CONTACT INFORMATION
Mining Records Curator
Arizona Geological Survey
3550 N. Central Ave, 2nd floor
Phoenix, AZ, 85012
602-771-1601
http://www.azgs.az.gov
inquiries@azgs.az.gov

The following file is part of the Walter E. Heinrichs, Jr. Mining Collection

**ACCESS STATEMENT**

These digitized collections are accessible for purposes of education and research. We have indicated what we know about copyright and rights of privacy, publicity, or trademark. Due to the nature of archival collections, we are not always able to identify this information. We are eager to hear from any rights owners, so that we may obtain accurate information. Upon request, we will remove material from public view while we address a rights issue.

**CONSTRAINTS STATEMENT**

The Arizona Geological Survey does not claim to control all rights for all materials in its collection. These rights include, but are not limited to: copyright, privacy rights, and cultural protection rights. The User hereby assumes all responsibility for obtaining any rights to use the material in excess of "fair use."

The Survey makes no intellectual property claims to the products created by individual authors in the manuscript collections, except when the author deeded those rights to the Survey or when those authors were employed by the State of Arizona and created intellectual products as a function of their official duties. The Survey does maintain property rights to the physical and digital representations of the works.

**QUALITY STATEMENT**

The Arizona Geological Survey is not responsible for the accuracy of the records, information, or opinions that may be contained in the files. The Survey collects, catalogs, and archives data on mineral properties regardless of its views of the veracity or accuracy of those data.

Miller Pitt 5

Golden Dam etc.


# The Arizona Daily Star

★ An Independent NEWSpaper Printing The News Impartially ★

VOL. 127 NO. 29 Entered as second class matter Post Office, Tucson, Arizona

TUCSON, ARIZONA, MONDAY MORNING, JANUARY 29, 1968 622-5855


## GOOD MORNING

Don't knock the other fellow's fraternal affiliation—your outfit has no monopoly on sincerity of purpose.

## SECTION TWO

Editorial ★ Classified ★

Local News ★ Sports ★ Comics ★

№ 1043 Ha 2

NAME Robert Elliott

ADDRESS 5849 E. 1st

STORE NO. 5

DATE 1-30-68

PHONE

| CHECK FILM TYPE | ✓ |
|---|---|
| Black & White | |
| Kodacolor | |
| Kodachrome | |
| Ektacolor | |
| Ektachrome | |
| OTHER | |
| Duplicate Slides | |
| Color Print from Slides | |

**DEVELOP AND PRINT ORDERS**

FILM SIZE 5X5

NO. OF ROLLS

NO. OF PRINTS FROM EACH NEG.

**REPRINT ORDERS**

NO. OF NEGATIVES OR SLIDES

NO. OF PRINTS FROM EACH SLIDE OR NEG.

ENLARGEMENT SIZE

INSTRUCTIONS

plus - X 18

process only

please return

holders 1 of each 8x10 matt

no Borders

soon as possible

PRINTS MADE 13

| PRICE | |
|---|---|
| DEV. | 2.70 |
| PRINT | 16.25 |
| TOTAL | 18.95 |
| TAX | |
| TOTAL | |

QUALITY PROCESSING THRU YOUR COLOR Classics Dealer

# NU-ART PHOTO SERVICE

**3954 E. SPEEDWAY — TUCSON, ARIZONA**

**Dial EA 6-9606**

*"Tucson's Finest Camera Store"*

KODAK 2SAFETY-FILM

ROUTE

№ 7878

AMT. DUE

☐ B & W

☐ COLOR

THIS ONE FIRST

NAME Heinrich Hoeß

Jim B. AT 623-0578

DATE

ADDRESS

DEPOSIT

NO. OF ROLLS _____ (Limit 3) ROLL SIZE _____

NO. OF NEGS. _____ (For Reprints) PRINTS _____ EA.

## ENLARGEMENTS

5x7 ____ EA. 8x10 ____ EA.

SPECIAL INSTRUCTIONS

Clean neg.
wash + refix if necessary

| | PRICE EACH | TOTAL |
|---|---|---|
| DEVELOPING | | |
| PRINTS | | |
| ENLARGEMENTS | | |
| TAX | | |
| TOTAL | | |
| Total Less Deposit | | |

Your film is guaranteed against loss or damage by us to the extent of replacement cost of film before exposure.

# TUCSON PHOTO COMPANY

521 N. 4th Ave. 623-8881

Tucson, Arizona 85705

Quality Photofinishing at LOW PRICES

ANSCO PHOTO PRODUCTS OF

gaf GENERAL ANILINE & FILM CORPORATION

140 WEST 51 STREET, NEW YORK, NEW YORK 10020

ROUTE

№ 7879

AMT. DUE

☐ B & W

☐ COLOR

NAME Heinrichs Geoz

DATE

ADDRESS

DEPOSIT

NO. OF ROLLS (Limit 3) ROLL SIZE

NO. OF NEGS. (For Reprints) PRINTS EA.

## ENLARGEMENTS

5x7 EA. 8x10 EA.

| | PRICE EACH | TOTAL |
|---|---|---|
| DEVELOPING | | |
| PRINTS | | |
| ENLARGEMENTS | | |
| TAX | | |
| TOTAL | | |
| Total Less Deposit | | |

SPECIAL INSTRUCTIONS

Clean negatives
TRY OTHER ONE FIRST

Your film is guaranteed against loss or damage by us to the extent of replacement cost of film before exposure.

