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MX SITING INVESTIGATION. GEOTECHNICAL EVALUATION. VOLUME II. NE--ETC(U)

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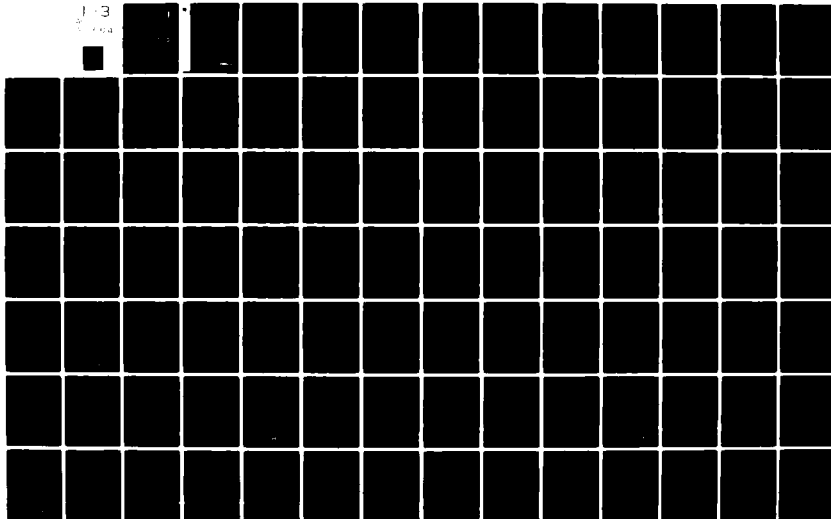
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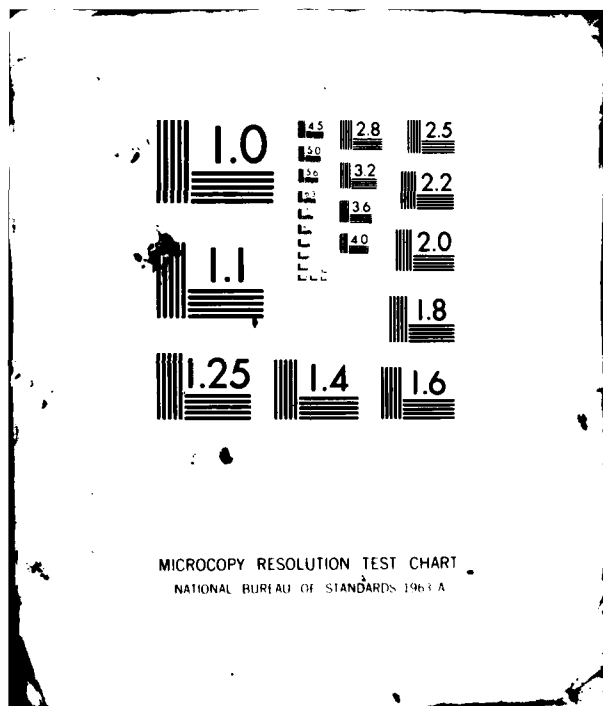
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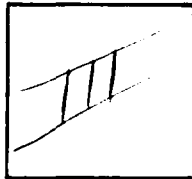




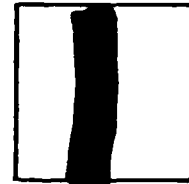
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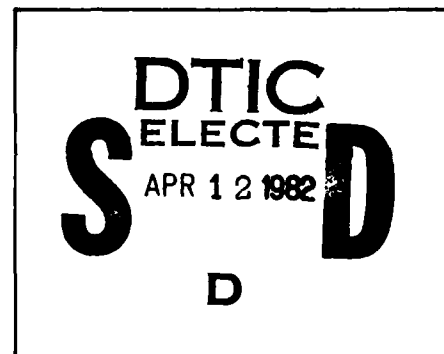
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**MX SITING INVESTIGATION
GEOTECHNICAL EVALUATION**

AD A113324

**VOLUME II
NEVADA-UTAH
VERIFICATION STUDIES, FY 79
GEOTECHNICAL DATA,
WHIRLWIND CDP, UTAH**

**PREPARED FOR
SPACE AND MISSILE SYSTEMS ORGANIZATION (SAMSO)
NORTON AIR FORCE BASE, CALIFORNIA**

FURBER
NATIONAL, INC.
Consulting Engineers and Geologists

MX SITING INVESTIGATION
GEOTECHNICAL EVALUATION
VOLUME II, NEVADA-UTAH
VERIFICATION STUDIES, FY 79
GEOTECHNICAL DATA
WHIRLWIND CDP, UTAH

Prepared for:

U. S. Department of the Air Force
Space and Missile Systems Organization (SAMSO)
Norton Air Force Base, California 92409

Prepared by:

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

24 August 1979

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) THE OBJECTIVES OF THIS REPORT ARE TO VERIFY SUFFICIENT SUITABLE AREA FOR DEPLOYMENT OF THE MX SYSTEM AND TO PROVIDE PRELIMINARY PHYSICAL AND ENGINEERING CHARACTERISTICS OF THE SOILS. The data was used to determine the suitability of the area for the MX system. The data was used to determine the physical and engineering characteristics of the soils. The data was used to determine the physical and engineering characteristics of the soils.		

VOLUME II
GEOTECHNICAL DATA, WHIRLWIND CDP

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DRAWINGS IN POCKET

- 1 ACTIVITY LOCATION MAP
- 2 CONE PENETROMETER TEST RESULTS

FOREWORD

This report was prepared for the Department of the Air Force, Space and Missile Systems Organization (SAMSO), in compliance with Contract No. F04704-78-C-0027, CDRL Item 005A2. It presents geological, geophysical, and geotechnical data and evaluates the suitability of portions of Nevada and Utah for siting the MX Land Mobile Advanced ICBM System.

This report is the first of several Verification reports which will be prepared. The objectives are to verify sufficient suitable area for deployment of the MX System and to provide preliminary physical and engineering characteristics of the soils. The Verification Studies are the final phase of a site-selection process which was begun in 1977. Previous studies have been termed Screening, Characterization, and Ranking. In preparing this report, it has been assumed that the reader is familiar with these previous studies.

Results of the FY 79 Verification studies are contained in 11 volumes as follows:

Geotechnical Results

Volume 1A - Sections 1.0, 2.0, and 3.0 contain Introduction, Results and Conclusions, and Recommendations for Future Studies. Sections 4.0 through 6.0 contain summary geotechnical data for Whirlwind, Snake East, and Hamlin CDP's.

Volume 1B - Sections 7.0 through 10.0 contain summary geotechnical data for White River North, Garden-Coal, Reveille-Railroad and Big Smoky CDP's.

Geotechnical Data Volumes

- * Volume II - Whirlwind CDP
- Volume III - Snake East CDP
- Volume IV - Hamlin CDP
- Volume V - White River North CDP
- Volume VI - Garden-Coal CDP
- Volume VII - Reveille-Railroad CDP
- Volume VIII - Big Smoky CDP
- Volume IX - Dry Lake CDP
- Volume X - Ralston CDP

* This volume is presented herein.

SECTION 1.0
GEOLOGIC STATION DATA

EXPLANATIONS OF GEOLOGIC STATION DATA

Geologic stations were established at selected locations throughout the CDP at which detailed descriptions of surficial basin-fill deposits or rock were recorded. Locations of all geologic stations are shown in Drawing 1, Activity Location Map. All data taken on surficial basin-fill units at these stations are listed in Table 1-1 and an explanation of the column headings in the table is given below. At stations where rock descriptions were made, only geologic unit designations are listed. A general explanation of all geologic unit symbols used in Verification Studies is included at the end of this section.

Column Heading
Table 1-1

Explanation

Station Number	Geologic stations are numbered sequentially. Where more than one geologic field team worked in a CDP, stations made by each team are differentiated with a letter (A, B, or C) following the station number.
Geologic Unit	Generic geologic unit only, i.e. the grain-size designation (f, s, g, c) is omitted from surficial basin-fill units. The letter B in the unit designation indicates a buried deposit not exposed at the surface.
MPS MM	Average maximum particle size in millimeters.
Grain Size (%B, %C, %G, %S, %F)	Estimated particle size distribution using the Unified Soil Classification System. Percentages of boulders (%B) and cobbles (%C) are based on the entire deposit, whereas percentages of gravel (%G), sand (%S) and fines (%F) are taken only on the fraction composed of particles less than 3 inches (76 mm) in diameter.
USCS	Soil class according to the Unified Soil Classification System.

Munsell Color Soil color based on Munsell Soil Color Chart.

Source Rock Rock types of coarse clasts listed in order of
Types(s) abundance.

* Physical
Properties Data listed in columns 6 through 15 address
specific soil properties. These are listed
below in parentheses following the column
heading number and are also listed at the
bottom of Table 1-1. Data are coded with each
numerical entry referring to a specific soil
condition as listed below.

- 6 (Grain Shape) 1) Angular, 2) Subangular, 3) Subrounded,
4) Rounded, 5) Well rounded
- 7 (Moisture 1) Dry, 2) Moist, 3) Wet
Content)
- 8 (Plasticity 1) None, 2) Low, 3) Medium, 4) High
of Fines)
- 9 (Consistency) Coarse grained: 1) Very Loose, 2) Loose,
3) Medium Dense, 4) Dense, 5) Very Dense,

Fine grained: 1) Soft, 2) Firm, 3) Stiff,
4) Hard
- 10 (Structure) 1) Stratified Tabular, 2) Stratified Other
(lensed, cross bedded, discontinuous beds),
3) Nonstratified
- 11 (Cementation 1) None, 2) Weak, 3) Moderate, 4) Strong
Induration)
- 12 (Depth to Depth to layer (in centimeters) exhibiting
Cemented cementation induration described in Column 11
Layers) (above)
- 13 (Weathering 1) Fresh, 2) Slight, 3) Moderate, 4) Very
of clasts)
- 14 (Soil 1) None (A-C profile), 2) Poor (incipient
Profile B-horizon), 3) Well (prominant B-horizon)
Development)
- 15 (Caliche 1) Stage I, 2) Stage II, 3) Stage III,
Development) 4) Stage IV, 5) None

Drainage

DP (M)

Average depth of drainages (in meters)

WD (M)

Average width of drainages (in meters)

Slope (%)

Average slope of ground surface (in percent grade)

Sample

Number of samples taken

GENERALIZED GEOLOGIC UNITSExplanation

Surficial Basin-fill Units

- A1 Younger Fluvial Deposits - Major modern stream channel and flood-plain deposits.
- A2 Older Fluvial Deposits - Older incised stream channel and flood-plain deposits in elevated terraces bordering major modern drainages.
- A3 Eolian Deposits - Wind-blown deposits of sand occurring as either thin sheets (A3s) or dunes (A3d).
- A4 Playa and Lacustrine Deposits - Deposits occurring in modern, active playas (A4) or in either inactive playas or older lake beds and abandoned shorelines associated with extinct lakes (A4o).
- A5 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 (A5y), intermediate (A5i), and older (A5o) alluvial fans are differentiated by surface soil development, terrain conditions, and present depositional/erosional environment.

Grain sizes of these deposits (except A3 deposits, which are exclusively sandy) are indicated by a single letter (f, s, g, or c) following the geologic unit symbol. These letters indicate the predominant grain size and range of soil types according to the Unified Soil Classification System:

- f - fine-grained (ML, CL, MH, CH)
- s - sands (SP, SW, SM, SC)
- g - gravels (GP, GW, GM, GC)
- c - coarse grained with greater than 30 percent boulders and cobbles (generally GP, GW, GM, GC)

ROCK UNITS

- I Igneous (undifferentiated). Rocks formed by solidification of a molten or partially molten mass.
 - I1 Intrusive - Plutonic rocks formed by solidification of molten material beneath the surface (e.g., granite, granodiorite, diorite, gabbro).
 - I2 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,).
 - I3 Extrusive (basic) - Volcanic rocks of basic composition, generally formed by solidification of molten materials at or near the surface (e.g., basalt).
 - I4 Extrusive (pyroclastic) - Rocks formed by accumulation of volcanic ejecta (e.g., ash, tuff, welded tuff, agglomerate).
- S Sedimentary (undifferentiated) - Rocks formed by accumulation of clastic solids, organic solids and/or chemically precipitated minerals.
 - S1 Arenaceous and/or Siliceous Rocks - Composed of sand size particles (e.g., sandstone, orthoquartzite) or of cryptocrystalline silica (e.g., opal, chert).
 - S2 Carbonate Rocks - Composed predominantly of calcium carbonate detritus or chemical precipitates (e.g., limestone, dolomite, chalk):
 - S3 Argillaceous Rocks - Composed of clay and silt-sized particles (e.g., siltstone, shale, claystone).
 - S4 Evaporite Rocks - Precipitated from solution as a result of evaporation (e.g., halite, gypsum, anhydrite, sylvite).
 - S5 Coarse Clastic Rocks - Composed of gravel sized or larger clasts (e.g., conglomerate, breccia).
- M Metamorphic (undifferentiated) - Rocks formed through recrystallization in the solid state of preexisting rocks by heat and pressure (e.g., gneiss, schist, hornfels, metaquartzite).

2. - CALICUT DEVELOPMENT

2 JUL 79

SECTION 2.0
GROUND-WATER DATA

EXPLANATIONS OF GROUND-WATER DATA

Existing ground-water data were collected from all available sources. These data were updated where possible from measurements taken during Fugro field operations, and all data are shown on Table 2-1. Locations of water wells and boreholes in which water-level measurements were available are shown in Drawing 1. Well numbers listed in Column 1 (Table 2-1) refer to well locations in Drawing 1. Actual well numbers giving location according to the Bureau of Land Management Land Survey System are shown in Column 2.

Water levels generally refer to the static ground-water table in the unconfined basin-fill aquifer. Perched conditions or levels in artesian aquifers are noted where known.

WELL NO.	WELL LOCATION NUMBER*	ELEVATION OF GROUND SURFACE - FEET (METERS) ABOVE M.S.L.	DEPTH OF WELL - FEET (METERS)	WATER LEVEL			REFERENCES**/REMARKS
				DEPTH BELOW GROUND SURFACE - FEET (METERS)	DATE MEASURED	ELEVATION - FEET (METERS) ABOVE M.S.L.	
W1	14S/11W-29c	5600 (1707)	-	100 (30)	-	5500 (1676)	2, In Rock
W2	14S/12W-34d	5193 (1583)	-	700-800 213-244	-	4393-4493 (1339-1370)	2
W3	15S/12W-20b	5190 (1582)	-	800 (244)	-	4390 (1338)	2
W4	15S/12W-25	5210 (1538)	-	800 (244)	-	4410 (1344)	2
W5	16S/11W-17d	5145 (1568)	-	700 (213)	-	4445 (1355)	2
W6	17S/10W-14bb	4649 (1417)	204. (62)	116 (35)	1963	4533 (1382)	1, 3
W7	17S/10W-20c	4770 (1454)	-	200-300 (61-91)	-	4470-4570 (1363-1393)	2
W8	17S/11W-3c	4950 (1509)	-	250-350 (76-107)	-	4600-4700 (1402-1433)	2
W9	18S/10W-3	4625 (1410)	-	100-200 (30-61)	-	4425-4525 (1349-1379)	2
W10	18S/10W-26bda	4580 (1396)	280 (85)	48 (15)	1951	4532 (1381)	1, 3
W11	18S/10W-28	4620 (1408)	-	100-200 (30-61)	-	4420-4520 (1347-1378)	2
W12	18S/11W-5dbb	4880 (1487)	565 (172)	250 (76)	1935	4630 (1411)	1
W13	18S/12W-5	5390 (1643)	542 (165)	250 (76)	1935	5140 (1567)	3
W14	19S/10W-6d	4680 (1427)	592 (180)	190 (58)	-	4490 (1369)	2
W15	19S/11W-21d	4765 (1452)	-	215 (66)	-	4550 (1387)	2
W16	19S/11W-28bad	4670 (1423)	524 (160)	217 (66)	1951	4453 (1357)	3

*Salt Lake Baseline and Meridian

**References:

1. Mower and Feltis (1964)
2. Snyder (1963) - All depths to water are estimated
3. Utah State Engineers Office (1979)

NOTE: All wells tap unconfined alluvial aquifers except where noted. Where published data are lacking or inaccurate, ground surface elevations are taken from topographic maps.

GROUND-WATER DATA
VERIFICATION SITE, WHIRLWIND COP, UTAH

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TABLE
2-1
1 OF 2

UGRO NATIONAL, INC.

WELL NO.	WELL LOCATION NUMBER*	ELEVATION OF GROUND SURFACE - FEET (METERS) ABOVE M.S.L.	DEPTH OF WELL - FEET (METERS)	WATER LEVEL			REFERENCES**/REMARKS
				DEPTH BELOW GROUND SURFACE - FEET (METERS)	DATE MEASURED	ELEVATION - FEET (METERS) ABOVE M.S.L.	
W17	19S/12W-27d	4700 (1433)	-	250-350 (76-107)	-	4350-4450 (1326-1356)	2
W18	19S/12W-30abb	5090 (1551)	560 (171)	DRY	1936	4530+ (1381+)	1, 3
W19	21S/13W-1a	4720 (1286)	176 (54)	DRY	-	4544+ (1385+)	2
W20	21S/13W-10	4980 (1518)	660 (201)	422 (129)	1935	4558 (1389)	3, In Rock
W21	22S/12W-20b	4560 (1390)	-	200-300 61-91	-	4260-4360 (1298-1329)	2

* Salt Lake Baseline and Meridan

** References:

1. Mower and Feltis (1964)
2. Snyder (1963) - All depths to water are estimated
3. Utah State Engineers Office (1979)

NOTE: All wells tap unconfined alluvial aquifers except where noted. Where published data are lacking or inaccurate, ground surface elevations are taken from topographic maps.

GROUND-WATER DATA
VERIFICATION SITE, WHIRLWIND COP, UTAH

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DEPARTMENT OF THE AIR FORCE - SAMSO

TABLE
2-1
2 OF 2

FUGRO NATIONAL, INC.

SECTION 3.0
SEISMIC REFRACTION DATA

EXPLANATIONS OF SEISMIC REFRACTION DATA

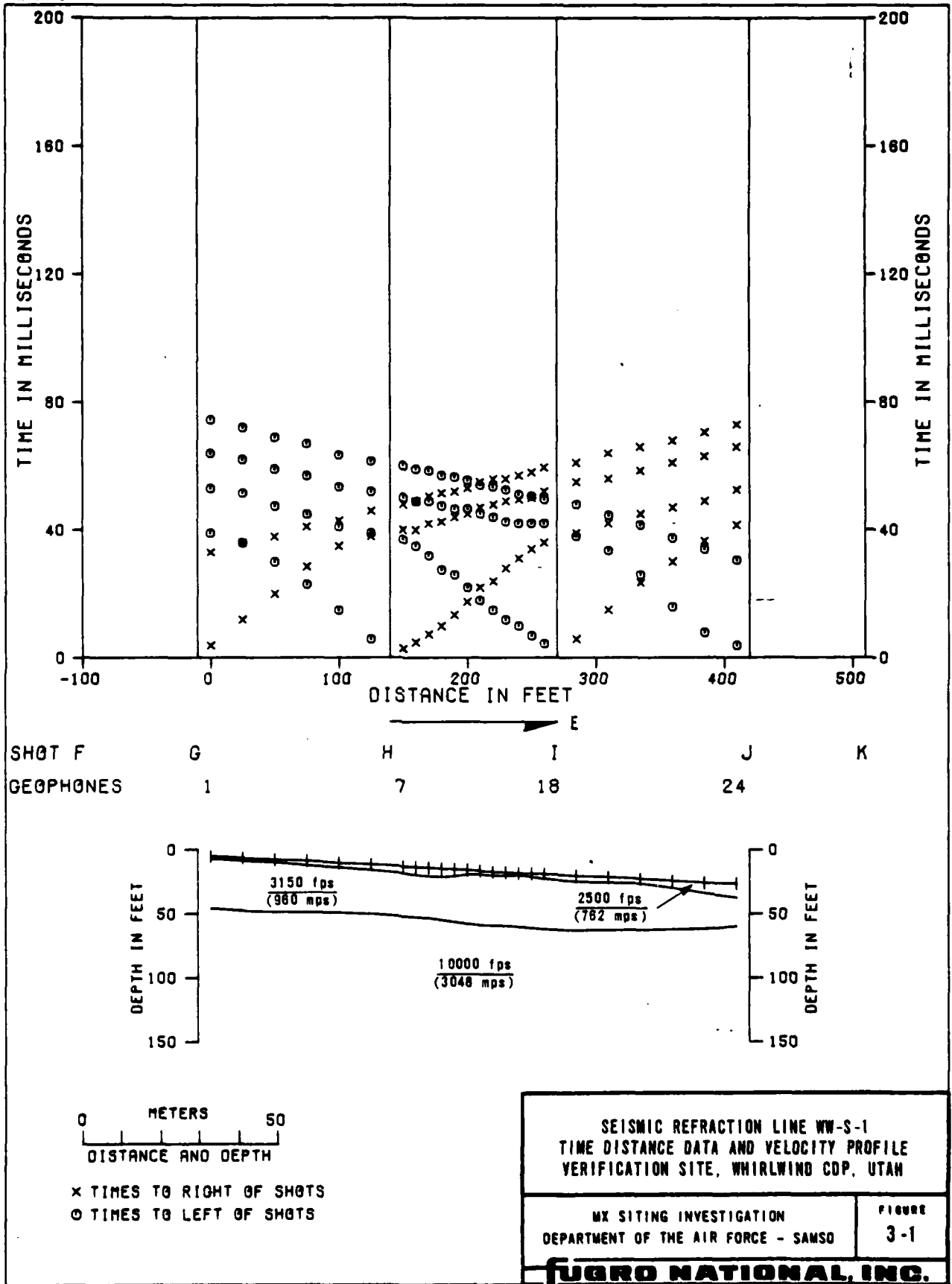
Each figure shows seismic wave travel times plotted versus surface distance between the energy source (shot) and the detector (geophone) for a single seismic line. Distances are measured along the line from geophone number 1 which is designated as zero distance. Distances to the right (on the paper) of geophone 1 are positive. The direction arrow gives the approximate direction of the geophone array from geophone 1 to geophone 24.

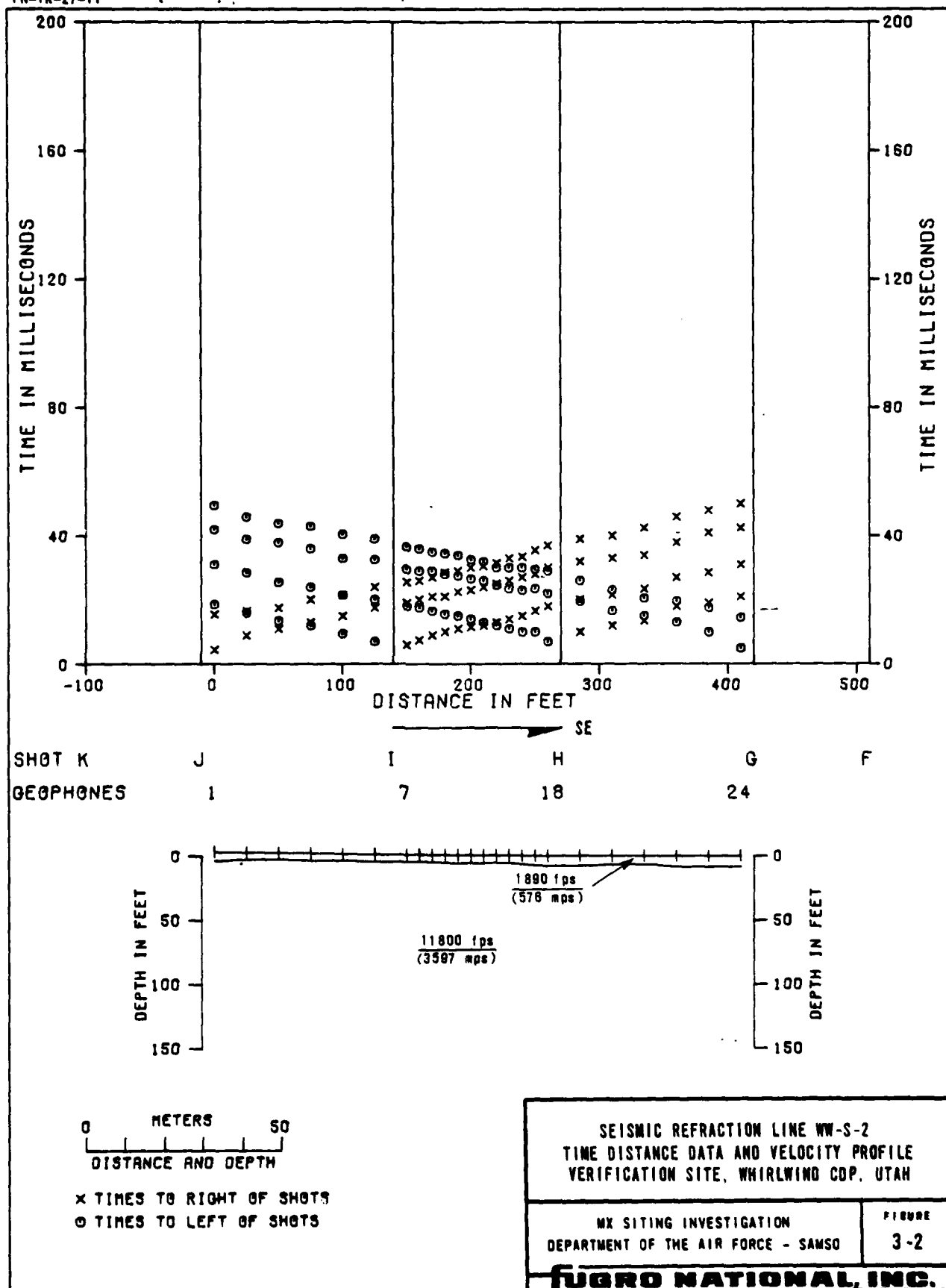
Travel Time Versus Distance Graph (Upper Half of Figure)

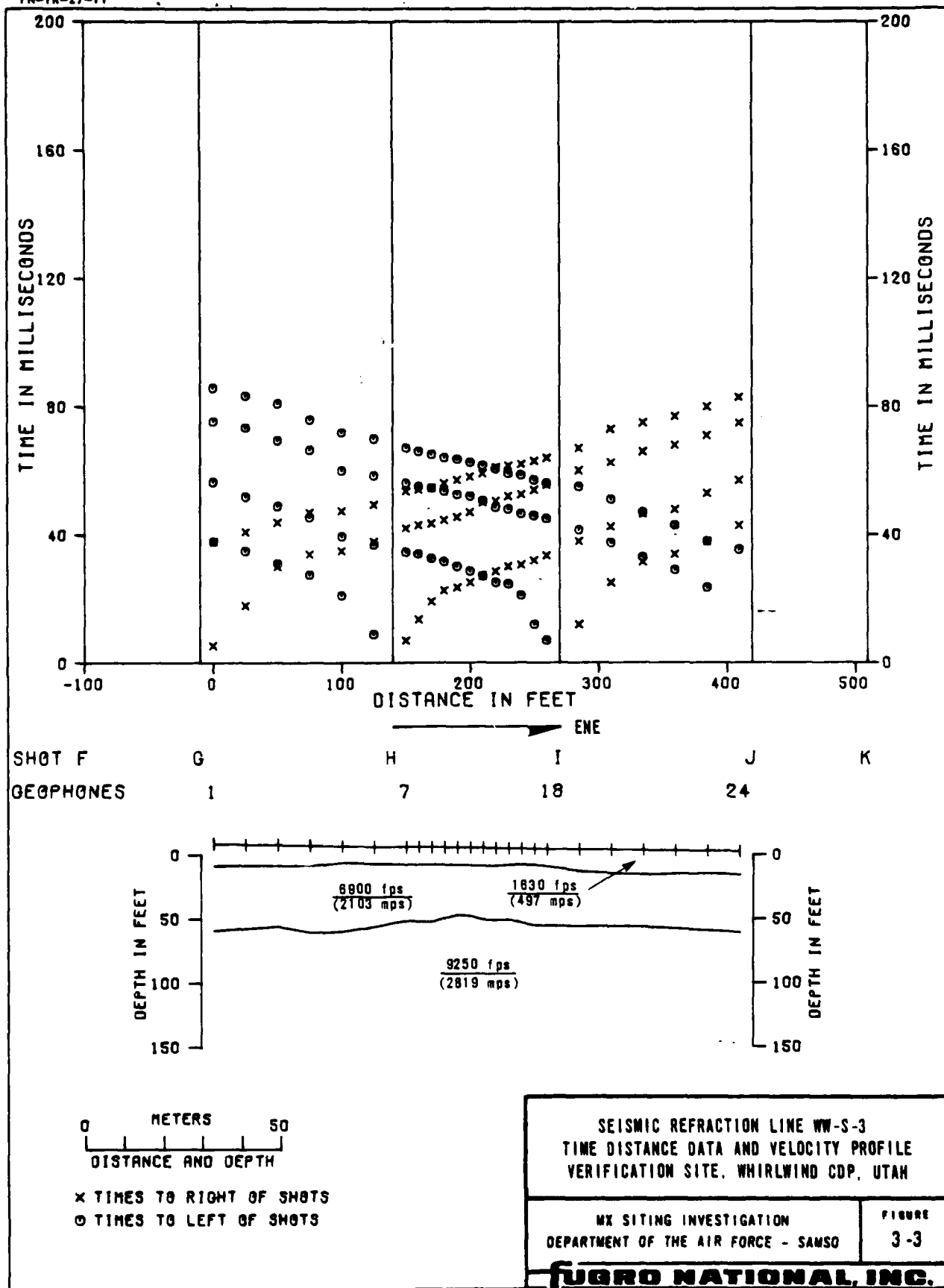
This is a travel time versus distance graph. The abscissa represents distance; the ordinate, time. The six vertical lines represent the locations of shots (designated as F, G, H, I, J, and K). The symbol, X, denotes travel times at geophones that were located to the right of a shot. The symbol, @, denotes travel times that were located to the left of shots.

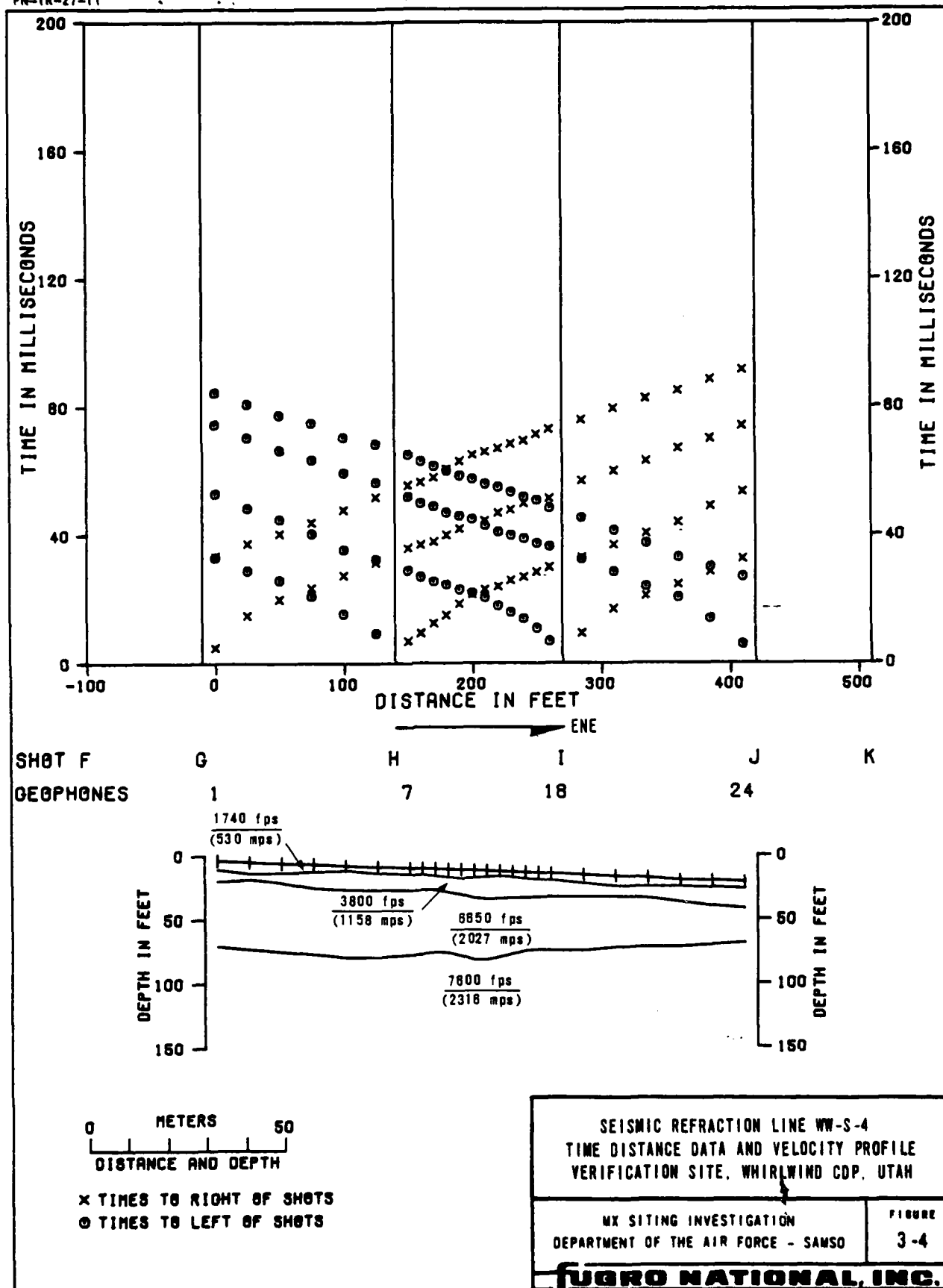
Velocity Cross Section (Lower Half of Figure)

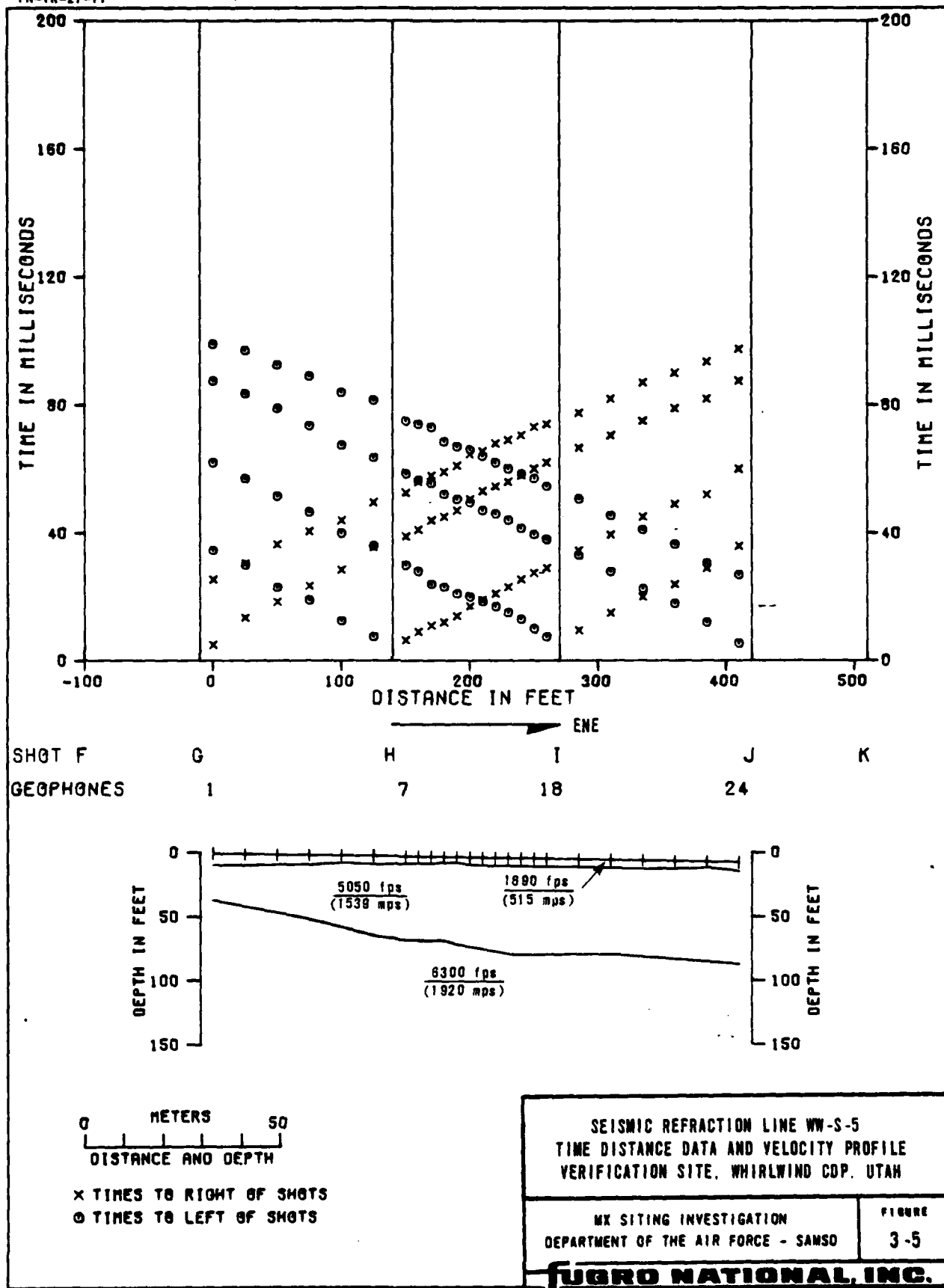
This is an interpreted velocity cross section beneath the seismic line. The top line represents the ground-surface profile. The short vertical lines crossing the top line mark the geophone positions. The depth scale is plotted relative to a point on the line which was arbitrarily chosen as "zero elevation" at the time the line was surveyed. The additional lines across the cross section represent the interpreted boundaries between layers of material with different compressional wave velocities. These boundaries are commonly called "refractors". The velocity interpreted to be representative of each layer is shown.

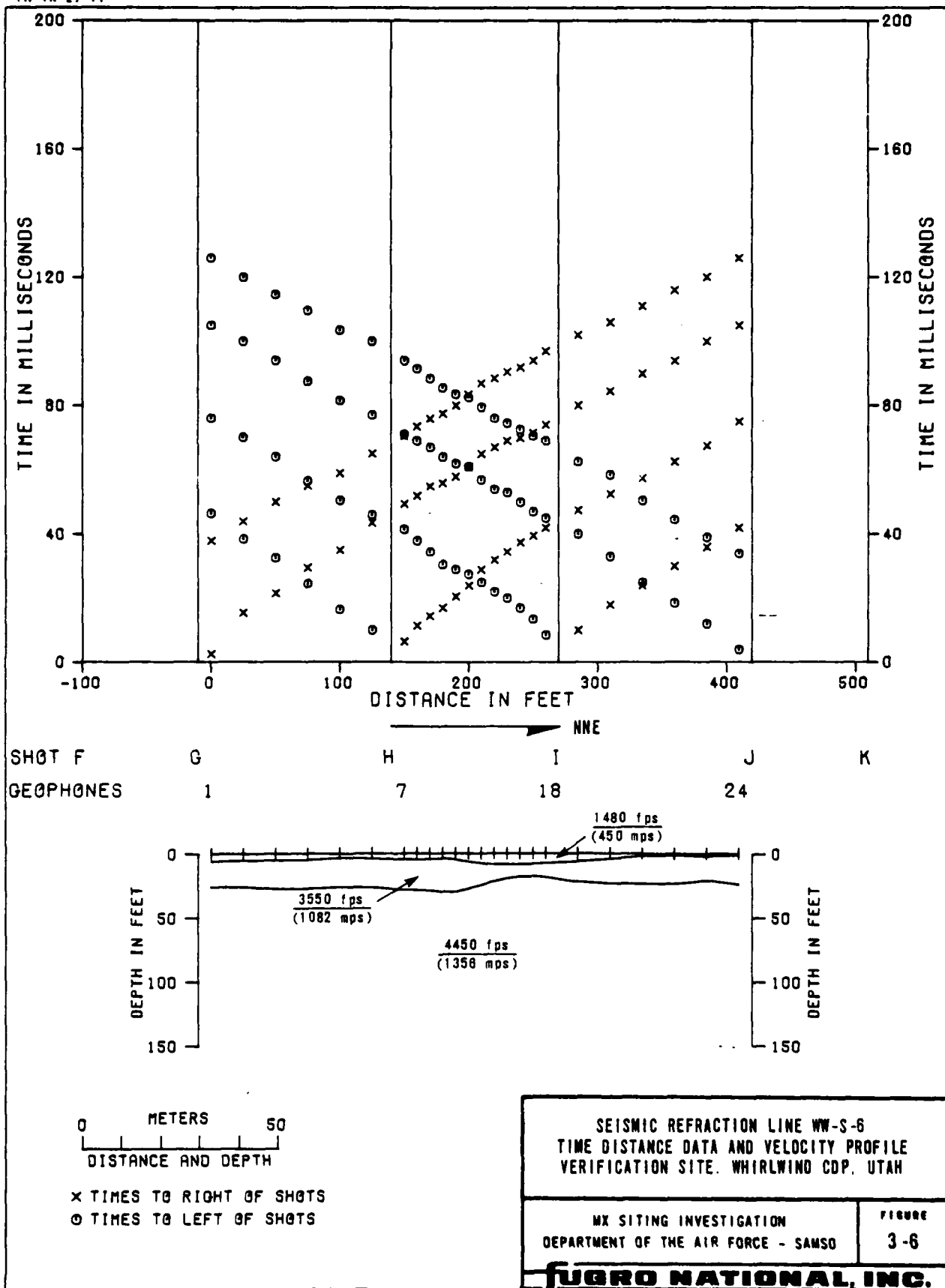


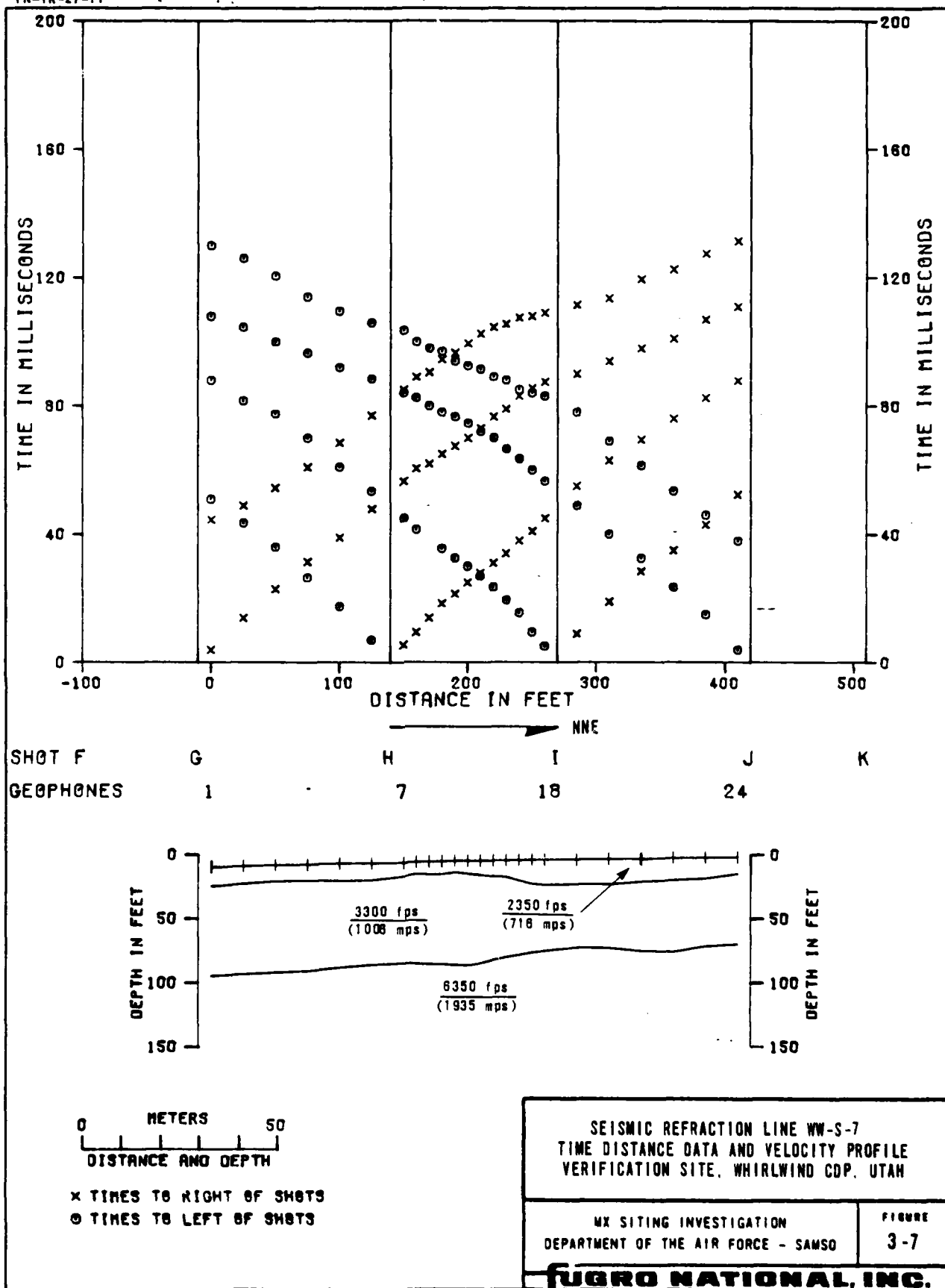


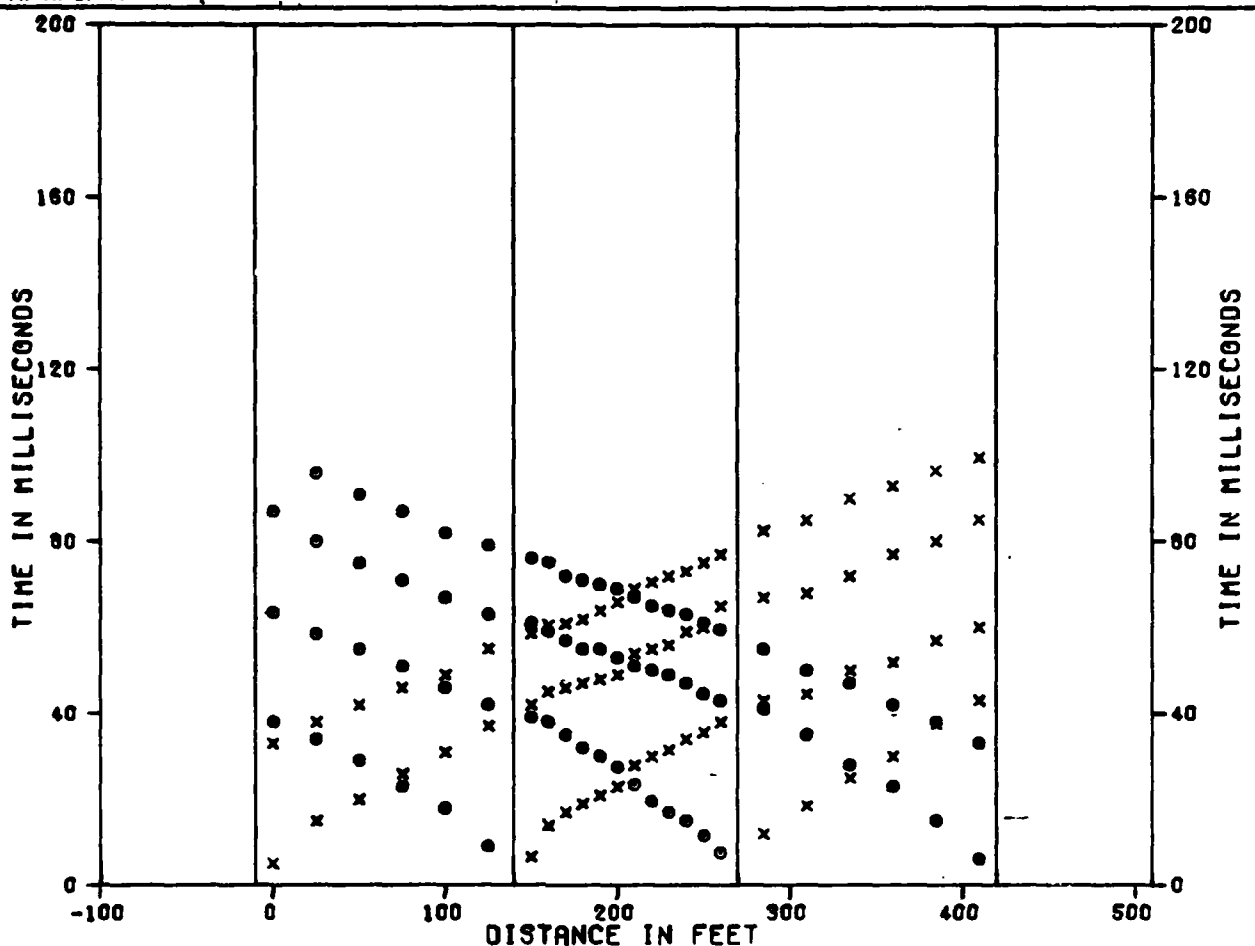












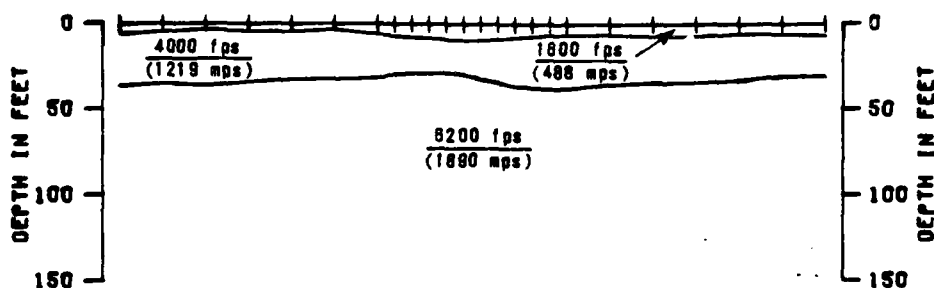
SHOT F
GEOPHONES

G
1

H
7

I
18

J
24



0 METERS 50
DISTANCE AND DEPTH

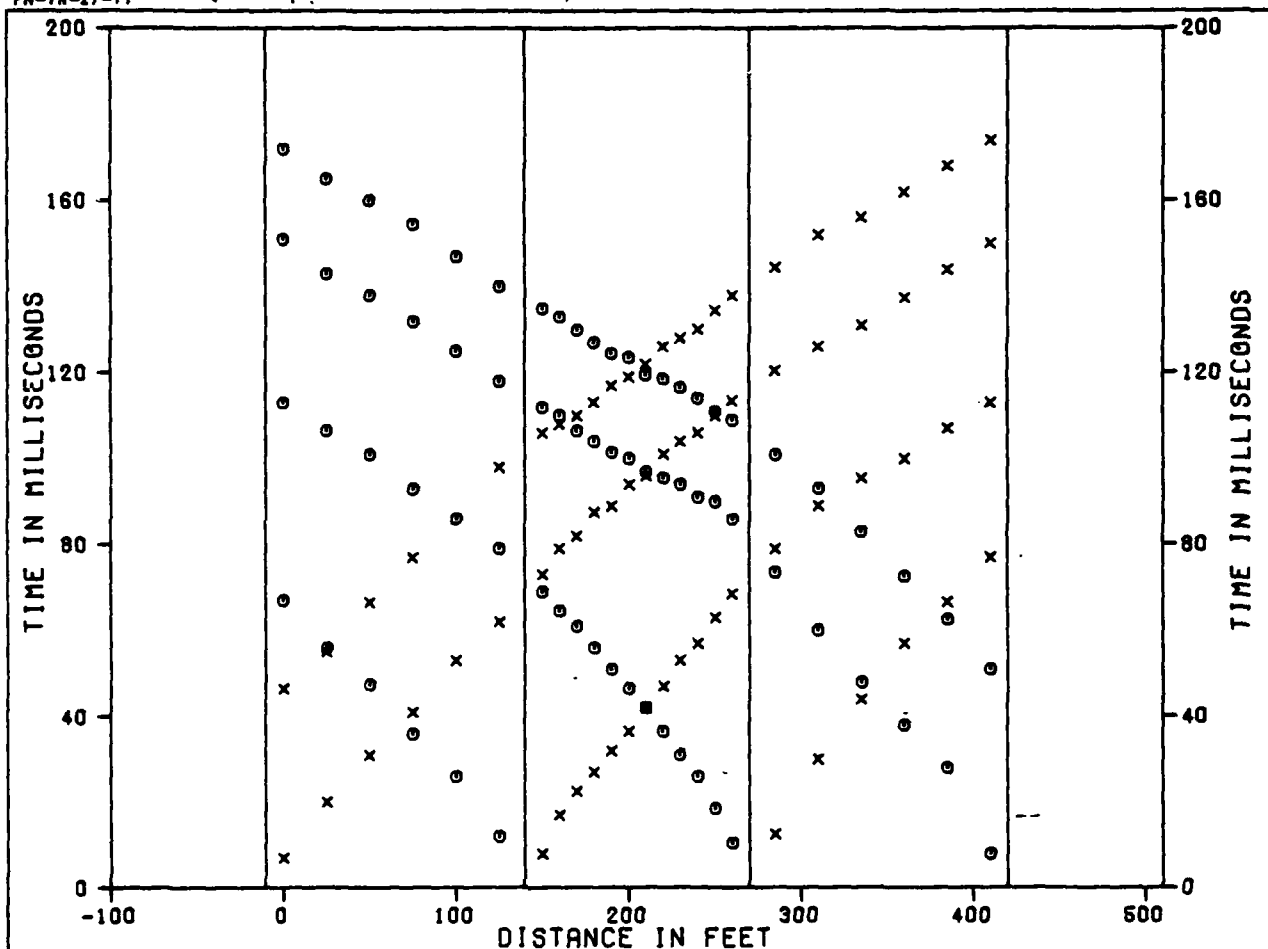
x TIMES TO RIGHT OF SHOTS
o TIMES TO LEFT OF SHOTS

SEISMIC REFRACTION LINE WW-S-8
TIME DISTANCE DATA AND VELOCITY PROFILE
VERIFICATION SITE, WHIRLWIND COP, UTAH

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FIGURE
3-8

FUGRO NATIONAL, INC.



SHOT F
GEOPHONES

G

1

H

7

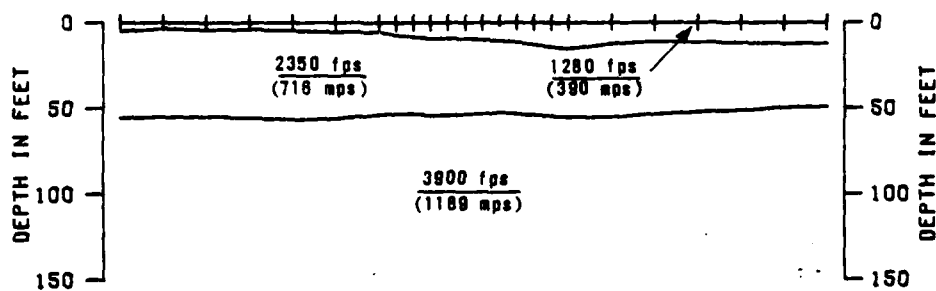
I

18

J

24

K



0 METERS 50
DISTANCE AND DEPTH

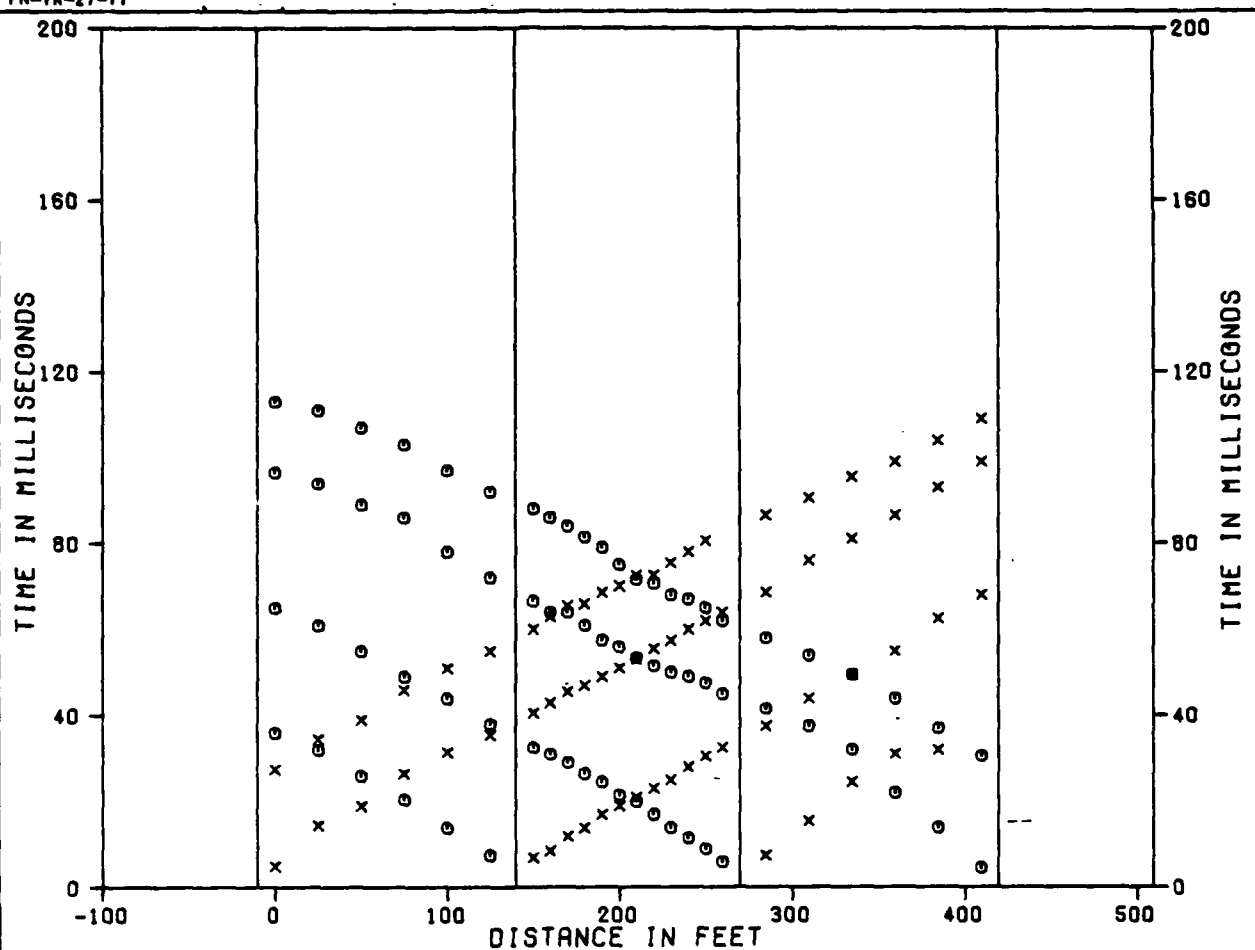
x TIMES TO RIGHT OF SHOTS
o TIMES TO LEFT OF SHOTS

SEISMIC REFRACTION LINE WW-S-9
TIME DISTANCE DATA AND VELOCITY PROFILE
VERIFICATION SITE, WHIRLWIND CDP, UTAH

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DEPARTMENT OF THE AIR FORCE - SANSO

FIGURE
3-9

FUGRO NATIONAL, INC.



SHOT F
GEOPHONES

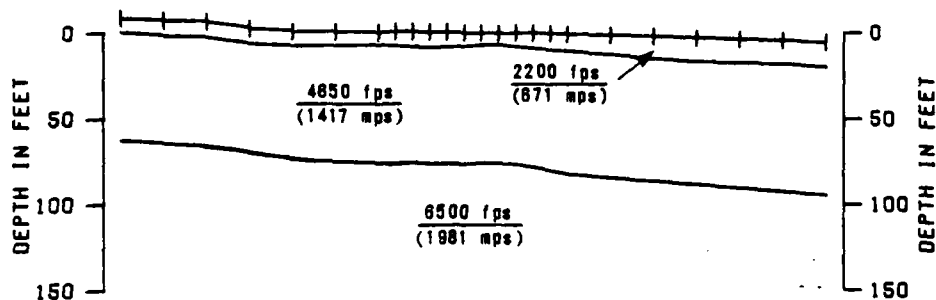
G
1

H
7

I
18

J
24

K



0 METERS 50
DISTANCE AND DEPTH

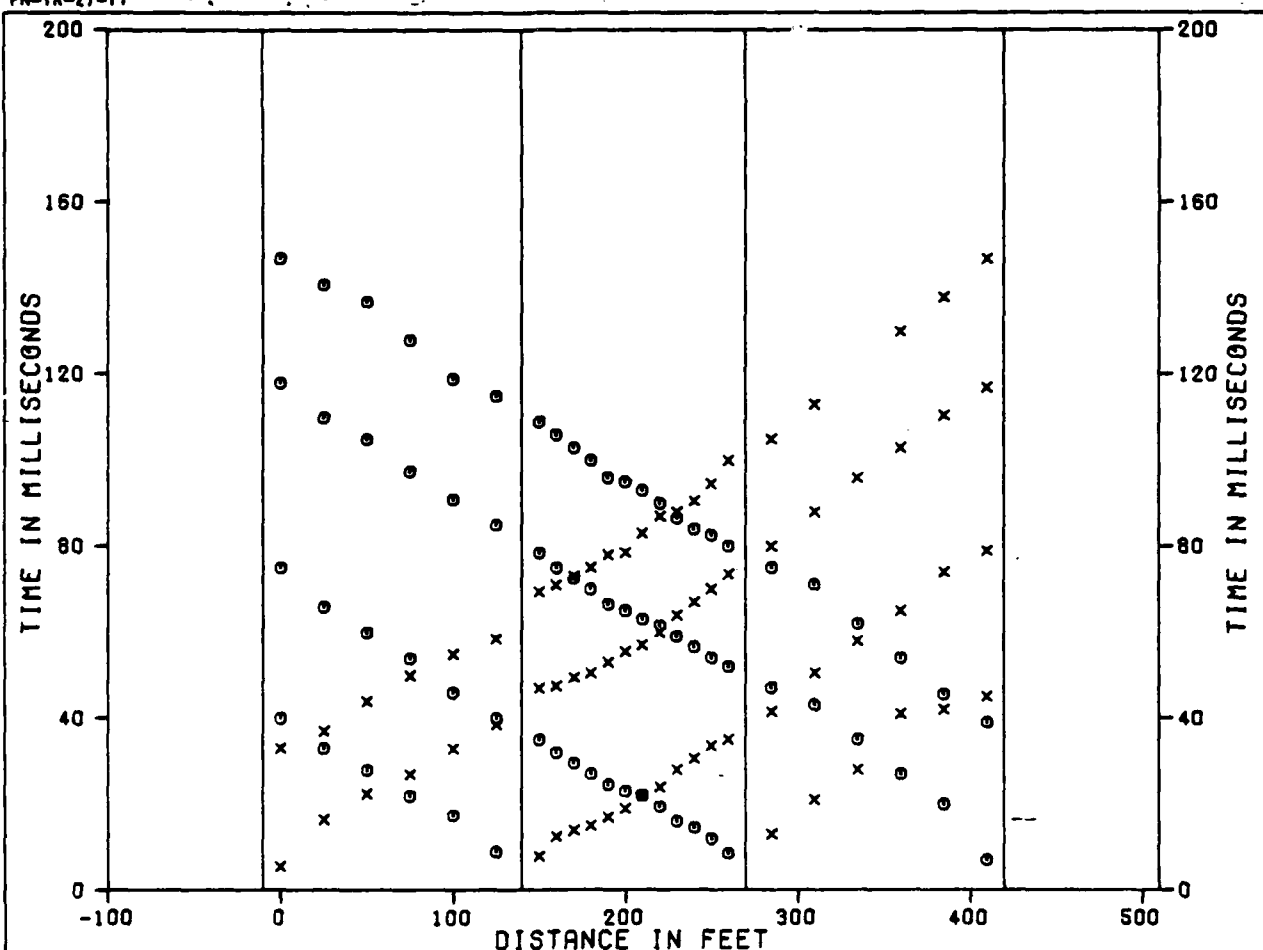
x TIMES TO RIGHT OF SHOTS
o TIMES TO LEFT OF SHOTS

SEISMIC REFRACTION LINE WW-S-11
TIME DISTANCE DATA VELOCITY PROFILE
VERIFICATION SITE, WHIRLWIND CDP, UTAH

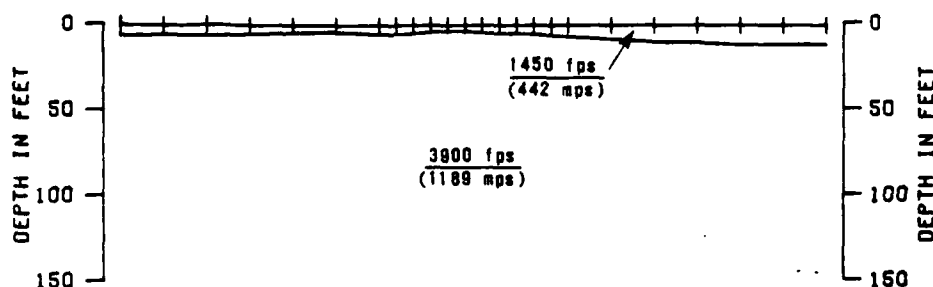
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FIGURE
3-11

FUGRO NATIONAL, INC.



