u>Particle Shape</u> — See Appendix B explanation pages.

<u>Gradation</u> — Gradations listed are those determined from percent amounts of boulders, cobbles, and gravel present. Descriptive terms used include: poor and well.

<u>Poor(ly)</u>	Predominantly one size or a range of sizes, with some intermediate sizes missing.
<u>Well</u>	Wide range in grain sizes present, with substantial amounts of most intermediate sizes.
<u>Secondary Material</u>	Percentage present by dry weight. Trace 5-12 percent Little 13-20 percent Some > 20 percent (e.g., <u>Some</u> slightly plastic <u>silt</u>)
<u>Plasticity of Fines</u>	See Appendix A explanation pages
<u>HCL Reaction</u>	As an aid for identifying calcium carbonate coatings and cementation, soil samples were tested in the field for their reaction to dilute hydrochloric acid. The intensity of the HCL reaction was described as none, weak, or strong.
<u>Caliche</u>	Caliche is a term applied to calcareous material of secondary accumulation. In this study, the definition includes both the soluble calcium (and other) salts and the clastic material (gravel, sand, silt or clay) in which the salts exist. See Table F-2 for a description of the stages of caliche development.
<u>Cobbles and Boulders</u>	See Appendix A explanation pages.
<u>Lithology</u>	The various rock types found in an excavated deposit are listed in order of decreasing abundance.
<u>Remarks</u>	This column was provided for comments regarding difficulty of excavation, caliche development, and backhoe refusal. Refusal indicates the inability of a JCB 3DIII backhoe (Case 680 equivalent) with a 2-foot wide bucket to excavate a trench to completion.
SIEVE ANALYSIS	The numbers cited represent the percentage by dry weight of each of the following soil components.

GR	Coarse aggregate particles that pass a 3-inch (75 mm) sieve but are predominantly retained on a No. 4 (4.75 mm) sieve.
SA	Fine aggregate particles that almost entirely pass a No. 4 sieve but are predominantly retained on a No. 200 (0.075 mm) sieve.
FI	Soil particles that pass a No. 200 sieve (silt and clay).

All percentages shown on logs are the result of laboratory testing.

BULK SAMPLE	DEPTH METERS	DEPTH FEET	LITHOLOGY	USCS	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS GR	SIEVE ANALYSIS SA	SIEVE ANALYSIS FI
	0	0–2		SM	loose	SILTY SAND, fine to coarse, subangular to subrounded, poorly graded; some slightly plastic silt; little fine to coarse, subrounded gravel. - OVERBURDEN				
	1	2–4		SM	dense	GRAVELLY SAND, fine to medium, subangular to subrounded, poorly graded; some fine to coarse, subangular to subrounded gravel; little slightly plastic silt; strong HCl reaction; rare cobble; stage III caliche; predominantly volcanics, minor limestone, dolomite				
	2–3	4–10		SP-SM	medium dense; very dense	GRAVELLY SAND, fine to coarse, subrounded to rounded, poorly graded; some fine to coarse, subangular to rounded gravel; trace non - plastic silt; strong HCl reaction; some stage II caliche; rare cobble; predominantly intermediate volcanics, some limestone and dolomite.	refusal			
		10				TOTAL DEPTH 10.0 ft.(3.0m)				

Depth scale: Meters 0, 1, 2, 3, 4, 5, 6; Feet 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20

TRENCH DETAILS

SURFACE ELEVATION	: 5620 ft.(1713 m)
DATE EXCAVATED	: 17 October 1980
SURFACE GEOLOGIC UNIT	: Aafs
TRENCH LENGTH	: 15.ft (4.6m)
TRENCH ORIENTATION	: N - S

Ertec The Earth Technology Corporation

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

TRENCH LOG OF DM-A-1
DELAMAR VALLEY, NEVADA

29 MAY 81

FIGURE C-1

BULK SAMPLE	DEPTH (METERS / FEET)	LITHOLOGY	USCS	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS GR	SA	FI
	0 / 0, 2, 1, 4, 6, 2		GW-GM	loose to medium dense	SANDY GRAVEL, fine to coarse, subrounded, poorly graded; some fine to coarse, subrounded sand; trace non-plastic silt; strong HCl reaction; few cobbles; volcanics, limestone/dolomite.		50	42	8
	8		SM	medium dense	SILTY SAND, stage II caliche throughout				
	3, 10, 12, 4		GM	medium dense	SANDY GRAVEL, fine to coarse, subrounded, poorly graded; some fine to coarse, subrounded sand; little non - plastic silt; strong HCl reaction; few cobbles; volcanics, limestone/dolomite.	Note: Bedrock encountered at 9.0' at trench DM-A-5.			
	14, 16, 5, 18, 6, 20				TOTAL DEPTH 13.5 ft.(4.1m)				

TRENCH DETAILS

SURFACE ELEVATION : 5560 ft.(1695m)
DATE EXCAVATED : 17 October 1980
SURFACE GEOLOGIC UNIT : Aafg
TRENCH LENGTH : 13 ft.(4.0m)
TRENCH ORIENTATION : E-W

Ertec
The Earth Technology Corporation

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

TRENCH LOG OF DM-A-3
DELAMAR VALLEY, NEVADA

29 MAY 81 FIGURE C-2

BULK SAMPLE	DEPTH METERS	DEPTH FEET	LITHOLOGY	USCS	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS GR	SA	FI
	0	0		SM	loose	SILTY SAND - OVERBURDEN				
		2		SM	dense	GRAVELLY SAND, fine to coarse, subangular to subrounded, poorly graded; some fine to coarse subangular to subrounded gravel; little silt; strong HCl reaction; stage II caliche throughout; volcanics, little limestone/dolomite.				
	1, 2, 3	4, 6, 8, 10, 12		SP-SM	medium dense	GRAVELLY SAND, fine to coarse, subangular to subrounded, poorly graded; some fine to coarse, subangular to subrounded gravel; trace silt; strong HCl reaction; trace stage I caliche from 3.5' to 5.0'; rare cobble; predominantly volcanics, little limestone/dolomite.		35	60	5
	4, 5, 6	14, 16, 18, 20				TOTAL DEPTH 13.0 ft.(4.0m)				

TRENCH DETAILS

SURFACE ELEVATION	: 5560 ft.(1695m)
DATE EXCAVATED	: 18 October 1980
SURFACE GEOLOGIC UNIT	: Aafg
TRENCH LENGTH	: 15 ft.(4.6m)
TRENCH ORIENTATION	: E - W

Ertec
The Earth Technology Corporation

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

TRENCH LOG OF DM-A-6
DELAMAR VALLEY, NEVADA

29 MAY 81

FIGURE C-3

BULK SAMPLE	DEPTH METERS	DEPTH FEET	LITHOLOGY	USCS	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS GR	SA	FI
	0	0–3		SM	loose	GRAVELLY SAND, fine to coarse, subrounded, poorly graded; some fine to coarse, subrounded gravel; little silt. - OVERBURDEN				
	1–2	3–7		SM	dense	GRAVELLY SAND, fine to coarse, subangular to subrounded, poorly graded; some fine to coarse, subangular to subrounded gravel; little silt; strong HCl reaction; stage III caliche throughout.				
	2–3	7–11.5		SP	medium dense	GRAVELLY SAND, fine to coarse, subangular to subrounded, poorly graded; some fine to coarse, subangular to subrounded gravel; strong HCl reaction; stage II caliche from 10' to 11'; intermediate volcanics, quartzite, dolomite.	caliche layer			
						TOTAL DEPTH 11.5 ft.(3.5m)				

TRENCH DETAILS

SURFACE ELEVATION : 5745 ft.(1751m)
DATE EXCAVATED : 18 October 1980
SURFACE GEOLOGIC UNIT : Aaig
TRENCH LENGTH : 15 ft.(4.6m)
TRENCH ORIENTATION : N - S

Ertec
The Earth Technology Corporation

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

TRENCH LOG OF DM-A-9
DELAMAR VALLEY, NEVADA

29 MAY 81

FIGURE C-4

E-TR-47-DM

BULK SAMPLE	DEPTH METERS	DEPTH FEET	LITHOLOGY	USCS	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS GR	SA	FI
	0	0		GP-GM	medium dense	SANDY GRAVEL; some sand; trace silt; some cobbles and few boulders.				
			—	—	very dense	Stage IV caliche, backhoe refusal at approximately 2.0' on all trenches.				
		2				TOTAL DEPTH 2.0 ft.(0.6m)				

TRENCH DETAILS

SURFACE ELEVATION : 5400 ft.(1646m)
DATE EXCAVATED : 18 October 1980
SURFACE GEOLOGIC UNIT : Aaf
TRENCH LENGTH : 10 ft.(3.0m)
TRENCH ORIENTATION : NW - SE to E - W

Ertec
The Earth Technology Corporation

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

TRENCH LOG OF DM-A-(11-15)
DELAMAR VALLEY, NEVADA

29 MAY 81

FIGURE C-6

Depth (m)	Depth (ft)	USCS	Consistency	Soil Description	Remarks	Sieve Analysis GR	SA	FI
0	0	SM	loose	GRAVELLY SAND, silty - OVERBURDEN				
		GP-GM	medium dense	SANDY GRAVEL, fine to coarse, subrounded, poorly graded; some fine to coarse, subrounded sand; trace non - plastic silt; strong HCl reaction; few cobbles; dolomite, limestone, quartzite, minor volcanics.		58	35	7
		SM	dense	GRAVELLY SAND, stage II - III caliche throughout.				
	10	GP-GM	medium dense	SANDY GRAVEL, fine to coarse, subrounded, poorly graded; some fine to coarse, subrounded sand; trace non - plastic silt; strong HCl reaction; few cobbles; dolomite/limestone, quartzite, minor volcanics.		62	31	7
4				TOTAL DEPTH 13.0 ft.(4.0m)				

Bulk samples taken: 1.5–9 ft and 10–13 ft.

TRENCH DETAILS

SURFACE ELEVATION : 4990 ft. (1521m)
DATE EXCAVATED : 18 October 1980
SURFACE GEOLOGIC UNIT : Aafg
TRENCH LENGTH : 15 ft. (4.6m)
TRENCH ORIENTATION : E - W

Ertec — The Earth Technology Corporation

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

TRENCH LOG OF DM-A-18
DELAMAR VALLEY, NEVADA

29 MAY 81 FIGURE C-6

BULK SAMPLE	DEPTH METERS	DEPTH FEET	LITHOLOGY	USCS	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS GR	SA	FI
	0	0		SM	loose	SILTY SAND - OVERBURDEN				
				SP-SM	medium dense	GRAVELLY SAND, fine to coarse, subangular to subrounded, poorly graded; some fine to coarse, subangular to subrounded gravel; trace slightly plastic silt; strong HCl reaction; some stage II to III caliche in lenses; rare cobble; predominantly volcanics, some limestone/dolomite.		38	56	6
		12				TOTAL DEPTH 12.0 ft. (3.7m)				

Depth scale: METERS 0, 1, 2, 3, 4, 5, 6; FEET 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20

TRENCH DETAILS

SURFACE ELEVATION	:	5070 ft. (1546m)
DATE EXCAVATED	:	19 October 1980
SURFACE GEOLOGIC UNIT	:	Aafg
TRENCH LENGTH	:	16 ft. (4.9m)
TRENCH ORIENTATION	:	E - W

Ertec
The Earth Technology Corporation

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

TRENCH LOG OF DM-A-23
DELAMAR VALLEY, NEVADA

29 MAY 81

FIGURE C-7

BULK SAMPLE	DEPTH METERS	DEPTH FEET	LITHOLOGY	USCS	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS GR	SIEVE ANALYSIS SA	SIEVE ANALYSIS FI
	0	0–2		SM	loose	SILTY SAND, fine to medium, subangular to subrounded, poorly graded; some medium plastic silt; little fine to coarse, subrounded gravel. - OVERBURDEN				
	1	2–4		SM	very dense	GRAVELLY SAND, stage III caliche throughout; some cobbles and boulders.				
	2	4–9		SM	medium dense	GRAVELLY SAND, fine to medium, subrounded, poorly graded; some fine to coarse, subrounded gravel; little slightly plastic silt; strong HCl reaction; stage III caliche from 7' to 8'; some cobbles, few boulders; volcanics, limestone/dolomite, intrusive igneous rock.	caliche layer			
						TOTAL DEPTH 9.0 ft. (2.7m)				

Depth scale: meters 0, 1, 2, 3, 4, 5, 6; feet 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20.

TRENCH DETAILS

SURFACE ELEVATION : [illegible] ft. (1612m)
DATE EXCAVATED : 19 October 1980
SURFACE GEOLOGIC UNIT : Aafg
TRENCH LENGTH : 10 ft. (3.0m)
TRENCH ORIENTATION : E - W

Ertec
The Earth Technology Corporation

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

TRENCH LOG OF DM-A-24
DELAMAR VALLEY, NEVADA

29 MAY 81

FIGURE C-8

E-TR-47-DM

BULK SAMPLE	DEPTH (METERS)	DEPTH (FEET)	LITHOLOGY	USCS	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS GR	SA	FI
	0	0		SM	loose	SILTY SAND - OVERBURDEN				
		2		SM	dense	SILTY SAND, stage II caliche throughout - OVERBURDEN				
	1–4	4–12		GP-GM	medium dense	SANDY GRAVEL, fine to coarse, subrounded to rounded, poorly graded; some fine to coarse, subrounded to rounded sand; trace slightly plastic silt; strong HCl reaction; trace stage I caliche; some cobbles, rare boulder; limestone/dolomite, quartzite, volcanics.		51	43	6
	4–6	14–20				TOTAL DEPTH 13.0 ft. (4.0m)				

TRENCH DETAILS

SURFACE ELEVATION : 5085 ft. (1550m)
DATE EXCAVATED : 19 October 1980
SURFACE GEOLOGIC UNIT : Aafg
TRENCH LENGTH : 15 ft. (4.6m)
TRENCH ORIENTATION : E - W

Ertec
The Earth Technology Corporation

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

TRENCH LOG OF DM-A-28
DELAMAR VALLEY, NEVADA

29 MAY 81

FIGURE C-8

E-TR-47-DM

BULK SAMPLE	DEPTH METERS	DEPTH FEET	LITHOLOGY	USCS	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS GR	SA	FI
	0–4	0–13.0		SW-SM	medium dense	GRAVELLY SAND, fine to coarse, subrounded, well graded; some fine to coarse, subrounded to rounded gravel; trace slightly plastic silt; strong HCl reaction; some stage I caliche; rare cobble; limestone/dolomite, volcanics.		43	50	7
						TOTAL DEPTH 13.0 ft.(4.0m)				

TRENCH DETAILS

SURFACE ELEVATION : 5060 ft. (1538m)
DATE EXCAVATED : 20 October 1980
SURFACE GEOLOGIC UNIT : Aafg
TRENCH LENGTH : 15 ft. (4.6m)
TRENCH ORIENTATION : SW - NE

Ertec
The Earth Technology Corporation

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

TRENCH LOG OF DM-A-31
DELAMAR VALLEY, NEVADA

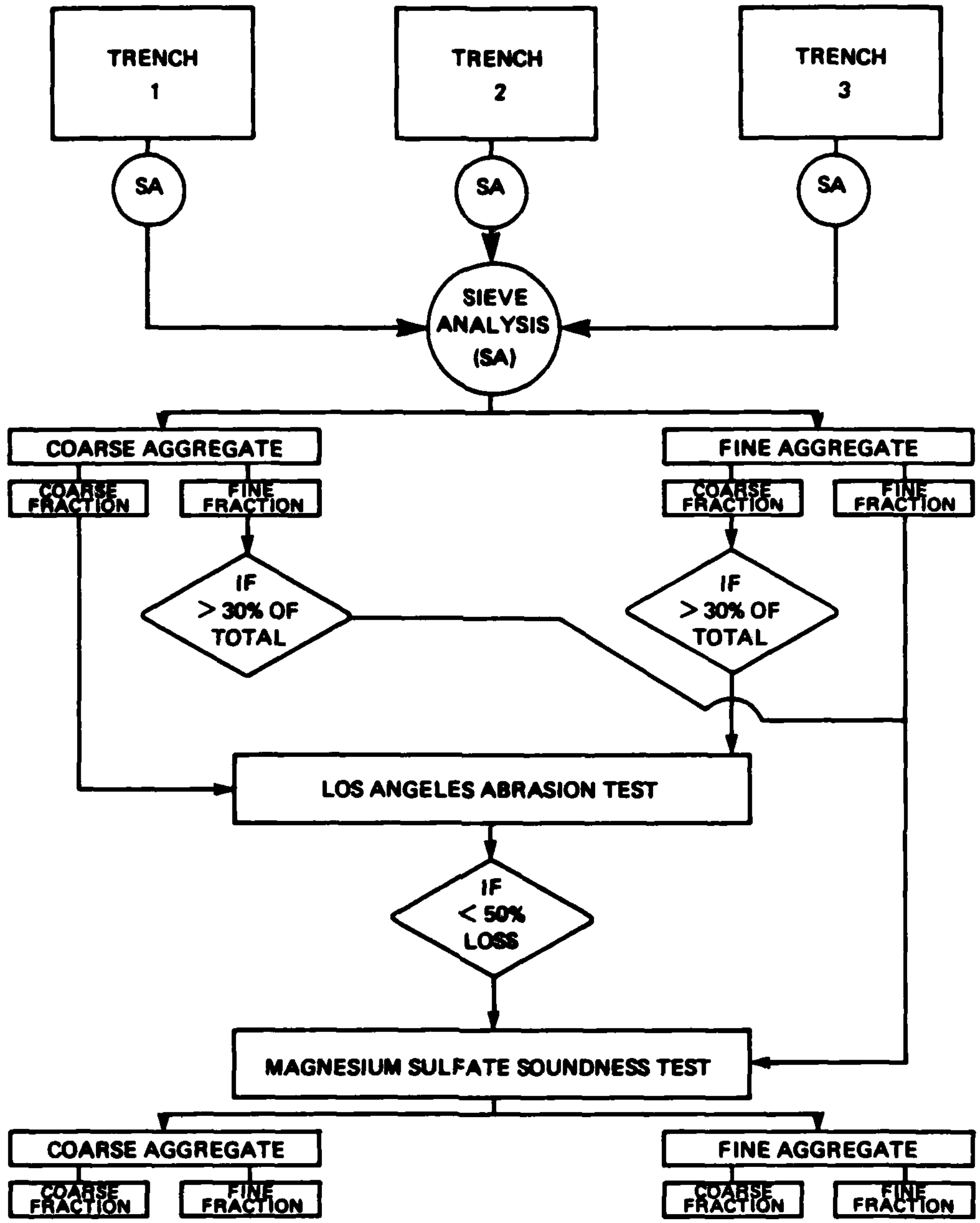
29 MAY 81

FIGURE C-10

APPENDIX D

FLOW DIAGRAM - ROAD-BASE AGGREGATES TESTING

FLOW DIAGRAM - CONCRETE TRIAL MIX DESIGN AND TESTING



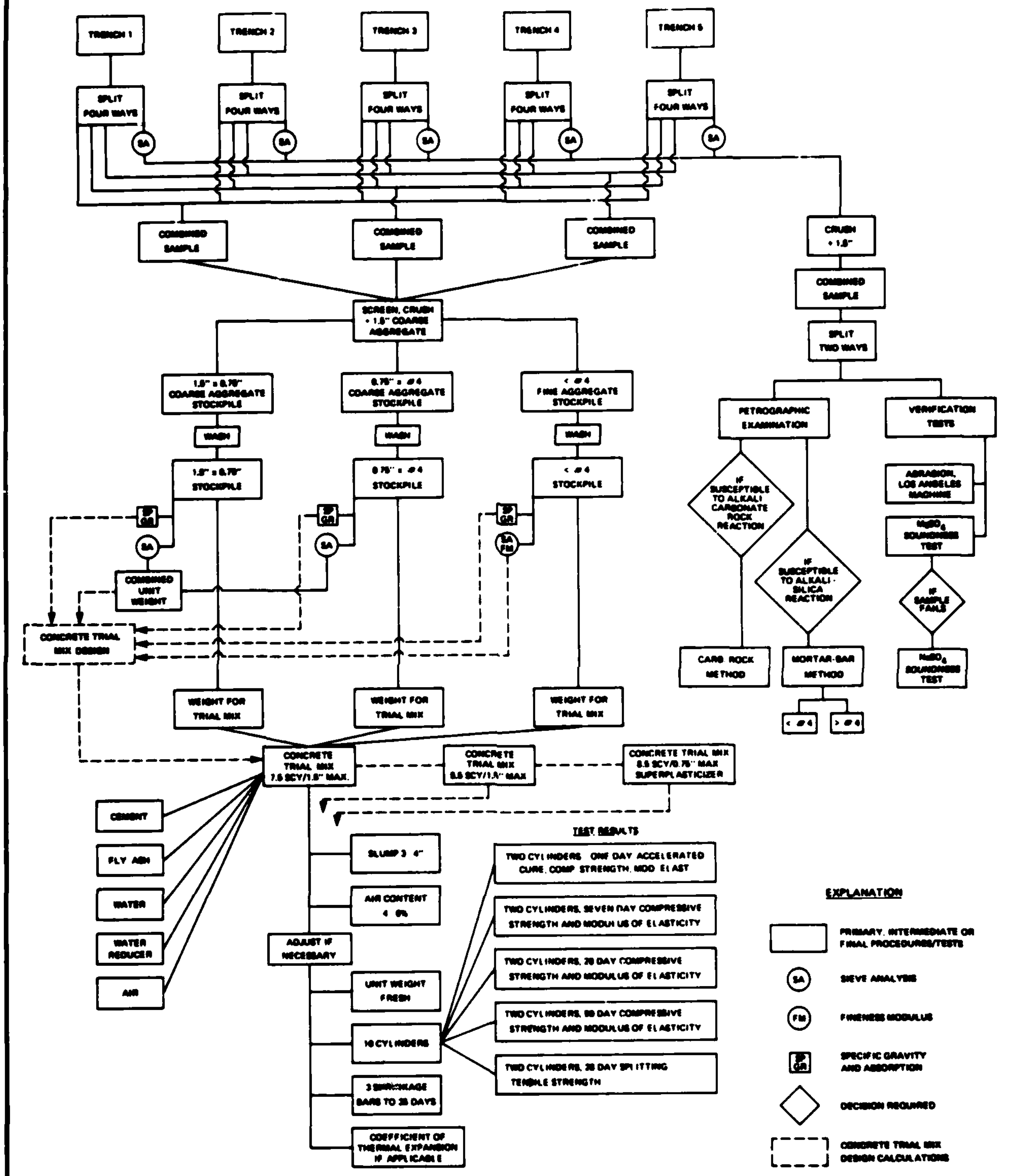
Ertec
The Earth Technology Corporation

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

FLOW DIAGRAM —
ROAD BASE AGGREGATES
TESTING

29 MAY 81

FIGURE D-1



Ertec
The Earth Technology Corporation

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

FLOW DIAGRAM – CONCRETE TRIAL MIX DESIGN AND TESTING

29 MAY 81

FIGURE D-2

APPENDIX E

CHEMICAL ANALYSES OF CEMENT, FLY ASH, AND WATER USED IN CONCRETE TRIAL MIXES

	PROPERTY ANALYZED	TOTAL PERCENTAGE OF SAMPLE	MINIMUM OR MAXIMUM REQUIREMENTS
CEMENT ASTM C 150, TYPE II	SiO_2	26.8	20.0 MIN.
	AL_2O_3	1.95	6.0 MAX.
	Fe_2O_3	2.71	6.0 MAX.
	MgO	1.57	6.0 MAX.
	ALKALIES (Na_2O + 0.658 K_2O)	0.53	0.60 MAX.
	LOSS ON IGNITION	0.56	3.0 MAX.
	SO_3	1.97	3.0 MAX.
	INSOLUBLE RESIDUE	0.61	0.75 MAX.
FLY ASH ASTM C 618, CLASS F	SiO_2	67.7	–
	AL_2O_2	17.2	–
	Fe_2O_3	8.34	–
	TOTAL	93.24	70.0 MIN.
	MgO	1.69	5.0 MAX.
	SO_3	0.14	5.0 MAX.
	Na_2O (OPTIONAL)	1.68	1.5 MAX.
	MOISTURE	0.08	3.0 MAX.
	LOSS ON IGNITION	0.63	12.0 MAX.
WATER CALIF. DEPT. TRANS. SEC. 90 - 2.03	pH	7.5	–
	COLOR	0 - 5	–
	SO_4	8 ppm	1300 ppm
	Cl	10.6 ppm	650 ppm
	OIL AND GREASE	NONE	NONE

Ertec
The Earth Technology Corporation

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

CHEMICAL ANALYSES OF CEMENT, FLY ASH, AND WATER USED IN CONCRETE TRIAL MIXES

29 MAY 81

TABLE E-1

APPENDIX F

UNIFIED SOIL CLASSIFICATION SYSTEM

SUMMARY OF CALICHE DEVELOPMENT

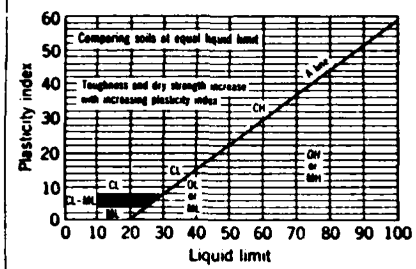
ERTEC WESTERN GEOLOGIC UNIT CROSS REFERENCE

Major Divisions			Field Identification Procedures (Excluding particles larger than 3 in. and basing fractions on estimated weights)	Group Symbols [a]	Typical Names	Information Required for Describing Soils	Laboratory Classification Criteria	
Coarse-grained soils. More than half of material is *larger* than No. 200 sieve size[b] (The No. 200 sieve size is about the smallest particle visible to naked eye)	Gravels. More than half of coarse fraction is larger than No. 4 sieve size (For visual classification, the ¼ in. size may be used as equivalent to the No. 4 sieve size)	Clean gravels (little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes	*GW*	Well graded gravels, gravel-sand mixtures, little or no fines	Give typical name; indicate approximate percentages of sand and gravel; maximum size; angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information; and symbols in parentheses	Determine percentages of gravel and sand from grain size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size) coarse grained soils are classified as follows: Less than 5% *GW, GP, SW, SP*; More than 12% *GM, GC, SM, SC*; 5% to 12% *Borderline* cases requiring use of dual symbols	$C_U = \frac{D_{60}}{D_{10}}$ Greater than 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			Predominantly one size or a range of sizes with some intermediate sizes missing	*GP*	Poorly graded gravels, gravel-sand mixtures, little or no fines			Not meeting all gradation requirements for *GW*
		Gravels with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures see *ML* below)	*GM*	Silty gravels, poorly graded gravel-sand-silt mixtures	For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics		Atterberg limits below "A" line, or *PI* less than 4 — Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols
			Plastic fines (for identification procedures, see *CL* below)	*GC*	Clayey gravels, poorly graded gravel-sand-clay mixtures			Atterberg limits above "A" line, with *PI* greater than 7
	Sands. More than half of coarse fraction is smaller than No. 4 sieve size	Clean sands (little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes	*SW*	Well graded sands, gravelly sands, little or no fines	Example: *Silty sand*, gravelly; about 20% hard, angular gravel particles ½-in. maximum size; rounded and subangular sand grains coarse to fine, about 15% non-plastic fines with low dry strength; well compacted and moist in place; alluvial sand; (*SM*)		$C_U = \frac{D_{60}}{D_{10}}$ Greater than 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			Predominantly one size or a range of sizes with some intermediate sizes missing	*SP*	Poorly graded sands, gravelly sands, little or no fines			Not meeting all gradation requirements for *SW*
		Sands with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures, see *ML* below)	*SM*	Silty sands, poorly graded sand-silt mixtures			Atterberg limits below "A" line or *PI* less than 5 — Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols
			Plastic fines (for identification procedures, see *CL* below)	*SC*	Clayey sands, poorly graded sand-clay mixtures			Atterberg limits below "A" line with *PI* greater than 7

Identification Procedures on Fraction Smaller than No. 40 Sieve Size

Major Divisions		Dry Strength (crushing characteristics)	Dilatancy (reaction to shaking)	Toughness (consistency near plastic limit)	Group Symbols	Typical Names	Information Required for Describing Soils
Fine-grained soils. More than half of material is *smaller* than No. 200 sieve size	Silts and clays liquid limit less than 50	None to slight	Quick to slow	None	*ML*	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity	Give typical name; indicate degree and character of plasticity, amount and maximum size of coarse grains; colour in wet condition, odour if any, local or geologic name, and other pertinent descriptive information, and symbol in parentheses
		Medium to high	None to very slow	Medium	*CL*	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
		Slight to medium	Slow	Slight	*OL*	Organic silts and organic silt-clays of low plasticity	For undisturbed soils add information on structure, stratification, consistency in undisturbed and remoulded states, moisture and drainage conditions
	Silts and clays liquid limit greater than 50	Slight to medium	Slow to none	Slight to medium	*MH*	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	
		High to very high	None	High	*CH*	Inorganic clays of high plasticity, fat clays	Example: *Clayey silt*, brown; slightly plastic; small percentage of fine sand; numerous vertical root holes; firm and dry in place; loess; (*ML*)
		Medium to high	None to very slow	Slight to medium	*OH*	Organic clays of medium to high plasticity	
Highly Organic Soils		Readily identified by colour, odour, spongy feel and frequently by fibrous texture			*Pt*	Peat and other highly organic soils	

Use grain size curve in identifying the fractions as given under field identification



Plasticity chart
for laboratory classification of fine grained soils

From Wagner, 1957.
[a] *Boundary classifications*. Soils possessing characteristics of two groups are designated by combinations of group symbols. For example *GW-GC*, well graded gravel-sand mixture with clay binder.
[b] *All sieve sizes on this chart are U.S. standard.*

Field Identification Procedure for Fine Grained Soils or Fractions

These procedures are to be performed on the minus No. 40 sieve size particles, approximately 1/64 in. For field classification purposes, screening is not intended, simply remove by hand the coarse particles that interfere with the tests.

Dilatancy (Reaction to shaking):
After removing particles larger than No. 40 sieve size, prepare a pat of moist soil with a volume of about one-half cubic inch. Add enough water if necessary to make the soil soft but not sticky.
Place the pat in the open palm of one hand and shake horizontally, striking vigorously against the other hand several times. A positive reaction consists of the appearance of water on the surface of the pat which changes to a livery consistency and becomes glossy. When the sample is squeezed between the fingers, the water and gloss disappear from the surface, the pat stiffens and finally it cracks or crumbles. The rapidity of appearance of water during shaking and of its disappearance during squeezing assist in identifying the character of the fines in a soil.
Very fine clean sands give the quickest and most distinct reaction whereas a plastic clay has no reaction. Inorganic silts, such as a typical rock flour, show a moderately quick reaction.

Dry Strength (Crushing characteristics):
After removing particles larger than No. 40 sieve size, mould a pat of soil to the consistency of putty, adding water if necessary. Allow the pat to dry completely by oven, sun or air drying, and then test its strength by breaking and crumbling between the fingers. This strength is a measure of the character and quantity of the colloidal fraction contained in the soil. The dry strength increases with increasing plasticity.
High dry strength is characteristic for clays of the CH group. A typical inorganic silt possesses only very slight dry strength. Silty fine sands and silts have about the same slight dry strength, but can be distinguished by the feel when powdering the dried specimen. Fine sand feels gritty whereas a typical silt has the smooth feel of flour.