# TUCSON PHOTO COMPANY

521 N. 4th Ave. 623-8881

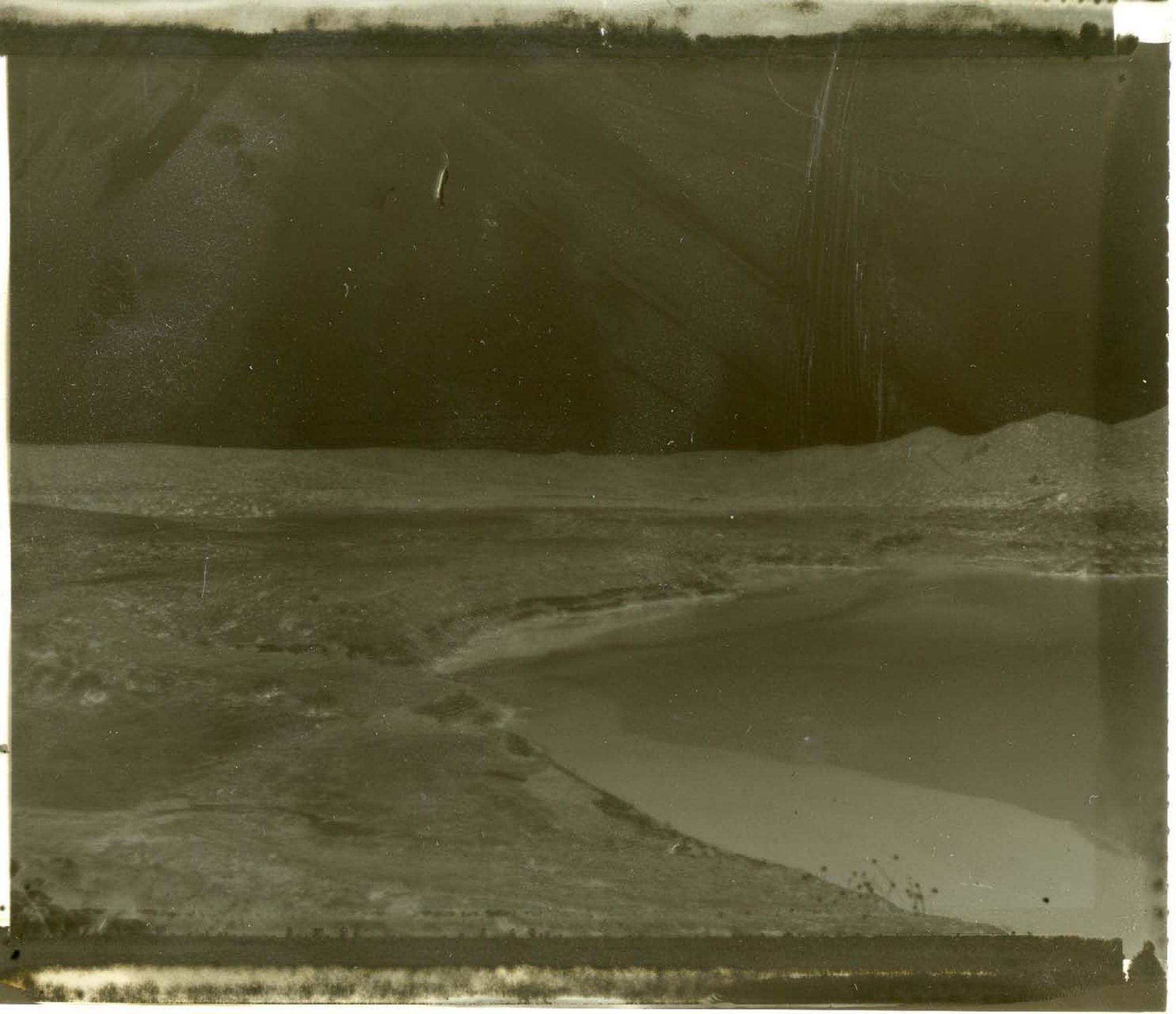
Tucson, Arizona 85705

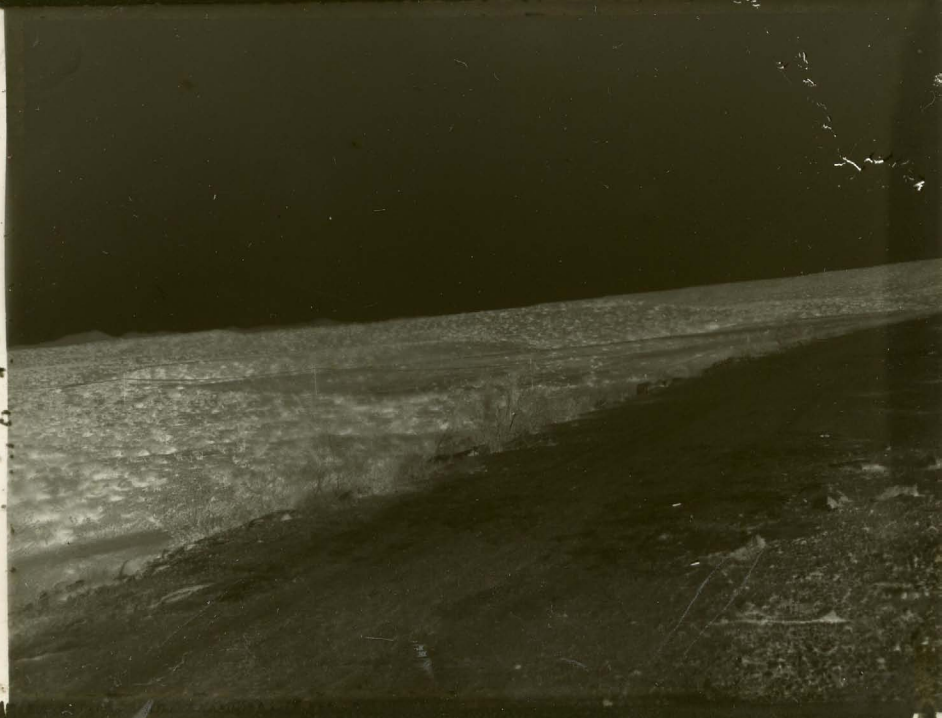
Quality Photofinishing at LOW PRICES

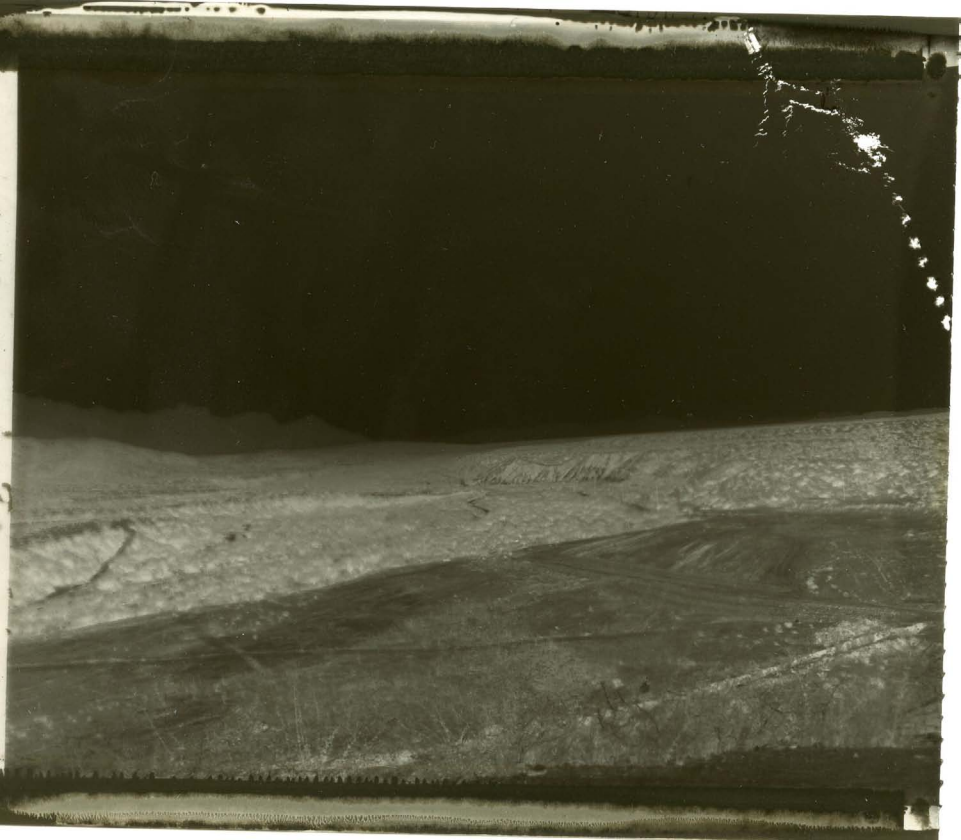
ANSCO PHOTO PRODUCTS OF

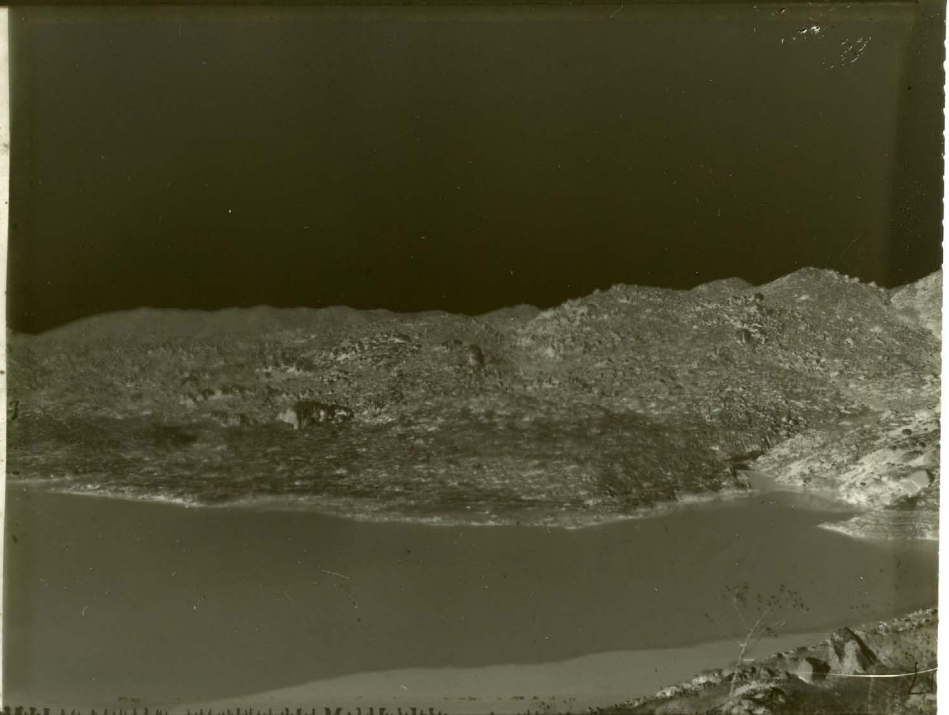
gaf GENERAL ANILINE & FILM CORPORATION

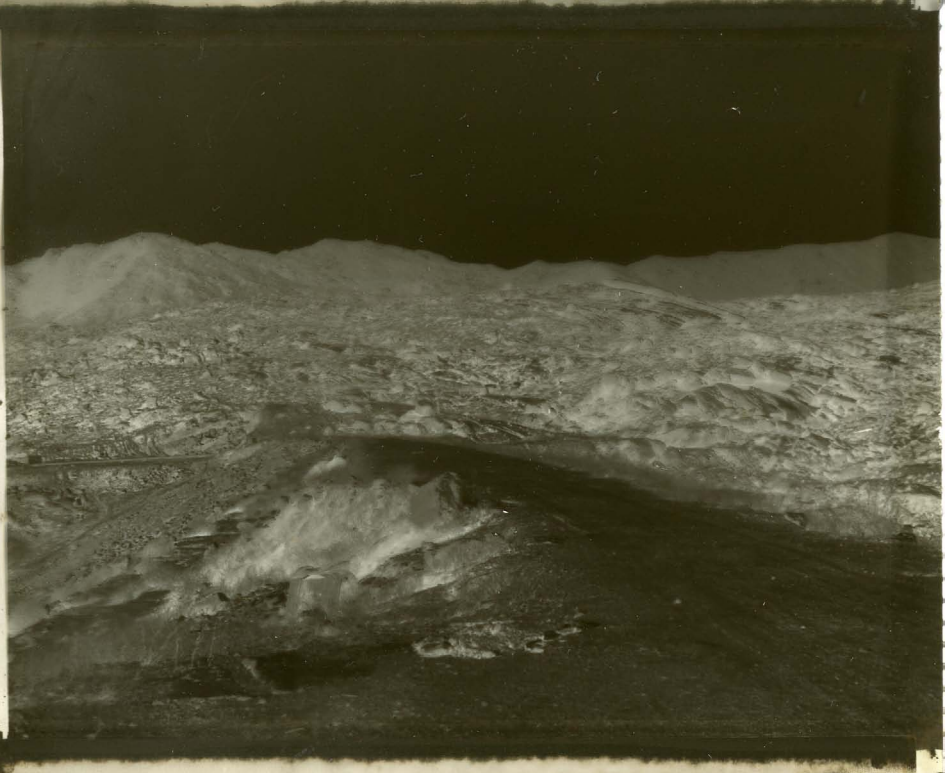
140 WEST 51 STREET, NEW YORK, NEW YORK 10020

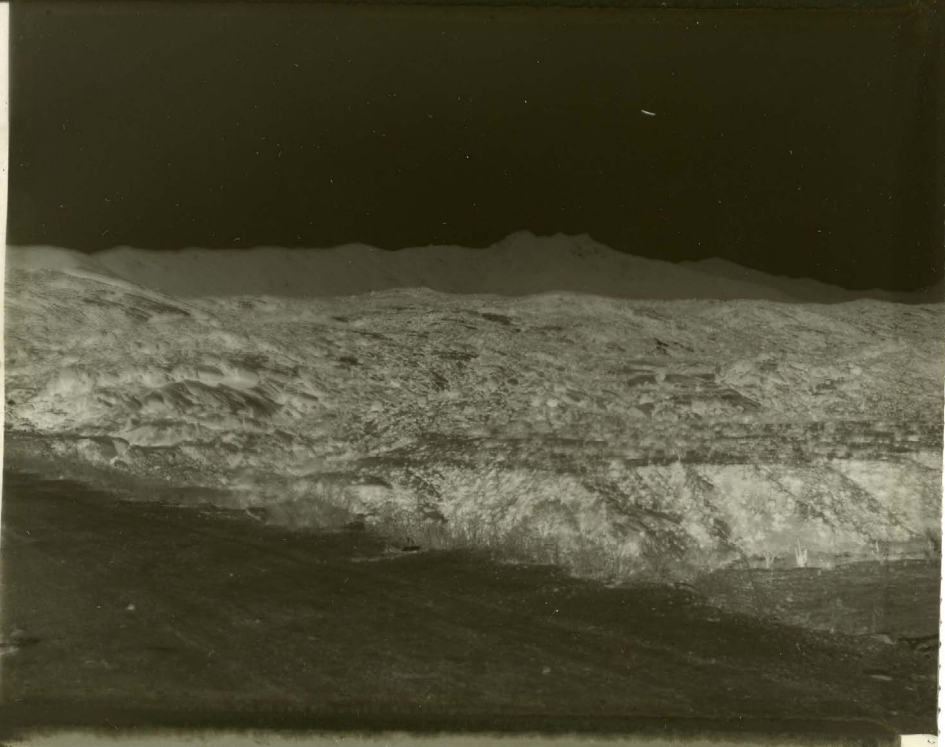


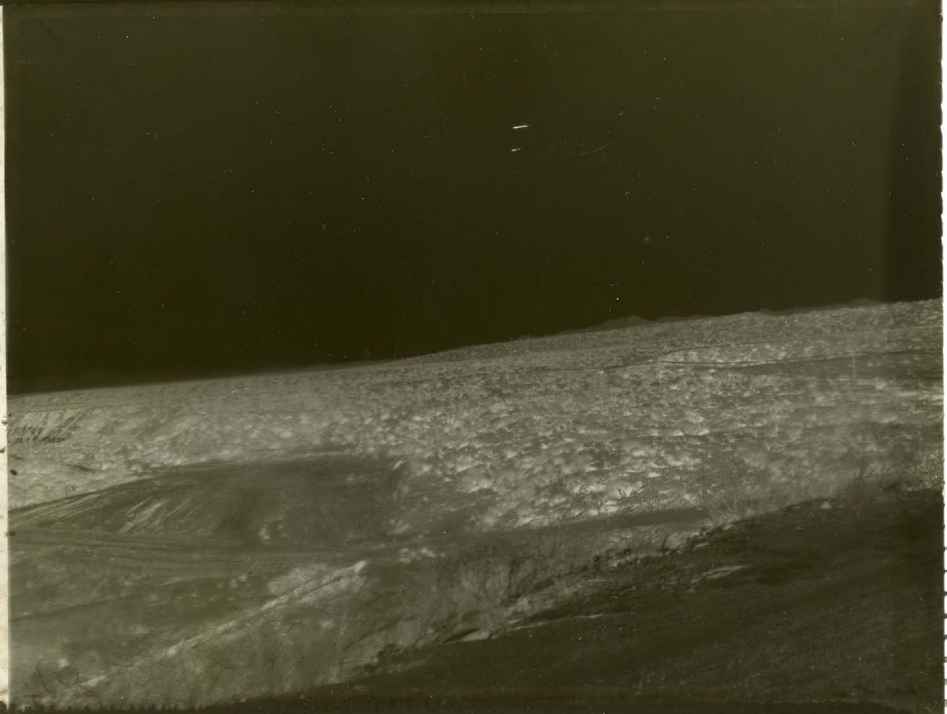












# HOFFMAN-MILLER, ENGINEERS, INC.

1242 East McDowell Road
Phoenix, Arizona

## TEST BORING LOG

PROJECT [illegible]
HOLE No. 16 SHEET No. 1 of 2 GROUND ELEVATION [illegible]
HOLE LOCATION [illegible] - STA 16+00

| HOLE DEPTH (Feet) | BLOWS PER FOOT: Casing | 2 in. Penetro-Meter | 1½ in. Soil Sampler | SOIL GRAPH | DESCRIPTION OF MATERIAL AND REMARKS | Date 8/15/63 By O.K.M. |
|---|---|---|---|---|---|---|
| 0 to 1 | | | | | WATER SURFACE 8/15/63 | |
| 2 | | | | | | |
| 3 | | | | | Decomposed granite sand, gravels, | |
| 4 | | | | | cobbles & occasional small | |
| 5 | | | | | boulders. Very little tanish | |
| 6 | | | | | brown colored silt. Moist | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | |
| 1 | | | | | | |
| 2 | | | | | WATER SURFACE 8/15/63 | |
| 3 | | | | | | |
| 4 | | | | | Decomposed granite sand, gravels, | |
| 15 | | | | | cobbles, & occasional small | |
| 6 | | | | | boulders. Quite high content | |
| 7 | | | | | of grayish brown colored silty | |
| 8 | | | | | clay. | |
| 9 | | | | | | |
| 20 | | | | | WATER ENCOUNTERED IN DRILLING 8/15/63 | |
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | Drove 1½ Sampler | |
| 25 | | | 60:6" 14:6" | | Tightly compacted decomposed granite | |
| 6 | | | | | sands, gravels, cobbles & small | |
| 7 | | | | | boulders. Tanish brown colored. | |
| 8 | | | | | | |
| 9 | | | 60:6" | | | |
| 30 | | | | | Drove 1½ Sampler | |

STANDARD PENETRATION TEST

# HOFFMAN-MILLER, ENGINEERS, INC.

1242 East McDowell Road
Phoenix, Arizona

## TEST BORING LOG

PROJECT Gaucin Dam

HOLE No. 16 SHEET No. 2 of 2 GROUND ELEVATION 163.9 FT. CORE TRENCH

HOLE LOCATION 75' N. CORE TRENCH STA 16+00

| HOLE DEPTH (Feet) | BLOWS PER FOOT: Casing | BLOWS PER FOOT: 2 in. Penetro-Meter | BLOWS PER FOOT: 1¾ in. Soil Sampler | SOIL GRAPH | DESCRIPTION OF MATERIAL AND REMARKS (Date 8/16/62, By A.F.M.) |
|---|---|---|---|---|---|
| 50 to 51 | | | | | Tuff, composite, decomposed granite, sand and gravel, some cobbles & small boulders. Tan & brown color. |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | Solid granite rock - stopped coring drilling |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |
| 60 | | | | | |
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |
| 0 | | | | | |
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |
| 0 | | | | | |

STANDARD PRINTING CO. — PHOENIX

# HOFFMAN-MILLER, ENGINEERS, INC.

1242 East McDowell Road
Phoenix, Arizona

## TEST BORING LOG

PROJECT GOLDEN DAM

HOLE No. 17 SHEET No. 1 OF 1 GROUND ELEVATION IN CORE TRENCH 105.0

HOLE LOCATION IN CORE TRENCH - STA. 14+50

| HOLE DEPTH (Feet) | BLOWS PER 1 FOOT: Casing | 2 in. Penetro-Meter | 1¾ in. Soil Sampler | SOIL GRAPH | DESCRIPTION OF MATERIAL AND REMARKS — Water Surface 8/20/63 | Date 8/19/63 By A.T. N. |
|---|---|---|---|---|---|---|
| 0 to 1 | | | | | Water Surface 8/19/63 | |
| 2 | | | | | Decomposed granite sand with few gravels. Very little silt or clay | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | Decomposed granite sandy gravels few cobbles & occasional small boulders. Quite high content of light greyish colored silty clay | |
| 9 | | | | | | |
| 10 | | | | | | |
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 15 | | | | | | |
| 6 | | | | | | |
| 7 | | | | | Same as last above & boulders to 12" size. | |
| 8 | | | | | | |
| 9 | | | | | Tightly compacted decomposed granitic sand - silica cementation *Appears to be soft granitic rock | |
| 20 | | | 24 blows | | | |
| 1 | | | | | | |
| 2 | | | | | Soft granitic rock | |
| 3 | | | | | | |
| 4 | | | | | | |
| 25 | | | | | | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 30 | | | | | | |

STANDARD PRINTING CO. - PHOENIX

# HOFFMAN-MILLER, ENGINEERS, INC.

1242 East McDowell Road
Phoenix, Arizona

## TEST BORING LOG

PROJECT [illegible]
HOLE No. [illegible] SHEET No. [illegible] GROUND ELEVATION [illegible]
HOLE LOCATION [illegible]

| HOLE DEPTH (feet) | BLOWS PER FOOT: Casing | 2 in. Penetrometer | 1.5 in. Soil Sampler | SOIL GRAPH | DESCRIPTION OF MATERIAL AND REMARKS<br>Note: Water [illegible] from top of hole in [illegible] 8/22/63 | Date [illegible]<br>By [illegible] |
|---|---|---|---|---|---|---|
| 0 to 1 | [illegible] | | | | Water surface 8/22/63 | |
| 2 | [illegible] | | | [illegible] | | |
| 3 | [illegible] | | | | | |
| 4 | [illegible] | | | | | |
| 5 | [illegible] | | | | | |
| 6 | [illegible] | | | | Compact gravel and gravel [illegible] & some boulders. Occasional boulders to 12 [illegible] | |
| 7 | | | | | | |
| 8 | [illegible] | | | | | |
| 9 | | | | | | |
| 10 | [illegible] | | | | | |
| 1 | [illegible] | | | | | |
| 2 | | | | | | |
| 3 | [illegible] | | | | | |
| 4 | [illegible] | | | | | |
| 15 | [illegible] | | | | | |
| 6 | [illegible] | | | | | |
| 7 | [illegible] | | | [illegible] | [illegible] | |
| 8 | [illegible] | | | | [illegible] | |
| 9 | [illegible] | | | | [illegible] | |
| 20 | [illegible] | | | | | |
| 1 | [illegible] | | | | | |
| 2 | [illegible] | | | | [illegible] - [illegible] | |
| 3 | [illegible] | | | | [illegible] | |
| 4 | [illegible] | | | | [illegible] | |
| 25 | [illegible] | | | | | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 30 | | | | | | |

PANCHAS PRINTING - PHOENIX, ARIZ.