SHOT F G H I J K
 GEOPHONES 1 7 18 24



0 50
 METERS
 DISTANCE AND DEPTH

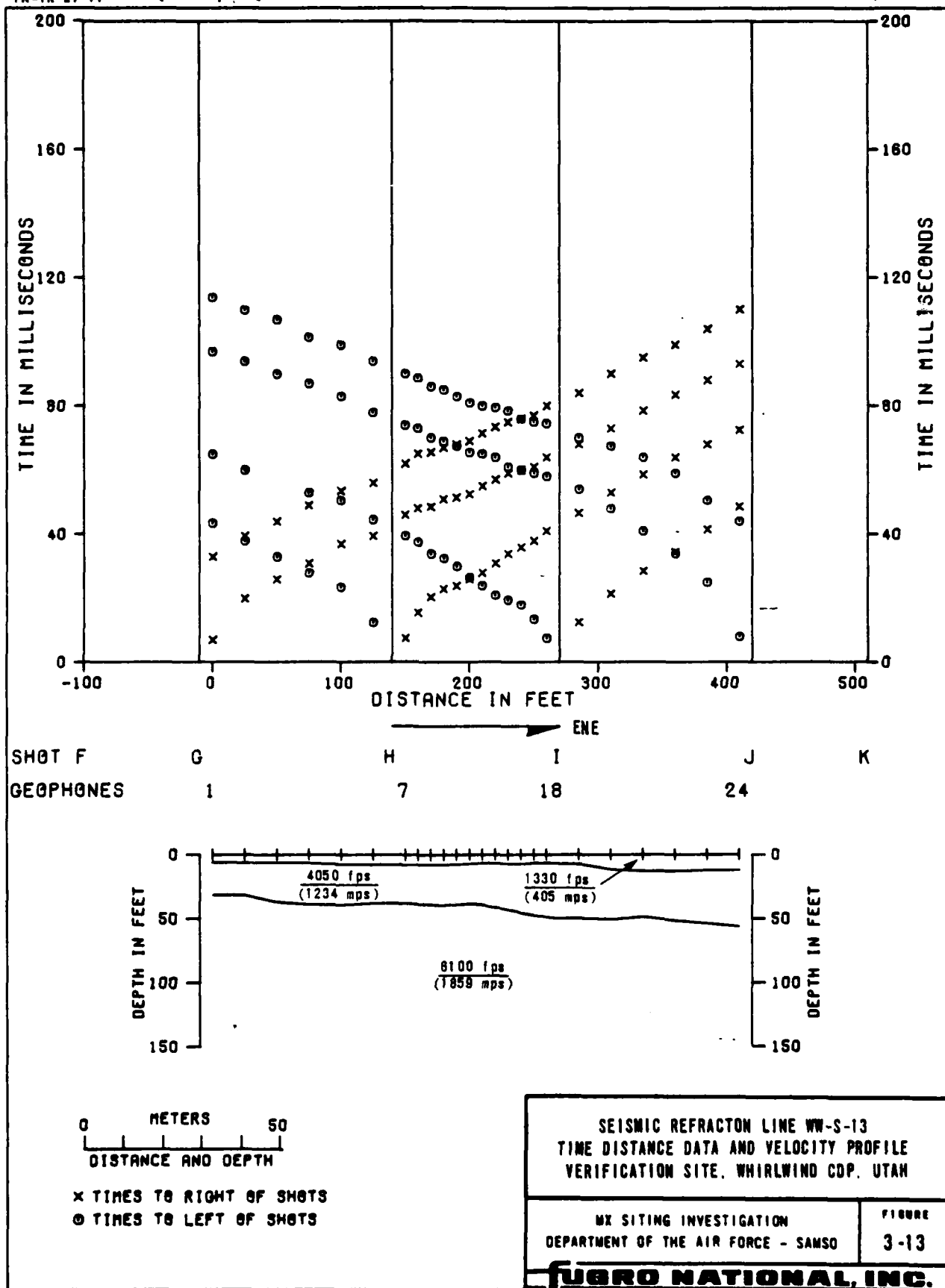
x TIMES TO RIGHT OF SHOTS
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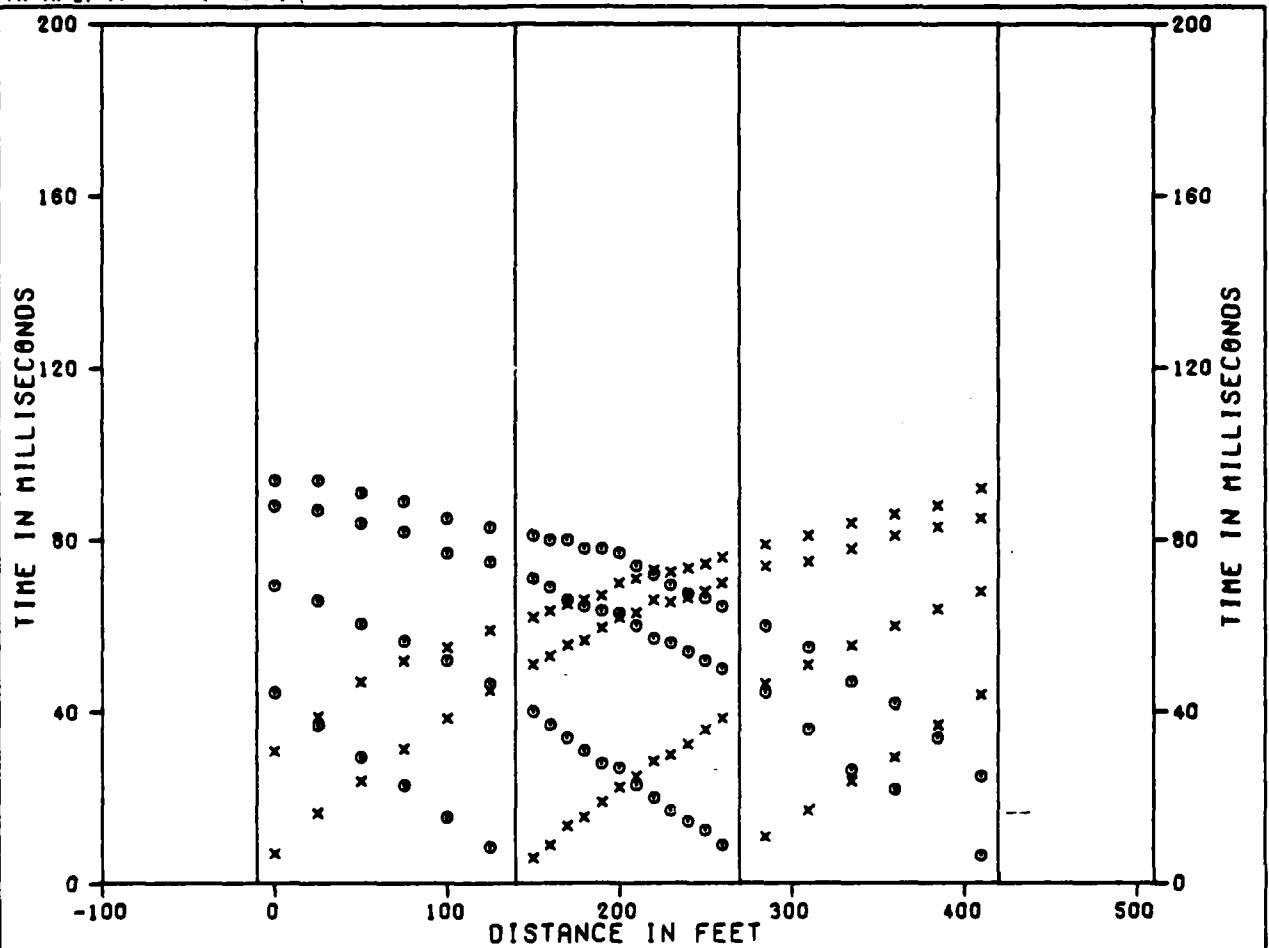
SEISMIC REFRACTION LINE WW-S-12
 TIME DISTANCE DATA AND VELOCITY PROFILE
 VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
 DEPARTMENT OF THE AIR FORCE - SAWSO

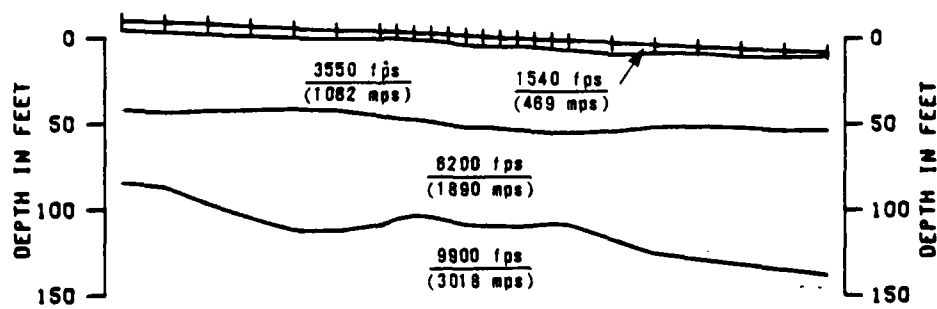
FIGURE
 3-12

FUGRO NATIONAL, INC.





SHOT F G H I J K
GEOPHONES 1 7 18 24



0 METERS 50
DISTANCE AND DEPTH

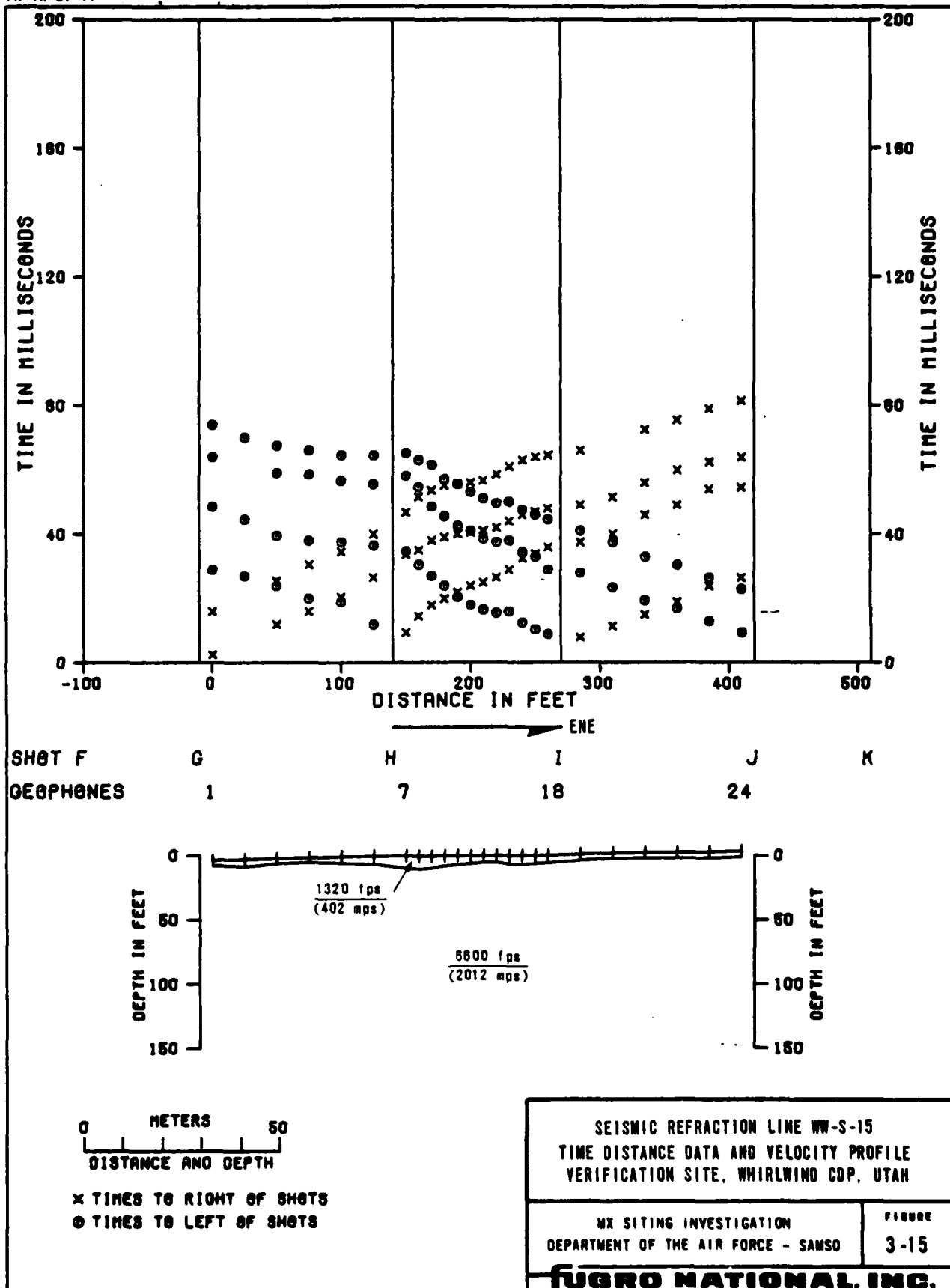
x TIMES TO RIGHT OF SHOTS
o TIMES TO LEFT OF SHOTS

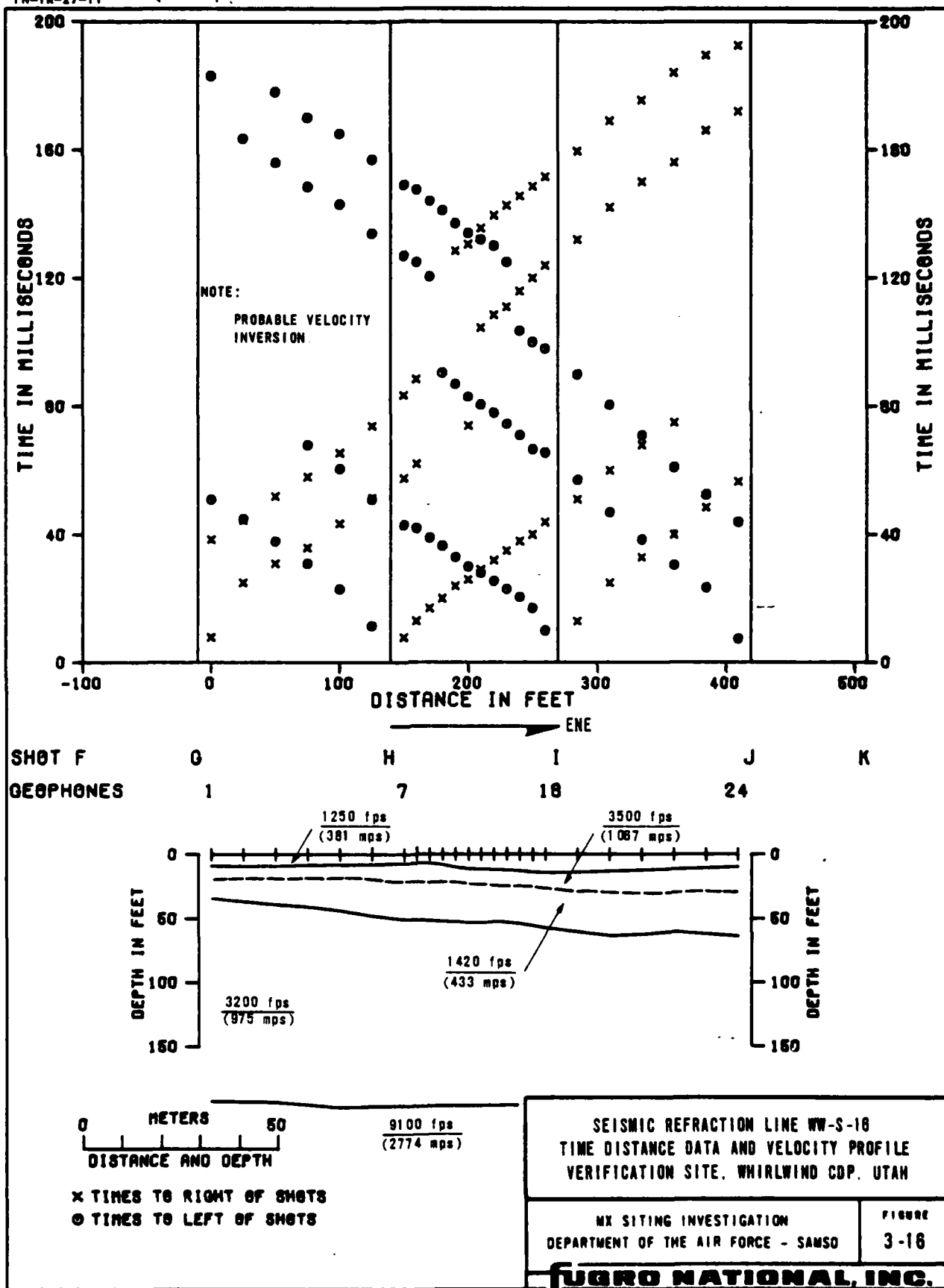
SEISMIC REFRACTION LINE WW-S-14
TIME DISTANCE DATA AND VELOCITY PROFILE
VERIFICATION SITE, WHIRLWIND CDP, UTAH

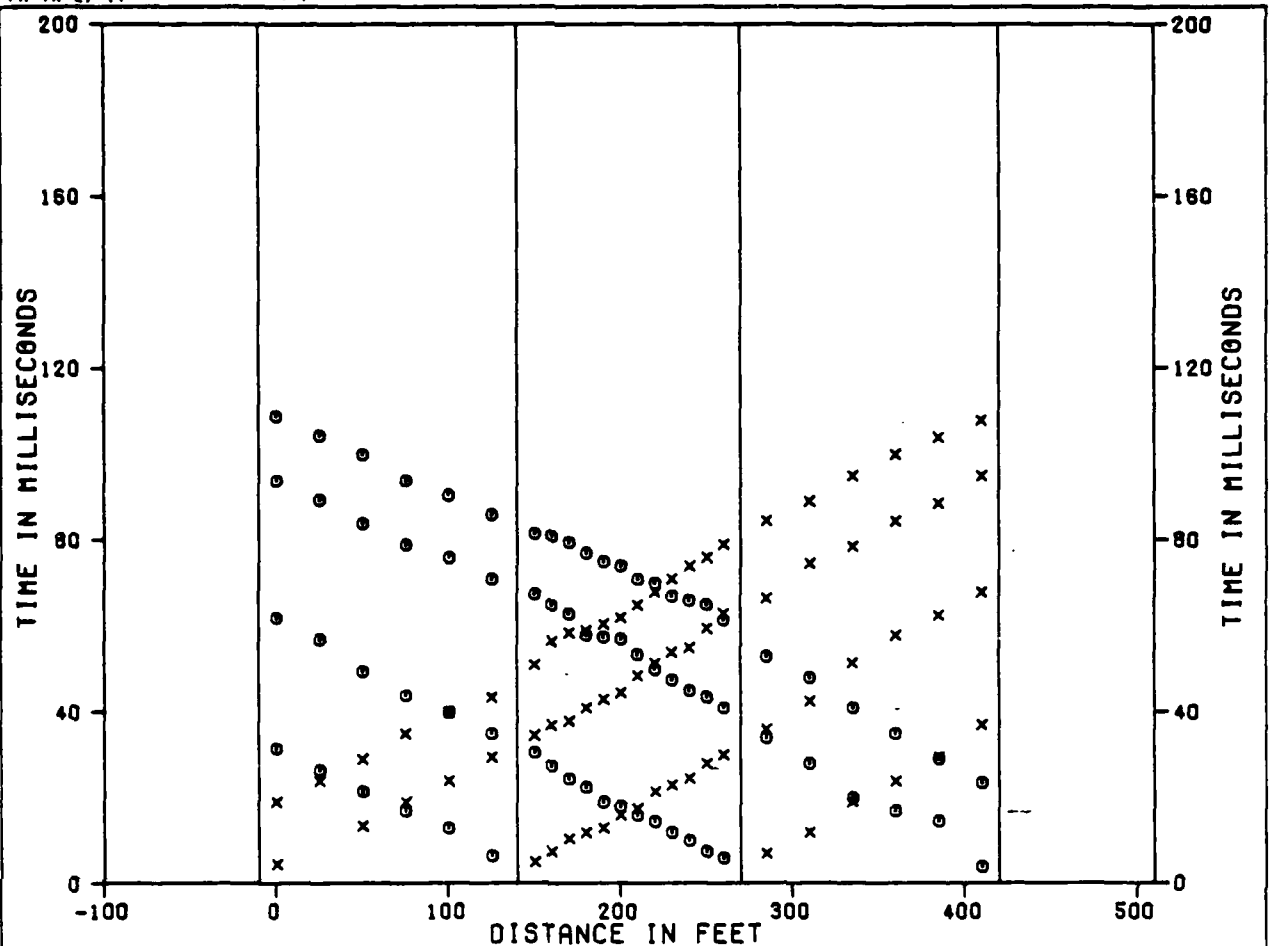
MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SANSCO

FIGURE
3-14

FUGRO NATIONAL, INC.







SHOT F
GEOPHONES

G

1

H

7

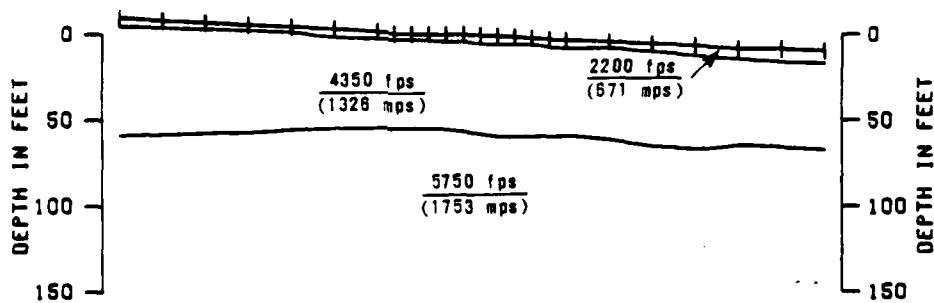
I

18

J

24

K



0 METERS 50
DISTANCE AND DEPTH

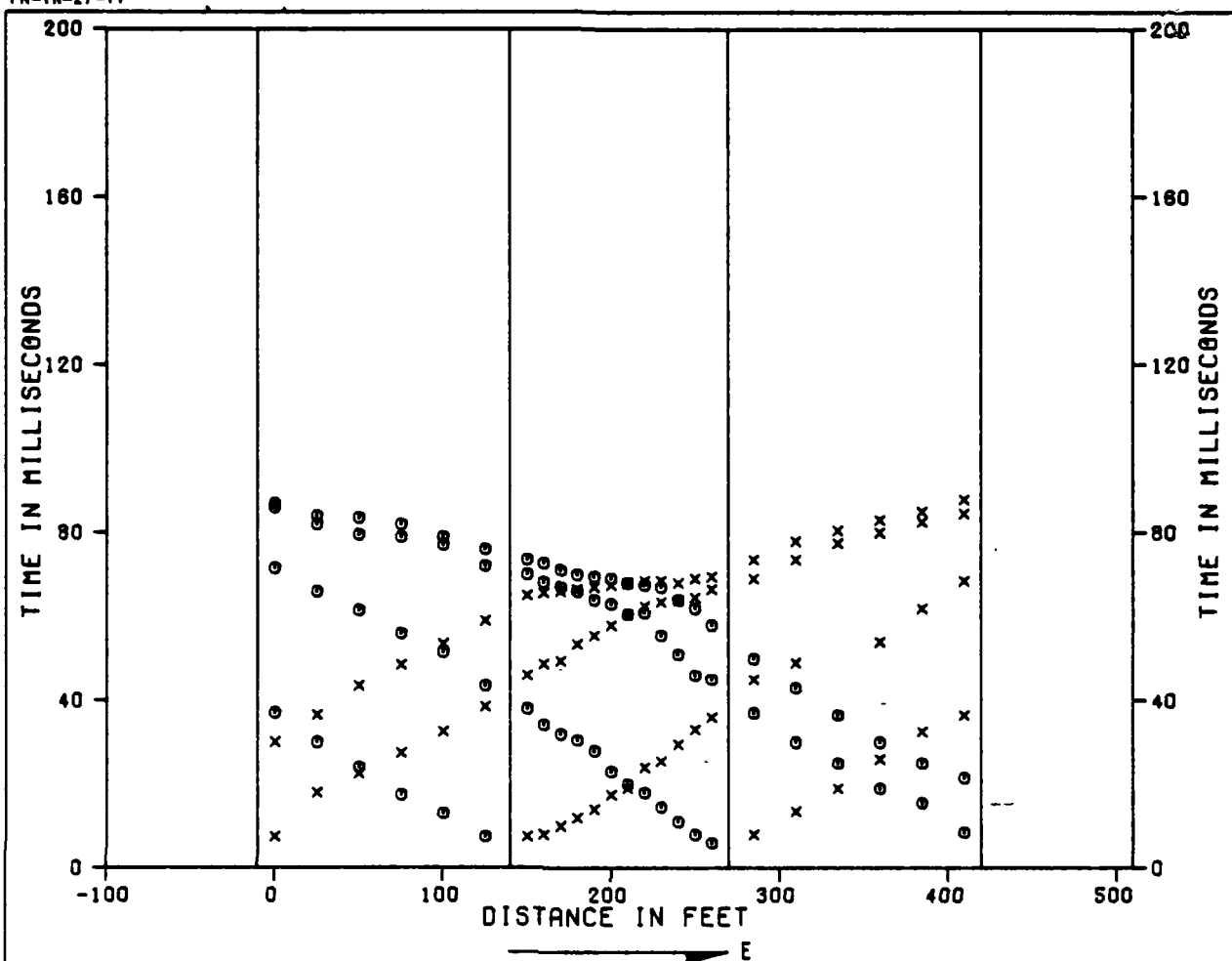
x TIMES TO RIGHT OF SHOTS
o TIMES TO LEFT OF SHOTS

SEISMIC REFRACTION LINE WW-S-17
TIME DISTANCE DATA AND VELOCITY PROFILE
VERIFICATION SITE, WHIRLWIND COP, UTAH

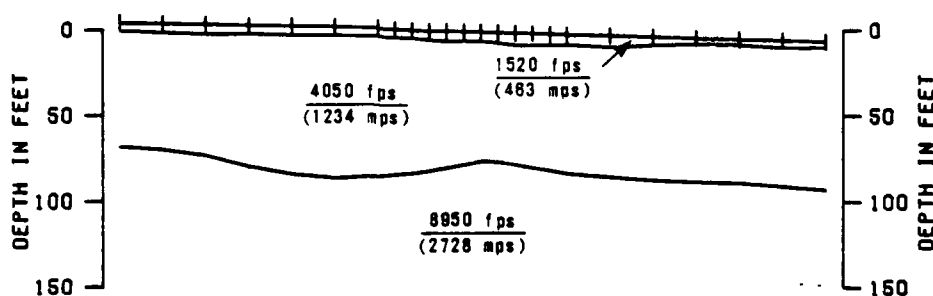
MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SANSO

FIGURE
3-17

FUGRO NATIONAL, INC.



SHOT F G H I J K
 GEOPHONES 1 7 18 24



0 50
 METERS
 DISTANCE AND DEPTH

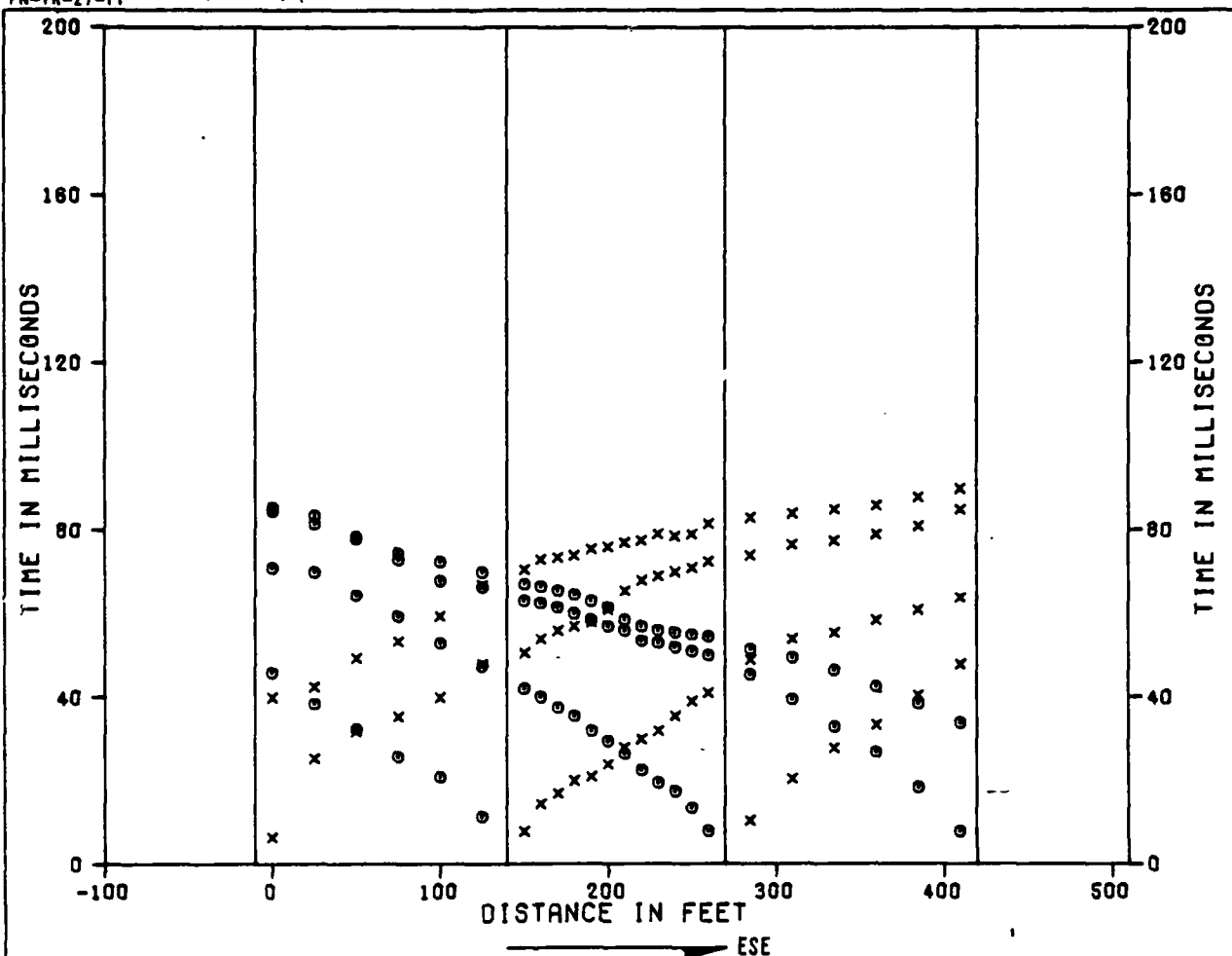
X TIMES TO RIGHT OF SHOTS
 O TIMES TO LEFT OF SHOTS

SEISMIC REFRACTION LINE WW-S-18
 TIME DISTANCE DATA AND VELOCITY PROFILE
 VERIFICATION SITE, WHIRLWIND COP. UTAH

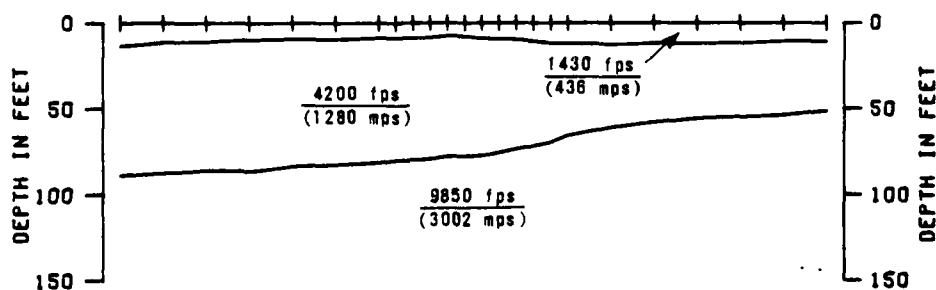
MX SITING INVESTIGATION
 DEPARTMENT OF THE AIR FORCE - SANSO

FIGURE
 3-18

FUGRO NATIONAL, INC.



SHOT F G H I J K
 GEOPHONES 1 7 18 24



0 50
 METERS
 DISTANCE AND DEPTH

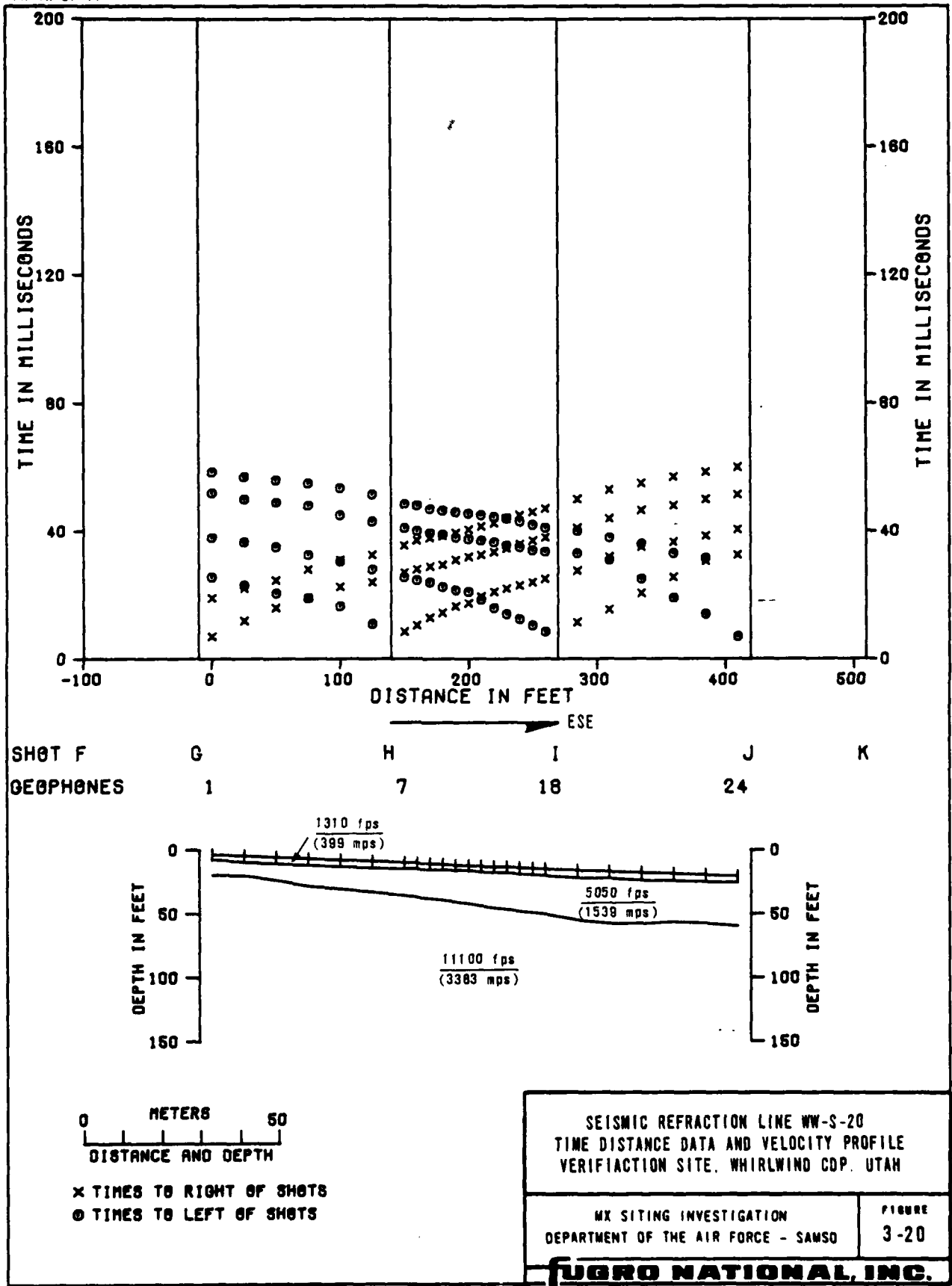
x TIMES TO RIGHT OF SHOTS
 o TIMES TO LEFT OF SHOTS

SEISMIC REFRACTION LINE WW-S-19
 TIME DISTANCE DATA AND VELOCITY PROFILE
 VERIFICATION SITE, WHIRLWIND COP, UTAH

MX SITING INVESTIGATION
 DEPARTMENT OF THE AIR FORCE - SAMSO

FIGURE
 3-19

FUGRO NATIONAL, INC.



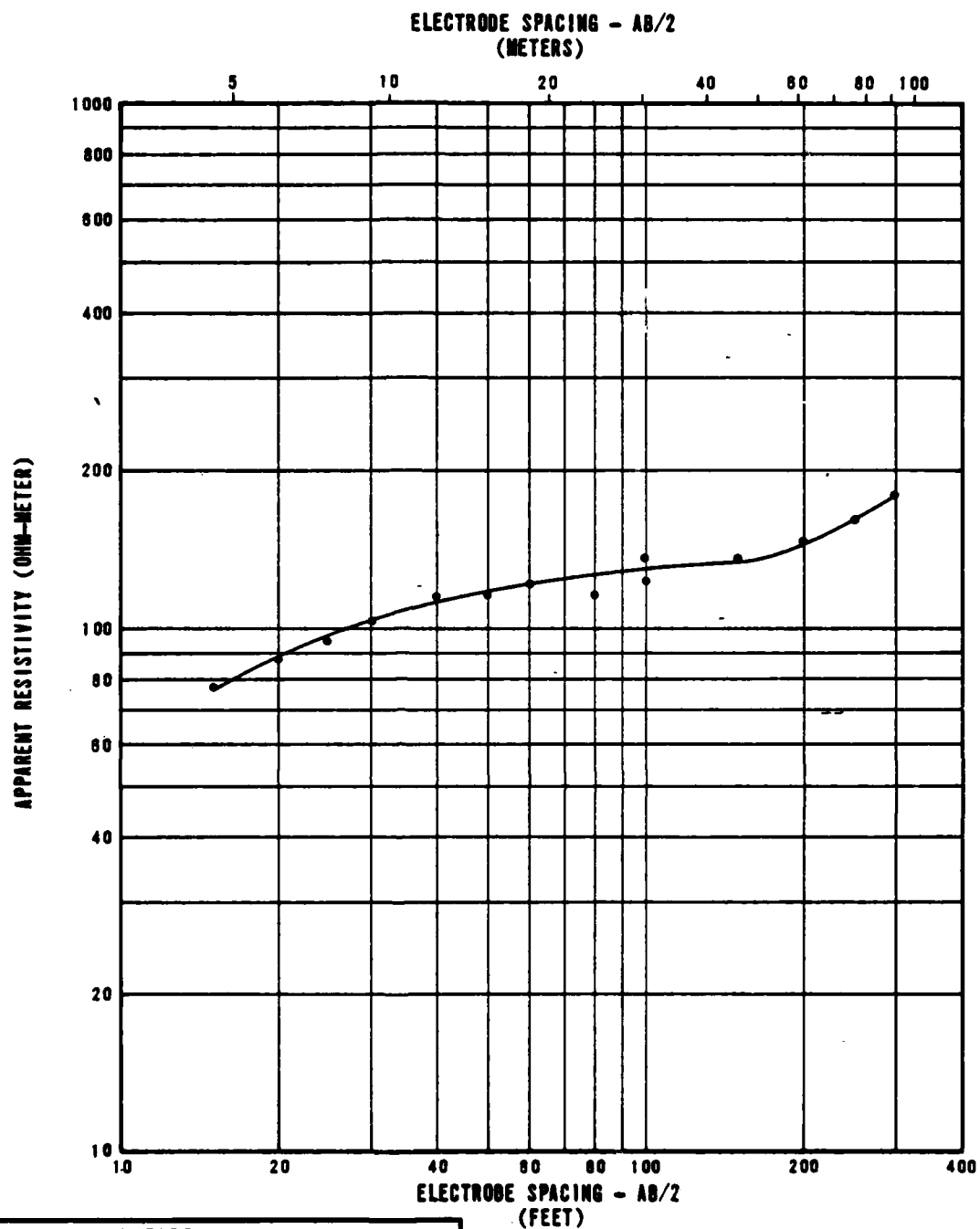
SECTION 4.0
ELECTRICAL RESISTIVITY DATA

EXPLANATIONS OF ELECTRICAL RESISTIVITY DATA

Each figure in this section presents the data obtained from a resistivity sounding and a tabulated model of resistivity layers that would produce a curve similar to the observed curve.

The upper portion of the figures is a graph in which measured apparent resistivity values in ohm-meters are plotted versus one-half the distance between the current electrodes.

The interpreted model tabulated at the bottom of the page shows a combination of true resistivity layers and thicknesses obtained by matching theoretical curves to the field curve.



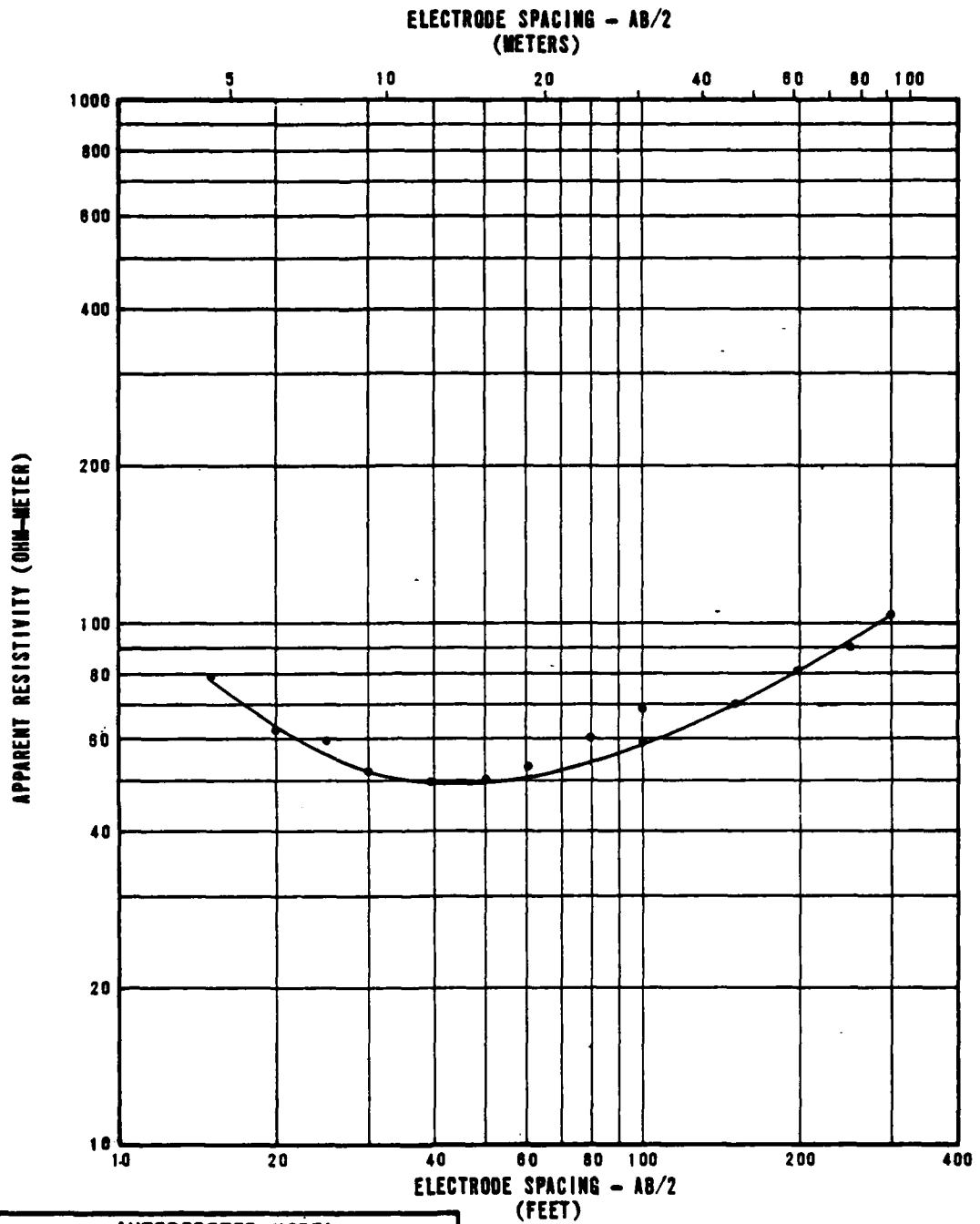
INTERPRETED MODEL		
LAYER DEPTH		RESISTIVITY VALUES
FEET	METERS	OHM-METER
0	0	85
8	2	140
52	16	100
125	38	220
202	62	1130

**RESISTIVITY SOUNDING WW-R-1
SOUNDING CURVE AND INTERPRETATION
VERIFICATION SITE, WHIRLWIND CDP, UTAH**

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SANSO

FIGURE
4-1

FUGRO NATIONAL, INC.



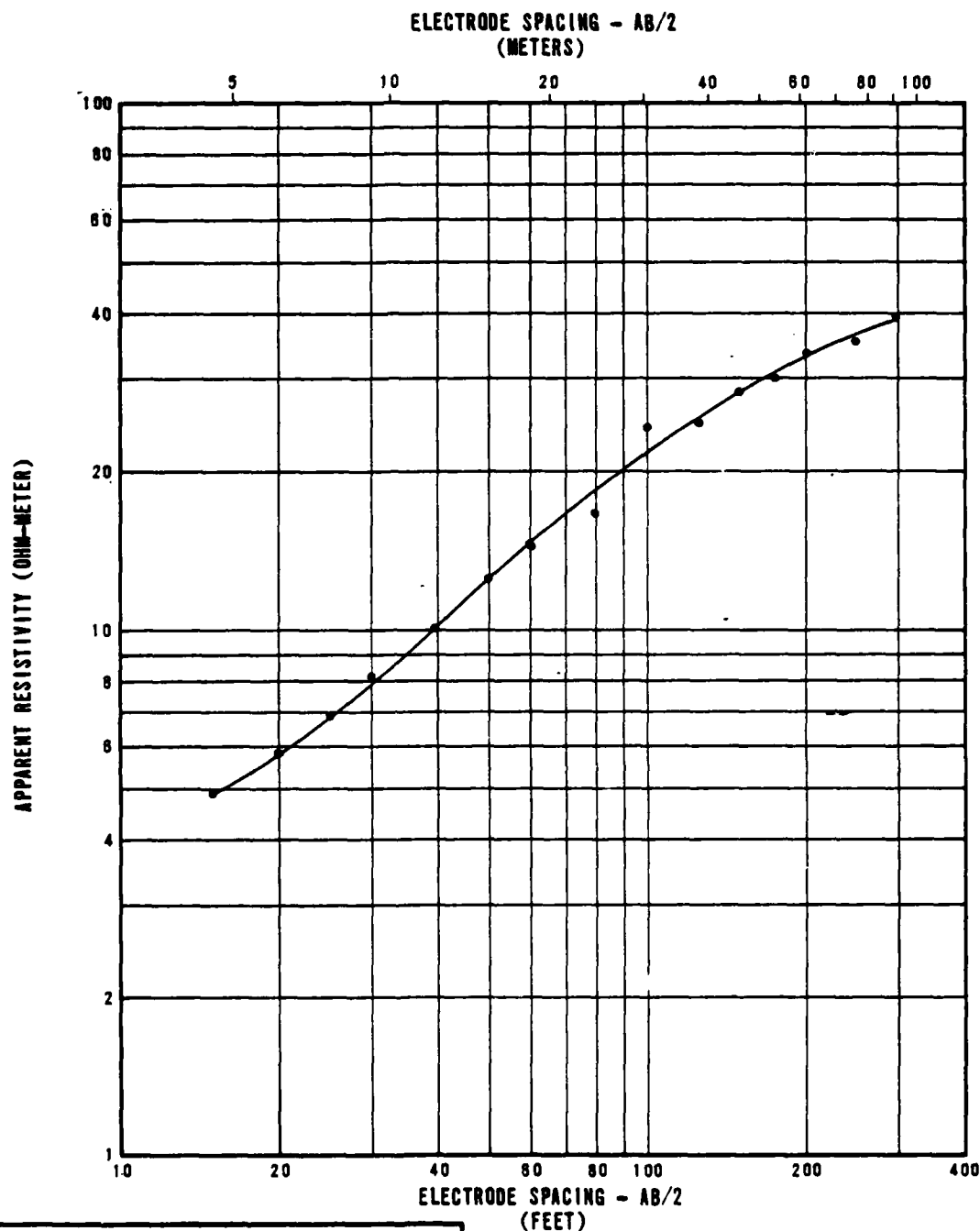
INTERPRETED MODEL		
LAYER DEPTH		RESISTIVITY VALUES
FEET	METERS	OHM-METER
0	0	120
8	2	50
101	31	280

RESISTIVITY SOUNDING WW-R-2
SOUNDING CURVE AND INTERPRETATION
VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SANSO

FIGURE
4-2

FUGRO NATIONAL, INC.



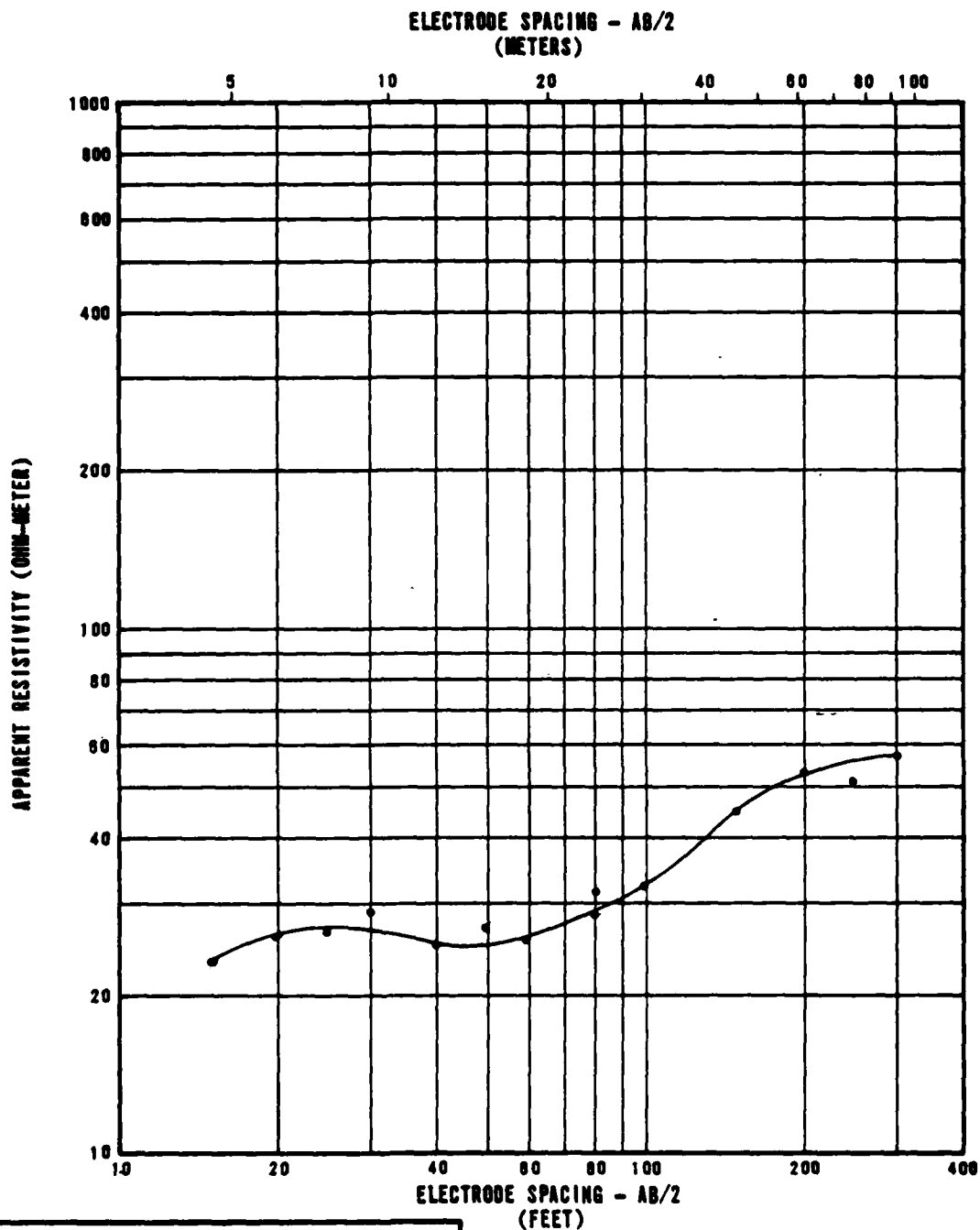
INTERPRETED MODEL		
LAYER DEPTH		RESISTIVITY VALUES
FEET	METERS	OHM-METER
0	0	4
11	3	18
24	7	270
29	9	55

RESISTIVITY SOUNDING WW-R-3
SOUNDING CURVE AND INTERPRETATION
VERIFICATION SITE, WHIRLWIND COP. UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMSO

FIGURE
4-3

FUGRO NATIONAL, INC.



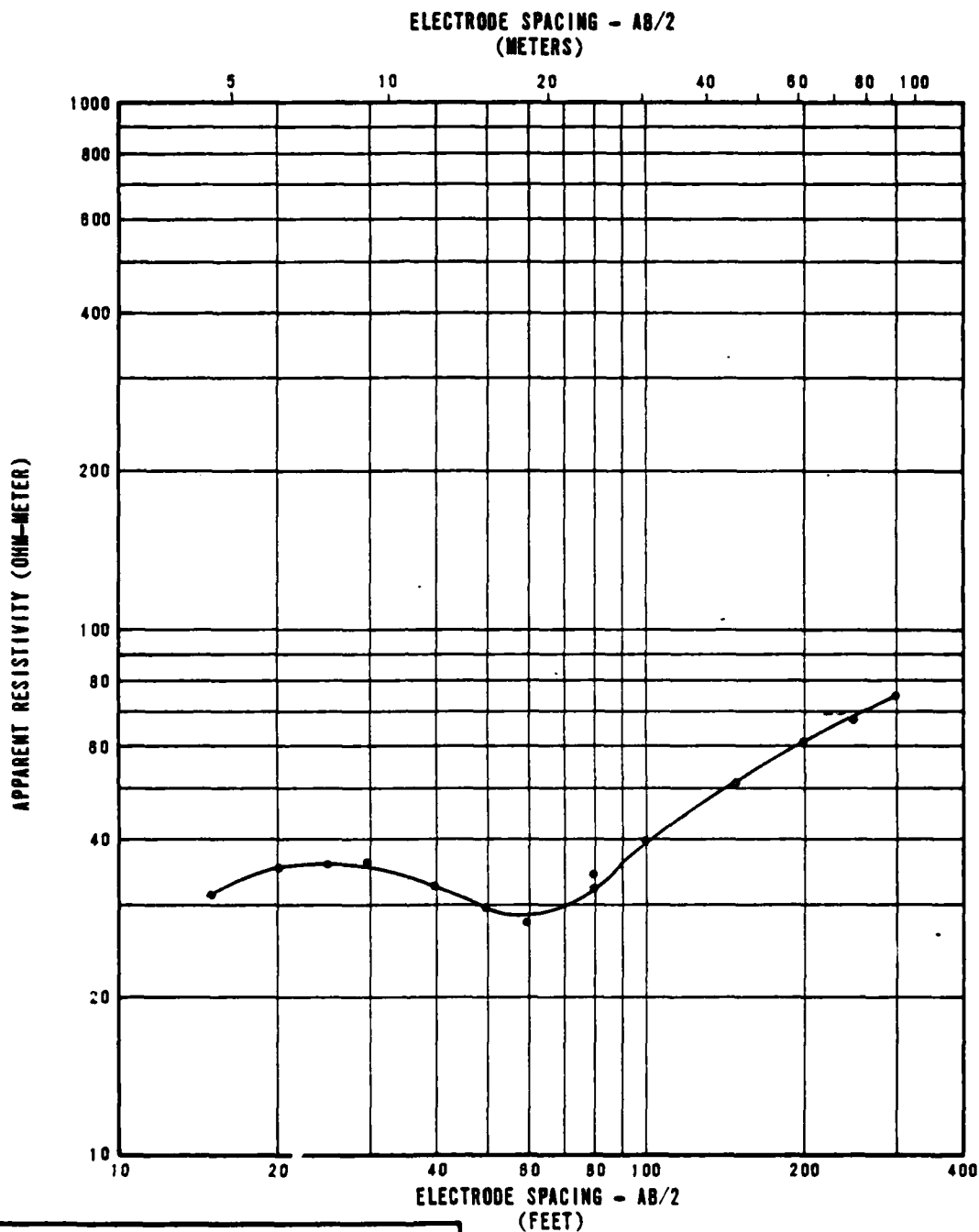
INTERPRETED MODEL		
LAYER DEPTH		RESISTIVITY VALUES
FEET	METERS	OHM-METER
0	0	25
4	1	40
17	5	20
27	8	120
65	20	75

RESISTIVITY SOUNDING WW-R-4
SOUNDING CURVE AND INTERPRETATION
VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMSO

FIGURE
4-4

USRO NATIONAL INC.



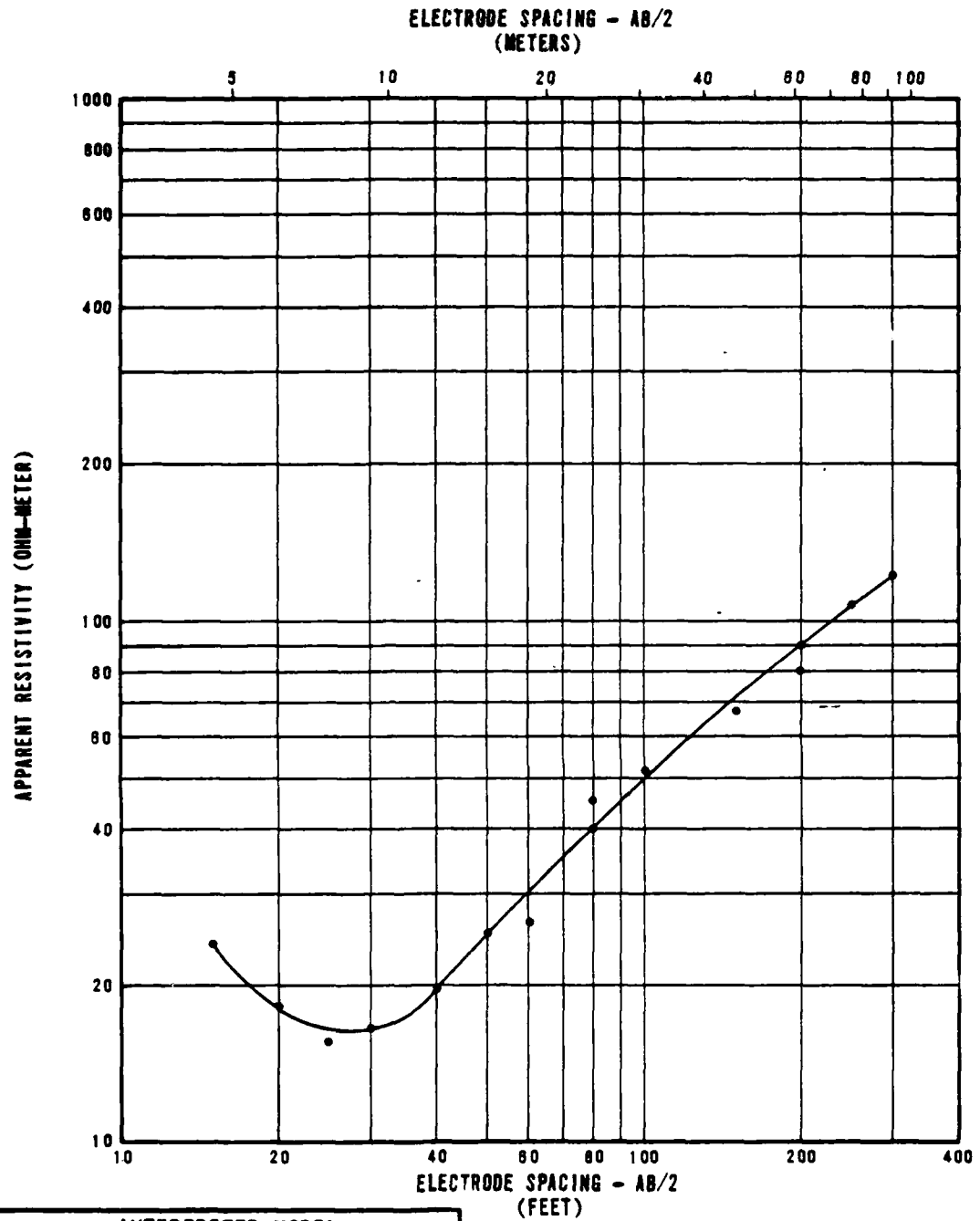
INTERPRETED MODEL		
LAYER DEPTH		RESISTIVITY VALUES
FEET	METERS	OHM-METER
0	0	25
5	1	45
18	5	18
48	14	150
103	31	120

RESISTIVITY SOUNDING WW-R-5
SOUNDING CURVE AND INTERPRETATION
VERIFICATION SITE, WHIRLWIND COP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMS0

FIGURE
4-5

FUGRO NATIONAL, INC.