Toughness (Consistency near plastic limit):
After removing particles larger than the No. 40 sieve size, a specimen of soil about one-half inch cube in size, is moulded to the consistency of putty. If too dry, water must be added and if sticky, the specimen should be spread out in a thin layer and allowed to lose some moisture by evaporation. Then the specimen is rolled out by hand on a smooth surface or between the palms into a thread about one-eight inch in diameter. The thread is then folded and re-rolled repeatedly. During this manipulation the moisture content is gradually reduced and the specimen stiffens, finally loses its plasticity, and crumbles when the plastic limit is reached.
After the thread crumbles, the pieces should be lumped together and a slight kneading action continued until the lump crumbles.
The tougher the thread near the plastic limit and the stiffer the lump when it finally crumbles, the more potent is the colloidal clay fraction in the soil. Weakness of the thread at the plastic limit and quick loss of coherence of the lump below the plastic limit indicate either inorganic clay of low plasticity, or materials such as kaolin-type clays and organic clays which occur below the A-line.
Highly organic clays have a very weak and spongy feel at the plastic limit.

Ertec
The Earth Technology Corporation

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

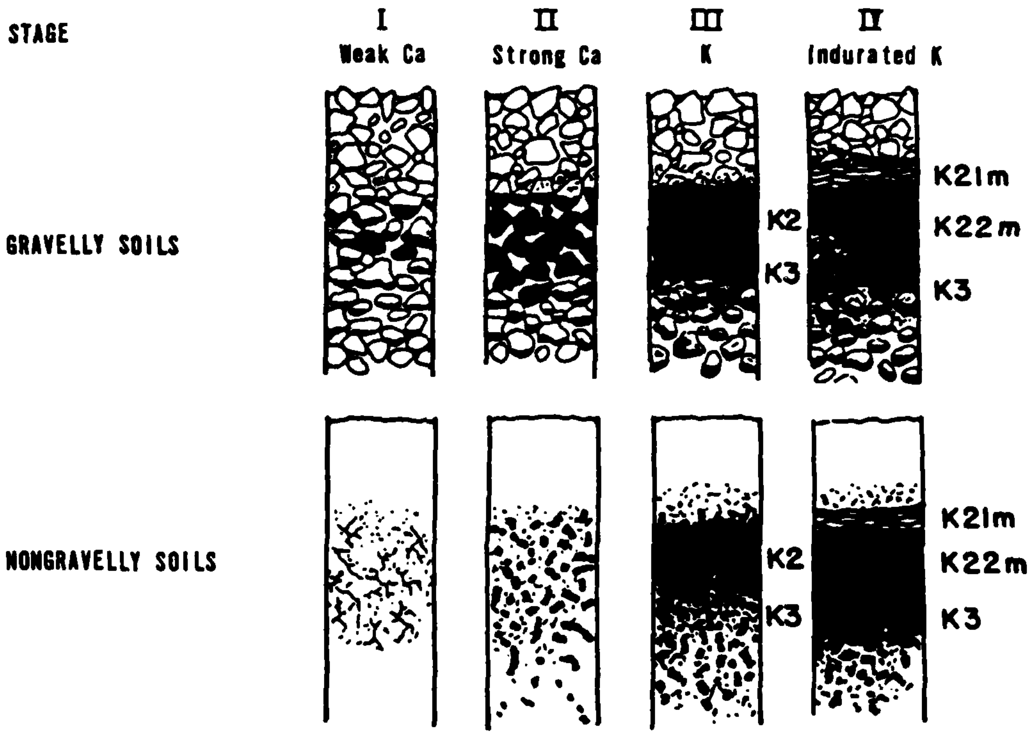
UNIFIED SOIL CLASSIFICATION SYSTEM

29 MAY 81

TABLE F-1

DIAGNOSTIC CARBONATE MORPHOLOGY

STAGE	GRAVELLY SOILS	NONGRAVELLY SOILS
I	Thin, discontinuous pebble coatings	Few filaments or faint coatings
II	Continuous pebble coatings, some interpebble fillings	Few to abundant nodules, flakes, filaments
III	Many interpebble fillings	Many nodules and internodular fillings
IV	Laminar horizon overlying plugged horizon	Laminar horizon overlying plugged horizon



Stages of development of a caliche profile with time. Stage I represents incipient carbonate accumulation, followed by continuous build-up of carbonate until, in Stage IV, the soil is completely plugged.

Reference: Gile, L.G. Peterson, F.F., and Grossman, R.B., 1965, The K horizon: A master horizon of carbonate accumulation: Soil Science, v. 99, p. 74-82.

Ertec — The Earth Technology Corporation	MX SITING INVESTIGATION DEPARTMENT OF THE AIR FORCE BMO/AFRCE-MX

SUMMARY OF CALICHE DEVELOPMENT

29 MAY 81 TABLE F-2

UARSA POTENTIAL AGGREGATE SOURCE SYMBOLS	ERTEC WESTEN GENERAL GEOLOGIC UNIT EXPLANATION	
		ROCK
		Shown in regions where rock is exposed, the areally predominant (greater than 70 percent) rock type is indicated. In those areas where two rock types occur the predominant rock type is shown followed by the subordinate rock type (e.g. S_{2} / I_{4}). Rock may be subdivided into bedrock (R).
	I	IGNEOUS (UNDIFFERENTIATED): Rocks formed by solidification of a molten or partially molten mass.
GR	I_1	Intrusive: Plutonic rocks formed by solidification of molten material beneath the surface (e.g. granite, granodiorite, diorite, gabbro).
Vu	I_2	Extrusive (intermediate and acidic): Volcanic rocks of intermediate and acidic composition formed by solidification of molten material at or near the surface (e.g. rhyolite, latite, dacite, andesite).
Vb	I_3	Extrusive (basic): Volcanic rocks of basic composition, generally formed by solidification of molten materials at or near the surface (e.g. basalt).
Vu	I_4	Extrusive (pyroclastic): Rocks formed by accumulation of volcanic ejecta (e.g. ash, tuff, welded tuff, agglomerate).
Su	S	SEDIMENTARY (UNDIFFERENTIATED): Rocks formed by accumulation of clastic solids, organic solids and/or chemically precipitated minerals.
Su, Qtz	S_1	Arenaceous and/or Siliceous Rocks: Composed of sand size particles (e.g. sandstone, orthoquartzite) or of cryptocrystalline silica (e.g. agate, chert).
Ls, Do, Cau	S_2	Carbonate Rocks: Composed predominantly of calcium carbonate detritus or chemical precipitates (e.g. limestone, dolomite, chalk).
	S_3	Argillaceous Rocks: Composed of clay and silt-sized particles (e.g. siltstone, shale, claystone).
	S_4	Evaporite Rocks: Precipitated from solution as a result of evaporation (e.g. halite, gypsum, anhydrite, sylvite).
Su	S_5	Coarse Clastic Rocks: Composed of gravel-sized or larger clasts (e.g. conglomerate, breccia).
Mu	M	METAMORPHIC (UNDIFFERENTIATED): Rocks formed through recrystallization in the solid state of preexisting rocks by heat and pressure.
Mu	M_1	Coarse grained: rocks formed by higher-grade regional metamorphism, either banded or granular (e.g. gneiss, granulite, amphibolite).
Mu	M_2	Fine grained: schistose rocks formed by lower grade regional metamorphism (e.g. schist, slate, phyllite).
Mu	M_3	Nonfoliated: rocks formed chiefly by contact metamorphism (e.g. hornfels, marble).
Qtz	M_4	Metaquartzite: rocks formed by metamorphism of highly siliceous rocks.
		BASIN-FILL
	A	BASIN-FILL DEPOSITS: Fine- to coarse-grained materials deposited principally by wind, water or gravity.
Aal	A_1	Younger Fluvial Deposits: Major modern stream channel and flood-plain deposits.
Au, Aal	A_2	Older Fluvial Deposits: Older incised stream channel and flood-plain deposits in elevated terraces bordering major modern drainages.
Au	A_3	Eolian Deposits: Wind-blown deposits of sand occurring as either thin sheets (A_{3s}) or dunes (A_{3d}).
Aol	A_4	Playa and Lacustrine Deposits: Deposits occurring in modern, active playas (A_{4}) or in either inactive playas or older lake beds and abandoned shorelines associated with extinct lakes (A_{4o}).
Aaf	A_5	Alluvial Fan Deposits: Alluvial deposits consisting of debris flow and water-laid alluvium near mountain fronts, grading into predominantly water-laid alluvium deposited in shifting distributary channels near the basin center. Younger (A_{5y}), intermediate (A_{5i}) and older (A_{5o}) alluvial fans are differentiated by surface soil development, terrain conditions and present depositional/erosional environment.
Au	A_5/A_1	Mixed non-rock units: Most areally extensive unit is listed first.
Aaf	A_{5y} (A_1)	Parenthetic unit underlies thin veneer of overlying mapped unit.

Ertec
The Earth Technology Corporation

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

ERTEC WESTERN GEOLOGIC UNIT CROSS REFERENCE

29 MAY 81

TABLE F-3

APPENDIX G

CROSS REFERENCE FROM MAP NUMBER TO VERIFICATION ACTIVITY

CROSS REFERENCE FROM MAP NUMBER TO VERIFICATION ACTIVITY

Included in this appendix is one table that is presented to allow cross reference to be made from this aggregate resources study to an appropriate verification study. Map numbers in the number series 400 to 599 on Drawing 1 are keyed to the published Verification report of Delamar Valley, Nevada (FN-TR-27-DM-I and II). If detailed information is required from a verification activity, the following search procedure can be used: determine the location of the activity required on Drawing 1, note the map number, refer to that map number in Table G-1, read from that table the verification activity type and number, refer to the appropriate verification report for the data required.

MAP NUMBER	ACTIVITY LOCATION	MAP NUMBER	ACTIVITY LOCATION
400	GS - 27	422	P - 7
401	GS - 29	423	GS - 44
402	GS - 46	424	GS - 18
403	GS - 61	425	CS - 14
404	GS - 24	426	GS - 32
405	P - 3	427	GS - 49
406	GS - 38	428	GS - 40
407	GS - 30	429	P - 10
408	GS - 28	430	GS - 78
409	GS - 47	431	CS - 20
410	GS - 25	432	GS - 21
411	CS - 9	433	GS - 41
412	GS - 48	434	P - 9
413	GS - 62	435	CS - 18
414	T - 1	436	GS - 19
415	GS - 26	437	P - 8
416	GS - 23	438	GS - 33
417	CS - 11	439	GS - 42
418	GS - 39	440	GS - 9
419	GS - 79	441	GS - 43
420	GS - 22	442	P - 11
421	P - 6	443	GS - 65

T - TRENCH
B - BORING
P - TEST PIT
CS - SURFACE SAMPLE
GS - GEOLOGIC STATION

Ertec
The Earth Technology Corporation

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

CROSS REFERENCE FROM MAP NUMBER
TO VERIFICATION ACTIVITY
DELAMAR VALLEY, NEVADA

29 MAY 81

TABLE G-1 1 OF 3

MAP NUMBER	ACTIVITY LOCATION	MAP NUMBER	ACTIVITY LOCATION
444	GS - 55	466	GS - 57
445	CS - 24	467	GS - 59
446	GS - 12	468	GS - 15
447	P - 78	469	CS - 5
448	GS - 50	470	GS - 36
449	GS - 20	471	P - 4
450	GS - 13	472	T - 9
451	GS - 35	473	GS - 37
452	GS - 51	474	GS - 17
453	GS - 14	475	GS - 5
454	GS - 66	476	P - 14
455	GS - 67	477	CS - 32
456	GS - 77	478	GS - 72
457	GS - 10	479	GS - 70
458	CS - 27	480	GS - 1
459	CS - 29	481	GS - 71
460	GS - 11	482	CS - 34
461	P - 13	483	P - 1
462	GS - 56	484	GS - 58
463	GS - 52	485	CS - 36
464	GS - 54	486	CS - 1
465	GS - 69	487	P - 3

T - TRENCH
B - BORING
P - TEST PIT
CS - SURFACE SAMPLE
GS - GEOLOGIC STATION

Ertec
The Earth Technology Corporation

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

CROSS REFERENCE FROM MAP NUMBER
TO VERIFICATION ACTIVITY
DELAMAR VALLEY, NEVADA

29 MAY 81

TABLE G-1 2 OF 3

MAP NUMBER	ACTIVITY LOCATION	MAP NUMBER	ACTIVITY LOCATION
488	GS - 53		
489	GS - 16		
490	GS - 76		
491	GS - 60		
492	GS - 3		
493	GS - 75		
494	GS - 73		
495	GS - 4		
496	GS - 74		
497	GS - 2		
498	T - 8		
499	T - 10		
500	T - 7		
501	T - 6		
502	T - 5		
503	T - 4		
504	T - 2		
505	T - 3		

T - TRENCH
B - BORING
P - TEST PIT
CS - SURFACE SAMPLE
GS - GEOLOGIC STATION

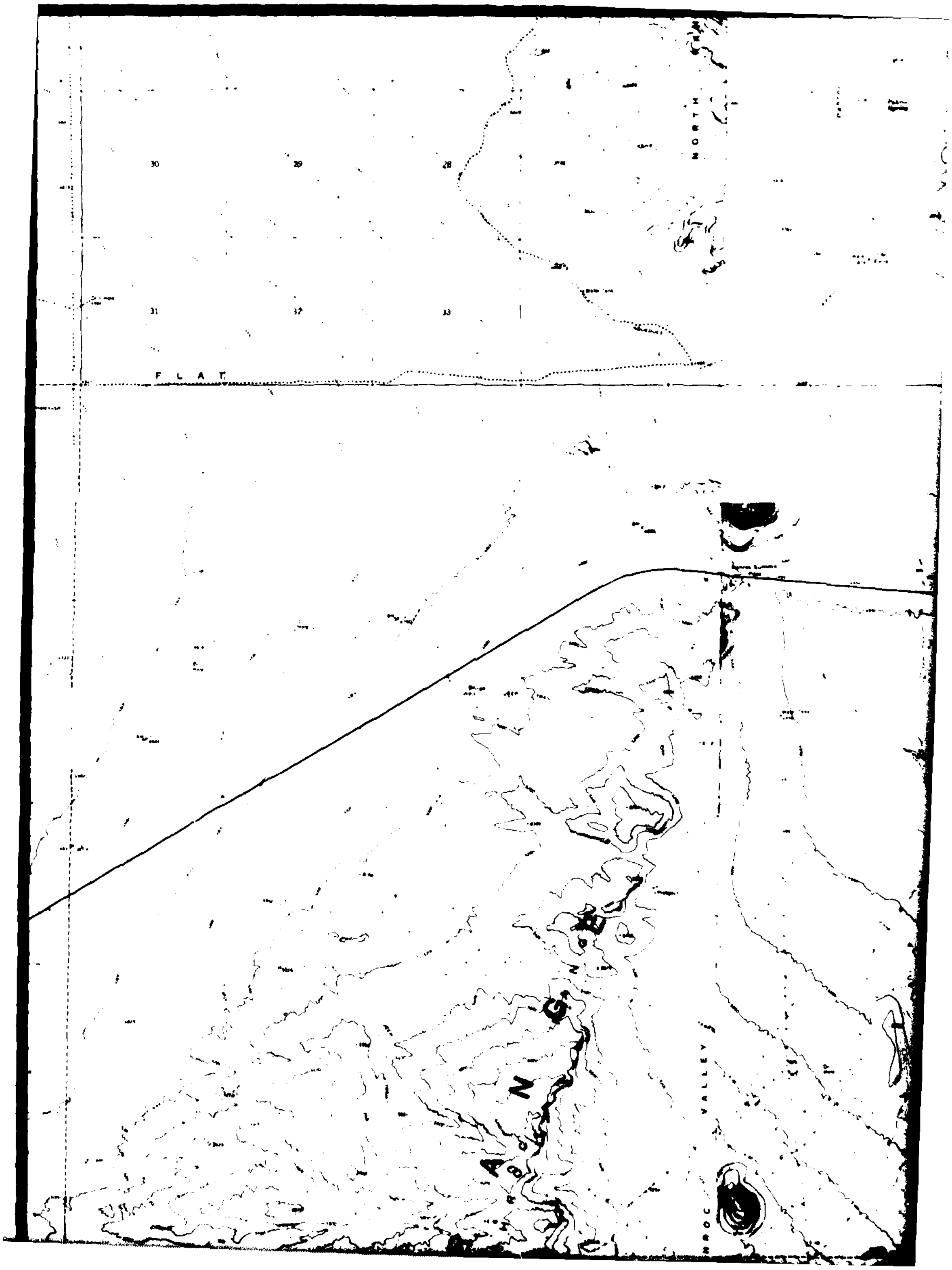
Ertec
The Earth Technology Corporation

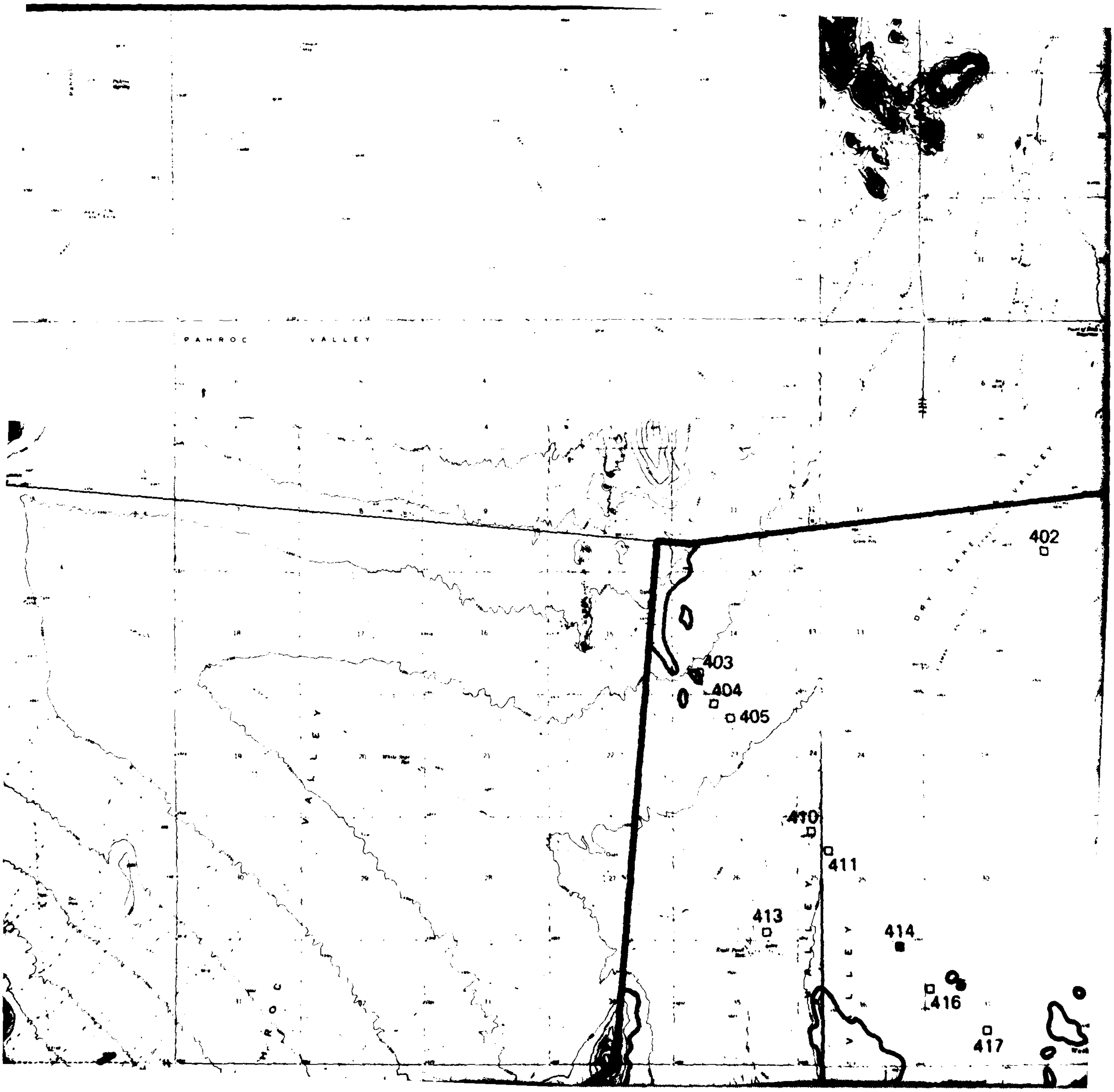
MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

CROSS REFERENCE FROM MAP NUMBER
TO VERIFICATION ACTIVITY
DELAMAR VALLEY, NEVADA

29 MAY 81

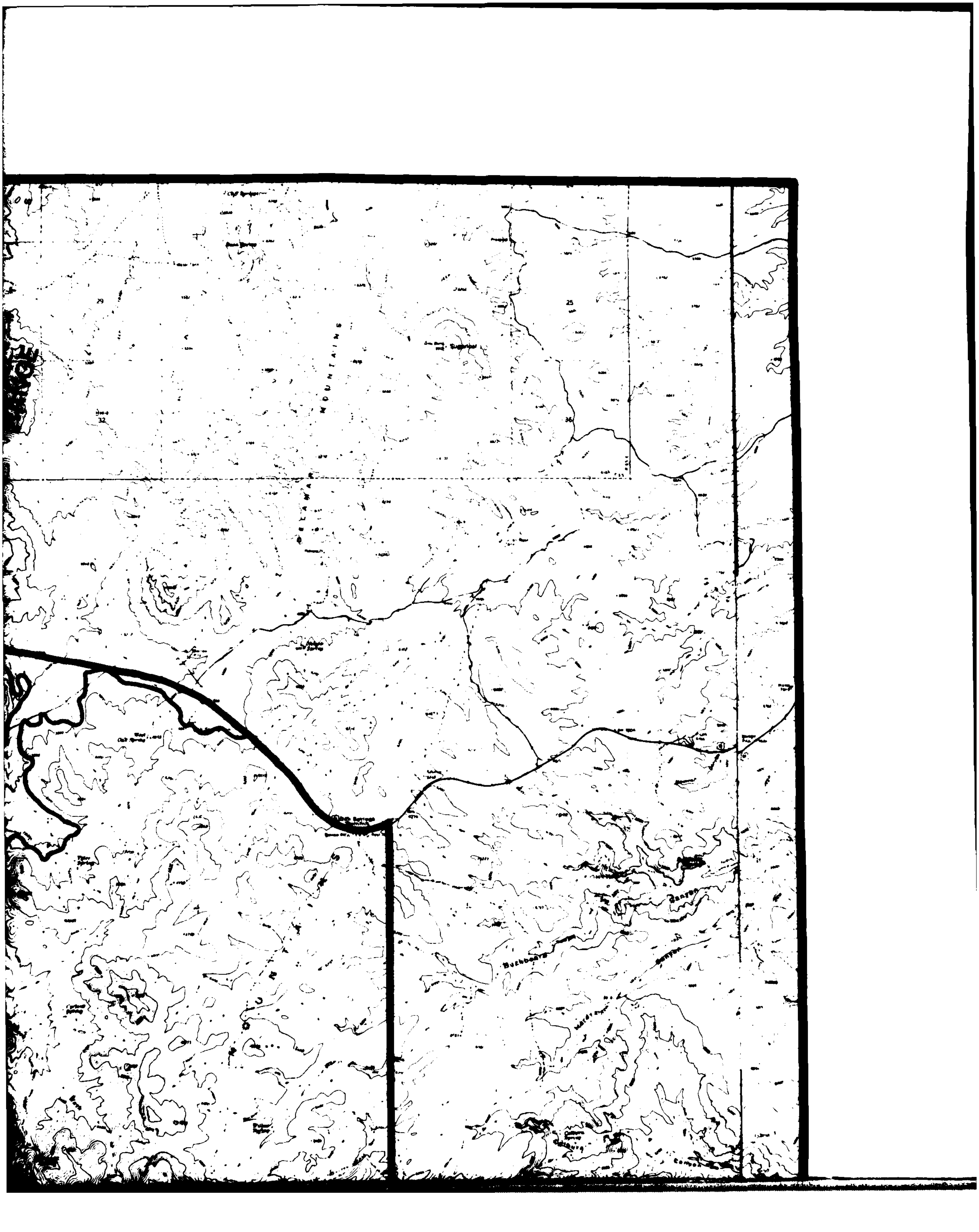
TABLE G-1 3 OF 3

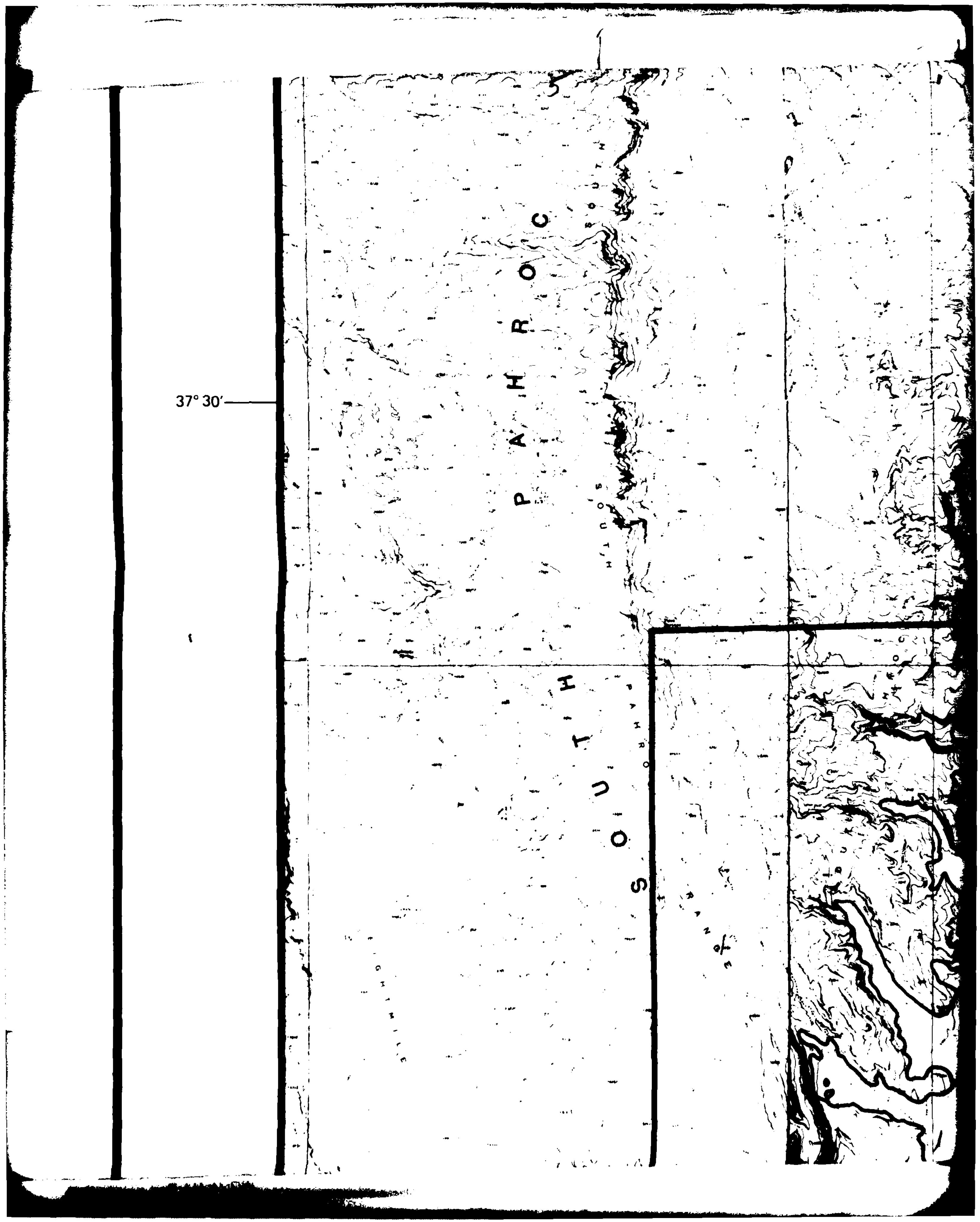

30
29
28
31
32
33
F L A T
NORTH
VALLEY
A N G E

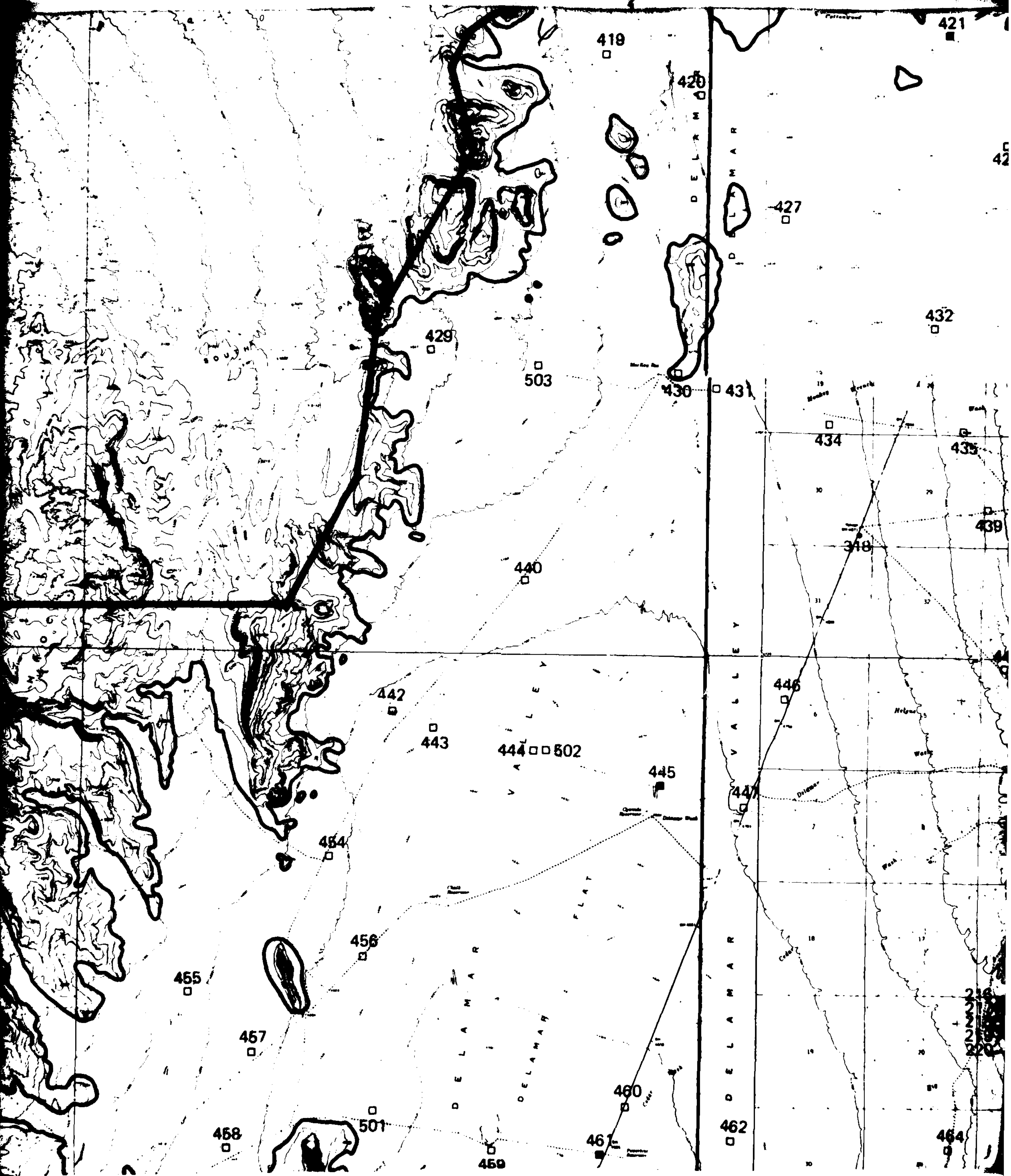


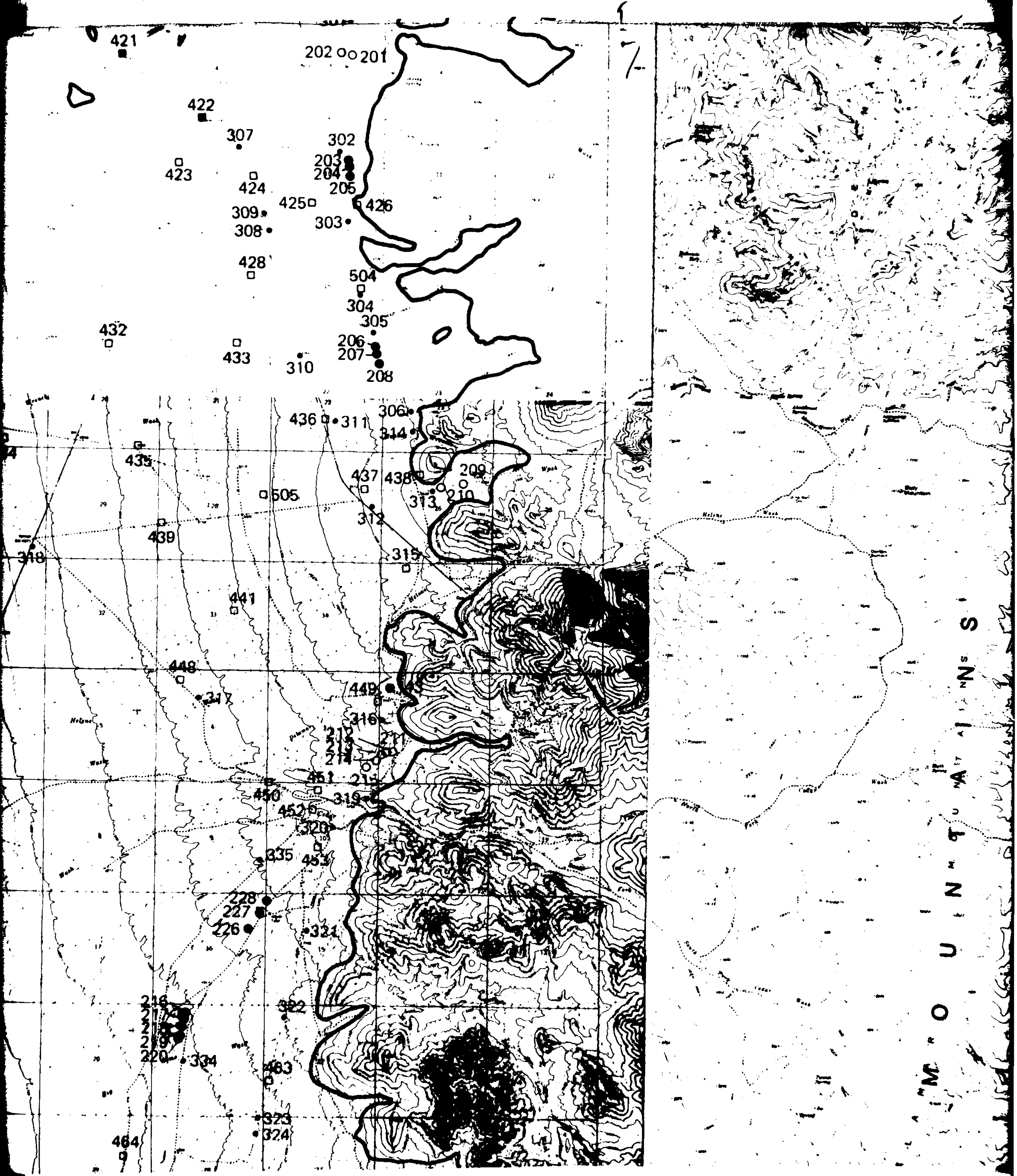
PAHROC VALLEY
DRY LAKE VALLEY
402
403
404
405
410
411
413
414
416
417