# HOFFMAN-MILLER, ENGINEERS, INC.

1242 East McDowell Road
Phoenix, Arizona

## TEST BORING LOG

PROJECT [illegible]
HOLE No. [illegible] SHEET No. [illegible] GROUND ELEVATION IN CORE TRENCH 187.9
HOLE LOCATION IN CORE TRENCH - STA 13+50

| HOLE DEPTH (Feet) | BLOWS PER FOOT: Casing | 2 in. Penetrometer | 1⅜ in. Soil Sampler | SOIL GRAPH | DESCRIPTION OF MATERIAL AND REMARKS | Date 8/21/63 By ATM |
|---|---|---|---|---|---|---|
| 0 to 1 | | | | | WATER SOLEDIN 8/22/63 | |
| 2 | | | | | Decomposed granite sand, gravel, | |
| 3 | | | | | small cobbles & occasional small | |
| 4 | | | | | boulders. Very little tannish brown | |
| 5 | | | | | colored silt. | |
| 6 | | | | | WATER SOLEDIN AT COMPLETION OF BORING | |
| 7 | | | | | RISES 1½' IN HOLE 1-HOUR AFTER BORING | |
| 8 | | | | | Same as above with little tannish | |
| 9 | | | | | gray colored silty clay. | |
| 10 | | | | | | |
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | Decomposed granite sand, gravel, | |
| 4 | | | | | cobbles & boulders 8" to 12" size. | |
| 15 | | | | | Little tannish gray colored clay. | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 20 | | | | | | |
| 1 | | | | | Solid granitic rock | |
| 2 | | | | | Drills quite smooth | |
| 3 | | | | | 1200 to 1500 # drill pressure | |
| 4 | | | | | required | |
| 25 | | | 150-5" | | | |
| 6 | | | | | Drove 1¾ sampler | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 30 | | | | | | |

GENERAL PRINTING CO. - PHOENIX

# HOFFMAN-MILLER, ENGINEERS, INC.

1242 East McDowell Road
Phoenix, Arizona

## TEST BORING LOG

PROJECT [illegible]
HOLE No. [illegible] SHEET No. 1 of 1 GROUND ELEVATION [illegible]
HOLE LOCATION [illegible]

| HOLE DEPTH (Feet) | BLOWS PER FOOT: Casing | 2 in. Penetro-Meter | 1¾ in. Soil Sampler | SOIL GRAPH | DESCRIPTION OF MATERIAL AND REMARKS | Date [illegible] By [illegible] |
|---|---|---|---|---|---|---|
| 0 to 1 | | | | | [illegible] | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | [illegible] | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | |
| 1 | | | | | [illegible] | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 15 | | | | | | |
| 6 | | | | | [illegible] | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 20 | | | | | | |
| 1 | | | | | | |
| 2 | | | | | [illegible] | |
| 3 | | | | | | |
| 4 | | | | | | |
| 25 | | | | | | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 30 | | | | | | |

STANDARD PRINTING CO. — PHOENIX

# TURNER AND ASSOCIATES

CONSULTING
GEOLOGISTS, ENGINEERS
AND GEOPHYSICISTS
SPECIALIZING IN WATER

SAMUEL F. TURNER
REGISTERED GEOLOGIST
REGISTERED ENGINEER

350 EAST CAMELBACK ROAD
CRESTWOOD 4-2262
PHOENIX, ARIZONA


September 6, 1963

Hoffman & Miller, Consulting Engineers
1242 E. McDowell Road
Phoenix, Arizona

Dear Sirs:

Herewith is our report on "Investigation of Materials Underlying Dam Site on Canado del Oro Wash." The geological work was by Samuel F. Turner. The geophysical field work was by Paul Manera of the E. R. Geophysical Company. The interpretation and preparation of the report was by Samuel F. Turner.

We thank you for this opportunity to work with you. Please feel free to ask any questions about the report.

Very truly yours,

TURNER & ASSOCIATES

Samuel F. Turner

Samuel F. Turner

SFT:ca

# ENGINEERING OF MATERIALS UNDERLYING
# DAM SITE ON CAYUDO del OJO MASA

By

Samuel F. Turner

of

Turner & Associates,
Consulting Geologists and Engineers
358 E. Camelback Road
Phoenix, Arizona

REGISTERED GEOLOGIST
CERTIFICATE EXPIRES
SAMUEL F.
TURNER
DEC. 31, 1963
ARIZONA, U.S.A.

Registered Professional Engineer (Civil)
CERTIFICATE EXPIRES
SAMUEL F.
TURNER
DEC. 31, 1963
ARIZONA, U.S.A.

September 6, 1963

# INVESTIGATION OF MATERIALS UNDERLYING THE SITE OF CANADO del ORO WASH

By

Samuel F. Turner

of

Turner & Associates,
Consulting Geologists and Engineers

An earth-fill dam had been planned and construction started on the Canado del Oro Wash or Canyon, located in the southeastern part of Section 24, T. 10 S., R. 14 E. A coffer dam of earth-fill having been constructed upstream from the dam site, the site has been stripped and the construction of the trench down to impermeable materials has been partially dug. The concrete core wall across the lowest part of the present channel was partially constructed. It rests on granite exposed in the bed of the wash.

The trench was failed to find solid impermeable material for a distance of about 500 feet in the western part of the dam. The purpose of this investigation was to disclose more fully the materials which underlie this section of the site. This section might be described as starting at Station 12 + 00 on the northwest and continuing to Station 17 + 00 on the southeast.

Field Work.

The field work for this investigation consisted of one day geologic reconnaissance by Samuel F. Turner accompanied by Mr. Miller, of Hoffman and Miller, and two extremely long days of geophysical investigation by Mr. Paul A. Manera of the A. A. Geophysical Company. A normal three days work was accomplished in these two days in the field.

GENERAL GEOLOGY OF THE AREA NEAR THE
DAM SITE ON CANADA del ORO

The general geology of this area was well known to the author prior to this investigation. The eastern side of the dam site is on granite consisting having large acicular feldspars. This granite was further deeply weathered at the surface and somewhat fractured by the nearby faulting. Geologic work done by the U. S. Geological Survey in the area shows that a probable fault limits the western exposure of the granite. This probable fault was indicated by them as under or near the bed of the Canada del Oro in this locality. It was thought at first by the author that this fault underlay the section between Station 12/00 and 17/00, but the geophysical work failed to find the fault in this area and it is now believed that the fault is farther to the west.

The formation exposed to the west of the granite is the unconsolidated sand and gravel fill in the bed of the Canada del Oro and on the terrace at the sides. Underlying this recent material and exposed in the hills to the west is the Gila conglomerate. Our geophysical work in Arizona has disclosed that the Gila conglomerate can usually be divided into three different formations based on its geophysical and geological characteristics. The younger Gila is not well consolidated and is a good water-bearing bed. The middle formation has considerably more consolidation and can be considered as only a fair water-bearing bed. This is the material developed by the Calder Well which supplies water for the dam construction and is located about 1/2 mile farther west.

The older Gila or bottom Gila is well consolidated and is so old that the materials have been subject to so much weathering that the granite boulders have decomposed with the feldspars in the boulders becoming kaolin clay. In the larger boulders there may be a core of hard granite left in the center of the boulder. This is the material underlying the core trench and which was found and classified as granite in some of the core holes. This classification is easy to understand. The Gila conglomerate in this area consists entirely of granitic boulders enclosed in a clay ground-mass. The boulders have weathered into much clay. Therefore, it is almost impossible to tell the difference between weathered granite and weathered Gila conglomerate.

This older Gila conglomerate is considered to be a consolidated bed that will not transmit water readily under pressure. It will not channel and is not believed to be suitable for dam foundations. The Army Engineers plan to construct a large dam at the Cassadiaga site on the Gila River above Safford Valley. This site has the older Gila conglomerate not only in the bottom but in the walls. It was drilled and cleaned as satisfactory for dam construction.

The older Gila will not produce satisfactory industrial or irrigation wells. In places it will produce water enough for single domestic supplies. Its characteristics are best described by the results of one well in the Mimbres area. This was drilled to 1,500 feet and the water stands at 100 feet below the surface. However, a pump discharging 5 gallons per minute would pull the water completely to the bottom of the well. The reason for the low permeability in Gila conglomerate is the high degree of cementation with clay and the high degree of weathering, breaking the boulders down into clay.

Description of Geophysical Method Used

The geophysical method used was electrical resistivity as adapted for the surveying of dam sites and the locating of water wells.

The geophysical equipment used was built in the shop of Turner and Associates from designs originally prepared by O. M. Gish and W. J. Rooney and is known as Gish-Rooney Resistivity Apparatus. The Turner equipment, however, has been considerably improved over the original Gish-Rooney equipment because of the requirement for instruments that are much more sensitive and accurate in penetrating to the depths that are called for in this work.

The equipment is used to determine the electrical characteristics of the various layers of material that occur beneath the earth's surface. The theory of operation is based on the fact that different earth materials offer different degrees of resistance to the passage of an electrical current. The values are usually expressed in ohms per cubic centimeter. Clay and silt usually show lower resistivity than sand and gravel, although the amount and conductivity of the enclosed ground-water affects the value and may alter this general relation. Bedrock usually has a very high resistivity [illegible] conductive ore bodies [illegible] the surface.

The values of resistivity are plotted against the corresponding distance between the electrodes, which is related to the depth that the current penetrates, and the curves of the resistivity graph are adjusted mathematically to indicate the type and thickness of formations that the current passed through. The graphs are plotted on log-log paper as the type curves used for comparison were so plotted.

The following references give details regarding the theory of design and operation of this type of geophysical equipment.

Eve, A. S., and Keys, D. A., Applied Geophysics in the Search of Minerals: Cambridge University Press, 1932.

Heiland, C. A., Geophysical Exploration: Prentice-Hall, Inc., 1940.

Jakosky, J. J., Exploration Geophysics: Times-Mirror Press 2nd Edition 1950.

Turner, Samuel F., Practical Results from Resistivity Methods as applied to Ground-Water Problems in Arizona: presented before the American Institute of Mining and Metallurgical Engineers and the Society of Economic Geologists, St. Louis, Mo., 1951. Revised and expanded article by the same title published in Proceedings Fourth Nevada Water Conference, Carson City, Nevada 1956.

Dobrin, Milton B., Introduction to Geophysical Prospecting: McGraw-Hill Book Co., 1952.

The computed unit resistances in ohms per cubic centimeter have been placed on all of the cross-sections showing geophysical probes along with our interpretation of the probable formations that these unit resistances indicate.

## RESULTS OF GEOPHYSICAL WORK

The geophysical work consisted of six probes made in the bottom of one trench from Station 12+00 to Station 17+00, one probe made on top of the cutoff dam and one probe made on the flat-terrace surface south of the probes in the trench.

Cross-Section Under Earthfill Dam.

In this method of geophysics we are measuring the characteristics of half of a sphere in the ground. We measure this half sphere by halves or 1/4 spheres, first measuring the characteristics of the half to the right and then the characteristics of the half to the left. The characteristics or readings on these halves are plotted in cross-section form on diverging lines starting at the center at the surface and the reading to a depth of 10 feet is plotted at a depth of 10 feet but 5 feet to the right of the center for the right half and 5 feet to the left of the center for the left half. The reading for 100 feet is plotted at a distance of 50 feet to the right and at a depth of 100 feet, and 50 feet to the left and at a depth of 100 feet. This explains the cone shaped lines shown as the approximate centers of the halves in the cross-section. The computed resistances of the various layers are shown on the accompanying cross-section.

The interpretation of the cross-section will be given starting at the east at Station 17+00 and proceeding to the west. A granite knob is exposed at the surface just east of Station 17+00. Probe 1 was centered at Station 17+00 and the right or southeastern half of this probe encountered this solid granite at a depth of 70 feet.

Probe 2 was centered at Station 16+00, and Probe 3 at station 15+00, Probe 4 was made on the coffer dam, and Probe 5 was made at station 14+00. Probe 6 was at Station 13+00, and then Probe 7 was made between Probes 3 and 5 at Station 14+50. Probe 8 was made on the terrace flat south of the cross-section to show the characteristics of the material when not affected by the crushing.