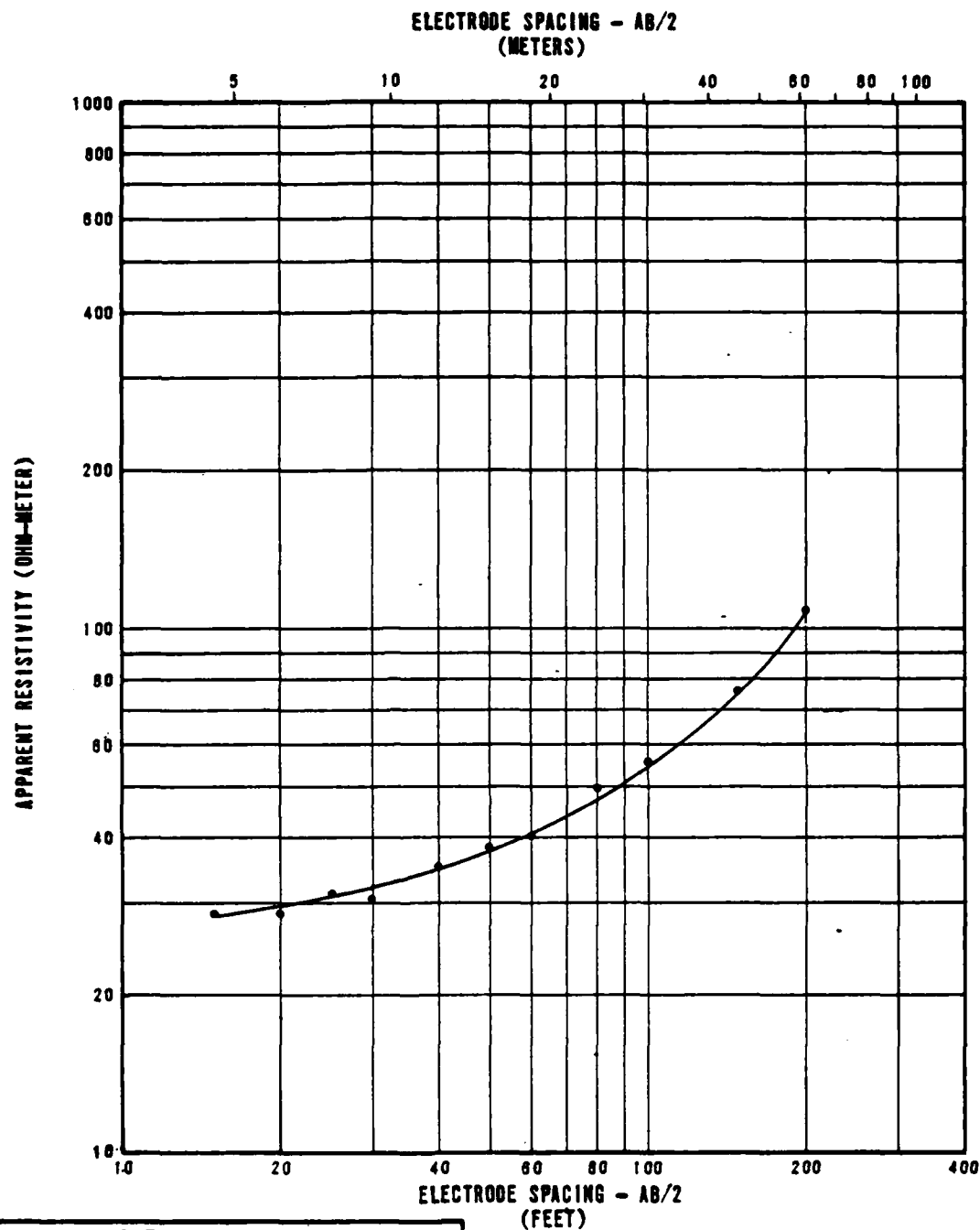
INTERPRETED MODEL		
LAYER DEPTH		RESISTIVITY VALUES
FEET	METERS	OHM-METER
0	0	25
11	3	18
38	12	110
45	14	280

RESISTIVITY SOUNDING WW-R-8
SOUNDING CURVE AND INTERPRETATION
VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMSO

FIGURE
4-6

FUGRO NATIONAL, INC.



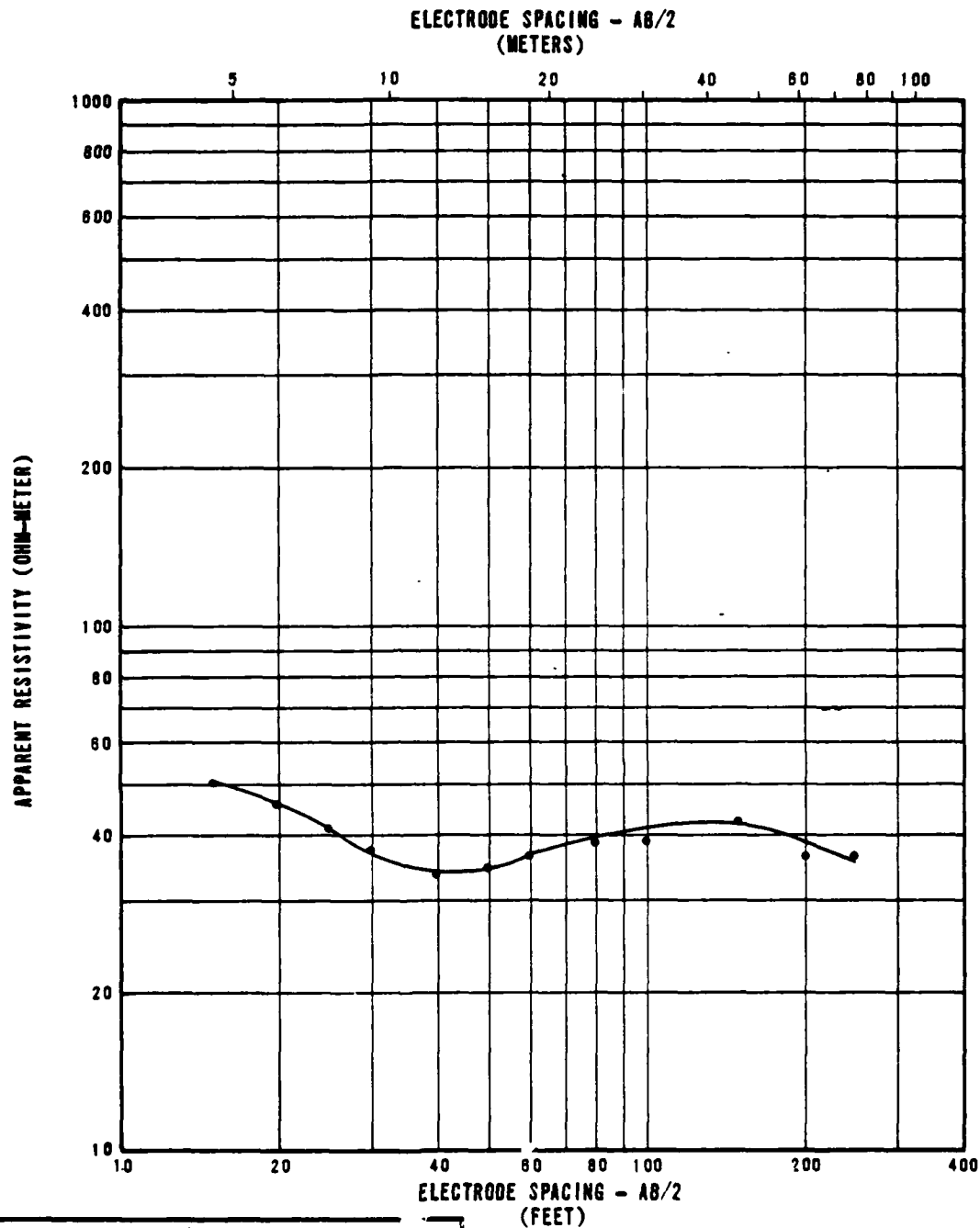
INTERPRETED MODEL		
LAYER DEPTH		RESISTIVITY VALUES
FEET	METERS	OHM-METER
0	0	30
27	8	75
104	32	2910

RESISTIVITY SOUNDING WW-R-7
SOUNDING CURVE AND INTERPRETATION
VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMSO

FIGURE
4-7

FUGRO NATIONAL, INC.



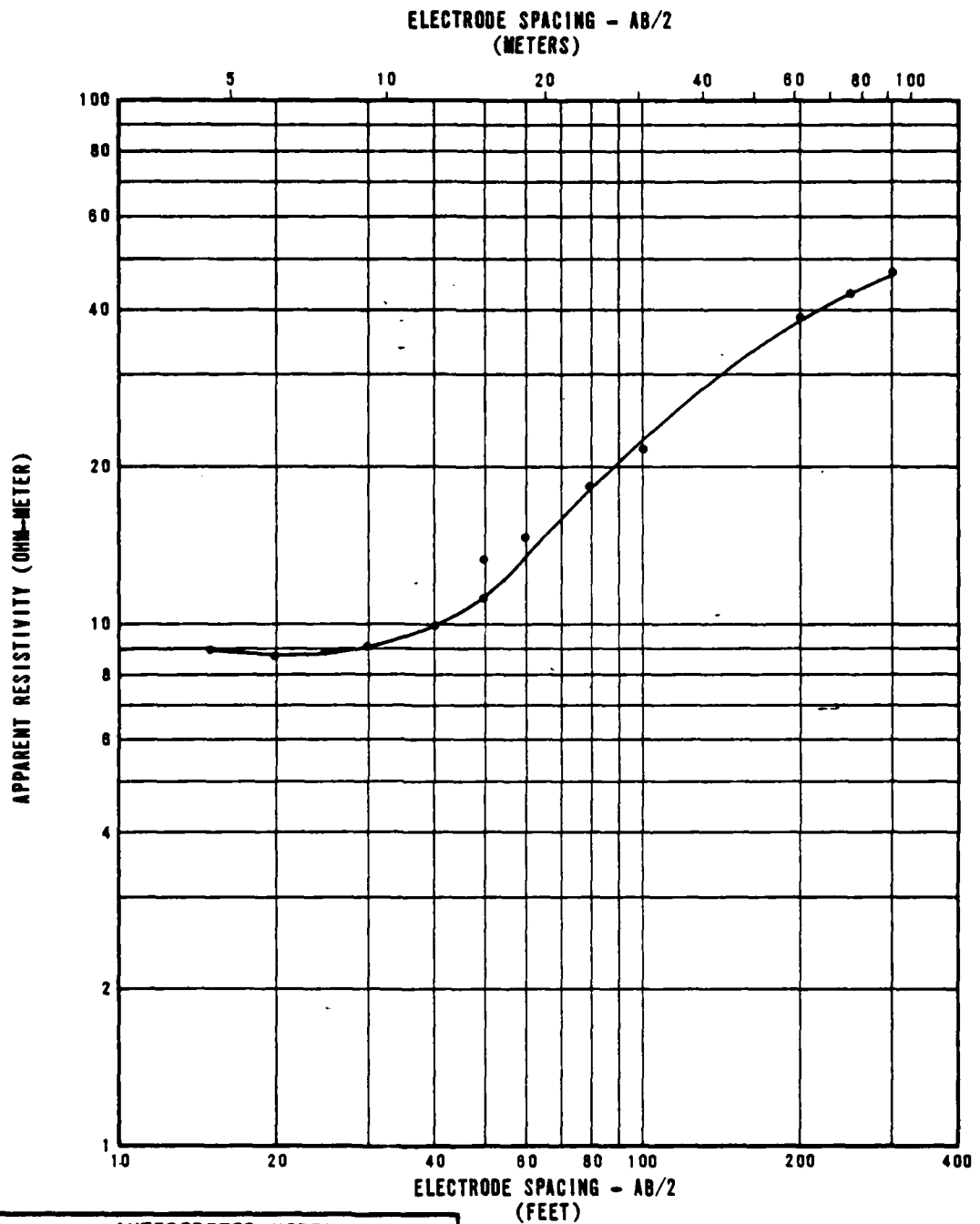
INTERPRETED MODEL		
LAYER DEPTH		RESISTIVITY VALUES
FEET	METERS	OHM-METER
0	0	60
11	3	25
33	10	70
99	30	19

RESISTIVITY SOUNDING WW-R-8
SOUNDING CURVE AND INTERPRETATION
VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SANSO

FIGURE
4-8

FUBRO NATIONAL, INC.



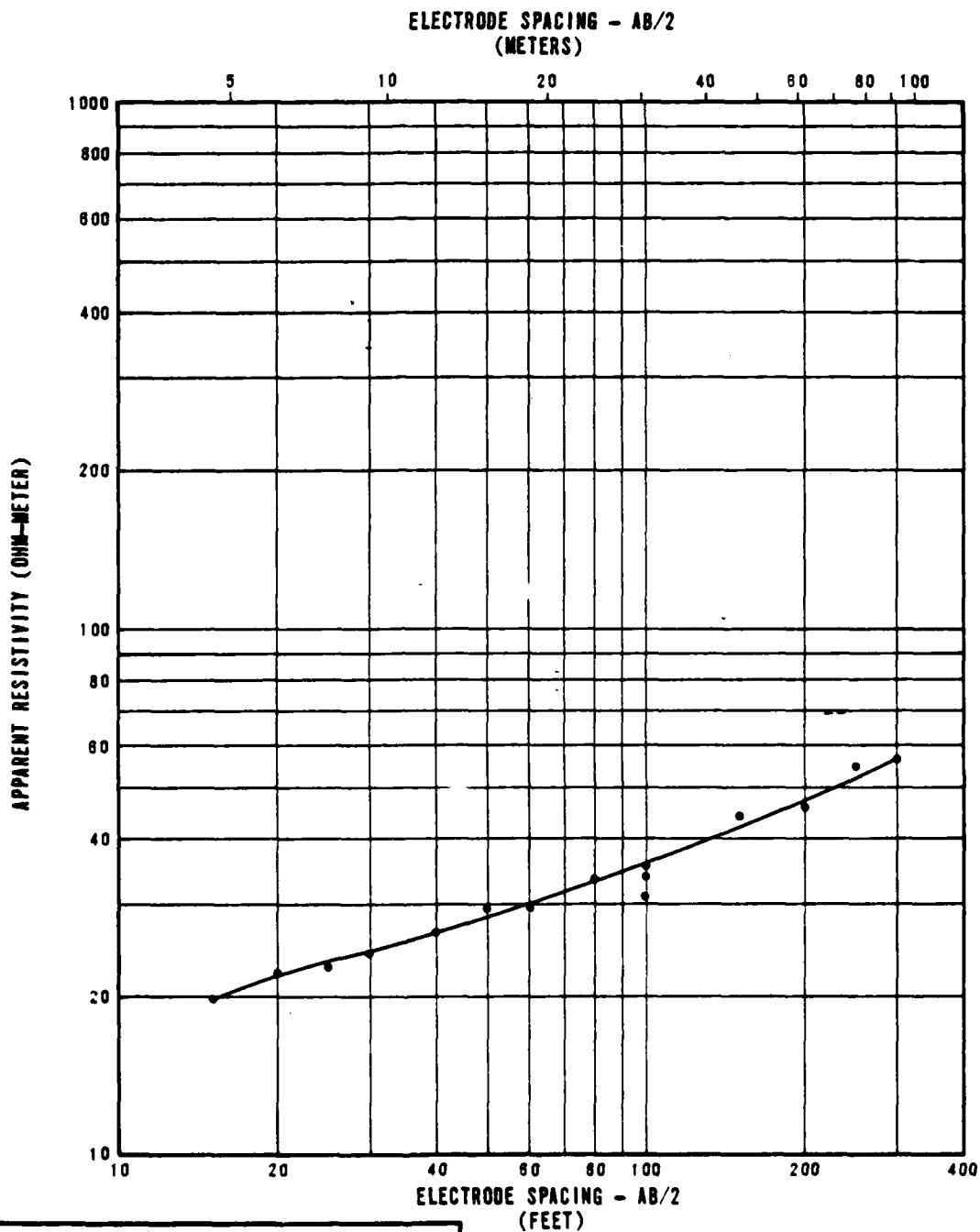
INTERPRETED MODEL		
LAYER DEPTH		RESISTIVITY VALUES
FEET	METERS	OHM-METER
0	0	9
14	4	8
28	8	30
81	19	120

RESISTIVITY SOUNDING WW-R-9
SOUNDING CURVE AND INTERPRETATION
VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMS0

FIGURE
4-9

FUGRO NATIONAL, INC.



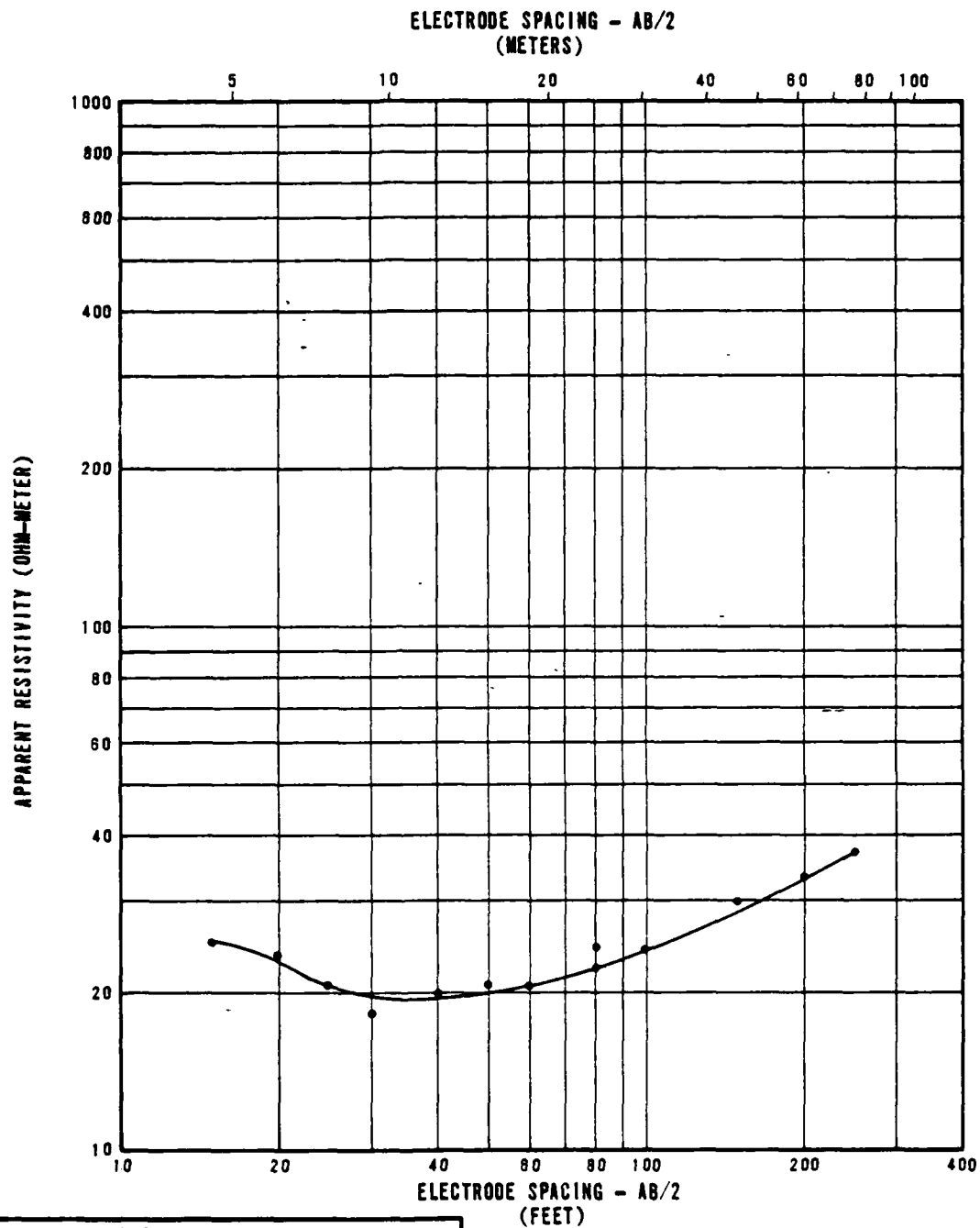
INTERPRETED MODEL		
LAYER DEPTH		RESISTIVITY VALUES
FEET	METERS	OHM-METER
0	0	10
14	4	40
99	30	85

RESISTIVITY SOUNDING WW-R-10
SOUNDING CURVE AND INTERPRETATION
VERIFICATION SITE, WHIRLWIND COP. UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMS0

FIGURE
4-10

FUGRO NATIONAL, INC.



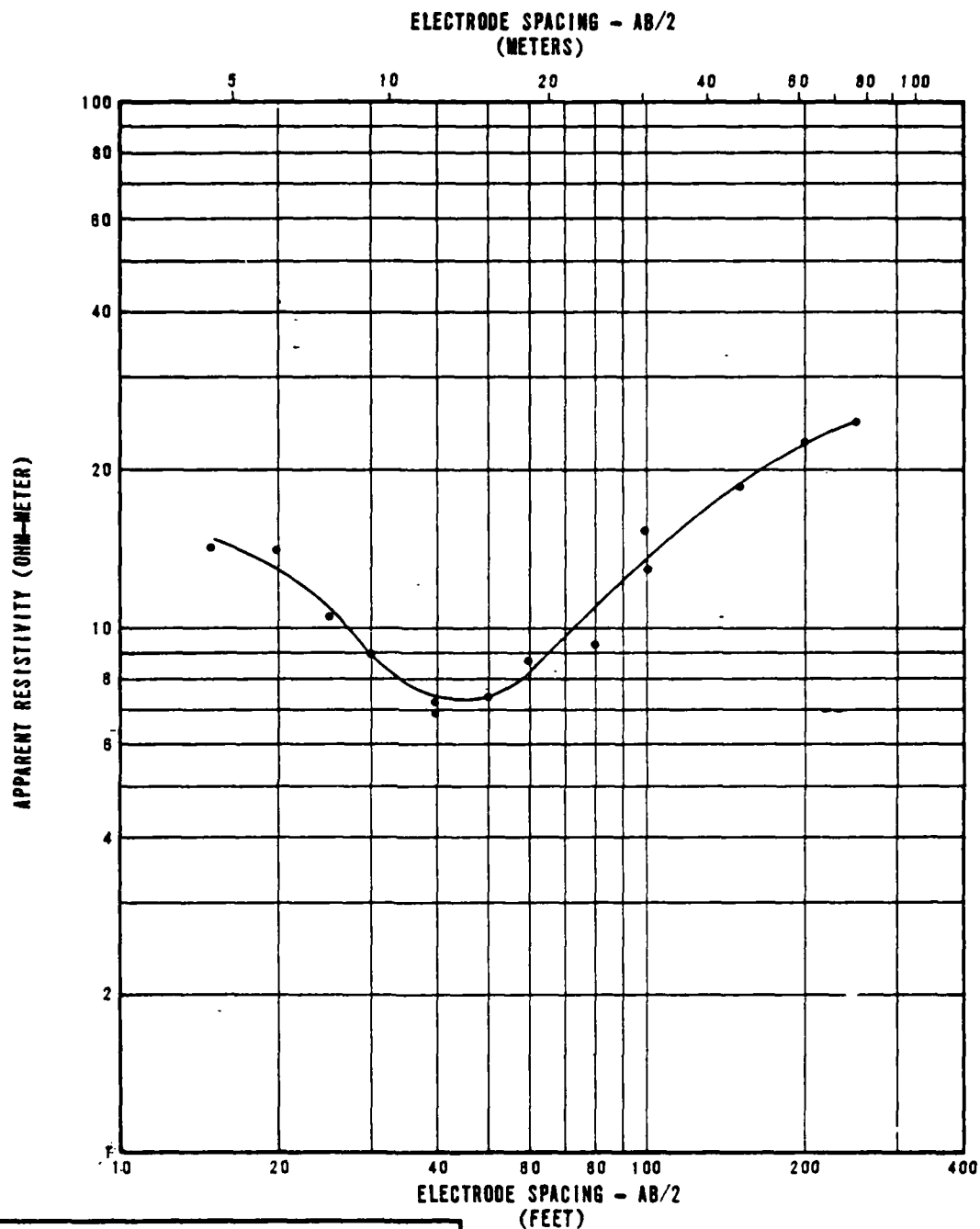
INTERPRETED MODEL		
LAYER DEPTH		RESISTIVITY VALUES
FEET	METERS	OHM-METER
0	0	30
8	2	18
39	12	30
100	30	80

RESISTIVITY SOUNDING WW-R-11
SOUNDING CURVE AND INTERPRETATION
VERIFICATION SITE, WHIRLWIND COP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SANSO

FIGURE
4-11

FUGRO NATIONAL, INC.



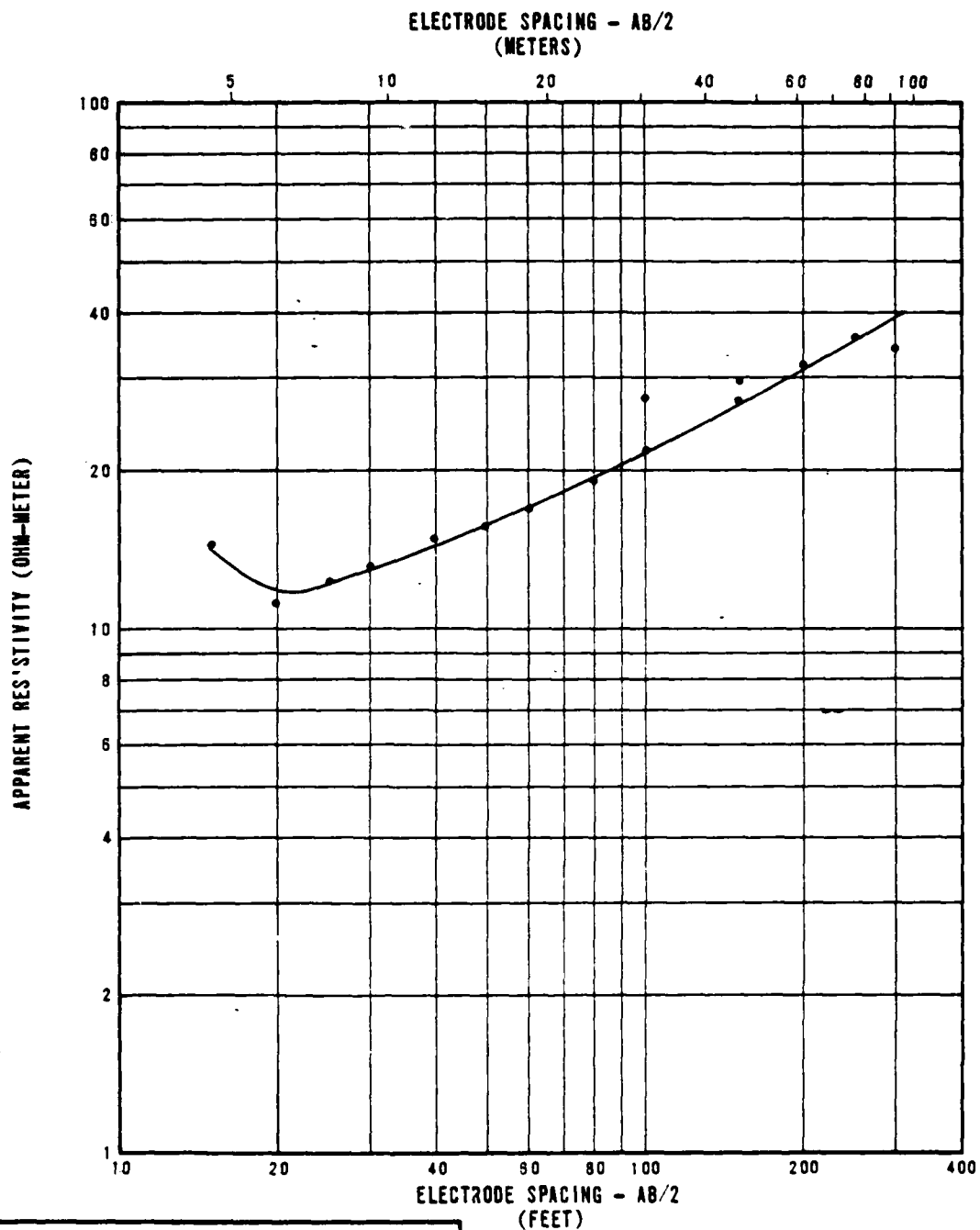
INTERPRETED MODEL		
LAYER DEPTH		RESISTIVITY VALUES
FEET	METERS	OHM-METER
0	0	20
10	3	4
23	7	50
97	30	40

RESISTIVITY SOUNDING WW-R-12
SOUNDING CURVE AND INTERPRETATION
VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMSQ

FIGURE
4-12

UGRO NATIONAL, INC.



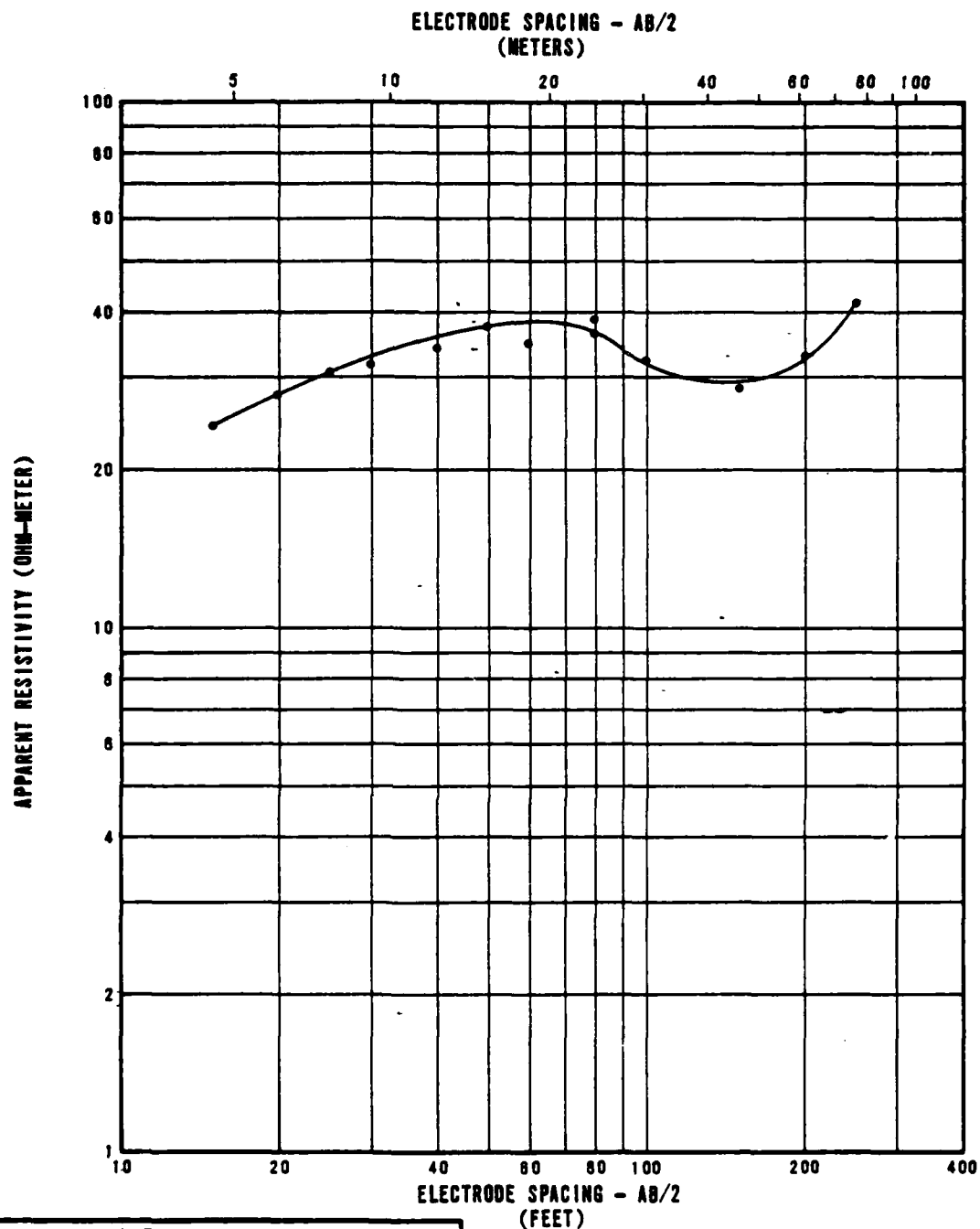
INTERPRETED MODEL		
LAYER DEPTH		RESISTIVITY VALUES
FEET	METERS	OHM-METER
0	0	20
6	2	9
23	7	25
52	16	55

RESISTIVITY SOUNDING WW-R-13
SOUNDING CURVE AND INTERPRETATION
VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMSO

FIGURE
4-13

FUGRO NATIONAL, INC.



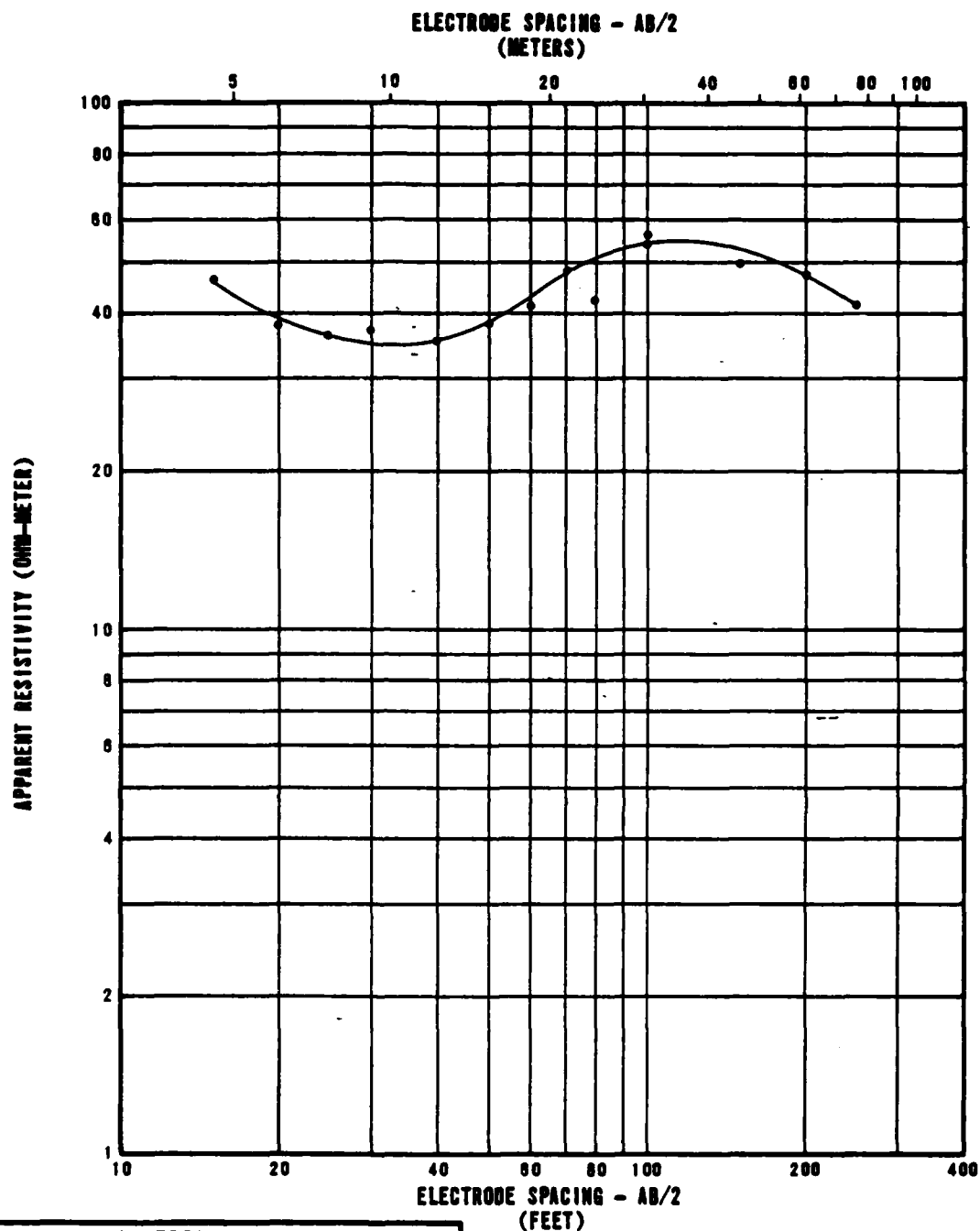
INTERPRETED MODEL		
LAYER DEPTH		RESISTIVITY VALUES
FEET	METERS	OHM-METER
0	0	18
7	2	50
41	12	17
147	45	800

RESISTIVITY SOUNDING WW-R-14
SOUNDING CURVE AND INTERPRETATION
VERIFICATION SITE, WHIRLWIND CDP, UTAH

WX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMS0

FIGURE
4-14

FUGRO NATIONAL, INC.



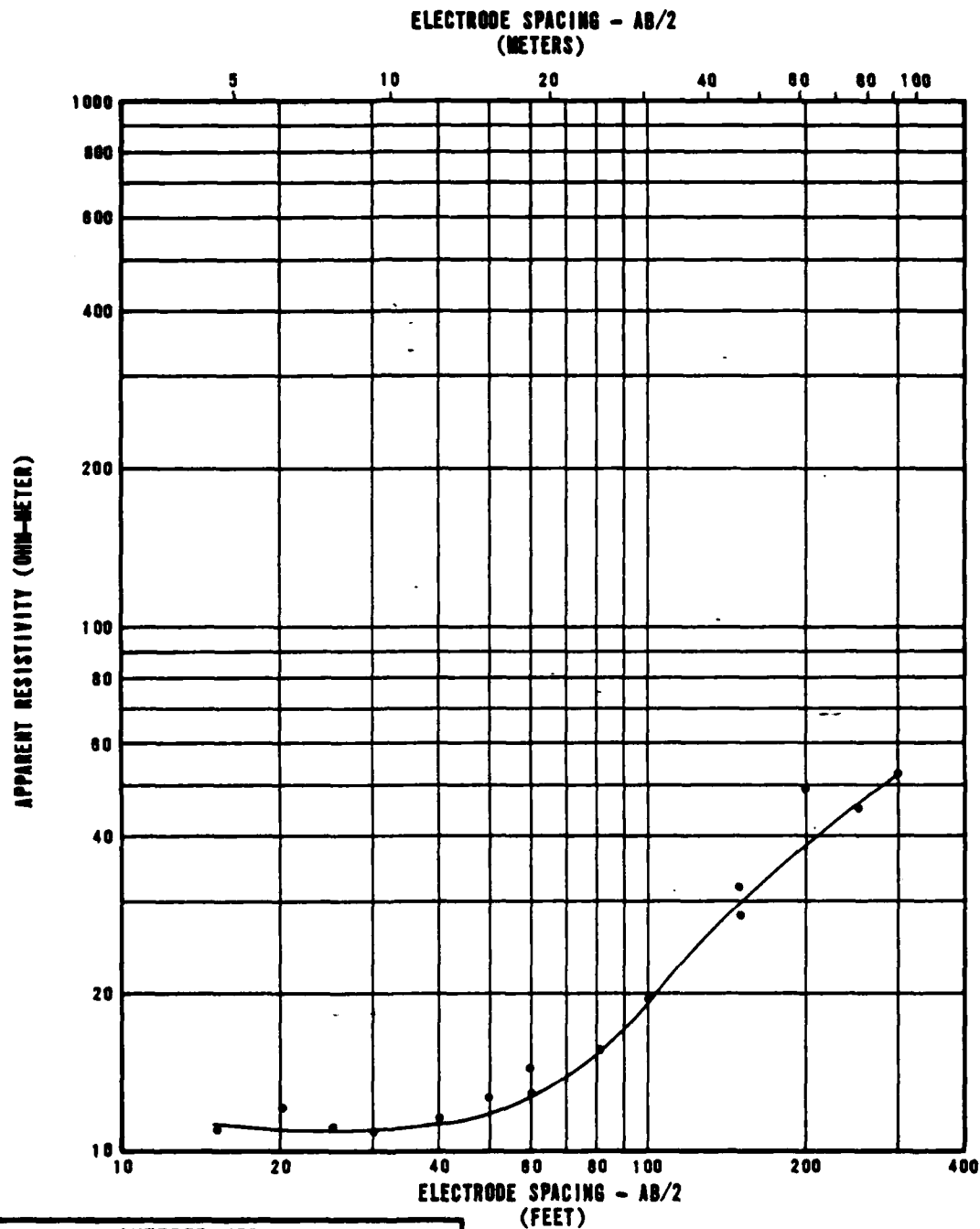
INTERPRETED MODEL		
LAYER DEPTH		RESISTIVITY VALUES
FEET	METERS	OHM-METER
0	0	70
5	2	30
38	12	95
74	23	19

RESISTIVITY SOUNDING WW-R-15
SOUNDING CURVE AND INTERPRETATION
VERIFICATION SITE, WHIRLWIND COP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SANSO

FIGURE
4-15

FURRO NATIONAL, INC.



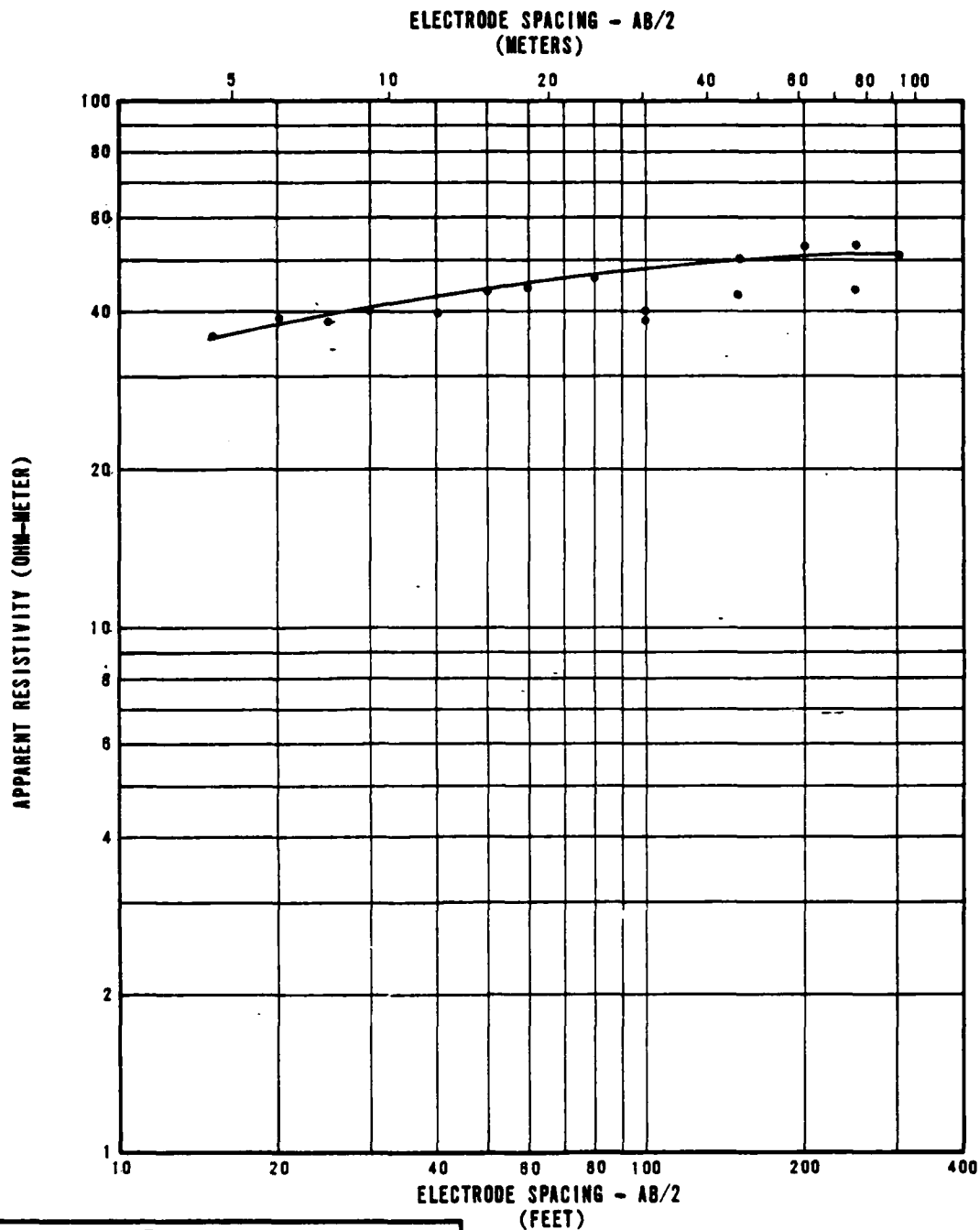
INTERPRETED MODEL		
LAYER DEPTH		RESISTIVITY VALUES
FEET	METERS	OHM-METER
0	0	10
50	15	70
87	20	210

RESISTIVITY SOUNDING WW-R-16
SOUNDING CURVE AND INTERPRETATION
VERIFICATION SITE, WHIRLWIND COP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SANSO

FIGURE
4-16

FUBRO NATIONAL, INC.



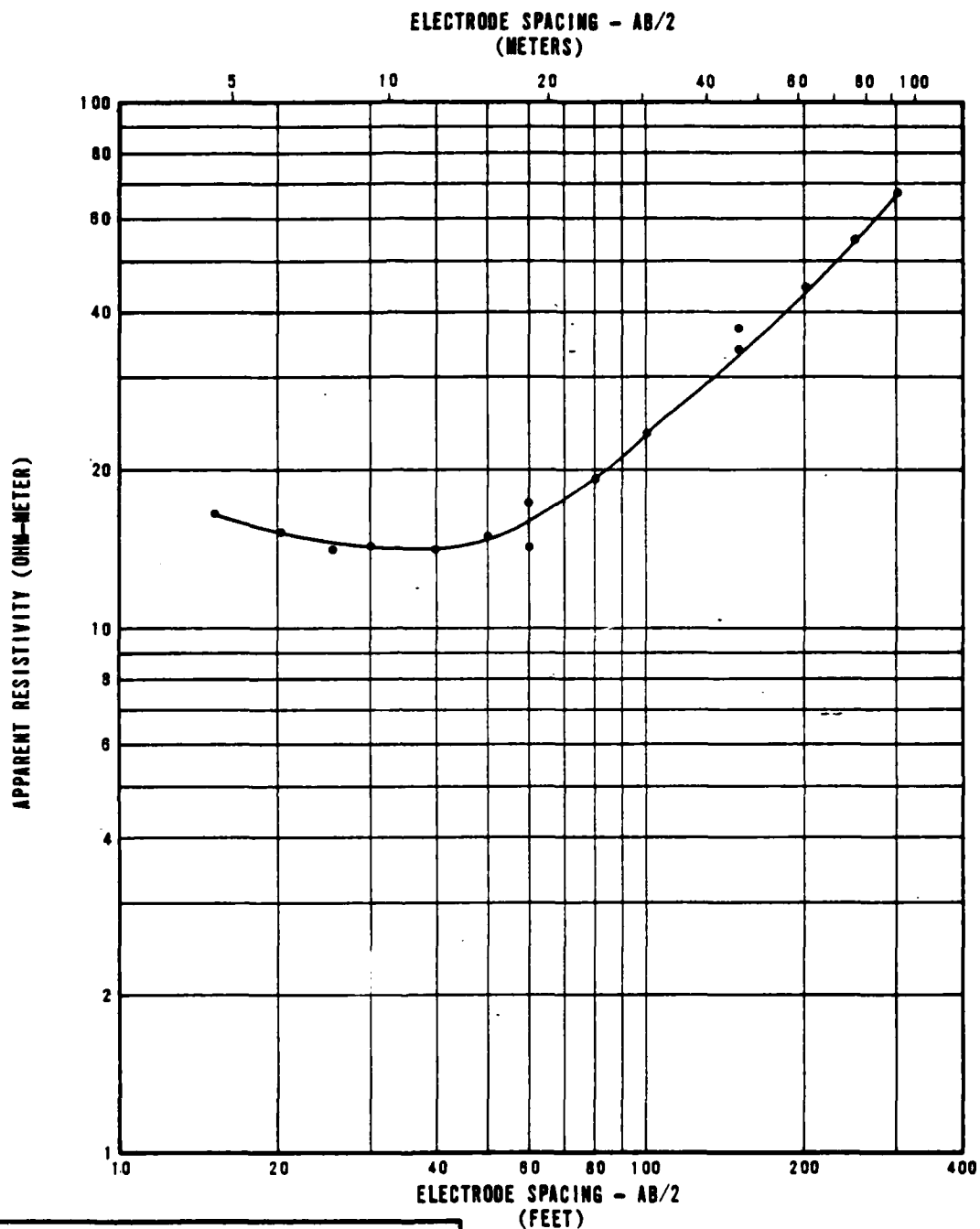
INTERPRETED MODEL		
LAYER DEPTH		RESISTIVITY VALUES
FEET	METERS	OHM-METER
0	0	35
18	6	55

RESISTIVITY SOUNDING WW-R-17
SOUNDING CURVE AND INTERPRETATION
VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMSO

FIGURE
4-17

FUGRO NATIONAL, INC.



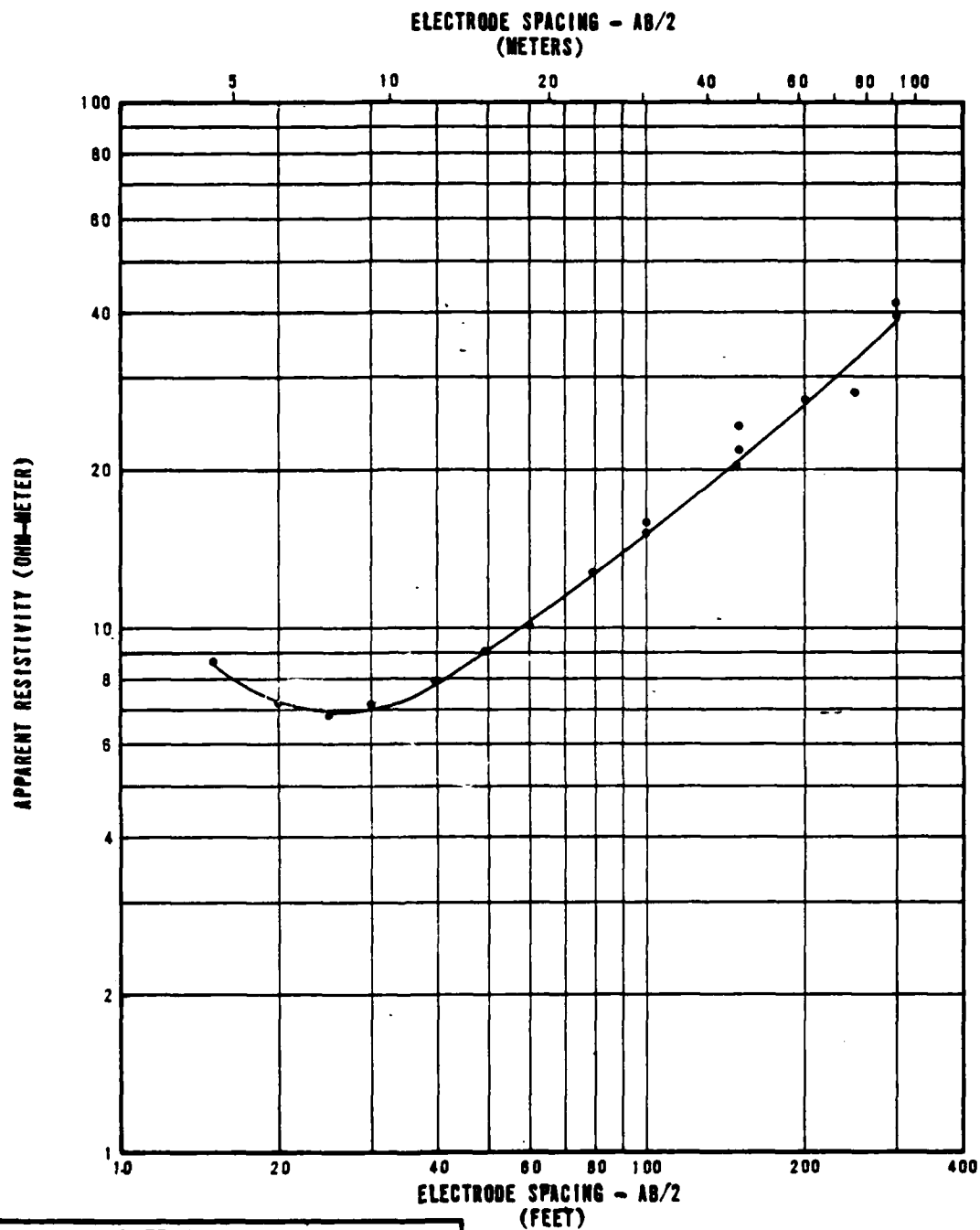
INTERPRETED MODEL		
LAYER DEPTH		RESISTIVITY VALUES
FEET	METERS	OHM-METER
0	0	18
11	3	11
48	15	95
85	28	310
103	31	2030

RESISTIVITY SOUNDING WW-R-18
SOUNDING CURVE AND INTERPRETATION
VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SANSO

FIGURE
4-18

FUGRO NATIONAL, INC.



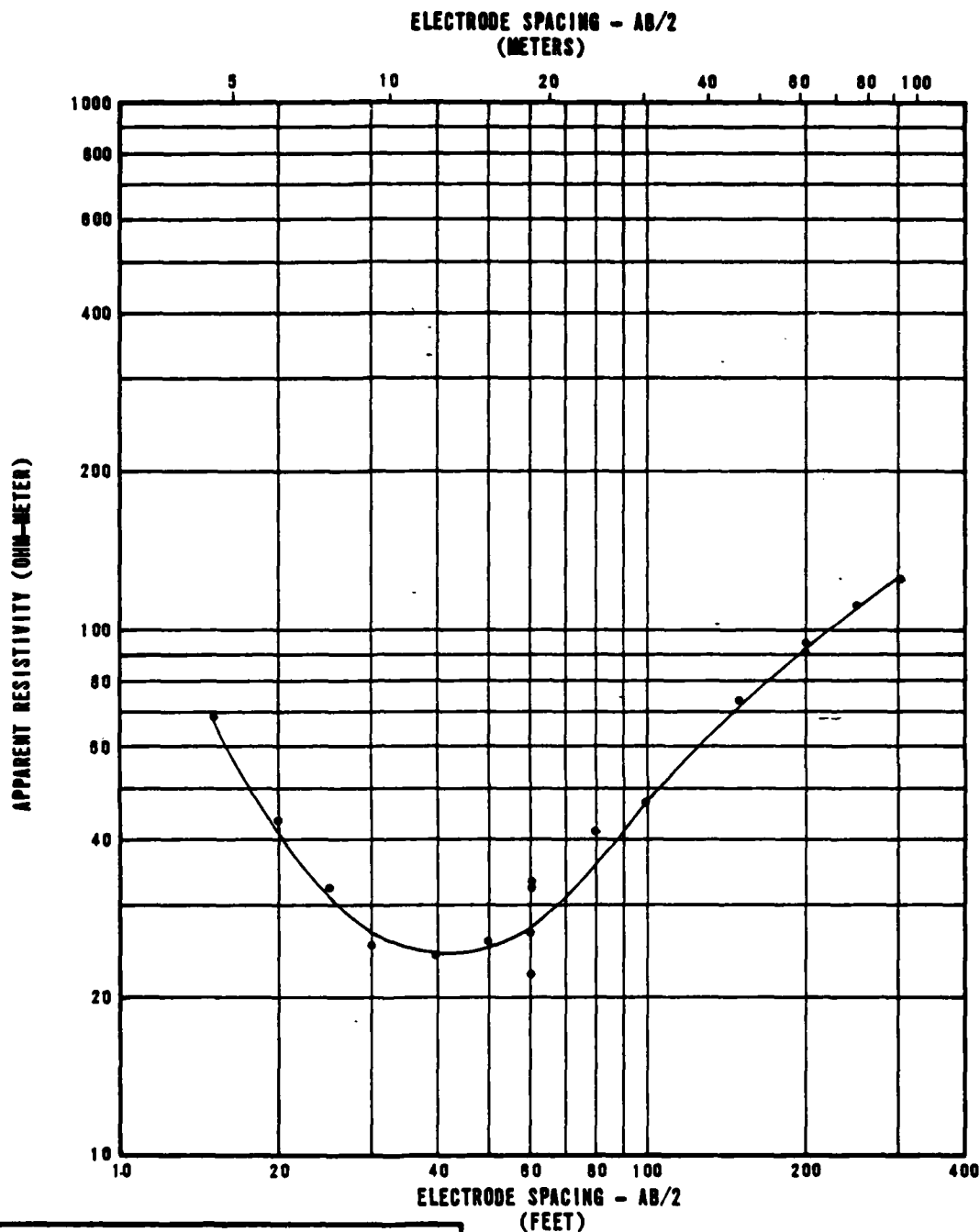
INTERPRETED MODEL		
LAYER DEPTH		RESISTIVITY VALUES
FEET	METERS	OHM-METER
0	0	13
6	2	8
28	9	19
83	25	90
118	36	1080

RESISTIVITY SOUNDING WW-R-19
SOUNDING CURVE AND INTERPRETATION
VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SANSO

FIGURE
4-19

FUGRO NATIONAL, INC.



INTERPRETED MODEL		
LAYER DEPTH		RESISTIVITY VALUES
FEET	METERS	OHM-METER
0	0	70
11	3	18
38	12	300

RESISTIVITY SOUNDING WW-R-20
SOUNDING CURVE AND INTERPRETATION
VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMSO

FIGURE
4-20

FUGRO NATIONAL, INC.

SECTION 5.0

GRAVITY DATA

EXPLANATIONS OF GRAVITY DATA

Gravity data were not available in time (prior to June 1979) for incorporation into this report. A supplemental report containing gravity data and results will be issued at a later date.

SECTION 6.0
BORING LOGS

C

EXPLANATIONS OF BORING, TRENCH, AND TEST PIT LOGS

All data from borings, trenches, and test pits are presented on standard Fugro National logs in Sections 6.0 and 7.0. The following explanations are provided as a key to the logs.

- A. Designations - Borings, trenches, and test pits are identified as follows:

WW-B-1

WW - abbreviation for the site (e.g., WW-Whirlwind)

B - abbreviation for activity (e.g., B-boring, T-trench, P-test pit)

1 - number of activity

- B. Sample Type - Different sampling techniques were used and the symbols are explained at the bottom of the boring logs. For details of sampling techniques, see Section A5.0 of Appendix in Volume I. Horizontal lines, to scale, indicate the depth where sampling was attempted.

- C. Percent Recovery - The numbers shown represent the ratio (in percent) of the soil sample recovered in the sampler to the full penetration of the sampler.

- D. N Value - Corresponds to standard penetration resistance, which is number of blows required to drive a standard split-spoon sampler for the second and third of three 6-inch (15 cm) increments with a 140-pound (63.5 kg) hammer falling 30 inches (76 cm) (ASTM D 1586-67).

- E. Depth - Corresponds to depth below ground surface in meters and feet.

- F. Lithology - Graphic representation of the soil and rock types.

- G. USCS - Unified Soil Classification System (see Table 6-1 for complete details) symbols.
- H. Soil Description - Except in cases where samples were classified based on laboratory test 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 change in strata at the depth shown.

Definitions of some of the terms and criteria to describe soils and conditions encountered during the exploration follow.

Gradation : A coarse-grained soil is well graded if it has a wide range in grain size and substantial amounts of most intermediate particle sizes.

Poorly graded indicates that the soil consists predominantly of one size (uniformly graded) or has a wide range of sizes with some intermediate sizes obviously missing (gap-graded).

Moisture :	Dry	- no feel of moisture
	Slightly Moist	- much less than normal moisture
	Moist	- normal moisture for soil
	Very Moist	- much greater than normal moisture
	Wet	- for soils below the water table (if known)

From Wagner, 1937	TESTS
These procedures are to be performed on the minus No. 40 sieve size particles, approximately $\frac{1}{4}$ 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 soil about the size of a golf ball, and place it on a surface of about one half inch water. If necessary, 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 dilatancy reaction will be observed if the soil is loose. The soil will become stiffer and changes to a looser condition and becomes slushy. 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 rapid suctioning of water from the soil is the cause of the dilatancy reaction. During squeezing absent 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 loess flint, show a moderately quick reaction.	Field Identification Procedure for Fine Grained Soils or Functions Dry Strength (Crushing Characteristic): A lump of soil, approximately 1 in. No. 40 sieve size, moulds a pat of soil 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. Soil strength is a function of the amount of clay in the soil. High dry strength is characteristic for clays of the CII 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 from silts by the dilatancy reaction. A soil of fine sand and silt, especially where a typical silt has the smooth feel of the silt. Toughness (Consistency near plastic limit): A lump of soil, approximately 1 in. 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 into a one-inch diameter thread. The thread is then folded and is rolled repeatedly. During this manipulation the moisture content is gradually reduced and the specimen stiffens, finally loses its plasticity, and crumbles when the thread is pulled apart. After the thread crumbles, the pieces should be lumped together and a slight kneading action continued until the lump crumbles. The toughness of the thread near the plastic limit and the siltiness of the soil are the two characteristics of the soil. Shrinkage: Weakness of the thread at the plastic limit and quick loss of coherence of the lump below the plastic limit indicate either inorganic clay or low plasticity, or materials such as kaolin-type clays and organic clays. Organic clays have a very weak and spongy feel at the plastic limit. Highly organic silts have a very weak and spongy feel at the plastic limit.

FUGRO NATIONAL, INC.

Consistency: Consistency descriptions of coarse-grained soils (GW, GP, GM, GC, SW, SP, SM, SC) are as follows.

<u>Consistency</u>	<u>N Value (ASTM D 1586-67)</u>
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	>50

Consistency descriptions of fine-grained soils (ML, CL, MH, CH,) are as follows:

<u>Consistency</u>	<u>Shear Strength</u>		<u>Field Guide</u>
	<u>(ksf)</u>	<u>(kn/m²)</u>	
Very Soft	0.25	12	Sample with height equal to twice the diameter, sags under own weight
Soft	0.25- 0.50	12 - 24	Can be squeezed between thumb and forefinger
Firm	0.50- 1.00	24- 48	Can be molded easily with fingers
Stiff	1.00- 2.00	48- 96	Can be imprinted with slight pressure from fingers
Very Stiff	2.00- 4.00	96- 192	Can be imprinted with considerable pressure from fingers
Hard	over 4.00	over 192	Cannot be imprinted by fingers

Grain Shape: Angular - particles have sharp edges and relatively plane sides with unpolished surfaces.