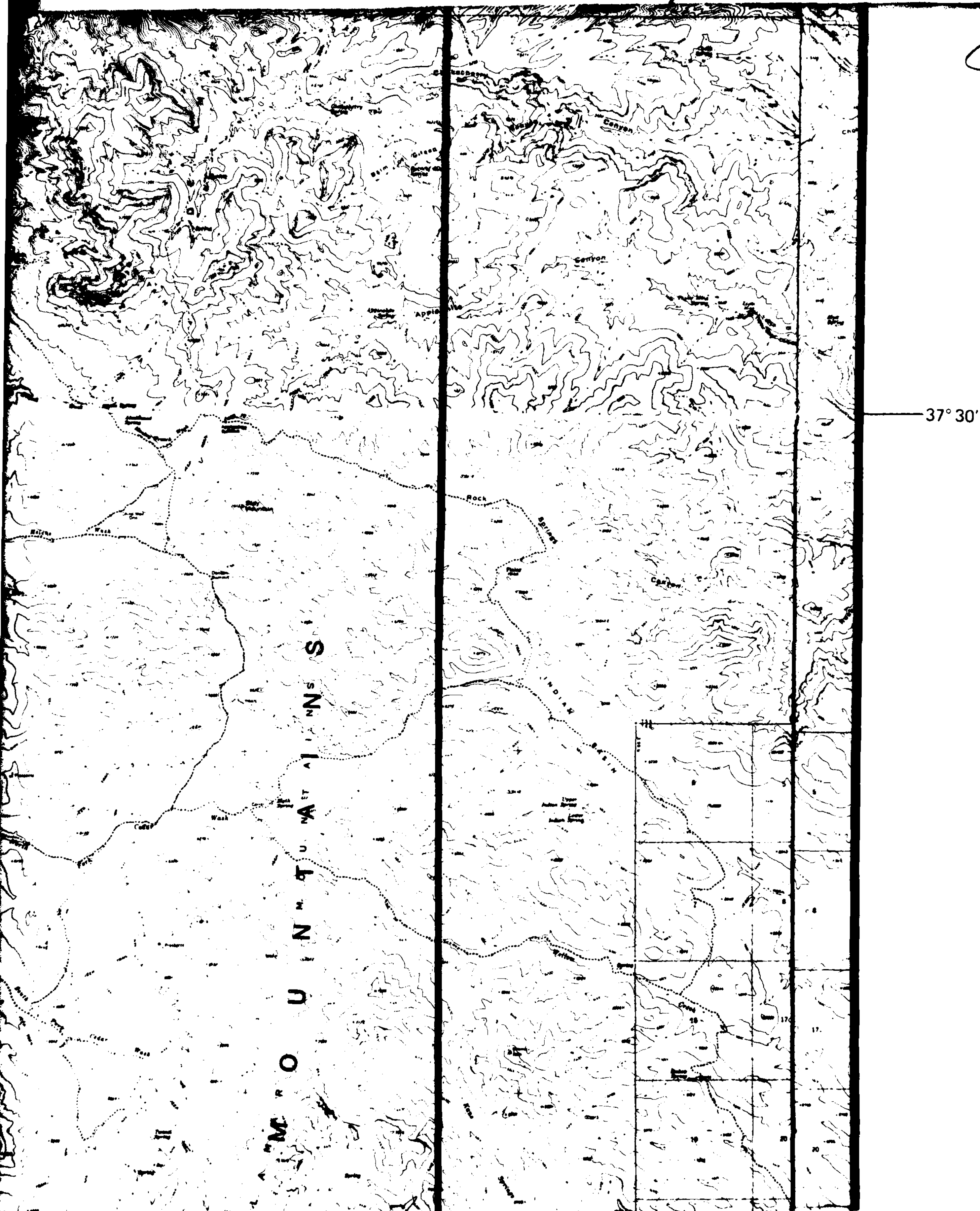

RANGE
229
230
231
42
400
402
401
BURNT SPRINGS
406
336
407
408
409
412
337
415
416
417
418
301

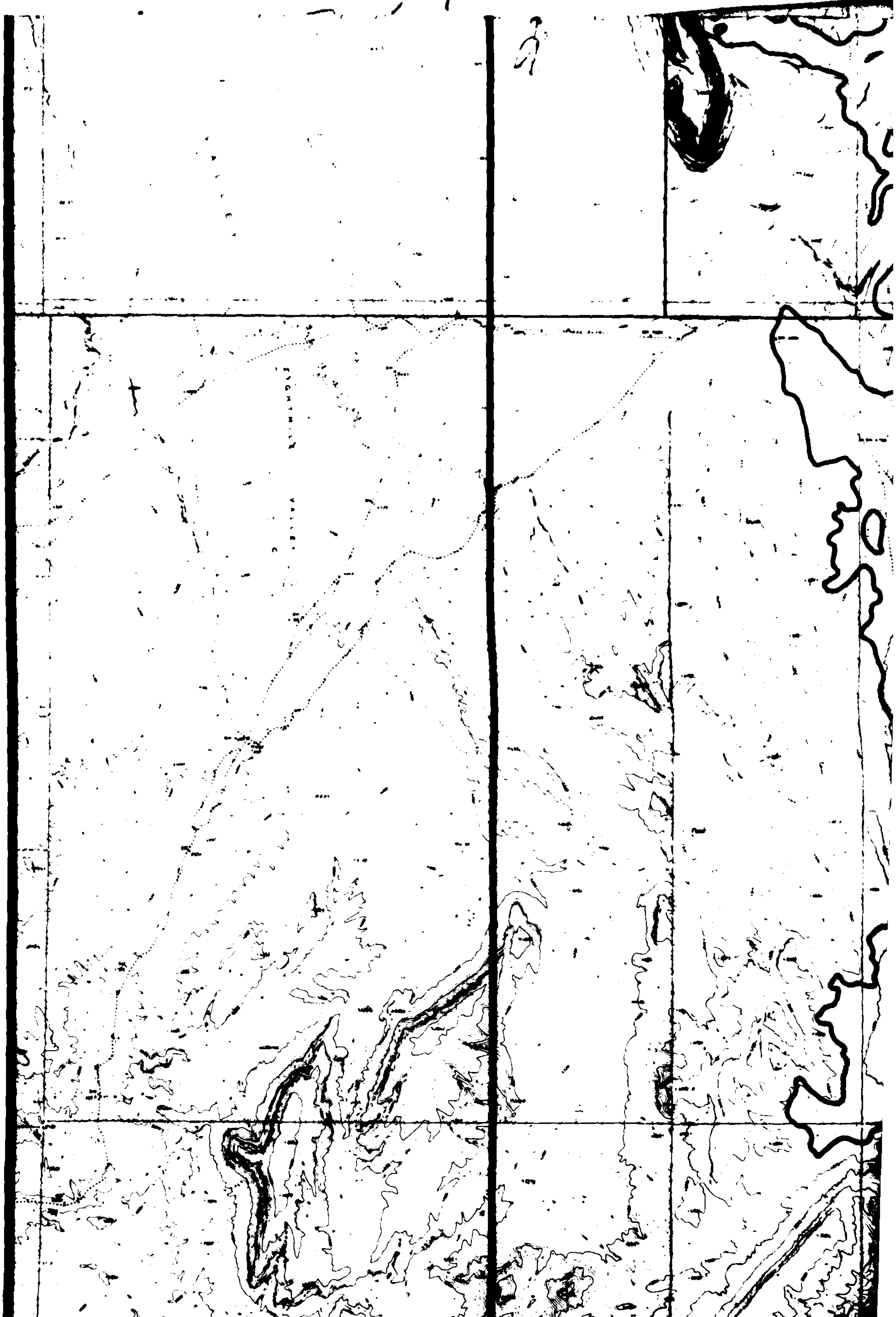

MOUNTAINS
Buckboard
Canyon
Canyon

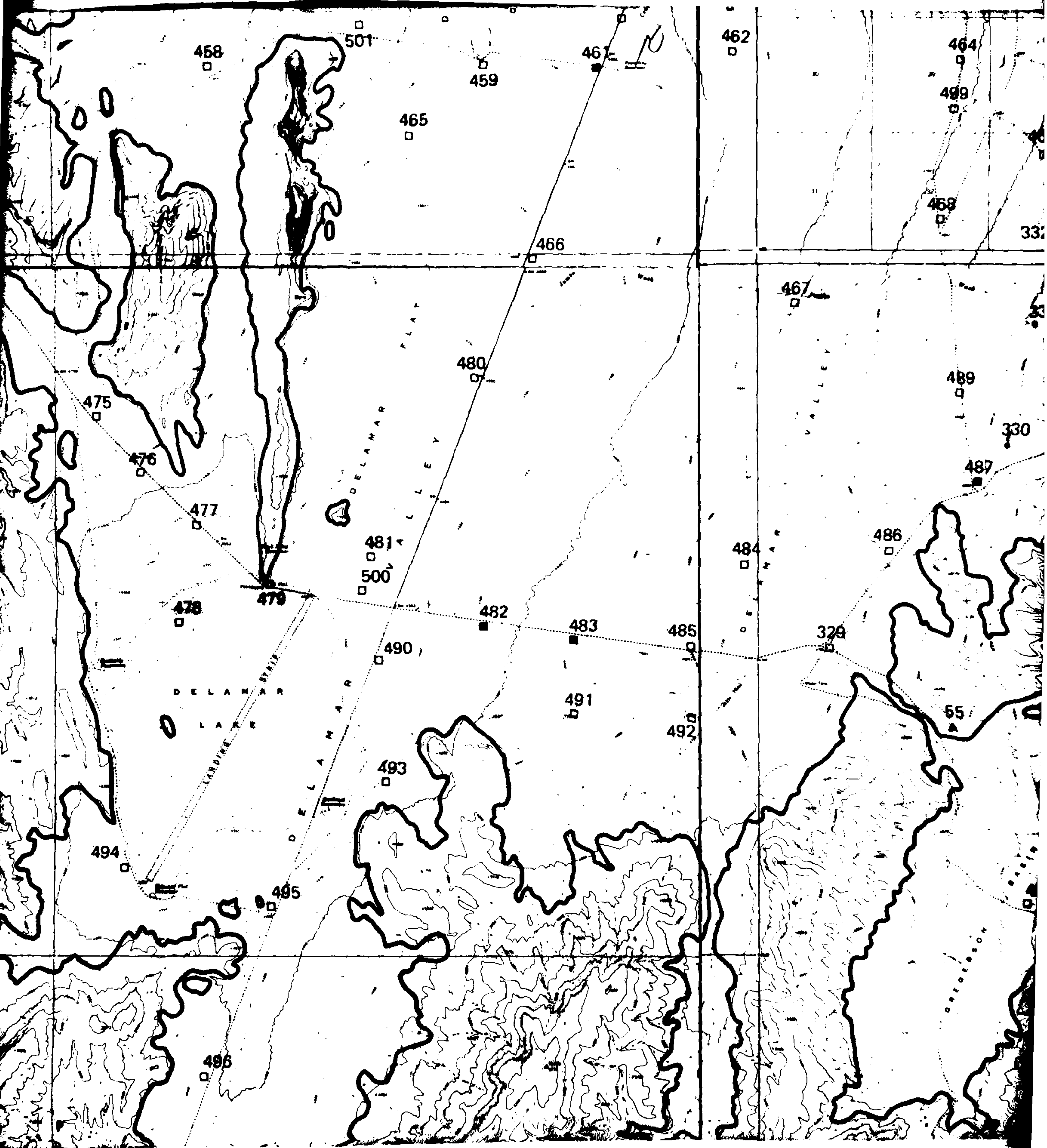

37° 30′
PAHROC
SOUTH
RANGE


419
420
421
427
429
503
430
431
432
434
435
439
318
440
442
443
444
502
445
446
447
454
455
456
457
458
459
460
461
462
464
501
DELAMAR
DELAMAR VALLEY
DELAMAR FLAT

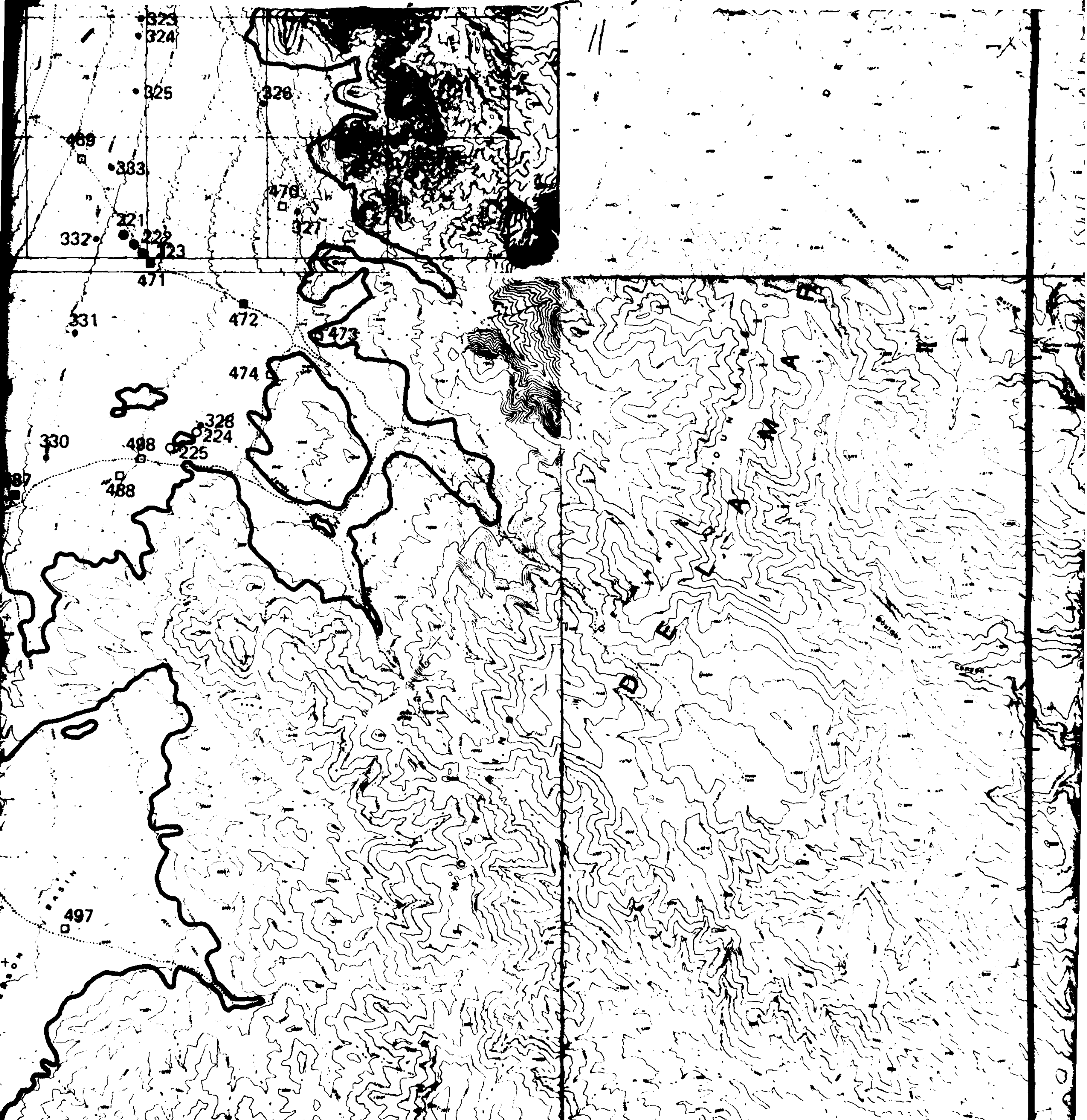

421
202
201
422
307
302
203
204
205
423
424
425
426
309
308
303
428
504
304
305
432
433
206
207
310
208
436
311
306
314
435
209
437
438
505
313
210
312
439
318
315
441
448
449
317
316
212
213
214
211
215
451
450
319
452
320
335
453
228
227
226
321
216
322
220
334
463
323
324
464
MOUNTAINS


37° 30′
Canyon
Rock
INDIAN
Wash
Cedar

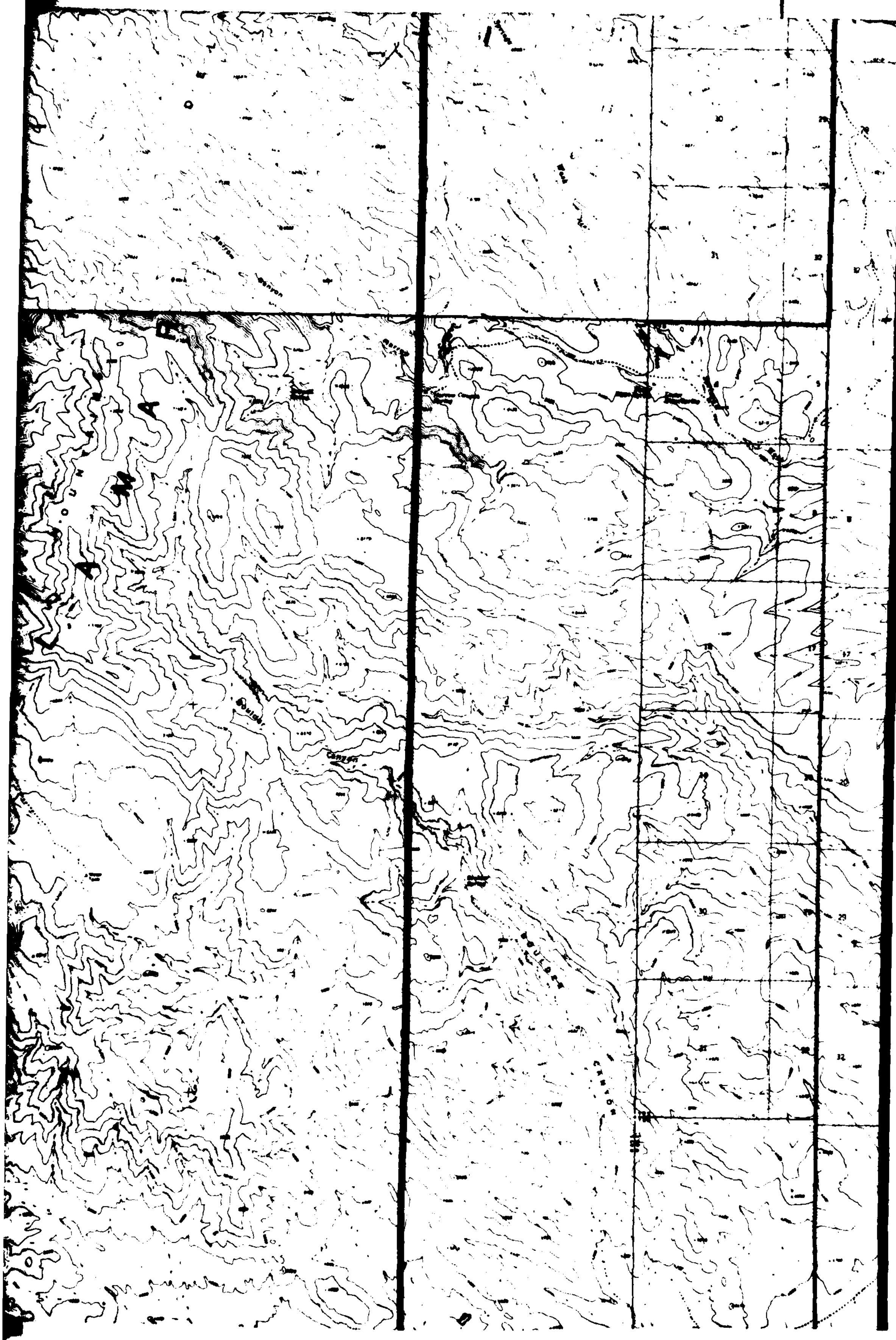




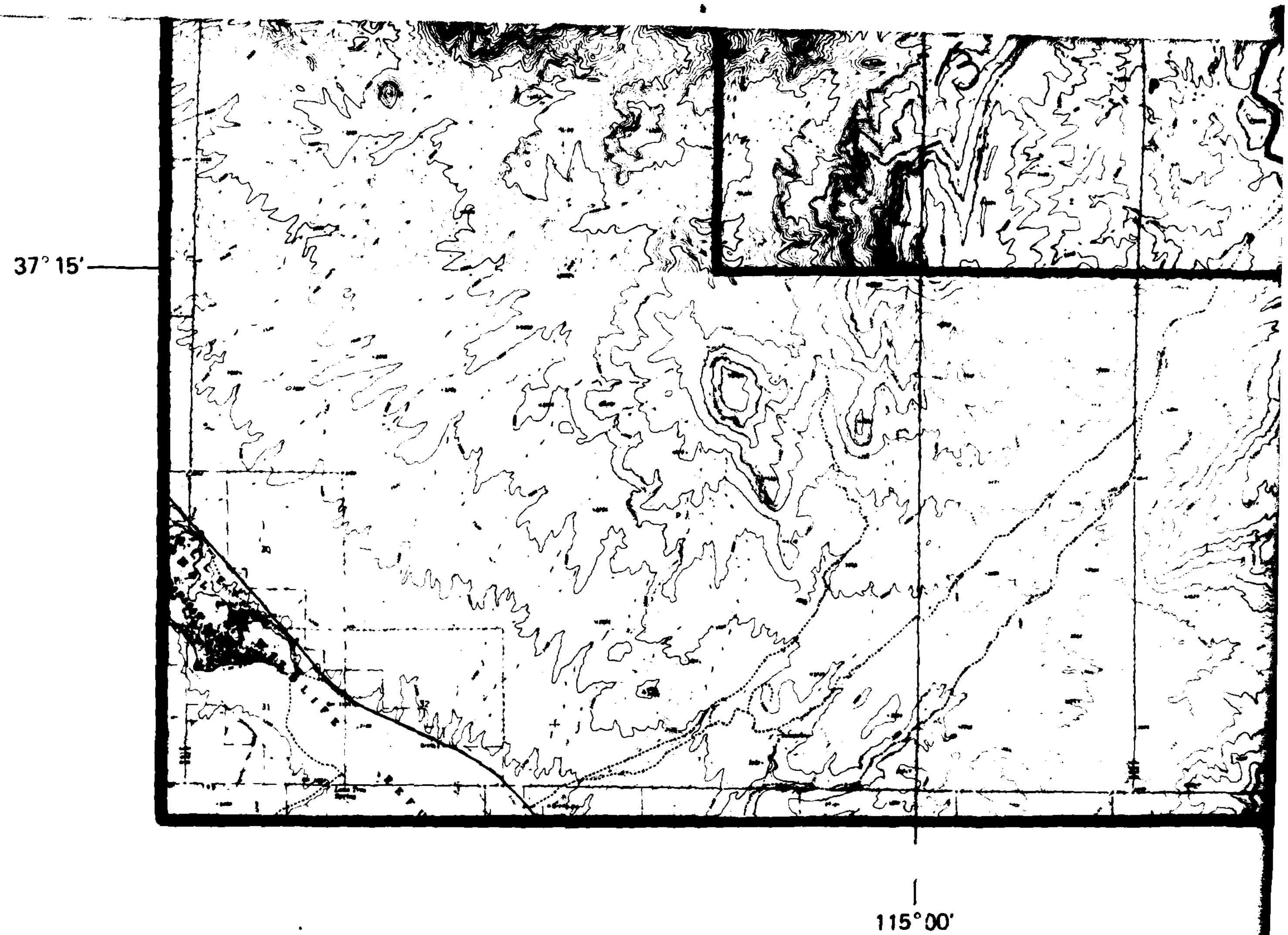
458
501
459
461
462
464
499
465
466
468
332
467
480
489
330
475
476
477
487
481
500
484
486
479
478
482
483
485
329
490
491
492
55
493
494
495
DELAMAR FLAT
DELAMAR VALLEY
DELAMAR LAKE
LANDING STRIP
VALLEY
DELAMAR
GREGERSON



323
324
325
326
469
333
470
221
222
332
223
327
471
331
472
473
474
328
224
330
498
225
488
497
D E L A M A R



Boulder
Canyon
BOULDER
CANYON



ERTEC WESTERN AGGREGA

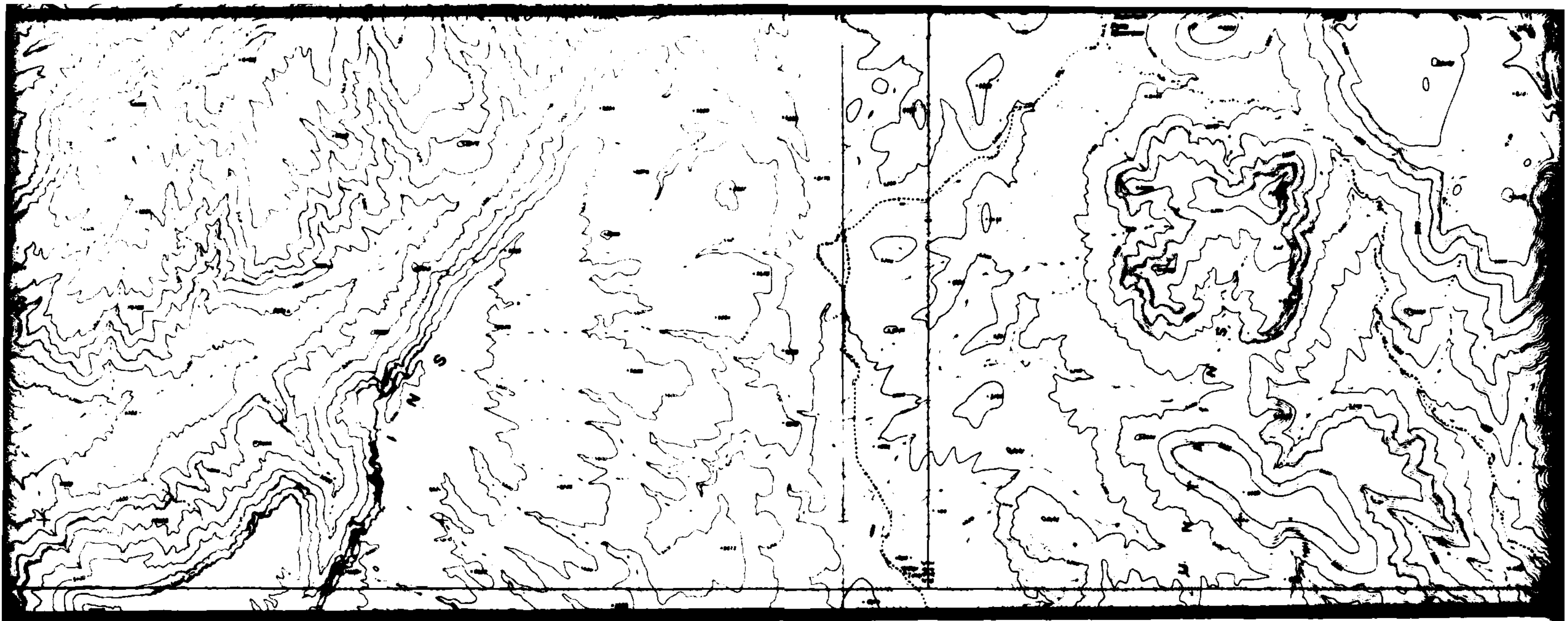
VALLEY-SPECIF
(MAP NUM

BASIN-FI

●

o

ROCK U



EXPLANATION

TE RESOURCES STUDY FIELD STATIONS

AGGREGATE RESOURCES STUDY *
ERS FROM 1 TO 199)

UNITS (COARSE AND/OR FINE AGGREGATES)

TA STOP, SAMPLED AND TESTED

TA STOP

(CRUSHED-ROCK AGGREGATES)