On the cross-section the larger horizontal numbers or the numbers parallel to the probe lines represent the computed resistances of the layers indicated. The small figures located by dashes in the probe lines represent the depth below the bottom of the trench to the contact between different types of material.

The material in the bottom of the creek was loose unconsolidated sand and gravel with some silt and clay. The resistances of this layer varied from 1,000 to as high as 10,000 ohms per cubic centimeter. This variation is accounted for by varying amounts of clay in the material with the clayey material having the highest resistance. This material apparently continues to a depth of about 30 feet on the west half of Probe 1 and the east half of Probe 2, but for the rest of the cross-section it was not 10 feet. On the west half of Probe 3 it again went down to 20 feet.

Below this surface layer there is a layer of material with unit resistance values of 4,000 to 12,000 ohms per cubic centimeter. This is given on the graph as cobbles in the loose fill. It is possible that this is the top of the Gila conglomerate hardened and indicated by the deposition of lime. The drag line should tell which this is in short order after it has reached the correct depth.

There is always a tendency for the top of a formation to be harder than the remainder. This is because of the action of water bringing materials from above or back to the top and depositing them near the top of the formation. This is why the granite in the bed of the stream at the coffer dam is relatively resistant but then 10 to 20 feet underneath it becomes a weathered granite and continues that way for a hundred feet.

It should be kept in mind that each one of these depths may be off by several feet with the actual depth to the contact being less or more than that indicated. I would not be surprised if the drag line is stopped at a depth of 25 feet between Probes 1 and 2 and at 8 to 10 feet the rest of the distance to the west except on the left half of Probe 3 where it may go to 15 or 20 feet.

What we have called the old Gila conglomerate is the next formation and its resistance varies from 1,800 to 3,000 ohms per cubic centimeter, unless the second layer, as previously discussed, represents the top of this formation. The fourth formation beneath the surface with computed resistances varying from 1,000 to as great as 2,800 probably is the old Gila conglomerate but it is possible that it is weathered granite. A differentiation is not important to the problem as neither will transmit water in any amount or will give under pressure of the water in the dam.

Hard granite was found at a depth of 70 feet on the right half of Probe 1 and at 130 feet on the right half of Probe 2. It was found at 215 feet in the right half of Probe 3 and at 210 feet in the right half of Probe 5. At Probe 12 we found that this contact represented the fault zone and it was not until all of the probes were placed on the cross section and interpreted that it was seen that this is a topographical contact, that is, the conglomerate was deposited on a weathered and eroded granite surface. The fault will have to be to the left of Probe 7 and we had no indications of the fault in any of these probes.

Probe on Top of Coffer Dam

Probe 4 of this investigation was made on top of the coffer dam. The center was located 300 feet N 69° W of the grade over the overflow outlet at the east side of the coffer dam. The materials found in this probe will be discussed below.

The probe was started on the clay fill placed in the coffer dam. This is a weathered clay conglomerate produced by weathering of the Gila formation. From the surface down to a depth of 20 feet the material was this compacted clay conglomerate and the computed resistance was 3,000 ohms per cubic centimeter. From 20 to 40 feet the computed resistance was 10,000 ohms per cubic centimeter and this would be classed as fractured granite containing some water in the pressure zones. From 40 to 150 feet the computed resistance was 3,500 and this is classed as either weathered granite or fractured granite. It is believed that it is granite broken down by the action of the water or moisture constantly present under the bed of the stream and this has weathered the feldspar to a kaolin type of clay. At a depth of 150 feet hard granite was found and continued down to a depth of 250 feet which was the bottom of the probe. This granite had a resistance of 50,000 to 100,000 ohms per cubic centimeter.

Earth Resistivity Survey Dam Site, Canado del Oro

The center was located 470 feet N 25° W of the bench mark on the old masonry dam. Geophone was placed at the surface of the ground 250 to 300 feet southeast of the center of the probe. This geophone was connected and screened buried.

From the surface down to a depth of 20 feet the unit resistance was 30,000 ohms per cubic centimeter and this represents dry sand and gravel fill with some silt. From 20 feet to 50 feet the resistance was 1,200 and this usually represents a sandy silt but in this particular locality we believe it represents the unsaturated Gila conglomerate containing moisture. From 50 feet to 125 feet the resistance was 2,000 which represents more solid Gila conglomerate and from 125 feet to 250 feet the resistance was 3,000 representing still harder consolidated conglomerate. This rested on solid granite at 250 feet with the solid granite having a unit resistance of 50,000 to 100,000 ohms per cubic centimeter.

## CONCLUSIONS AND RECOMMENDATIONS

As a result of the geological and geophysical work at the dam site on Canado del Oro, it is believed that a drag line will be the best machine to be used to excavate the remaining unconsolidated material in the bottom of the trench. The maximum depth of this unconsolidated material is about 30 feet and it is probable that the depth will be about 10 feet in most of the section. The material in the bottom of the trench is unconsolidated sand and gravel and at a depth of about 10 feet in most of the probes we found a much more resistant material. This may be cobbles or very coarse gravel but I believe it more probable that this material will turn out to be cemented conglomerate at the top of the old Gila conglomerate. If this is correct, the drag line will not be able to penetrate this material to any degree and the material will be so cemented that it will not transmit water and will serve as a suitable foundation for the core of the dam.

The old Gila conglomerate which is the principal material underlying this part of the dam is considered to be tight enough and strong enough to hold the dam and the core wall without any drain or cutoff. One of the Large Army Engineer dams on the Gila River is planned at a site where both the bed and banks are of conglomerate similar to this.

Bob Elliott
623-0578
ROUTE

PHONE Nº 8073

AMT. DUE

☐ B & W

☐ COLOR

Henrich Geesp
NAME

DATE 2/3/8

ADDRESS

DEPOSIT

NO. OF ROLLS _____ (Limit 3)

ROLL SIZE 135

NO. OF NEGS. 3 strips (For Reprints)

PRINTS _____ EA.

## ENLARGEMENTS

5x7 ____ EA. 8x10 ____ EA.

| FX 135-36 | PRICE EACH | TOTAL |
|---|---|---|
| 1 DEVELOPING | | 100 film |
| 6 glassine PRINTS | 2½ | 15 MS |
| ENLARGEMENTS | 14 | 17.50 |
| TAX | | 18.65 |
| TOTAL | | 75 |
| Total Less Deposit | | 19.40 |

Bell

**SPECIAL INSTRUCTIONS**
best of each two neg
DW Matte
1 ea 8X10
panoramic view

Your film is guaranteed against loss or damage by us to the extent of replacement cost of film before exposure.

check neg for dust

OA — #1A - scratched do not print any

total 14
#

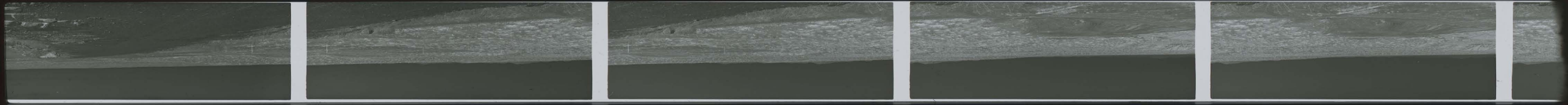
# TUCSON PHOTO COMPANY

521 N. 4th Ave. 623-8881
Tucson, Arizona 85705
Quality Photofinishing at LOW PRICES

~~OA~~ A

print #8 or 9 - #10 is 3rd of same

ANSCO PHOTO PRODUCTS OF
gaf GENERAL ANILINE & FILM CORPORATION
140 WEST 51 STREET, NEW YORK, NEW YORK 10020



Use for only one type of film

Responsibility for loss or damage limited to cost of film before exposure

778

P.O. # 0597

STORE NO.

NAME HEINRICHS GEOCX

DATE

ADDRESS P.O. BOX 5671

PHONE 623-0578

| CHECK FILM | √ |
|---|---|
| BLACK AND WHITE | |
| KODACOLOR | |
| KODACHROME | |
| EKTACHROME | |
| OTHER | |
| COLOR PRINT FROM SLIDE | |

**DEVELOP AND PRINT ORDERS**

FILM SIZE 35

NO. OF ROLLS

NO. OF PRINTS FROM EACH NEG.

**REPRINT ORDERS**

NO. OF NEGATIVES OR SLIDES

NO. OF PRINTS FROM EACH SLIDE OR NEG.

ENLARGEMENT SIZE

Jim - Grover

| INSTRUCTIONS | PRINTS MADE | PRICE |
|---|---|---|
| 16 X 20 | 5 | DEV. |
| | | PRINT 30.00 |
| | | TOTAL |
| | | TAX 1.20 |
| | | TOTAL 31.20 |

**TUCSON PHOTO COMPANY**

521 N. 4th Avenue 623-8881

TUCSON, ARIZONA 85705

Highest Quality Photofinishing

# USE THIS ENVELOPE TO ORDER

**CAUTION: HANDLE NEGATIVES BY EDGES ONLY**

**COLOR**

NO. OF COLOR TRANSPARENCIES _____

NO. OF COLOR PRINTS FROM EACH _____

NO. OF COLOR ENLARGEMENTS FROM EACH _____

(SIZE_____x_____-in.)

NO. OF DUPLICATE COLOR TRANSPARENCIES _____

NO. OF COLOR NEGATIVES _____

NO. OF STANDARD COLOR PRINTS FROM EACH _____

NO. OF ENLARGEMENTS FROM EACH _____

(SIZE_____x_____-in.)

**BLACK AND WHITE**

NO. OF NEGATIVES _____

NO. OF PRINTS FROM EACH NEGATIVE_____

NO. OF ENLARGEMENTS FROM EACH _____

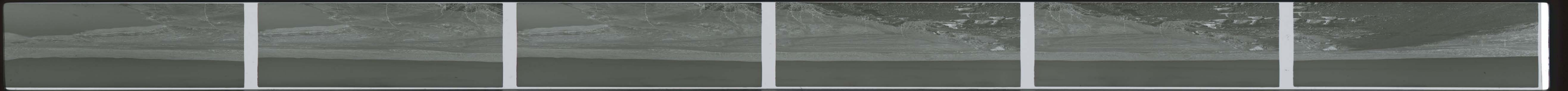
(SIZE_____x_____-in.)

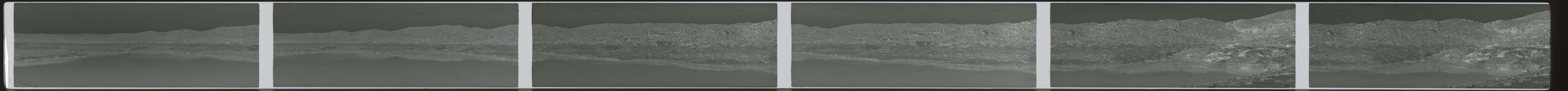
NAME_____

ADDRESS_____

_____

9A
2A
4A





# USE THIS ENVELOPE TO ORDER

**CAUTION: HANDLE NEGATIVES BY EDGES ONLY**

**COLOR**

NO. OF COLOR TRANSPARENCIES _____

NO. OF COLOR PRINTS FROM EACH _____

NO. OF COLOR ENLARGEMENTS FROM EACH _____
(SIZE _____ x _____ -in.)

NO. OF DUPLICATE COLOR TRANSPARENCIES _____

NO. OF COLOR NEGATIVES _____

NO. OF STANDARD COLOR PRINTS FROM EACH _____

NO. OF ENLARGEMENTS FROM EACH _____
(SIZE _____ x _____ -in.)

**BLACK AND WHITE**

NO. OF NEGATIVES _____

NO. OF PRINTS FROM EACH NEGATIVE _____

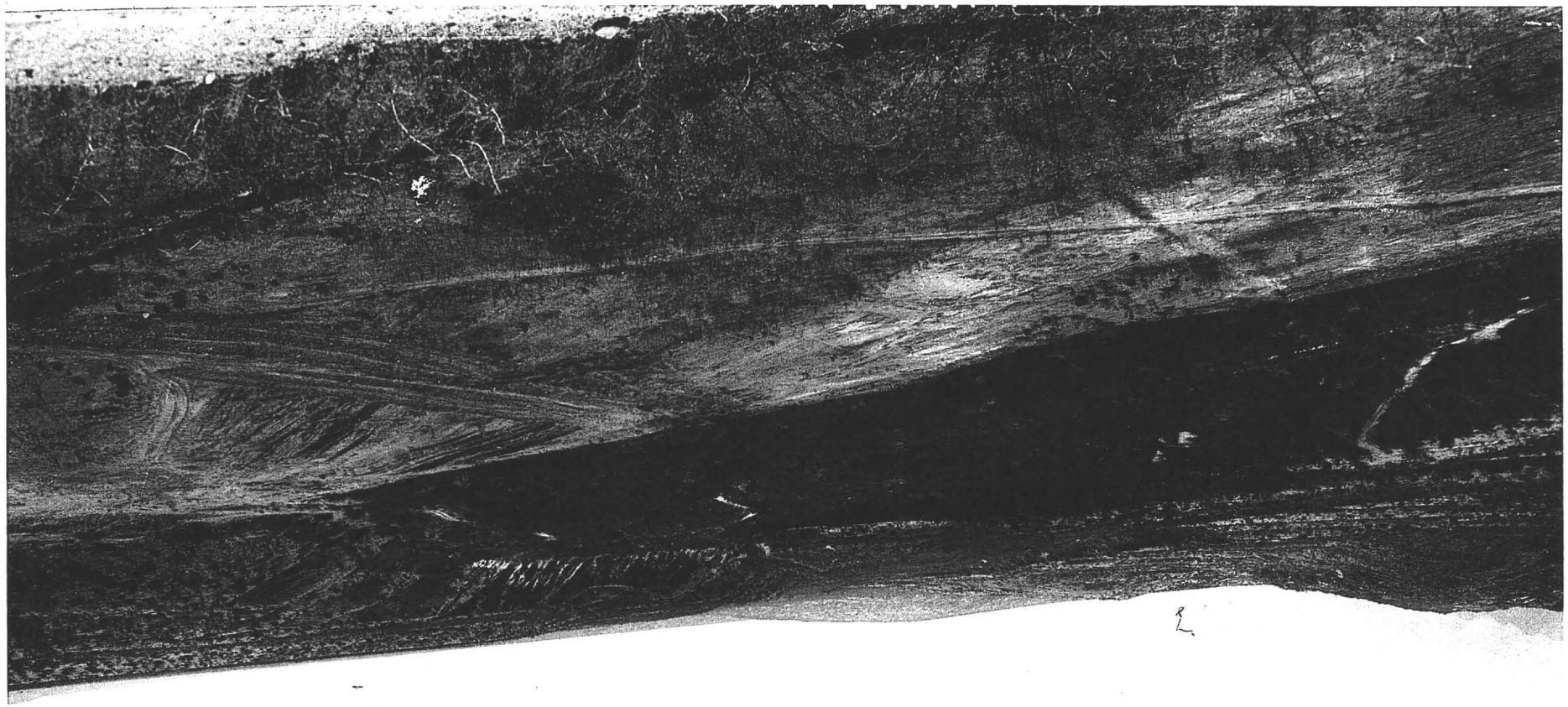
NO. OF ENLARGEMENTS FROM EACH _____
(SIZE _____ x _____ -in.)