Subangular - particles are similar to angular but have somewhat rounded edges.

Subrounded - particles exhibit nearly plane sides but have well-rounded corners and edges.

Rounded - particles have smoothly curved sides and no edges.

Calcareous : Containing calcium carbonate; presence of calcium carbonate is commonly identified on the basis of reaction with dilute hydrochloric acid.

Caliche : Soils cemented by porous calcium carbonate and/or other soluble minerals by upward-moving solutions.

Degree of Cementation: (Stages of development of caliche profile)

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	Increasing carbonate impregnation

Secondary Material : Example - Sand with trace to some silt

Trace - 5-12% (by dry weight)
 Little - 13-20% (by dry weight)
 Some - >21% (by dry weight)

Plasticity : Plasticity index is the range of water content, expressed as a percentage of the weight of the oven-dried soil, through which the soil is plastic. It is defined as the liquid limit minus the plastic limit. Descriptive ranges used on the logs include:

Nonplastic	(PI, 0 - 4)
Slightly Plastic	(PI, 4 - 15)
Medium Plastic	(PI, 15 - 30)
Highly Plastic	(PI, >31)

Cobbles and Boulders : A cobble is a rock fragment, usually rounded by weathering or abrasion, with an average diameter ranging between 3 and 12 inches (8 and 30 cm).

A boulder is a rock fragment, usually rounded by weathering or abrasion, with an average diameter of 12 inches (30 cm) or more.

- I. Remarks - This column was provided on boring and trench logs for comments regarding drilling difficulty, number and size of cobbles or boulders encountered, trench wall stability, loss of drilling fluid in the boring, and other conditions encountered during drilling and excavations.
- J. Dry Density and Moisture Content - The boring logs include a graphical display of laboratory test results for dry density (ASTM D 2937-71) in pounds per cubic foot and kilograms per cubic meter and moisture content (ASTM D 2216-71) in percent from representative samples taken during drilling. The symbols are explained at the bottom of the boring logs.

K. Sieve Analysis - The numbers represent the percentage by dry weight (ASTM D 422-63) of each of the following soil components:

GR - Gravel, rock particles that will pass a 3-inch (76 mm) sieve and are retained on No. 4 (4.75 mm) sieve.

SA - Sand, soil particles passing No. 4 sieve and retained on No. 200 (0.075 mm) sieve.

FI - Fines, silt or clay, soil particles passing No. 200 sieve.

L. Atterberg Limits (LL and PI) -

LL - Liquid Limit, the water content corresponding to the arbitrary limit between the liquid and plastic states of consistency of a soil (ASTM D 423-66).

PL - Plastic Limit, the water content corresponding to an arbitrary limit between the plastic and the semisolid state of consistency of a soil (ASTM D 424-59).

PI - Plasticity Index, numerical difference between the liquid limit (LL) and the plastic limit (PL) indicating the range of moisture content within which a soil-water mixture is plastic.

NP - Nonplastic.

M. Miscellaneous Information -

Elevations - indicated elevations on the logs are estimated from topographic maps of the study area, within an accuracy of half the contour interval.

Surficial
Geologic Unit - indicates the surficial geologic unit in which the activity is located.

Date Drilled - indicates the period from beginning to completion of the activity.

Drilling
Method - signifies the type of drilling procedure used such as rotary wash.

Hole Diameter - nominal size of boring drilled.

Water Level - indicates depth from ground surface to water table where encountered.

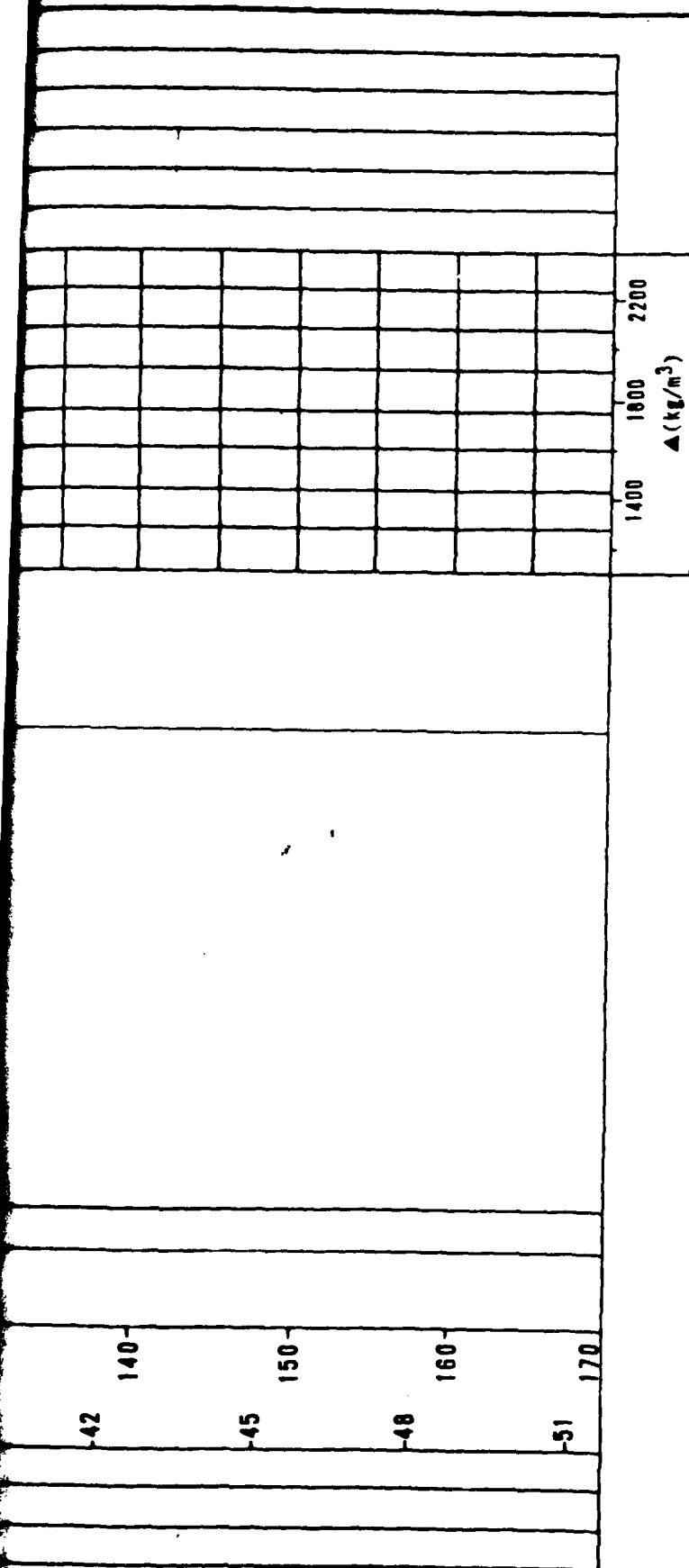
Trench Length - length at ground surface of final trench excavation.

Trench
Orientation - bearing of longitudinal trench centerline.

CHECKED BY _____ APPROVED BY _____

SAMPLE TYPE	% RECOVERY	N VALUE	METERS	DEPTH	LITHOLOGY	USCS	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS												
									Δ(pcf)										ANALYSIS		
										80	100	110	120	130	140	GR	SA	FI	LL	PI	
										5	10	15	20	25	30	35					
										● (%)											
[Pattern]	87	0	0	0	GN	GN	SANDY GRAVEL, brown, fine, poorly graded, medium dense, rounded, calcareous; some fine to coarse subrounded sand; some silt.	[Graph]	●	▲						48	33	27			
	100				ML	ML	GRAVELLY SAND, brown, fine to coarse, poorly graded, very dense, subrounded, calcareous; some fine rounded gravel; trace silt.		▲							38	58	13			
[Pattern]	48	3	10	10	SM	SM	SILT, light gray, very stiff, nonplastic, calcareous; trace fine sand.	average coring rate 2.5 min/ft	●							0	0	02			
	100				SM	SM	SILTY SAND, gray brown, fine to medium poorly graded, subangular to subrounded, calcareous; some slightly plastic silt.														
[Pattern]	100	8	20	20	SM	SM	WELED TUFF, rhyodacitic, pink, medium grained, weathered, fractures, massive, limonite stained, calcite fracture fillings.	[Graph]													
	100				SM	SM															
TOTAL DEPTH 30.0' (9.1m)																					

[illegible]



EXPLANATION

■ FUGRO DRIVE SAMPLE

□ BULK SAMPLE

■ PITCHER TUBE SAMPLE

□ STANDARD PENETRATION TEST SAMPLE

▨ CORE SAMPLE

N - STANDARD PENETRATION RESISTANCE

▲ - DRY UNIT WEIGHT (ASTM: D-2937-71)

● - MOISTURE CONTENT (ASTM: D-2218-71)

NR - NO RECOVERY

BORING DETAILS

ELEVATION : 5033' (1534m)

SURFICIAL GEOLOGIC UNIT : A4o

DATE DRILLED : 18 October 1978

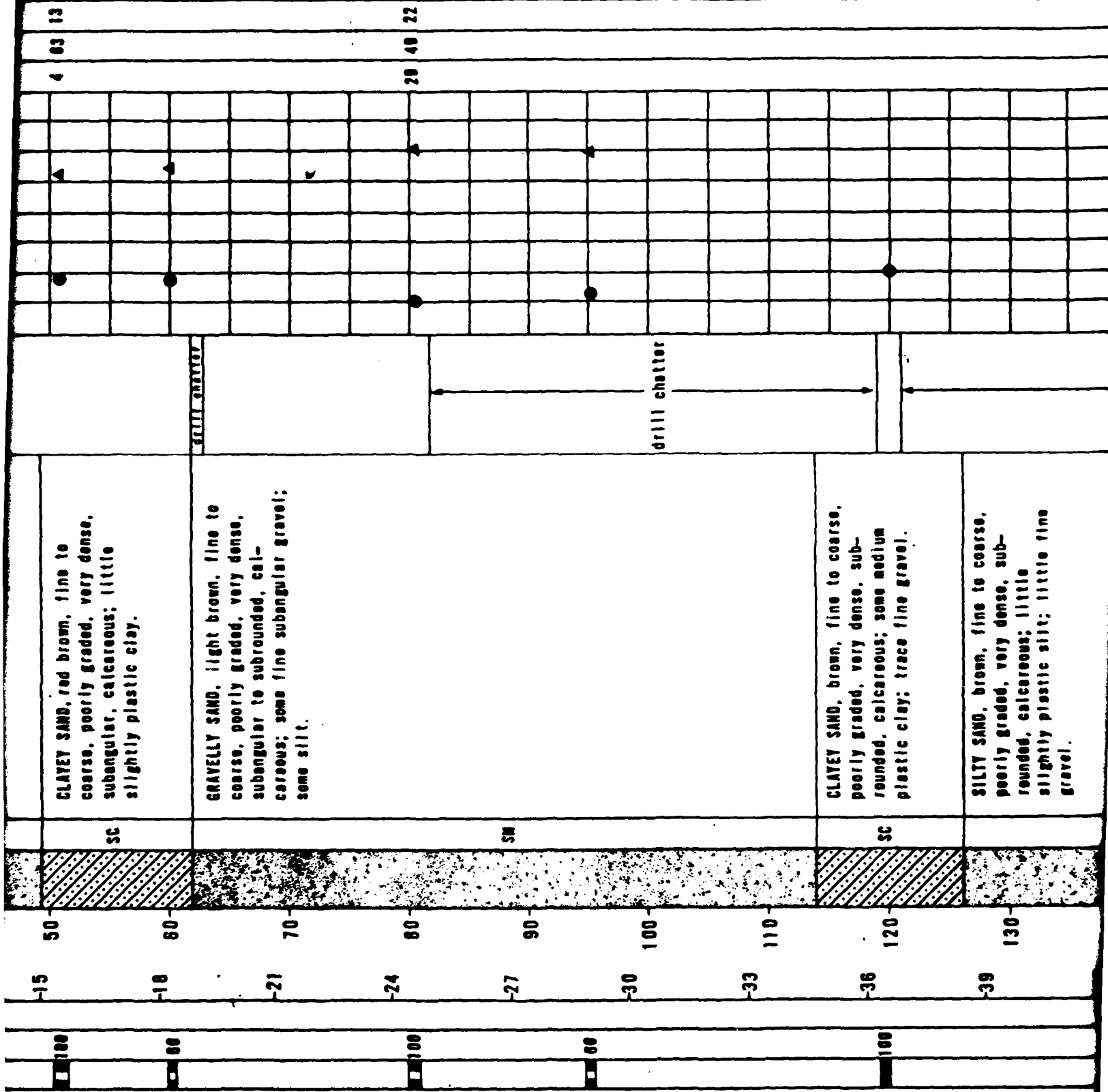
DRILLING METHOD : Rotary Wash

HOLE DIAMETER : 4 7/8" (124mm)

WATER LEVEL : Not Encountered

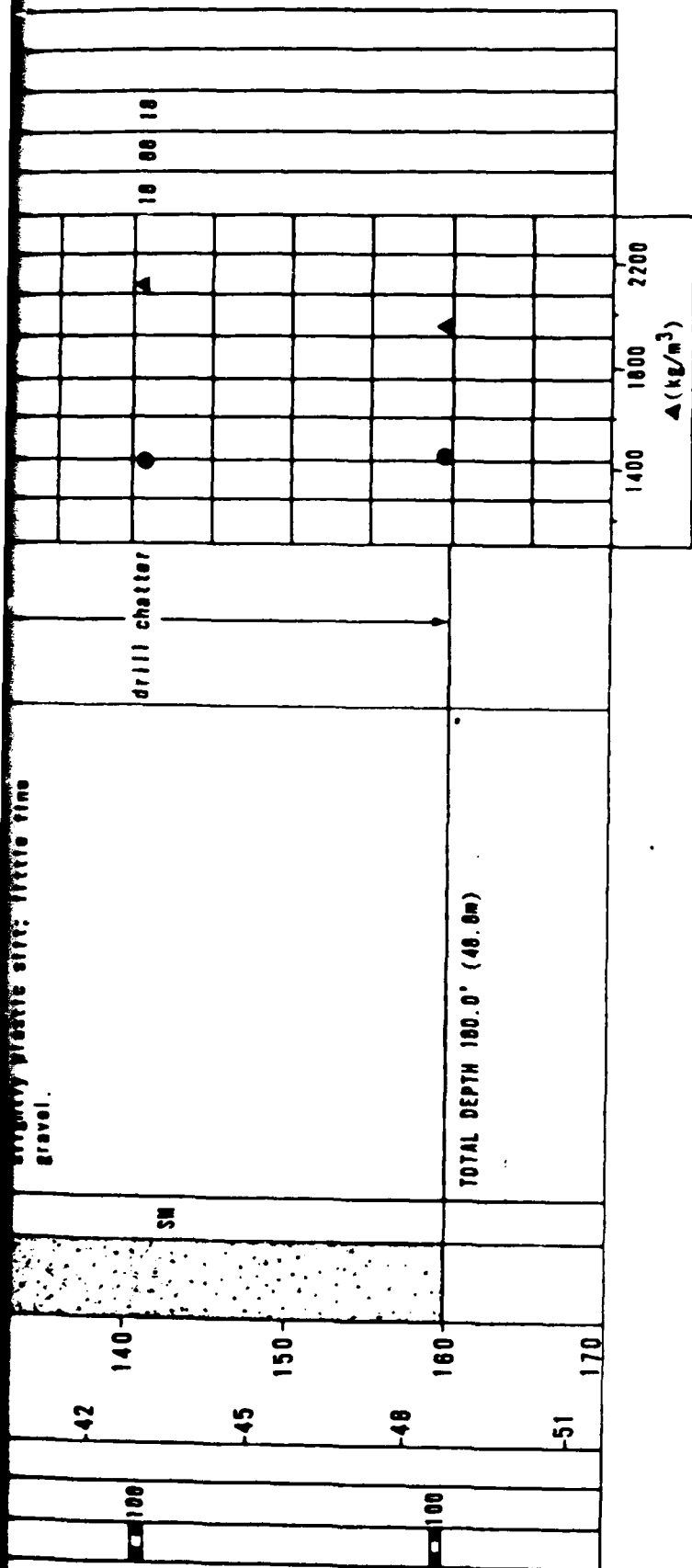
LOG OF BORING BH-1	
VERIFICATION SITE, WHIRLWIND COP, UTAH	
MX SITING INVESTIGATION DEPARTMENT OF THE AIR FORCE - SAMSO	FIGURE 8-1
FUGRO NATIONAL INC.	

[illegible]



2

strongly plastic silt; little fine gravel.



EXPLANATION

■ FUGRO DRIVE SAMPLE

□ BULK SAMPLE

■ PITCHER TUBE SAMPLE

□ STANDARD PENETRATION TEST SAMPLE

▨ CORE SAMPLE

N - STANDARD PENETRATION RESISTANCE

▲ - DRY UNIT WEIGHT (ASTM: D-2937-71)

● - MOISTURE CONTENT (ASTM: D-2216-71)

NR - NO RECOVERY

BORING DETAILS

ELEVATION : 5260' (1603m)

SURFICIAL GEOLOGIC UNIT : A51

DATE DRILLED : 16-18 October 1978

DRILLING METHOD : Rotary Wash

HOLE DIAMETER : 4 7/8" (124mm)

WATER LEVEL : Not Encountered

LOG OF BORING WH-8-2,
VERIFICATION SITE, WHIRLWIND COP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMSO

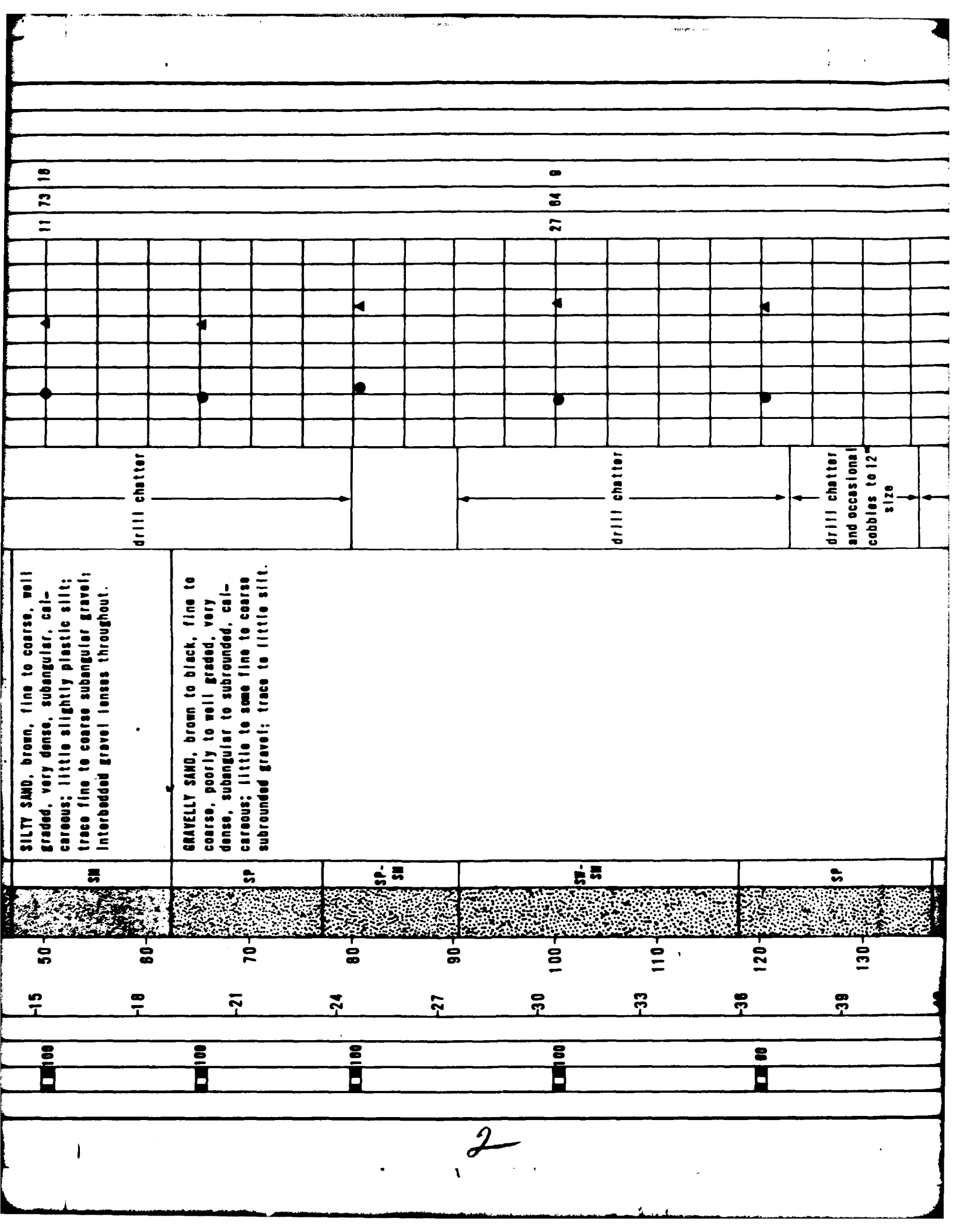
FIGURE
8-2

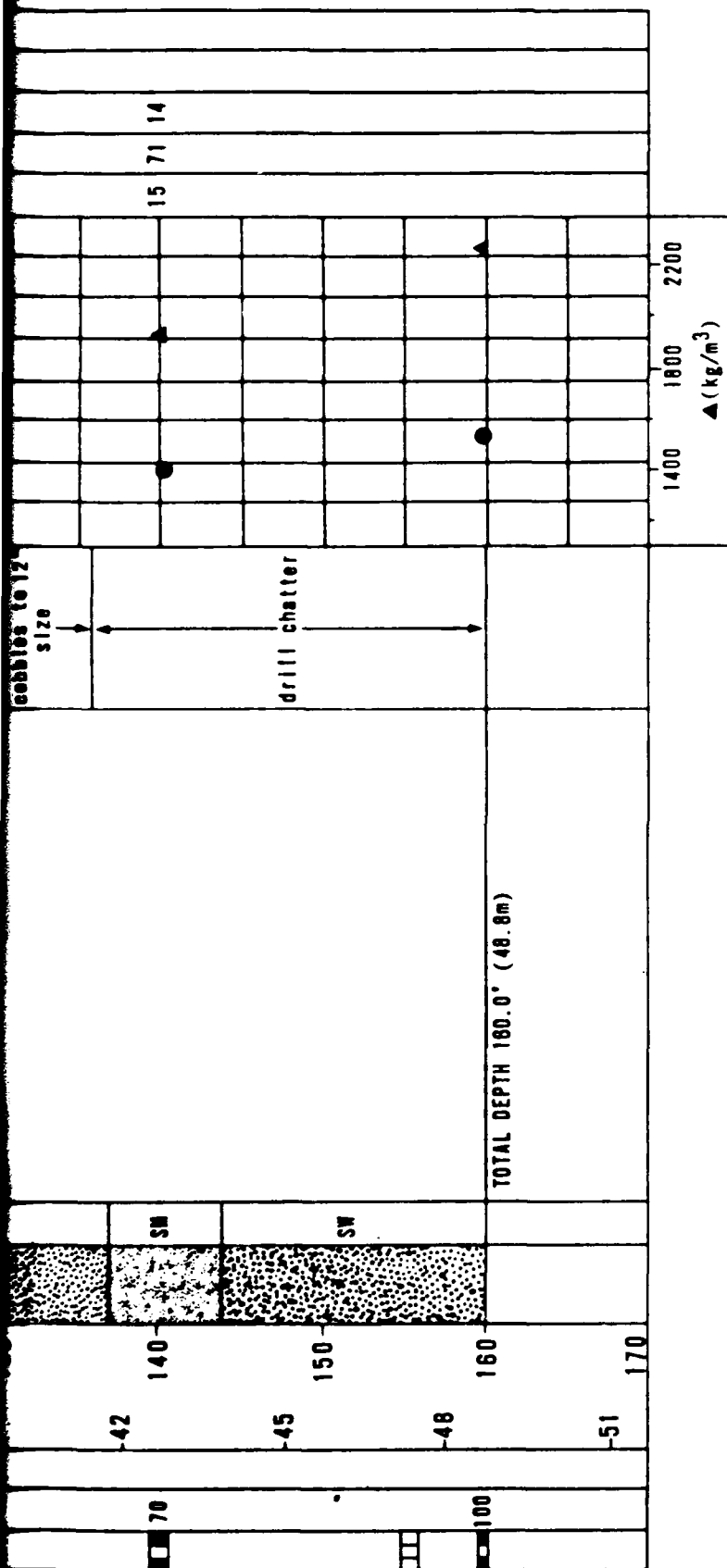
FUGRO NATIONAL, INC.

APV-08

APPROVED BY _____

SAMPLE TYPE	% RECOVERY	N VALUE	DEPTH METERS	DEPTH FEET	LITHOLOGY	USCS	SOIL DESCRIPTION	REMARKS
07	87		0	0	SM	SM	SILTY SAND AND SAND, brown, fine to coarse, poorly to well graded, medium dense to dense, angular, calcareous; trace to some silt.	
07	87				SP-SM	SP-SM		
100	100		3	10	SW-SM	SW-SM	GRAVELLY SAND, brown to black, fine to coarse, well graded, dense to very dense, subangular, calcareous; some fine sub-angular gravel; trace silt.	
07	87		6	20	SM	SM	SILTY SAND, brown, fine to coarse, poorly graded, dense to very dense, subangular, calcareous; some nonplastic silt; trace fine subangular gravel.	
07	87		9	30	SP	SP	GRAVELLY SAND, brown to black, medium to coarse, poorly graded, dense, subangular, calcareous; some fine to coarse sub-angular gravel; stage I caliche (37.5'-38.4').	
100	100		12	40				





EXPLANATION

FUGRO DRIVE SAMPLE

BULK SAMPLE

PITCHER TUBE SAMPLE

STANDARD PENETRATION TEST SAMPLE

CORE SAMPLE

N - STANDARD PENETRATION RESISTANCE

Δ - DRY UNIT WEIGHT (ASTM: D-2937-71)

● - MOISTURE CONTENT (ASTM: D-2216-71)

NR - NO RECOVERY

BORING DETAILS

ELEVATION : 5275' (1608m)

SURFICIAL GEOLOGIC UNIT : A51

DATE DRILLED : 20-21 October 1978

DRILLING METHOD : Rotary Wash

HOLE DIAMETER : 4 7/8" (124mm)

WATER LEVEL : Not Encountered

LOG OF BORING WH-9-3
VERIFICATION SITE, WHIRLWIND COP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE SAMS0

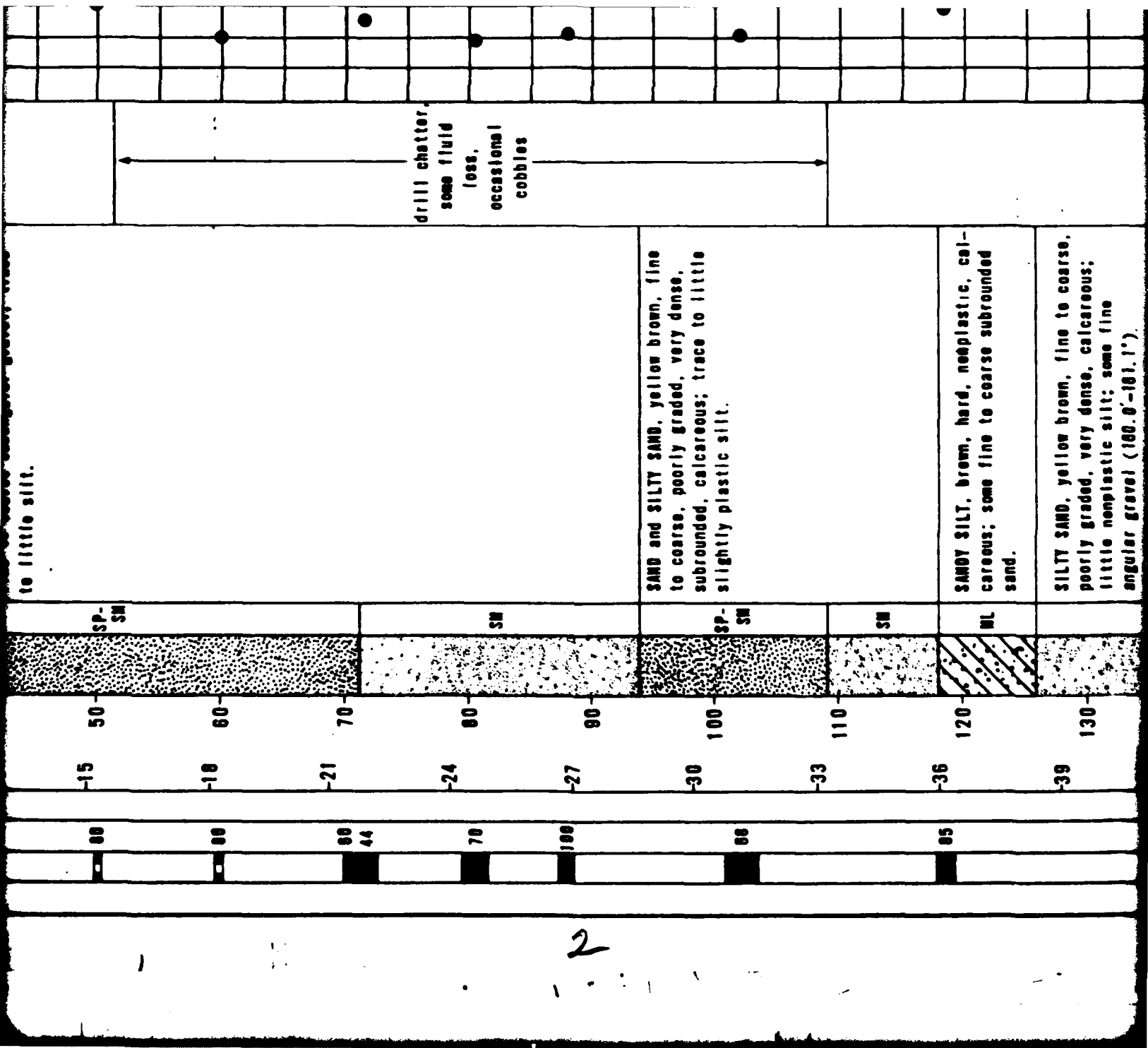
FIGURE
6-3

FUGRO NATIONAL, INC.

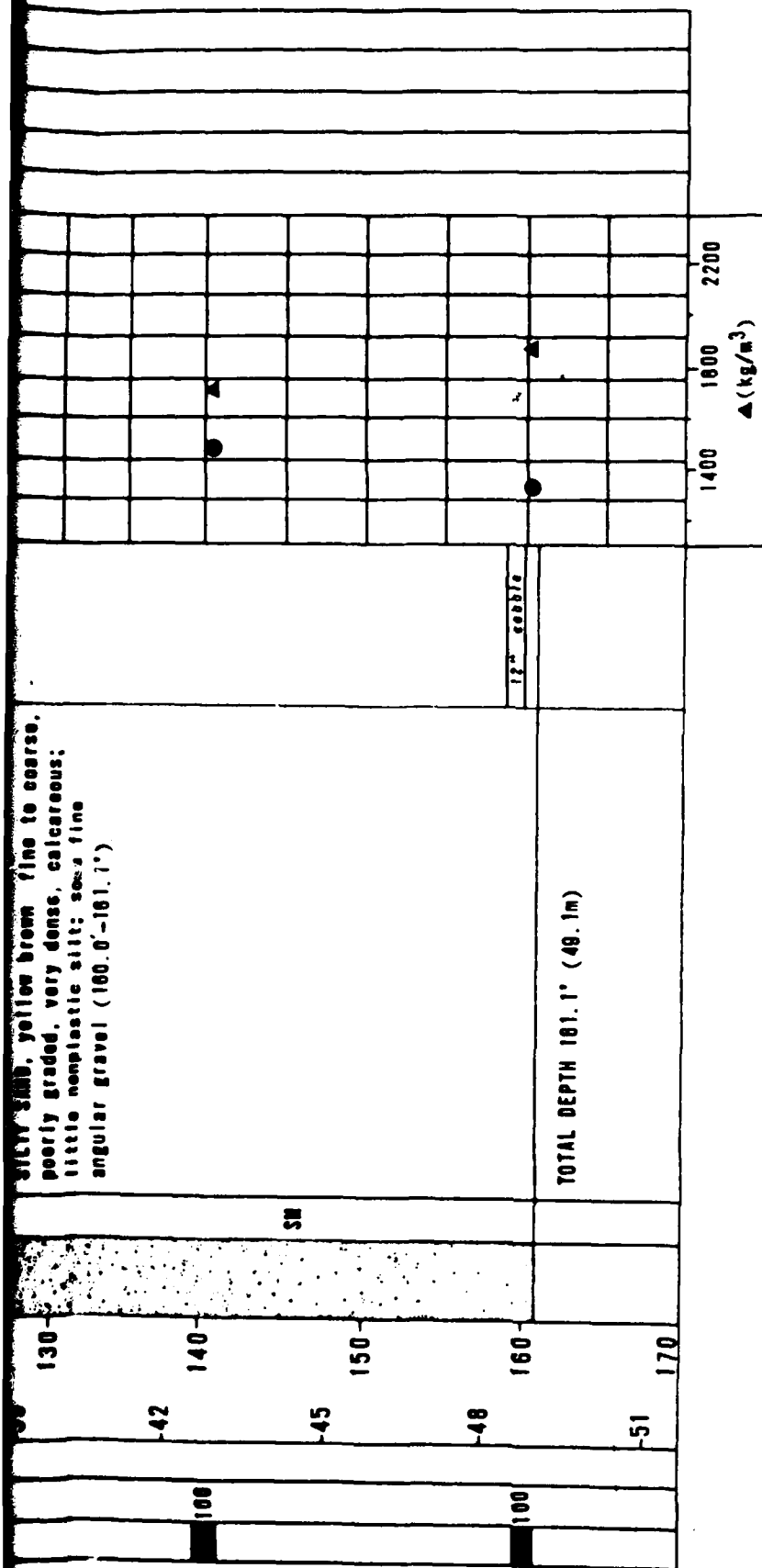
AFV-88

APPENDIX A

SAMPLE TYPE	% RECOVERY	N VALUE	METERS	FEET	LITHOLOGY	USCS	SOIL DESCRIPTION	REMARKS
	00		0	0		SW	GRAVELLY SAND, brown, fine to coarse, well graded, dense, subangular, calcareous; some fine to coarse gravel.	
	100		3	10		SM	SILTY SAND, yellow brown, fine to coarse, well graded, dense to very dense, sub-angular, calcareous; little to some silt; little fine to coarse subrounded gravel (12.0'-35.0').	
	80		6	20		SM		drill chatter
	90		9	30				
	100		12	40			GRAVELLY SAND, yellow brown to black, fine to coarse, poorly graded, very dense, subangular, calcareous; little to some fine to coarse subangular gravel; trace to little silt.	



Silty sand, yellow brown fine to coarse, poorly graded, very dense, calcareous; little nonplastic silt; some fine angular gravel (100.0'-161.1')



EXPLANATION

■ FUGRO DRIVE SAMPLE

□ BULK SAMPLE

■ PITCHER TUBE SAMPLE

□ STANDARD PENETRATION TEST SAMPLE

▨ CORE SAMPLE

N - STANDARD PENETRATION RESISTANCE

▲ - DRY UNIT WEIGHT (ASTM: D-2937-71)

● - MOISTURE CONTENT (ASTM: D-2216-71)

NR - NO RECOVERY

BORING DETAILS

ELEVATION

SURFICIAL GEOLOGIC UNIT : A5y/A4o

DATE DRILLED : 21-22 October 1978

DRILLING METHOD : Rotary Wash

HOLE DIAMETER : 4 7/8" (124mm)

WATER LEVEL : Not Encountered

LOG OF BORING W-2-4
VERIFICATION SITE, WHIRLWIND COP, UTAH

W-2 SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMSQ

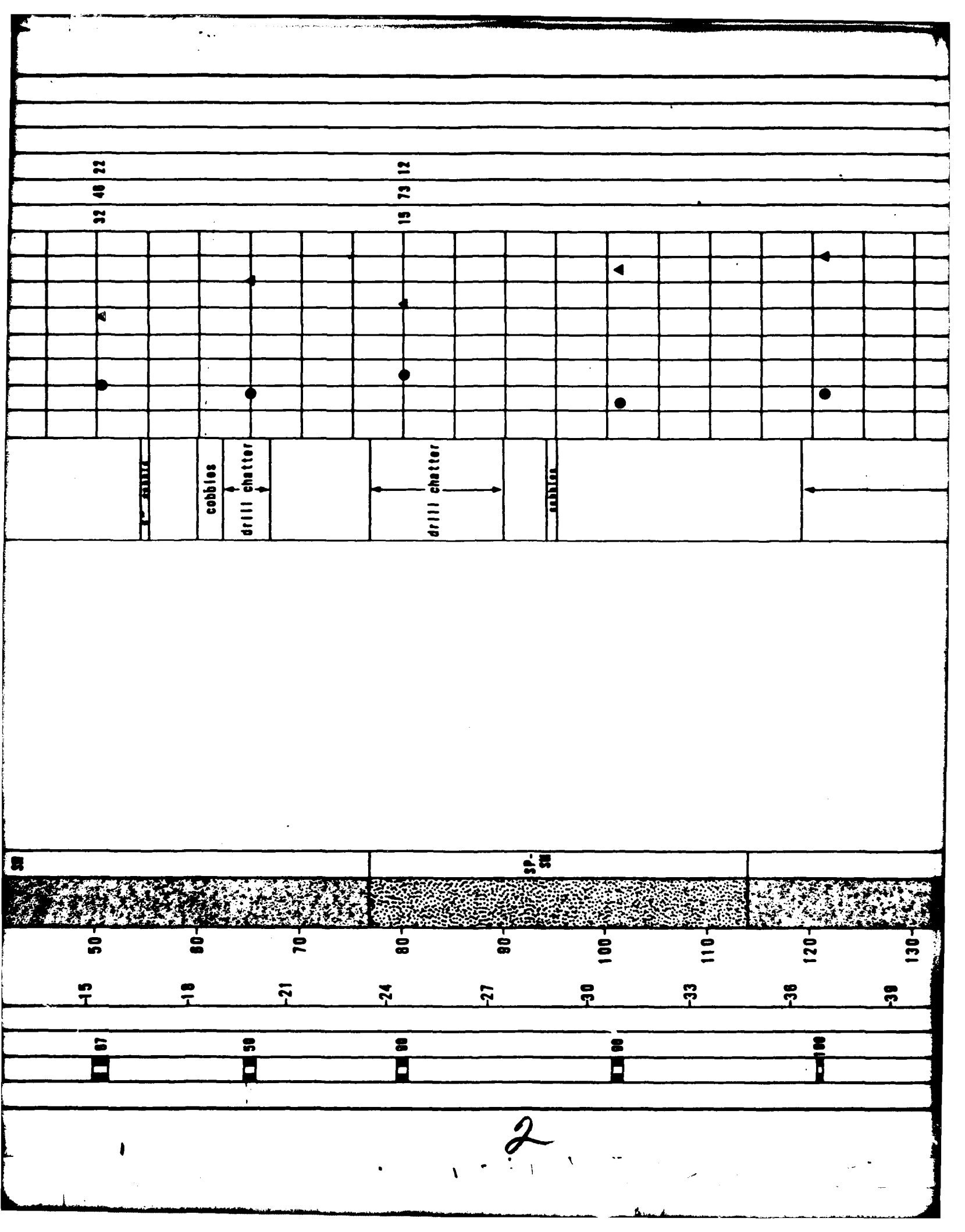
FIGURE
6-4

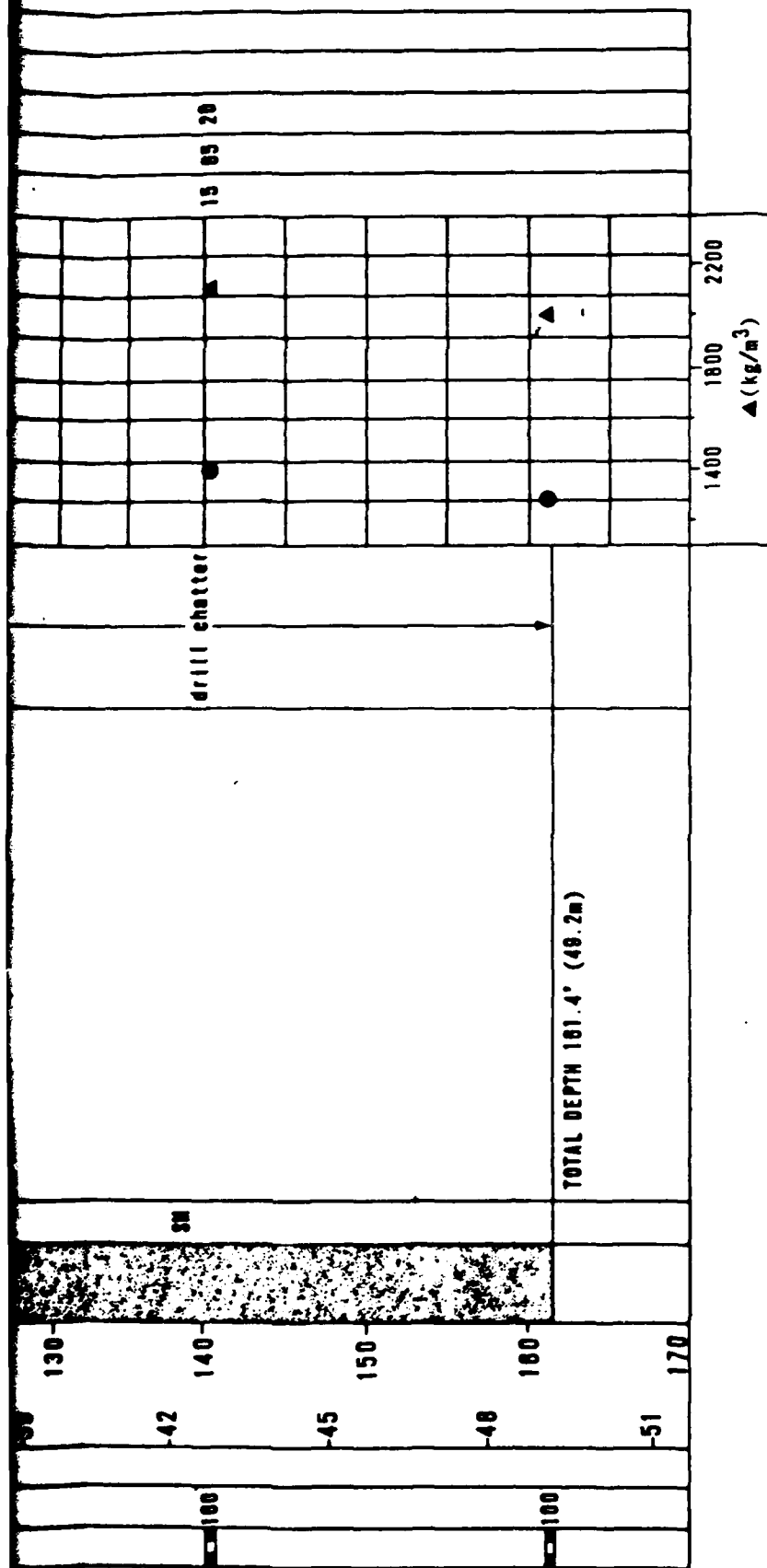
FUGRO NATIONAL, INC.

APP-

1

2 JUL 70





EXPLANATION

- FUGRO DRIVE SAMPLE
- BULK SAMPLE
- PITCHER TUBE SAMPLE
- STANDARD PENETRATION TEST SAMPLE
- ▨ CORE SAMPLE
- N - STANDARD PENETRATION RESISTANCE
- ▲ - DRY UNIT WEIGHT (ASTM: D-2937-71)
- - MOISTURE CONTENT (ASTM: D-2216-71)
- NR - NO RECOVERY

BORING DETAILS

ELEVATION : 5440' (1658m)
 SURFICIAL GEOLOGIC UNIT : A51
 DATE DRILLED : 23 October 1978
 DRILLING METHOD : Rotary Wash
 HOLE DIAMETER : 4 7/8" (124mm)
 WATER LEVEL : Not Encountered

LOG OF BORING WH-8-5,
 VERIFICATION SITE, WHIRLWIND COP, UTAH

MR SITING INVESTIGATION
 DEPARTMENT OF THE AIR FORCE - SAMSO

FIGURE
 8-5

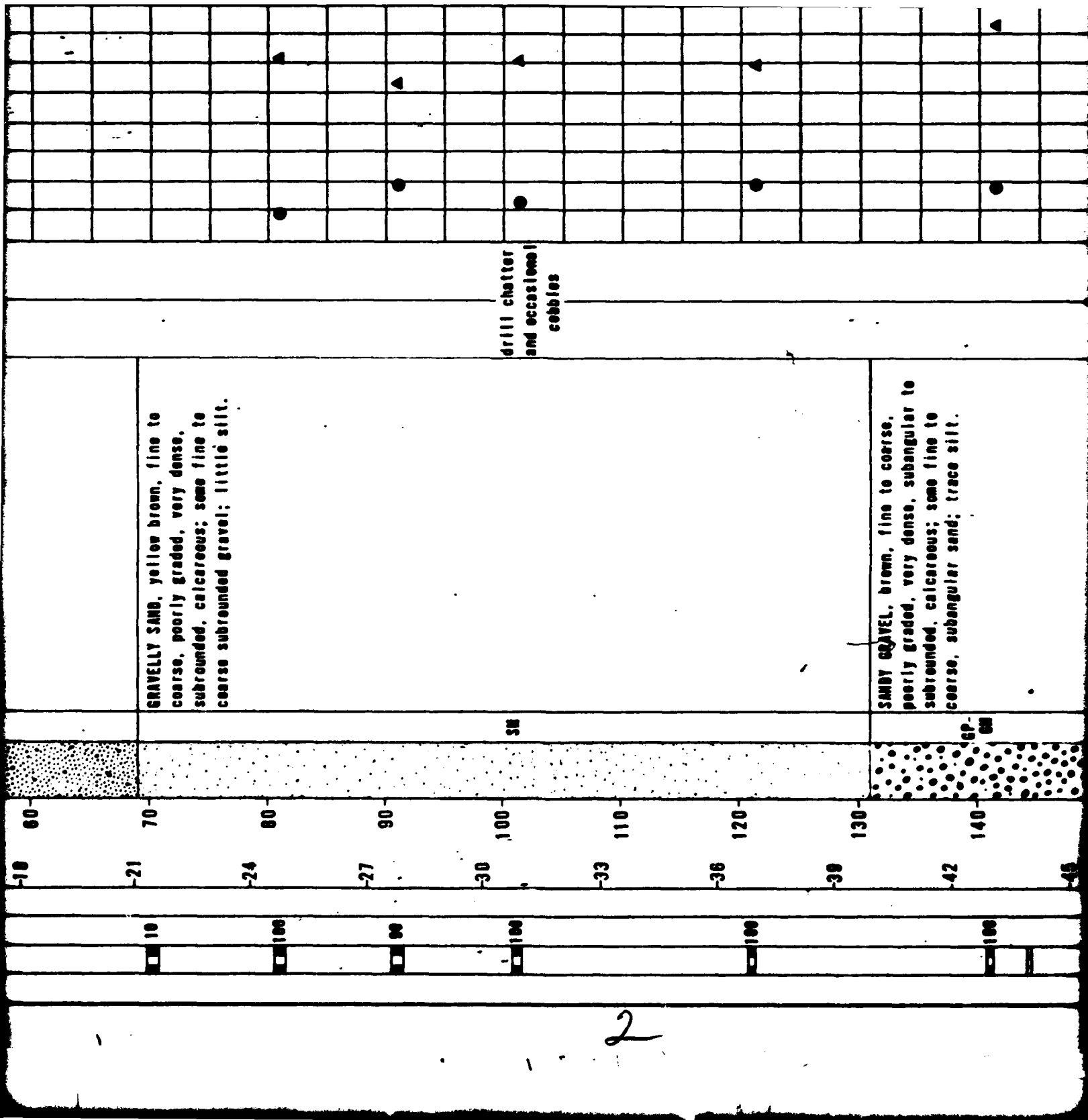
FUGRO NATIONAL, INC.

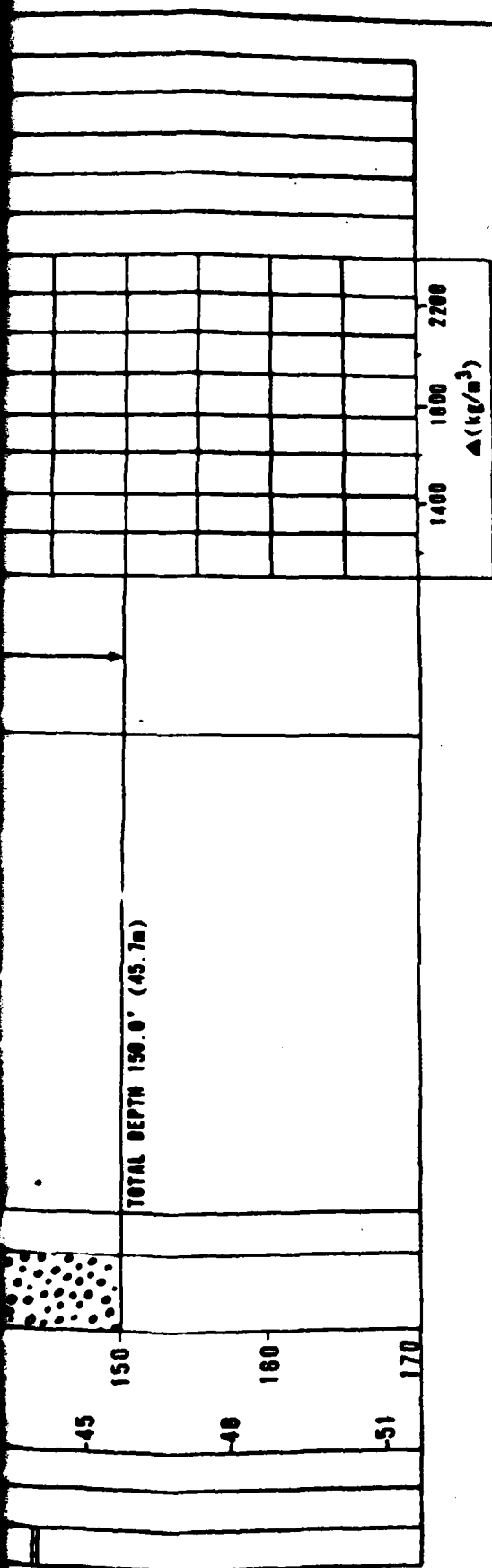
AFV-88

CHECKED BY _____ APPROVED BY _____

FM-10-27-11

SAMPLE TYPE	% RECOVERY	N VALUE	METERS	FEET	LITHOLOGY	USCS	SOIL DESCRIPTION	REMARKS	▲(pcf)													SIEVE ANALYSIS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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100	20		0	0	CM	CM	SANDY GRAVEL, light brown, fine to coarse, poorly graded, medium dense to very dense, subangular, calcareous; some fine to coarse subangular sand; trace to little silt.	drill chatter and occasional cobbles to 8" size	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●</





EXPLANATION

- FUGRO DRIVE SAMPLE
- BULK SAMPLE
- PITCHER TUBE SAMPLE
- STANDARD PENETRATION TEST SAMPLE
- CORE SAMPLE
- N - STANDARD PENETRATION RESISTANCE
- Δ - DRY UNIT WEIGHT (ASTM: D-2937-71)
- - MOISTURE CONTENT (ASTM: D-2216-71)
- NR - NO RECOVERY

BORING DETAILS

ELEVATION : 5050' (1542m)
 SURFICIAL GEOLOGIC UNIT : A5y/A4o
 DATE DRILLED : 24 - 25 October 1970
 DRILLING METHOD : Rotary Wash
 HOLE DIAMETER : 4 7/8" (124mm)
 WATER LEVEL : Not Encountered

LOG OF BORING WH-8-6
 VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
 DEPARTMENT OF THE AIR FORCE SAMS0

FIGURE
 6-6

FUGRO NATIONAL, INC.

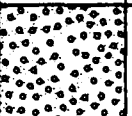
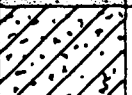
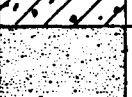
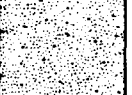
AFV-88

SECTION 7.0
TRENCH AND TEST PIT LOGS

EXPLANATIONS OF TRENCH AND TEST PIT LOGS

See Section 6.0, "Boring Logs", for explanations.

CHECKED BY _____ APPROVED BY _____

BULK SAMPLE	DEPTH		LITHOLOGY	USCS	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS				
	METERS	FEET						GR	SA	FI	LL	PI
	0	0		GM	medium dense	SANDY GRAVEL, brown, fine to coarse, poorly graded, slightly moist, rounded, calcareous; some fine to coarse sub-rounded sand; some silt.	vertical walls stable	35	32	33		
	2			SM	dense	GRAVELLY SAND, brown, fine to coarse, poorly graded, slightly moist, sub-rounded, calcareous; some fine rounded gravel; little silt.						
	4				very stiff	SANDY SILT, light gray, slightly moist, nonplastic, calcareous; little fine sand; stage I caliche (4.6"-5.3").				82		NP
	6			ML								
	8											
	10			SM	very dense	SILTY SAND, gray brown, fine to medium, poorly graded, slightly moist, subangular to subrounded, calcareous; little silt						
	12											
	14					TOTAL DEPTH 13.5' (4.1m)	encountered rock at 13.5'					
	16											
	18											
	20											

TRENCH DETAILS

SURFACE ELEVATION : 5033' (1534m)
 DATE EXCAVATED : 18 OCT 1978
 SURFICIAL GEOLGIC UNIT : A4a
 TRENCH LENGTH : 17.5' (5.3m)
 TRENCH ORIENTATION : ENE - WSW

LOG OF TRENCH WW-T-1
 VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
 DEPARTMENT OF THE AIR FORCE - SAMS0

FIGURE
 7-1

FUGRO NATIONAL, INC.

2 JUL 79

AFV-04

BULK SAMPLE	DEPTH METERS FEET	LITHOLOGY	USCS	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS				
							GR	SA	FI	LL	PI
	0			medium dense	SILTY SAND, gray brown, fine to coarse, poorly graded, slightly moist, rounded, calcareous; some nonplastic silt; little fine to coarse rounded gravel.	vertical walls stable	20	40	40		NP
	2		SM	dense							
	4		CL	stiff	SILTY CLAY, brown, slightly moist, slightly plastic, calcareous; some fine to medium sand.						
	6				GRAVELLY SAND, brown, fine to coarse, poorly graded, slightly moist, sub-rounded, calcareous; some fine to coarse subrounded gravel; some silt.						
	8		SM	very dense							
	10										
	12				TOTAL DEPTH 12.0' (3.7m)						
	14										
	16										
	18										
	20										

TRENCH DETAILS

SURFACE ELEVATION : 5260' (1603m)
 DATE EXCAVATED : 19 OCTOBER 1978
 SURFICIAL GEOLOGIC UNIT : A51
 TRENCH LENGTH : 14.0' (4.3m)
 TRENCH ORIENTATION : ENE - WSW

LOG OF TRENCH WW-T-2
 VERIFICATION SITE, WHIRLWIND COP, UTAH

MX SITING INVESTIGATION
 DEPARTMENT OF THE AIR FORCE - SAMS0

FIGURE
 7-2

FUGRO NATIONAL, INC.

BULK SAMPLE	DEPTH METERS FEET	LITHOLOGY	USCS	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS				
							GR	SA	FI	LL	PI
	0										
	0										
	2		CL	stiff	SANDY CLAY, light brown, slightly moist, slightly plastic, calcareous; some fine to coarse sand; stage I caliche (0.0'-4.5').		1	25	74	38	15
	1										
	4										
	8		GP		SANDY GRAVEL, brown, fine to coarse, poorly graded, slightly moist, sub-rounded to rounded, calcareous; some fine to coarse subrounded sand; layer of gravelly sand (10.0'-11.5').						
	2										
	8			very dense							
	3										
	10		SP								
	12		GP								
	4										
	14				TOTAL DEPTH 13.0' (4.0m)						
	16										
	5										
	18										
	6										
	20										

TRENCH DETAILS

SURFACE ELEVATION : 5003' (1525m)
 DATE EXCAVATED : 20 OCTOBER 1978
 SURFICIAL GEOLOGIC UNIT : A5y/A4e
 TRENCH LENGTH : 15.0' (4.6m)
 TRENCH ORIENTATION : E - W

LOG OF TRENCH WW-T-3
 VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
 DEPARTMENT OF THE AIR FORCE - SANSO

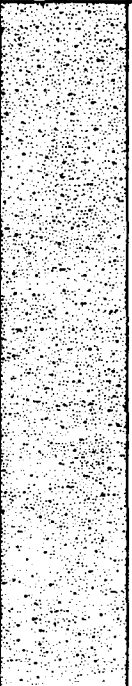
FIGURE
 7-3

FUGRO NATIONAL, INC.

2 JUL 78

AFV-04

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BULK SAMPLE	DEPTH		LITHOLOGY	USCS	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS				
	METERS	FEET						GR	SA	FI	LL	PI
	0	0				SILTY SAND, brown, fine to coarse, poorly graded, slightly moist, sub-angular to angular, calcareous; occasional cobbles to 5" size.	vertical walls stable	5	87	28		
	2				medium dense							
	4				dense							
	6				medium dense							
	8				medium dense							
	10			SM	dense							
	12				dense							
	14				dense							
	16				dense							
	18				dense							
	20					TOTAL DEPTH 15.0' (4.8m)						
	22											
	24											
	26											
	28											
	30											
	32											
	34											
	36											
	38											
	40											
	42											
	44											
	46											
	48											
	50											
	52											
	54											
	56											
	58											
	60											
	62											
	64											
	66											
	68											
	70											
	72											
	74											
	76											
	78											
	80											
	82											
	84											
	86											
	88											
	90											
	92											
	94											
	96											
	98											
	100											

TRENCH DETAILS

SURFACE ELEVATION : 5275' (1608m)
 DATE EXCAVATED : 21 OCTOBER 1978
 SURFICIAL GEOLOGIC UNIT: A51
 TRENCH LENGTH : 15.0' (4.8m)
 TRENCH ORIENTATION : NE - SW

LOG OF TRENCH WW-T-4
 VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
 DEPARTMENT OF THE AIR FORCE - SAMSO

FIGURE
 7-4

UGRO NATIONAL, INC.

AD-A113 324

FUGRO NATIONAL INC LONG BEACH CA

F/8 8/13

MX SITING INVESTIGATION. GEOTECHNICAL EVALUATION. VOLUME II. NE-ETC(U)

AUG 79

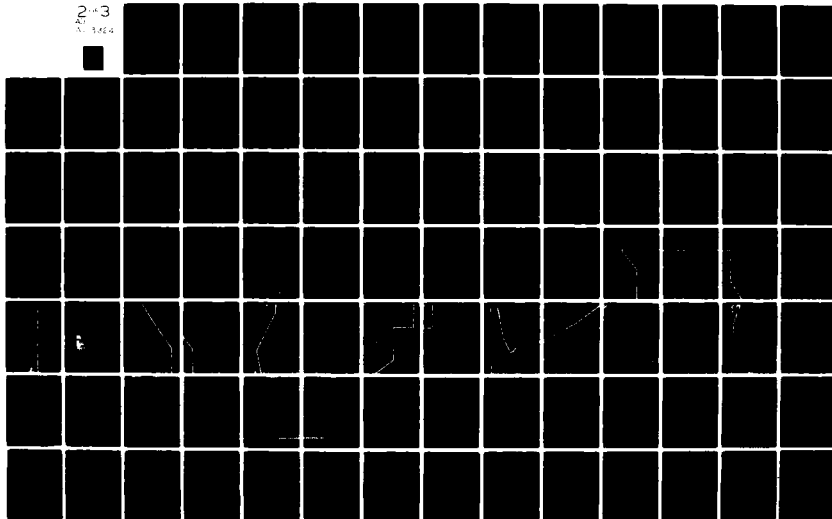
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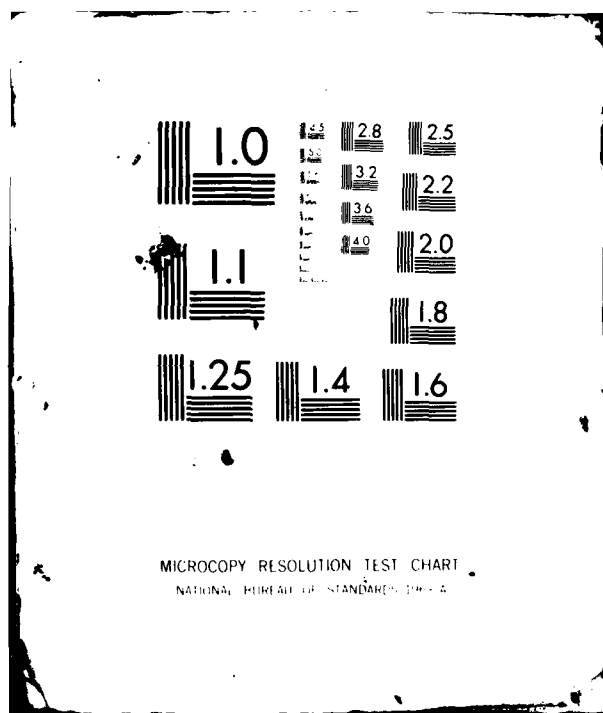
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BULK SAMPLE	DEPTH METERS FEET	LITHOLOGY	USCS	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS				
							GR	SA	FI	LL	PI
	0		SM	medium dense	SILTY SAND, brown, fine to coarse, poorly graded, slightly moist, sub-angular, calcareous; some silt; trace fine to coarse subangular gravel (0.0'-3.2').	↑ sloughing					
	2					↓					
	4			dense		↑ vertical walls stable					
	6			medium dense		↓					
	8		SP-SM	dense	GRAVELLY SAND, brown, fine to coarse, poorly graded, slightly moist, sub-angular, calcareous; some fine to coarse subangular gravel; trace silt;	↑ vertical walls stable					
	10					↓					
	12			very dense							
	14										
	16				TOTAL DEPTH 13.0' (4.0m)						
	18										
	20										
	22										

TRENCH DETAILS

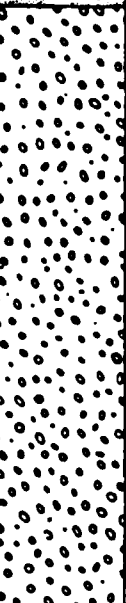
SURFACE ELEVATION : 5028' (1532m)
 DATE EXCAVATED : 22 OCTOBER 1978
 SURFICIAL GEOLOGIC UNIT: A5y/A4e
 TRENCH LENGTH : 14.0' (4.3m)
 TRENCH ORIENTATION : E - W

LOG OF TRENCH WW-T-5,
 VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
 DEPARTMENT OF THE AIR FORCE - SAMSO

FIGURE
 7-5

FUGRO NATIONAL, INC.