TA STOP, SAMPLED AND TESTED

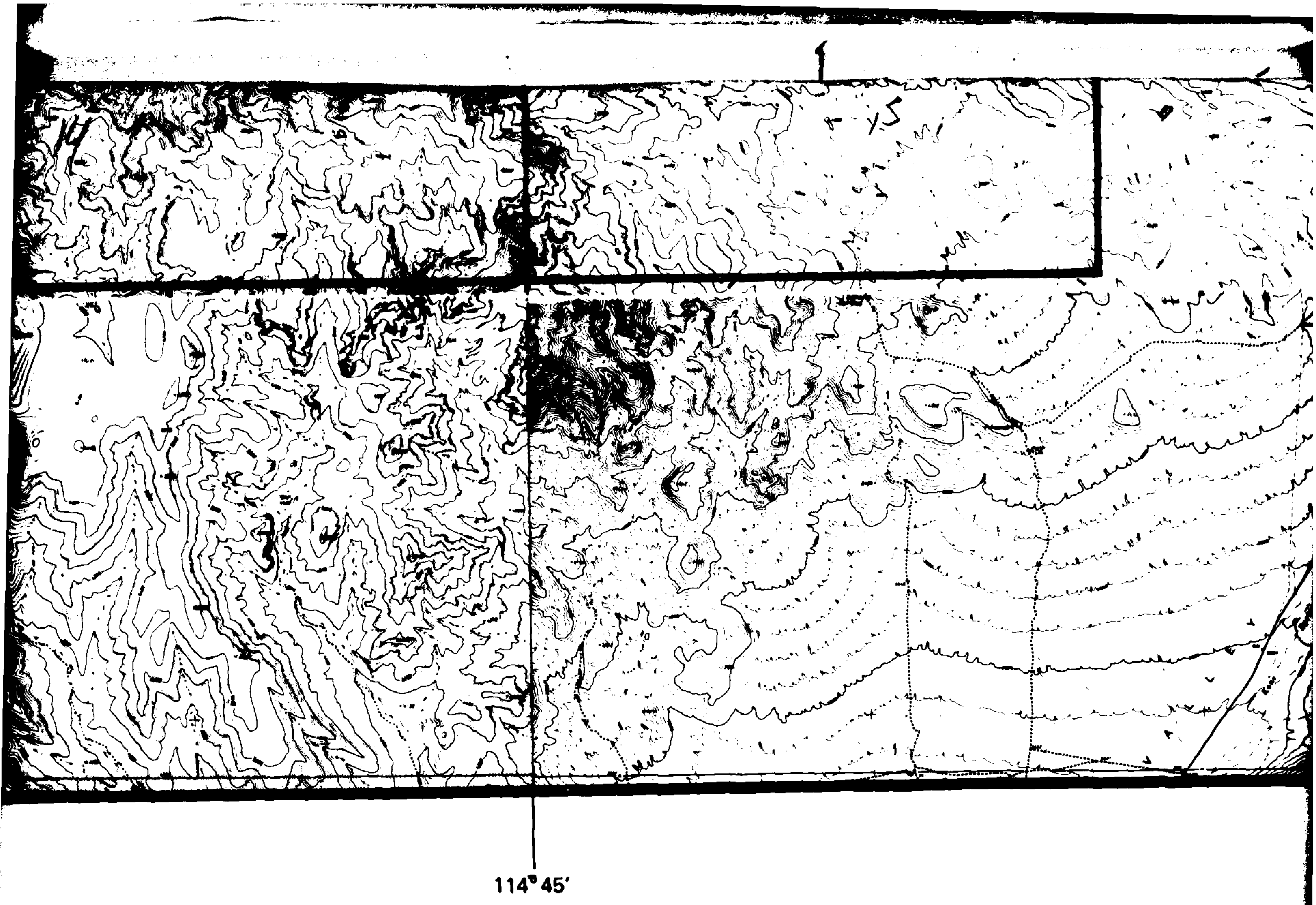
EXISTING ERTEC WESTERN TEST DATA
(MAP NUMBERS FROM 400 TO 59

■ DATA STOP, SAMPLED

□ DATA STOP

* SEE DRY LAKE, MULESHOE, DEL
REPORT (FN-TR-37-a) FOR DETAI

** SEE CORRESPONDING MAP NUM
FOR DETAILED INFORMATION.

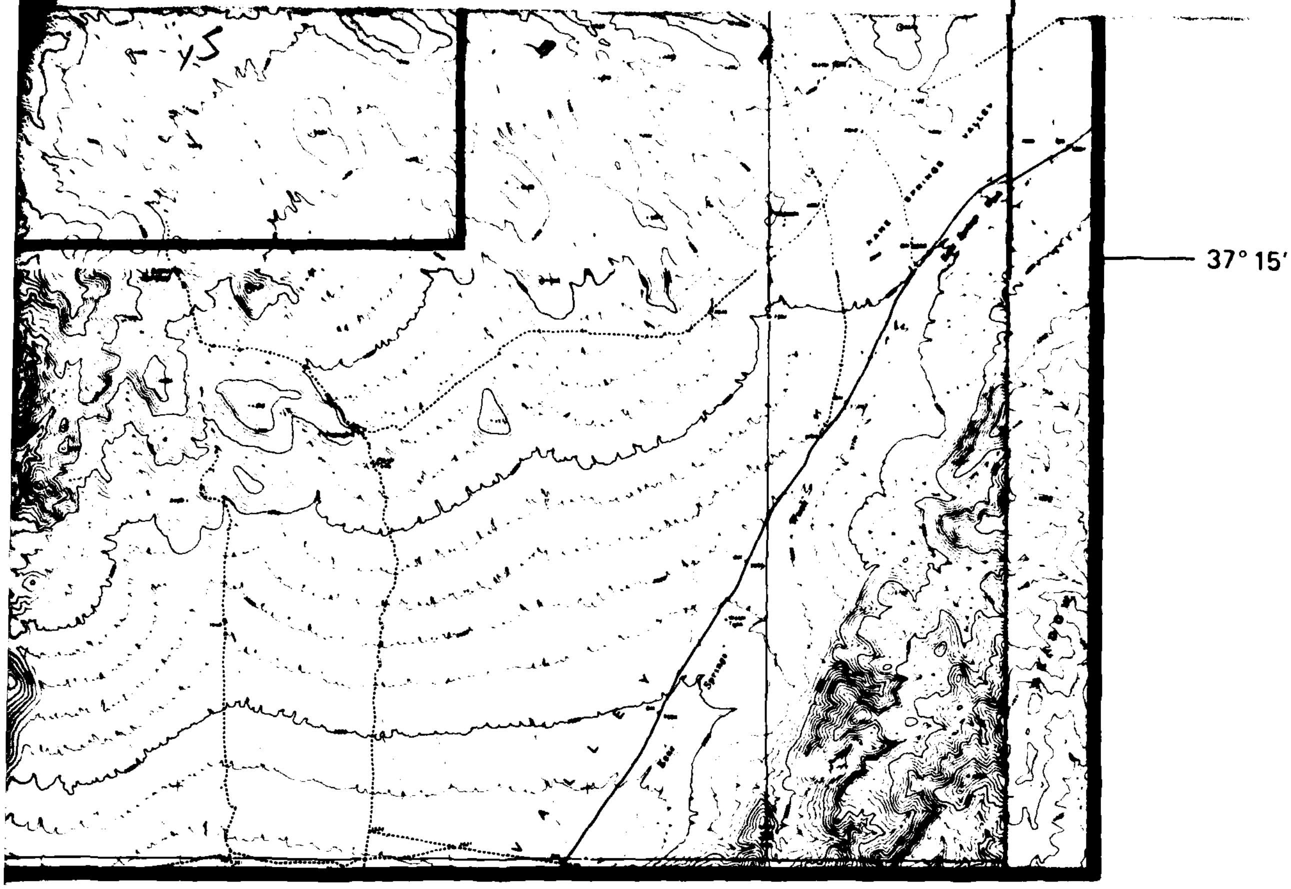


EST DATA LOCATIONS* * *
400 TO 599)

, SAMPLED AND TESTED

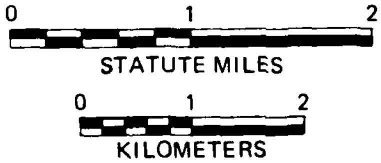
SHOE, DELAMAR, PAHROC VSARS
OR DETAILED INFORMATION.

MAP NUMBER IN APPENDICES A AND B
MATION.

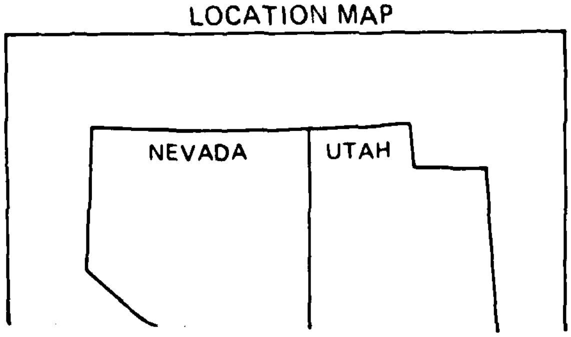


NORTH

SCALE 1:62,500



LOCATION MAP



115°00′

ERTEC WESTERN AGGREG

VALLEY–SPECIF
(MAP NU

BASIN–F

●

○

ROCK UN

▲

△

DETAILED AGG
(MAP NU
AND ROC
PETROGR

BASIN–F

●

○

ROCK U

▲

PETROGR

•

17

EXPLANATION

TERN AGGREGATE RESOURCES STUDY FIELD STATIONS

ALLEY-SPECIFIC AGGREGATE RESOURCES STUDY *
(MAP NUMBERS FROM 1 TO 199)

BASIN-FILL UNITS (COARSE AND/OR FINE AGGREGATES)

● DATA STOP, SAMPLED AND TESTED

○ DATA STOP

ROCK UNITS (CRUSHED-ROCK AGGREGATES)

▲ DATA STOP, SAMPLED AND TESTED

△ DATA STOP

TAILED AGGREGATE RESOURCES STUDY * *
(MAP NUMBERS FROM 200 TO 299 FOR BASIN-FILL AND ROCK SAMPLE LOCATIONS; 300 TO 399 FOR FIELD PETROGRAPHIC STATIONS)

BASIN-FILL UNITS (COARSE AND/OR FINE AGGREGATES)

● DATA STOP, SAMPLED AND TESTED

○ DATA STOP

ROCK UNITS (CRUSHED-ROCK AGGREGATES)

▲ DATA STOP, SAMPLED AND TESTED

PETROGRAPHIC FIELD STATIONS

• DATA STOP

EXISTING ERTEC WESTE
(MAP NUMBERS F

■ DATA

□ DATA

* SEE DRY LAKE, M
REPORT (FN-TR-37

* * SEE CORRESPOND
FOR DETAILED IN

* * * SEE CORRESPOND
APPENDIX G FOR
VERIFICATION RE

SYMBOLS

▬▬ STUDY

—— ROCK/B

114°45'

NG ERTEC WESTERN TEST DATA LOCATIONS* * *
(MAP NUMBERS FROM 400 TO 599)

■ DATA STOP, SAMPLED AND TESTED

□ DATA STOP

SEE DRY LAKE, MULESHOE, DELAMAR, PAHROC VSARS
REPORT (FN-TR-37-a) FOR DETAILED INFORMATION.

SEE CORRESPONDING MAP NUMBER IN APPENDICES A AND B
FOR DETAILED INFORMATION.

SEE CORRESPONDING MAP NUMBER AND ACTIVITY TYPE IN
APPENDIX G FOR REFERENCE TO DELAMAR VALLEY
VERIFICATION REPORT (FN-TR-27-DM-I AND II)

LS

STUDY AREA BOUNDARY

ROCK/BASIN–FILL CONTACT

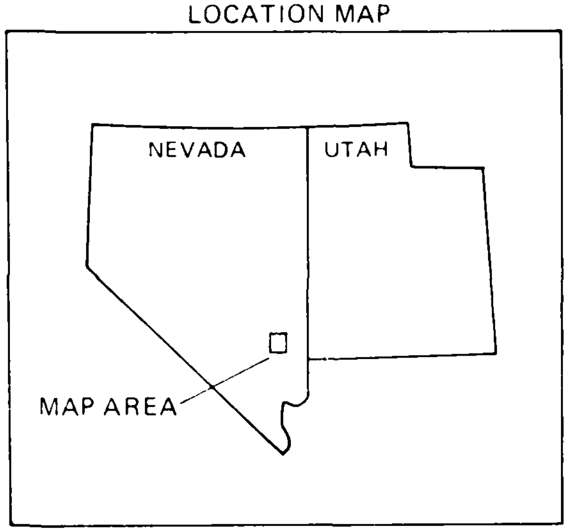
NORTH

SCALE 1:62,500

0 1 2
STATUTE MILES

0 1 2
KILOMETERS

LOCATION MAP



Ertec
The Earth Technology Corporation

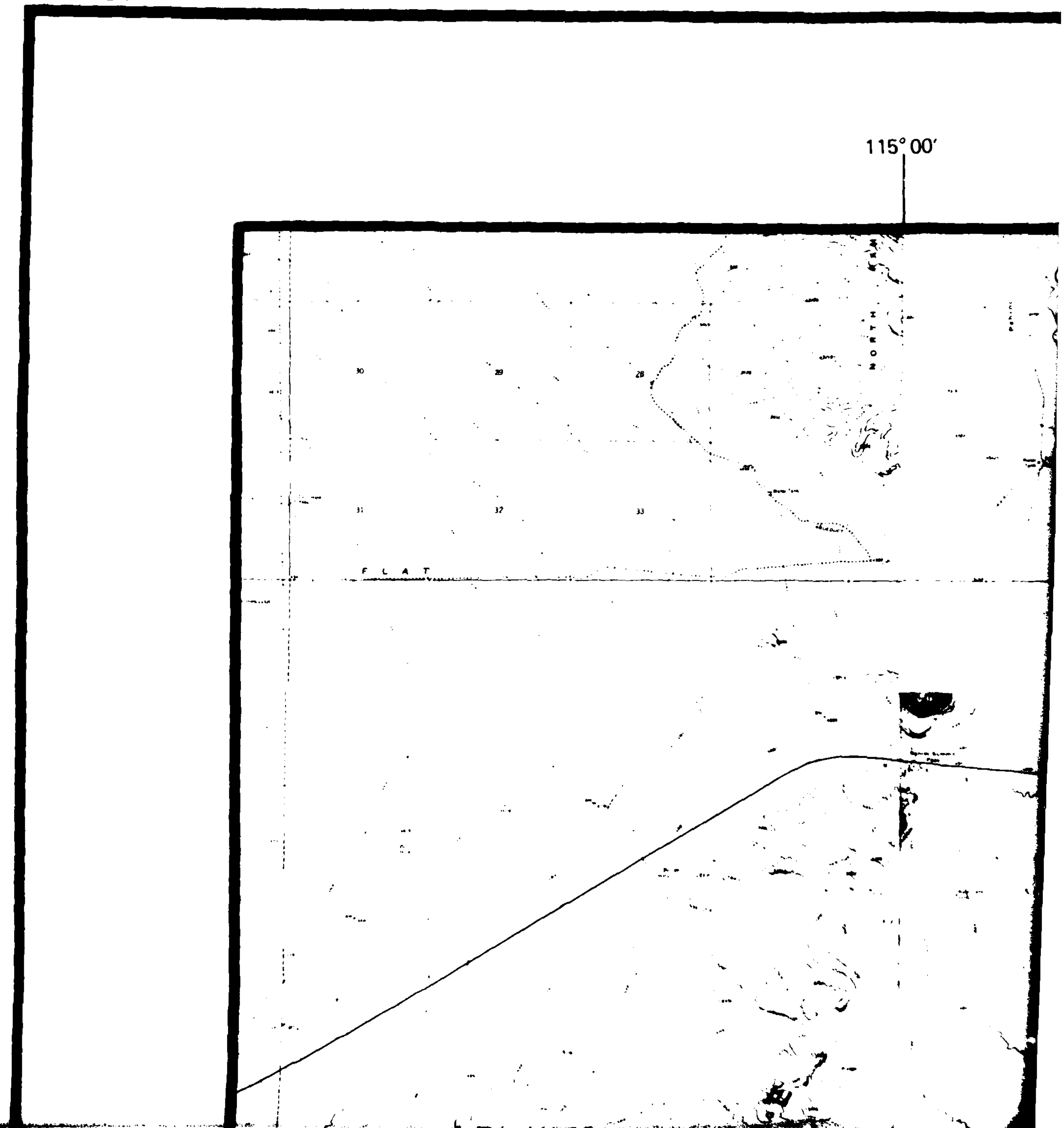
MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

