of filing fees and other expenses in connection therewith, and the appointment of a statutory agent for the service of process in the State of Arizona.

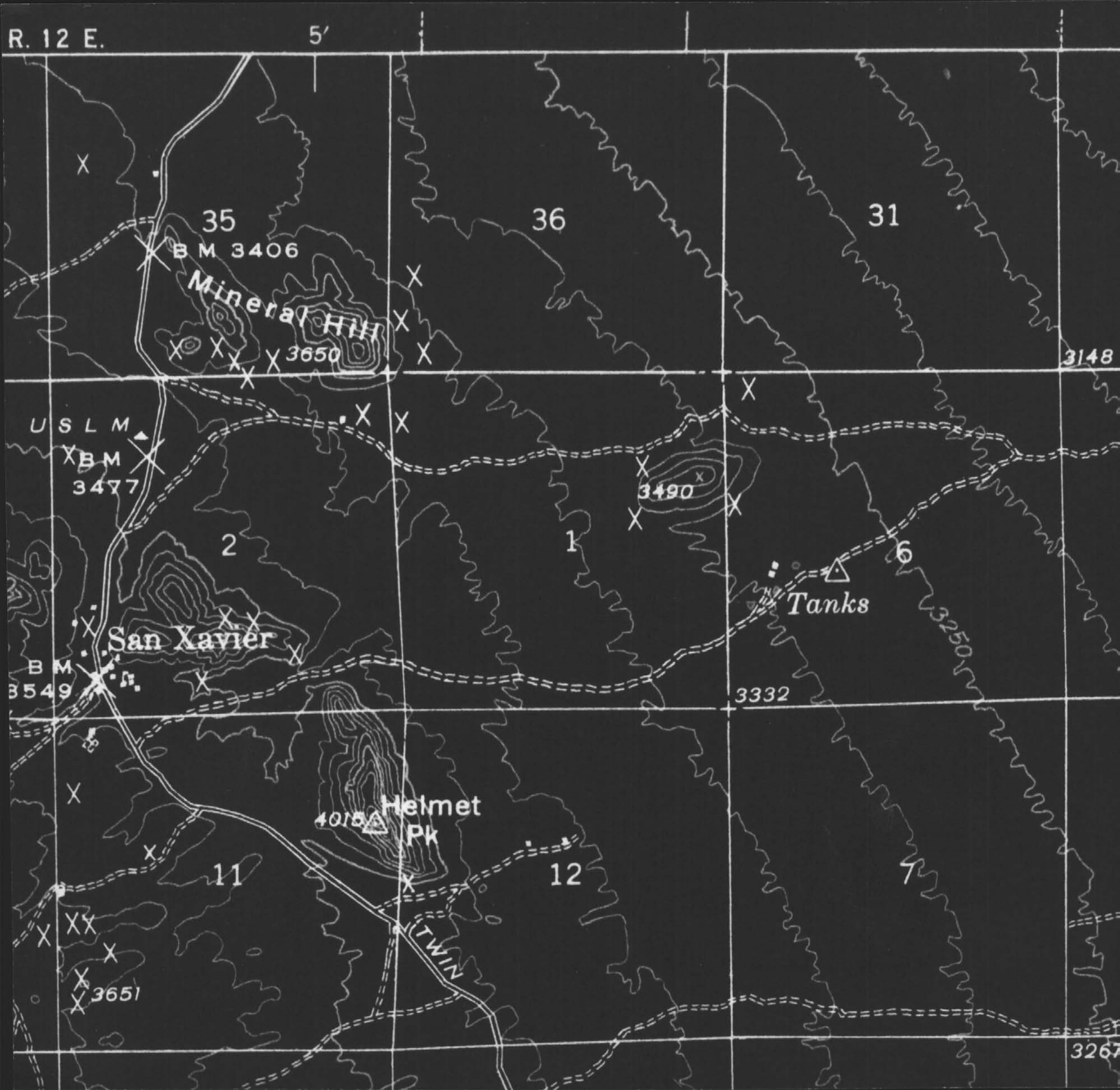
The Chairman then suggested that it would be advisable for the corporation to issue 50,000 shares of its authorized capital stock to United Geophysical Company, Inc. for cash in order to provide funds for the company's operations. After some discussion, on motion duly made, seconded, and unanimously carried, the following resolution was adopted:

> WHEREAS, this corporation is authorized to issue an aggregate of 75,000 shares of its capital stock of the par value of $1.00 per share;
>
> NOW, THEREFORE, BE IT RESOLVED, that any officer of this corporation be, and he hereby is, authorized and directed to prepare, or cause to be prepared, verified and filed on behalf of this corporation an application to the Commissioner of Corporations of the State of California (including amendments and supplements thereto and applications for amended permits) for a permit authorizing this corporation to sell and issue not to exceed 50,000 shares of its capital of the par value of $1.00 per share for cash at the price of $1.00 per share to United Geophysical Company, Inc.
>
> RESOLVED FURTHER, that upon the issuance of a permit by the Commissioner of Corporations of the State of California pursuant to such application, the President, or the Vice-President, and the Secretary, or the Assistant Secretary, be, and they hereby are, authorized and directed to sell and issue shares of stock of this corporation to United Geophysical Company, Inc. in the amount and for the consideration stated in, and in compliance with all the terms and conditions of, such permit and these resolutions.

RESOLVED FURTHER, that the officers of this corporation be, and they hereby are, authorized and directed to execute all documents and to take such action as they may deem necessary or advisable in order to carry out and perform the purposes of these resolutions.

There being no further business to come before the meeting, the same was upon motion duly made, seconded and unanimously carried, adjourned.

E. W. Cairns, Secretary (s)
E. W. Cairns, Secretary



R. 12 E.
5′
35
36
31
BM 3406
Mineral Hill
3650
3148
USLM
BM
3477
3490
2
1
6
Tanks
3250
San Xavier
BM
3549
3332
Helmet
Pk
4015
11
12
7
TWIN
3651
3267

The following claims are now to be considered holdings of Pima Mining Company. This includes those claims that are part of the original transfer from United Geophysical Company to Pima Mining Company

NAME	~~TYPE~~ LEASE	STATUS	TRANSFER
Delta	State lease	assigned Pima	none required
Beta	" "	" "	" "
Gamma	" "	" "	" "
Alpha 5	" "	" "	" "
Alpha 6	" "	" "	" "
Alpha 7	" "	" "	" "
Alpha 8	" "	" "	" "
Alpha fraction	Federal "	Pima	" "
Union No. 1 (patent pending)	Federal	assigned Pima	" "
Union No. 2 (patent pending)	"	" "	" "
Herrick No. 1 (patent pending)	"	Pima	" "
Herrick No. 2 (patent pending)	"	"	" "
Alpha 1	"	assigned Pima	" "
Alpha 2	"	" "	" "
Alpha 3 (patent pending)	"	" "	" "
Alpha 4 (patent pending)	"	" "	" "
Alpha 9	"	United	Transfer to Pima
Alpha 10	"	"	" "
Alpha 11	"	"	" "
Alpha 12	"	"	" "

PIMA MINING COMPANY

Holdings of Pima Mining Company

NAME	TYPE LEASE	STATUS	TRANSFER	
Alpha 13	Federal	United	Trans.	to Pima
Alpha 14	"	"	"	"
Alpha 15	"	"	"	"
Alpha 16	"	"	"	"
Alpha 17	"	"	"	"
Alpha 18	"	"	"	"
Alpha 19	"	"	"	"
Alpha 20	"	"	"	"
Alpha 21	"	"	"	"
Alpha 22	"	"	"	"
Alpha 23	"	"	"	"
Alpha 24	Federal	Pima	none	required
Alpha 25	"	"	"	"
Alpha 26	"	"	"	"
Alpha 27	"	"	"	"
Alpha 28	"	"	"	"
Alpha 29	"	"	"	"
Alpha 30	"	"	"	"
Alpha 31	"	"	"	"
Alpha 32	"	"	"	"
Alpha 33	"	"	"	"
Alpha 34	"	"	"	"

PIMA MINING COMPANY

Holdings of Pima Mining Company

NAME	TYPE LEASE	STATUS	TRANSFER
Alpha 35	Federal	Pima	none required
Alpha 36	"	"	" "
Alpha 37	"	"	" "
Alpha 38	"	"	" "
Alpha 39	"	"	" "
Alpha 40	"	"	" "
Alpha 41	"	"	" "
Alpha 42	"	"	" "
Alpha 43	"	"	" "
Alpha 56	"	"	" "
Alpha 57	"	"	" "
Alpha 60	"	"	" "
Alpha 61	"	"	" "
Alpha 62	"	"	" "
Alpha 63	"	"	" "
Alpha 64	"	"	" "
Alpha 65	"	"	" "
Alpha 66	"	"	" "
Alpha 67	"	"	" "
Alpha 68	"	"	" "
Alpha 69	"	"	" "
Alpha 70	"	"	" "
Alpha 71	"	"	" "
Alpha 72	"	"	" "