BULK SAMPLE	DEPTH		LITHOLOGY	USCS	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS				
	METERS	FEET						GR	SA	FI	LL	PI
	0	0		SM	medium dense	GRAVELLY SAND, brown, fine to coarse, poorly graded, slightly moist, sub-angular, calcareous; some fine to coarse subangular gravel; some silt.	↑ sloughing ↓	35	38	26		
	2											
	1	4		GP-GM	dense	SANDY GRAVEL, brown, fine to coarse, poorly graded, slightly moist, sub-angular, calcareous; some fine to coarse subangular sand; trace silt.	↑ vertical walls stable ↓					
	2	8										
	3	10			very dense							
	4	12										
	4					TOTAL DEPTH 12.5' (3.8m)						
		14										
		16										
	5	18										
		20										

TRENCH DETAILS

SURFACE ELEVATION : 5058' (1542m)
 DATE EXCAVATED : 23 OCTOBER 1978
 SURFICIAL GEOLOGIC UNIT : A5y/A4e
 TRENCH LENGTH : 13.5' (4.1m)
 TRENCH ORIENTATION : NW - SE

LOG OF TRENCH WW-T-6
 VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
 DEPARTMENT OF THE AIR FORCE - SANSO

FIGURE
 7-6

FUGRO NATIONAL, INC.

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SURFACE ELEVATION: 5148' (1569m)
SURFICIAL GEOLOGIC UNIT: A5i

0	0				
1		CL	very stiff	SILTY CLAY, brown, slightly moist, slightly plastic, calcareous; little fine to coarse sand; trace fine to coarse gravel, stage I-III caliche (1.2"-2.2").	
2					
3		SM	very dense	GRAVELLY SAND, brown, fine to coarse, poorly graded, calcareous; some fine to coarse gravel; trace cobbles to 4" size; stage I caliche.	
4					
5				TOTAL DEPTH 4.0' (1.2m)	

SURFACE ELEVATION: 5380' (1640m)
SURFICIAL GEOLOGIC UNIT: A51

LOG OF TEST PIT WW-P-2

LOGS OF TEST PITS WW-P-1 AND WW-P-2
VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMS0

FIGURE
7-7

FUGRO NATIONAL, INC.

LABORATORY DEPARTMENT OF THE AIR FORCE - 24W20 MX SITING INVESTIGATION 7-8 FIGURE	
VERIFICATION SITE, WHIRLWIND COP, UTAH LOGS OF TEST PITS WW-P-3 AND WW-P-4	

DEPTH FEET	DEPTH METERS	MOISTURE %	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS				
						GR	SA	FI	LT	PI
0	0									
1	1		2C - medium dense	SILTY SAND - CLAYEY SAND, brown, fine to coarse, poorly graded, subangular to coarse, calcareous; some slightly plastic silt; little fine to coarse sand; angular gravel; stage I caliche.		12	40	42	31	8
2	2		2M - dense	GRAVELLY SAND, brown, fine to coarse, poorly graded, subangular, calcareous; fine to coarse, subangular gravel; little silt; occasional cobbles to 8" size; stage I caliche.						
3	3									
4	4									
5	5									
6	6									
TOTAL DEPTH 4.2' (1.4m)										

SURFACE ELEVATION: 2200' (1878m)
SURFACE GEOLGIC UNIT: A21

LOG OF TEST PIT WW-P-4

DEPTH FEET	DEPTH METERS	MOISTURE %	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS				
						GR	SA	FI	LT	PI
0	0									
1	1		2M - dense	GRAVELLY SAND, brown, fine to coarse, poorly graded, subangular, calcareous; some fine to coarse subangular gravel; little silt; occasional cobbles to 7" size.		37	43	51		
2	2		2M - very dense							
3	3									
4	4									
5	5									
TOTAL DEPTH 4.0' (1.2m)										

SURFACE ELEVATION: 2430' (1852m)
SURFACE GEOLGIC UNIT: A21

LOG OF TEST PIT WW-P-3

BULK SAMPLE	DEPTH METERS FEET	LITHOLOGY	USCS	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS				
							GR	SA	FI	LL	PI
	0										
	1		CL	stiff	SANDY CLAY, brown, slightly moist, slightly plastic, calcareous; some fine to coarse sand; little fine to coarse subangular gravel; stage I caliche.						
	2										
	3		SM	dense	GRAVELLY SAND, brown, fine to coarse, poorly graded, subangular, calcareous; some fine to coarse subangular gravel; little silt; occasional cobbles to 8" size; stage I caliche.						
	4										
	5										
					TOTAL DEPTH 5.0' (1.5m)						

SURFACE ELEVATION: 5787' (1784m)
SURFICIAL GEOLOGIC UNIT: A51

LOG OF TEST PIT WW-P-5

	0										
	1		SP	medium dense	GRAVELLY SAND, gray, fine to coarse, poorly graded, angular, calcareous; some fine to coarse angular gravel; weathered tuff (2.5'-3.0').						
	2			dense							
	3										
	4										
	5										
					TOTAL DEPTH 3.0' (0.9m)	encountered rock at 3.0'					

SURFACE ELEVATION: 4853' (1510m)
SURFICIAL GEOLOGIC UNIT: A5y

LOG OF TEST PIT WW-P-6

LOGS OF TEST PITS WW-P-5 AND WW-P-6
VERIFICATION SITE, WHIRLWIND COP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMSO

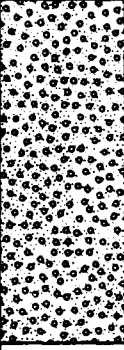
FIGURE
7-9

FUGRO NATIONAL, INC.

2 JUL 78

AFV-03

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BULK SAMPLE	DEPTH		LITHOLOGY	USCS	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS				
	METERS	FEET						GR	SA	FI	LL	PI
	0	0		CL	hard	SILTY CLAY, brown, dry, slightly plastic, calcareous; trace fine sand.						
	1											
	2											
				GM	dense	SILTY GRAVEL, brown, fine to coarse, poorly graded, subangular, calcareous; little fine to coarse sand; little silt.						
	3											
	4											
	5											
						TOTAL DEPTH 5.0' (1.5m)						

SURFACE ELEVATION: 4911' (1497m)
SURFICIAL GEOLOGIC UNIT: A4a

LOG OF TEST PIT WW-P-7

	0	0										
	1											
	2											
	3											
	4											
	5											

SURFACE ELEVATION:
SURFICIAL GEOLOGIC UNIT:

LOG OF TEST PIT

LOG OF TEST PIT WW-P-7
VERIFICATION SITE, WHIRLWIND COP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMSO

FIGURE
7-10

FUGRO NATIONAL, INC.

2 JUL 79

AFV-03

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CHECKED BY _____ APPROVED BY _____

BULK SAMPLE	DEPTH METERS FEET	LITHOLOGY	USCS	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS				
							GR	SA	FI	LL	PI
	0										
	1		SM	medium dense	SILTY SAND, brown, fine to coarse, poorly graded, subrounded, calcareous; little silt; little fine to coarse subrounded gravel.	vertical walls stable	15	68	16		
	2										
	3		SP	medium dense	GRAVELLY SAND, gray brown, fine to coarse, poorly graded, subangular, calcareous; some fine to coarse subangular gravel; trace rounded cobbles to 8" size; layer of sandy gravel (5.0'-8.5').	vertical walls stable					
	4										
	5		GP	medium dense							
	6										
	7		SM	dense	SILTY SAND, brown, fine to coarse, poorly graded, subangular, calcareous.	vertical walls stable					
	8										
	9										
	10				TOTAL DEPTH 8.0' (2.4m)						

SURFACE ELEVATION: 4790' (1460m)
SURFICIAL GEOLOGIC UNIT: A4a/A5y

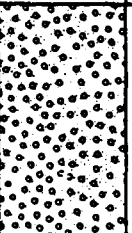
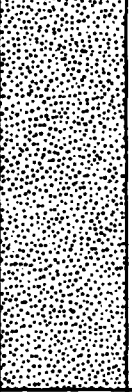
LOG OF TEST PIT WW-P-8

LOG OF TEST PIT WW-P-8
VERIFICATION SITE, WHIRLWIND COP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMSO

FIGURE
7-11

UGRO NATIONAL, INC.

BULK SAMPLE	DEPTH METERS FEET	LITHOLOGY	USCS	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS				
							GR	SA	FI	LL	PI
	0		GM	dense	SANDY GRAVEL, brown, fine to coarse, poorly graded, subrounded, calcareous; some fine to coarse subrounded sand; little silt.						
	1										
	2		SP	very dense	GRAVELLY SAND, gray, fine to coarse, poorly graded, subrounded, calcareous; some fine to coarse subrounded gravel; occasional cobbles to 8" size.						
	3										
	4										
	5										
	6				TOTAL DEPTH 5.5' (1.7m)	soil strength exceeded capacity of Case 580B backhoe at 5.5'					
	7										
	8										
	9										
	10										

SURFACE ELEVATION: 5050' (1539m)
SURFICIAL GEOLOGIC UNIT: A56(A40)

LOG OF TEST PIT WW-P-8

LOG OF TEST PIT WW-P-8
VERIFICATION SITE, WHIRLWIND COP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SANSO

FIGURE
7-12

FUGRO NATIONAL, INC.

2 JUL 78

AFV-03

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BULK SAMPLE	DEPTH METERS FEET	LITHOLOGY	USCS	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS				
							GR	SA	FI	LL	PI
	0			medium dense	CLAYEY GRAVEL, brown, fine to coarse, poorly graded, subrounded, calcareous; some slightly plastic clay; some fine to coarse subrounded sand; occasional cobbles to 8" size; stage I caliche.		40	27	33	35	12
	1		GC								
	2			very dense							
	3				TOTAL DEPTH 3.0' (0.9m)	cementation and soil strength exceeded capacity of Case 5808 backhoe at 3.0'					
	4										
	5										

SURFACE ELEVATION: 5218' (1580m)
SURFICIAL GEOLOGIC UNIT: A51

LOG OF TEST PIT WW-P-10

	0				SILTY SAND, brown, fine to coarse, poorly graded, slightly moist, calcareous; some silt; trace fine to coarse gravel.						
	1										
	2										
	3				TOTAL DEPTH 5.0' (1.5m)						
	4										
	5										

SURFACE ELEVATION: 5148' (1569m)
SURFICIAL GEOLOGIC UNIT: A5y/A4e

LOG OF TEST PIT WW-P-11

LOGS OF TEST PITS WW-P-10 AND WW-P-11
VERIFICATION SITE, WHIRLWIND COP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMSO

FIGURE
7-13

FUGRO NATIONAL, INC.

BULK SAMPLE	DEPTH METERS FEET	LITHOLOGY	USCS	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS				
							GR	SA	FI	LL	PI
	0										
	1		CL	stiff	SANDY CLAY, brown, slightly plastic calcareous; some fine to coarse sand; trace fine to coarse gravel.					60	32 11
	2		GP	dense	SANDY GRAVEL, gray brown, fine to coarse, poorly graded, subrounded, calcareous; some medium to coarse sand; stage I caliche.						
	3										
	1				TOTAL DEPTH 3.0' (0.9m)	cementation and soil strength exceeded capacity of Case 580B backhoe at 3.0'					
	4										
	5										

SURFACE ELEVATION: 5152' (1570m)
SURFICIAL GEOLOGIC UNIT: A4e

LOG OF TEST PIT WW-P-12

	0		CL	stiff	SANDY CLAY, brown, slightly plastic, calcareous; some fine to coarse sand; trace fine to coarse gravel; stage I caliche.						
	1										
	2		GP	dense	SANDY GRAVEL, gray brown, fine to coarse, poorly graded, subrounded, calcareous; some medium to coarse sand; stage II caliche						
	3			very dense							
	1				TOTAL DEPTH 3.5' (1.1m)	cementation and soil strength exceeded capacity of Case 580B backhoe at 3.5'					
	4										
	5										

SURFACE ELEVATION: 5240' (1597m)
SURFICIAL GEOLOGIC UNIT: A5y

LOG OF TEST PIT WW-P-13

LOGS OF TEST PITS WW-P-12 AND WW-P-13
VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SANSO

FIGURE
7-14

FUSRO NATIONAL, INC.

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CHECKED BY _____ APPROVED BY _____

BULK SAMPLE	DEPTH METERS FEET	LITHOLOGY	USCS	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS				
							GR	SA	FI	LL	PI
	0										
	1		GM-SC	medium dense	SANDY GRAVEL, light brown, fine to coarse, poorly graded, subrounded, calcareous; some fine to coarse sand; occasional rounded cobbles and boulders to 13" size; some silt (0.0'-2.0').		44	33	23	25	4
	2										
	3										
	4		GP	medium dense							
	5										
	6				TOTAL DEPTH 5.5' (1.7m)						
	7										
	8										
	9										
	10										

SURFACE ELEVATION: 5240' (1597m)
SURFICIAL GEOLOGIC UNIT: A5y1

LOG OF TEST PIT WW-P-14

LOG OF TEST PIT WW-P-14
VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMS0

FIGURE
7-15

FUGRO NATIONAL, INC.

2 JUL 78

AFV-05

BULK SAMPLE	DEPTH METERS FEET	LITHOLOGY	USCS	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS				
							GR	SA	FI	LL	PI
	0				SILTY CLAY, brown, slightly moist, slightly plastic, calcareous; little fine to coarse sand.						
	1										
	2		CL	stiff	SANDY CLAY, light brown, slightly moist, slightly plastic, calcareous; some fine to coarse sand; little fine to coarse subrounded gravel; stage I caliche.						
	3										
	4										
	5		GP-GM	dense	SANDY GRAVEL, brown, fine to coarse, poorly graded, slightly moist, subrounded, calcareous; some fine to coarse sand; trace silt; stage I caliche.						
					TOTAL DEPTH 5.0' (1.5m)						

SURFACE ELEVATION: 5480' (+1870m)
SURFICIAL GEOLOGIC UNIT: ASi

LOG OF TEST PIT WW-P-15

	0				SILTY SAND, brown, fine to coarse, poorly graded, calcareous; some silt; trace fine gravel; stage I caliche						
	1			medium dense							
	2										
	3		SM								
	4			dense	GRAVELLY SAND, gray brown, fine to coarse, poorly graded, calcareous; some fine to coarse subrounded gravel; stage I caliche						
	5										
					TOTAL DEPTH 5.0' (1.5m)						

SURFACE ELEVATION: 5147' (+1589m)
SURFICIAL GEOLOGIC UNIT: ASy/A40

LOG OF TEST PIT WW-P-16

LOGS OF TEST PITS WW-P-15 AND WW-P-16
VERIFICATION SITE, WHIRLWIND COP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMS0

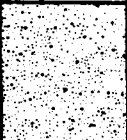
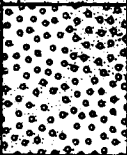
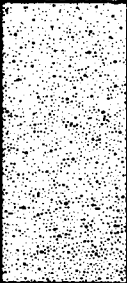
FIGURE
7-18

FUGRO NATIONAL, INC.

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2 JUL 78

AFV-03

BULK SAMPLE	DEPTH		LITHOLOGY	USCS	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS					
	METERS	FEET						GR	SA	FI	LL	PI	
	0	0		SM	medium dense	SILTY SAND, brown, fine to coarse, poorly graded, calcareous; some silt; little fine to coarse sub-rounded gravel; stage I caliche.							
	1												
	2		GM	dense	SANDY GRAVEL, gray brown, fine to coarse, poorly graded, subrounded, calcareous; some fine to coarse sand; occasional subrounded cobbles; stage II caliche								
	3		SM	dense	SILTY SAND, gray black, fine to coarse, poorly graded, calcareous; some silt; little fine gravel.								
	4												
5					TOTAL DEPTH 5.0' (1.5m)								

SURFACE ELEVATION: 5248' (1600m)
SURFICIAL GEOLOGIC UNIT: A5a

LOG OF TEST PIT WW-P-17

	0	0										
		1										
		2		SM	medium dense	SILTY SAND, brown, fine to coarse, poorly graded, calcareous; little silt; little fine to coarse subrounded gravel; occasional cobbles to 12" size.		13	89	18		
		3										
		4										
		5										
						TOTAL DEPTH 4.5' (1.4m)						

SURFACE ELEVATION: 5317' (1621m)
SURFICIAL GEOLOGIC UNIT: A5a

LOG OF TEST PIT WW-P-18

LOGS OF TEST PITS WW-P-17 AND WW-P-18
VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMSO

FIGURE
7-17

FUGRO NATIONAL, INC.

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AFV-03

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BULK SAMPLE	DEPTH METERS FEET	LITHOLOGY	USCS	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS				
							GR	SA	FI	LL	PI
	0										
	1		SM-SC	medium dense	SILTY SAND - CLAYEY SAND, brown, fine to coarse, poorly graded, calcareous; some slightly plastic silt; trace fine subrounded gravel.						
	2										
	3		GM	very dense	SANDY GRAVEL, light brown, fine to coarse, poorly graded, subrounded, calcareous; some medium to coarse sand; stage I caliche.						
	4										
	5				TOTAL DEPTH 4.0' (1.2m)						

SURFACE ELEVATION: 5080' (1548m)
SURFICIAL GEOLOGIC UNIT: ASy/A4a

LOG OF TEST PIT WW-P-19

	0										
	1		SC	dense	CLAYEY SAND, light brown, fine to coarse, calcareous; some slightly plastic clay; little gravel; stage I caliche.						
	2		GP	very dense	SANDY GRAVEL, light brown, fine to coarse, poorly graded, subrounded to rounded, calcareous; occasional cobbles to 12" size; stage II caliche						
	3										
	4										
	5				TOTAL DEPTH 2.5' (0.8m)	soil strength exceeded capacity of Case 5808 backhoe at 2.5'					

SURFACE ELEVATION: 5273' (1607m)
SURFICIAL GEOLOGIC UNIT: AS1

LOG OF TEST PIT WW-P-20

LOGS OF TEST PITS WW-P-19 AND WW-P-20
VERIFICATION SITE, WHIRLWIND COP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SANSO

FIGURE
7-18

FUGRO NATIONAL, INC.

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AFV-03

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BULK SAMPLE	DEPTH METERS FEET	LITHOLOGY	USCS	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS				
							GR	SA	FI	LL	PI
	0										
	1		ML	firm	SANDY SILT, brown, slightly plastic, calcareous; some fine to coarse sand; stage I caliche.				63	50	15
	2		GP	very dense	SANDY GRAVEL, light brown, fine to coarse, poorly graded, subrounded, calcareous; occasional cobbles and boulders to 18" size; stage IV caliche.						
	3										
	4										
	5										
					TOTAL DEPTH 3.0' (0.9m)	soil strength and cementation exceeded capacity of Case 5808 backhoe at 3.0'					

SURFACE ELEVATION: 5640' (1719m)
SURFICIAL GEOLOGIC UNIT: A5e

LOG OF TEST PIT WW-P-21

	0										
	1		SM-SC	medium dense	SILTY SAND - CLAYEY SAND, brown, fine to coarse, poorly graded, subrounded, calcareous; some slightly plastic silt; little fine rounded gravel.		17	58	24	38	13
	2										
	3		GM	dense	SANDY GRAVEL, light brown, fine to coarse, poorly graded, subrounded, calcareous; some medium to coarse sand; trace silt; occasional cobbles and boulders; stage I caliche.						
	4										
	5										
					TOTAL DEPTH 5.0' (1.5m)						

SURFACE ELEVATION: 5440' (1658m)
SURFICIAL GEOLOGIC UNIT: A5y

LOG OF TEST PIT WW-P-22

LOGS OF TEST PITS WW-P-21 AND WW-P-22
VERIFICATION SITE, WHIRLWIND COP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SANSO

FIGURE
7-19

FUGRO NATIONAL, INC.

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BULK SAMPLE	DEPTH METERS FEET	LITHOLOGY	USCS	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS				
							GR	SA	FI	LL	PI
	0										
	0			medium dense	SILTY SAND, brown, fine to coarse, poorly graded, subrounded, calcareous; some silt; little fine rounded gravel; stage I caliche						
	1										
	2		SM	dense	GRAVELLY SAND, light brown, fine to coarse, poorly graded, subrounded, calcareous; some fine to coarse rounded gravel; stage I caliche.						
	3										
	4										
	5										
					TOTAL DEPTH 5.0' (1.5m)						

SURFACE ELEVATION: 5888' (1797m)
SURFICIAL GEOLOGIC UNIT: A5i

LOG OF TEST PIT WW-P-23

	0										
	0				SILTY SAND, brown, fine to coarse, poorly graded, subrounded, calcareous; some fine to coarse subrounded gravel.						
	1										
	2		SM	medium dense	GRAVELLY SAND, light brown, fine to coarse, poorly graded, subrounded calcareous; some fine to coarse gravel.						
	3										
	4										
	5										
					TOTAL DEPTH 5.0' (1.5m)						

SURFACE ELEVATION: 4893' (1491m)
SURFICIAL GEOLOGIC UNIT: A5y/A4e

LOG OF TEST PIT WW-P-24

LOGS OF TEST PITS WW-P-23 AND WW-P-24
VERIFICATION SITE, WHIRLWIND COP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SANSO

FIGURE
7-20

FUGRO NATIONAL, INC.

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AFV-03

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CHECKED BY _____ APPROVED BY _____

BULK SAMPLE	DEPTH		LITHOLOGY	USCS	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS				
	METERS	FEET						GR	SA	FI	LL	PI
	0	0										
		1		SM	medium dense	SILTY SAND, light brown, fine to coarse, poorly graded, calcareous; some nonplastic silt.						
		2										
		3		ML	firm	SANDY SILT, white, nonplastic, calcareous; some fine to medium sand.				74		NP
		4										
		5										
		6		SP	dense	GRAVELLY SAND, brown, fine to coarse, poorly graded, calcareous; some fine to coarse gravel.						
		7										
		8		CN	very stiff	CLAY, green white, highly plastic, calcareous.						
		9										
		10				TOTAL DEPTH 10.0' (3.0m)						

SURFACE ELEVATION: 4785' (1458m)
SURFICIAL GEOLOGIC UNIT: A5y, A4e

LOG OF TEST PIT WW-P-25

LOG OF TEST PIT WW-P-25
VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMSO

FIGURE
7-21

FUGRO NATIONAL, INC.

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AFV-05

BULK SAMPLE	DEPTH		LITHOLOGY	USCS	CONSISTENCY	SOIL DESCRIPTION	REMARKS	SIEVE ANALYSIS				
	METERS	FEET						GR	SA	F1	LL	PI
	0	0		SM	medium dense	SILTY SAND, light brown, fine to coarse, poorly graded, slightly moist, calcareous; little slightly plastic silt; trace fine to coarse subrounded gravel; occasional cobbles to 8" size.						
	1											
	2											
	3											
	4											
	5											
						TOTAL DEPTH 5.0' (1.5m)						

SURFACE ELEVATION: 4820' (1500m)
SURFICIAL GEOLOGIC UNIT: A5y/A4es

LOG OF TEST PIT WW-P-26

	0	0										
	1											
	2											
	3											
	4											
	5											

SURFACE ELEVATION:
SURFICIAL GEOLOGIC UNIT:

LOG OF TEST PIT

LOG OF TEST PIT WW-P-26
VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMSO

FIGURE
7-22

FUSRO NATIONAL, INC.

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AFV-03

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SECTION 8.0
SURFICIAL SAMPLE LOGS

EXPLANATIONS OF SURFICIAL SAMPLE LOGS

Finalized logs of the surficial samples are presented in this section. The explanations provided here are to serve as general guidelines to reading the logs.

- A. Designations - Surficial samples are identified as follows:

SE-CS-1

SE - abbreviation for the site (e.g., SE - Snake East)

CS - abbreviation for surficial sample

1 - number of activity

- B. Ground Surface Elevation - Indicated elevations on the logs are estimated from topographic maps of the study area within an accuracy of half the contour interval.

- C. Surficial Geologic Unit - Indicates the surficial geologic unit in which the activity is located.

- D. Depth - Indicates depth interval for which soil description is given.

- E. USCS - Unified Soil Classification Symbol; see Table 6-1 of Section 6.0, "Boring Logs", for details of USCS.

- F. Soil Description - Soil is described based on field visual descriptions and/or laboratory test results. See Section 6.0, "Boring Logs", for procedures of soil description.

- G. Sieve Analysis, LL and PI - These are from results of laboratory tests. See Section 6.0, "Boring Logs", for explanation.

ACTIVITY NUMBER	GROUND SURFACE ELEVATION, FEET (METERS)	SURFICIAL GEOLOGIC UNIT	DEPTH, FEET (METERS)	USCS	SOIL DESCRIPTION	SIEVE ANALYSIS				
						GR	SA	FI	LL	PI
WW-CS-1	4723 (1440)	A4e	0.0-4.0 (0.0-1.2)	SM	SILTY SAND, light brown to green, fine to medium, poorly graded, calcareous; some silt.					
WW-CS-3	4840 (1475)	A4e	0.0-2.0 (0.0-0.6)	CL	SILTY CLAY, light brown, slightly plastic, calcareous; trace fine sand.					
WW-CS-7	5100 (1554)	A4e	0.0-2.0 (0.0-0.6)	SM	SILTY SAND, brown, fine to coarse, poorly graded; little silt; trace fine gravel.					
WW-CS-8	5212 (1589)	A5i	0.0-1.5 (0.0-0.5)	CL	SILTY CLAY, light brown, slightly plastic, calcareous; little fine sand; trace fine gravel.					
WW-CS-11	5340 (1628)	A5i	0.0-2.0 (0.0-0.6)	CL	SILTY CLAY, light brown, slightly plastic, calcareous; little fine to medium sand.					
WW-CS-19	5100 (1554)	A5y/A4e	0.0-2.0 (0.0-0.6)	ML	SANDY SILT, light brown, nonplastic, calcareous.			97	25	3
WW-CS-21	5213 (1589)	A5i	0.0-2.0 (0.0-0.6)	SP	SAND, light brown, fine to coarse, poorly graded, calcareous; trace silt; trace fine gravel.					
WW-CS-23	5300 (1615)	A5e	0.0-1.0 (0.0-0.3)	SC	CLAYEY SAND, brown, fine to coarse, poorly graded, calcareous; some slightly plastic clay; little fine gravel.	19	58	23		
			1.0-2.0 (0.3-0.6)	GP	SANDY GRAVEL, light brown, fine, poorly graded, subangular to sub-rounded, calcareous; some fine to coarse sand.					
WW-CS-24	5380 (1634)	A5e	0.0-2.0 (0.0-0.6)	SC	CLAYEY SAND, light brown, fine to coarse, poorly graded, calcareous; some slightly plastic clay; trace fine gravel.					
WW-CS-28	5291 (1613)	A5i	0.0-2.0 (0.0-0.6)	GM	SANDY GRAVEL, light brown, fine to coarse, poorly graded, subrounded, calcareous; some fine to coarse sand; occasional cobbles; some silt.					

LOGS OF SURFICIAL SOIL SAMPLES
VERIFICATION SITE,
WHIRLWIND COP, UTAH

MX SITING INVESTIGATION
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FIGURE
8-1
1 OF 3

TUGRO NATIONAL, INC.

ACTIVITY NUMBER	GROUND SURFACE ELEVATION, FEET (METERS)	SURFICIAL GEOLOGIC UNIT	DEPTH, FEET (METERS)	USCS	SOIL DESCRIPTION	SIEVE ANALYSIS				
						GR	SA	FI	LL	PI
WW-CS-27	5340 (1628)	A51	0.0-1.0 (0.0-0.3)	CL	SILTY CLAY, brown, slightly plastic, calcareous; trace fine sand; trace fine gravel.					
			1.0-2.0 (0.3-0.8)	GP	GRAVEL, light brown, fine to coarse, poorly graded, subrounded, calcareous; trace sand.					
WW-CS-37	5120 (1561)	A5y/A4e	0.0-2.0 (0.0-0.6)	SM	SILTY SAND, brown, fine to coarse, poorly graded, subangular, calcareous; some silt; trace fine to coarse gravel.					
WW-CS-44	4980 (1518)	A1/A4e	0.0-2.0 (0.0-0.6)	CL	SANDY CLAY, light brown, slightly plastic, calcareous; some fine sand.					
WW-CS-45	5090 (1551)	A5y/A4e	0.0-1.5 (0.0-0.5)	SC	CLAYEY SAND, light brown, fine to coarse, poorly graded, calcareous; some slightly plastic clay; little fine to coarse gravel.	17	41	42		
			1.5-2.0 (0.5-0.8)	GP	GRAVEL, white, fine to coarse, poorly graded, subrounded, calcareous; trace sand; trace silt.					
WW-CS-48	5153 (1571)	A5y/A4e	0.0-1.0 (0.0-0.3)	SM	SILTY SAND, light brown, fine, poorly graded, calcareous; some silt.					
			1.0-2.0 (0.3-0.8)	SC	CLAYEY SAND, light brown, fine, poorly graded, subrounded, calcareous; some slightly plastic clay; trace fine gravel.					
WW-CS-51	4970 (1515)	A5y/A4e	0.0-2.0 (0.0-0.8)	ML	SANDY SILT, light brown, nonplastic, calcareous; some fine sand.	0	40	80		
WW-CS-53	4895 (1492)	A5y/A4e	0.0-2.0 (0.0-0.8)	SM	SILTY SAND, light brown, fine to medium, poorly graded, calcareous; some silt; trace fine to coarse gravel.					
WW-CS-58	5853 (1723)	A51	0.0-1.0 (0.0-0.3)	SM	GRAVELLY SAND, light brown, fine to coarse, poorly graded, calcareous; some fine to coarse gravel; some silt.					
			1.0-2.0 (0.3-0.8)	GP	GRAVEL, light brown, fine to coarse, poorly graded, subrounded, calcareous; little fine to coarse sand; trace silt.					

LOGS OF SURFICIAL SOIL SAMPLES
VERIFICATION SITE,
WHIRLWIND COP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SANSO

FIGURE
8-1
2 OF 3

FUERO NATIONAL, INC.

ACTIVITY NUMBER	GROUND SURFACE ELEVATION, FEET (METERS)	SURFICIAL GEOLOGIC UNIT	DEPTH, FEET (METERS)	USCS	SOIL DESCRIPTION	SIEVE ANALYSIS				
						GR	SA	FI	LL	PI
WW-CS-58	5293 (1613)	A5y	0.0-1.0 (0.0-0.3)	GC	SANDY GRAVEL, light brown, fine to coarse, poorly graded, subrounded to subangular, calcareous; some fine to coarse sand; some slightly plastic clay.	41	38	23		
			1.0-2.0 (0.3-0.8)	GP	GRAVEL, light brown, fine to coarse, poorly graded, calcareous; little fine to coarse sand; trace silt.					
WW-CS-60	4883 (1488)	A5y/A4o	0.0-2.0 (0.0-0.6)	SM	SILTY SAND, light brown, fine to coarse, poorly graded, calcareous; some silt; some fine to coarse gravel.					
WW-CS-81	4892 (1491)	A5y/A4o	0.0-2.0 (0.0-0.6)	SM	SILTY SAND, brown, fine to coarse, poorly graded, subrounded, calcareous; some silt; little fine gravel.					
WW-CS-82	4850 (1478)	A5y/A4o	0.0-2.0 (0.0-0.6)	SM	SILTY SAND, brown, fine to coarse, poorly graded, calcareous; little to some silt; trace to some fine to coarse gravel; trace cobbles.					
WW-CS-84	4893 (1430)	A4o	0.0-1.0 (0.0-0.3)	CH	CLAY, brown, highly plastic, calcareous.					
			1.0-2.5 (0.3-0.8)	SM	SILTY SAND, white, fine, poorly graded, calcareous; some silt; little fine to coarse gravel.					
WW-CS-85	4850 (1417)	A4o	0.0-1.0 (0.0-0.3)	CL	SILTY CLAY, brown, slightly plastic, calcareous; trace fine sand.					
			1.0-2.0 (0.3-0.8)	GM	SANDY GRAVEL, brown, fine to coarse, poorly graded, calcareous; some fine to coarse sand.					
WW-CS-88	4543 (1385)	A4o	0.0-1.0 (0.0-0.3)	SC	CLAYEY SAND, brown, fine to coarse, poorly graded, calcareous; some slightly plastic clay.	4	62	34		
			1.0-2.0 (0.3-0.8)	SP	GRAVELLY SAND, brown, fine to coarse, poorly graded, calcareous; some fine gravel.					

LOGS OF SURFICIAL SOIL SAMPLES
VERIFICATION SITE,
WHIRLWIND COP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SANSO

FIGURE
8-1
3 OF 3

FUGRO NATIONAL, INC.

SECTION 9.0
LABORATORY TEST RESULTS

EXPLANATIONS OF LABORATORY TEST RESULTS

Laboratory test results are presented in this section. Table 9-1 contains a summary of laboratory test results. This table contains results of sieve analysis; plasticity data; in-situ dry unit weight, moisture content, degree of saturation, and void ratio for drive and Pitcher samples; results of compaction tests; and specific gravity of solids. Other tests such as triaxial compression, unconfined compression, direct shear, consolidation, chemical, and California Bearing Ratio (CBR) are indicated on the table. Tables 9-2 through 9-6 and Figures 9-1 through 9-3 present results of triaxial compression, unconfined compression, direct shear, consolidation, chemical, and CBR tests.

All tests were performed in general accordance with the American Society for Testing and Materials (ASTM) procedures. The following table presents the ASTM designations for the tests performed during the investigation.

<u>Type of Test</u>	<u>ASTM Designations</u>
Particle Size Analysis	D 422-63
Liquid Limit	D 423-66
Plastic Limit	D 424-59
Unit Weight	D 2937-71
Moisture Content	D 2216-71
Compaction	D 1557-70
Specific Gravity of Solids	D 854-58
Triaxial	D 2850-70
Unconfined Compression	D 2166-66
Direct Shear	D 3080-72
Consolidation	D 2435-70
Test for Alkalinity (pH)	D 1067-70
Water Soluble Sodium	D 1428-64
Water Soluble Chloride	D 512-67
Water Soluble Sulphate	D 516-68
Water Soluble Calcium	D 511-72
Calcium Carbonate	D 1126-67
California Bearing Ratio (CBR)	D 1883-73

Explanation for the tables and figures presented in this section are as follows.

- A. Activity Number - Boring, trench, test pit, or surficial sample designation.
- B. Sample Number - Prefix indicates the type of sample; explanation is at the bottom of the table.
- C. Sample Interval - This is the depth range measured from ground surface over which the sample was obtained.
- D. Percent Finer by Weight - Presents the results of laboratory particle size analysis (ASTM D 422-63) performed on representative soil samples at the depth indicated. The numbers represent the percent (by dry weight) of the total sample weight passing through each sieve size indicated.
- E. Atterberg Limits (ASTM D 423-66 and D 424-59)
 - LL - Liquid Limit, the water content (as percent of soil dry weight) corresponding to the arbitrary limit between the liquid and plastic states of consistency of a soil (ASTM D 423-66).
 - PL - Plastic Limit, the water content corresponding to an arbitrary limit between the plastic and the semisolid state of consistency of a soil (ASTM D 424-59).
 - PI - Plasticity Index, numerical difference between the liquid limit (LL) and the plastic limit (PL) indicating the range of moisture content within which a soil-water mixture is plastic.
 - NP - Nonplastic.
- F. USCS - Unified Soil Classification Symbols are given here; see Table 6.1 in Section 6.0, "Boring Logs", for complete details of USCS system.

G. In Situ - Presents results of tests on drive and Pitcher samples.

Dry Unit Weight - indicates dry unit weight of soil determined as per ASTM D 2937-71

Moisture Content - weight of water reported in percent of dry weight of soil sample (ASTM D 2216-71)

Saturation - the degree of saturation in a soil sample is defined as the ratio (in percent) of the volume of water to the volume of all voids in the soil

Void Ratio - the numerical ratio of the volume of voids to the volume of solids in a soil specimen

H. Compacted - Indicates results of laboratory maximum dry density and optimum moisture content test as per ASTM D 1557-70.

I. Specific Gravity of Solids (ASTM D 854-58) - Indicates the ratio of (1) the weight in air of a given volume of soil solids at a stated temperature, to (2) the weight in air of an equal volume of distilled water at a stated temperature.

J. Triaxial - The triaxial compression tests were performed in accordance with the procedures of ASTM D 2850-70. The following explanations and definitions apply.

Triaxial Compression Test - a cylindrical specimen of soil is surrounded by a fluid in a pressure chamber and subjected to an isotropic pressure. An additional compressive load is then applied, directed along the axis of the specimen called the axial load.

Consolidated-Drained (CD) Test - a triaxial compression test in which the soil was first consolidated under an all-around confining stress (test chamber pressure), and was then compressed (and hence sheared) by increasing the

vertical stress. Drained indicates that excess pore water pressure generated by strains are permitted to dissipate by the free movement of pore water during consolidation and compression.

Consolidated-Undrained (CU) Test - a triaxial compression test in which essentially complete consolidation under the confining (chamber) pressure is followed by a shear test at constant water content.

Confining Pressure (σ_3) - the isotropic chamber pressure applied to the soil specimen during consolidation and compression.

Maximum Deviator Stress ($\sigma_1 - \sigma_3$) - the difference between the major and minor principal stresses in the specimen at failure. The major principal stress on the specimen is equal to the unit axial load plus the chamber pressure and the minor principal stress on the specimen is equal to the chamber pressure.

Strain Rate - axial strain, ϵ , at a given stress level is defined as the ratio of the change in length (ΔL) of the specimen to the original length of the specimen (L_0). The rate of strain was controlled during the test so that this ratio increased at equal increments for each minute of testing.

Back Pressure - pressure in excess of atmospheric applied to the pore water of a soil sample. Back pressure is usually applied to (1) increase saturation of the sample, or (2) simulate the actual in-situ pressure regime.

- K. Unconfined Compression - Test procedures were as described in ASTM D 2166-66. Unconfined compressive strength is defined as the load per unit area at which an unconfined prismatic or cylindrical specimen of soil will fail in a simple compression test. In these methods, unconfined compressive strength is taken as the maximum load attained per unit area or the load per unit area at 20 percent axial strain, whichever occurred first during the performance of a test.

- L. Direct Shear - The procedures of ASTM D 3080-72 were followed for direct shear testing. In this test, soil under an applied normal load is stressed to failure by moving one section of the soil container (shear box) relative to the other section. Normal stress is the value of load per unit area acting perpendicular to the plane of shearing. Maximum shear strength is defined as the maximum resistance (ksf) of a soil to shearing (tangential) stresses.
- M. Consolidation (ASTM D 2435-70) - A consolidation test is a test in which a cylindrical soil specimen is laterally confined in a ring and compressed between porous plates. The term "consolidation", as used here, indicates the gradual reduction in volume of the soil mass resulting from an increase in compressive stress (axial load per unit area).
- N. Chemical - The chemical tests performed on soil samples included: pH; water soluble sodium, chloride, sulphate, calcium; and calcium carbonate content. pH is an index of the acidity or alkalinity of a soil in terms of the logarithm of the reciprocal of the hydrogen ion concentration. ASTM test procedure designations for these chemical tests are included in the table at the beginning of the "Explanation of Laboratory Test Results".
- O. CBR - California Bearing Ratio (CBR) is the ratio (in percent) of the resistance to penetration developed by a subgrade soil to that developed by a standard crushed-rock

base material. The procedures for conducting a CBR test were as outlined in ASTM D 1883-73. The materials tested for CBR were also analyzed for particle size distribution (ASTM D 422-63) and compaction characteristics (ASTM D 1557-70). The term "percentage of maximum density" indicates the ratio (as a percentage) of the compacted sample dry unit weight to maximum dry density obtained in the laboratory from ASTM D 1557-70, "Moisture-Density Relations of Soils Using 10-pound (4.5 kg) Hammer and 18-inch (457 mm) Drop".

ACTIVITY NUMBER	SAMPLE NUMBER (a)	SAMPLE INTERVAL		PERCENT FINER							
				STANDARD SIEVE OPENING							
				BLDRS.	COBBLES		GRAVEL				
		FEET	METERS	24"	12"	6"	3"	1 1/2"	3/4"	3/8"	
WW-B-1	D-1	0.9-1.4	0.27-0.43						100	74	6
	P-2	2.5-3.3	0.76-1.01						100	85	6
	P-2	4.1-4.9	1.25-1.49								
	P-3	7.3-7.7	2.23-2.35								
	D-4	10.4-11.2	3.17-3.41								
WW-B-2	D-2	3.6-4.3	1.10-1.31				100	74	74	62	3
	D-3	6.6-7.3	2.01-2.23						100	98	8
	D-4	8.8-9.5	2.68-2.90								
	D-5	15.2-15.9	4.63-4.85					100	86	81	7
	D-6	20.0-20.7	6.10-6.31					100	88	80	8
	P-7	25.0-25.4	7.62-7.74								
	D-9	26.0-26.7	7.92-8.14								
	D-11	40.1-40.8	12.22-12.44								
	D-12	50.6-51.3	15.42-15.64							100	9
	D-13	65.0-65.3	19.81-19.90								
	D-14	80.4-80.9	24.51-24.66						100	95	
	D-15	95.2-95.4	29.02-29.08								
	P-16	119.5-120.1	36.42-36.61								
	D-17	140.5-141.1	42.82-43.01						100	92	
	D-18	159.5-159.9	48.62-48.74								
WW-B-3	D-1	0.5-1.2	0.15-0.37							100	
	D-2	3.1-3.8	0.94-1.16							100	
	D-3	6.7-7.4	2.04-2.26							100	
	P-5	9.0-9.5	2.74-2.90								
	D-6	11.6-12.3	3.54-3.75								
	D-7	15.6-16.3	4.75-4.97						100	96	
	D-10	30.7-31.2	9.36-9.51								
	D-11	40.3-40.8	12.28-12.44								
	D-12	50.3-50.8	15.33-15.48							100	96
	D-13	65.2-65.7	19.87-20.03								
	D-14	80.2-80.7	24.44-24.60								
	D-15	100.3-100.8	30.57-30.72					100	99	84	
	D-16	120.3-120.8	36.67-36.82								
	D-17	140.3-140.8	42.76-42.92							100	
	D-19	159.5-159.8	48.62-48.71								
WW-B-4	P-1	1.6-2.3	0.49-0.70					100	90	80	
	D-2	3.2-3.9	0.98-1.19							100	
	D-3	6.6-7.3	2.01-2.23							100	
	D-4	9.1-9.8	2.77-2.99								
	D-5	15.2-15.9	4.63-4.85					100	94	90	

NOTES:

(a) Sample types

SS - Standard split spoon

P - Pitcher

D - Fugro Drive

B.b - Bulk

(b) NP - Not Plastic

(c) USCS - Unified Soil Classification System

(d) * Indicates that test has been performed and results are included in this report

CHECKED BY _____ APPROVED BY _____

GRAIN SIZE DISTRIBUTION BY WEIGHT								ATTERBERG LIMITS (b)			USCS (c)	IN-SITU					COMPACTED			SPECIFIC GRAVITY OF SOLIDS
U S STANDARD SIEVE NO					PARTICLE SIZE (mm)		DRY UNIT WEIGHT					MOISTURE CONTENT (%)	SATURATION (%)	VOID RATIO	MAXIMUM DRY DENSITY		OPTIMUM MOISTURE (%)			
SAND					SILT OR CLAY		(pcf)								(kg/m ³)	(pcf)		(kg/m ³)		
	4	10	40	100	200	.005	.001	LL	PL	PI										
1	60	50	43	33	27						GM	102.2	1637	3.2	13.5	0.65				
2	62	42		15	12						SP-SM			3.3						
			100	99	88						ML									
		100	99	99	92						ML	98.8	1583	16.0	61.2	0.71				
											SM		1873	4.9	30.3	0.44				
3	36	23	16	13	11						GP-GM	121.2	1941	2.3	15.7	0.39				
4	84	49	22	15	13						SM	117.8	1887	2.9	17.9	0.43				
											SM	114.3	1831	4.5	25.7	0.47				
5	71	56	38	26	22						SC	112.0	1794	9.1	48.8	0.50				
6	54	36	25	17	13						GM	132.1	2116	6.5	63.8	0.28				
											SM	117.3	1879	12.9	80.2	0.44				
											SM	133.5	2138	9.0	92.8	0.26				
											SM	134.5	2154	6.9	74.6	0.25				
7	96	66	21	15	13						SC	123.6	1980	9.7	72.6	0.36				
											SM	124.1	1988	8.8	66.5	0.36				
8	71	53	36	27	22						SM	130.8	2095	5.3	49.5	0.29				
											SM	129.3	2071	6.7	60.3	0.30				
											SC			10.2						
9	84	62	32	21	18						SM	132.6	2124	9.8	97.6	0.27				
											SM	123.2	1973	10.8	79.2	0.37				
10	99	95	72	49	39						SM	105.7	1693	13.1	59.4	0.59				
11	97	77	35	18	13						SM	101.3	1623	6.8	27.9	0.66				
12	96	69	21	12	10						SP-SM	116.9	1873	5.4	32.9	0.44				
											SP-SM	100.9	1616	8.7	35.3	0.67				
											SW-SM	111.4	1784	5.3	27.9	0.51				
13	73	55	27	15	12						SW-SM	118.7	1901	9.5	61.4	0.42				
											SM	114.2	1829	11.5	65.5	0.48				
											SP	110.3	1773	15.8	80.7	0.53				
14	89	74	42	23	16						SM	118.3	1895	10.3	65.1	0.42				
											SP	116.7	1869	8.9	53.9	0.44				
											SP-SM	124.4	1993	12.1	92.3	0.36				
15	73	53	23	13	9						SW-SM	125.3	2007	8.6	67.2	0.34				
											SP	124.7	1998	8.3	63.6	0.35				
16	99	85	39	22	14						SM	120.6	1932	9.0	61.1	0.40				
											SW	124.2	1989	13.7	100.0	0.36				
17	68	47	18	7	4						SW	107.4	1720	3.6	17.0	0.57				
18	99	87	36	18	13						SM	104.8	1679	7.0	31.0	0.61				
19	99	80	31	19	15						SM	110.4	1768	6.4	32.9	0.53				
	100	89	49	33	22						SM	110.2	1765	7.0	35.8	0.53				
20	79	58	24	15	13						SM	118.5	1898	11.1	71.1	0.42				

WATER RATIO	COMPACTED		OPTIMUM MOISTURE (%)	SPECIFIC GRAVITY OF SOLIDS	TRIAxIAL (d)	UNCONFINED COMPRESSION	DIRECT SHEAR	CONSOLIDATION	CHEMICAL	CBR
	MAXIMUM DRY DENSITY									
	(pcf)	(kg m³)								
0.65										
0.71										
0.44										
0.39										
0.43										
0.47										
0.50										
0.28							*			
0.44										
0.26										
0.25										
0.36										
0.36										
0.29										
0.30										
0.27										
0.37										
0.59										
0.66										
0.44										
0.67										
0.51										
0.42										
0.48										
0.53										
0.42										
0.44										
0.36										
0.34										
0.35										
0.40										
0.36										
0.57										
0.61										
0.53							*			
0.53										
0.42										

SUMMARY OF LABORATORY TEST RESULTS
VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE SANSO

TABLE
9-1
1 OF 4

FUGRO NATIONAL, INC.

AFV-01

ACTIVITY NUMBER	SAMPLE NUMBER (a)	SAMPLE INTERVAL		PERCENT FINER							
				STANDARD SIEVE OPENING							
				BLDRS.	COBBLES		GRAVEL				
		FEET	METERS	24"	12"	6"	3"	1½"	3/4"	3/8"	4"
WW-B-4	P-6	20.0-20.5	6.10-6.25								
	D-8	25.5-25.9	7.77-7.89								
	D-9	30.2-30.9	9.20-9.42						100	94	84
	D-10	40.1-40.8	12.22-12.44								
	D-11	50.1-50.4	15.27-15.36								
	D-12	60.0-60.3	18.29-18.38								
	P-14	71.0-72.0	21.64-21.95					100	95	86	81
	P-15	80.0-80.9	24.38-24.66								
	P-16	88.0-88.8	26.82-27.07								
	P-17	101.9-102.5	31.06-31.24								10
	P-18	118.0-118.8	35.97-36.21								10
	P-19	140.0-140.8	42.67-42.92								
	P-20	160.0-160.8	48.77-49.01								
WW-B-5	D-1	0.1-0.8	0.03-0.24					100	72	48	34
	D-2	5.5-6.2	1.68-1.89						100	85	74
	D-4	11.0-11.7	3.35-3.60								
	D-6	16.2-16.9	4.94-5.15							100	94
	D-7	21.3-21.9	6.49-6.68								
	D-8	26.3-26.9	8.02-8.20								
	D-9	31.9-32.6	9.72-9.94								
	D-10	40.5-40.9	12.34-12.47						100	79	51
	D-11	50.9-51.4	15.51-15.67					100	93	87	64
	D-12	65.4-65.9	19.93-20.09								
	D-13	80.4-80.9	24.51-24.66						100	96	85
	D-14	101.4-101.9	30.91-31.06								
	D-15	121.0-121.3	36.88-36.97								
	D-16	141.0-141.5	42.98-43.13						100	99	81
	D-17	161.0-161.4	49.07-49.19								
WW-B-6	D-1	0.9-1.2	0.27-0.37						100	73	51
	D-2	5.1-5.8	1.55-1.77					100	91	57	31
	D-3	8.2-8.8	2.50-2.68								
	D-4	15.5-15.8	4.72-4.82								
	D-5	21.2-21.9	6.46-6.68								
	D-6	26.1-26.8	7.96-8.17								10
	D-7	31.4-31.7	9.57-9.66								
	D-8	45.6-45.9	13.90-13.99						100	96	8
	D-9	55.4-55.9	16.89-17.04								
	D-11	81.3-81.8	24.78-24.93					100	95	85	7
	D-12	91.4-91.9	27.86-28.01								
	D-13	101.2-101.6	30.85-30.97								
	D-14	121.0-121.2	36.88-36.94						100	88	6

NOTES:

(a) Sample types

SS - Standard split spoon

P - Pitcher

D - Fugro Drive

B,b - Bulk

(b) NP - Not Plastic

(c) USCS - Unified Soil Classification System

(d) * Indicates that test has been performed
and results are included in this report

CHECKED BY _____ APPROVED BY _____

PER BY WEIGHT							ATTERBERG LIMITS (b)			USCS (c)	IN-SITU					COMPACTED			SPECIFIC GRAVITY OF SOLIDS
U S STANDARD SIEVE NO					PARTICLE SIZE (mm)						DRY UNIT WEIGHT		MOISTURE CONTENT (%)	SATURATION (%)	VOID RATIO	MAXIMUM DRY DENSITY		OPTIMUM MOISTURE (%)	
SAND				SILT OR CLAY		(pcf)					(kg/m ³)	(pcf)				(kg/m ³)			
4	10	40	100	200	.005	.001	LL	PL	PI										
										SM									
										SM	116.1	1860	12.4	74.3	0.45				
86	71	48	41	38						SM	115.7	1853	11.0	64.8	0.45				
										SP-SM	110.7	1773	13.9	71.8	0.52				
										SP-SM	115.7	1853	15.1	89.2	0.46				
										SP-SM	120.2	1925	9.8	65.7	0.40				
81	63	22	15	12						SP-SM	115.3	1847	13.3	78.1	0.46				
										SM	124.8	1999	9.6	73.8	0.35				
										SM	105.8	1695	11.4	51.9	0.59				
100	98	73	20	10						SP-SM	122.5	1962	10.6	76.0	0.38				
100	97	90	84	74	16	6			NP	ML	101.7	1629	14.1	58.0	0.66				
										SM	107.4	1720	12.3	58.6	0.57				
										SM	117.5	1882	7.3	45.6	0.43				
36	32	29	27	25						GM	115.2	1845	5.0	29.3	0.46				
74	58	34	27	24						SM	103.6	1660	7.3	31.6	0.63				
										SM	121.1	1940	2.6	18.3	0.39				
98	97	95	92	86						CL	111.8	1791	4.0	21.3	0.51				
										SM	125.3	2007	8.4	65.6	0.34				
										SM	122.6	1964	6.8	49.3	0.38				
										SM	130.5	2090	8.0	74.6	0.29				
59	45	26	17	13						SM	129.9	2081	8.9	80.9	0.30				
68	50	34	27	22						SM	117.1	1876	9.8	60.2	0.44				
										SM	130.3	2087	7.6	70.0	0.29				
85	52	21	15	12						SP-SM	121.6	1948	12.4	86.8	0.39				
										SP-SM	135.4	2169	6.6	72.3	0.25				
										SM	139.6	2236	7.8	100.0	0.21				
85	53	32	25	20						SM	131.8	2111	8.0	78.0	0.28				
										SM	126.6	2028	5.4	43.8	0.33				
59	49	37	26	19						GM	103.4	1656	4.6	19.8	0.63				
39	27	16	9	7						GP-GM	112.0	1794	1.1	5.7	0.50				
										GM	126.3	2023	2.0	15.9	0.33				
										GM	131.7	2110	7.3	70.5	0.28				
										GM	122.6	1964	9.2	66.5	0.37				
100	99	88	61	38						SM	117.2	1877	12.5	77.2	0.44				
82	54	21	11	9						SW-SM	130.4	2089	7.9	73.8	0.29				
										SW-SM	136.5	2187	6.7	77.6	0.23				
93	79	39	14	9						SW-SM	119.9	1921	8.6	57.1	0.41				
74	65	47	31	20						SM	131.5	2106	4.5	43.3	0.28				
										SM	123.4	1977	8.6	63.7	0.37				
										SM	130.4	2089	6.9	64.3	0.29				
67	51	27	19	15						SM	129.5	2074	9.6	85.8	0.30				

ACTIVITY NUMBER	SAMPLE NUMBER (a)	SAMPLE INTERVAL		PERCENT FINER BY WEIGHT								
				STANDARD SIEVE OPENING							U S STAN	
				BLDRS.	COBBLES		GRAVEL				SA	
		FEET	METERS	24"	12"	6"	3"	1½"	3/4"	3/8"	4	10
WW-B-6	D-15	141.0-141.3	42.98-43.07					100	87	80	50	30
	b-16	145.4-145.6	44.32-44.38									
WW-T-1	B-1	0.0-2.0	0.00-0.61					100	93	80	65	53
	B-4	4.6-5.3	1.40-1.62									
WW-T-2	B-1	0.0-2.0	0.00-0.61				100	99	95	89	80	70
WW-T-3	B-1	0.4-2.0	0.12-0.61							100	99	95
	b-4	10.0-11.0	3.05-3.35									
WW-T-4	B-1	0.5-2.0	0.15-0.61						100	99	95	87
	b-2	7.0-8.0	2.13-2.44						100	99	98	94
	B-3	12.5-13.5	3.81-4.11					100	95	92	80	51
WW-T-6	B-1	0.5-2.0	0.15-0.61				100	94	89	77	65	55
WW-P-1	B-2	1.4-3.6	0.43-1.10					100	96	82	62	45
WW-P-3	B-1	0.3-1.3	0.09-0.40					100	98	82	63	47
WW-P-4	B-1	0.4-2.0	0.12-0.61						100	91	85	76
WW-P-8	B-1	0.4-2.0	0.12-0.61					100	98	91	85	80
WW-P-10	B-1	0.3-1.0	0.09-0.30				100	75	74	65	60	53
WW-P-12	B-1	0.3-1.5	0.09-0.46									
WW-P-14	B-1	0.4-2.0	0.12-0.61				100	94	84	66	56	48
WW-P-16	b-1	0.3-2.0	0.09-0.61							100	94	84
WW-P-18	B-1	0.3-2.0	0.09-0.61					100	96	93	87	75
WW-P-21	b-1	0.3-1.0	0.09-0.30									
WW-P-22	B-1	0.3-1.5	0.09-0.46						100	93	83	74
WW-P-24	B-1	0.3-1.5	0.09-0.46									
WW-P-25	B-2	2.0-4.0	0.61-1.22									

NOTES:

(a) Sample types

SS - Standard split spoon

P - Pitcher

D - Fugro Drive

B, b - Bulk :

(b) NP - Not Plastic

(c) USCS - Unified Soil Classification System

(d) * Indicates that test has been performed and results are included in this report

CHECKED BY _____ APPROVED BY _____

WEIGHT						ATTERBERG LIMITS (b)			USCS (c)	IN-SITU				COMPACTED			SPECIFIC GRAVITY OF SOLIDS	TRIAxIAL (d)	UNSATURATED WATER CONTENT (e)	
STANDARD SIEVE NO				PARTICLE SIZE (mm)						DRY UNIT WEIGHT		MOISTURE CONTENT (%)	SATURATION (%)	VOID RATIO	MAXIMUM DRY DENSITY					OPTIMUM MOISTURE (%)
SAND			SILT OR CLAY		(pcf)					(kg/m³)	(pcf)				(kg/m³)					
10	40	100	200	.005	.001	LL	PL	PI		GP-GM	143.7	2302	8.9	100.0	0.17					
30	15	10	8																	
53	43	37	33						GM											
			82					NP	ML											
70	59	45	40					NP	SM						131.5	2106	9.1			
95	88	82	74	43	22	39	24	15	CL						115.0	1842	16.0			
									SP											
87	62	35	28						SM											
94	70	38	35	20	6	22	19	3	SM											
51	12	5	3						SW											
55	43	33	26						SM											
45	30	21	16						SM											
47	31	25	21						SM											
76	64	54	45			31	23	8	SM-SC											
80	58	25	16						SM						139.7	2238	7.0			
53	47	39	33			35	23	12	GC											
			60			32	21	11	CL											
48	38	29	23			25	21	4	GM-GC						139.5	2235	6.1			
84	67	47	36						SM											
75	51	25	18						SM											
			63			50	35	15	ML											
74	54	34	24			38	25	13	SM-SC											
									SM											
			74					NP	ML											

SUMMARY
VERIFIED

BY
DEPARTMENT

FILE

2

SUMMARY OF LABORATORY TEST RESULTS VERIFICATION SITE, WHIRLWIND COP, UTAH	
MX SITING INVESTIGATION DEPARTMENT OF THE AIR FORCE SAMS0	TABLE 9-1 8 OF 4
FUERO NATIONAL, INC.	

NOTES:

- (a) Sample types
 SS - Standard split spoon
 P - Pitcher
 D - Fugro Drive
 B.b - Bulk
 (b) NP - Not Plastic
- (c) USCS - Unified Soil Classification System
 (d) * Indicates that test has been performed and results are included in this report

SUMMIT
VERIFIED
MX S
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SUMMARY OF DIRECT SHEAR TEST RESULTS

VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMSQ

**TABLE
9-2**

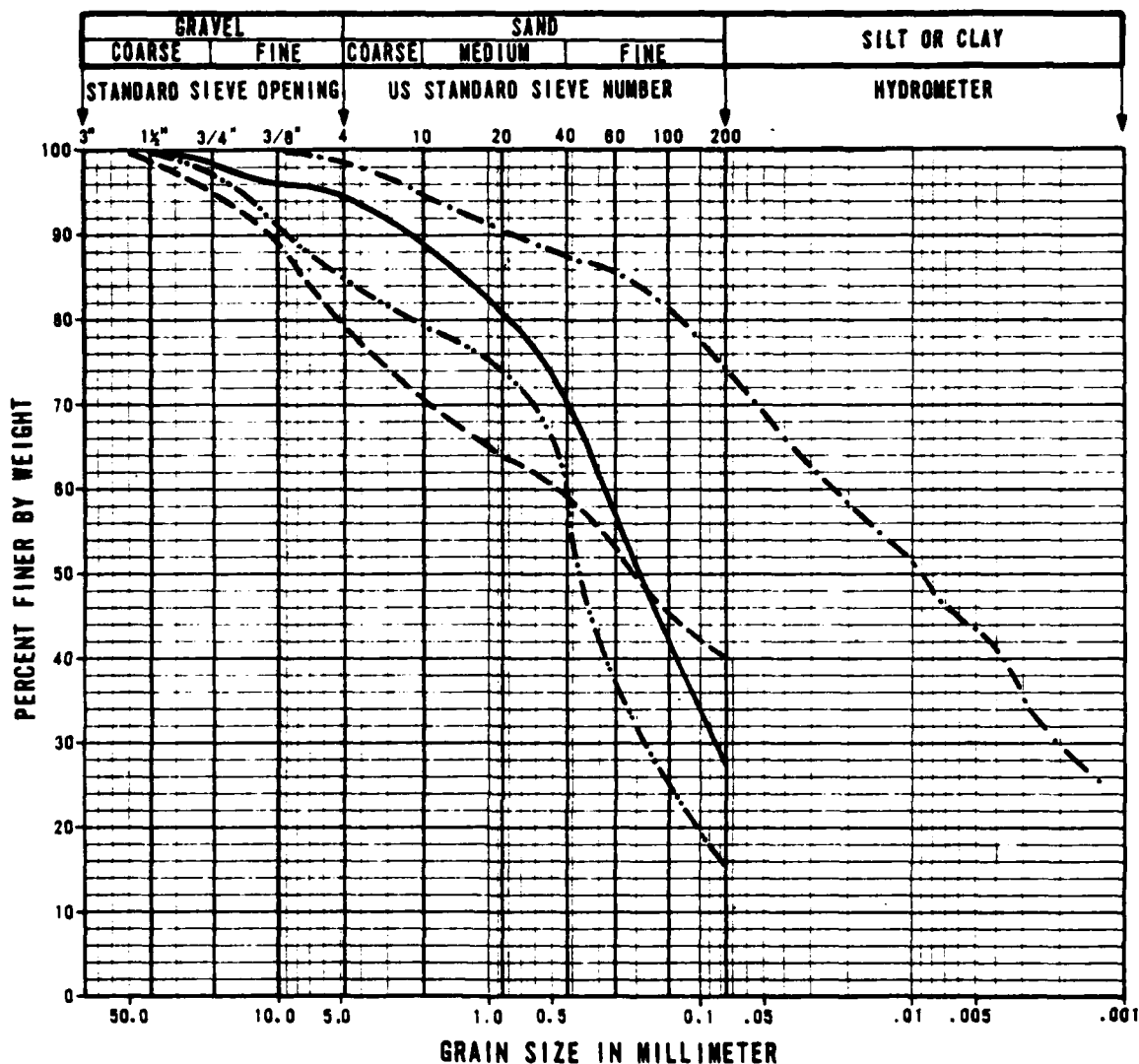
FUGRO NATIONAL, INC.

[illegible]

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMS

**TABLE
9-3**

FUGRO NATIONAL, INC.