FIELD STATION AND SELECTED EXISTING DATA SITE LOCATIONS DETAILED AGGREGATE RESOURCES STUDY DELAMAR VALLEY, NEVADA

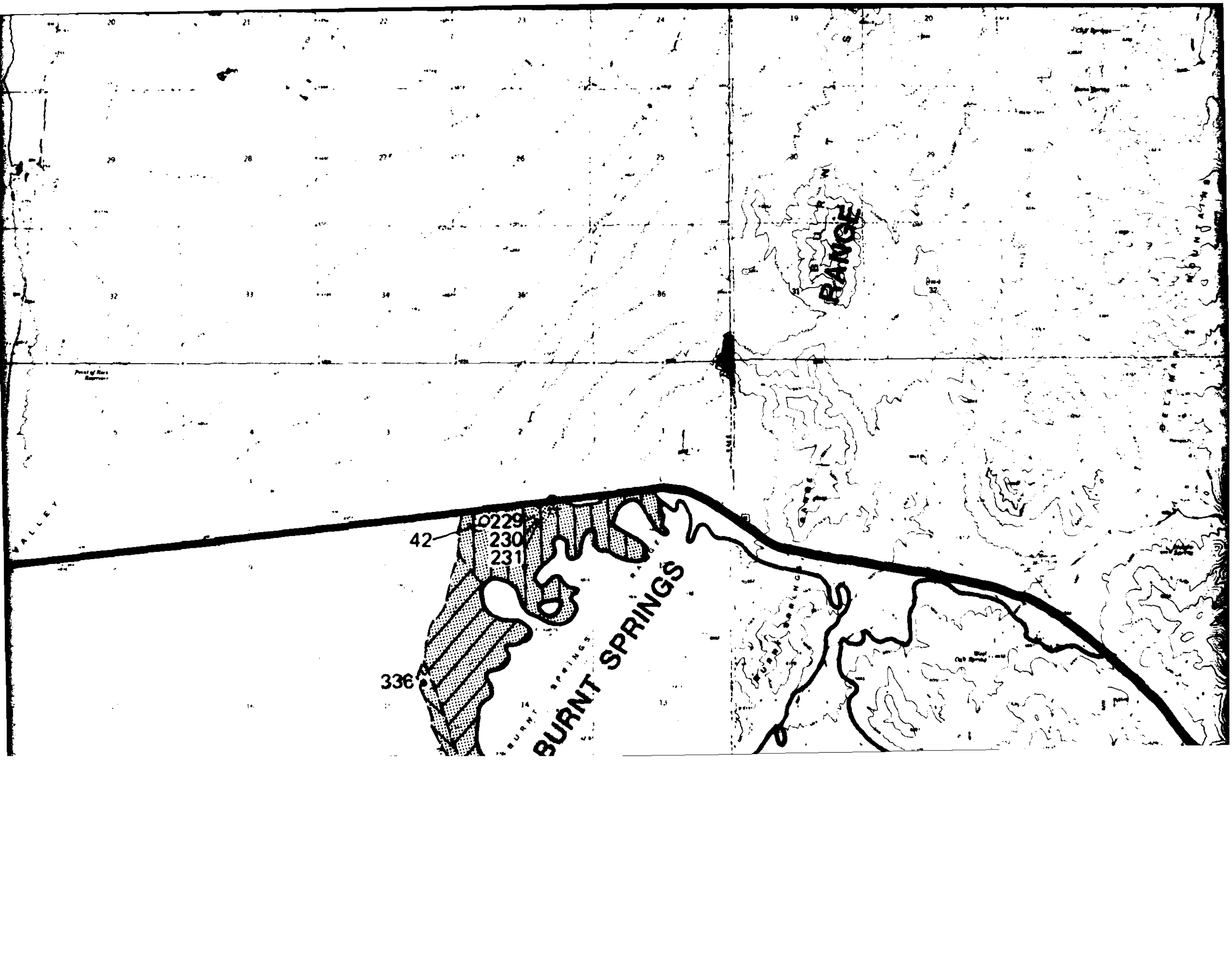
29 MAY 81

DRAWING 1

E TR 47 DM

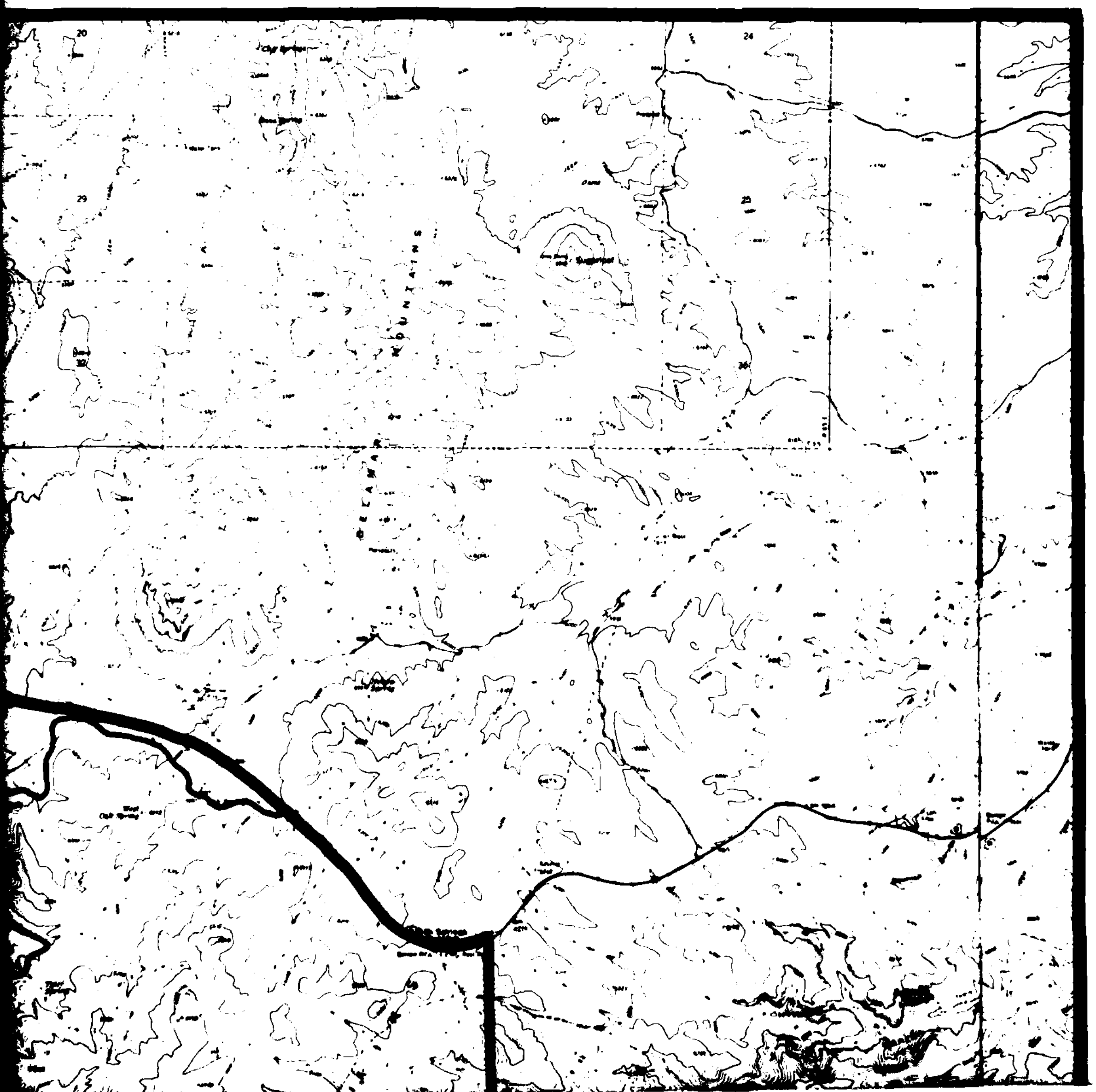


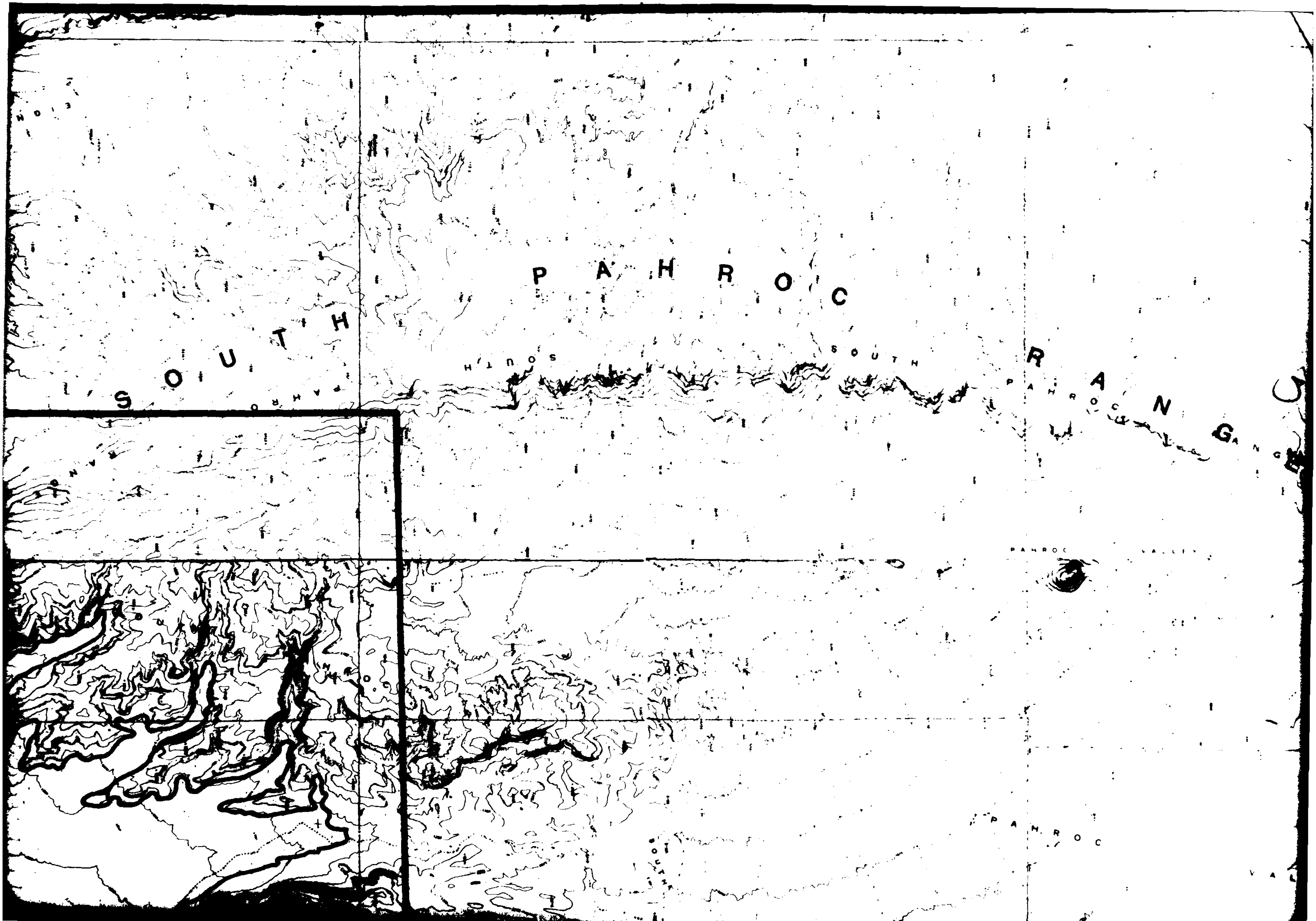
PAHROC VALLEY
DRY LAKE
VALLEY
VALLEY

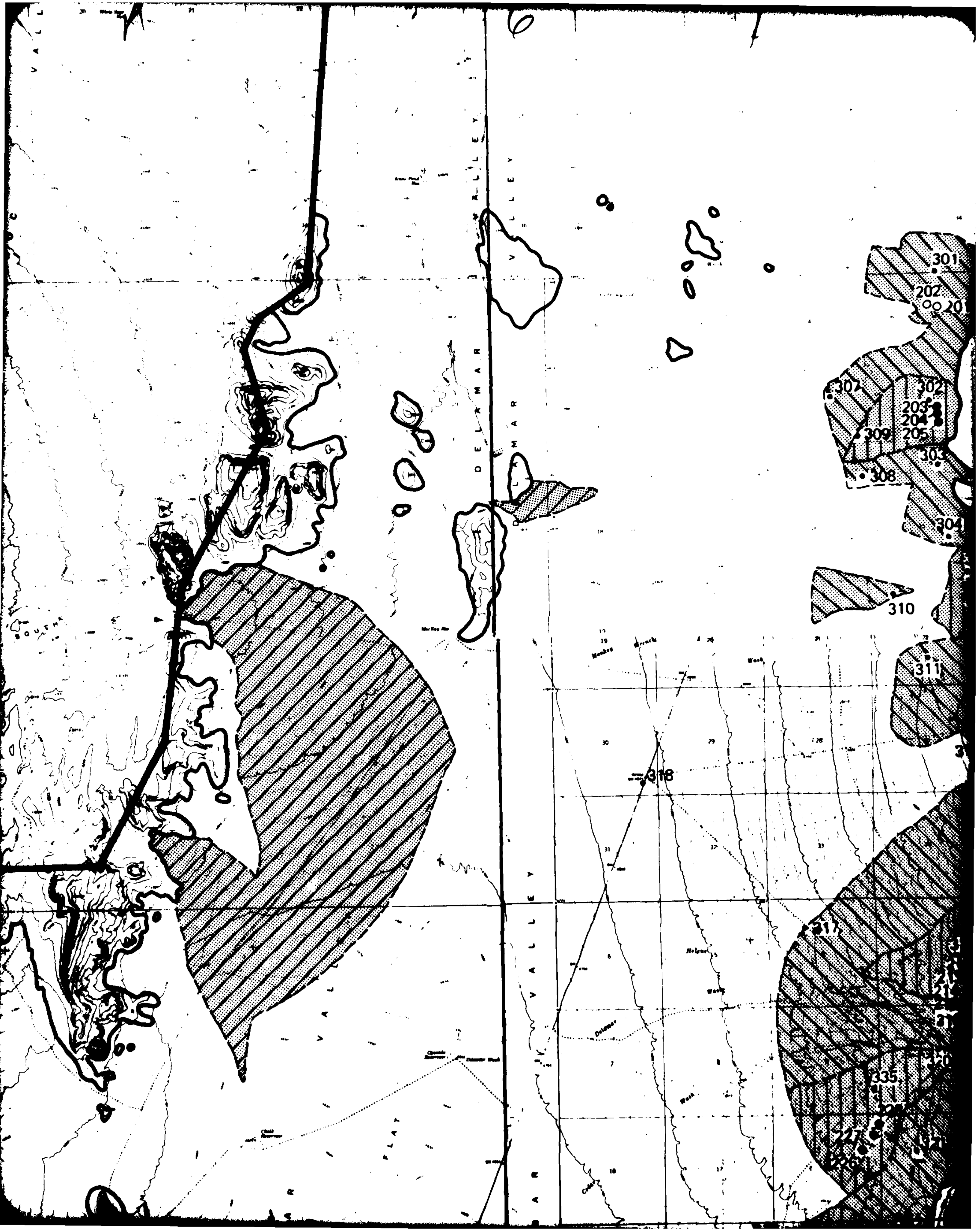


BURNT SPRINGS
RANGE
229
230
231
42
336

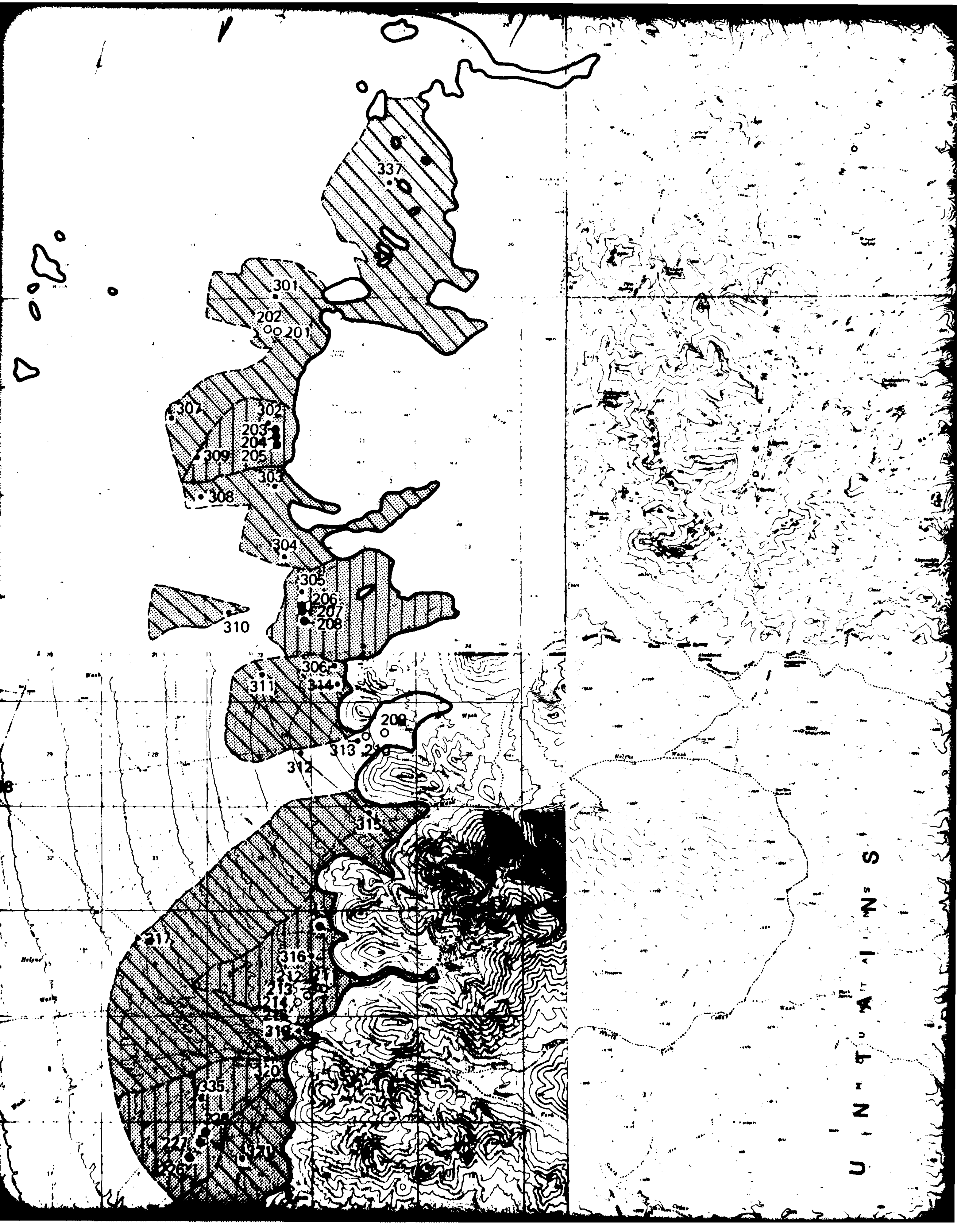
4



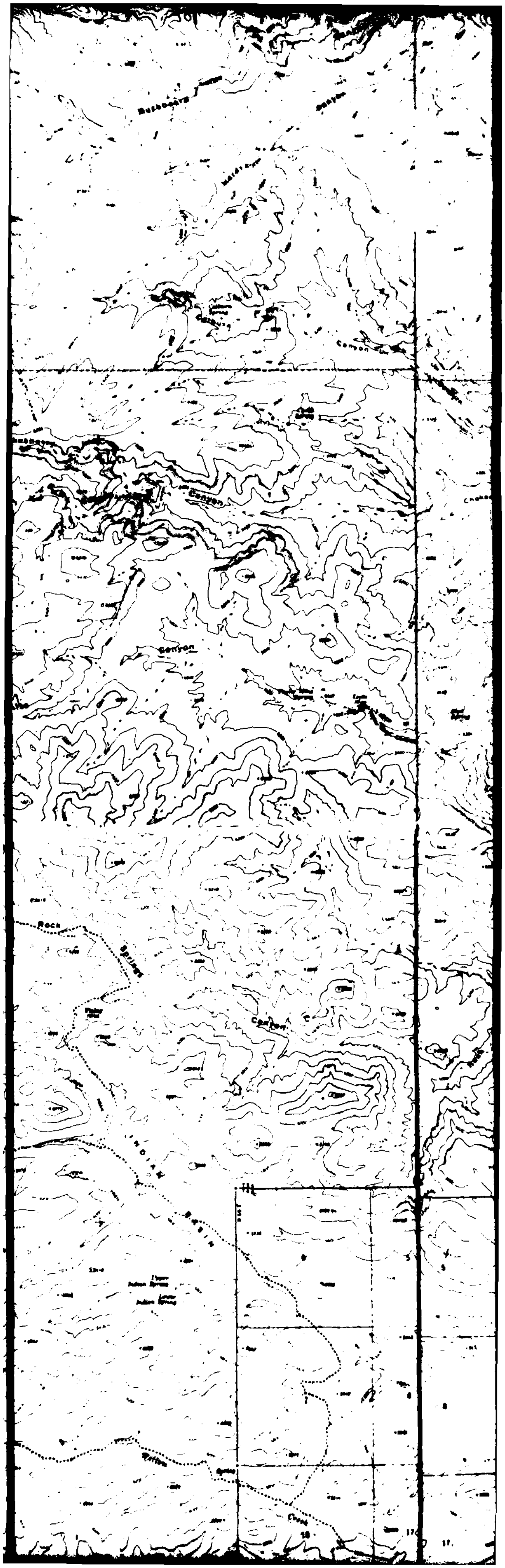

SOUTH PAHROC RANGE
PAHROC VALLEY



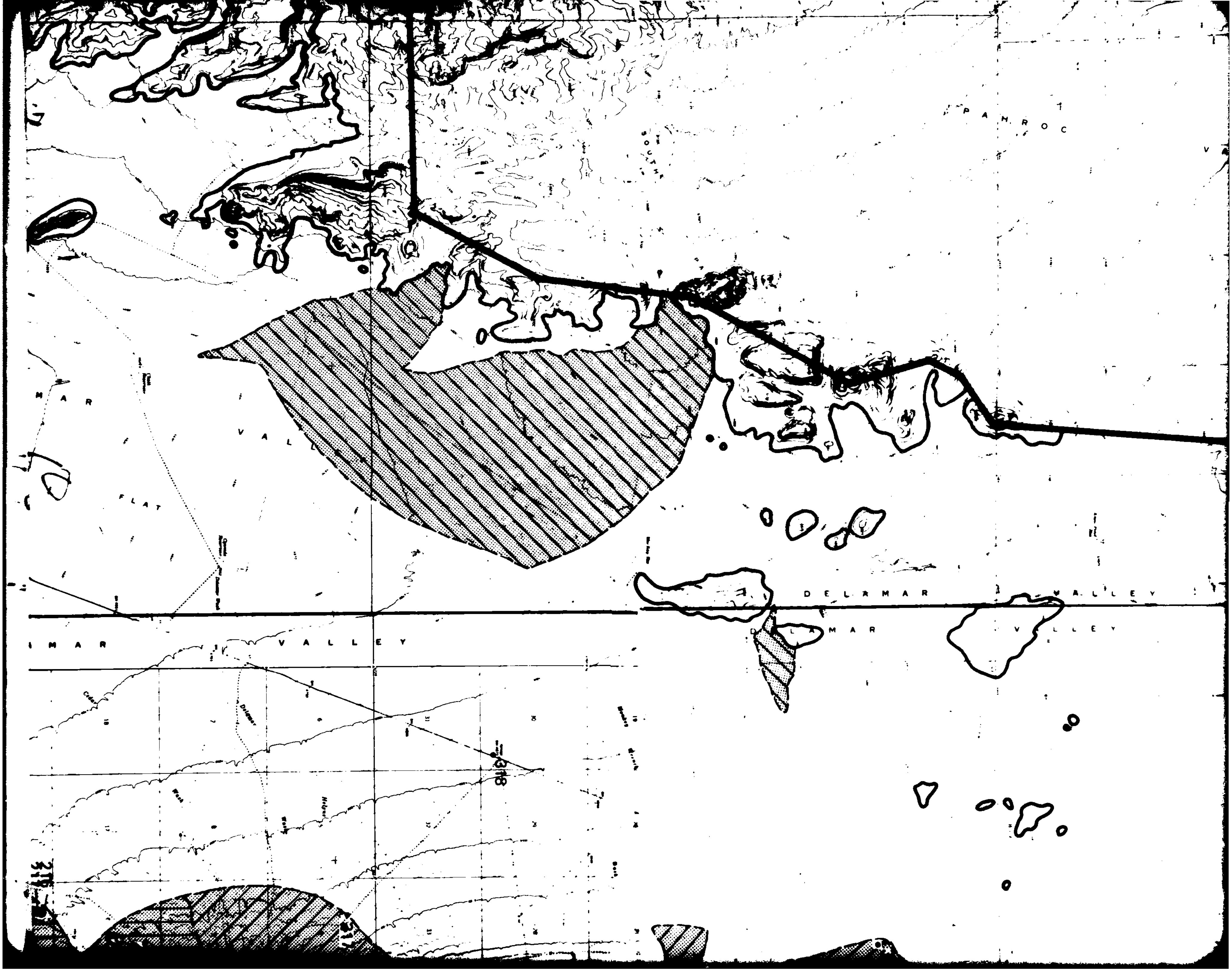
DELAMAR
VALLEY
DELAMAR
VALLEY
FLAT
301
202
307
302
203
204
205
309
303
308
304
310
311
318
317
335

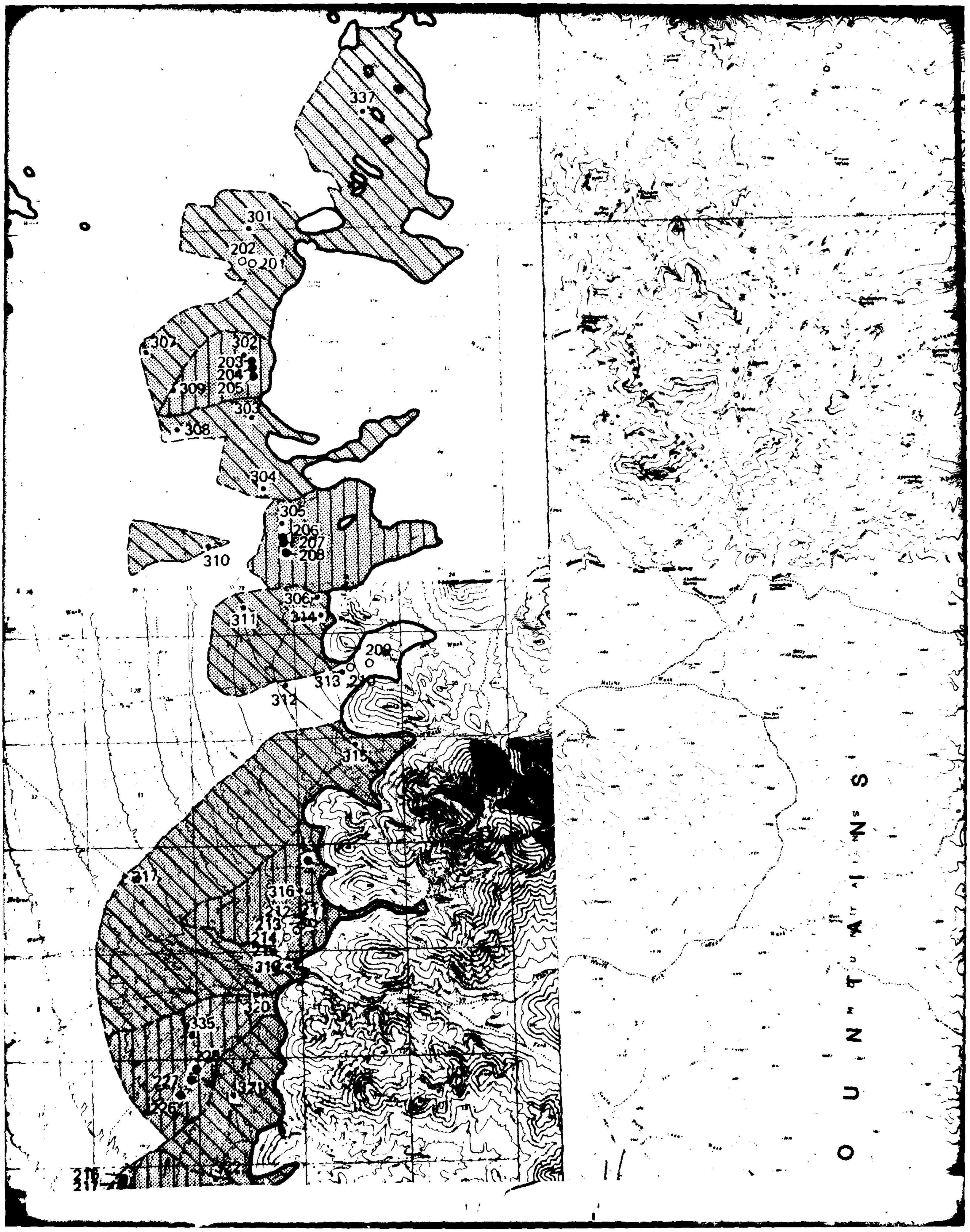


337
301
202
201
307
302
203
204
205
309
303
308
304
305
206
207
208
310
306
314
311
209
313
210
312
315
317
316
212
213
319
320
335
227

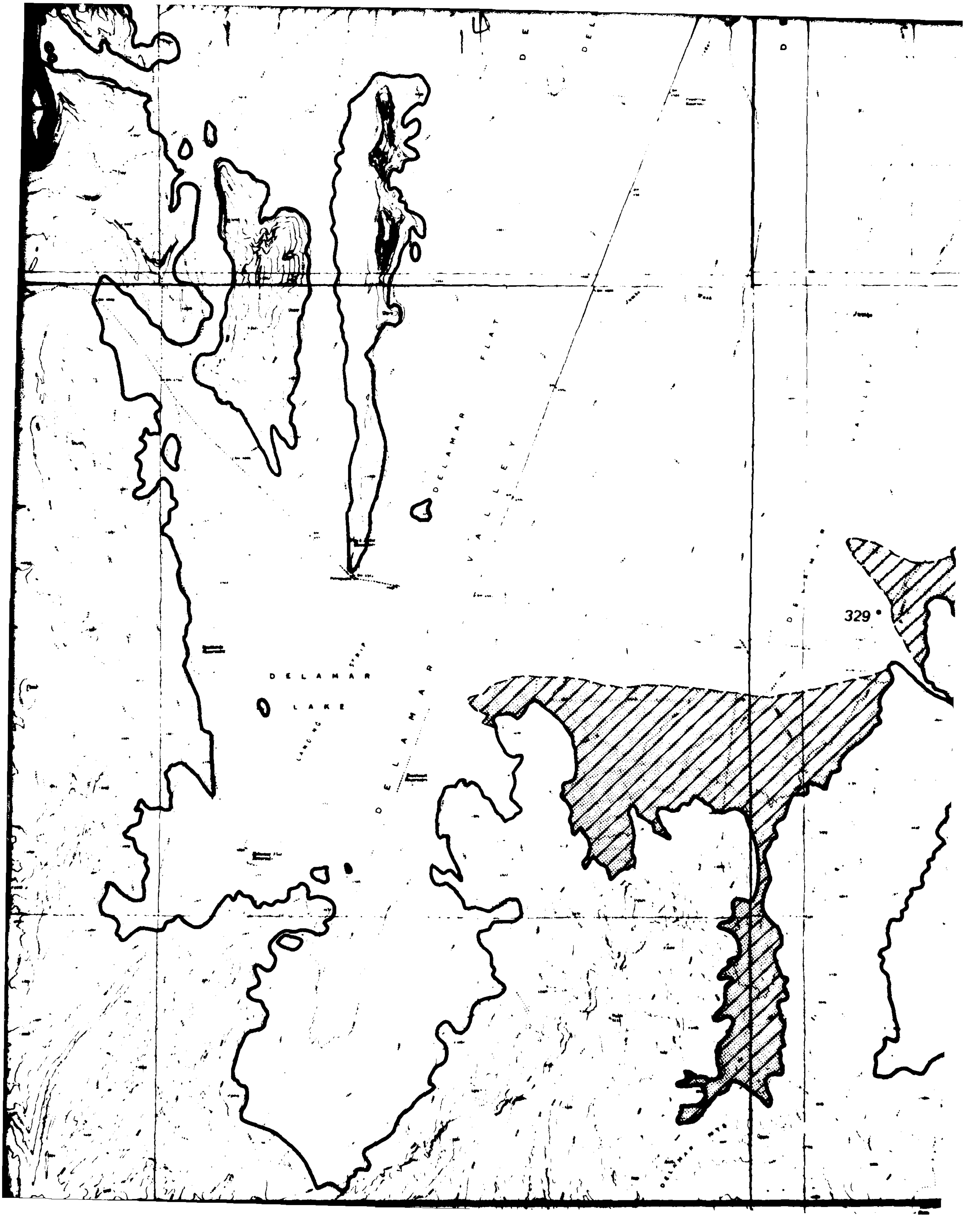

Canyon
Canyon
Canyon
Canyon
Rock
Springs
Canyon

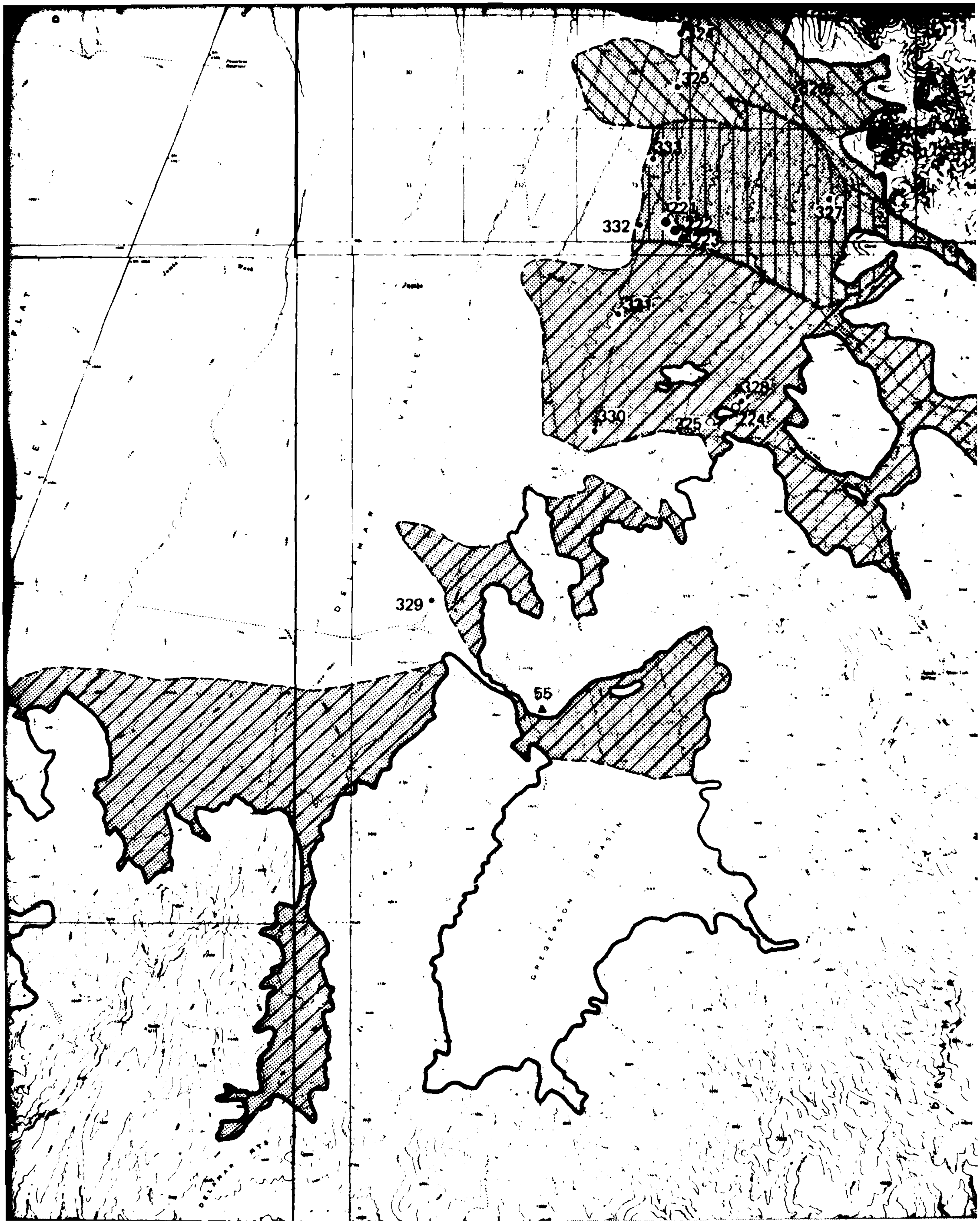

37° 30'
PAHROC RANGE
SOUTH PAHROC
SOUTH


PAHROC
SOUTH
DELMAR VALLEY
DELMAR VALLEY
FLAT
318
317

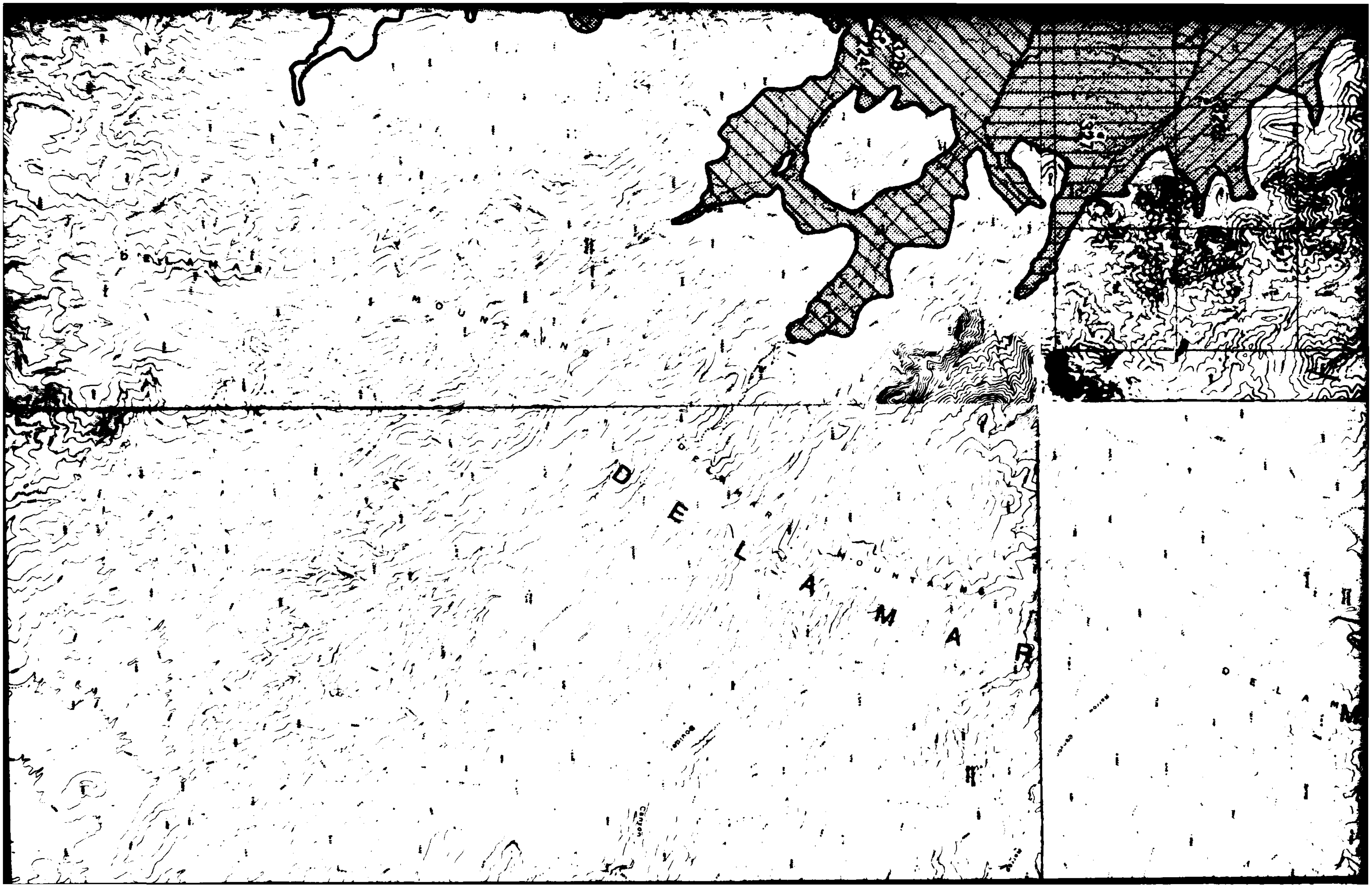

337
301
202
201
302
307
203
204
205
309
303
308
304
305
206
207
208
310
306
311
314
209
313
312
315
317
316
212
213
319
320
335
227

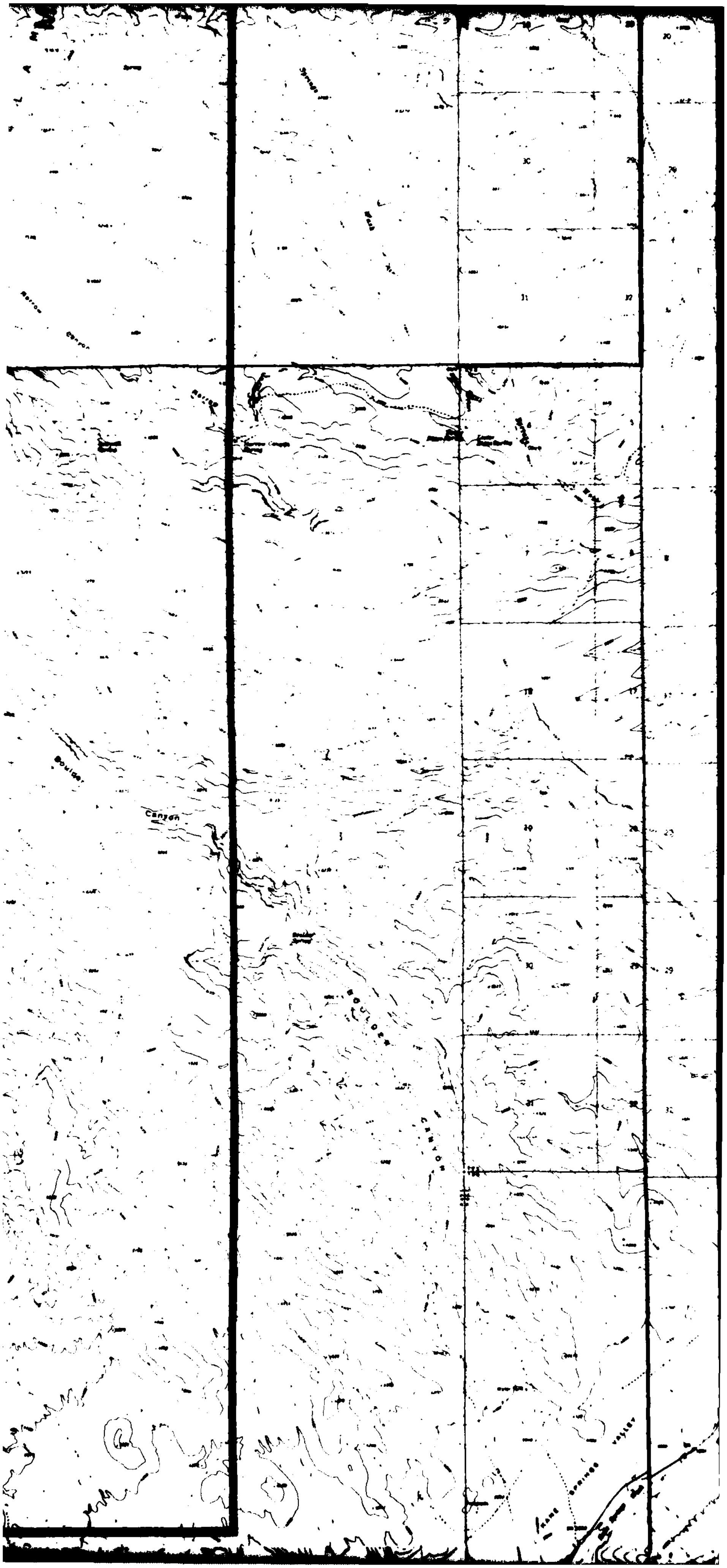
Buckboard
Canyon
Canyon
Canyon
Rock
Springs
Canyon
INDIAN
BASIN


DELAMAR
LAKE
DELAMAR VALLEY
FLAT
DELAMAR
329



324
325
326
331
327
332
321
328
330
225
224
329
55
VALLEY
DELAMAR
GREGERSON BASIN


DELAMAR
DELAMAR MOUNTAINS
DELAMAR
MOUNTAINS
Canyon


Canyon
BOULDER
CANYON

115° 00′

ERTEC WESTERN AGGREGATE RESOURCES STUDY FIELD STATIONS

VALLEY–SPECIFIC AGGREGATE RESOURCES STUDY
(MAP NUMBERS FROM 1 TO 199)

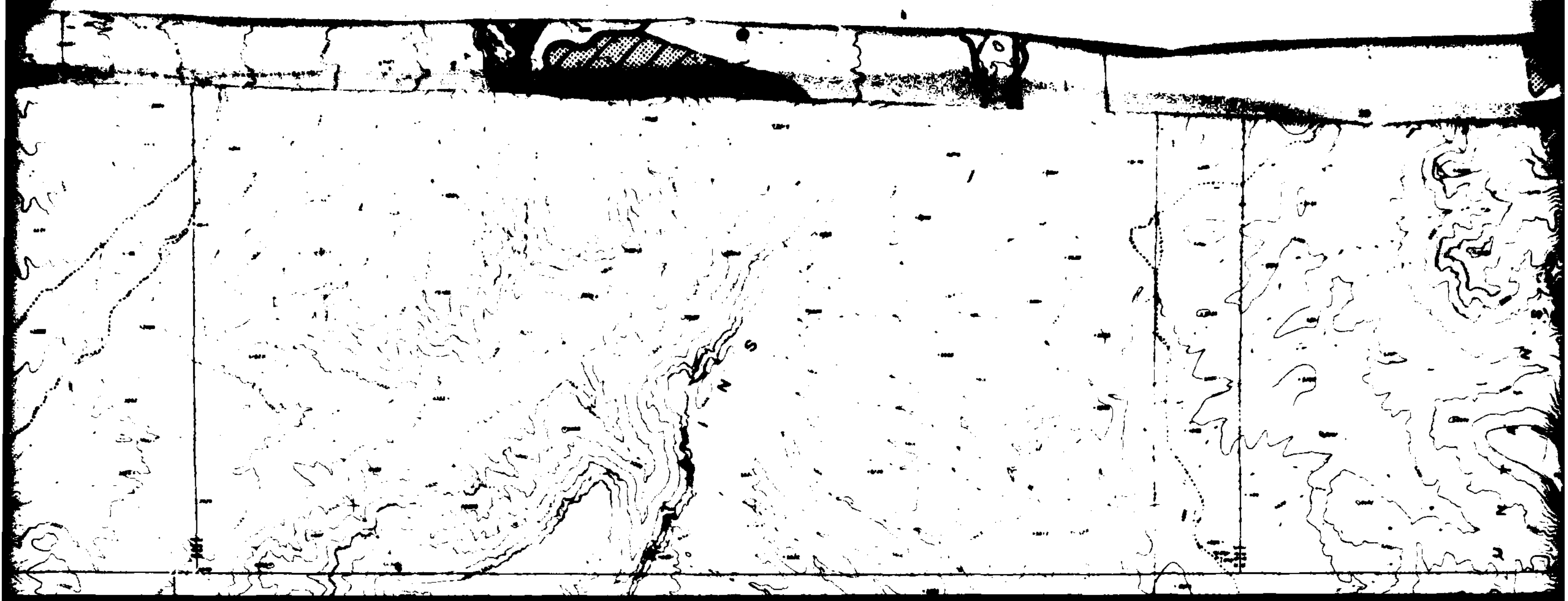
BASIN–FILL UNITS (COARSE AND/OR FINE AGGREGATES)