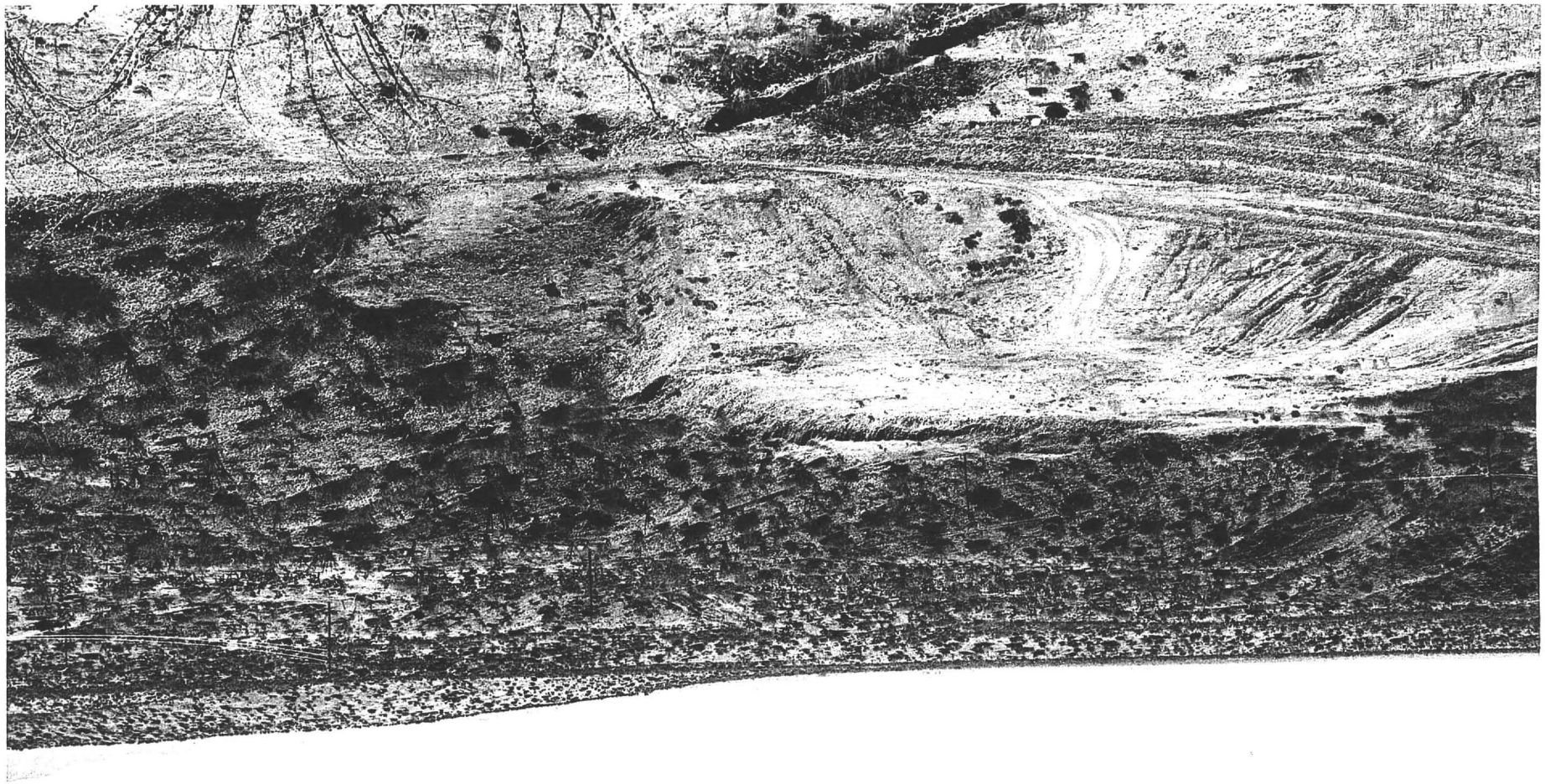
NAME _____

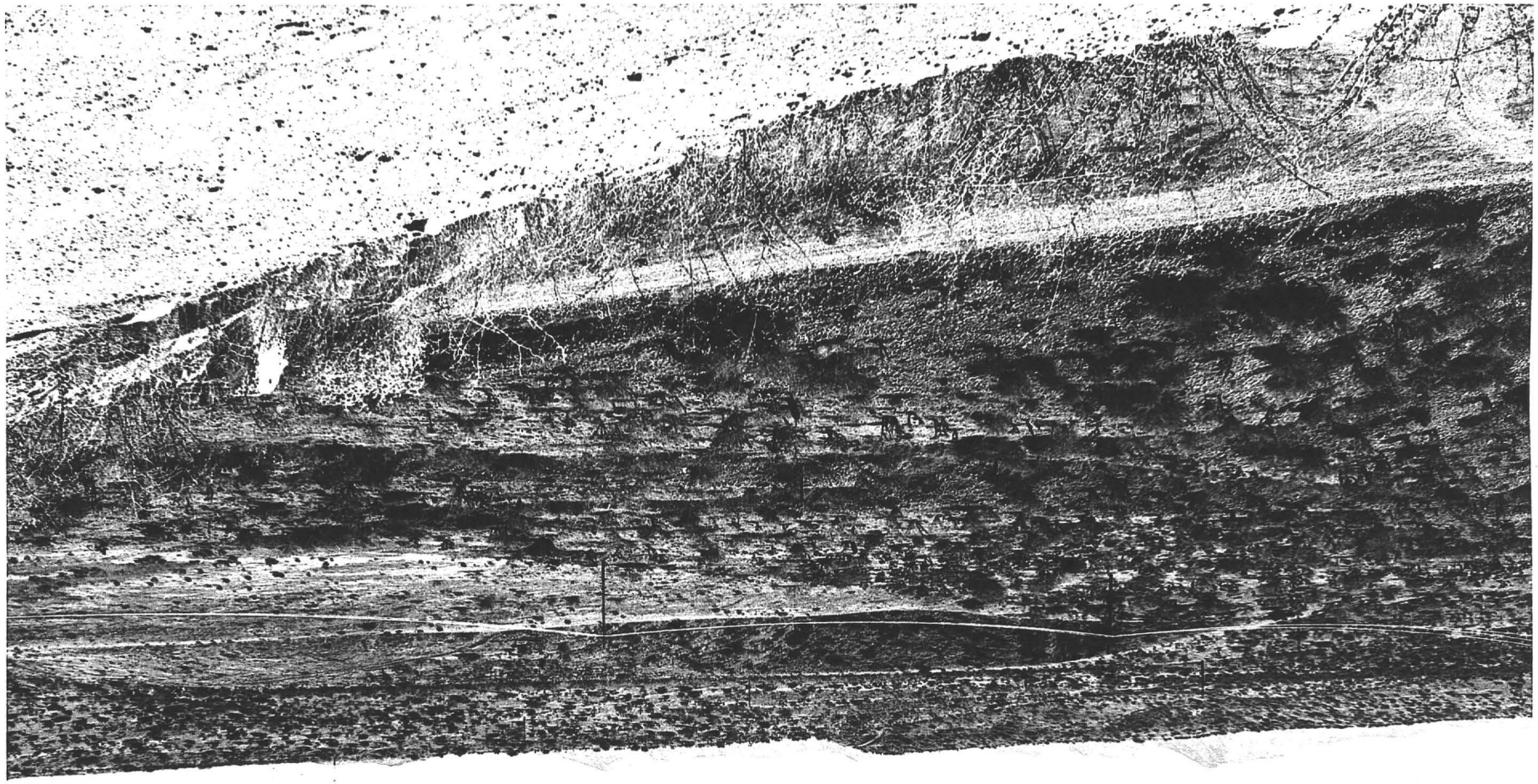
ADDRESS _____

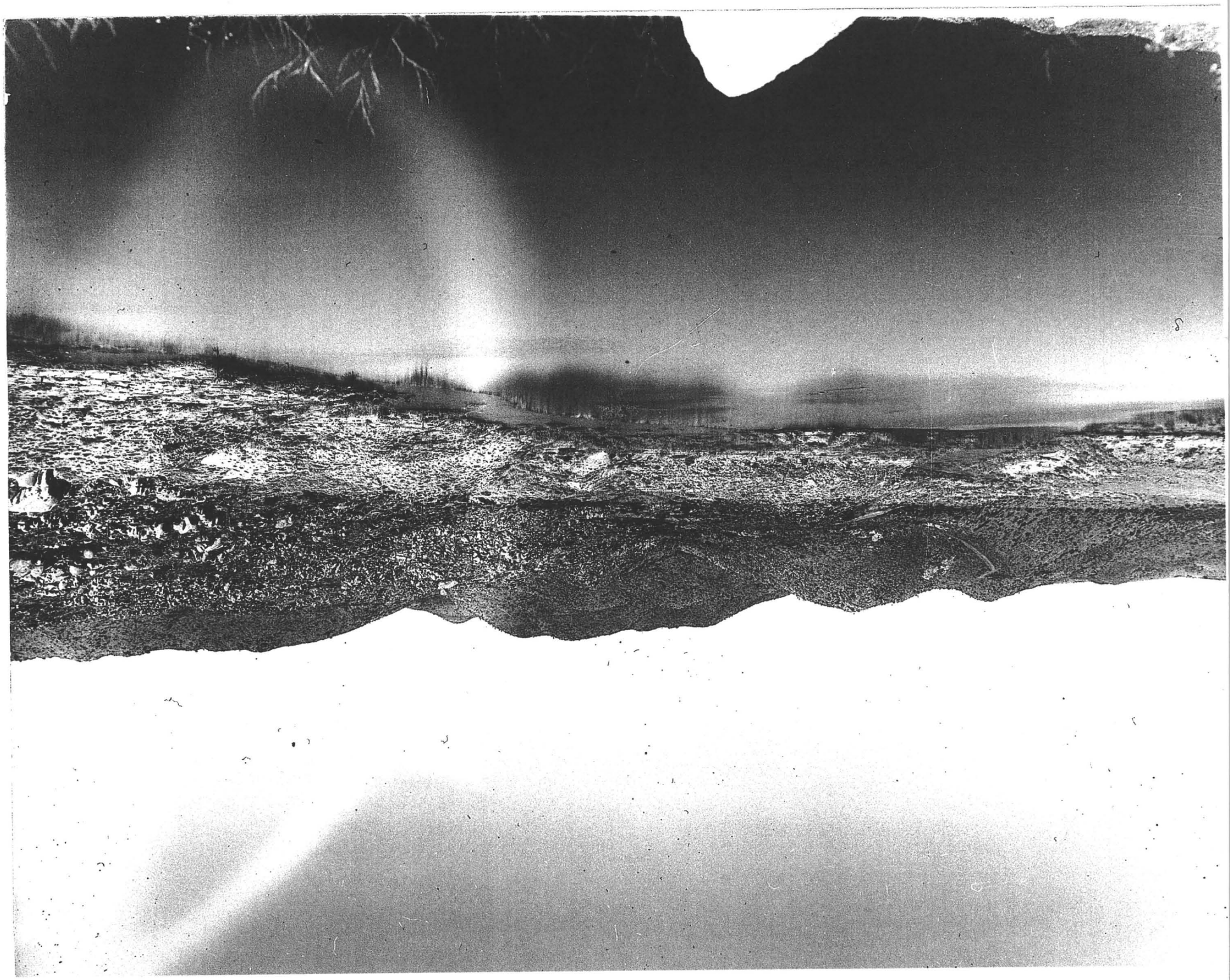
_____

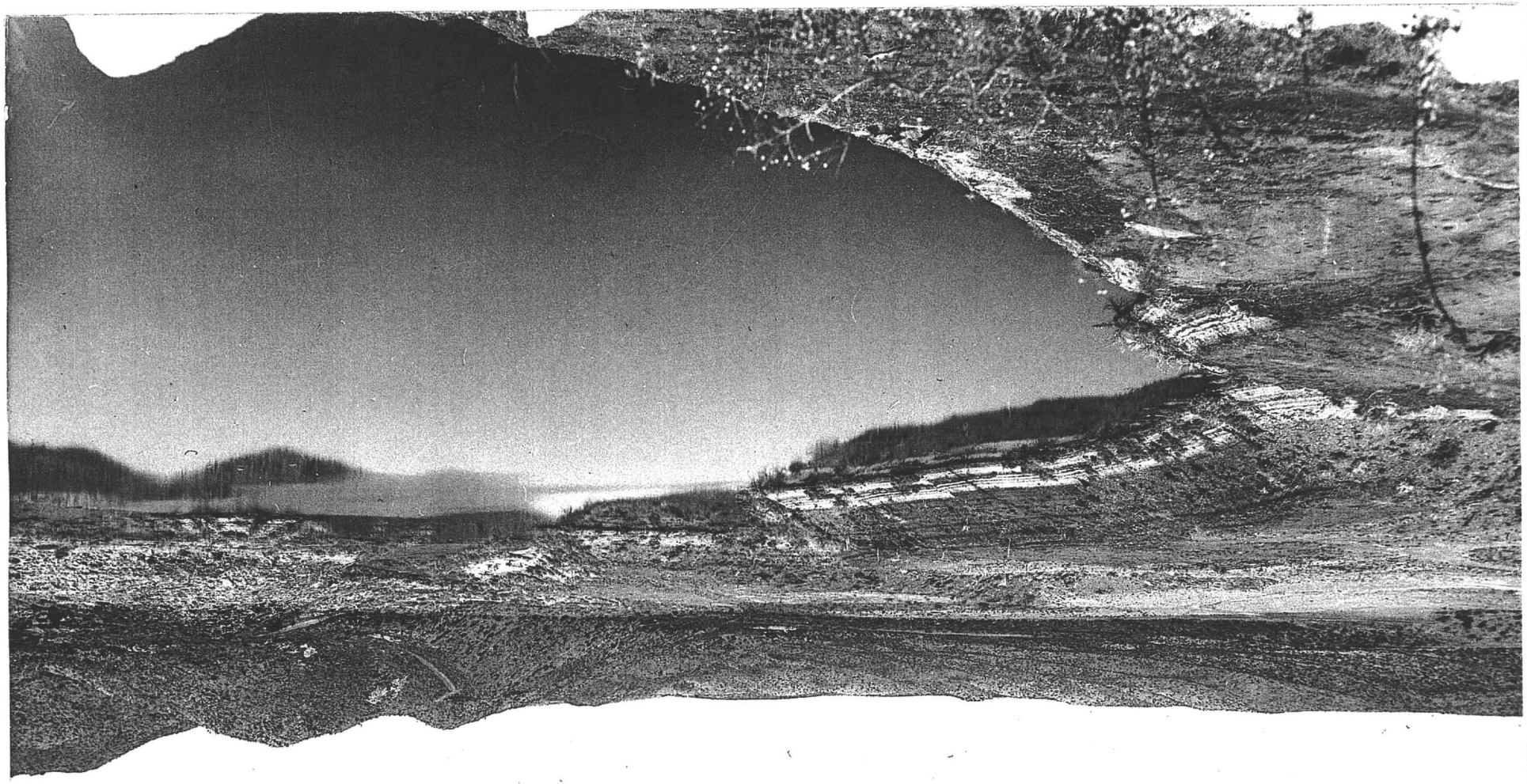
#16A
17A

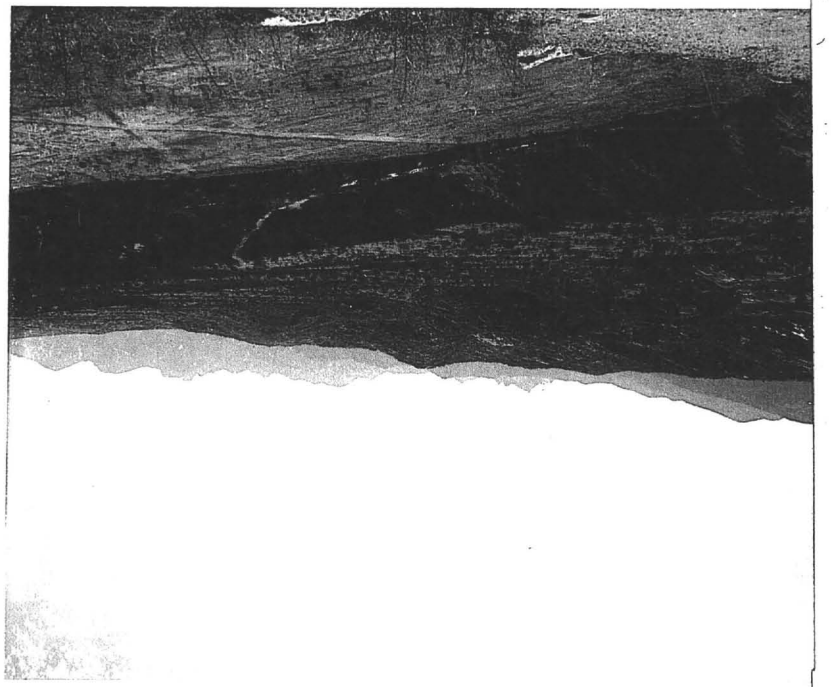


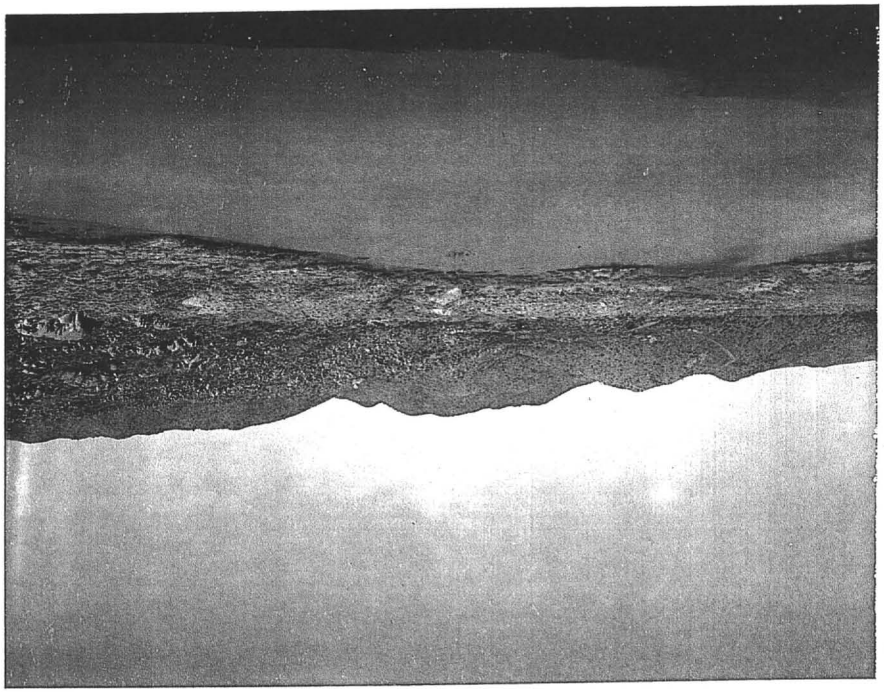


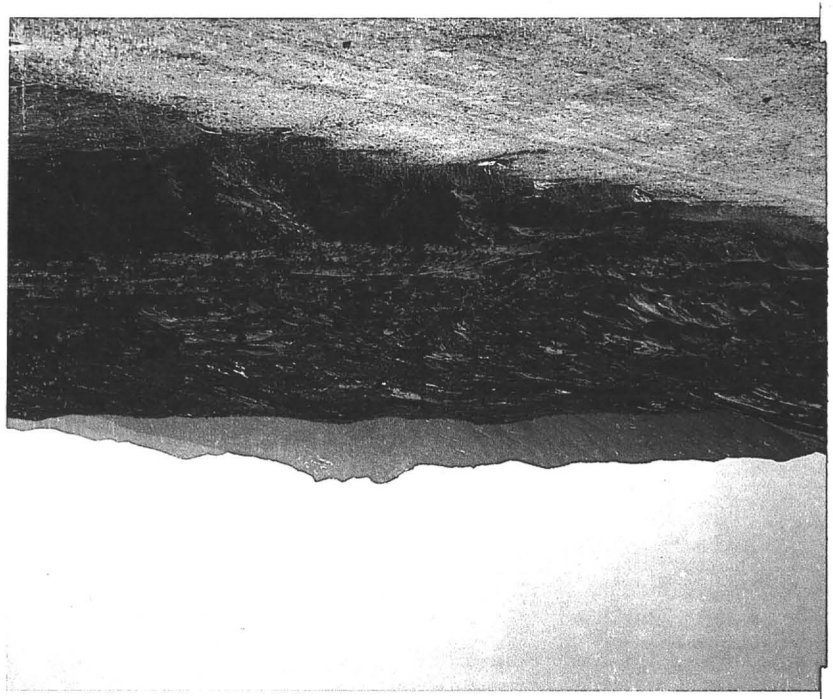


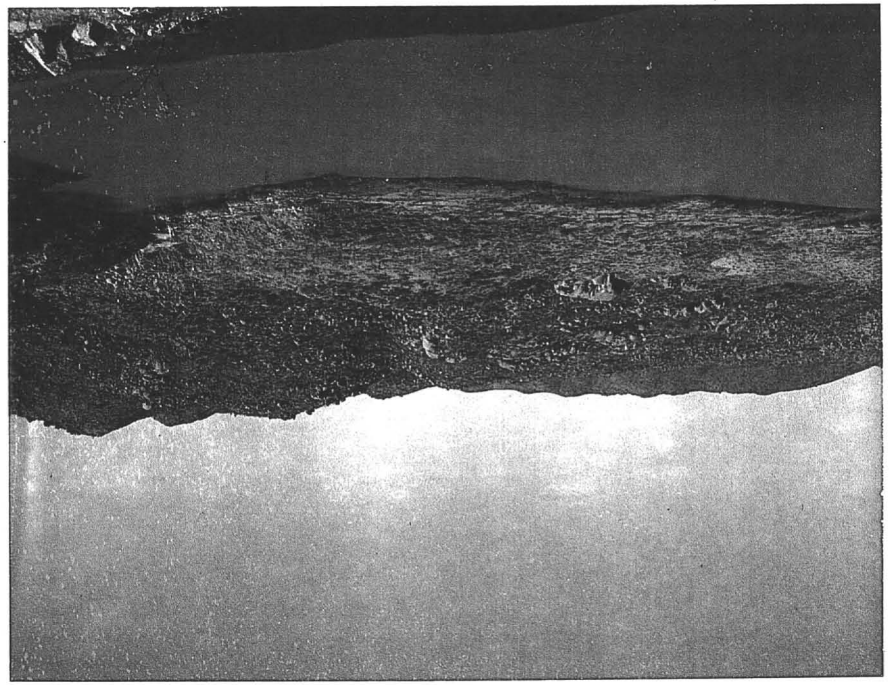












# ELECTRICAL RESISTIVITY SURVEY NEAR CANADA DEL ORO

SECTIONS 13 and 23, T. 10 S., R. 14 E. AND

SECTION 3, T. 11 S., R. 14 E. PIMA COUNTY, ARIZONA

for

RAIL N RANCH CORP.

by

Paul A. Manera

E. R. Geophysical Co.
350 E. Camelback Rd.
Phoenix, Arizona

April 29, 1963

REGISTERED GEOLOGIST
CERTIFICATE EXPIRES
PAUL A.
MANERA
DEC. 31, 19 63
ARIZONA U.S.A.

Paul A. Manera

# ELECTRICAL RESISTIVITY SURVEY NEAR CANADA DEL ORO SECTIONS 13 and 23, T. 10 S., R. 14 E. AND SECTION 3, T. 11 S., R. 14 E. PIMA COUNTY, ARIZONA

By

PAUL A. MANERA

## Introduction

This electrical resistivity survey was made at the request of Mr. Lloyd Golder for the purpose of locating one or more water well sites in the Canada del Oro area near Tucson, Arizona

The four electrical resistivity probes were located at sites determined by Mr. Samuel F. Turner during a geologic reconnaissance of the area.

## Probe 1

The center of Probe 1 was located 1,350 upstream from the road and creek crossing on the south line of Section 23, thence 525 feet due west in the SW¼ of Section 23, T. 10 S., R. 14 E. The probe was run in a N 2° E direction with the dotted half extended towards the north, the dashed half extended towards the south and the circles indicating the conditions at the center of the probe.