SYMBOL	COMPOSITE SAMPLE NUMBER	ACTIVITY NUMBER	SAMPLE INTERVAL		SOIL TYPE
			FEET	METERS	
—	A	WW-P-24	0.3-1.5	0.09-0.46	SM
—		WW-P-26	0.1-1.8	0.03-0.55	
---	B	WW-T-2	0.0-2.0	0.00-0.61	SM
-.-	C	WW-T-3	0.4-2.0	0.12-0.61	CL
-..-	D	WW-P-8	0.4-2.0	0.12-0.61	SM

GRAIN SIZE CURVES, CBR TESTS
VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMSO

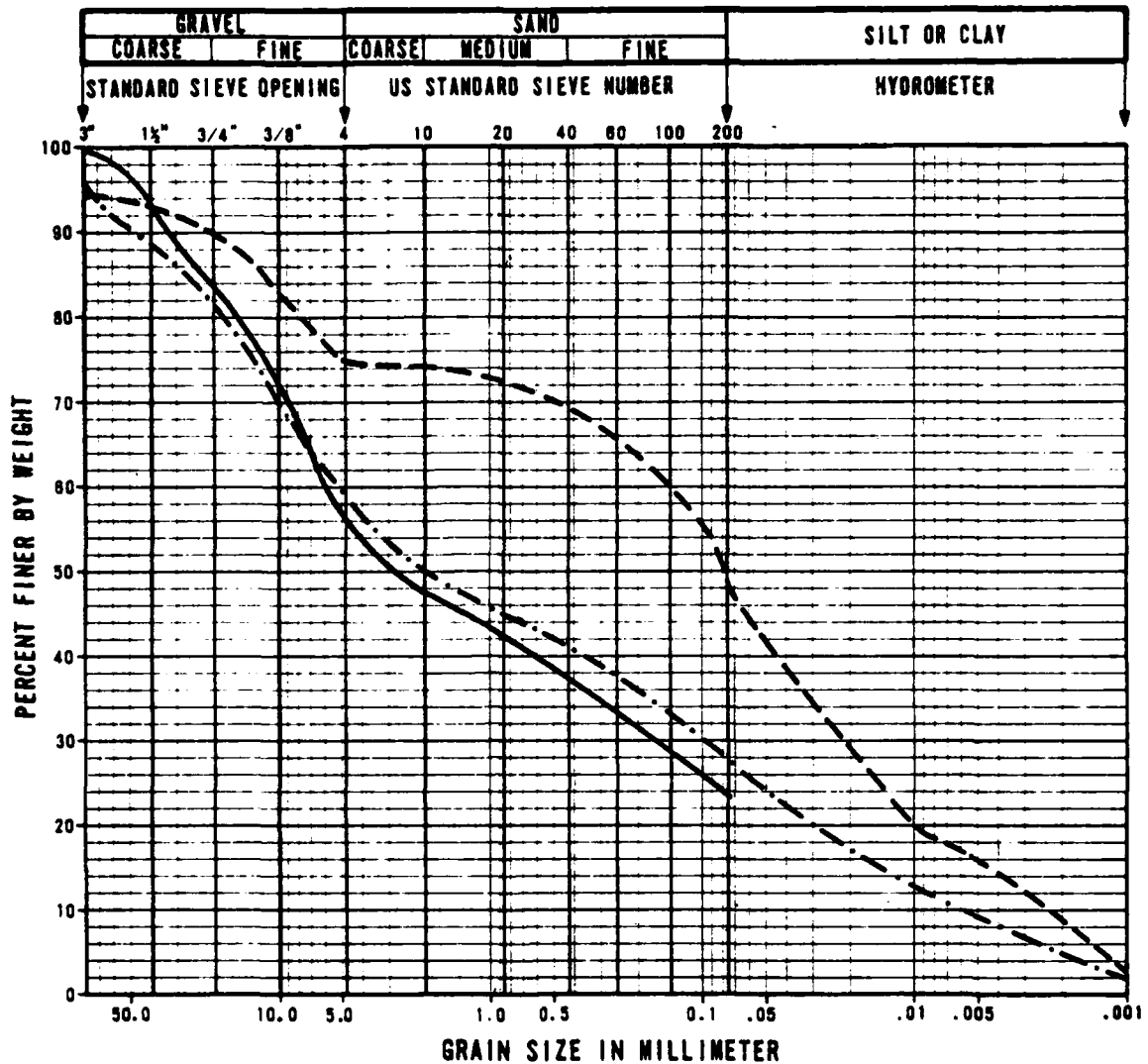
FIGURE
9-1
1 OF 2

FUGRO NATIONAL INC.

AFV-12

2 JUL 78

CHECKED BY _____ APPROVED BY _____



SYMBOL	COMPOSITE SAMPLE NUMBER	ACTIVITY NUMBER	SAMPLE INTERVAL		SOIL TYPE
			FEET	METERS	
—	E	WW-P-14	0.4-2.0	0.12-0.61	GM-GC
- - -	F	WW-P-4 WW-CS-45	0.4-2.0	0.12-0.61	SM-SC
- · - ·	G	WW-P-10 WW-CS-58	0.25-1.0	0.08-0.30	GC

GRAIN SIZE CURVES, CRB TESTS
VERIFICATION SITE, WHIRLWIND COP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMSQ

FIGURE
9-1
2 OF 2

FLUORO NATIONAL INC.

2 JUL 78

AFV-12

CHECKED BY _____ APPROVED BY _____

CHECKED BY _____ APPROVED BY _____

COMPOSITE SAMPLE NUMBER	SOIL TYPE	PERCENT PASSING #200	ATTERBERG LIMITS		SPECIFIC GRAVITY	MAXIMUM DRY DENSITY		OPTIMUM MOISTURE (%)	COMPACTED DRY DENSITY		COMPACTED MOISTURE (%)	PERCENT OF MAXIMUM DRY DENSITY	CBR (%)
			LL	PI		pcf	kg/m ³		pcf	kg/m ³			
A	SM	28			2.71	132.8	2127	7.8	122.1	1955	7.9	91.8	44
									114.5	1833	7.8	86.2	12
B	SM	40		NP		131.5	2108	9.1	117.9	1889	9.0	88.7	18
									113.2	1813	8.6	86.1	7
C	CL	74	39	15		115.0	1842	16.0	110.2	1766	16.4	95.8	23
									103.1	1651	16.5	89.7	8
									92.5	1481	17.1	80.4	4
D	SM	16				139.7	2238	7.0	129.5	2074	6.9	92.7	78
									123.5	1979	7.1	88.4	24

CALIFORNIA BEARING RATIO (CBR) TEST RESULTS
VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SANSO

TABLE
9-4
1 OF 2

USRO NATIONAL, INC.

2 JUL 78

AFV-13

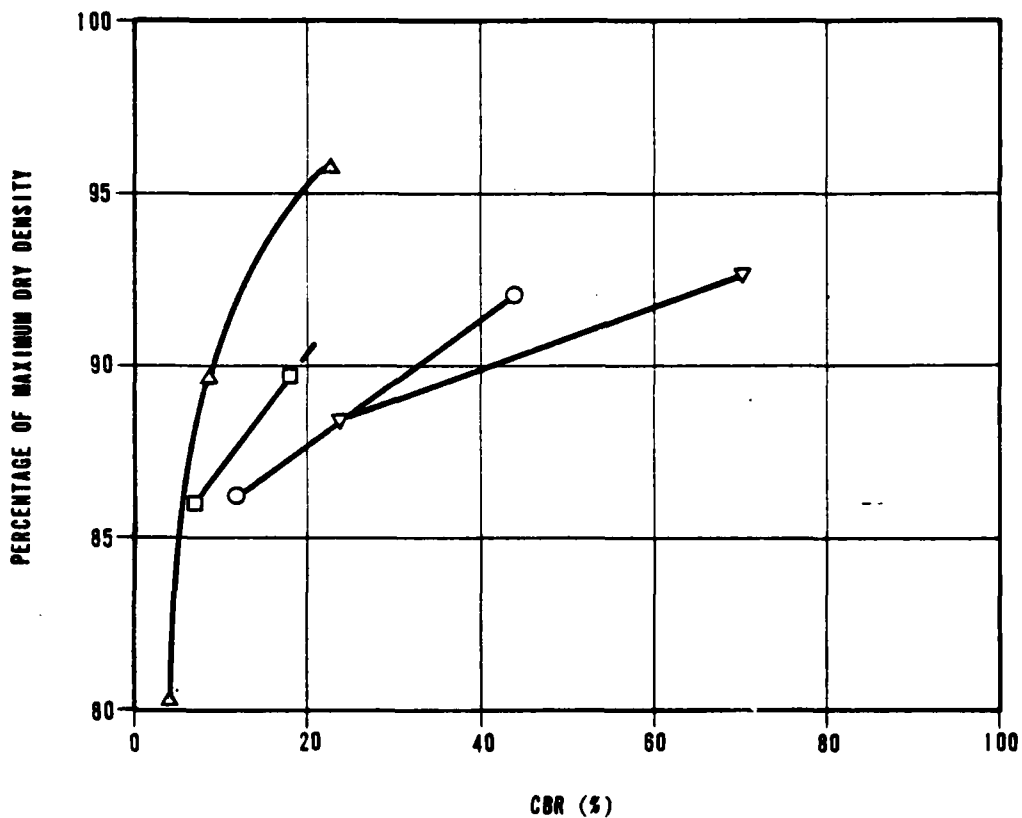
CHECKED BY _____ APPROVED BY _____

COMPOSITE SAMPLE NUMBER	SOIL TYPE	PERCENT PASSING #200	ATTERBERG LIMITS		SPECIFIC GRAVITY	MAXIMUM DRY DENSITY		OPTIMUM MOISTURE (%)	COMPACTED DRY DENSITY		COMPACTED MOISTURE (%)	PERCENT OF MAXIMUM DRY DENSITY	CBR (%)
			LL	PI		pcf	kg/m ³		pcf	kg/m ³			
E	GM-GC	23	25	4				6.1	128.9	2065	6.6	92.4	44
									124.5	1894	6.1	88.2	18
						139.5	2235						
F	SM-SC	40	28	8				9.5	126.7	2030	10.2	89.0	84
									121.9	1953	10.2	85.2	51
						128.0	2051		112.4	1801	9.7	87.8	10
G	GC	28	27	8				7.0	127.7	2046	7.0	93.2	65
									120.5	1930	7.0	88.0	18
						137.0	2195						

CALIFORNIA BEARING RATIO (CBR) TEST RESULTS
VERIFICATION SITE, WHIRLWIND COP, UTAHMX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMSOTABLE
9-4
2 OF 2

TUBRO NATIONAL, INC.

CHECKED BY _____ APPROVED BY _____



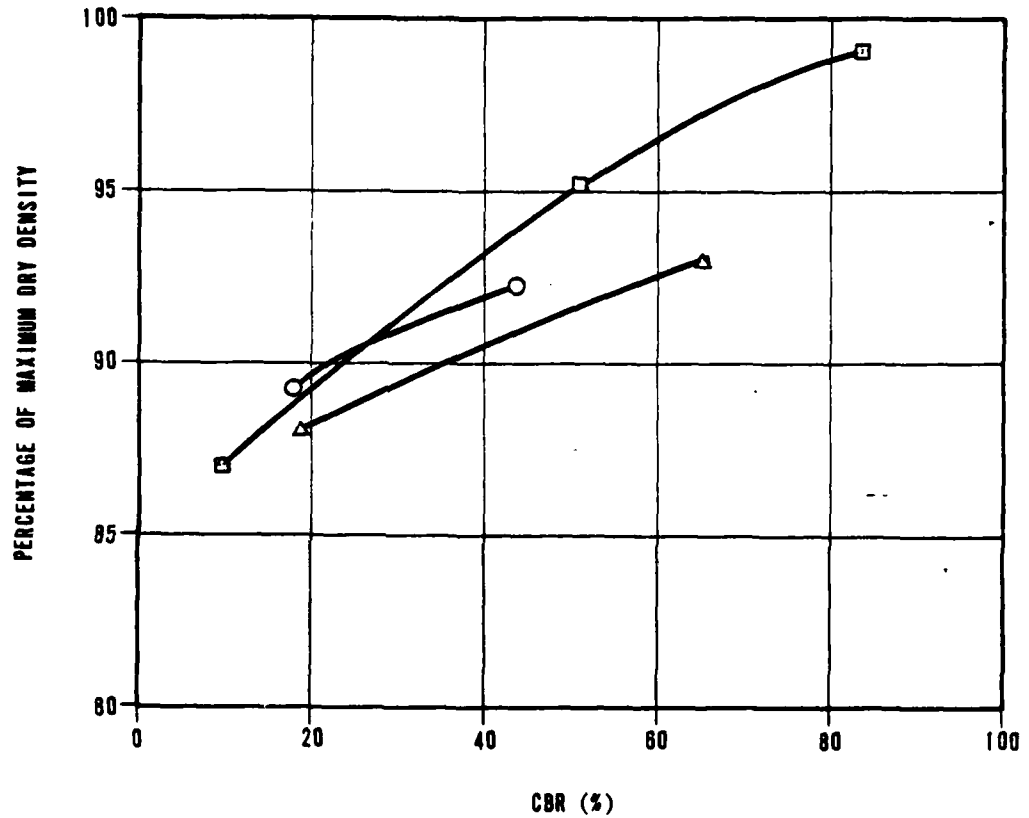
SYMBOL	COMPOSITE SAMPLE NUMBER	SOIL TYPE
○	A	SM
□	B	SM
△	C	CL
▽	D	SM

CALIFORNIA BEARING RATIO (CBR) CURVES
VERIFICATION SITE, WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMSO

FIGURE
9-2
1 OF 2

FUSRO NATIONAL, INC.



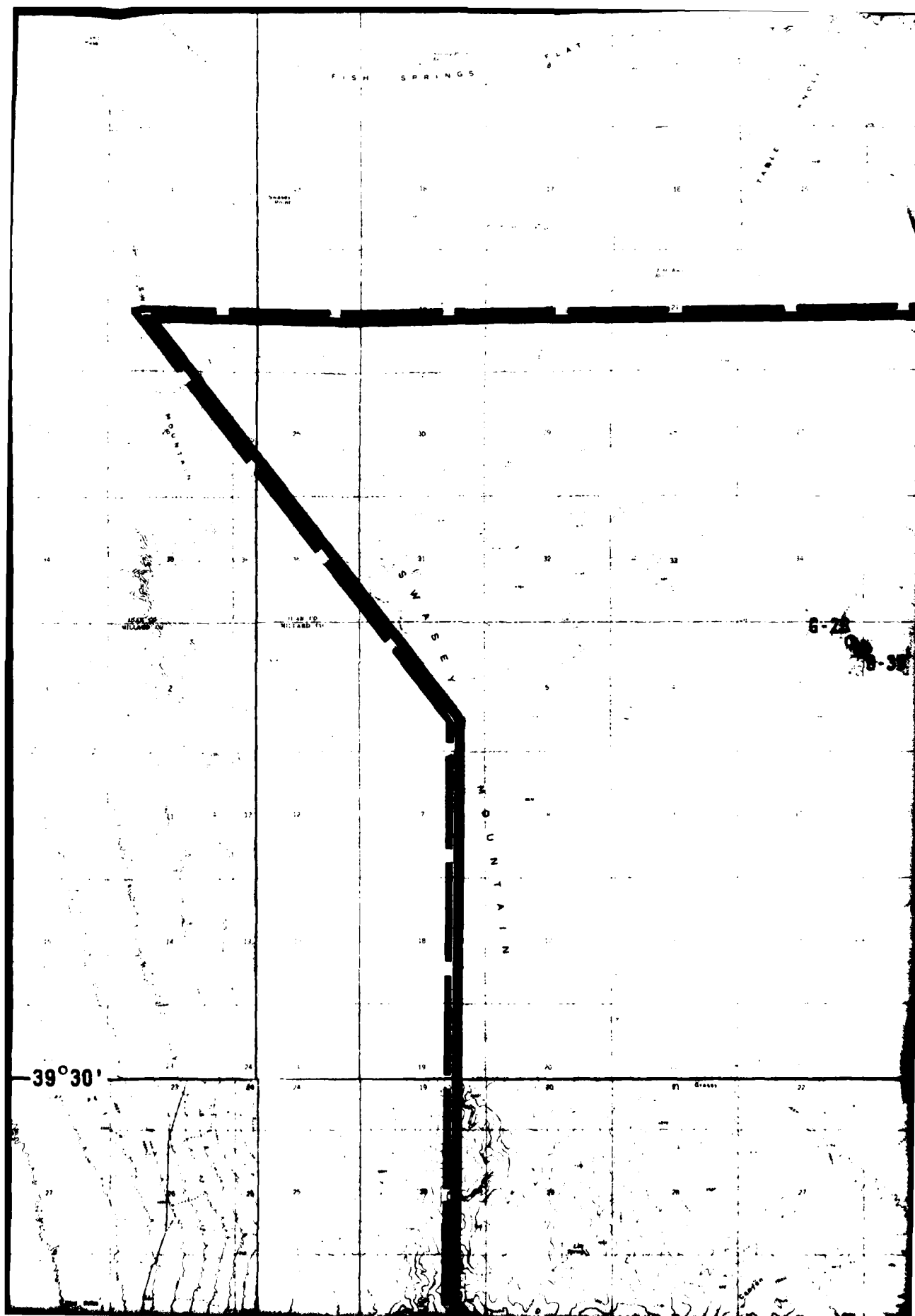
SYMBOL	COMPOSITE SAMPLE NUMBER	SOIL TYPE
○	E	GM-GC
□	F	SM-SC
△	G	GC

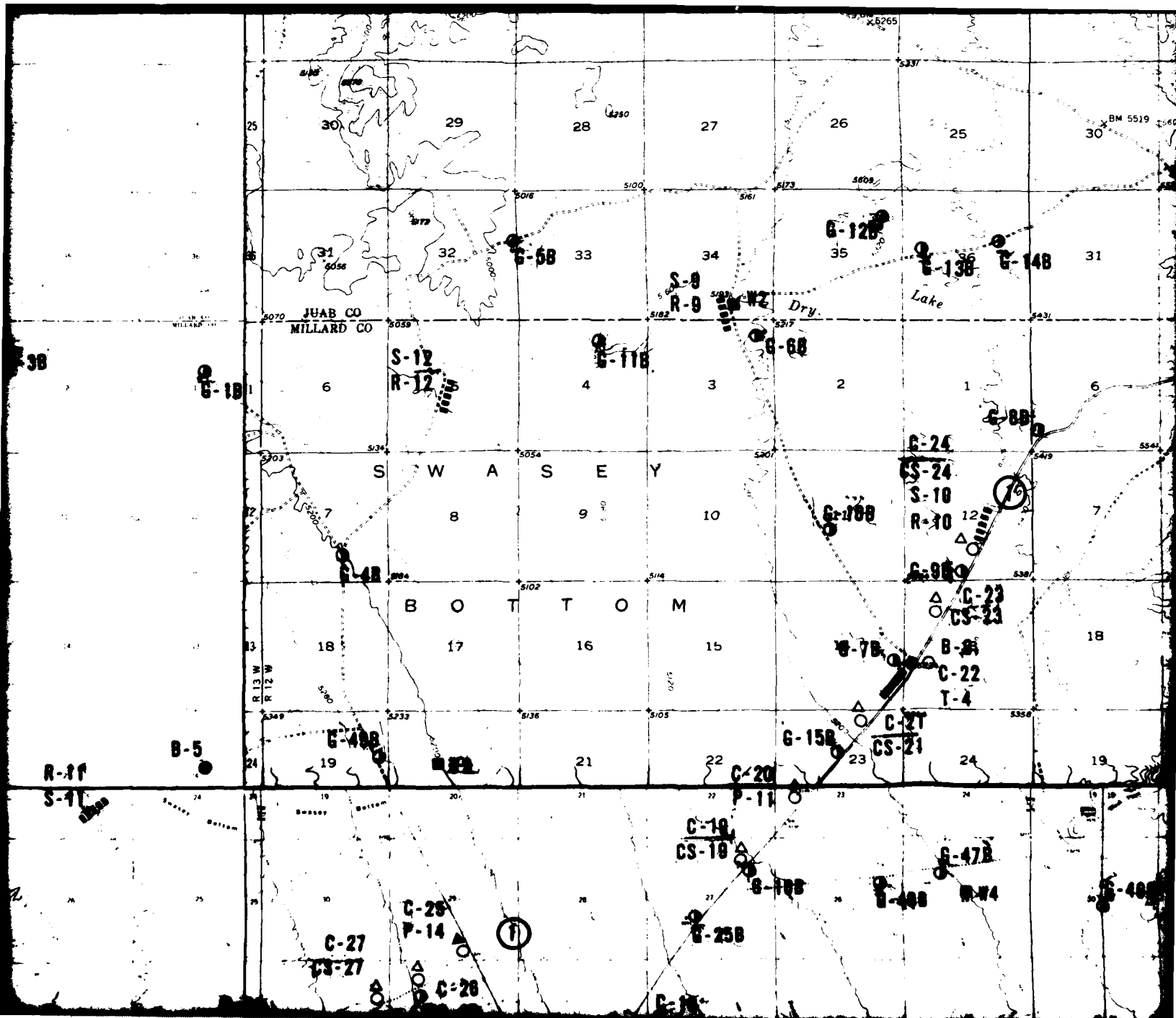
CALIFORNIA BEARING RATIO (CBR) CURVES
VERIFICATION SITE, WHIRLWIND CDP, UTAH

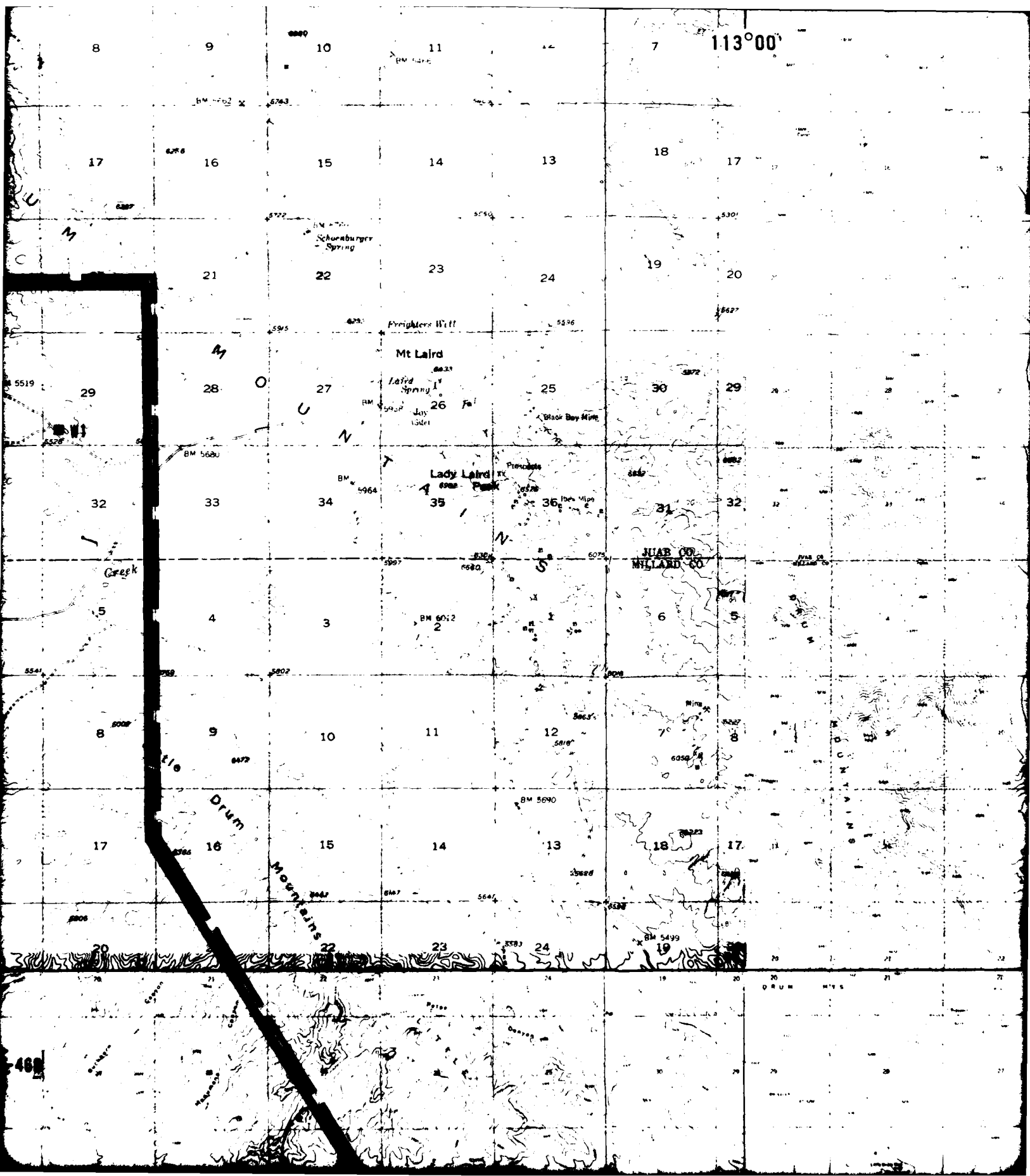
MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SANSO

FIGURE
9-2
2 OF 2

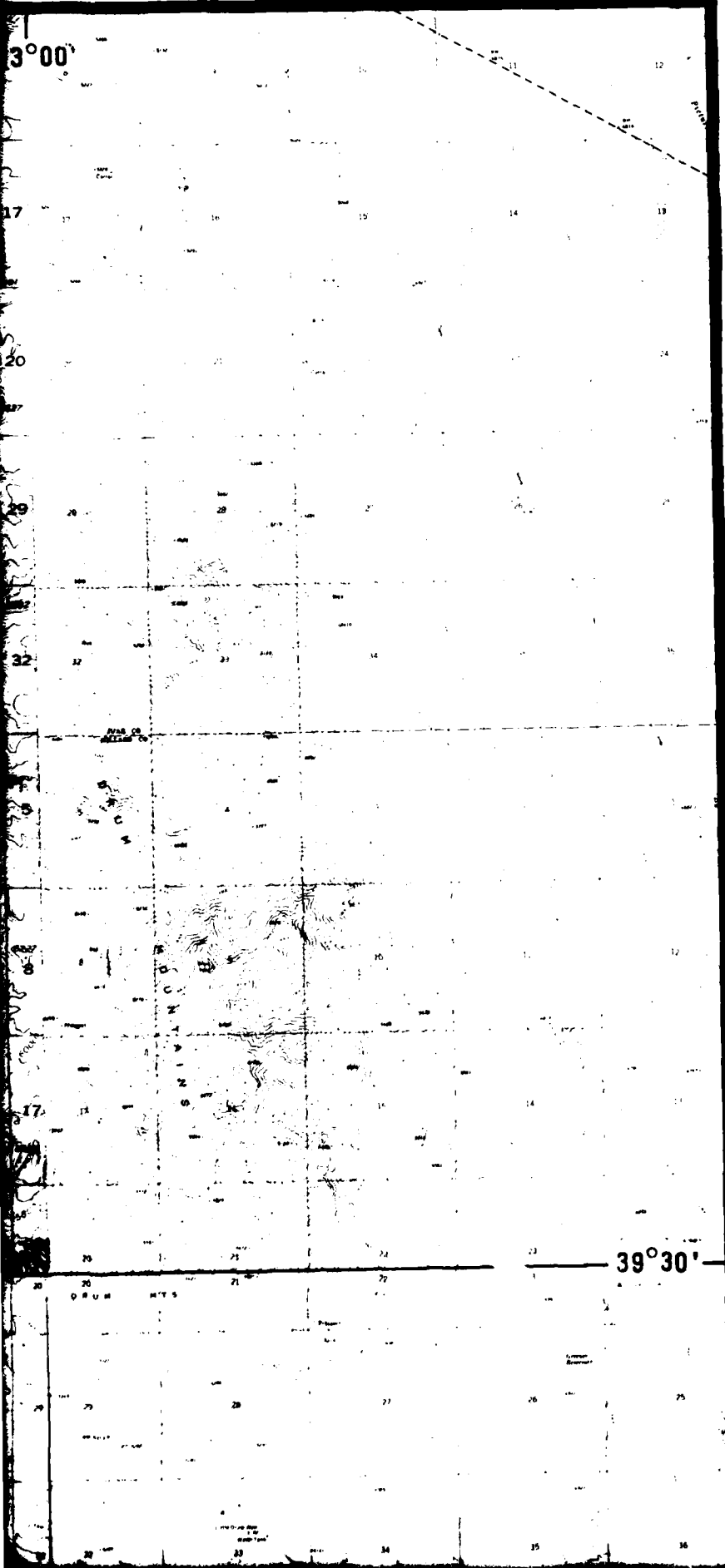
FUGRO NATIONAL, INC.

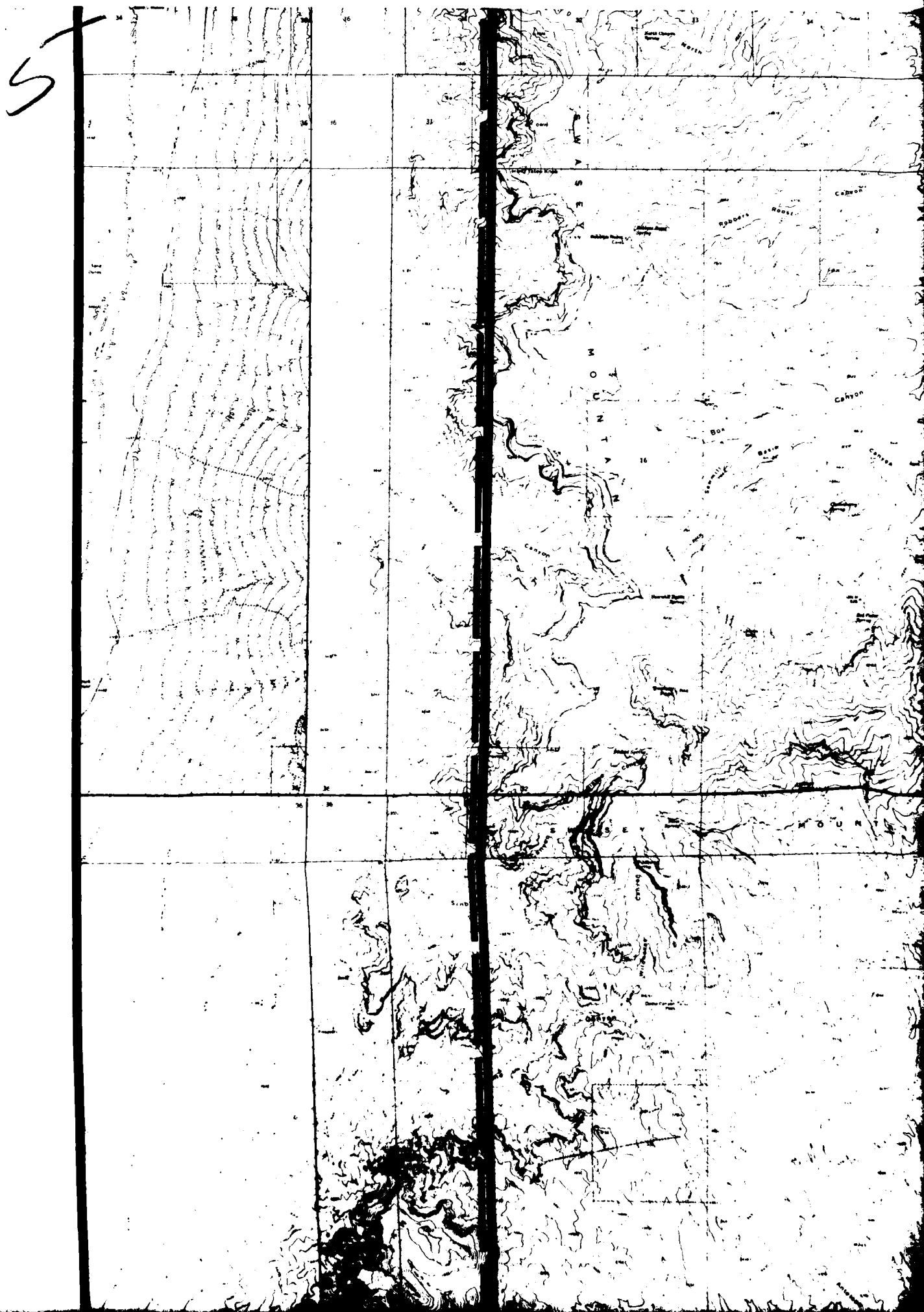


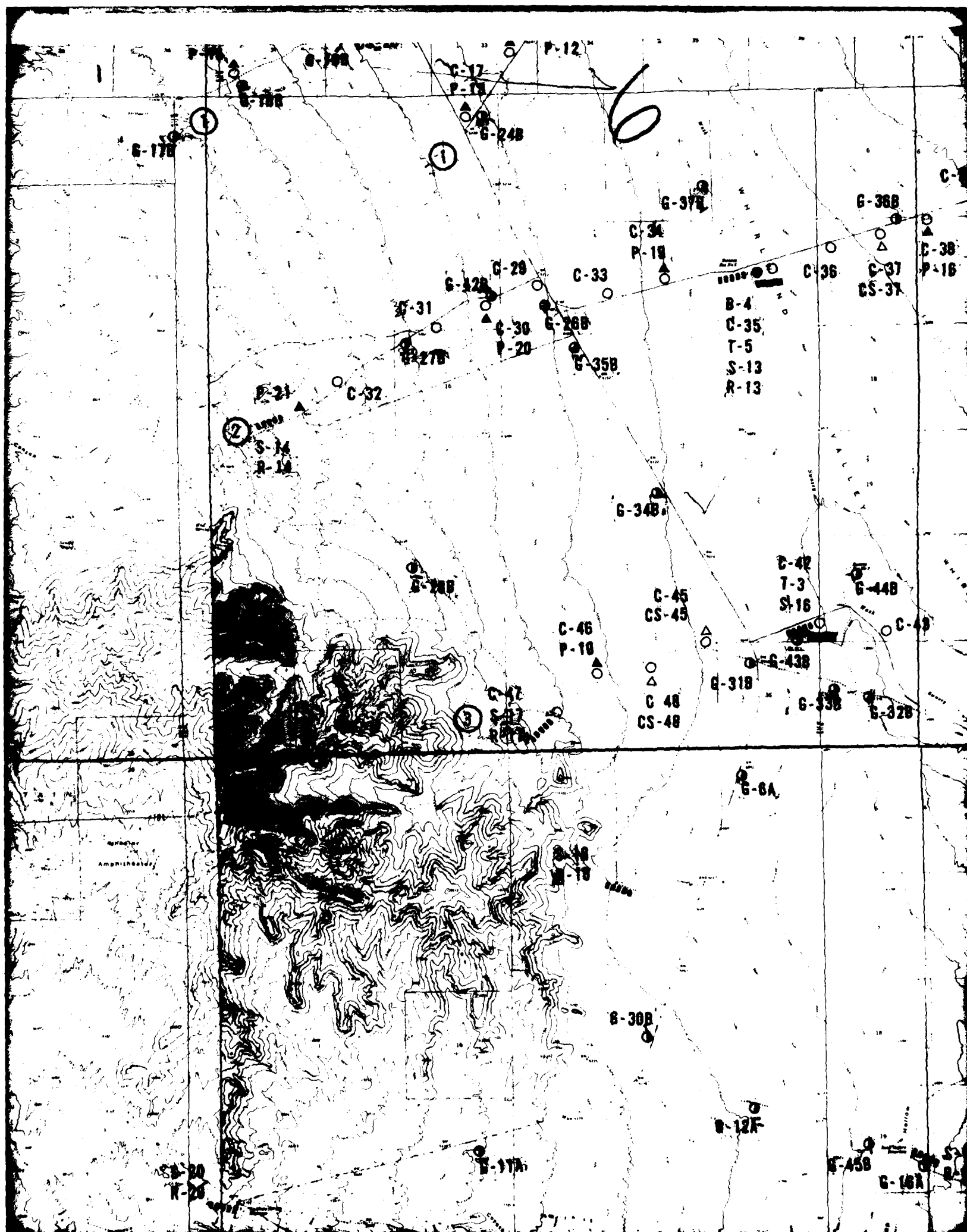


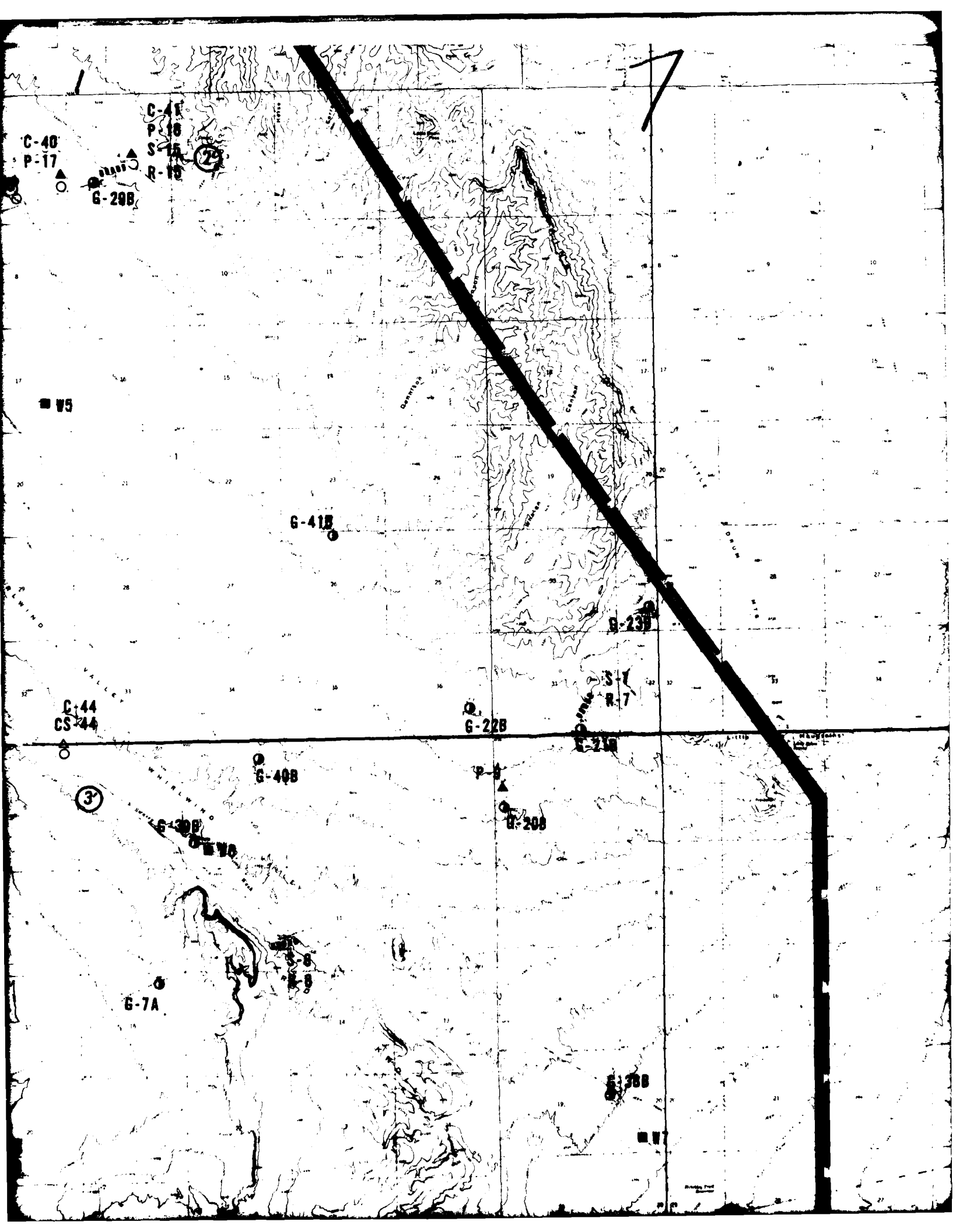


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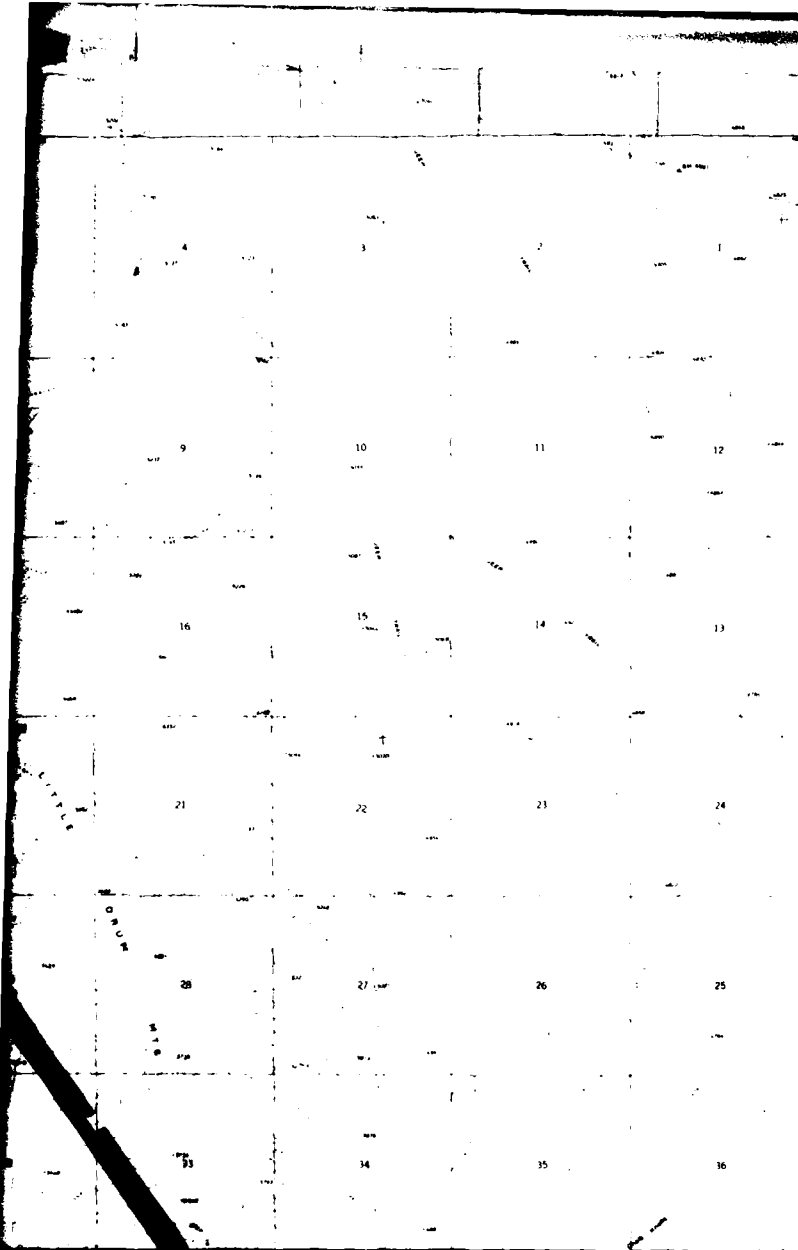




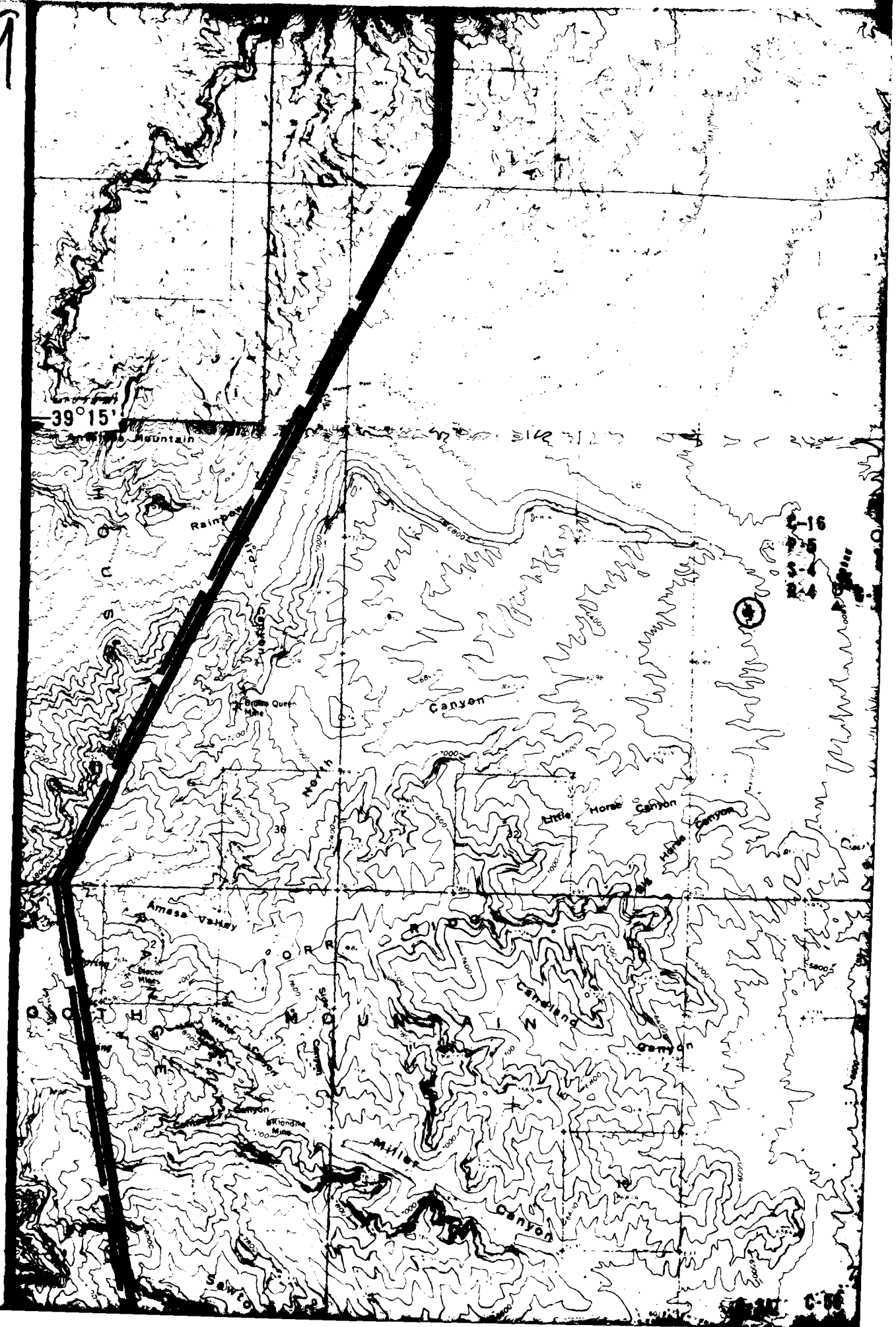




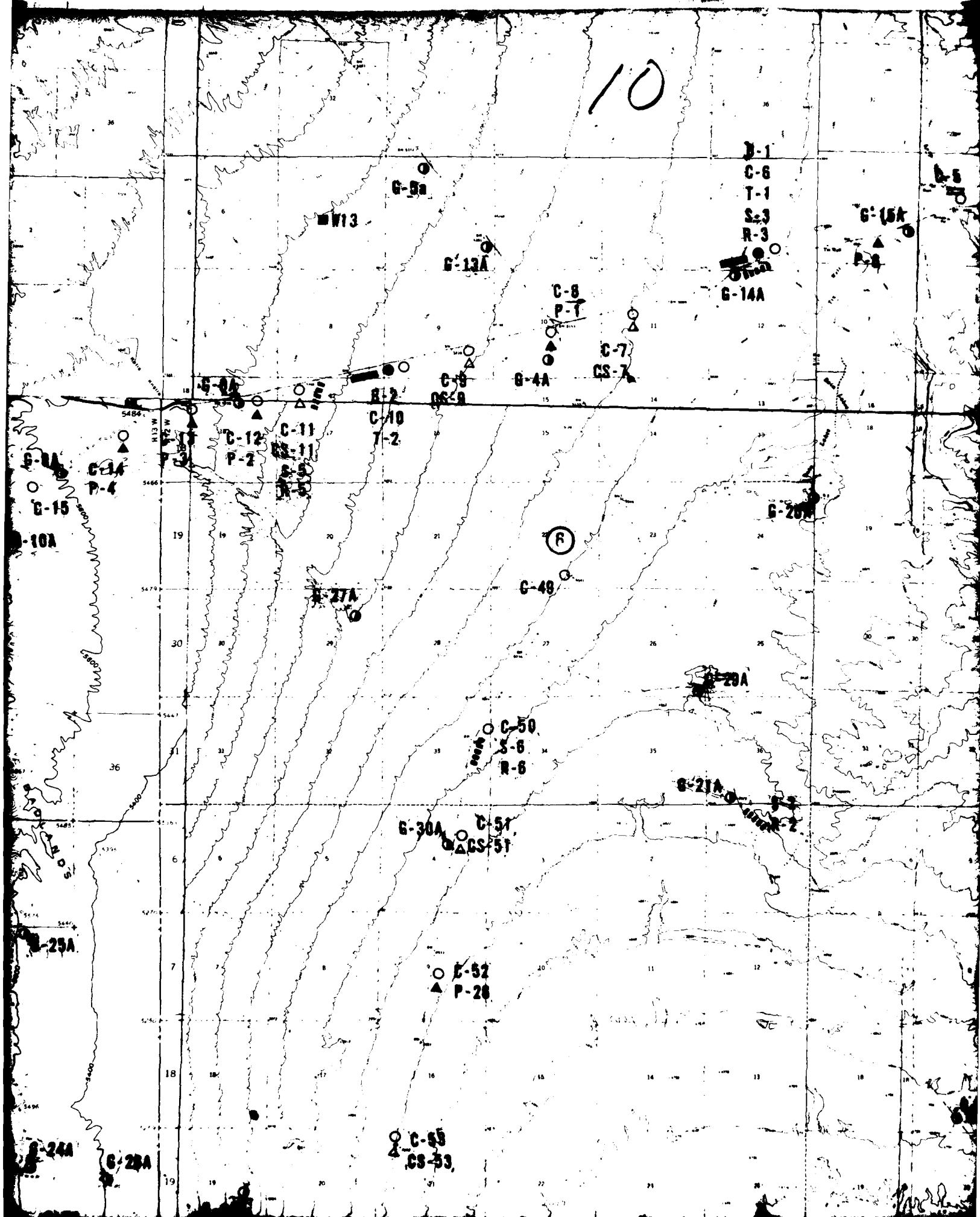
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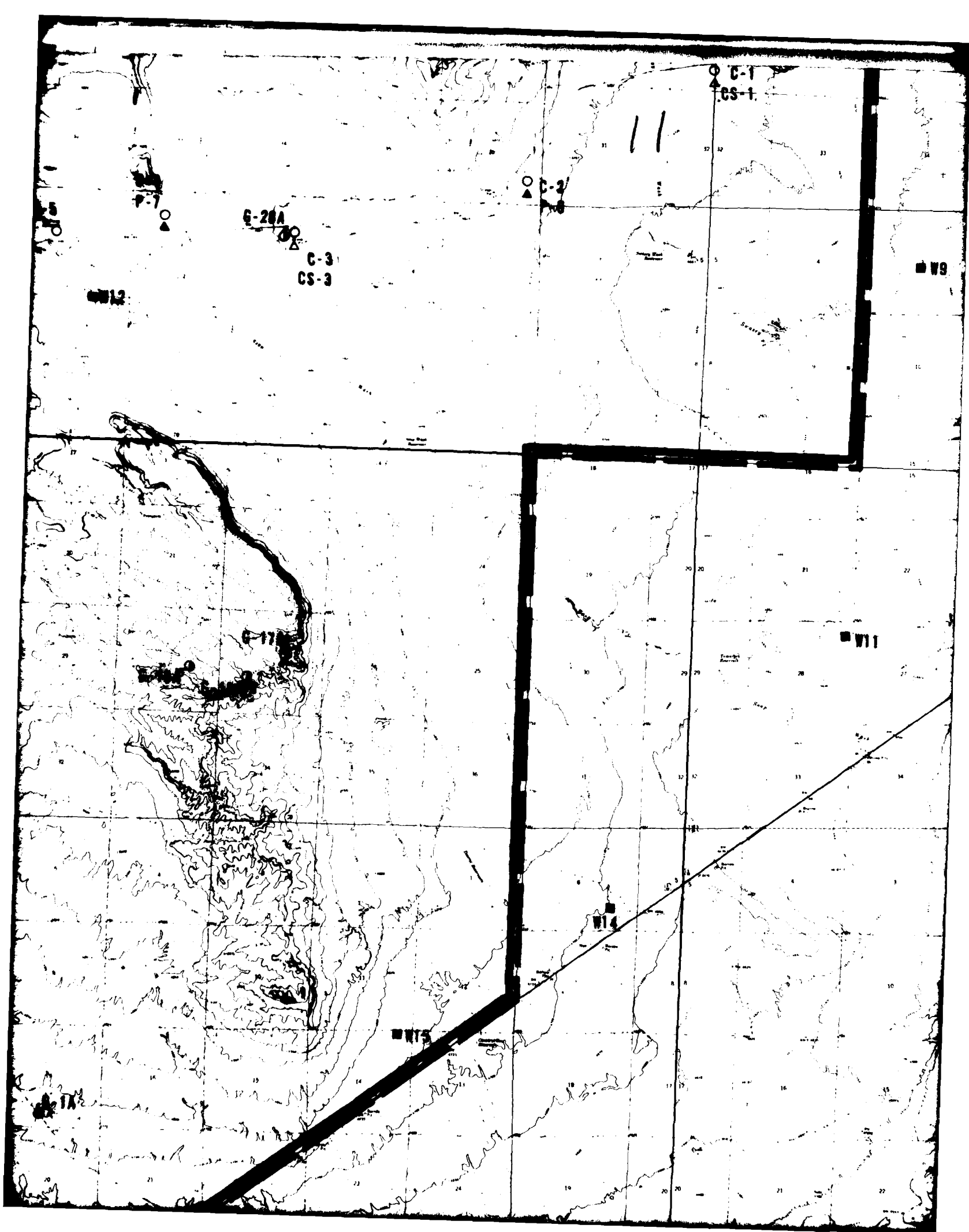


9



10





12

W9

39° 15'

W11

W10

DEPRESSION

12

W9

39° 15'

W11

W10

DEPRESSION

12

W9

39° 15'

W11

W10

DEPRESSION

12

W9

W10

W11

39° 15'

DEPRESSION

12

W9

W10

W11

39° 15'

DEPRESSION

12

W9

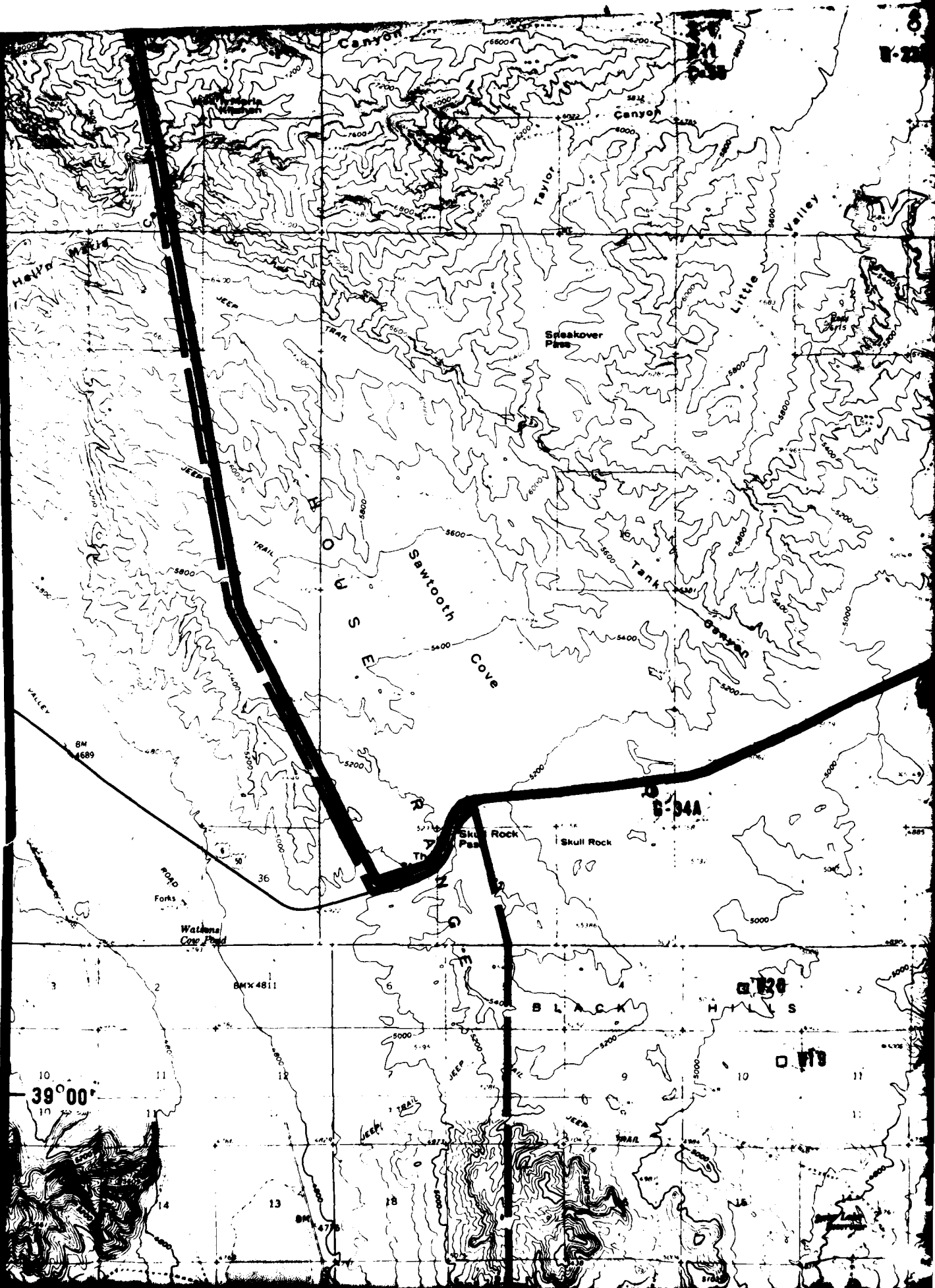
W10

W11

39° 15'

DEPRESSION

13



39°00'

6-34A

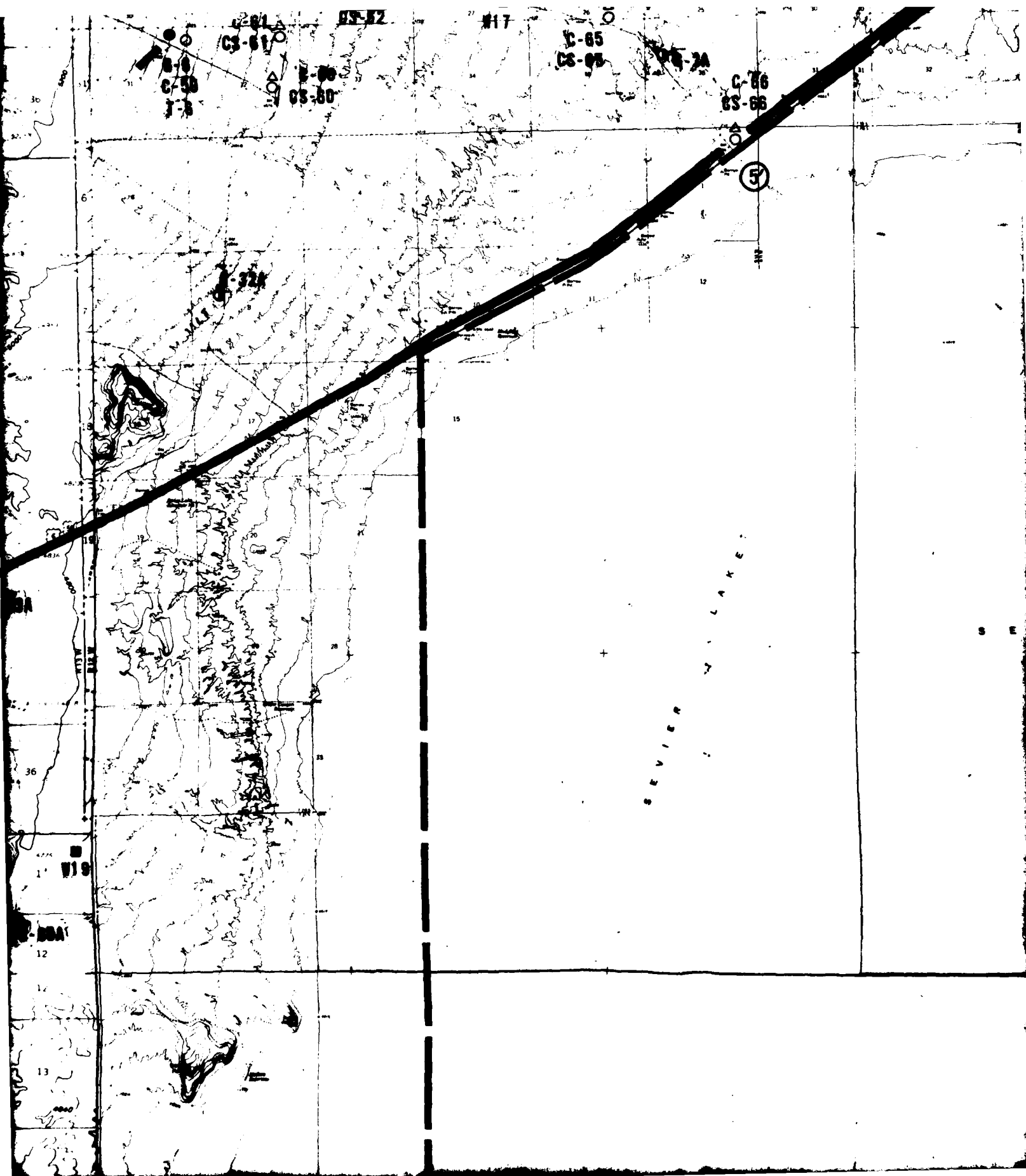
6-34

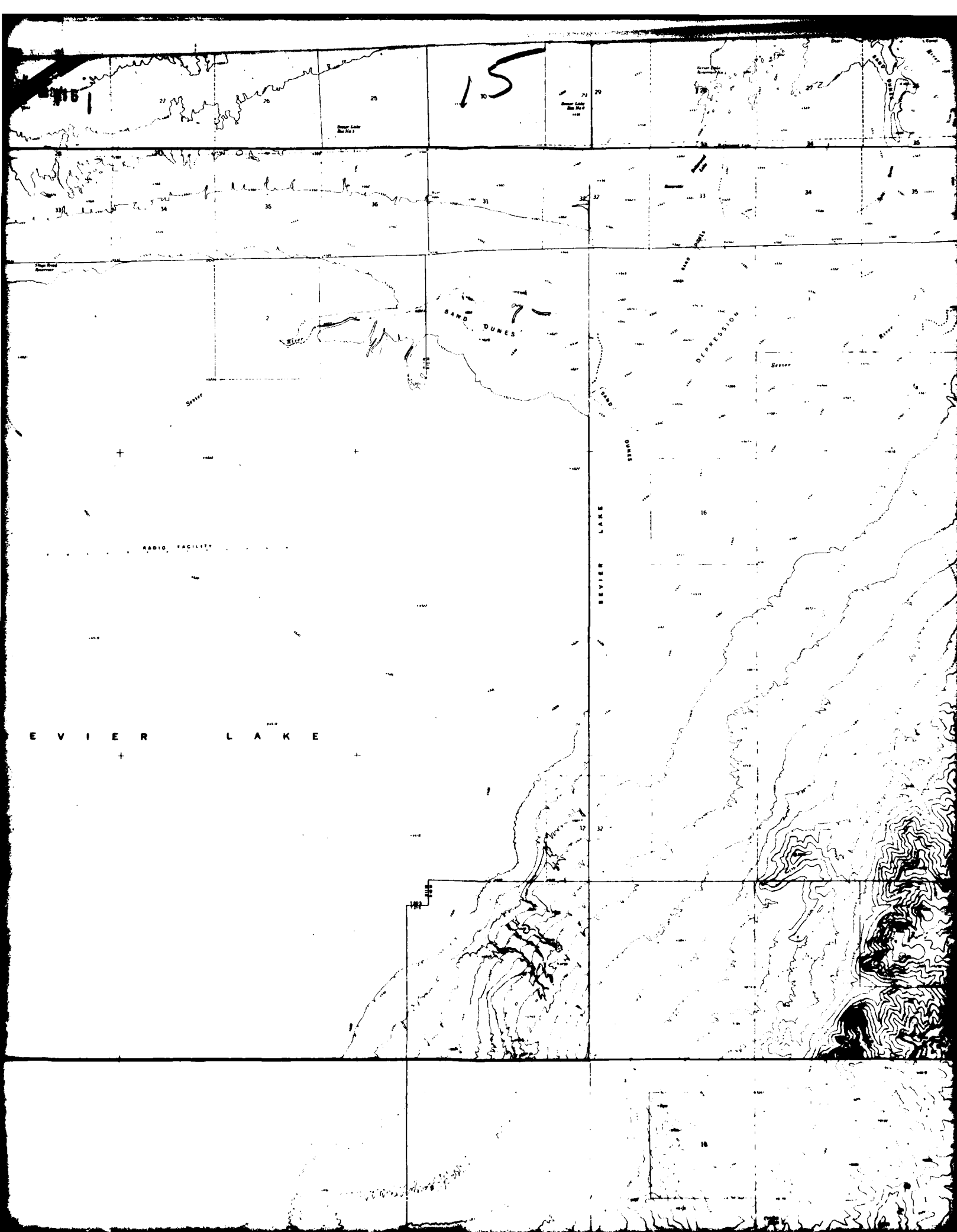
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BMX 4811

BM 478

BM 478

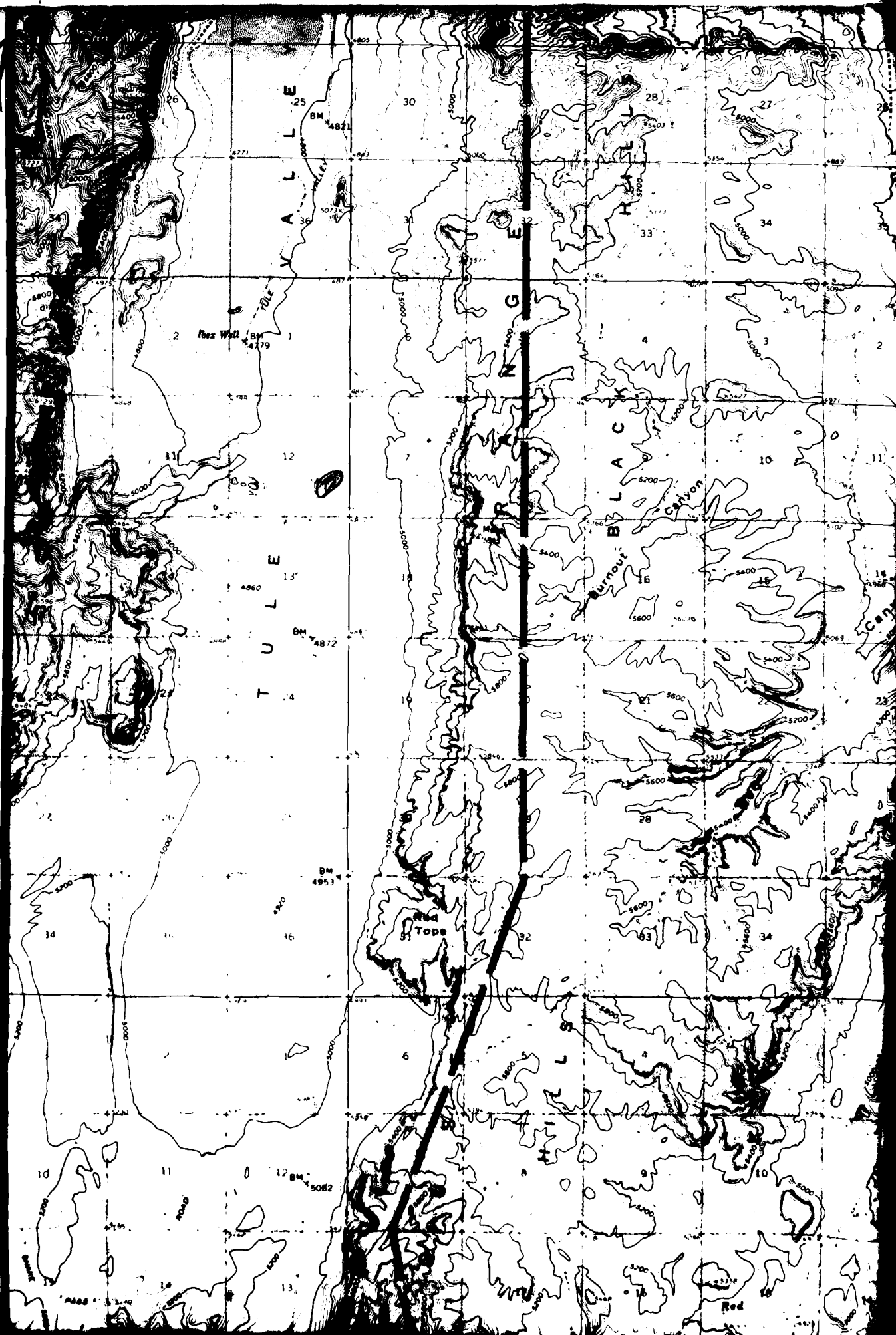




15

16





18

S E E V I E R L A K E

NEEDLE POINT

Needle Point
Barometer

W21

6-37A

Canyon

Wash

L A K E

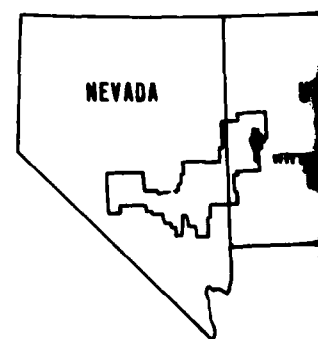
19

EXPLANATION

- G-1A GEOLOGIC STATION
- W1 GROUND WATER LEVEL MEASUREMENT
- B-1 BORING
- C-1 CONE PENETROMETER TEST (CPT)
- △ CS-1 SURFACE SAMPLE AT CPT LOG
- T-1 TRENCH
- ▲ P-1 TEST PIT
- S-1 SEISMIC REFRACTION LINE
- R-1 ELECTRICAL RESISTIVITY LOG
- ① — ①' ACTIVITY LINE
- VERIFICATION SITE BOUNDARY
- CANDIDATE DEPLOYMENT PARCEL

NOTE: Where multiple activities were performed at a location, the correct location is designated by (1) the symbol or (2) the CPT symbol, if no other symbol is present.