- ● DATA STOP, SAMPLED AND TESTED
- ○ DATA STOP

ROCK UNITS (CRUSHED-ROCK AGGREGATES)

- ▲ DATA STOP, SAMPLED AND TESTED
- △ DATA STOP

DETAILED AGGREGATE RESOURCES STUDY * *
(MAP NUMBERS FROM 200 TO



EXPLANATION

IONS

AGGREGATE CLASSIFICATION SYSTEM

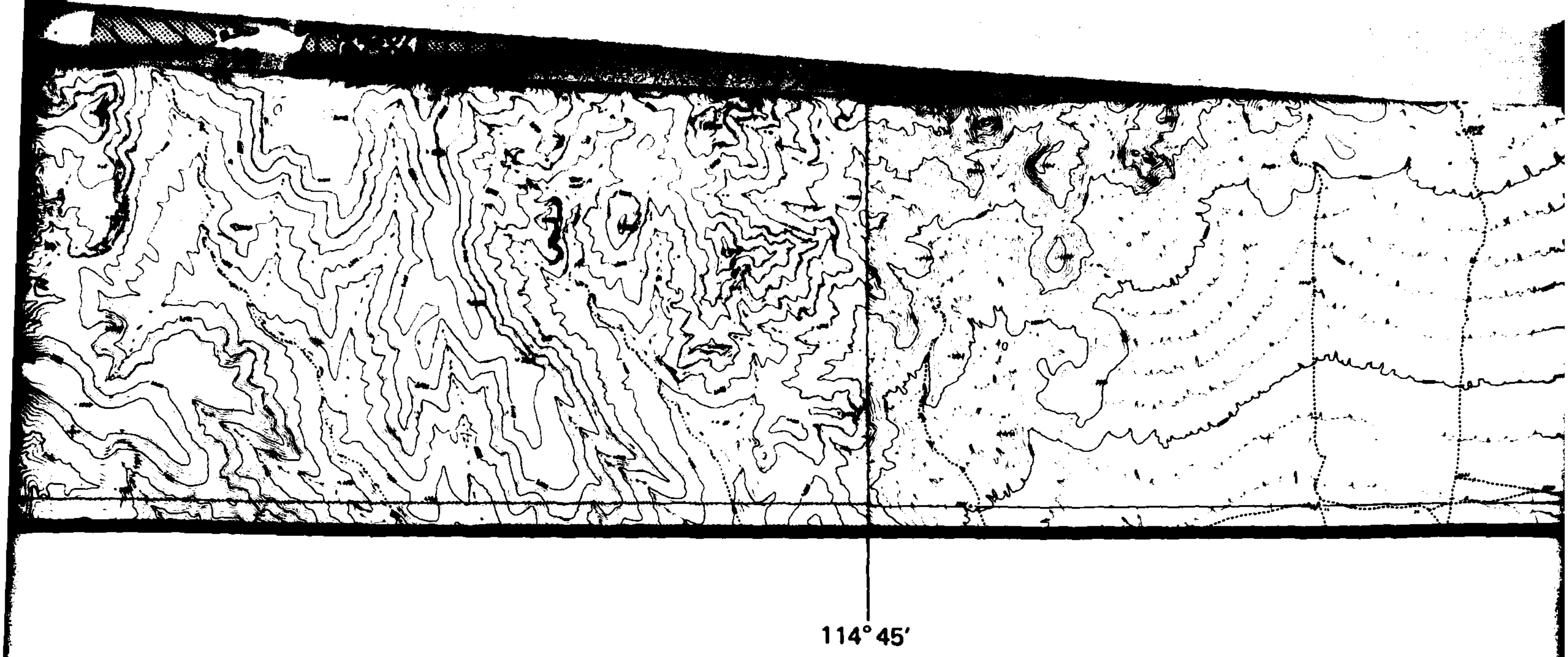
REGATES)

BASIN–FILL AND ROCK SOURCES* * *

RBIa		BASIN FILL ROCK	BASIN–FILL OR ROCK SOURCES CONTAINING MATERIALS SUITABLE FOR USE AS ROAD-BASE AGGREGATES; BASED ON ACCEPTABLE LABORATORY AGGREGATE TEST RESULTS.
RBIb		BASIN FILL	BASIN–FILL SOURCES CONTAINING MATERIALS SUITABLE FOR USE AS ROAD-BASE AGGREGATES; BASED ON CORRELATION WITH CLASS RBIa SOURC AREAS.
RBII		BASIN FILL	POTENTIAL BASIN–FILL SOURCES OF MATERIALS SUITABLE FOR USE AS ROAD-BASE AGGREGATES; BASED ON PHOTOGEOLOGIC INTERPRETATIONS, F OBSERVATIONS, AND LIMITED OR INCONCLUSIVE ANALYSIS AND/OR ABRASION DATA.

19

UNSUITABLE SOURCES OF BASIN–FILL MATERIAL THAT MAY LOCALLY CONTAIN POTENTIALLY SU SOURCES OF AGGREGATES OF LIMITED



GEOLOGIC UNITS †

BASIN–FILL UNITS

Aal	STREAM-CHANNEL AND/OR TERRACE DEPOSITS	(A1/A2)
Aaf	ALLUVIAL FAN DEPOSITS	(A5)

† SEE APPENDIX TABLE F-3 FOR SYMBOL EXPLANATION AND COMPARISON

SYMBOLS ††

(heavy line)	STUDY AREA BOUNDARY
(solid line)	ROCK/BASIN–FILL CONTACT
(dashed line)	GEOLOGIC ROCK CONTACT

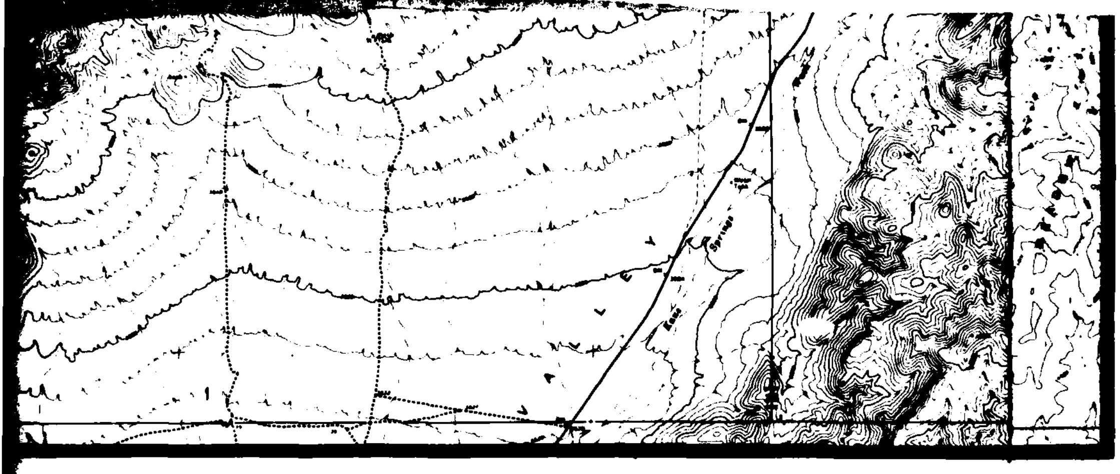
BE
RA-

LS
TES;
OURCE

ALS
TES;
NS, FIELD
SIVE SIEVE

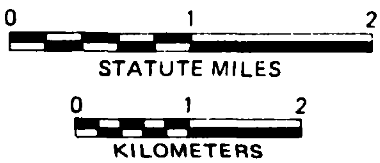
RIALS
SUITABLE
NT.

20



SCALE 1:62,500

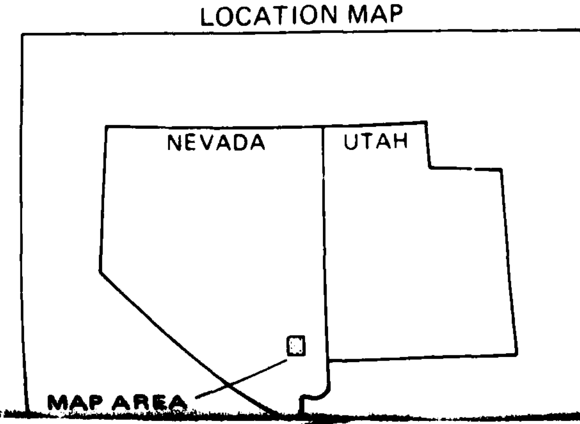
DEPOSITS (A1/A2)



(A5)

ND COMPARISON

LOCATION MAP



▵ DATA STOP

<u>DETAILED AGGREGATE RESOURCES STUDY</u> * *

(MAP NUMBERS FROM 200 TO 299 FOR BASIN–FILL AND ROCK SAMPLE LOCATIONS; 300 TO 399 FOR FIELD PETROGRAPHIC STATIONS)

<u>BASIN–FILL UNITS</u> (COARSE AND/OR FINE AGGREGAT

● DATA STOP, SAMPLED AND TESTED

○ DATA STOP

<u>ROCK UNITS</u> (CRUSHED ROCK AGGREGATES)

▲ DATA STOP, SAMPLED AND TESTED

<u>PETROGRAPHIC FIELD STATIONS</u>

• DATA STOP

* SEE DRY LAKE, MULESHOE, DELAMAR, PAHROC VSARS REPORT (FN-TR-37-a) FOR DETAILED INFORMATION.

* * SEE CORRESPONDING MAP NUMBER IN APPENDICES A AND B FOR DETAILED INFORMATION.

RBII		BASIN FILL	BASED ON PHOTOGEOLOGIC INTERPRETATIONS, FIELD OBSERVATIONS, AND LIMITED OR INCONCLUSIVE SIEVE ANALYSIS AND/OR ABRASION DATA.
			UNSUITABLE SOURCES OF BASIN–FILL MATERIALS THAT MAY LOCALLY CONTAIN POTENTIALLY SUITABLE SOURCES OF AGGREGATES OF LIMITED EXTENT. UNTESTED SOURCES OF ROCK MATERIALS THAT MAY CONTAIN POTENTIALLY SUITABLE CRUSHED ROCK AGGREGATES (SEE TEXT FOR ADDITIONAL INFORMATION).

* * * A COMPLETE CLASSIFICATION SYSTEM IS SHOWN, ALTHOUGH ALL BASIN–FILL OR ROCK SOURCES MAY NOT BE PRESENT WITHIN THE STUDY AREA.

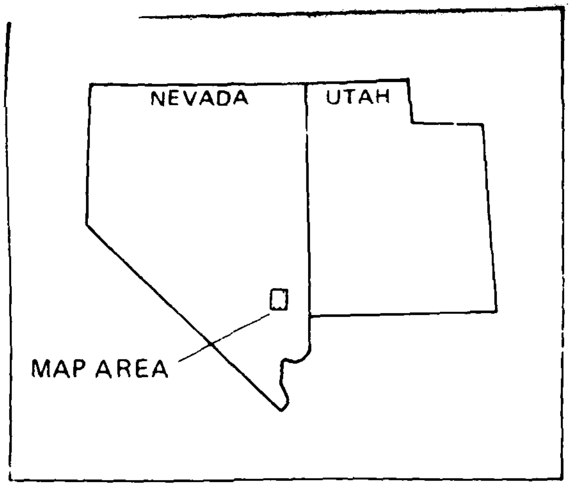
S:
, FIELD
VE SIEVE

IALS
UITABLE
T.
T MAY
OCK
ORMA-

SYMBOLS ††

(heavy line)	STUDY AREA BOUNDARY
(line)	ROCK/BASIN–FILL CONTACT
(long dash)	GEOLOGIC ROCK CONTACT
(short dash)	BASIN–FILL CONTACT

†† GEOLOGIC ROCK AND BASIN–FILL CONTACTS ARE APPROXIMATELY LOCATED AND MAY VARY LOCALLY.



The Earth Technology Corporation

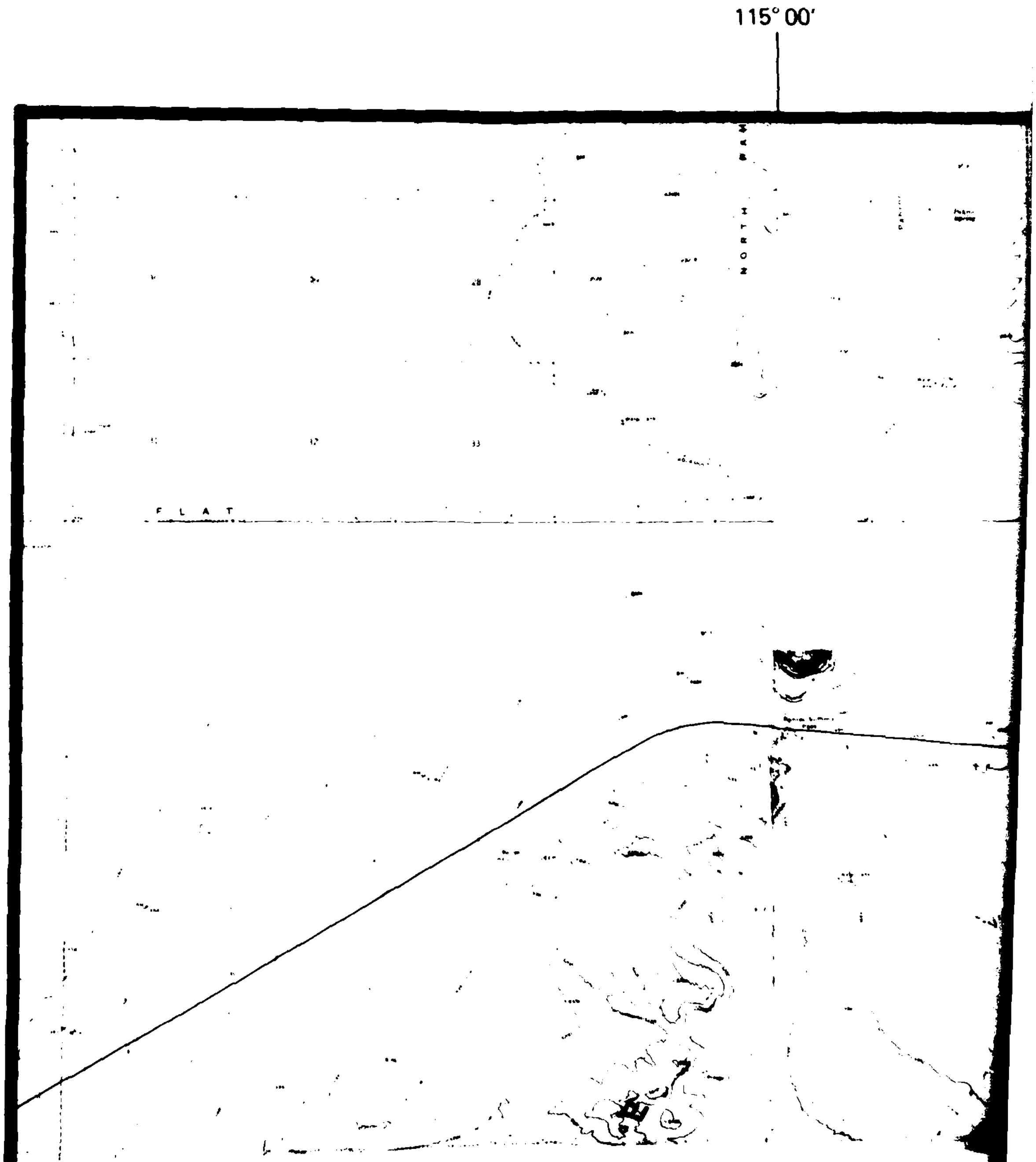
MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

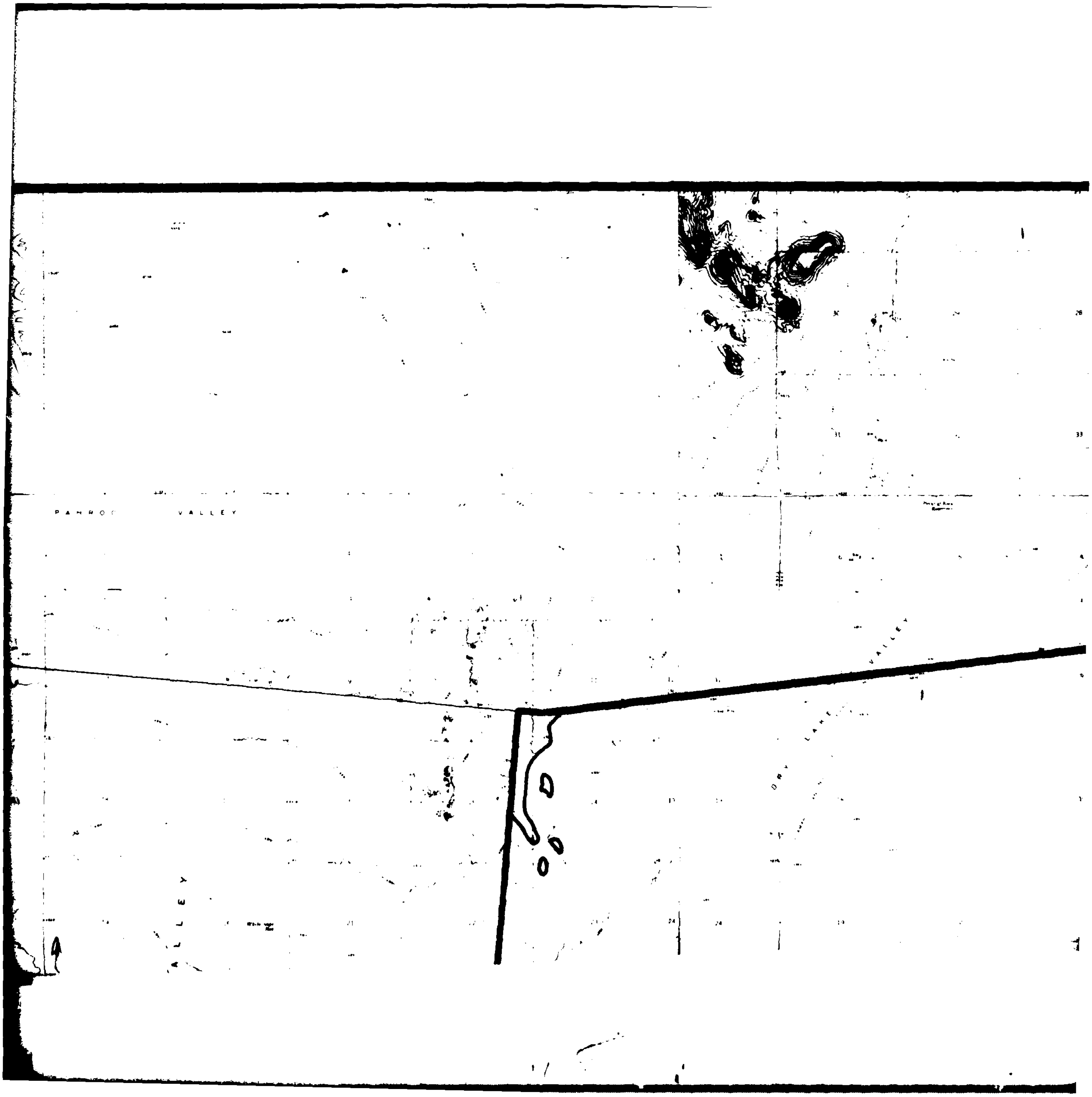
ROAD BASE AGGREGATE RESOURCES MAP
DETAILED AGGREGATE RESOURCES STUDY
DELAMAR VALLEY, NEVADA

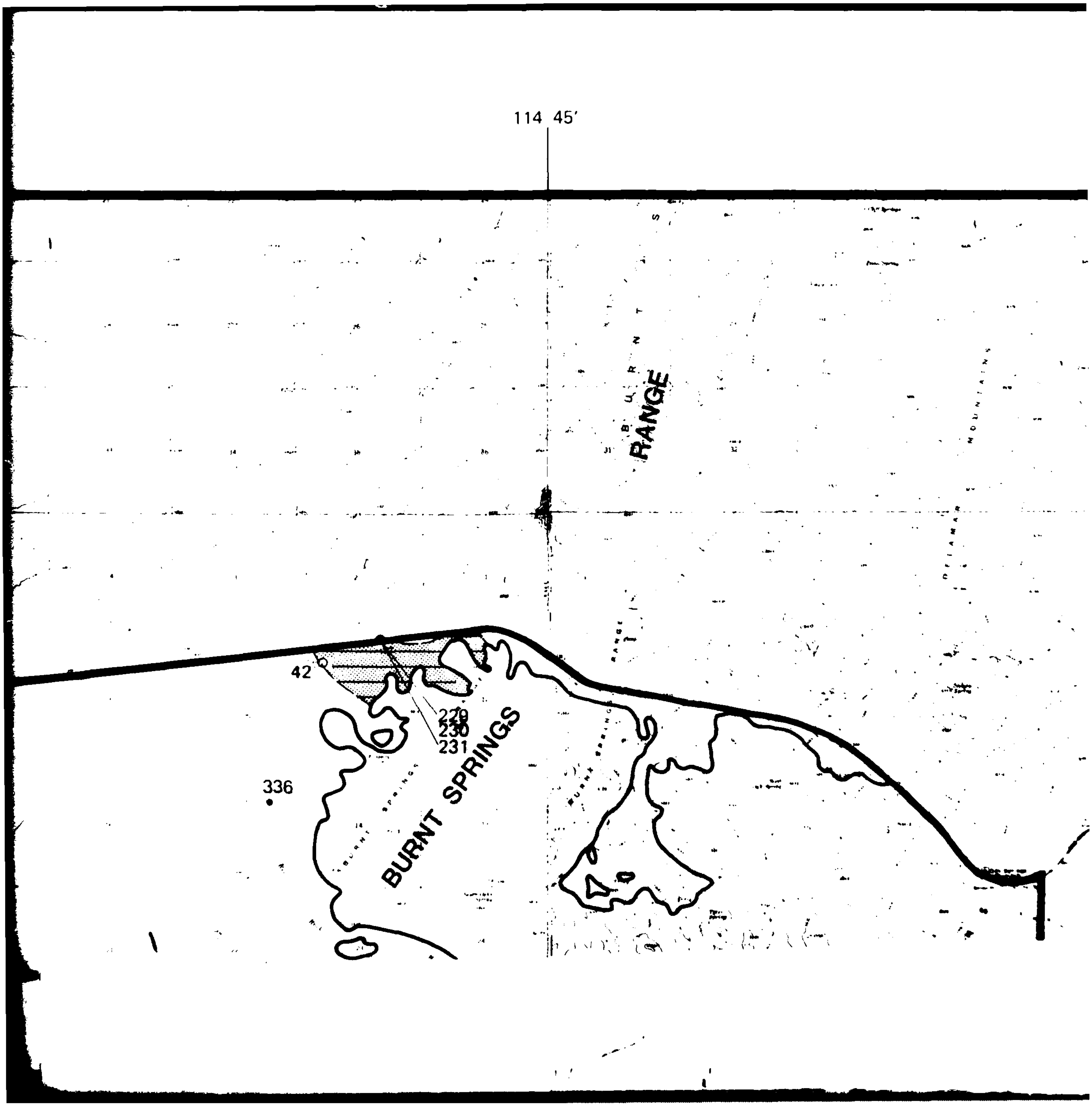
29 MAY 81

DRAWING 2

E-TR-47-DM

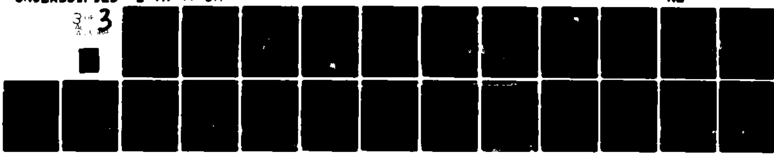



PAHROC VALLEY
DRY LAKE VALLEY


114 45′
RANGE
BURNT SPRINGS
42
229
230
231
336

AD-A113 069 ERTEC WESTERN INC LONG BEACH CA F/G 8/7
MX SITING INVESTIGATION. GEOTECHNICAL EVALUATION. DETAILED AGGR--ETC(U)
MAY 81 F04704-80-C-0006
UNCLASSIFIED E-TR-47-DM NL