In general all four of these probes indicate that the material to the bottom of the probes is predominantly conglomerate of varying hardness and varying amounts of cementation. These conglomerates are usually productive when there is some variation in the conglomerate. Some layers, the ones with a lower resistance, are permeable enough to produce water.

| Depth below Surface in feet | Resistance in ohm-centimeters | Description of Materials |
|---|---|---|
| 0-10 | 4,000 | Clay and boulders. |
| 10-20 | 8,300 | A larger percentage of boulders. |
| 20-70 | 3,600 | Clay cemented sand and gravel. |
| 70-200 | 4,800 | Mildly cemented conglomerate. |
| 200-250 | 5,500 | Moderately cemented conglomerate. |
| 250-900 | 4,000 | Mildly cemented conglomerate. |
| 900-1,100 | 2,000 | Primarily sand and gravel with clay layers. |
| 1,100-1,200 | 5,000 | Cemented sand or conglomerate. |
| 1,200-1,300 | 2,000 | Primarily sand and gravel with clay layers. |
| 1,300-1,500 | 3,600 | Moderately cemented sand and gravel. |
| 1,500-2,000 | 2,500 | Predominantly sand. |

Probe 2

The center of Probe 2 was located approximately 750 feet N 56° W from the south ¼ corner of Section 13, T. 10 S., R. 14 E. The probe was run in a N 5 E direction with the dotted half extended towards the south, the dashed half extended towards the north and the circles indicating the conditions at the center of the probe.