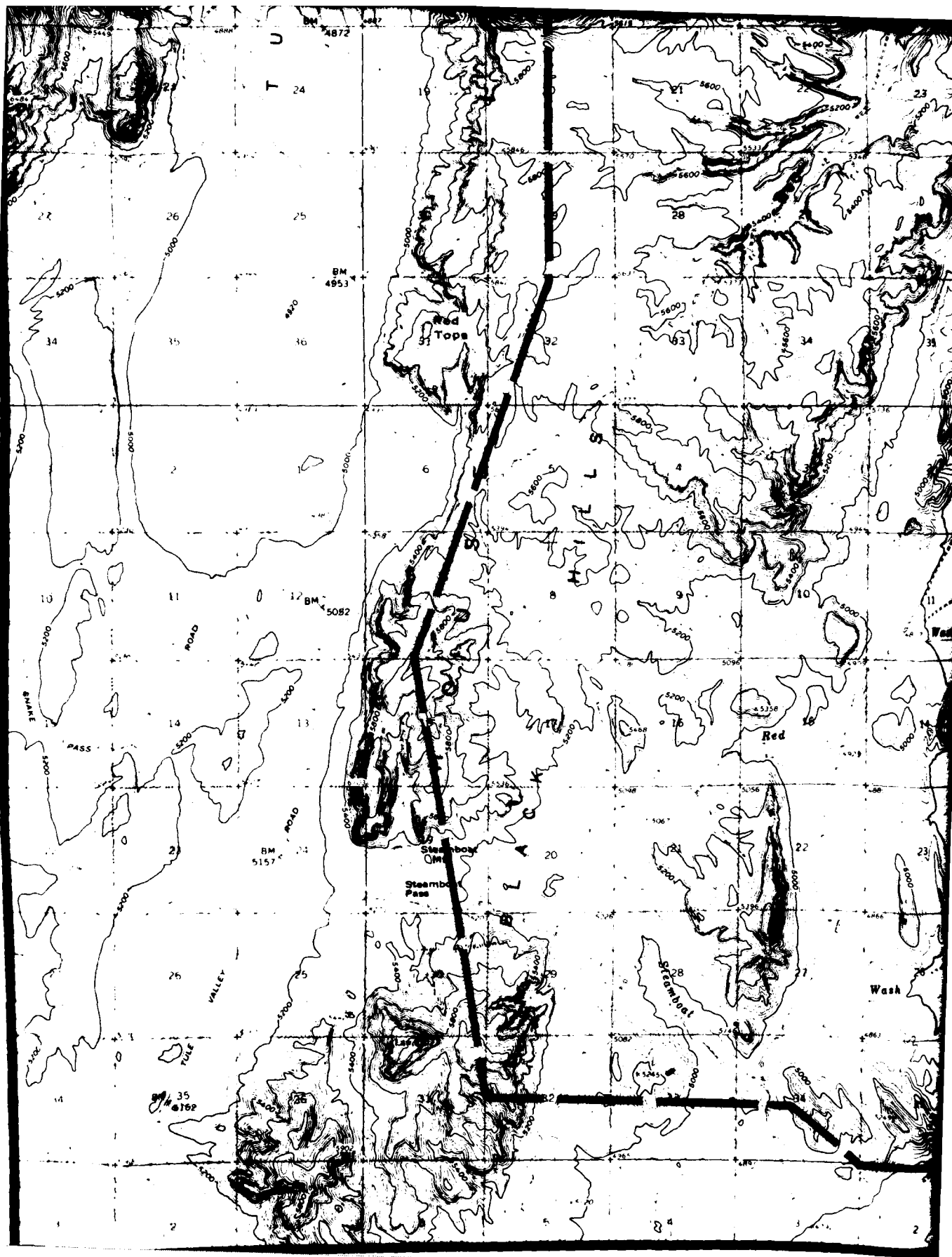
LOCATION MAP

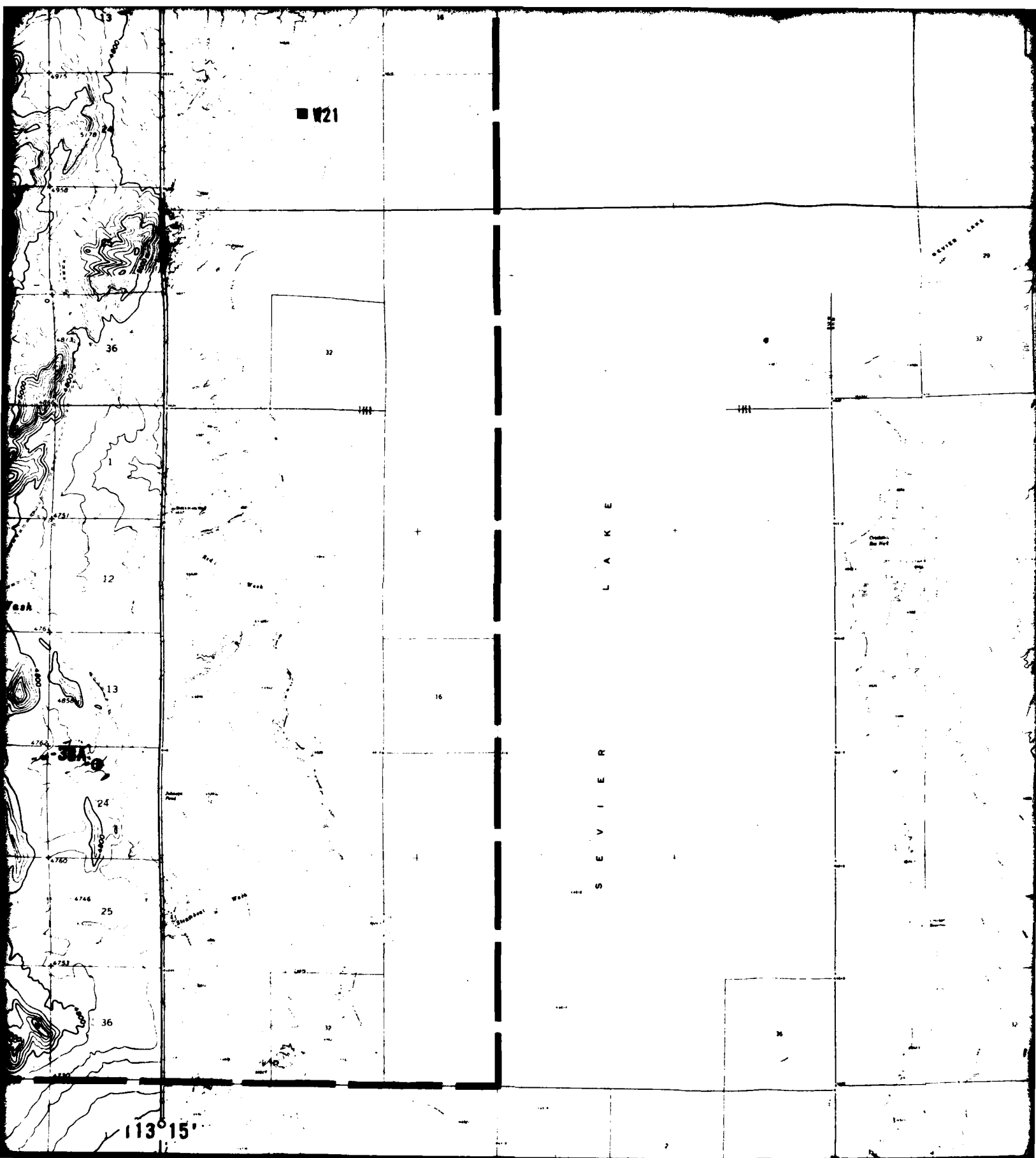


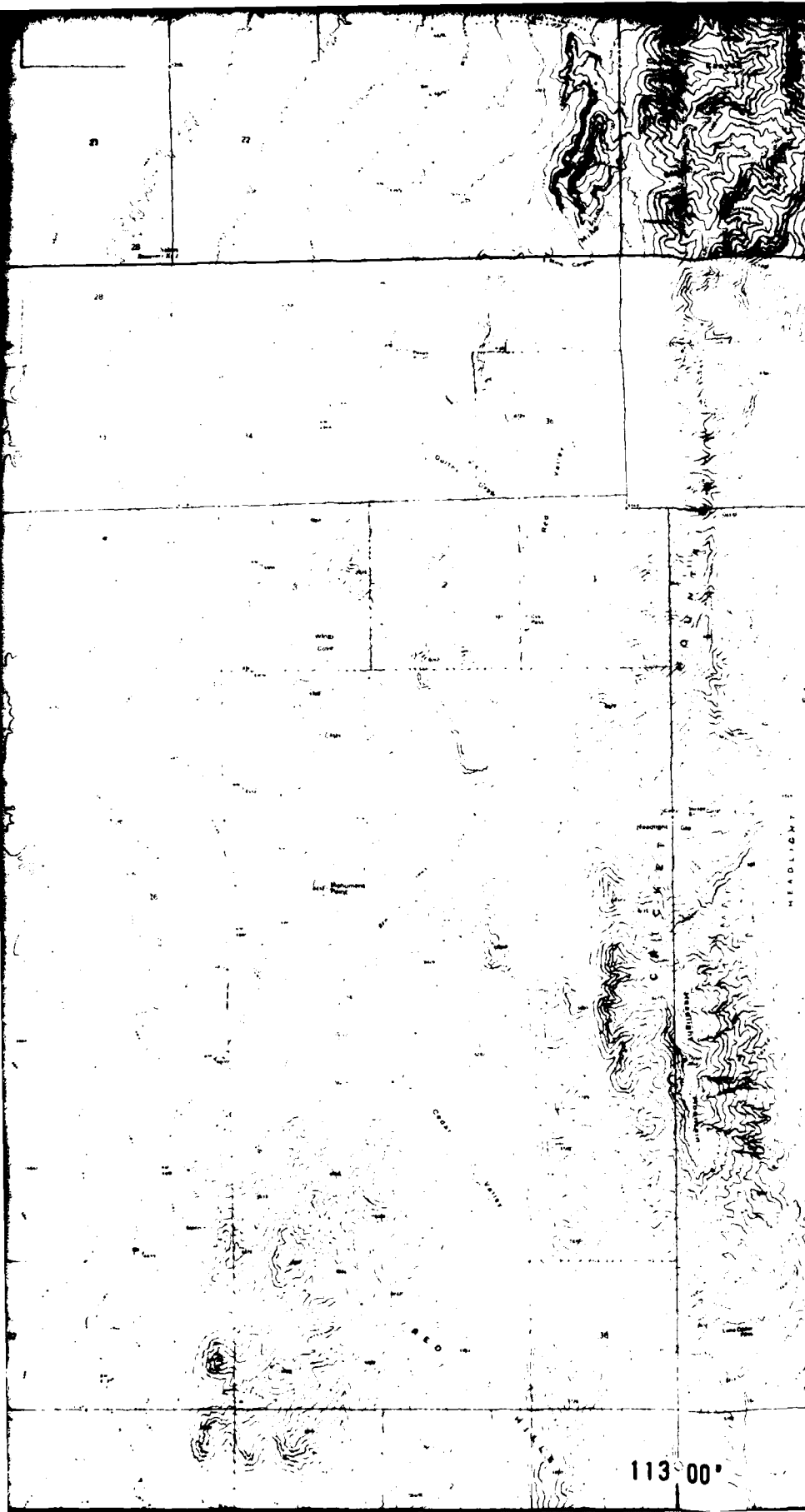
SCALE 1:62,500



20



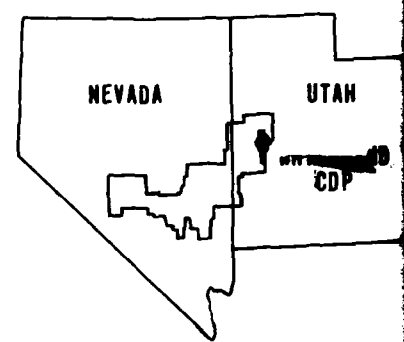




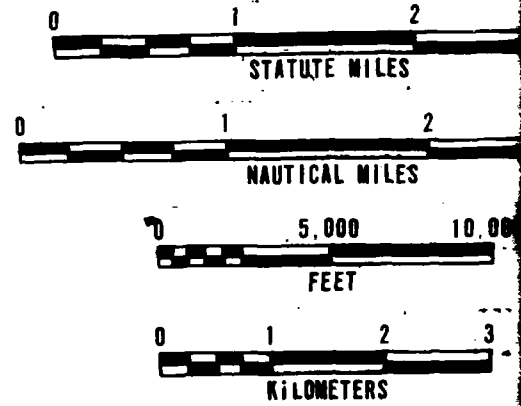
- T-T TRENCH
- P-1 TEST PIT
- S-1 SEISMIC REFRACTION LINE
- R-1 ELECTRICAL RESISTIVITY LINE
- (1) — (1) ACTIVITY LINE
- VERIFICATION SITE BOUNDARY
- CANDIDATE DEPLOYMENT PARCEL (C)

NOTE: Where multiple activities were performed the object symbol is (1) the CPT symbol, if no boring symbol or (2) the CPT symbol, if no boring

LOCATION MAP



SCALE 1:62,500



**ACTIVITY LOCATION MAP
WHIRLWIND CDP, UTAH**

**MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMS**

FUGRO NATIONAL

PIT

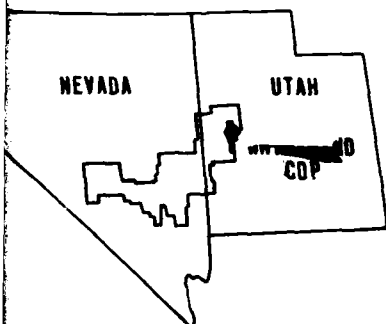
MIC REFRACTION LINE
TRICAL RESISTIVITY LINE
VITY LINE

LOCATION SITE BOUNDARY

DATE DEPLOYMENT PARCEL (CDP) BOUNDARY

activities were performed at the same location.
ation is designated by either (9) the boring
the CPT symbol, if no boring was drilled.

LOCATION MAP



SCALE 1:62,500

1 2 3

STATUTE MILES

1 2 3

NAUTICAL MILES

0 5,000 10,000

FEET

0 1 2 3

KILOMETERS

ACTIVITY LOCATION MAP
WHIRLWIND CDP, UTAH

ING INVESTIGATION
F THE AIR FORCE - SAMSO

DRAWING

1

D NATIONAL, INC.

24

FN-TR-27-11

CONE RESISTANCE

DEPTH

(METERS)

(FEET)

0 100 200 300 400 500 600 700 800 900
0 100 200 300 400 500 600 700 800 900

0

1

2

3

10

0

1

2

3

10

0

1

2

3

10

0

1

2

0

1

C-1 SURFACE ELEVATION: 4723'
SURFICIAL GEOLOGIC UNIT:

C-2 SURFACE ELEVATION: 4790'
SURFICIAL GEOLOGIC UNIT:

C-3 SURFACE ELEVATION: 4840'
SURFICIAL GEOLOGIC UNIT:

C-4 SURFACE ELEVATION: 4911'
SURFICIAL GEOLOGIC UNIT:

C-5 SURFACE ELEVATION: 4900'
SURFICIAL GEOLOGIC UNIT:

800 800 900 (kg/cm²)
800 900 (tsf)

CE ELEVATION: 4723' (1440m)
SOCIAL GEOLOGIC UNIT: A4o

CE ELEVATION: 4790' (1460m)
SOCIAL GEOLOGIC UNIT: A4o A5y

CE ELEVATION: 4840' (1475m)
SOCIAL GEOLOGIC UNIT: A4o

CE ELEVATION: 4911' (1497m)
SOCIAL GEOLOGIC UNIT: A4o

CE ELEVATION: 4908' (1496m)
SOCIAL GEOLOGIC UNIT: A1

SOIL COLUMN

SM
SC
CS-1

SM
SP
GP
SM
P-8

CL
CS-3

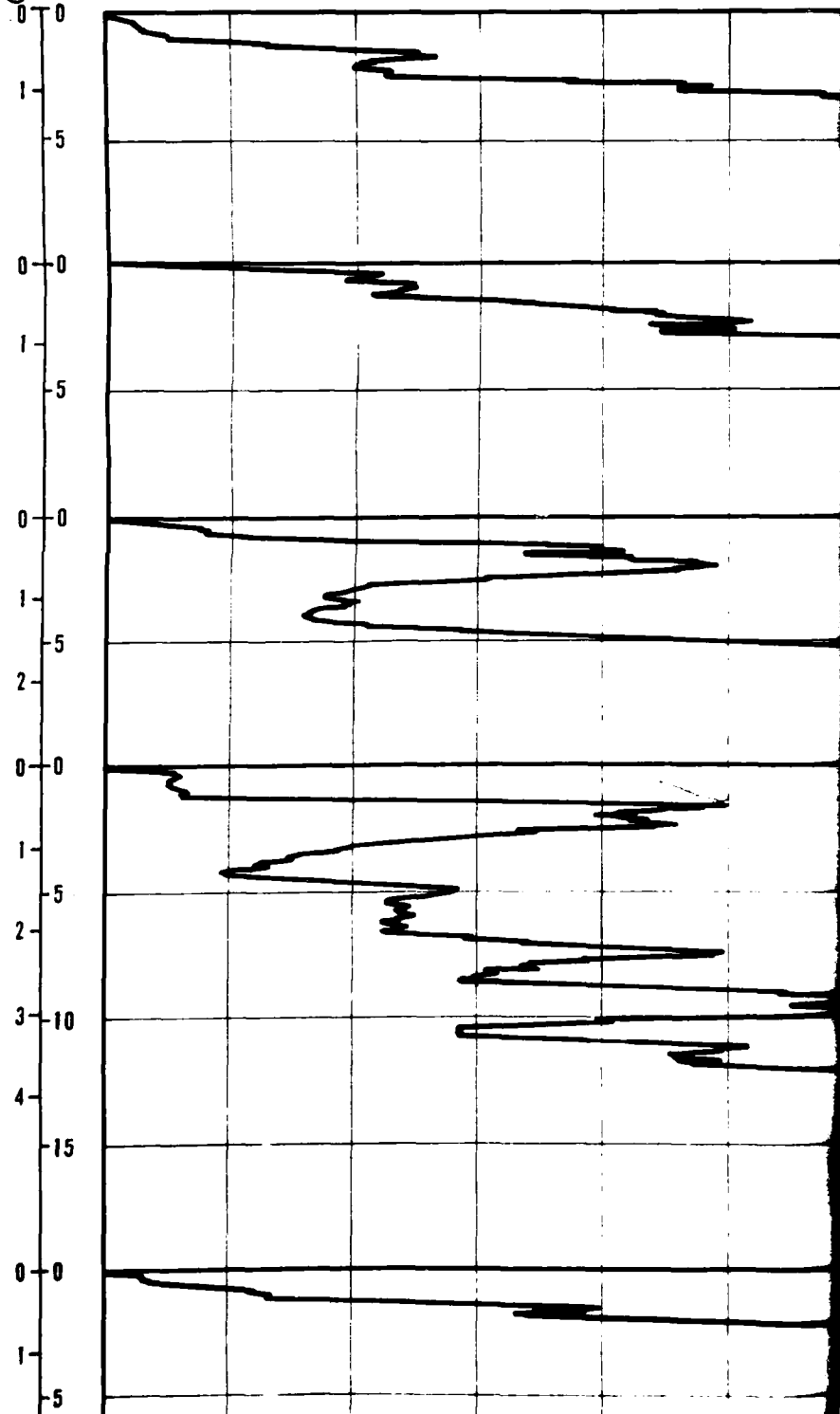
CL
GM
P-7

CONE RESISTANCE

DEPTH

(METERS)
(FEET)

0 100 200 300 400 500
0 100 200 300 400 500



3

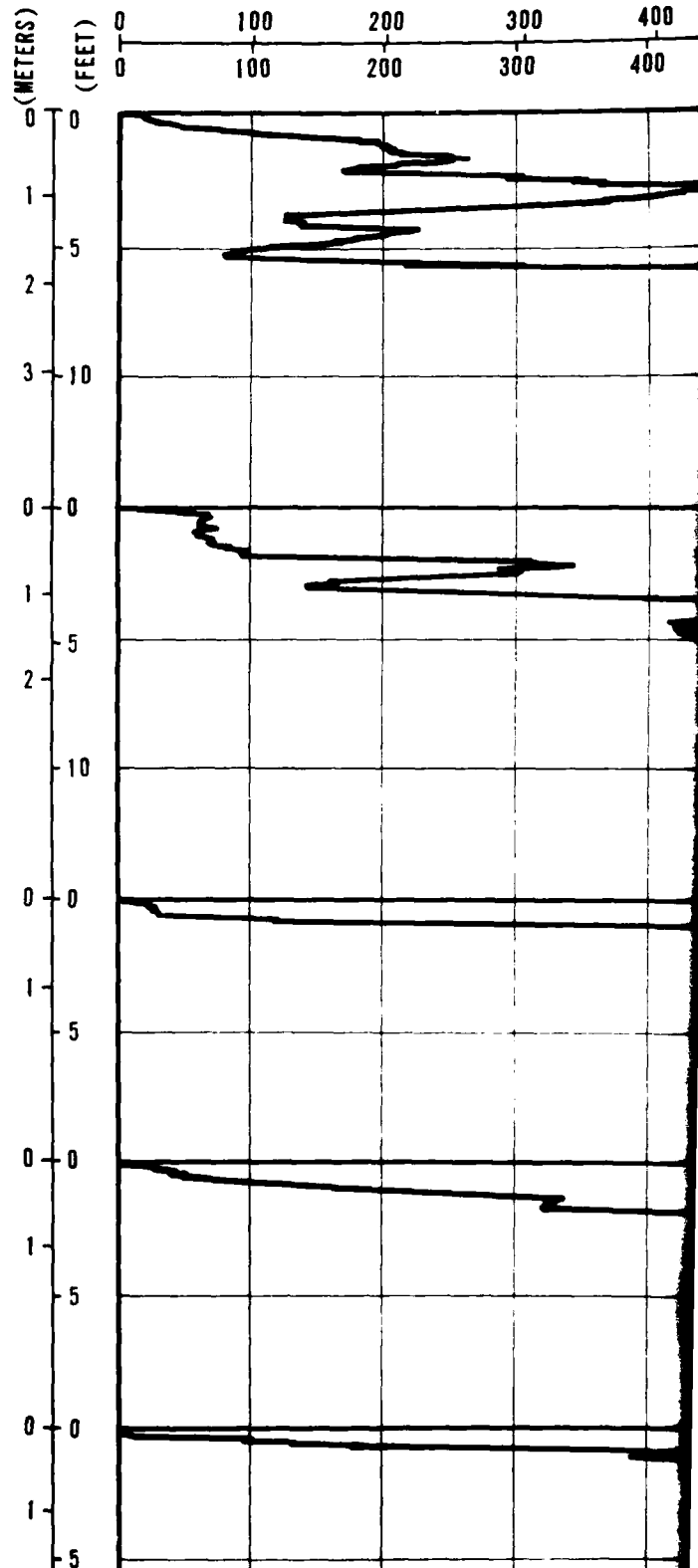
00 700 800 900 (kg/cm²)
 1 700 800 900 (tsf)

3-13	SURFACE ELEVATION: 5420' (1652m)		
	SURFICIAL GEOLOGIC UNIT: A5i		
3-14	SURFACE ELEVATION: 5500' (1676m)		
	SURFICIAL GEOLOGIC UNIT: A5i		
3-15	SURFACE ELEVATION: 5653' (1723m)		
	SURFICIAL GEOLOGIC UNIT: A5i		
3-16	SURFACE ELEVATION: 5787' (1764m)		
	SURFICIAL GEOLOGIC UNIT: A5i		
3-17	SURFACE ELEVATION: 5240' (1597m)		
	SURFICIAL GEOLOGIC UNIT: A5y		

SOIL COLUMN

	SM
P-3	
	CL
	SM
P-4	
	SM-SC
	SM
P-5	
	CL
	GP
P-13	

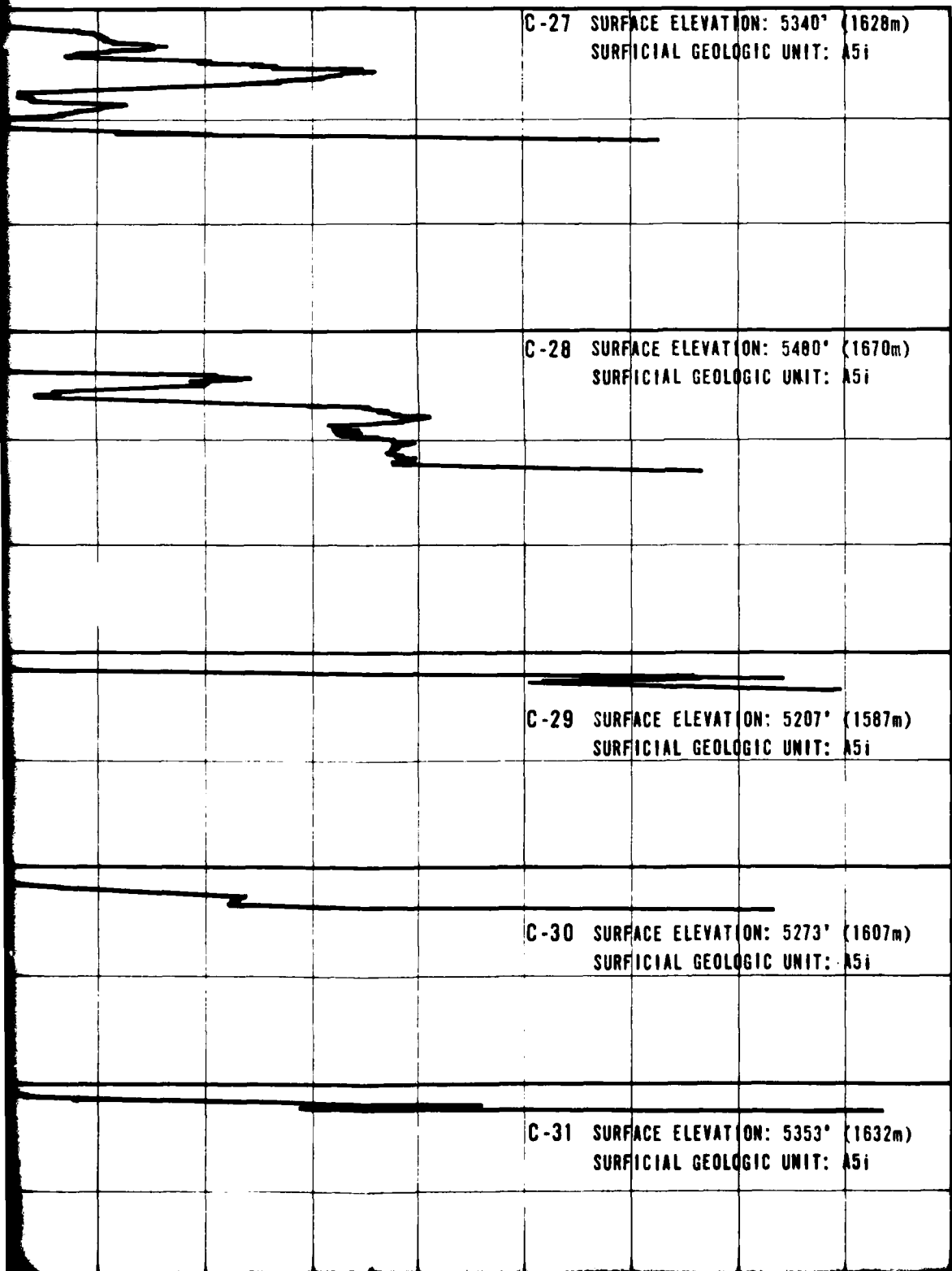
DEPTH



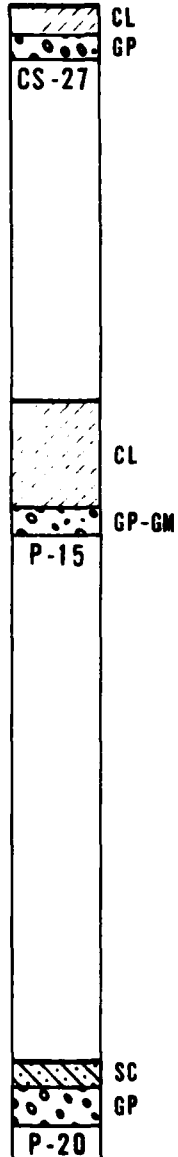
4

CONE RESISTANCE

200 300 400 500 600 700 800 900 (kg/cm²)
 200 300 400 500 600 700 800 900 (tsf)

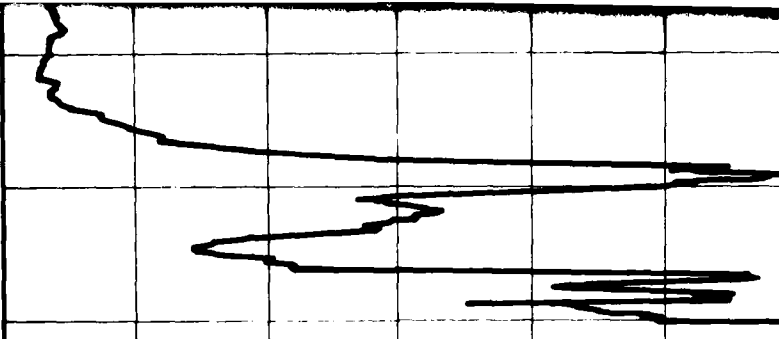


SOIL COLUMN

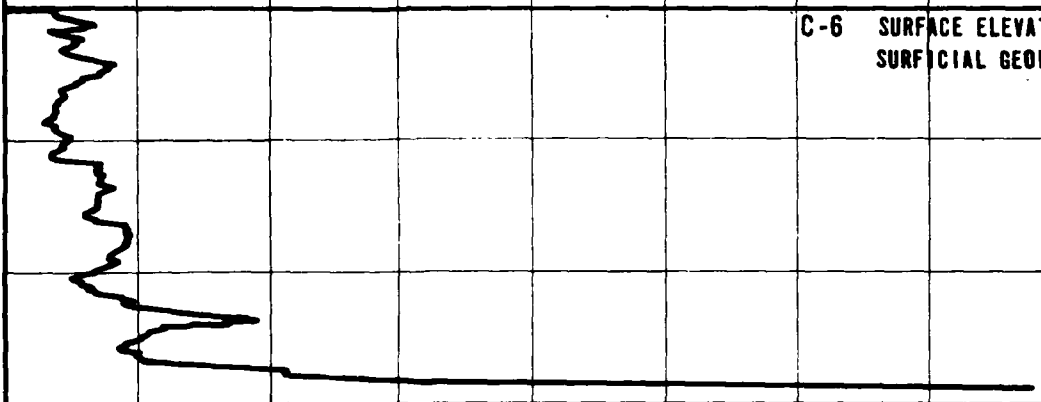


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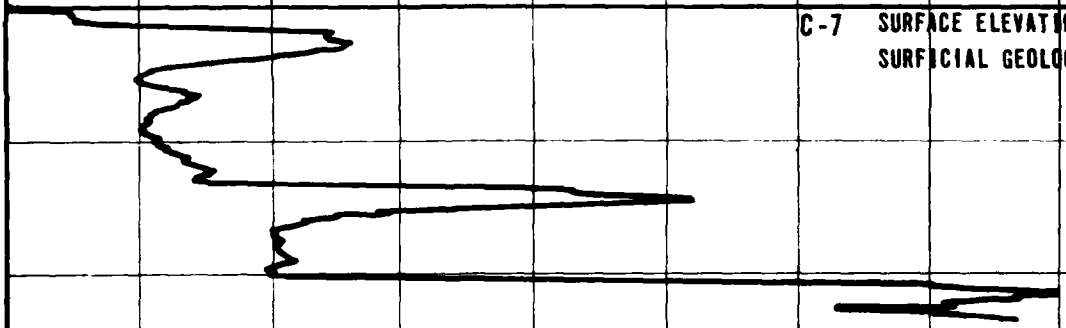
5
2
3-10
4
5-15
0-0
1
2
3-10
4
5-15
0-0
1
2
3-10
4
5-15
0-0
1
2
3-10
4
5-15
0-0
1
2
3-10



C-6 SURFACE ELEVATION: 5033' (1534)
SURFICIAL GEOLOGIC UNIT: A4o



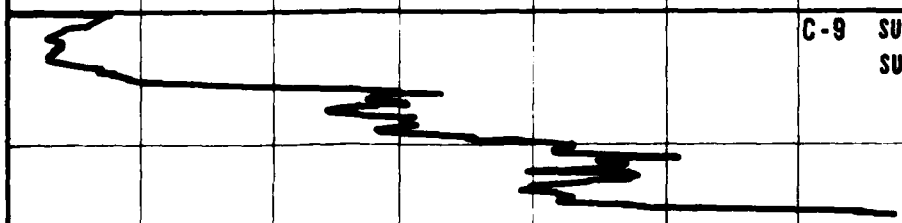
C-7 SURFACE ELEVATION: 5100' (1553)
SURFICIAL GEOLOGIC UNIT: A4o



C-8 SURFACE ELEVATION: 5148' (1588)
SURFICIAL GEOLOGIC UNIT: A51



C-9 SURFACE ELEVATION: 5212' (1588)
SURFICIAL GEOLOGIC UNIT: A51



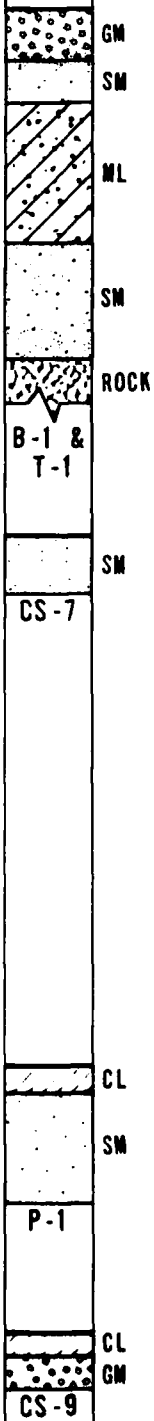
SURFACE ELEVATION: 4908' (1496m)
SURFICIAL GEOLOGIC UNIT: A1

SURFACE ELEVATION: 5033' (1534m)
SURFICIAL GEOLOGIC UNIT: A4o

SURFACE ELEVATION: 5100' (1553m)
SURFICIAL GEOLOGIC UNIT: A4o

SURFACE ELEVATION: 5148' (1569m)
SURFICIAL GEOLOGIC UNIT: A5i

SURFACE ELEVATION: 5212' (1589m)
SURFICIAL GEOLOGIC UNIT: A5i



See Drawing 2, Sheet 3 of 3 for C-19

C-18	SURFACE ELEVATION: 5152' (1570m)
	SURFICIAL GEOLOGIC UNIT: A4o

C-20 SURFACE ELEVATION: 5148' (1569m)
SURFICIAL GEOLOGIC UNIT: A5y/A4o

C-21	SURFACE ELEVATION: 5213' (1589m)
	SURFICIAL GEOLOGIC UNIT: A5i

C-22	SURFACE ELEVATION: 5275' (1608m)
	SURFICIAL GEOLOGIC UNIT: A5i

C-23	SURFACE ELEVATION: 5300' (1615m)
	SURFICIAL GEOLOGIC UNIT: A5o

CL
GP

P-12

SM

P-11

SP

CS-21

SM

SP-SM

SW-SM

B-3

SC
GP

CS - 23

SC



See Drawing 2, Sheet 3 of 3 for C-35

See Drawing 2, Sheet 3 of 3 for C-36



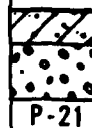
See Drawing 2, Sheet 3 of 3 for C-38

See Drawing 2, Sheet 3 of 3 for C-39



8

C-32 SURFACE ELEVATION: 5547' (1691m)
SURFICIAL GEOLOGIC UNIT: A5o

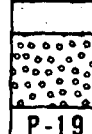


ML
GP

P-21

C-33 SURFACE ELEVATION: 5130' (1564m)
SURFICIAL GEOLOGIC UNIT: A5y/A4o

C-34 SURFACE ELEVATION: 5080' (1548m)
SURFICIAL GEOLOGIC UNIT: A5y/A4o



SM-SC
GM

P-19

ing 2, Sheet 3 of 3 for C-35

ing 2, Sheet 3 of 3 for C-36

C-37 SURFACE ELEVATION: 5120' (1561m)
SURFICIAL GEOLOGIC UNIT: A5y/A4o



SM

SP-SM

CS-37

ing 2, Sheet 3 of 3 for C-38

ing 2, Sheet 3 of 3 for C-39

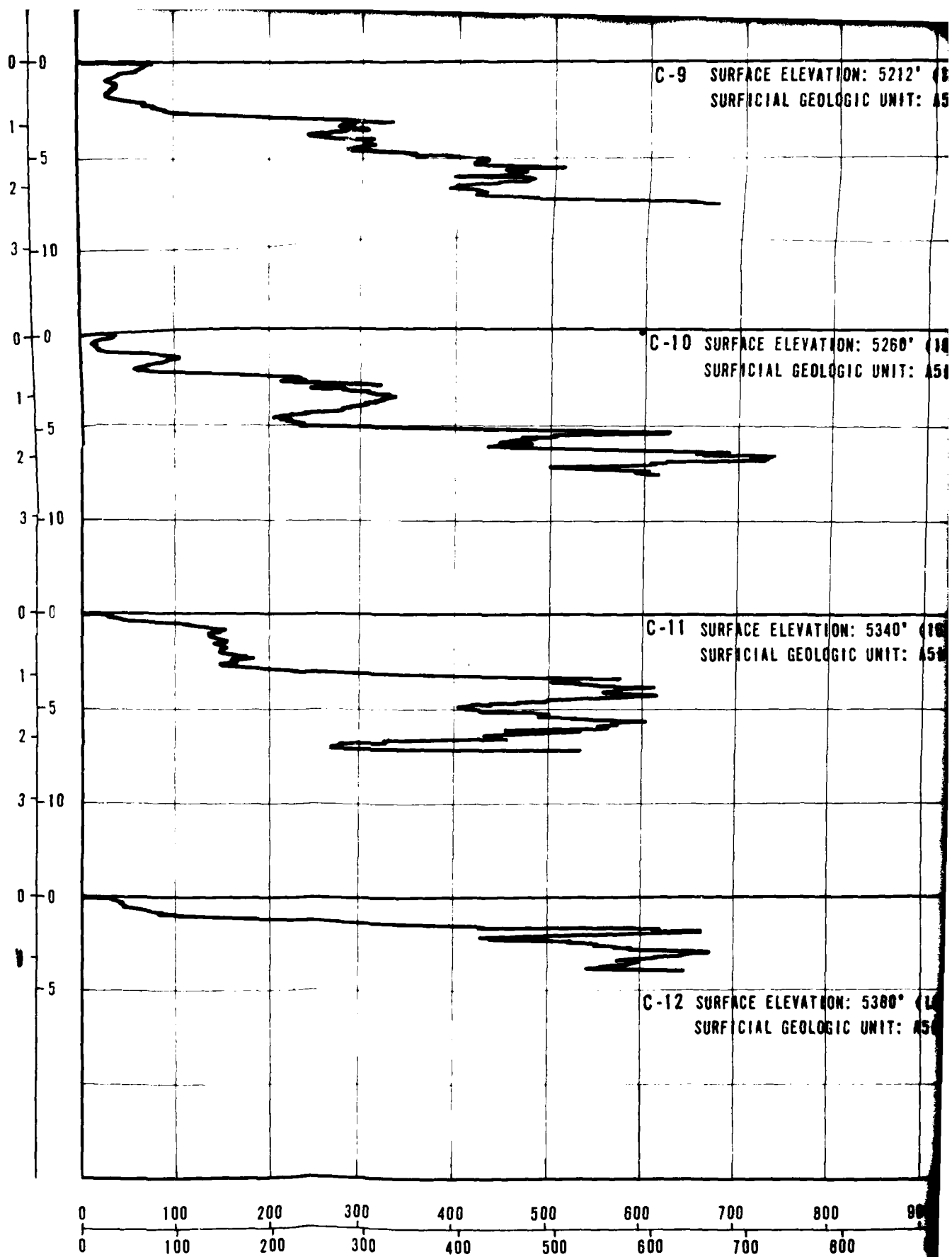
C-40 SURFACE ELEVATION: 5248' (1600m)
SURFICIAL GEOLOGIC UNIT: A5o



SM
GM
SM

11

CHECKED BY _____ APPROVED BY _____



2 JUL 79

9

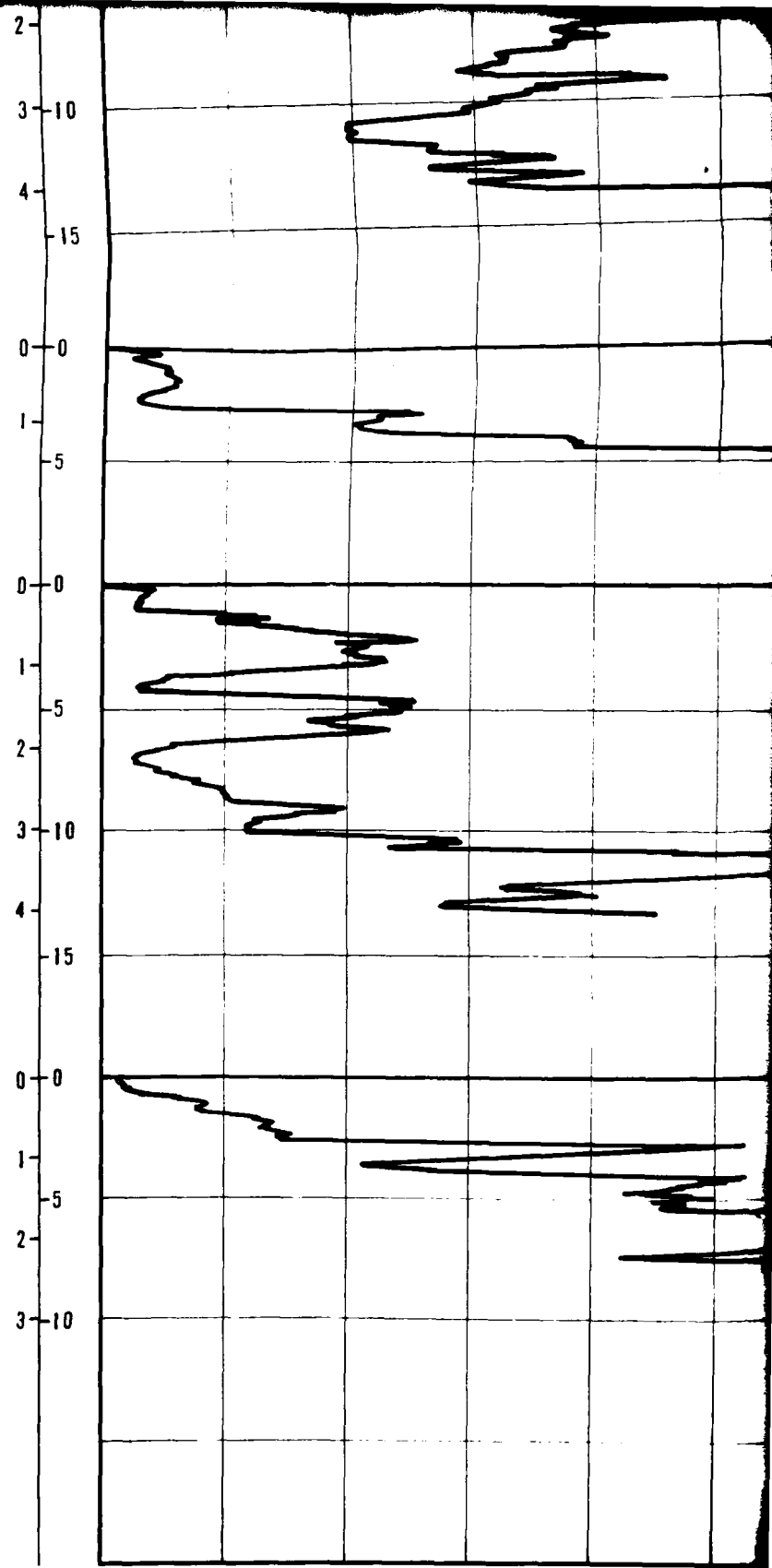
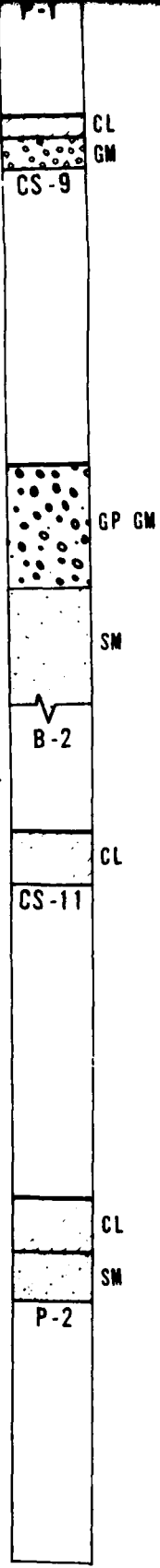
CRYSTAL GEOLOGIC UNIT: 45i

SURFACE ELEVATION: 5212' (1589m)
SURFICIAL GEOLOGIC UNIT: 45i

SURFACE ELEVATION: 5268' (1603m)
SURFICIAL GEOLOGIC UNIT: 45i

SURFACE ELEVATION: 5340' (1628m)
SURFICIAL GEOLOGIC UNIT: 45i

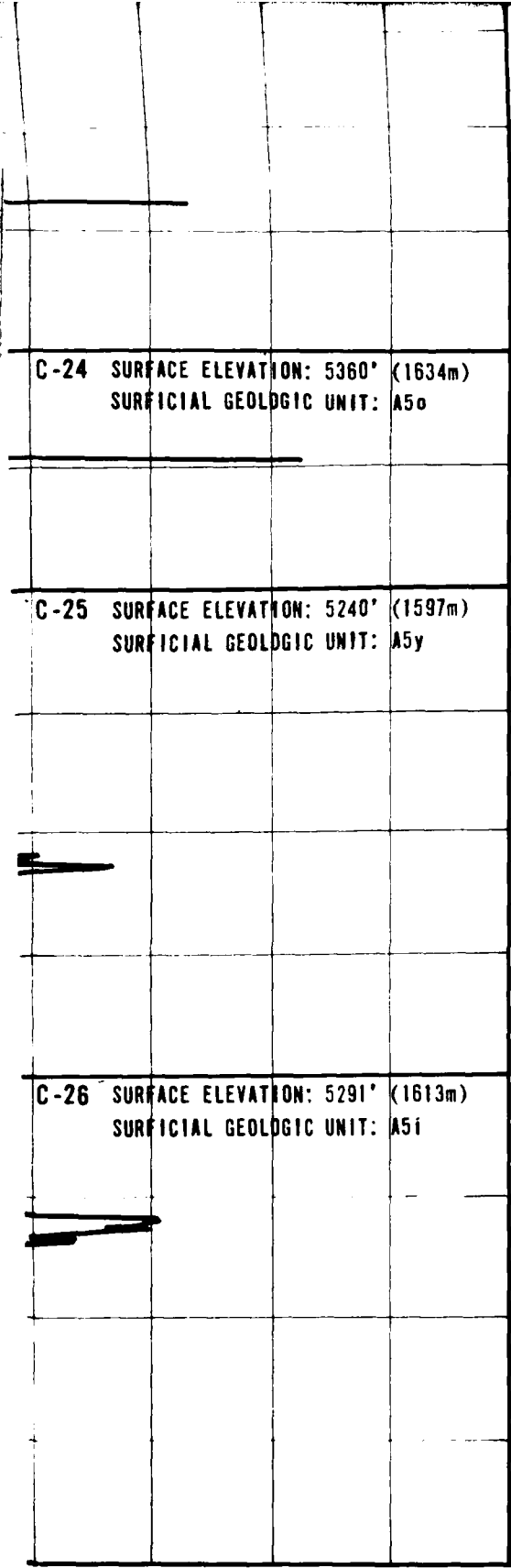
SURFACE ELEVATION: 5380' (1640m)
SURFICIAL GEOLOGIC UNIT: 45i



700 800 900 (tsf)
700 800 900 (kg/cm²)

0 100 200 300 400 500
0 100 200 300 400 500

10

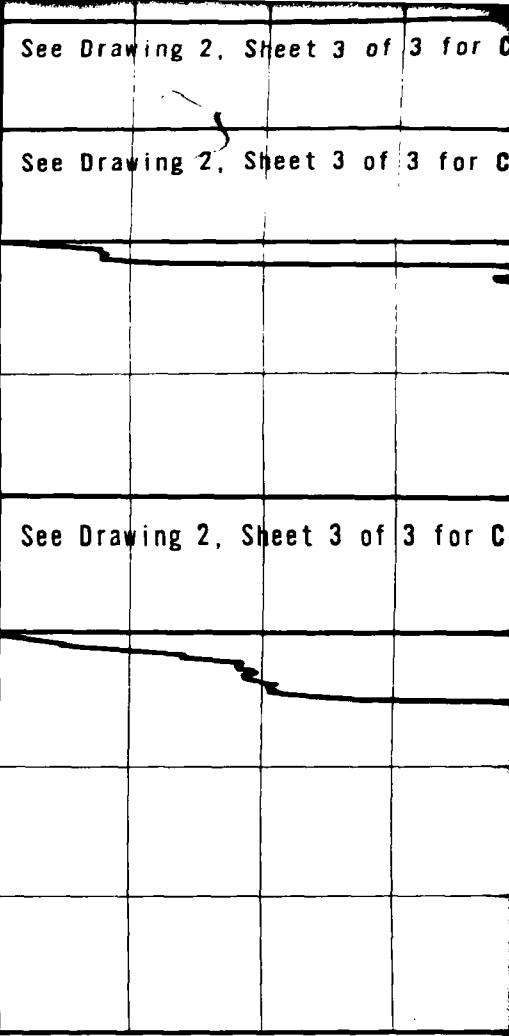


SC
CS-24

GM-GC
GP
P-14

GM
GP
CS-26

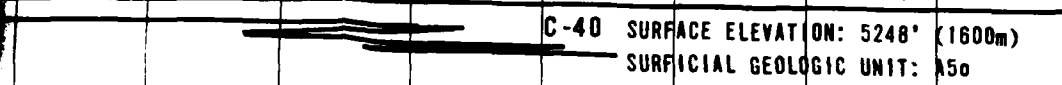
NO 700 800 900 (tsf)
800 700 800 900 (kg/cm²)



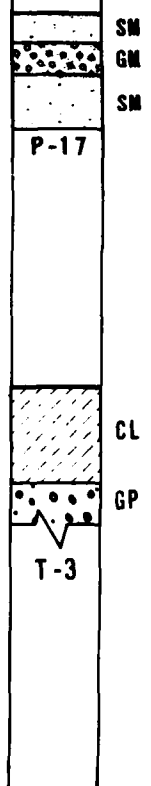
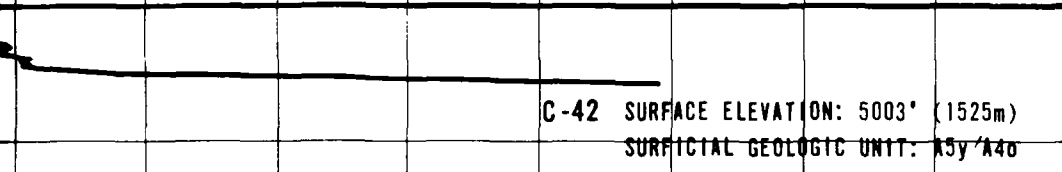
0 100 200 300
0 100 200 300

11

Sheet 3 of 3 for C-39



Sheet 3 of 3 for C-41



200 300 400 500 600 700 800 900 (tsf)
200 300 400 500 600 700 800 900 (kg/cm²)

CONE PENETROMETER TEST RESULTS
VERIFICATION SITE
WHIRLWIND CDP, UTAH

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMSO

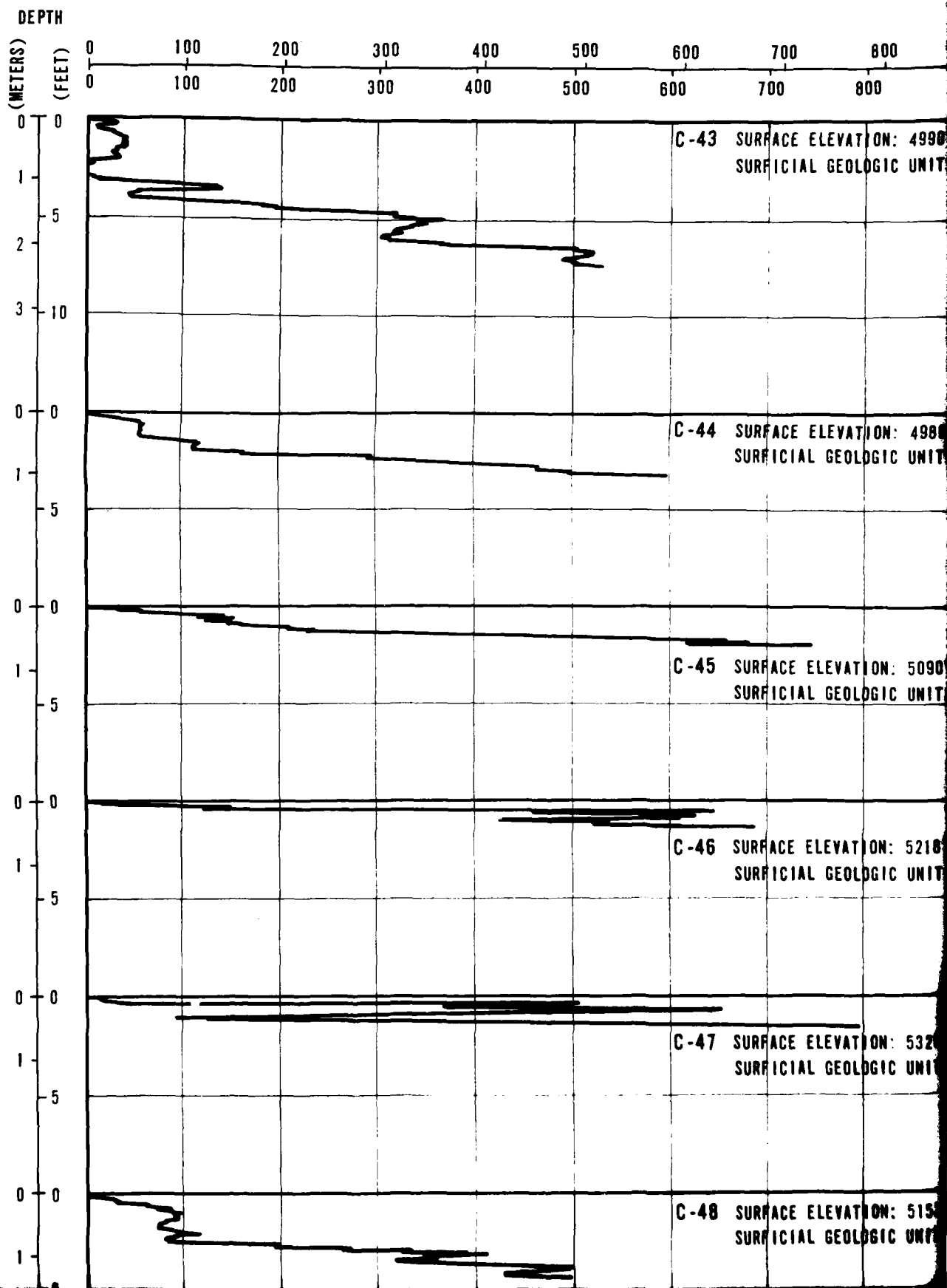
DRAWING
2
P OF 3

FUGRO NATIONAL, INC.