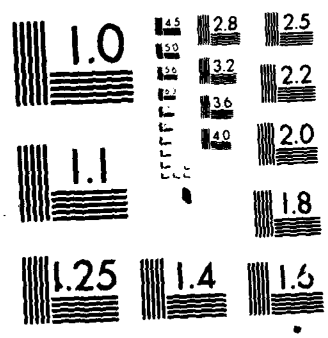
3 OF 3



END
DATE FILMED
4-82
DTIC

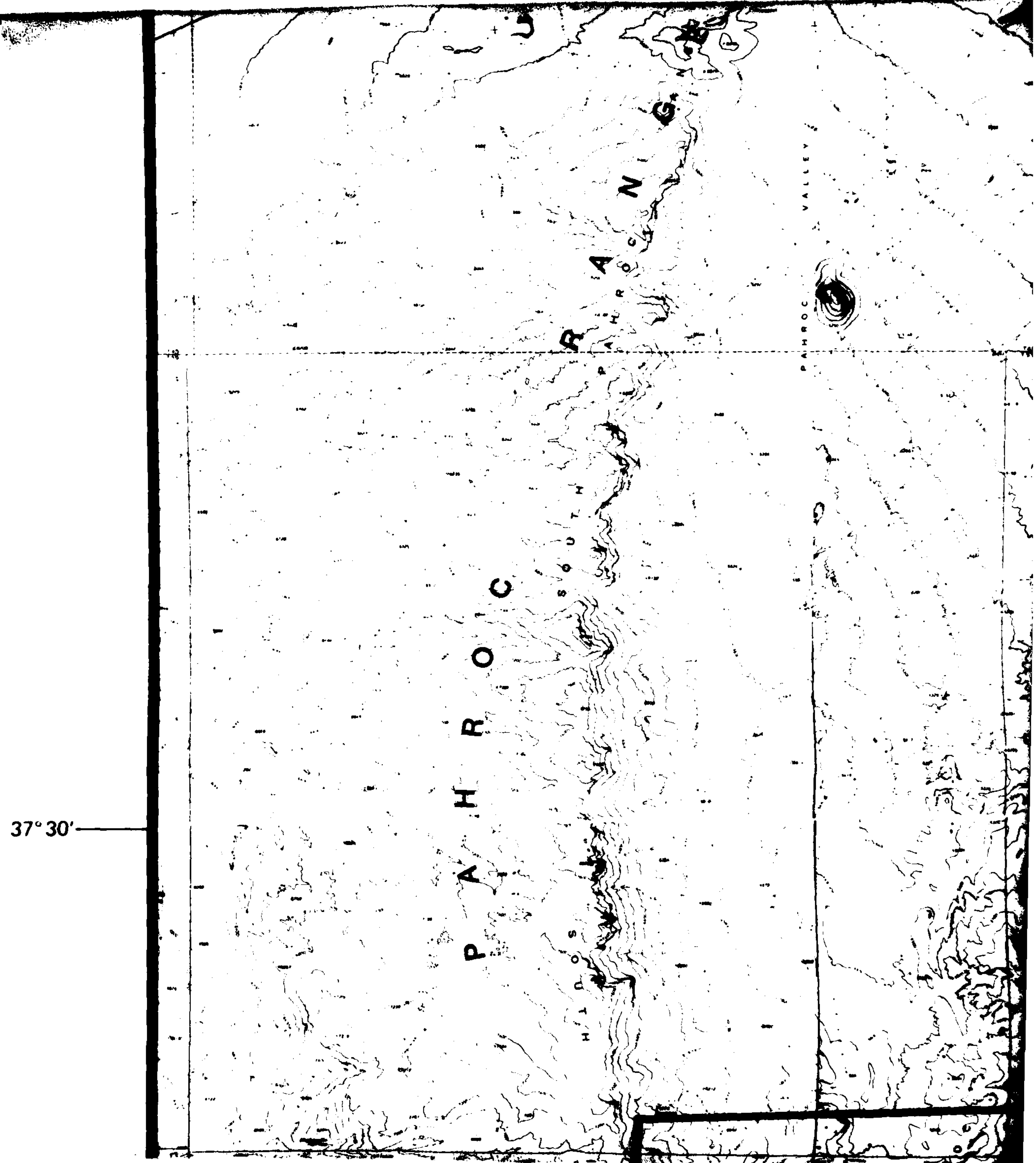
3 OF 3

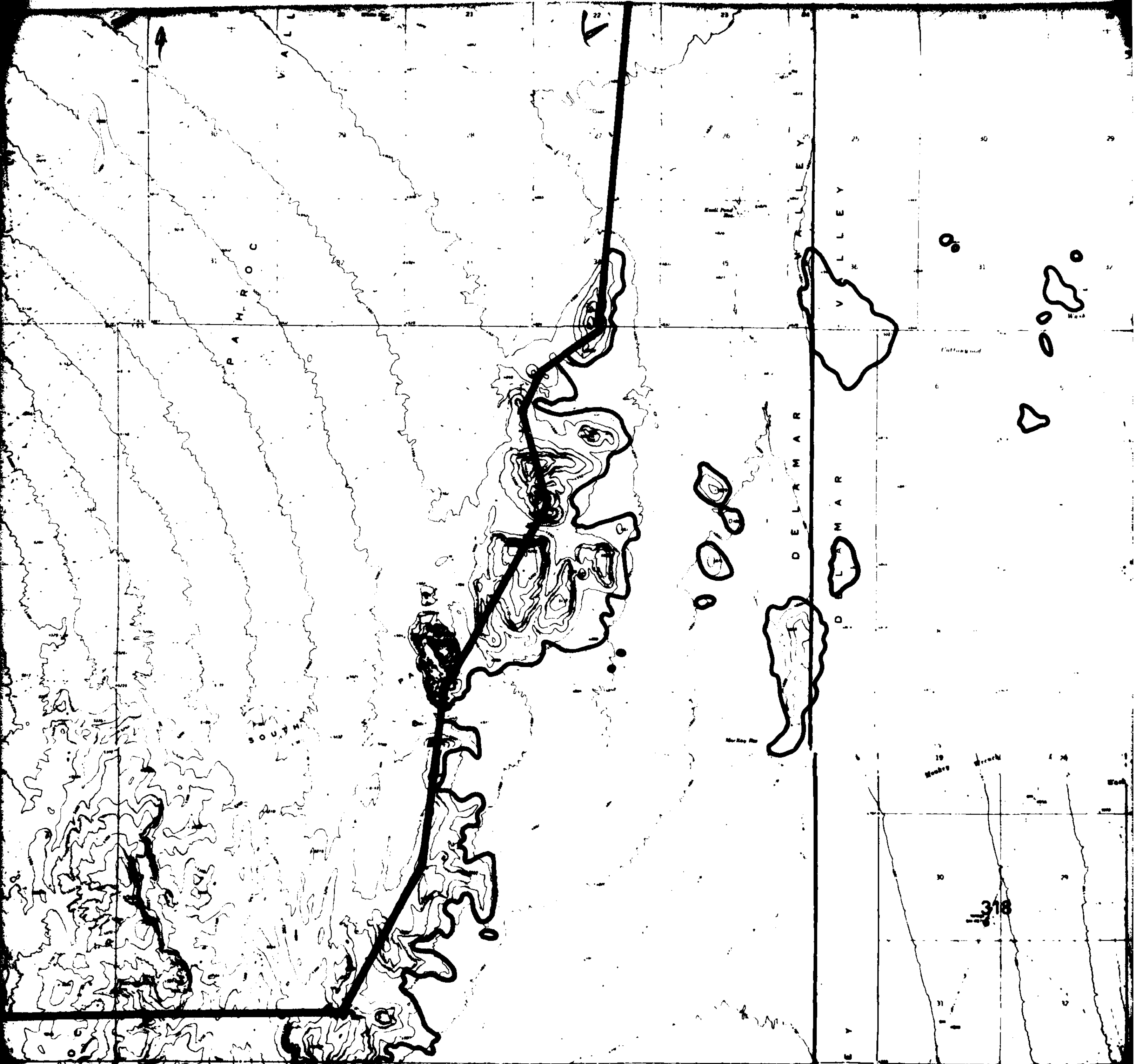
AD A113069



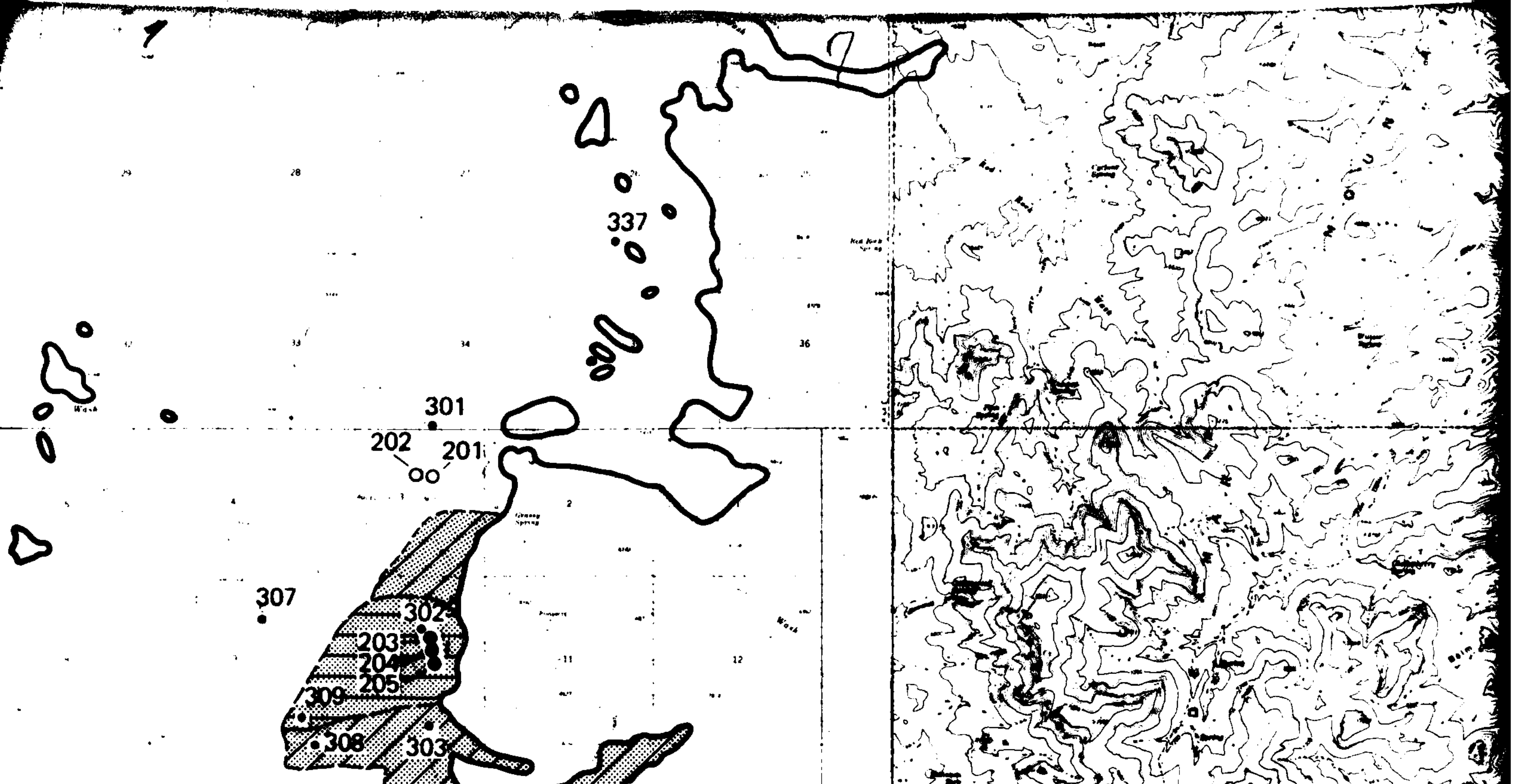
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A


MOUNTAINS

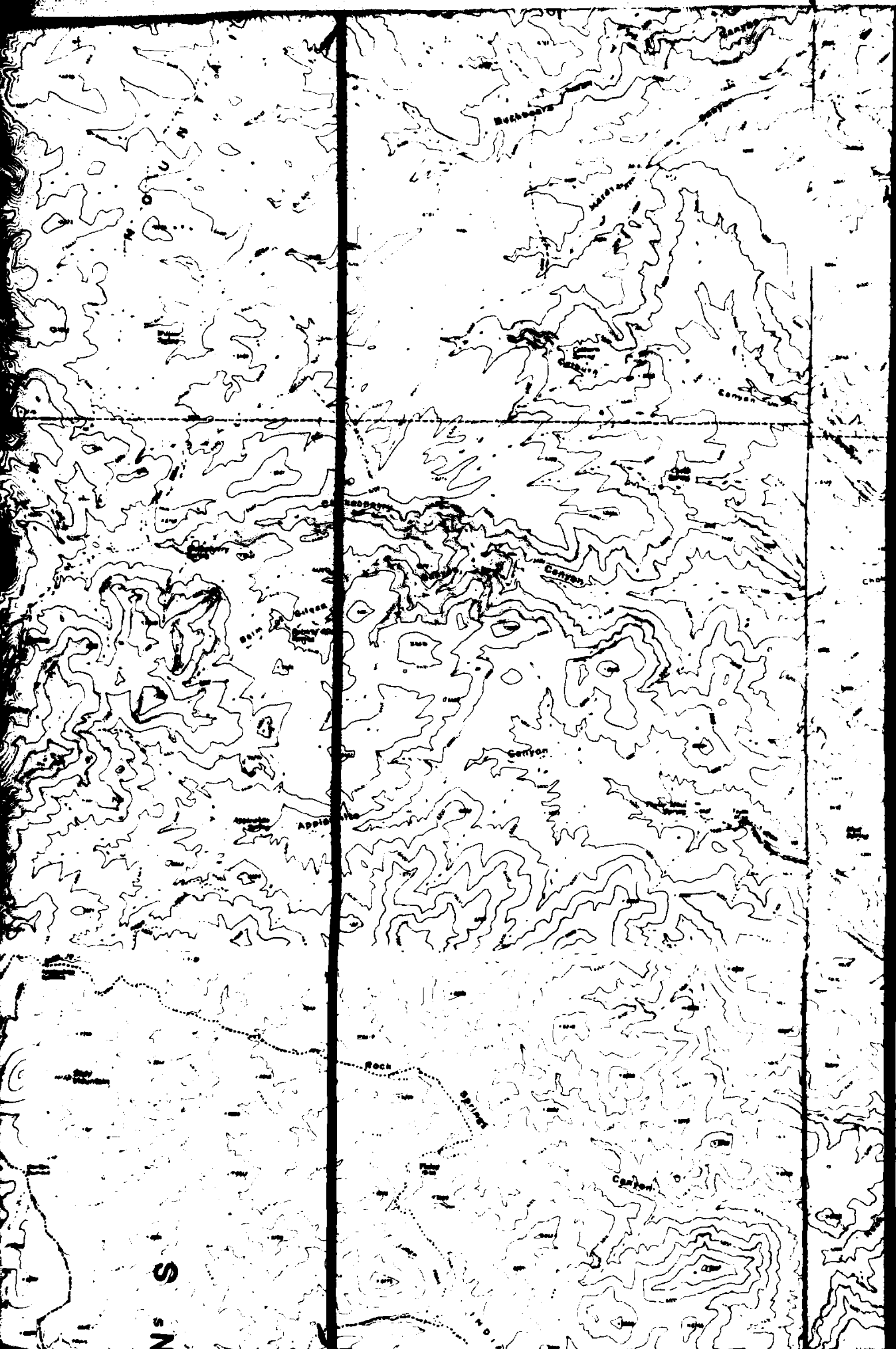

PAHROC RANGE
SOUTH PAHROC
PAHROC VALLEY
37° 30′



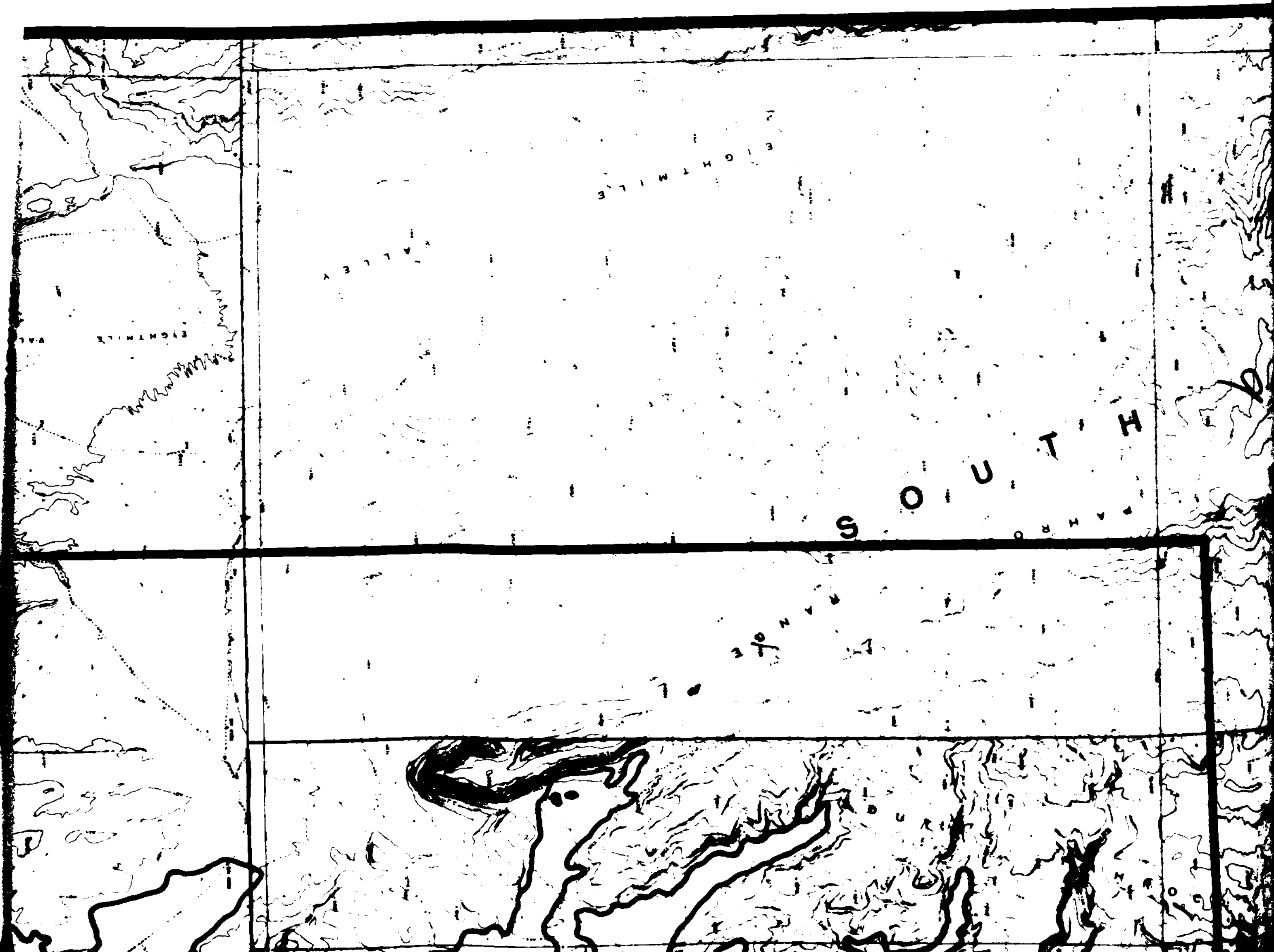
DELAMAR VALLEY
DELAMAR
VALLEY
PAHROC
SOUTH
318

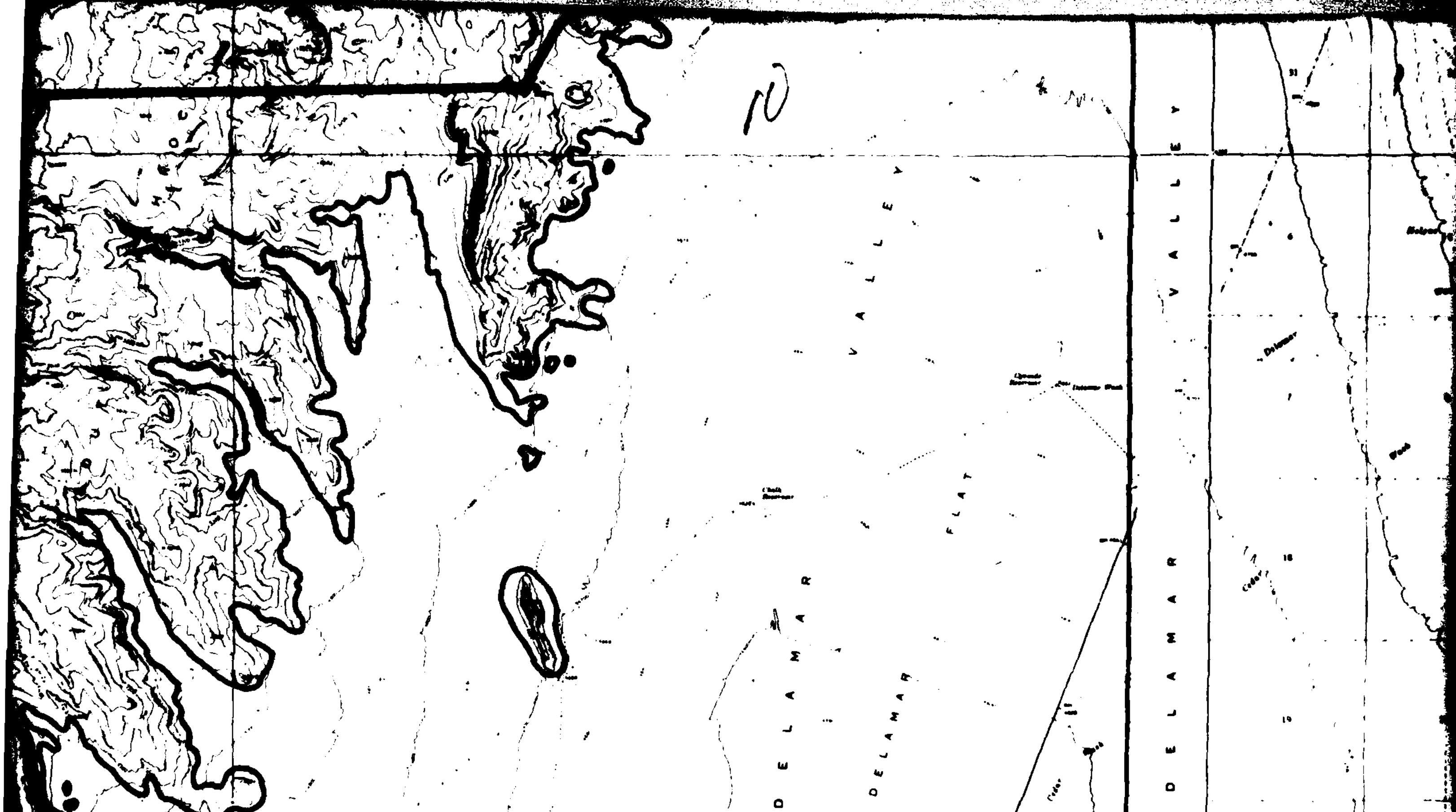


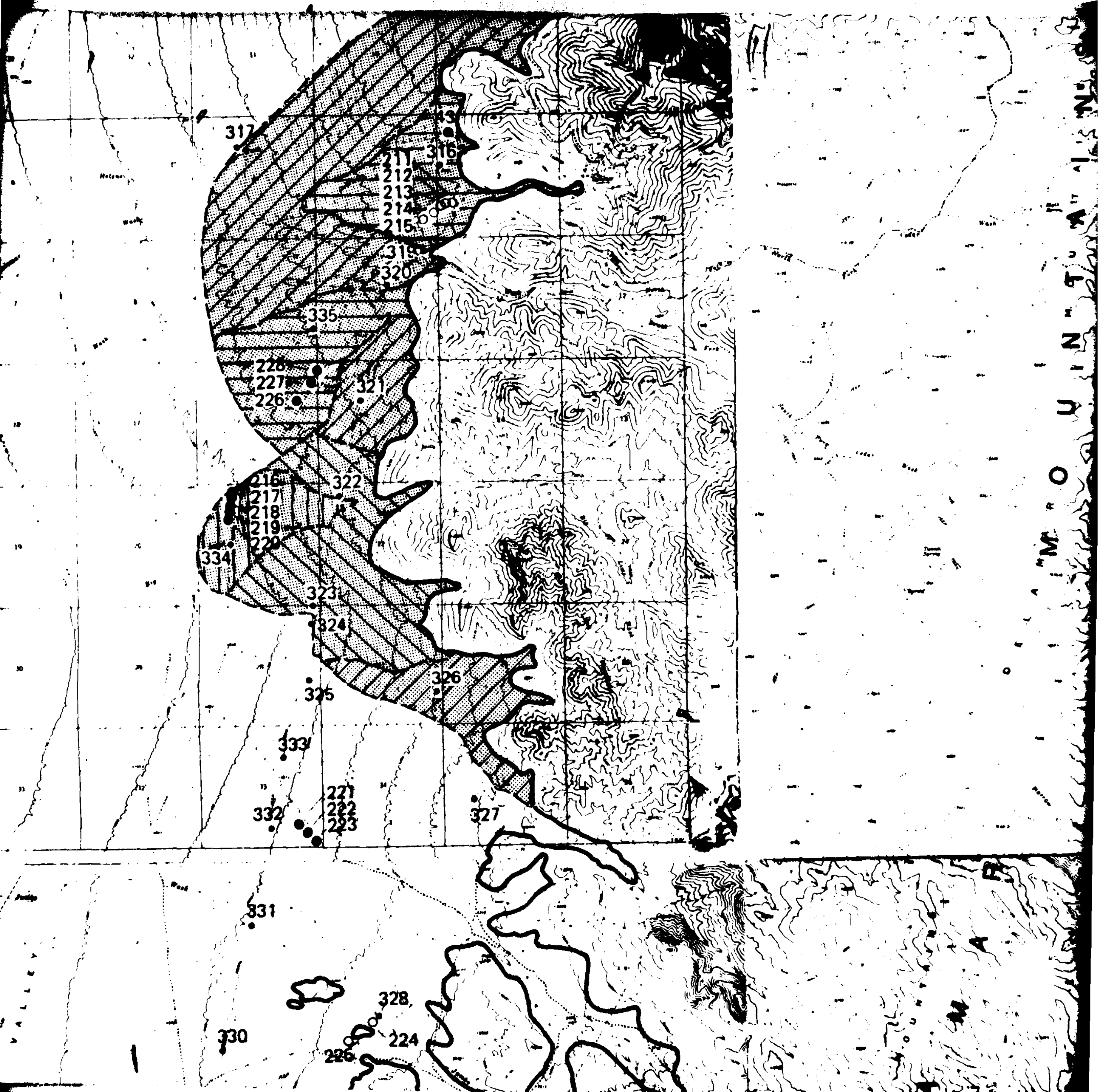
337
301
202
201
307
302
203
204
205
309
308
303
304
305
310
206
207
208
306
311
314
209
312
313
210
315