Beneath the center of this probe the materials are quite similar with small variations of 300 to 500 ohm-centimeters between the different layers. Actually this small a difference in the electrical characteristics indicates that there is very little differences in the amount of cementation or the types of materials at depth below the surface. In general since the resistances are around 5,000 to 6,000 ohm-centimeters this indicates a relatively well cemented conglomerate.

| Depth below Surface in feet | Resistance in ohm-centimeters | Description of Materials |
|---|---|---|
| 0-10 | 4,000 | Clay and boulders. |
| 10-40 | 5,400 | Moderately cemented conglomerate. |
| 40-100 | 5,000 | Moderately cemented conglomerate, slightly less than the above layer. |
| 100-350 | 6,200 | Well cemented conglomerate. |
| 350-450 | 5,500 | Moderately cemented conglomerate. |
| 450-900 | 6,000 | Well cemented conglomerate. |
| 900-1,000 | 3,500 | Mildly cemented sand and clay. |

| | | |
|---|---|---|
| 1,000-1,100 | 6,000 | Well cemented conglomerate. |
| 1,100-1,300 | 3,500 | Mildly cemented sand and clay. |

Probe 3

The center of Probe 3 was located 628 feet S 39 W thence 2,300 feet S 46 W of the NE corner of Section 23, T. 10 S., R. 14 E. The probe was run in a N 25 E direction with the dotted half extended towards the northeast, the dashed half extended towards the southwest and the circles indicating the conditions at the center of the probe.

| Depth below Surface in feet | Resistance in ohm-centimeters | Description of Materials |
|---|---|---|
| 0-10 | 4,200 | Clay and boulders. |
| 10-14 | 6,300 | A larger percentage of boulders. |
| 14-40 | 3,500 | Mildly cemented conglomerate. |
| 40-500 | 6,800 | Hard cemented conglomerate. |
| 500-550 | 8,000 | Very hard cemented conglomerate. |
| 550-600 | 6,500 | Hard cemented conglomerate. |
| 600-800 | 7,000 | Conglomerate. A little more cementation than above. |
| 800-1,000 | 5,000 | Moderately cemented conglomerate. |

| | | |
|---|---|---|
| 1,000-1,100 | 1,000 | Primarily clay with sand. |
| 1,100-1,200 | 6,000 | Hard cemented conglomerate. |
| 1,200-1,300 | 1,000 | Primarily clay with sand. |
| 1,300-1,400 | 6,000 | Hard cemented conglomerate. |
| 1,400-1,500 | 1,000 | Primarily clay with sand. |
| 1,500-1,600 | 6,000 | Hard cemented conglomerate. |

Probe 4

The center of Probe 4 was located 550 feet N 30 E of the SW corner of Section 3, T. 11 S., R. 14 E. The probe was run in N 50 W direction with the dotted half extended towards the northwest, the dashed half extended towards the southeast and the circles indicating the conditions at the center of the probe.

| Depth below Surface in feet | Resistance in ohm-centimeters | Description of Materials |
|---|---|---|
| 0-10 | 6,600 | Clay and boulders. |
| 10-40 | 12,000 | Some cliche in the clay and boulders. |
| 40-100 | 5,800 | Sand and gravel. |
| 100-200 | 9,000 | Dry sand and gravel |
| 200-600 | 1,000 | Alternating layers of sand and clay. |
| 600-650 | 2,500 | Predominantly sand. |
| 650-700 | 1,000 | Alternating layers of sand and clay. |

| | | |
|---|---|---|
| 700-800 | 2,000 | Predominantly sand. |
| 800-900 | 1,400 | Alternating layers of sand and clay. |
| 900-2,000 | 1,700 | Alternating layers of sand and clay with a predominance of sand. |

Estimated Static Water Level

The probable water level as estimated by differences in elevation and water levels in wells of the area indicate that in Section 13 and 23, T. 10 S., R. 14 E. the probable static water level will be 400 feet below the surface. In Section 3, T. 11 S., R. 14 E. the probable static water level will be 200 to 250 feet below the surface.

Recommendations

The best possibility for a water well location in Sections 13 and 23, T. 11 S., R. 14 E. is 400 feet N 2 E of the center of Probe 1. A well drilled at this site should be drilled to a depth of 1,500 feet. The reason for this depth is to intercept the favorable materials located between 900 and 1,500 feet. The material below the water table from approximately 400 to 900 feet appears to be a material with very little variation. This might be caused by cementation, and it is preferable to drill through this and into materials of varying resistances.

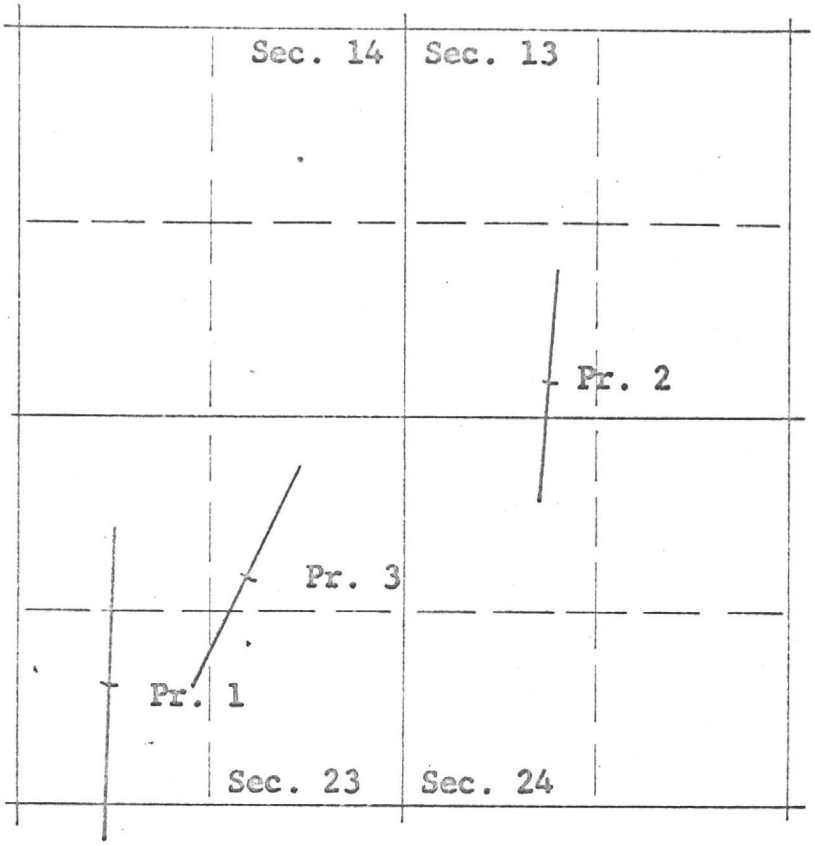
Probes 2 and 3 in this area, Section 13 and 23, do not appear as desirable for a well site as Probe 1. If future needs demand a second well, it is suggested that more detailed studies be made to determine the exact location for a second well. However, this area is not ruled out if more water is necessary in the future.

It is recommended that a well be drilled at the center of Probe 4 located in the SW¼ of Section 3, T. 11 S., R. 14 E. For maximum production it is recommended that the well be drilled to a depth of 1,500 feet. Actually this well may be drilled to a depth of 2,000 feet. Once again the reason for drilling to a depth of 1,500 feet is to encounter material of varying resistances below the water table primarily from 600 feet to the bottom of the recommended depth of 1,500 feet.

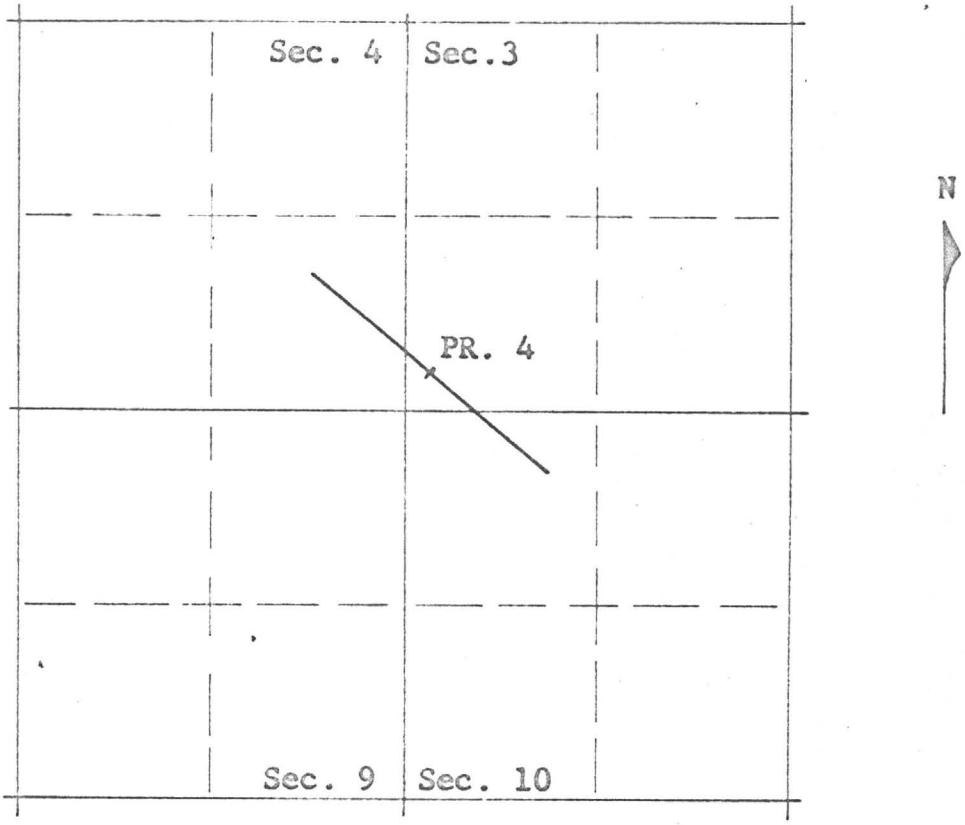
It is suggested that if a well is drilled on either of the recommended sites that drill samples be saved at 10 foot intervals during the drilling program. These samples when sent to this office will be logged at no additional charge. The purpose of these drill samples is to help determine the area for perforation if such data is necessary and to help in any future work in the area.

It is recommended that the well at Probe 1 be carried as deep as possible with 16 inch casing, then reduced to a 14 inch and then to 12 inch with the obsolute minimum diameter being 10 inch at the bottom of the hole. This applies to Probe 4 as well.

If there are any questions regarding this report, please feel free to call on us.




INDEX MAP SHOWING THE LOCATION OF PROBES 1, 2 & 3 IN T. 10 S., R. 14 E.




INDEX MAP SHOWING THE LOCATION OF PROBE

4 IN T. 11 S., R. 14 E.

K+E LOGARITHMIC 359-112L
KEUFFEL & ESSER CO. MADE IN U.S.A.
2 X 3 CYCLES

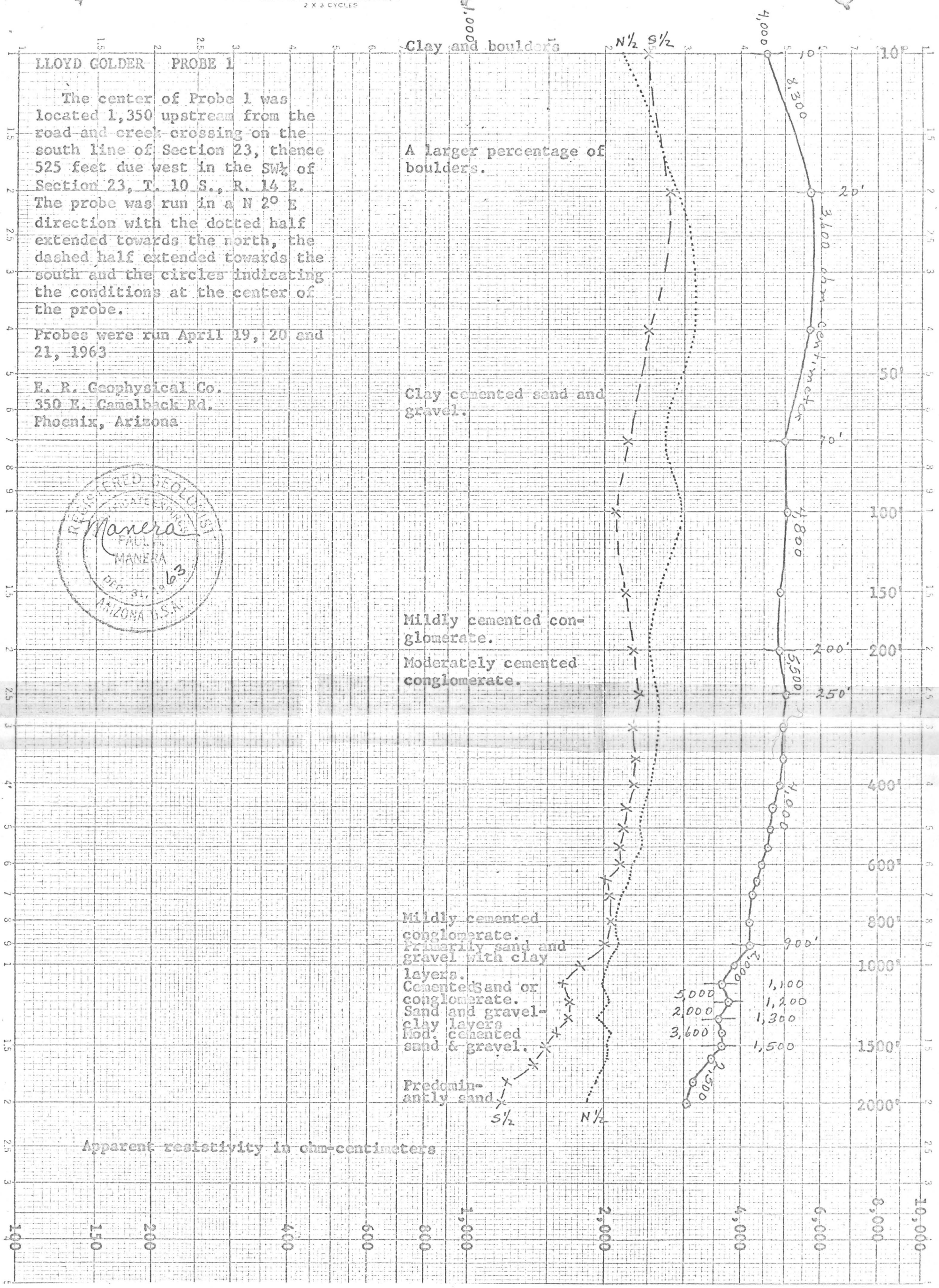
LLOYD GOLDER PROBE 1

The center of Probe 1 was located 1,350 upstream from the road and creek crossing on the south line of Section 23, thence 525 feet due west in the SW¼ of Section 23, T. 10 S., R. 14 E. The probe was run in a N 2° E direction with the dotted half extended towards the north, the dashed half extended towards the south and the circles indicating the conditions at the center of the probe.