12

FN-TR-27-11

CONE RESISTANCE



2

CONE RESISTANCE

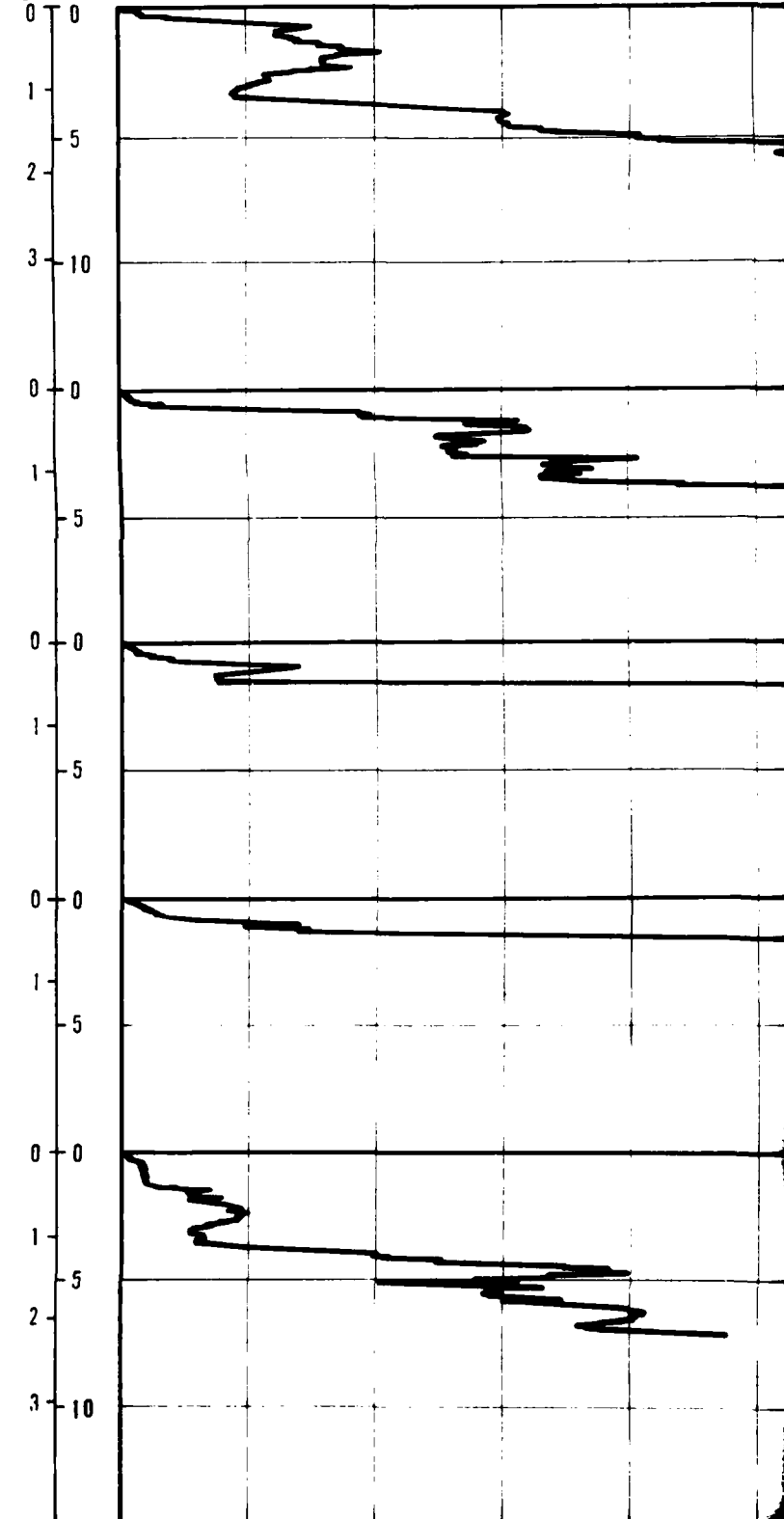
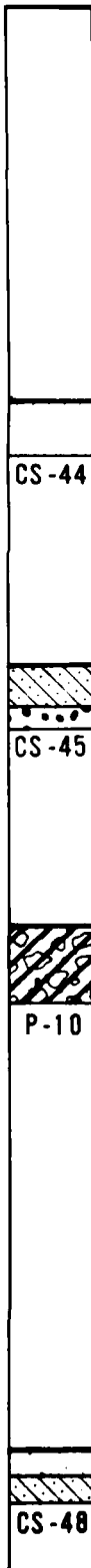
700 800 900 (kg/cm²)
700 800 900 (tsf)

SOIL
COLUMN

DEPTH

(METERS) (FEET)
0 100 200 300 400 500
0 100 200 300 400 500

3	SURFACE ELEVATION: 4990' (1521m) SURFICIAL GEOLOGIC UNIT: A1 A4o		
4	SURFACE ELEVATION: 4980' (1518m) SURFICIAL GEOLOGIC UNIT: A1 A4o		
5	SURFACE ELEVATION: 5090' (1551m) SURFICIAL GEOLOGIC UNIT: A5y A4o		
6	SURFACE ELEVATION: 5218' (1590m) SURFICIAL GEOLOGIC UNIT: A5i		
7	SURFACE ELEVATION: 5320' (1622m) SURFICIAL GEOLOGIC UNIT: A5i		
8	SURFACE ELEVATION: 5153' (1571m) SURFICIAL GEOLOGIC UNIT: A5y A4o		



3

CE

600	700	800	900	(kg/cm ²)
600	700	800	900	(tsf)

DEPTH

(METERS)	0	100	200	300
(FEET)	0	100	200	300

C-58 SURFACE ELEVATION: 5293' (1613m)
SURFICIAL GEOLOGIC UNIT: A5y

SOIL
COLUMN

GC
GP
CS-58

C-59 SURFACE ELEVATION: 5058' (1542m)
SURFICIAL GEOLOGIC UNIT: A5y A4o

GM
GP-GM
B-6

C-60 SURFACE ELEVATION: 4883' (1488m)
SURFICIAL GEOLOGIC UNIT: A5y A4o

SM
CS-60

C-61 SURFACE ELEVATION: 4892' (1491m)
SURFICIAL GEOLOGIC UNIT: A5y A4o

SM
CS-61

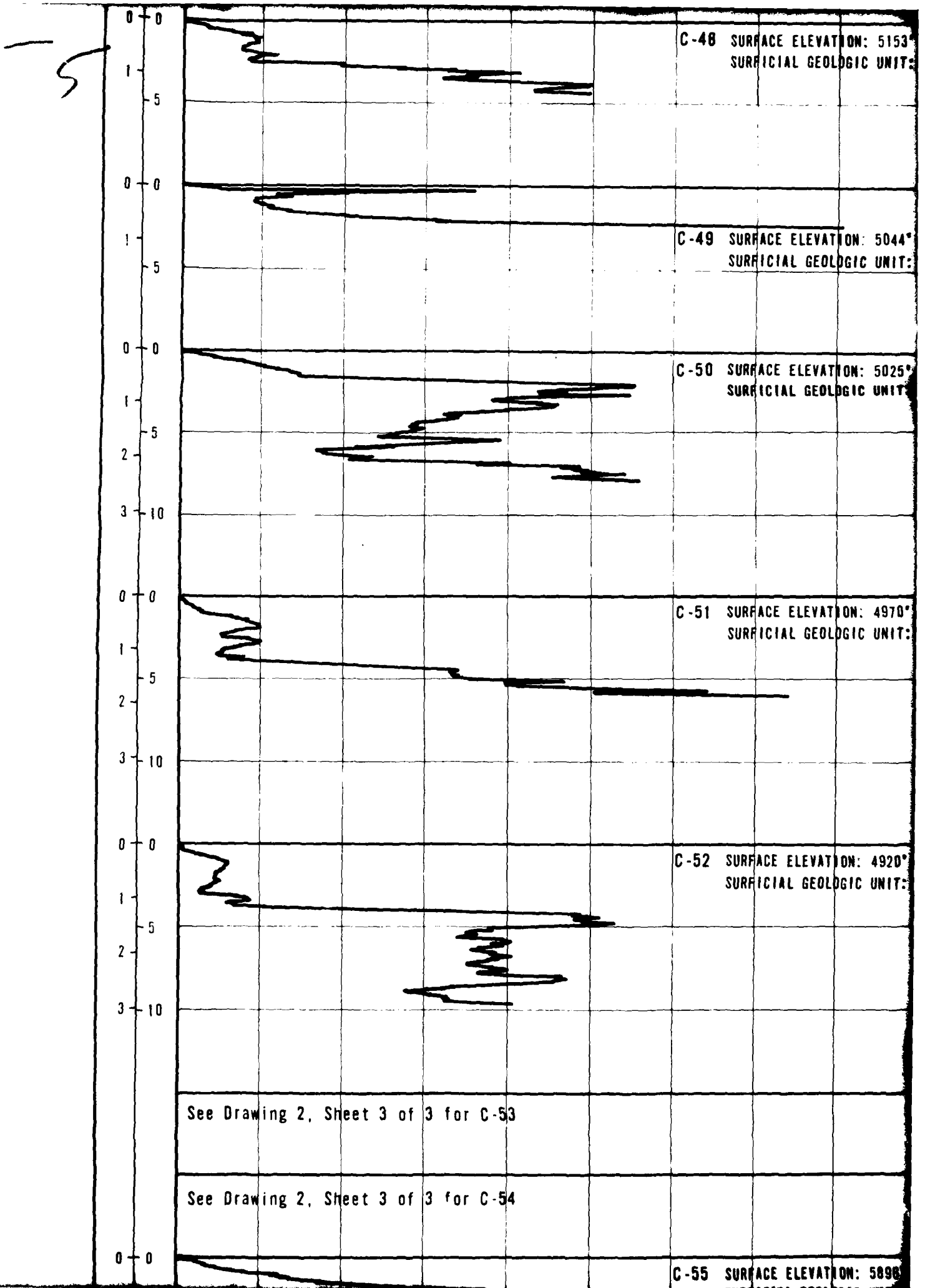
C-62 SURFACE ELEVATION: 4850' (1478m)
SURFICIAL GEOLOGIC UNIT: A5y A4o

SM
CS-62

4

CONE RESISTANCE

**SOIL
COLUMN**



See Drawing 2, Sheet 3 of 3 for C-53

See Drawing 2, Sheet 3 of 3 for C-54

48 SURFACE ELEVATION: 5153' (1571m)
SURFICIAL GEOLOGIC UNIT: A5y/A4o

49 SURFACE ELEVATION: 5044' (1537m)
SURFICIAL GEOLOGIC UNIT: A5y/A4o

50 SURFACE ELEVATION: 5025' (1532m)
SURFICIAL GEOLOGIC UNIT: A4o/A5i

51 SURFACE ELEVATION: 4970' (1515m)
SURFICIAL GEOLOGIC UNIT: A5y/A4o

52 SURFACE ELEVATION: 4920' (1500m)
SURFICIAL GEOLOGIC UNIT: A5y/A4o

CS-48

SM
SC

6

CS-51

ML

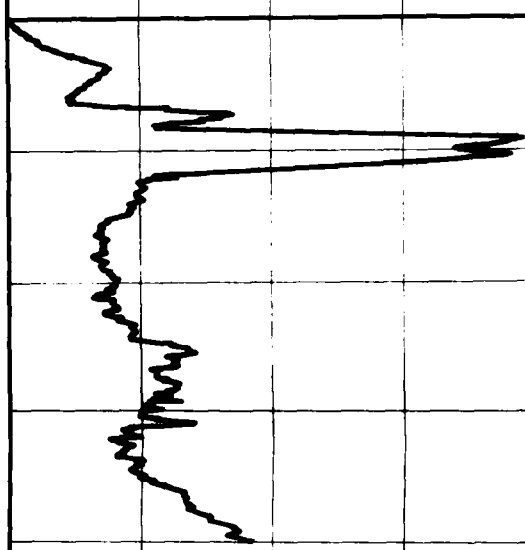
P-26

SM

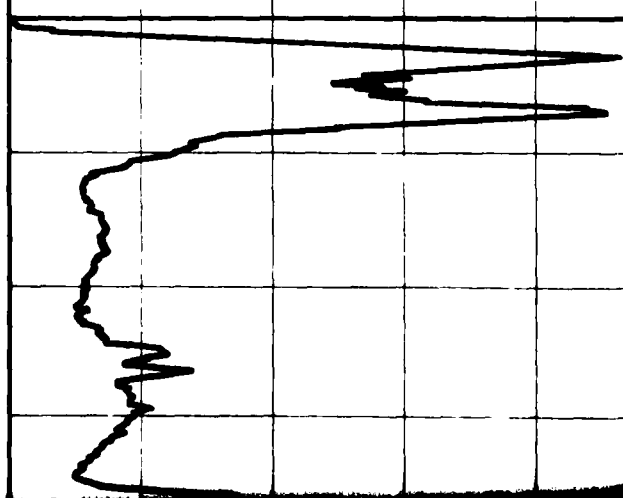
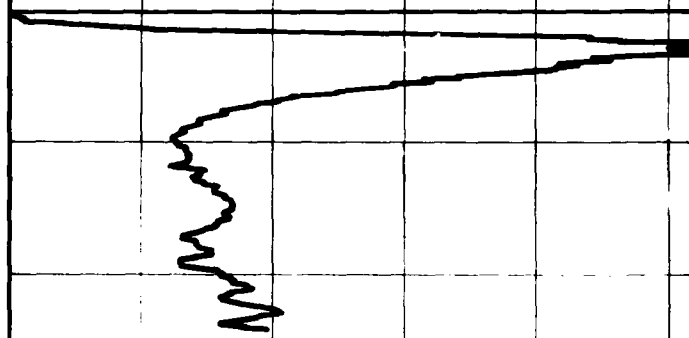
2
3 10
0 0
1
5
2
3 10
4
5 15
6 20

0 0
1
5
2
3 10
4
5 15

0 0
1
5
2
3 10
4
5 15



See Drawing 2, Sheet 3 of 3 for C-64



7

C-63 SURFACE ELEVATION: 4785' (1458m)
SURFICIAL GEOLOGIC UNIT: A5y/A4o



SM
ML
SP
CH

P-25

C-65 SURFACE ELEVATION: 4650' (1417m)
SURFICIAL GEOLOGIC UNIT: A4o



CL
GM

CS-65

C-66 SURFACE ELEVATION: 4543' (1385m)
SURFICIAL GEOLOGIC UNIT: A4o

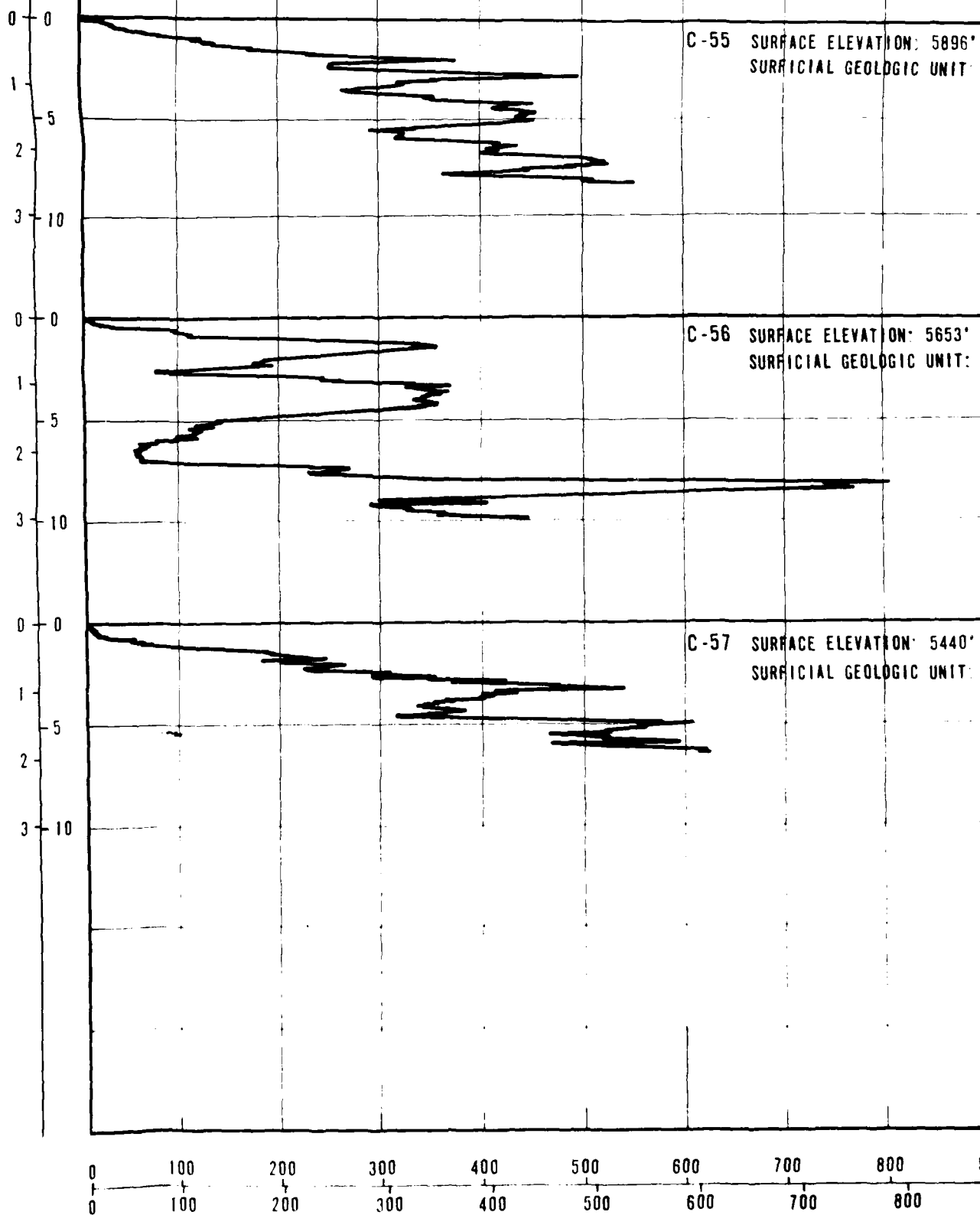


SC
SP

CS-66

81

See Drawing 2, Sheet 3 of 3 for C-54



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9

5 SURFACE ELEVATION 5896' (1797m)
SURFICIAL GEOLOGIC UNIT A5i

P-23

SM

6 SURFACE ELEVATION 5653' (1723m)
SURFICIAL GEOLOGIC UNIT A5i

CS-56

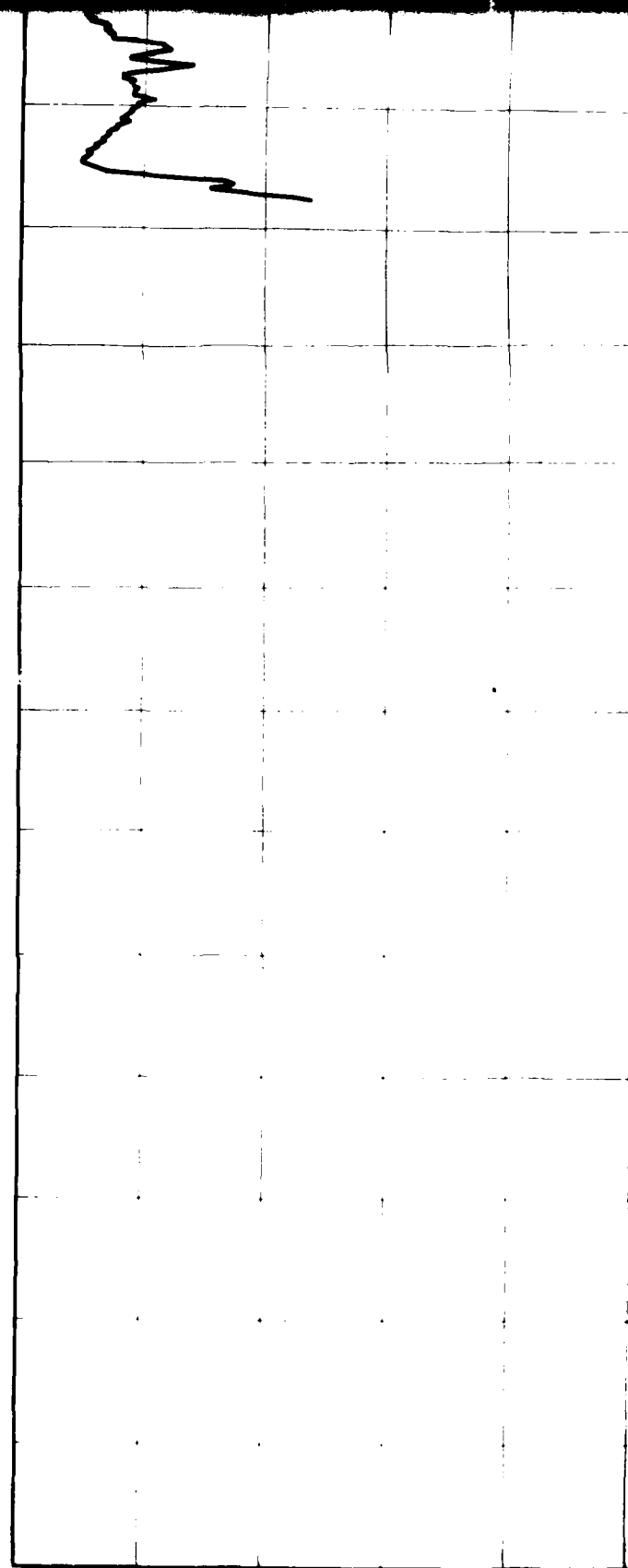
SM
GP

7 SURFACE ELEVATION 5440' (1658m)
SURFICIAL GEOLOGIC UNIT A5y

P-22

SM SC
GM

4
15
5
20



700 800 900 (tsf)
700 800 900 (kg cm²)

0 100 200 300 400 50
0 100 200 300 400 5

10

AD-A113 324

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AUG 79

F/8 8/13

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NL

3-13

3-13

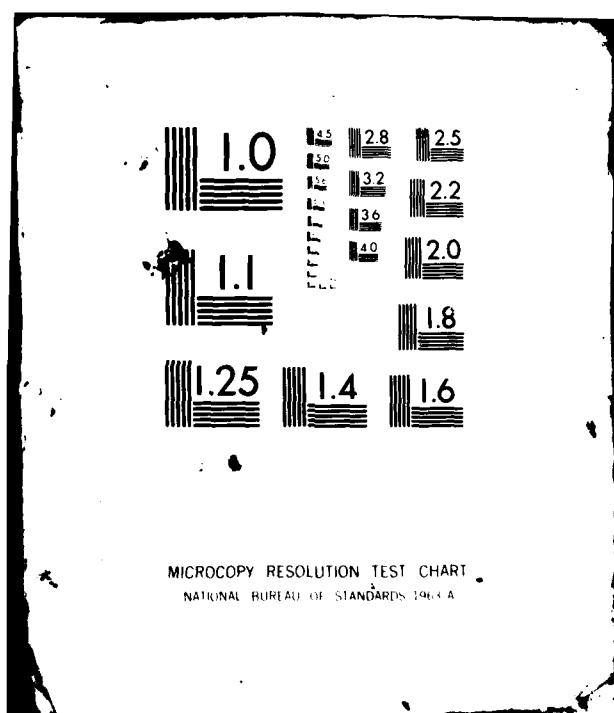
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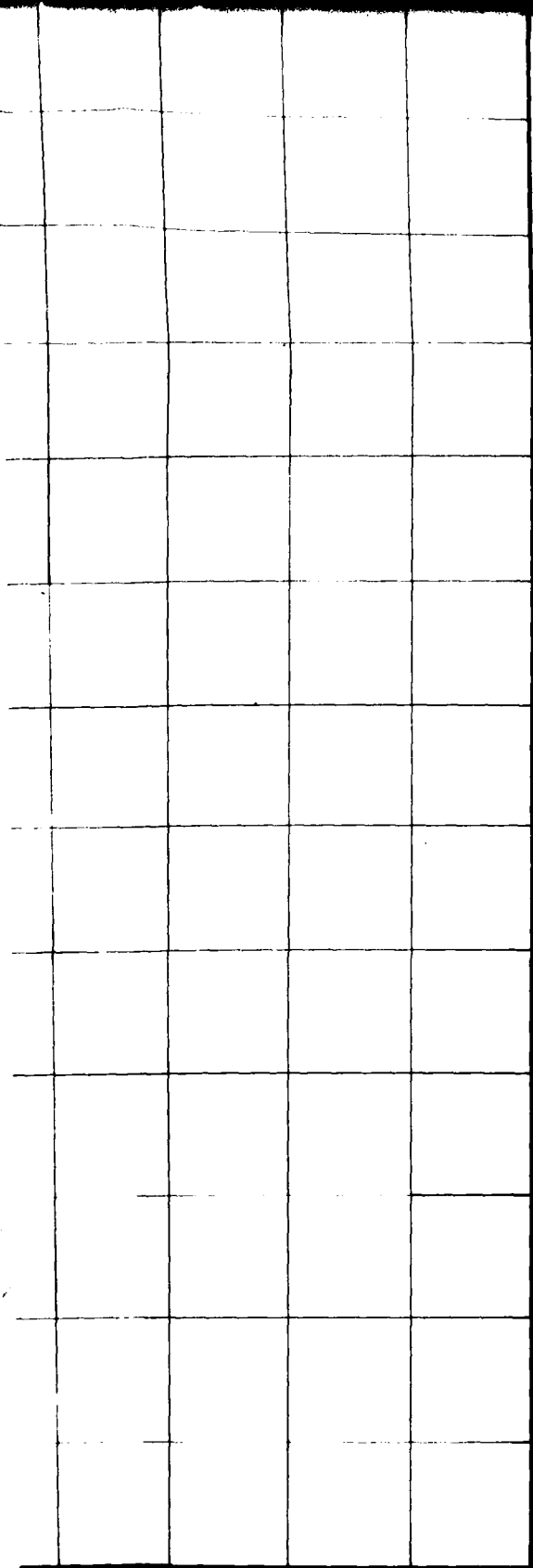
DATE

FILED

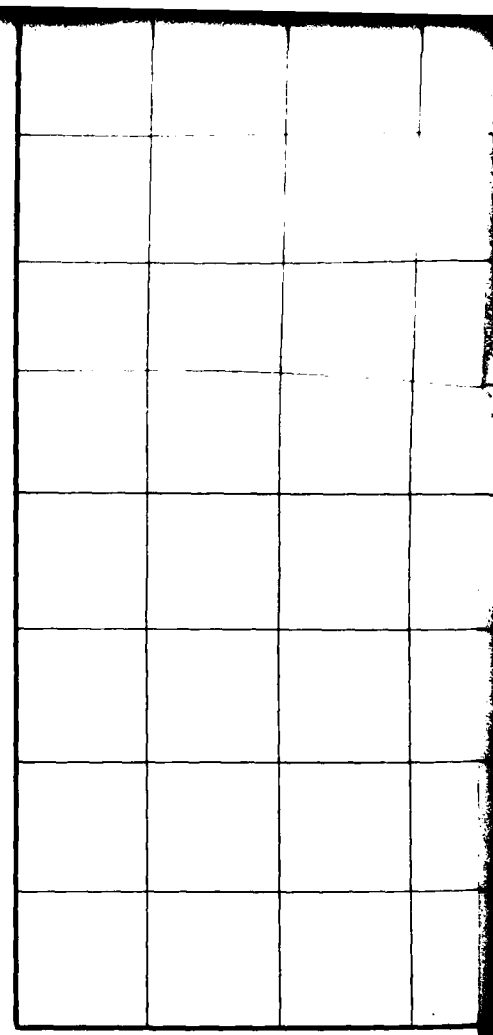
5 82

DTIC



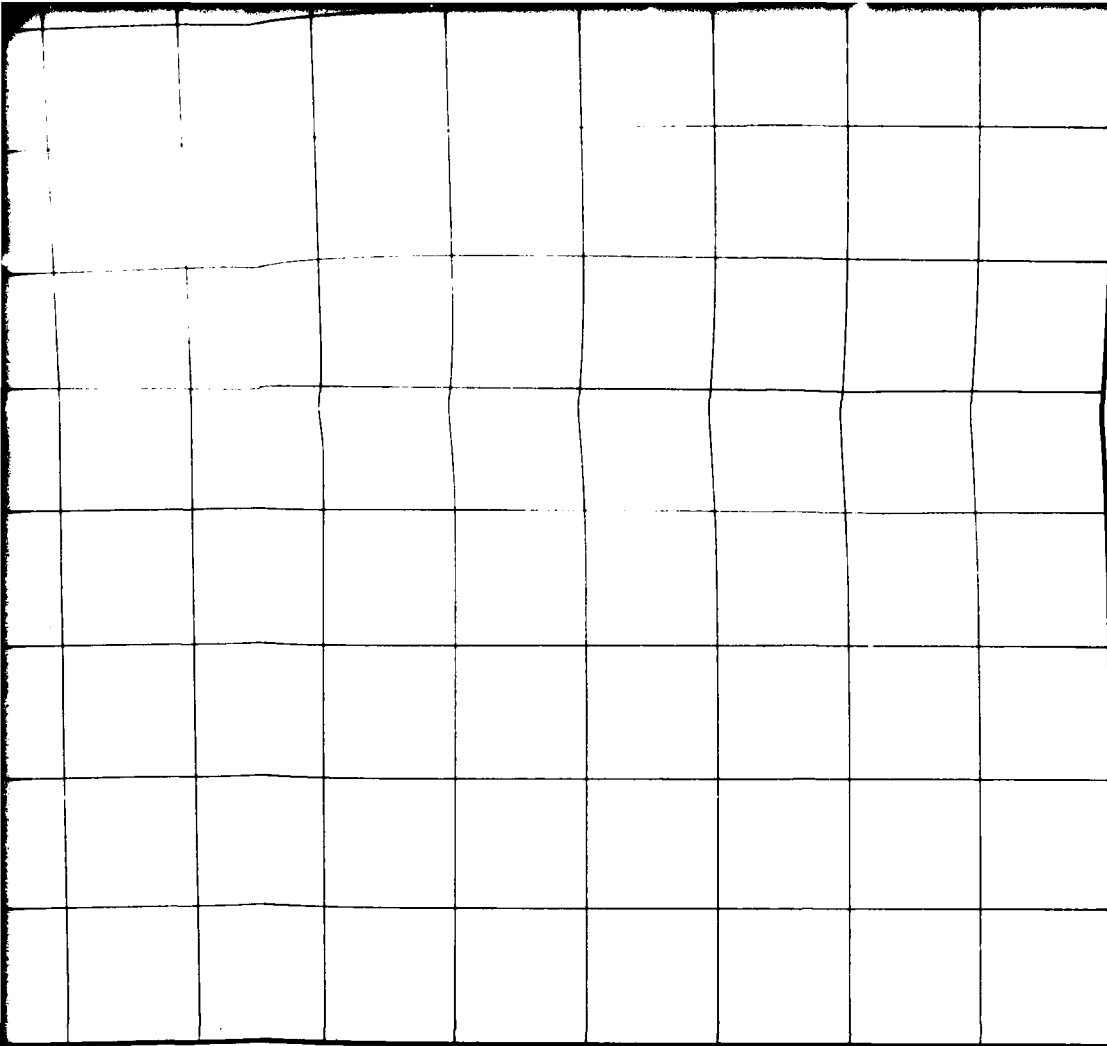


600 700 800 900 (tsf)
600 700 800 900 (kg/cm²)



0 100 200 300
0 100 200 300

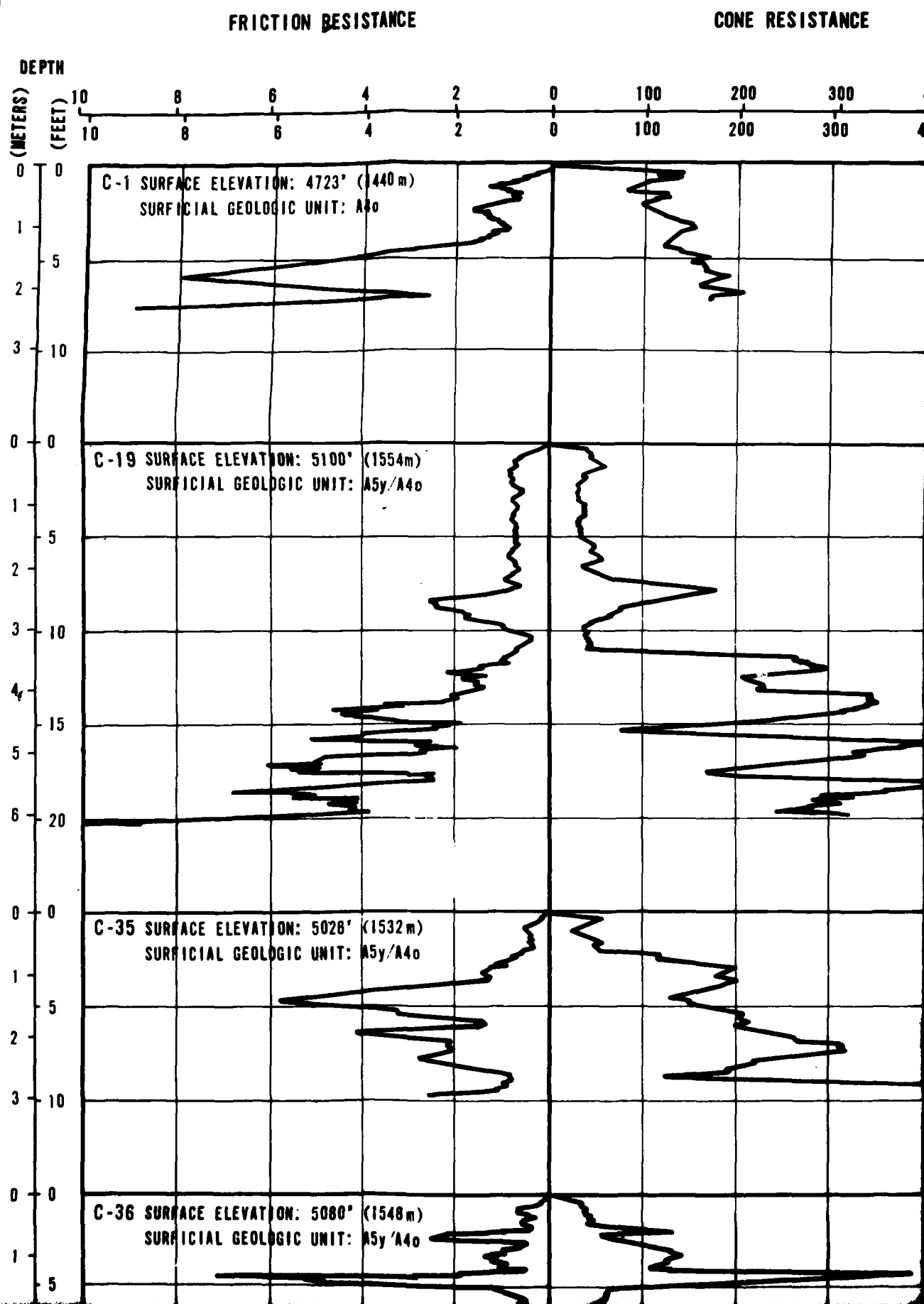
11



200	300	400	500	600	700	800	900	(tsf)
200	300	400	500	600	700	800	900	(kg/cm ²)

CONE PENETROMETER TEST RESULTS VERIFICATION SITE WHIRLWIND CDP, UTAH	
MX SITING INVESTIGATION DEPARTMENT OF THE AIR FORCE - SAMSO	DRAWING 2 2 OF 3
FUGRO NATIONAL, INC.	

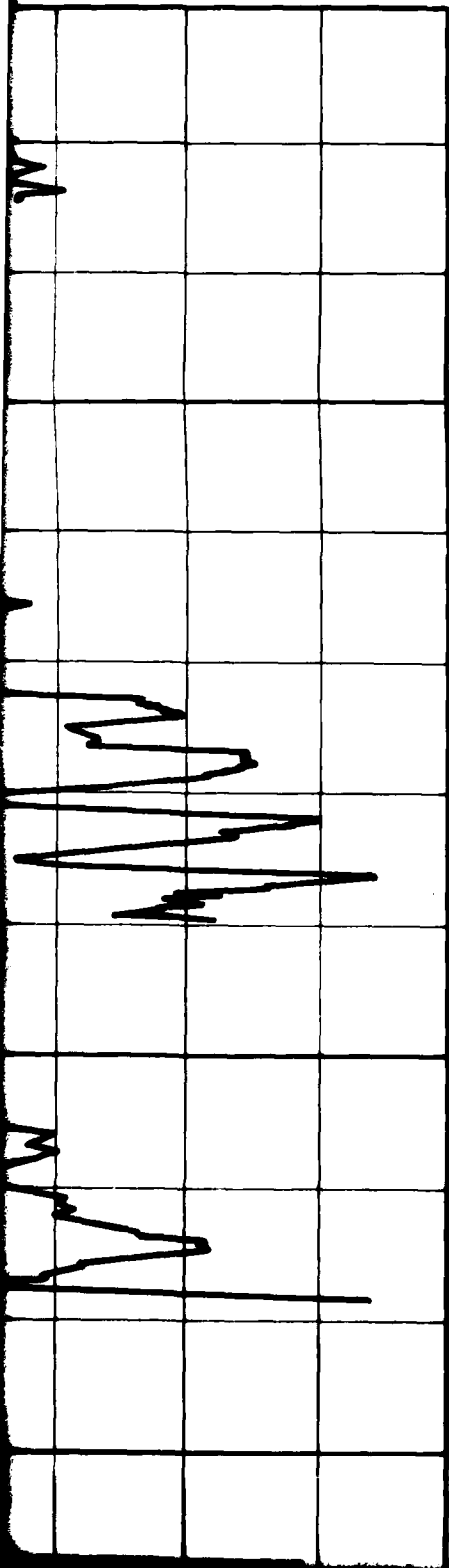
12



1
CONE RESISTANCE

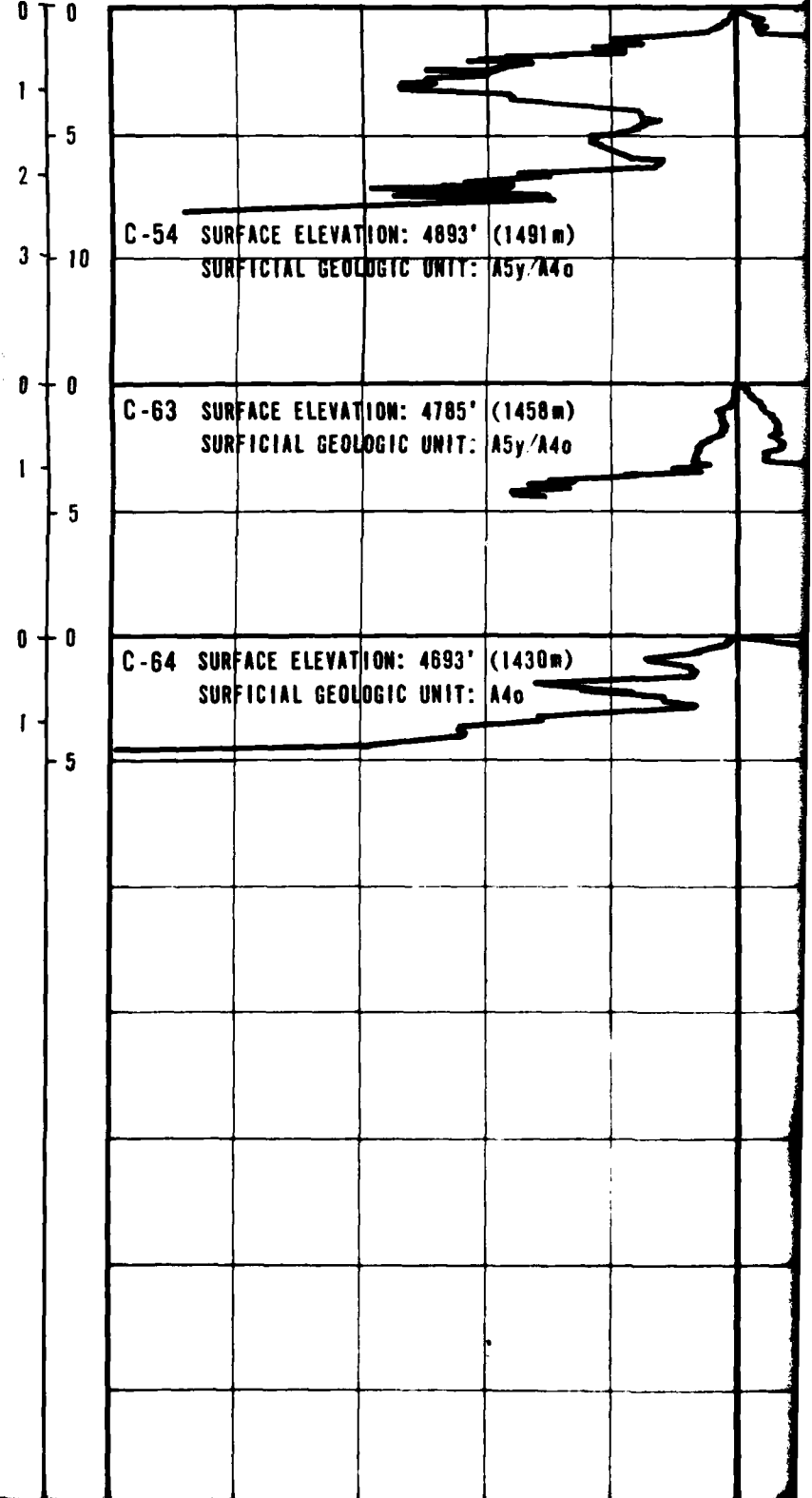
200 300 400 (kg/cm²)
200 300 400 (tsf)

SOIL COLUMN



FRICITION RESISTANCE

DEPTH
(METERS) 0 1 2 3 4 5
(FEET) 0 5 10 15 20 25



C-54 SURFACE ELEVATION: 4893' (1491m)
SURFICIAL GEOLOGIC UNIT: A5y/A4o

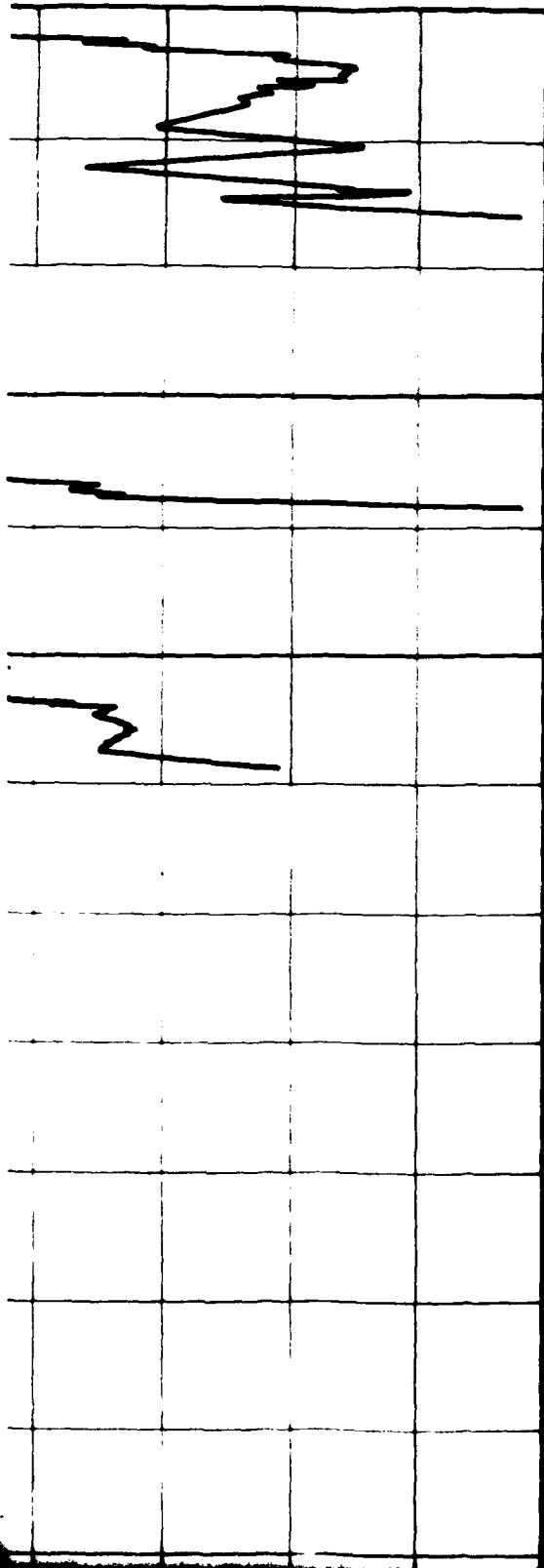
C-63 SURFACE ELEVATION: 4785' (1458m)
SURFICIAL GEOLOGIC UNIT: A5y/A4o

C-64 SURFACE ELEVATION: 4693' (1430m)
SURFICIAL GEOLOGIC UNIT: A4o

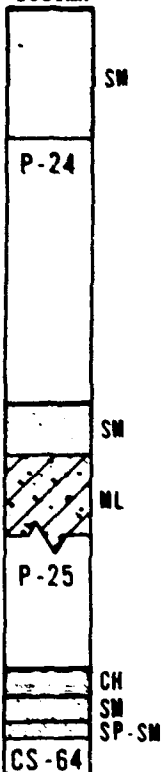
3

CONE RESISTANCE

100 200 300 400 (kg/cm²)
100 200 300 400 (tsf)



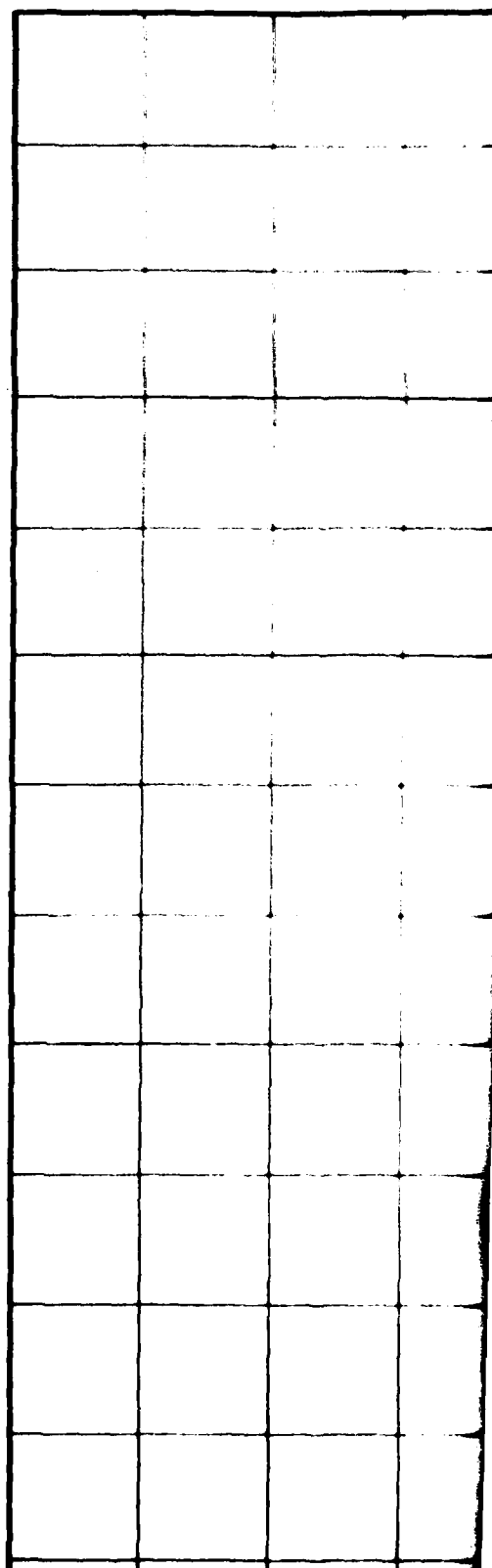
SOIL COLUMN



FRICTION RESISTANCE

DEPTH

(METERS) 10 8 6 4
(FEET) 10 8 6 4



FRICION RESISTANCE

CONE RESISTANCE

SOIL COLUMN

SURFICIAL GEOLOGIC UNIT: A5y/A4o

1
5
2
3 10
4
5 15
6 20
7 25

C-37 SURFACE ELEVATION: 5120' (1561m)
SURFICIAL GEOLOGIC UNIT: A5y/A4o

1
5
2
3 10

C-38 SURFACE ELEVATION: 5147' (1569m)
SURFICIAL GEOLOGIC UNIT: A5y/A4o

1
5
2
3 10

C-39 SURFACE ELEVATION: 5192' (1583m)
SURFICIAL GEOLOGIC UNIT: A5y

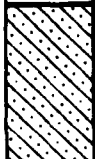
1
5
2

C-41 SURFACE ELEVATION: 5317 (1621m)
SURFICIAL GEOLOGIC UNIT: A5o

1
5
2

B-4

6



SC

SP-SM

T-5

SM

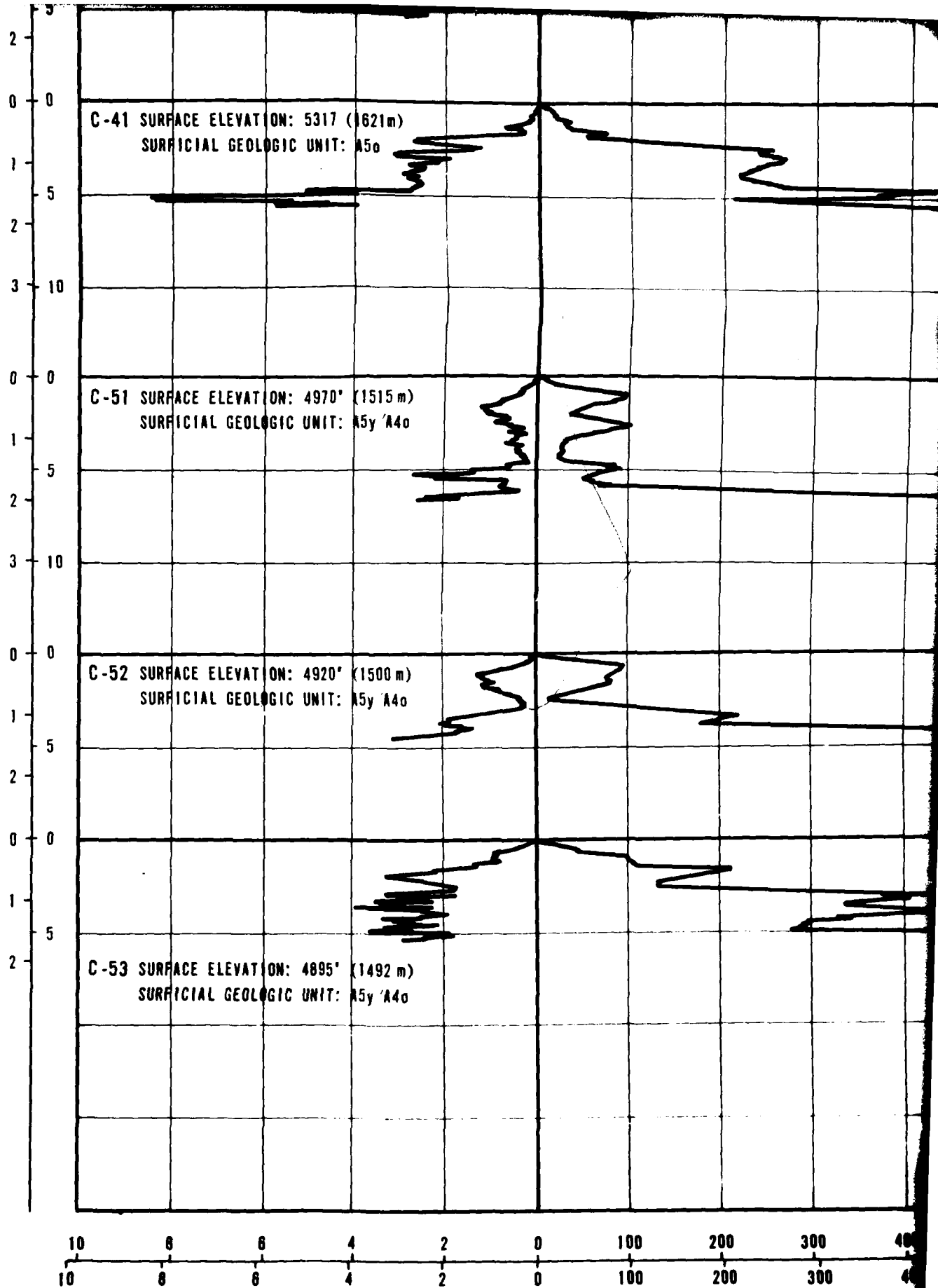
P-16

SM

7

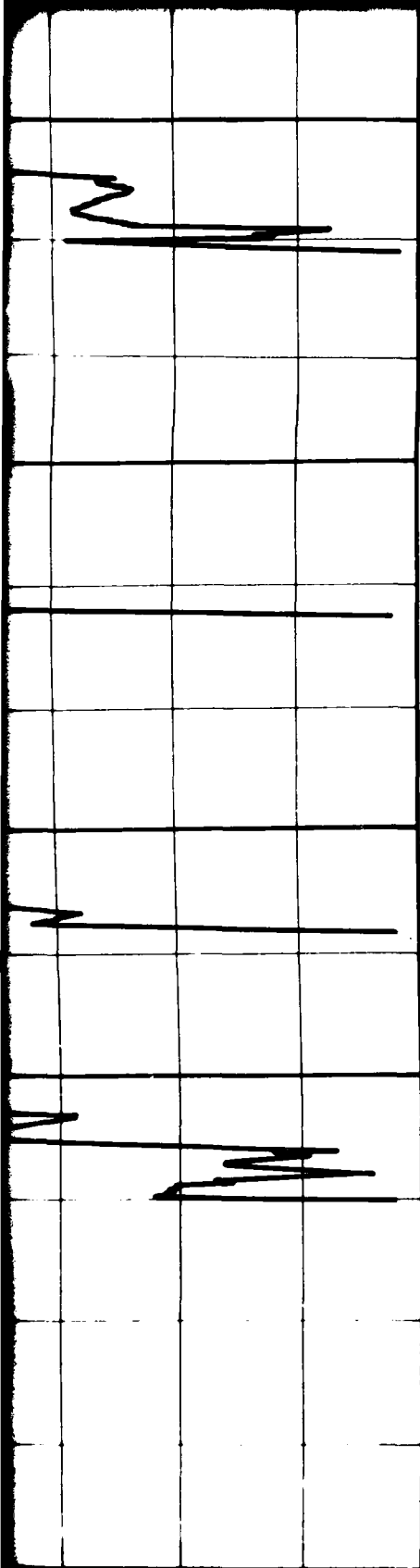
[illegible]

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9



SM

P-18

ML

CS-51

ML

SM

P-26

SM

SC-SM

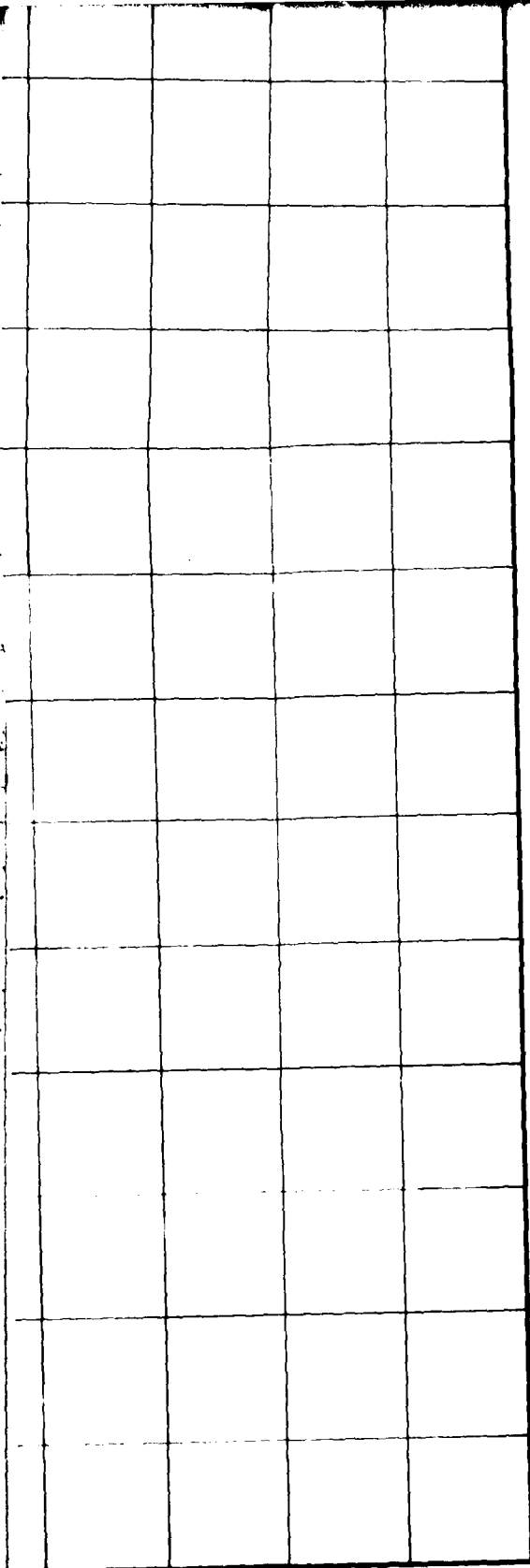
CS-53

SC-SM

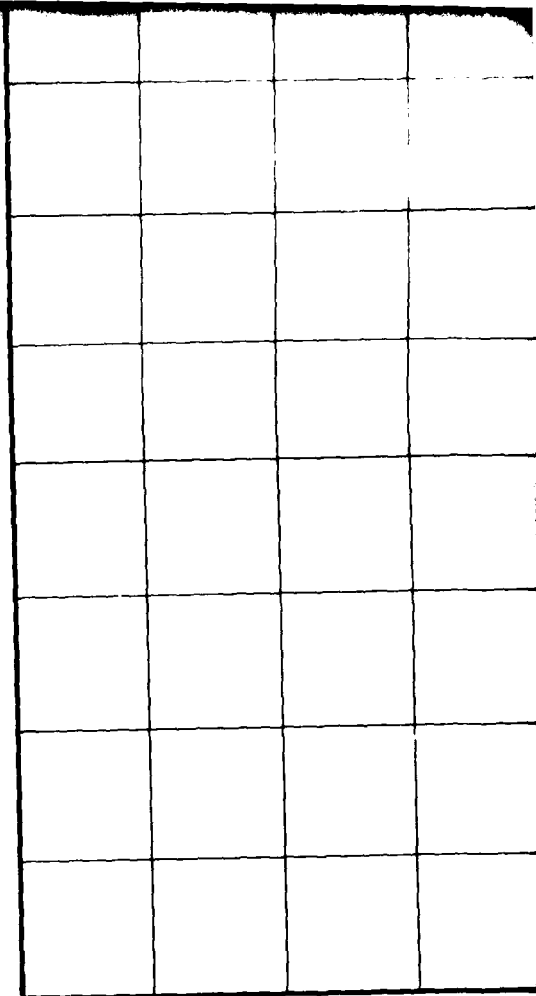
200 300 400 (tsf)
200 300 400 (kg/cm²)

10 8 6 4 2 0
10 8 6 4 2 0

10

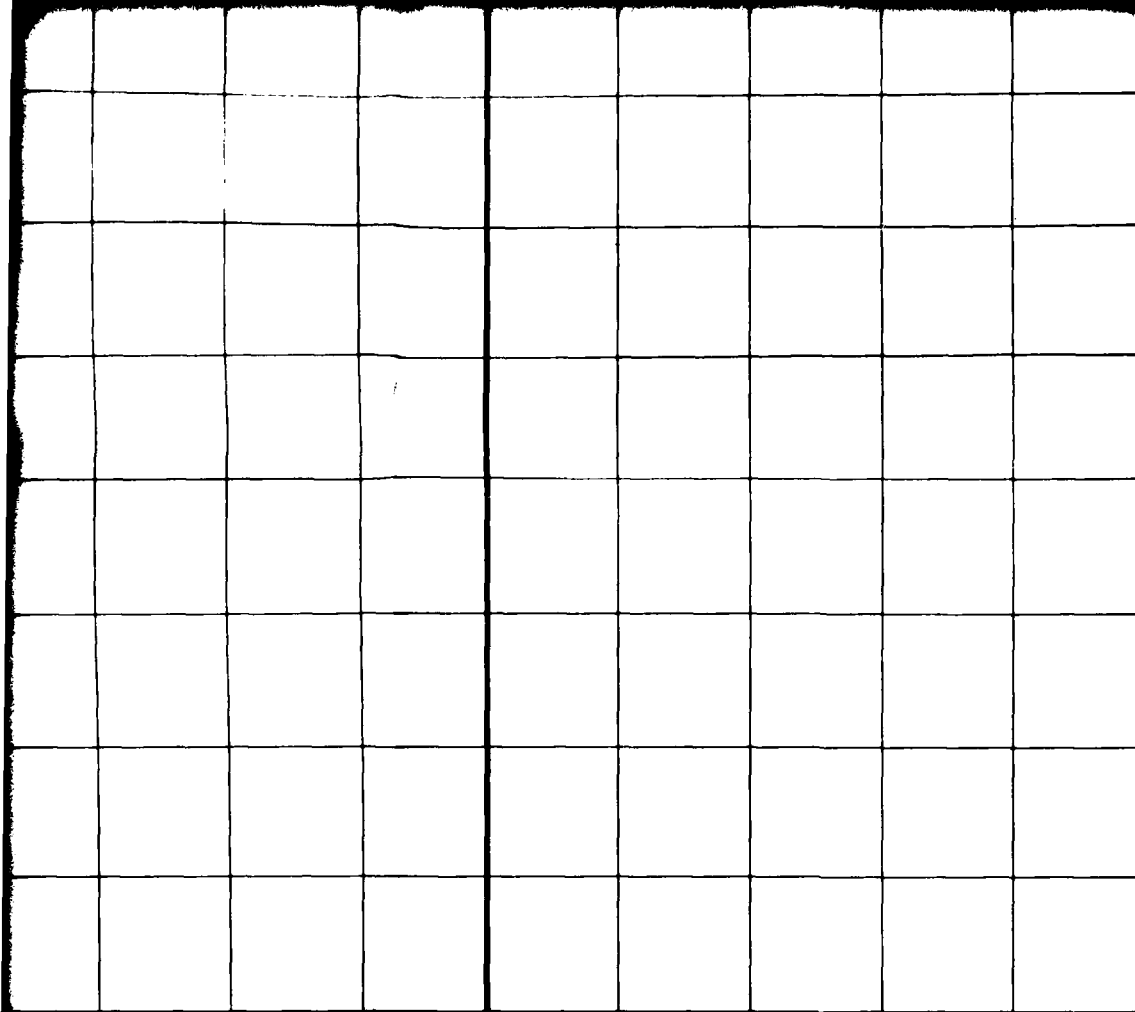


100 200 300 400 (tsf)
100 200 300 400 (kg/cm²)



10 8 6 4
10 8 6 4

11



6	4	2	0	100	200	300	400	(tsf)
6	4	2	0	100	200	300	400	(kg/cm ²)

CONE PENETROMETER TEST RESULTS
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2
3 OF 3

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