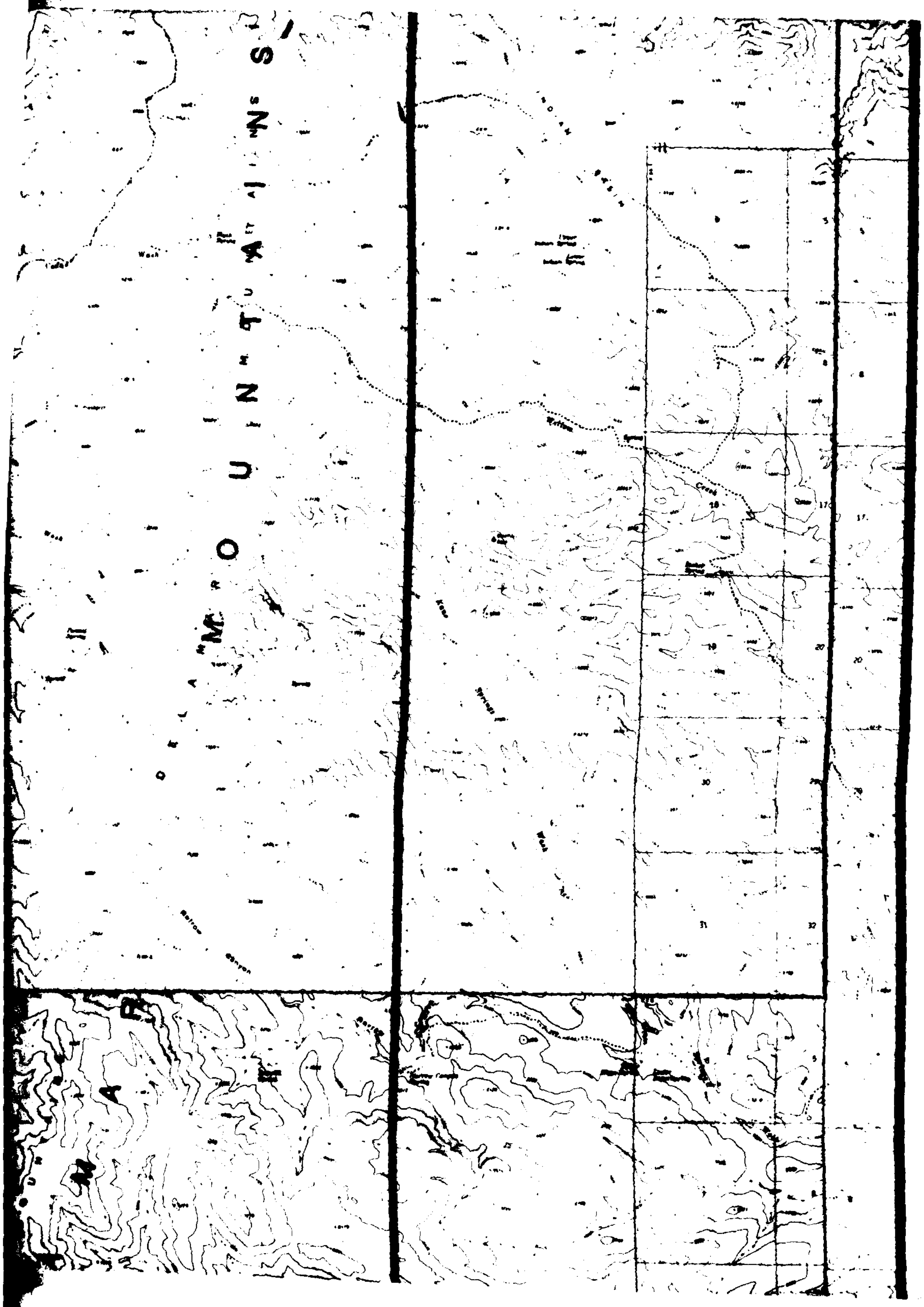


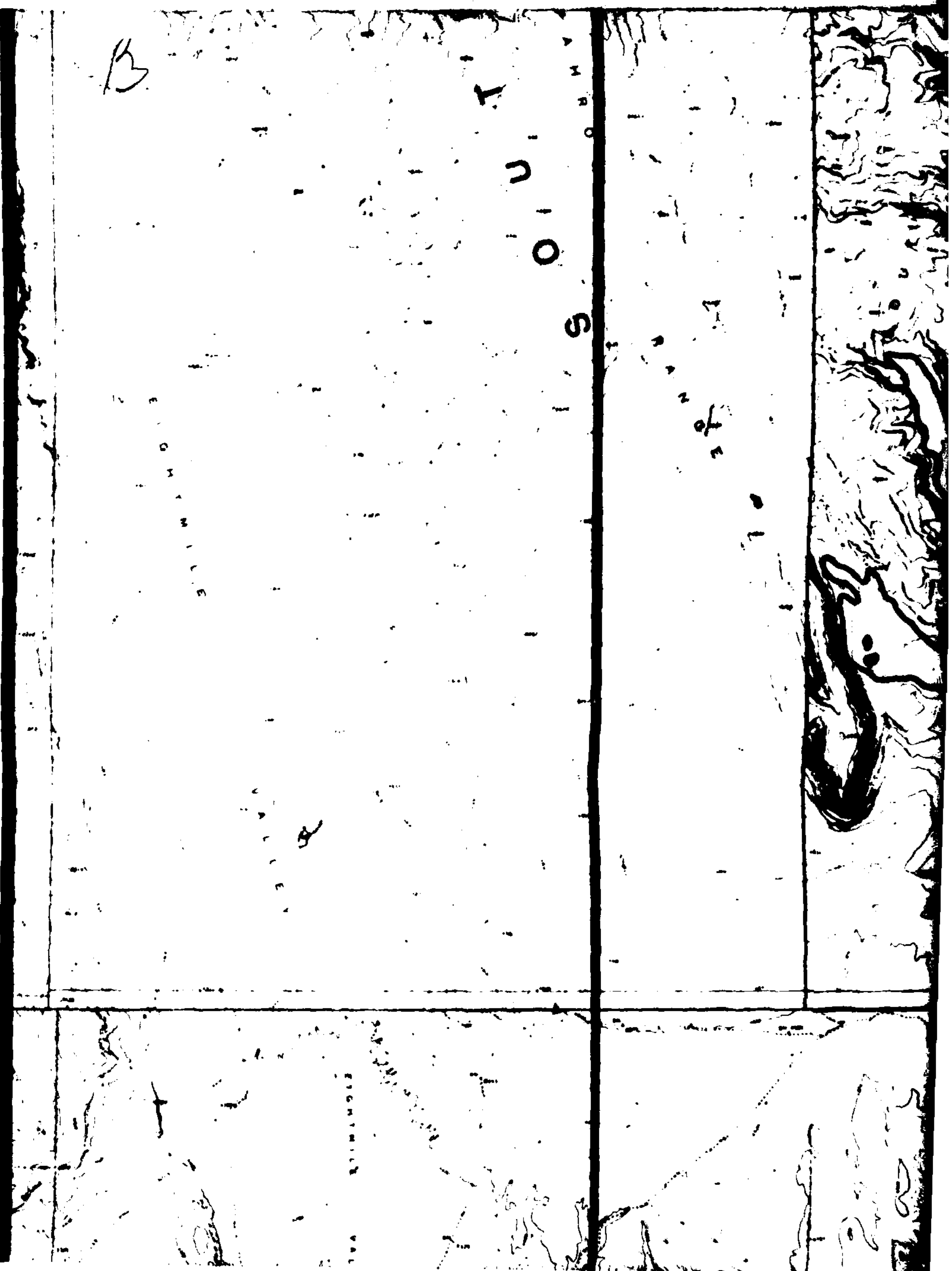
37° 30′


SOUTH
EIGHTMILE
VALLEY

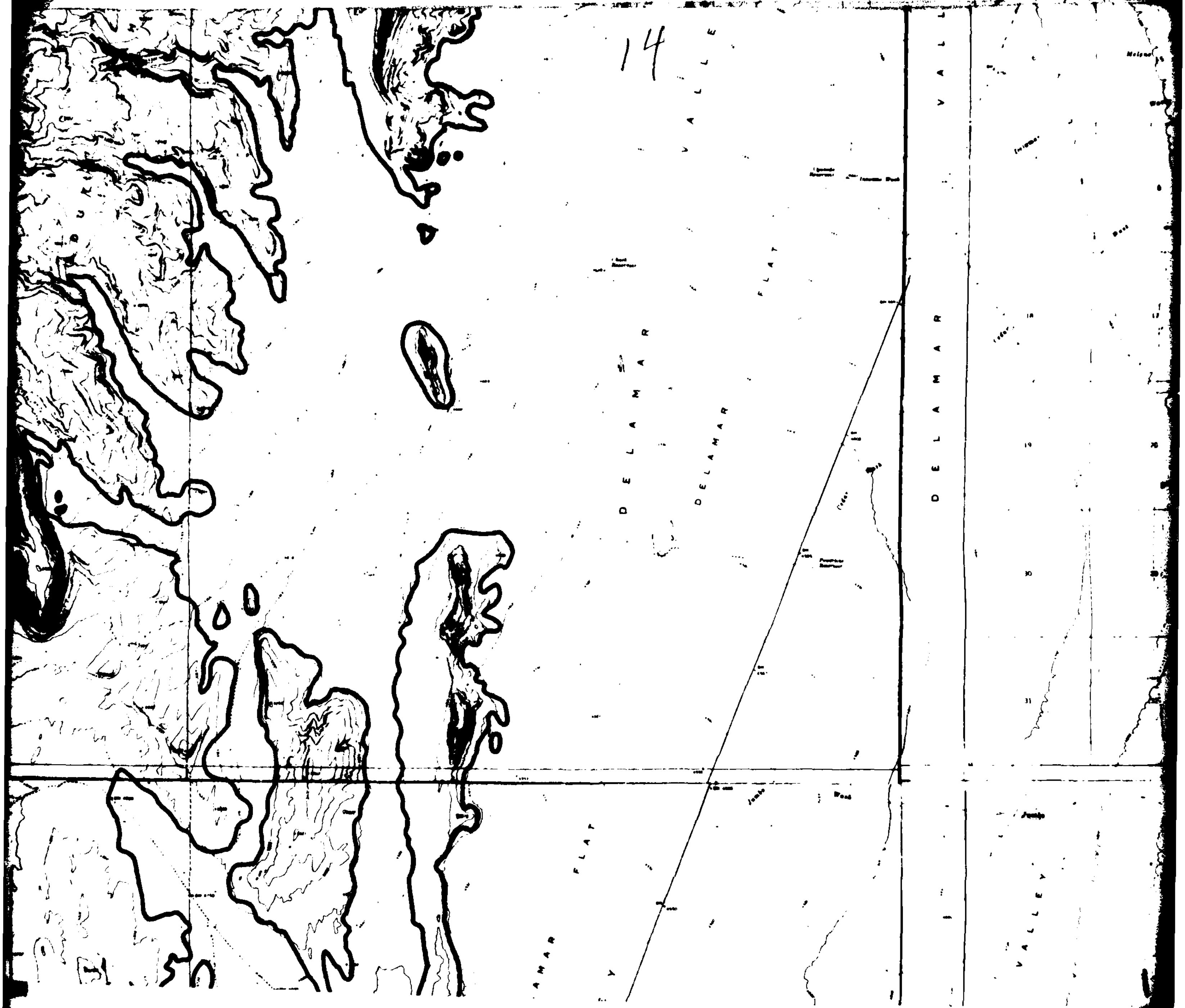

VALLEY
DELAMAR FLAT
DELAMAR
DELAMAR
VALLEY
DELAMAR
VALLEY

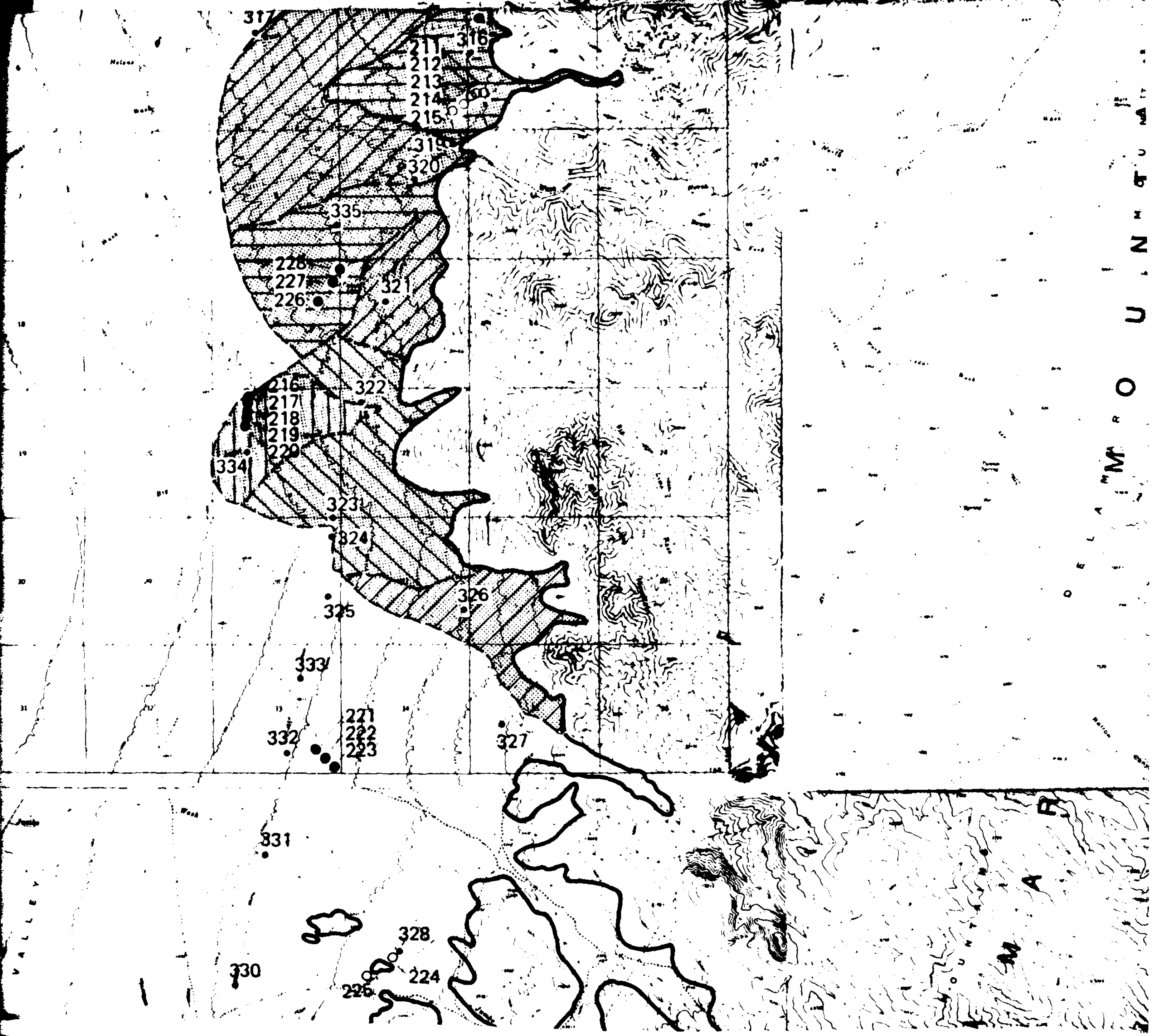

317
316
211
212
213
214
215
319
320
335
228
227
226
321
216
217
218
219
220
334
322
323
324
325
326
333
332
221
222
223
327
331
330
328
224
225
M O U N T A I N S
VALLEY

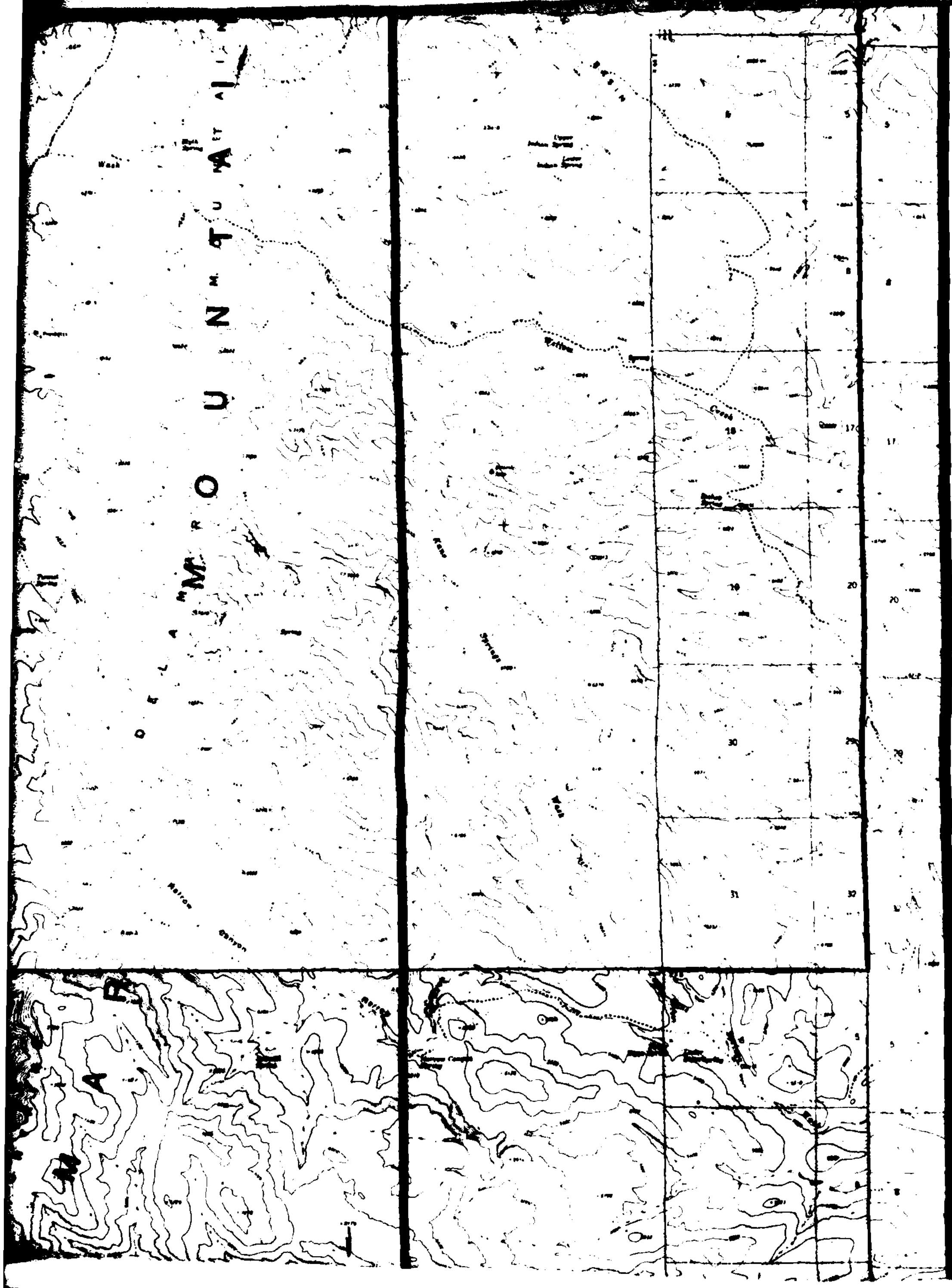

MOUNTAINS



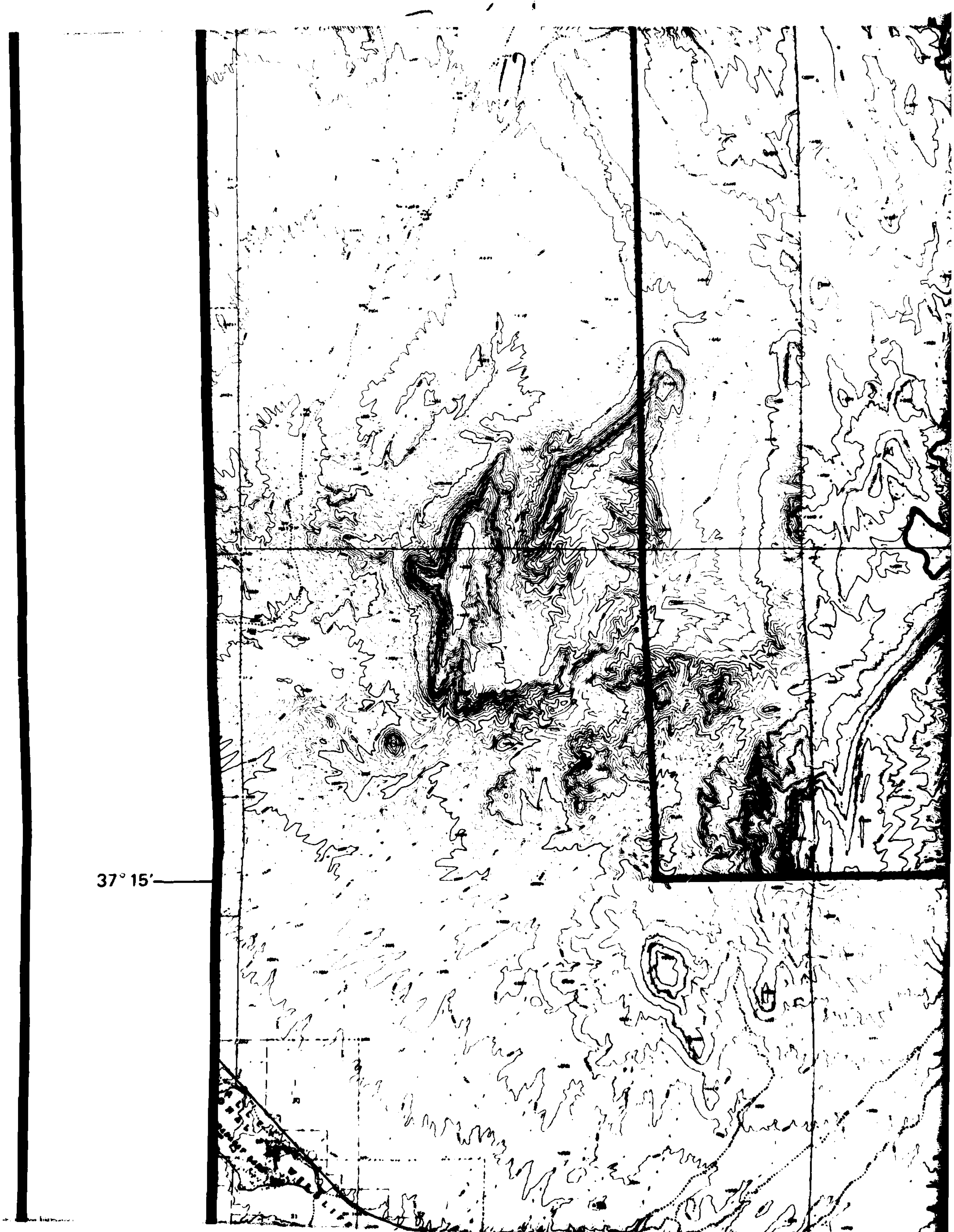
EIGHTMILE
VALLEY
RANGE

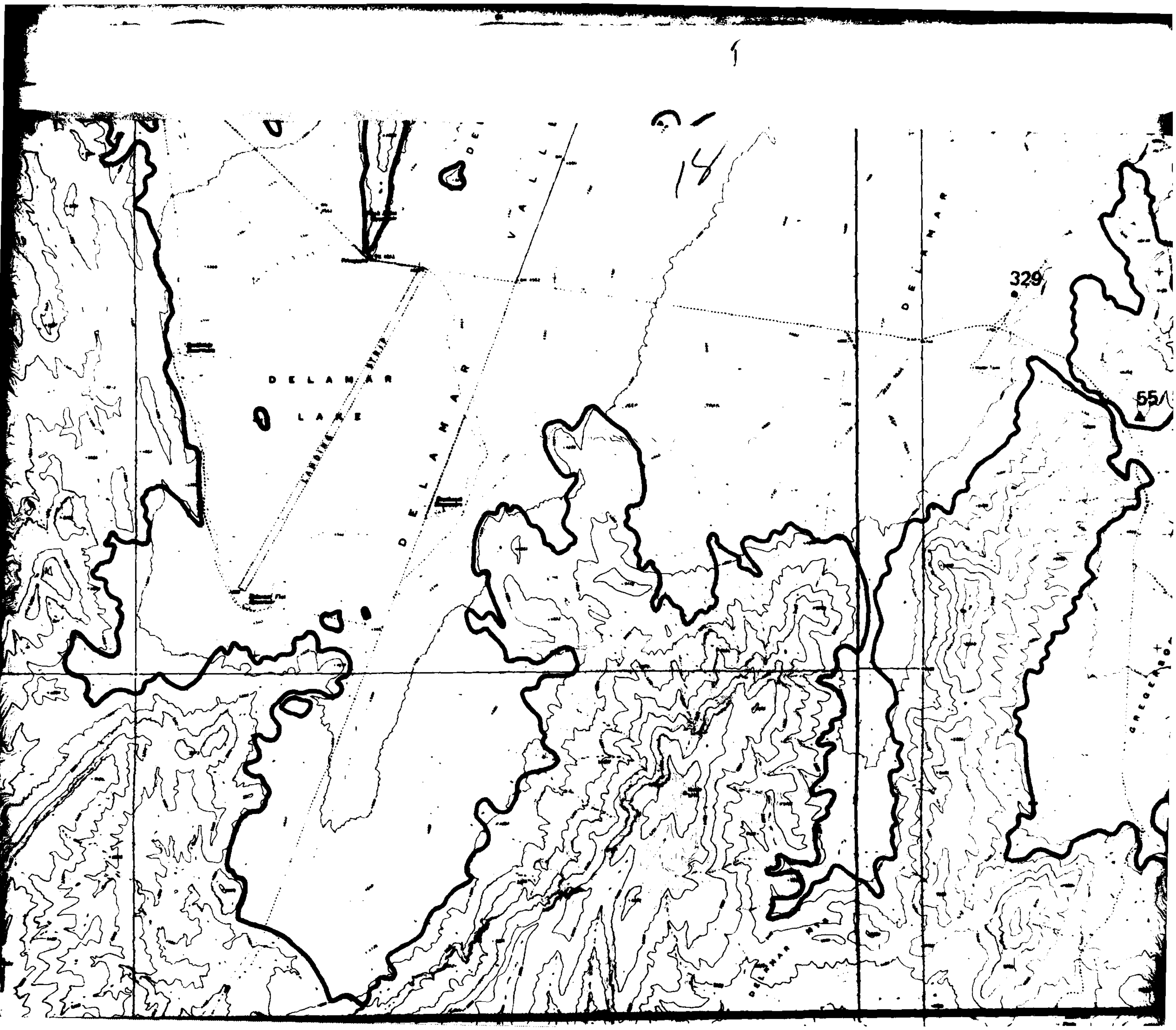

14
DELAMAR
DELAMAR FLAT
DELAMAR VALLEY
VALLEY


316
211
212
213
214
215
319
320
335
228
227
226
321
216
217
218
219
220
322
334
323
324
326
325
333
221
222
223
332
327
331
328
330
224
225

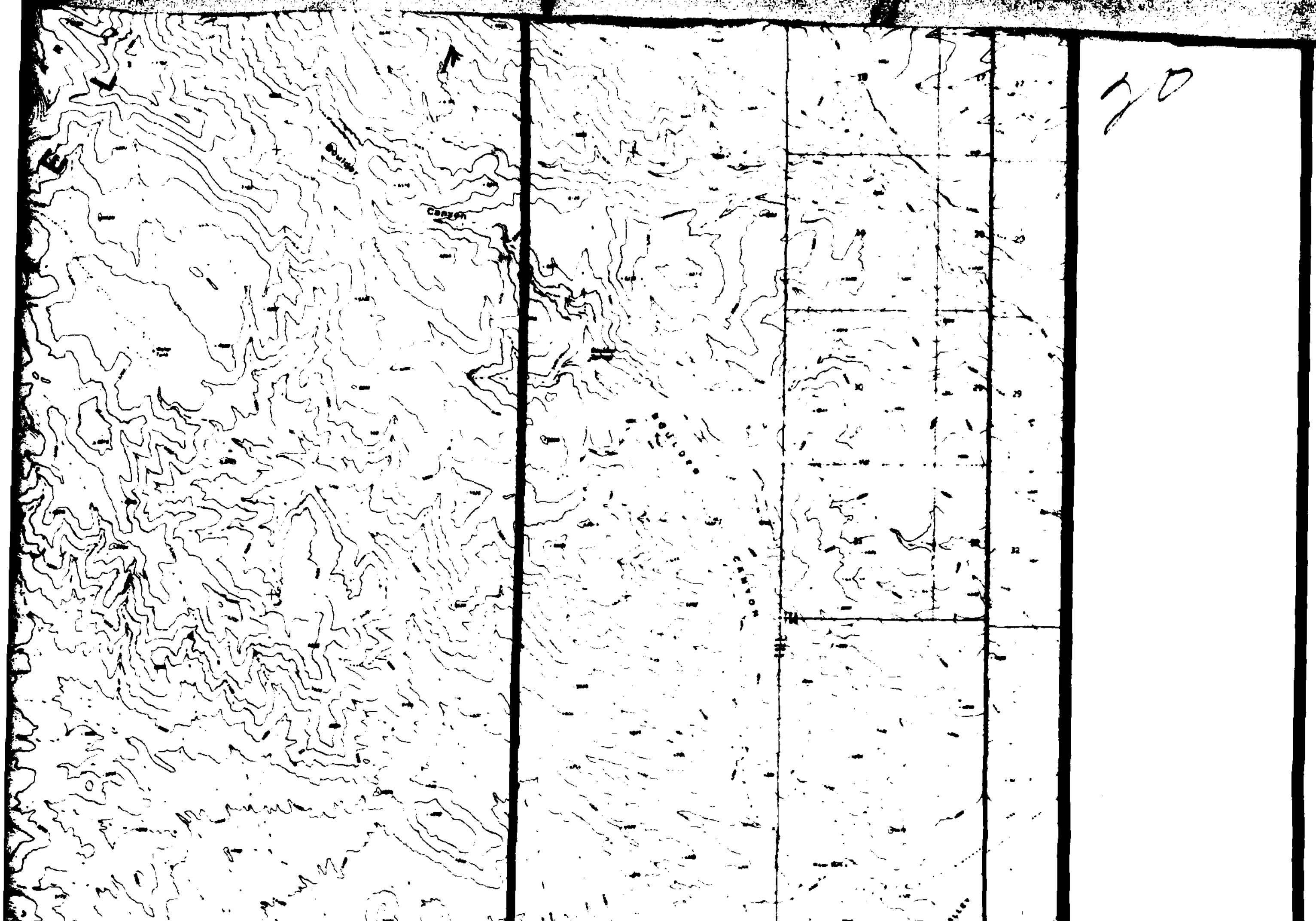


16


37° 15′


D E L A M A R
L A K E
D E L A M A R
329
55

55
BASIN
GREGERSON
D E L


37° 15′

21

115° 00′

ERTEC WESTERN AGGREGATE RESOURCES STUDY FIELD STATIONS

VALLEY–SPECIFIC AGGREGATE RESOURCES STUDY
(MAP NUMBERS FROM 1 TO 199)

BASIN–FILL UNITS (COARSE AND/OR FINE AGGREGATES)

● DATA STOP, SAMPLED AND TESTED

○ DATA STOP

ROCK UNITS (CRUSHED-ROCK AGGREGATES)

▲ DATA STOP, SAMPLED AND TESTED

△ DATA STOP

DETAILED AGGREGATE RESOURCES STUDY * *
(MAP NUMBERS FROM 200 TO 299 FOR BASIN–FILL AND ROCK SAMPLE LOCATIONS; 300 TO 399 FOR FIELD PETROGRAPHIC STATIONS)

BASIN–FILL UNITS (COARSE AND/OR FINE AGGREGATES)

DATA STOP, SAMPLED AND TESTED

○ DATA STOP

ROCK UNITS (CRUSHED-ROCK AGGREGATES)

▲ DATA STOP, SAMPLED AND TESTED

PETROGRAPHIC FIELD STATIONS

• DATA STOP

EXPLANATIO

TIONS

REGATES)

LL

REGATES)

AGGREGATE CLASSIFICATION SYSTEM

BASIN–FILL AND ROCK SOURCES***

CA1	BASIN FILL	ROCK	BASIN–FILL OR ROCK SOURCES CONTAINING AGGREGATES THAT PRODUCED TRIAL MIX CONCRETE WITH 28-DAY COMPRESSIVE STRENGTHS EQUAL TO OR GREATER THAN 6500 PSI.
CA2	BASIN FILL	ROCK	BASIN–FILL OR ROCK SOURCES CONTAINING AGGREGATES THAT PRODUCED TRIAL MIX CONCRETE WITH 28-DAY COMPRESSIVE STRENGTHS LESS THAN 6500 PSI.
CB	BASIN FILL	ROCK	BASIN–FILL OR ROCK SOURCES CONTAINING AGGREGATES POTENTIALLY SUITABLE FOR USE IN CONCRETE; BASED ON ACCEPTABLE LABORATORY AGGREGATE TEST RESULTS.
CC1	BASIN FILL	ROCK	BASIN–FILL OR ROCK SOURCES CONTAINING AGGREGATES POTENTIALLY SUITABLE FOR USE IN CONCRETE; BASED ON CORRELATION WITH CLASS CA1 OR CA2 SOURCE AREAS.
CC2	BASIN FILL		BASIN–FILL SOURCES CONTAINING AGGREGATES POTENTIALLY SUITABLE FOR USE IN CONCRETE; BASED ON CORRELATION WITH CLASS CB SOURCE AREAS.
			BASIN–FILL SOURCES CONTAINING FINE AGGREGATES USED WITH CRUSHED-ROCK SAMPLES FOR CERTAIN CONCRETE TRIAL MIXES.
			UNSUITABLE SOURCES OF BASIN–FILL MATERIALS THAT MAY LOCALLY CONTAIN POTENTIALLY SUITABLE SOURCES OF AGGREGATES OF LIMITED EXTENT. UNTESTED SOURCES OF ROCK MATERIALS THAT MAY CONTAIN POTENTIALLY SUITABLE CRUSHED-ROCK AGGREGATES (SEE TEXT FOR ADDITIONAL INFORMA-

23

114° 45′

TION

GEOLOGIC UNITS †

BASIN FILL UNITS

Aal	STREAM-CHANNEL AND/OR TERRACE DEPOSITS	(A1/A2)
Aaf	ALLUVIAL FAN DEPOSITS	(A5)

† SEE APPENDIX TABLE F-3 FOR SYMBOL EXPLANATION AND COMPARISON

SYMBOLS ††

▬▬▬	STUDY AREA BOUNDARY
———	ROCK/BASIN–FILL CONTACT
— —	GEOLOGIC ROCK CONTACT
— — —	BASIN–FILL CONTACT

†† GEOLOGIC ROCK AND BASIN–FILL CONTACTS ARE APPROXIMATELY LOCATED AND MAY VARY LOCALLY.

S
E
GATES
AIN
LS
TABLE
MAY
CK
MA-

24

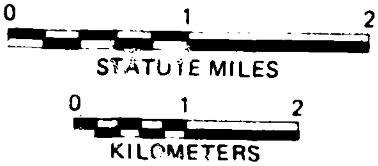
(A1/A2)

(A5)

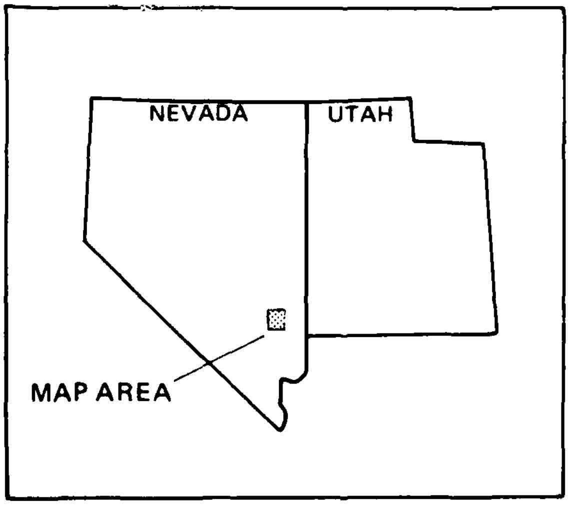
ISON

NORTH

SCALE 1:62,500



LOCATION MAP



MX SITING INVESTIGATION

VALLEY--SPECIFIC AGGREGATE RESOURCES STUDY
(MAP NUMBERS FROM 1 TO 199)

BASIN–FILL UNITS (COARSE AND/OR FINE AGGREGATES)

● DATA STOP, SAMPLED AND TESTED

○ DATA STOP

ROCK UNITS (CRUSHED-ROCK AGGREGATES)

▲ DATA STOP, SAMPLED AND TESTED

△ DATA STOP

DETAILED AGGREGATE RESOURCES STUDY * *
(MAP NUMBERS FROM 200 TO 299 FOR BASIN - FILL AND ROCK SAMPLE LOCATIONS; 300 TO 399 FOR FIELD PETROGRAPHIC STATIONS)

BASIN–FILL UNITS (COARSE AND/OR FINE AGGREGATES)

DATA STOP, SAMPLED AND TESTED

○ DATA STOP

ROCK UNITS (CRUSHED-ROCK AGGREGATES)

▲ DATA STOP, SAMPLED AND TESTED

PETROGRAPHIC FIELD STATIONS

• DATA STOP

* SEE DRY LAKE, MULESHOE, DELAMAR, PAHROC VSARS REPORT (FN-TR-37-a) FOR DETAILED INFORMATION.

* * SEE CORRESPONDING MAP NUMBER IN APPENDICES A AND B FOR DETAILED INFORMATION.

BASIN-FILL AND ROCK SOURCES***

Class	Source	Description
CA1	BASIN FILL ROCK	BASIN-FILL OR ROCK SOURCES CONTAINING AGGREGATES THAT PRODUCED TRIAL MIX CONCRETE WITH 28-DAY COMPRESSIVE STRENGTHS EQUAL TO OR GREATER THAN 6500 PSI.
CA2	BASIN FILL ROCK	BASIN-FILL OR ROCK SOURCES CONTAINING AGGREGATES THAT PRODUCED TRIAL MIX CONCRETE WITH 28-DAY COMPRESSIVE STRENGTHS LESS THAN 6500 PSI.
CB	BASIN FILL ROCK	BASIN-FILL OR ROCK SOURCES CONTAINING AGGREGATES POTENTIALLY SUITABLE FOR USE IN CONCRETE; BASED ON ACCEPTABLE LABORATORY AGGREGATE TEST RESULTS.
CC1	BASIN FILL ROCK	BASIN-FILL OR ROCK SOURCES CONTAINING AGGREGATES POTENTIALLY SUITABLE FOR USE IN CONCRETE; BASED ON CORRELATION WITH CLASS CA1 OR CA2 SOURCE AREAS.
CC2	BASIN FILL	BASIN-FILL SOURCES CONTAINING AGGREGATES POTENTIALLY SUITABLE FOR USE IN CONCRETE; BASED ON CORRELATION WITH CLASS CB SOURCE AREAS.
		BASIN-FILL SOURCES CONTAINING FINE AGGREGATES USED WITH CRUSHED-ROCK SAMPLES FOR CERTAIN CONCRETE TRIAL MIXES.
		UNSUITABLE SOURCES OF BASIN-FILL MATERIALS THAT MAY LOCALLY CONTAIN POTENTIALLY SUITABLE SOURCES OF AGGREGATES OF LIMITED EXTENT. UNTESTED SOURCES OF ROCK MATERIALS THAT MAY CONTAIN POTENTIALLY SUITABLE CRUSHED-ROCK AGGREGATES (SEE TEXT FOR ADDITIONAL INFORMATION).

*** A COMPLETE CLASSIFICATION SYSTEM IS SHOWN, ALTHOUGH ALL BASIN-FILL OR ROCK SOURCES MAY NOT BE PRESENT WITHIN THE STUDY AREA.

UNITS

BASIN FILL UNITS

Aal	STREAM CHANNEL AND/OR TERRACE DEPOSITS	(A1/A2)
Aaf	ALLUVIAL FAN DEPOSITS	(A5)

† SEE APPENDIX TABLE F-3 FOR SYMBOL EXPLANATION AND COMPARISON

SYMBOLS ††

STUDY AREA BOUNDARY

ROCK/BASIN–FILL CONTACT

GEOLOGIC ROCK CONTACT

BASIN–FILL CONTACT

†† GEOLOGIC ROCK AND BASIN–FILL CONTACTS ARE APPROXIMATELY LOCATED AND MAY VARY LOCALLY.

MAP

The Earth Tec

CONC
DETAI

29 MAY 81

NORTH

SCALE 1 62,500

0 1 2
STATUTE MILES

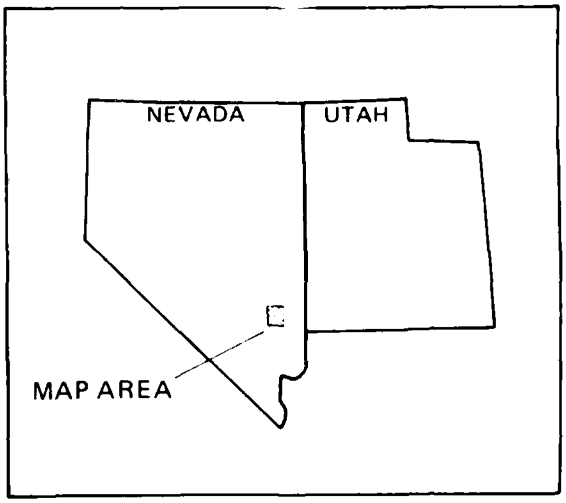
0 1 2
KILOMETERS

TERRACE DEPOSITS (A1/A2)

(A5)

ANATION AND COMPARISON

LOCAT ON MAP



CT

T

S ARE
LOCALLY.

Ertec
The Earth Technology Corporation

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

CONCRETE AGGREGATE RESOURCES MAP
DETAILED AGGREGATE RESOURCES STUDY
DELAMAR VALLEY, NEVADA

29 MAY 81

DRAWING 3

DATE

FILMED

8