Probes were run April 19, 20 and 21, 1963

E. R. Geophysical Co.
350 E. Camelback Rd.
Phoenix, Arizona

REGISTERED GEOLOGIST
Manera
FAUL
MANERA
DEC 31, 1963
ARIZONA U.S.A.



K+E LOGARITHMIC 359-112L
KEUFFEL & ESSER CO. MADE IN U.S.A.
2 X 3 CYCLES

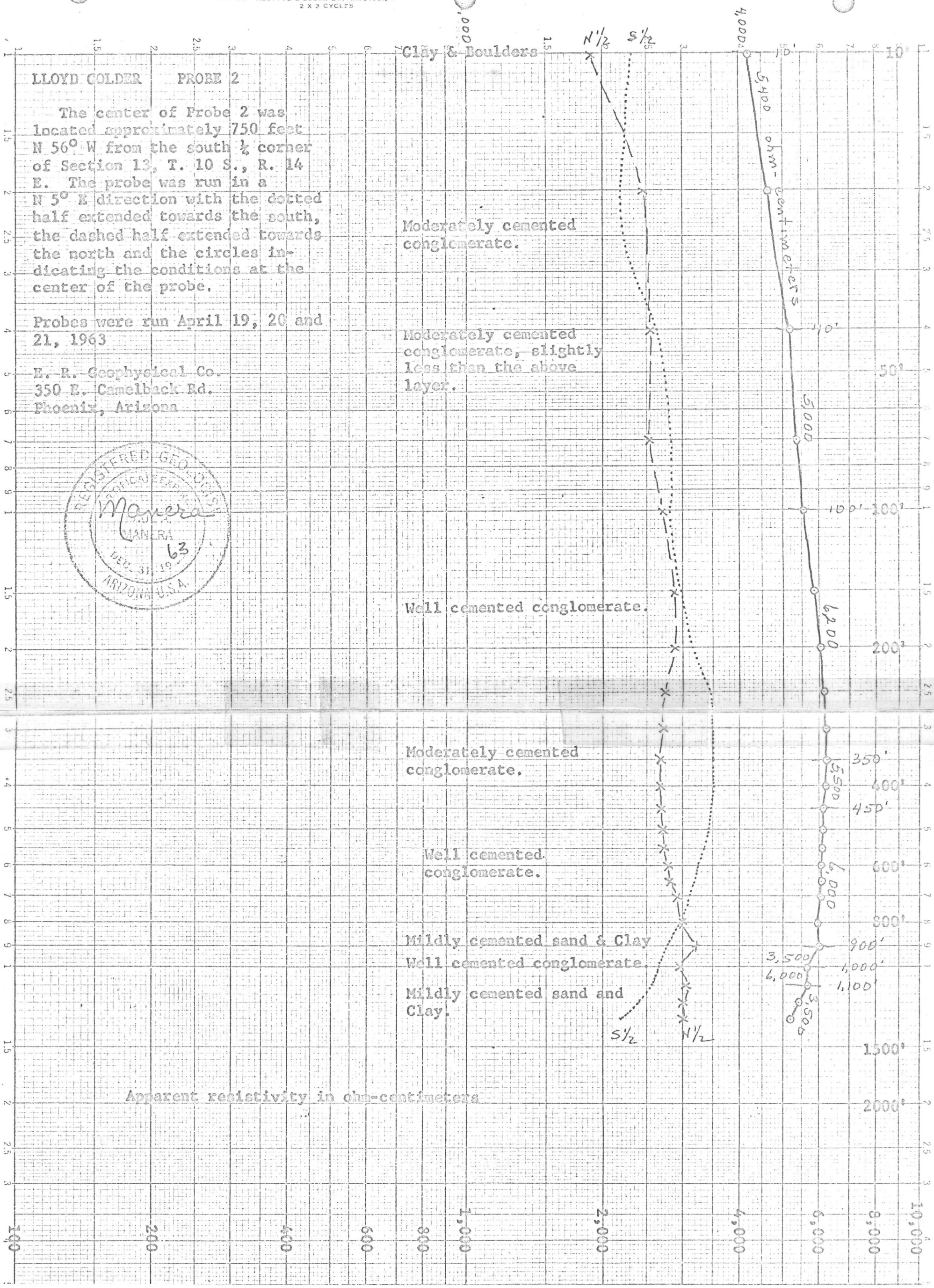
LLOYD COLDER PROBE 2

The center of Probe 2 was located approximately 750 feet N 56° W from the south ¼ corner of Section 13, T. 10 S., R. 14 E. The probe was run in a N 5° E direction with the dotted half extended towards the south, the dashed half extended towards the north and the circles indicating the conditions at the center of the probe.

Probes were run April 19, 20 and 21, 1963

E. R. Geophysical Co.
350 E. Camelback Rd.
Phoenix, Arizona

REGISTERED GEOPHYSICIST
Manera
MANERA
63
DEC. 31, 19
ARIZONA U.S.A.



K+E LOGARITHMIC 359-112L
KEUFFEL & ESSER CO. MADE IN U.S.A.
2 X 3 CYCLES

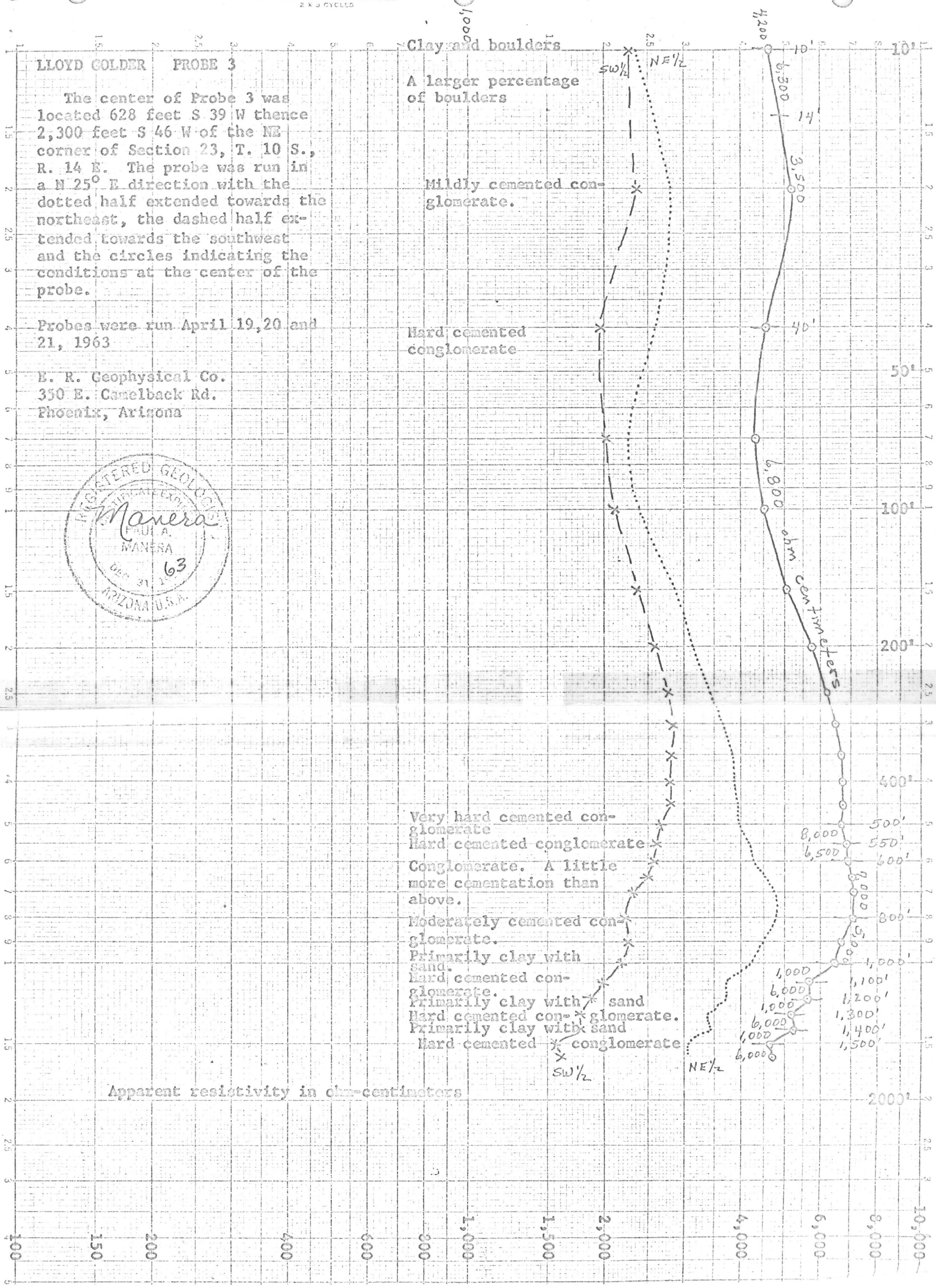
LLOYD GOLDER PROBE 3

The center of Probe 3 was located 628 feet S 39 W thence 2,300 feet S 46 W of the NE corner of Section 23, T. 10 S., R. 14 E. The probe was run in a N 25° E direction with the dotted half extended towards the northeast, the dashed half extended towards the southwest and the circles indicating the conditions at the center of the probe.

Probes were run April 19,20 and 21, 1963

E. R. Geophysical Co.
350 E. Camelback Rd.
Phoenix, Arizona

REGISTERED GEOLOGIST
PAUL A. MANERA
DEC 31 1963
ARIZONA U.S.A.

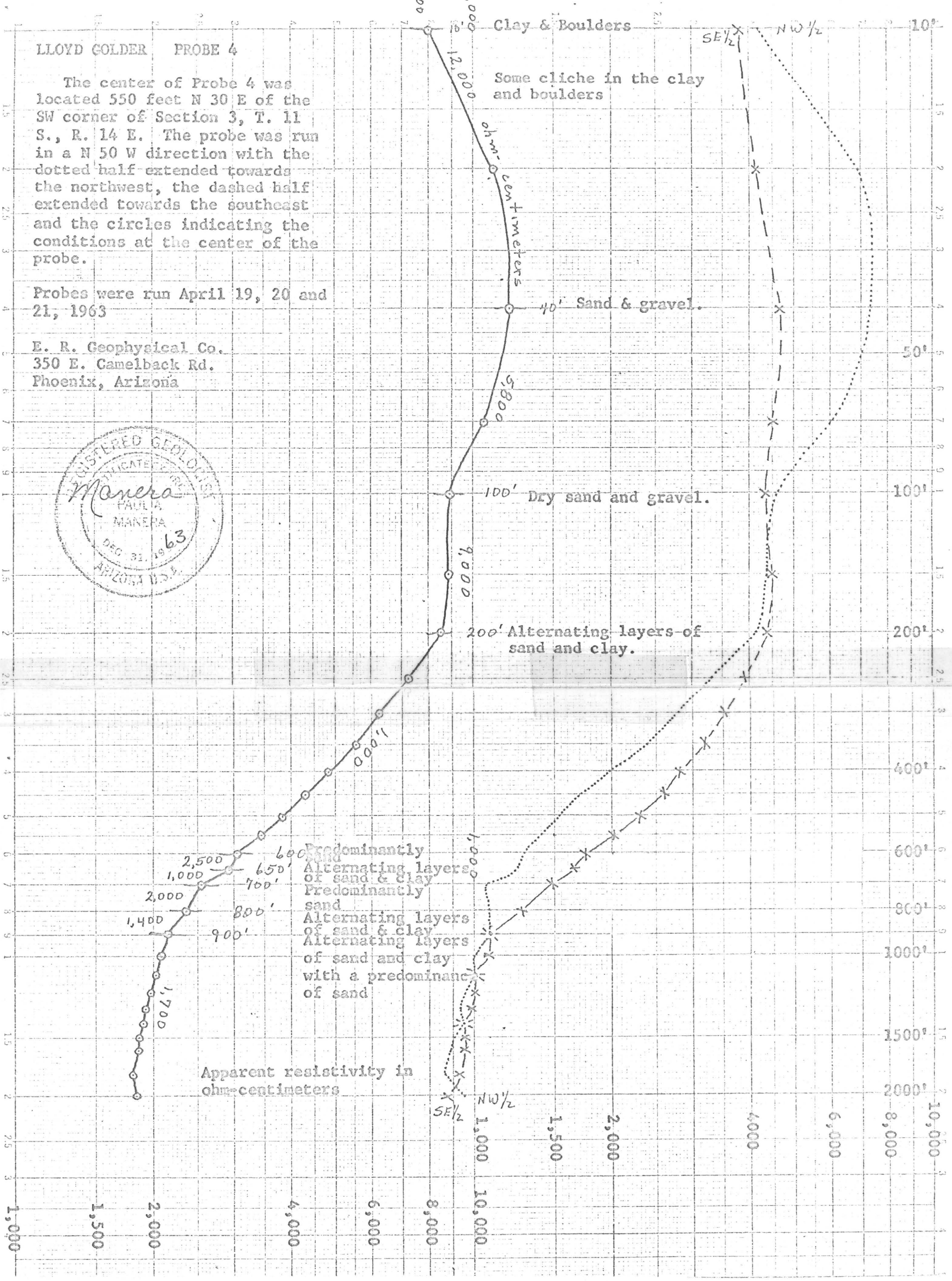


LLOYD GOLDER PROBE 4

The center of Probe 4 was located 550 feet N 30 E of the SW corner of Section 3, T. 11 S., R. 14 E. The probe was run in a N 50 W direction with the dotted half extended towards the northwest, the dashed half extended towards the southeast and the circles indicating the conditions at the center of the probe.

Probes were run April 19, 20 and 21, 1963

E. R. Geophysical Co.
350 E. Camelback Rd.
Phoenix, Arizona




REGISTERED GEOLOGIST
CERTIFICATE NO.
Manera
PAULA MANERA
DEC 31, 1963
ARIZONA U.S.A.