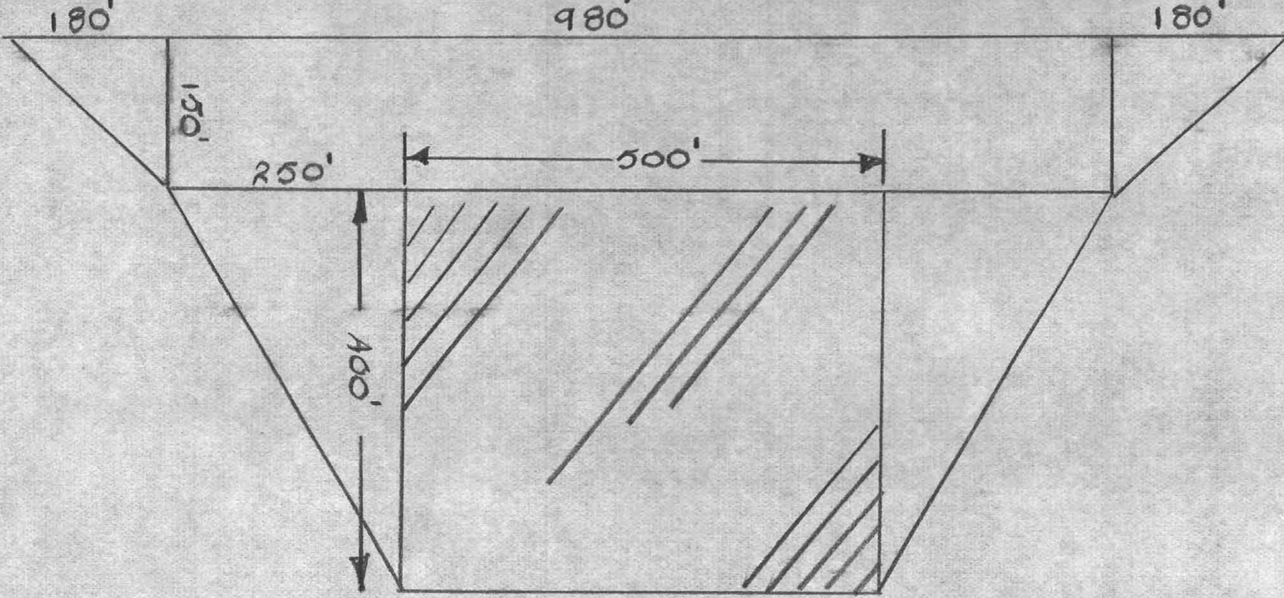
PIMA MINING COMPANY

Holdings of Pima Mining Company

NAME	TYPE LEASE	STATUS	TRANSFER
Alpha 73	Federal	Pima	none required
Alpha 74	"	"	" "
Alpha 75	"	"	" "
Alpha 76	"	"	" "
Alpha 77	"	"	" "
Alpha 78	"	"	" "
Alpha 79	"	"	" "
Alpha 80	"	"	" "
Alpha 81	"	"	" "
Alpha 82	"	"	" "
Alpha 83	"	"	" "
Alpha 84	"	"	" "
Alpha 85	"	"	" "
Alpha 86	"	"	" "
Peak No. 1	Federal	United	Trans. to Pima
Peak No. 2	"	"	" "
Peak No. 3	"	"	" "
Peak No. 4	"	"	" "
Peak No. 5	"	"	" "
Peak No. 6	"	"	" "
Peak No. 7	"	"	" "
Peak No. 8	"	"	" "
Peak No. 9	"	"	" "
Peak No. 10	"	"	" "
Peak No. 11	"	"	" "
Alpha 87	State lease	Pima	none required

NAME	TYPE LEASE	STATUS	TRANSFER
Alpha 88	State Lease	Pima	none required
Alpha 89	"	"	" "
Alpha 90	"	"	" "
Alpha 91	"	"	" "
Alpha 92	"	"	" "
Alpha 93	"	"	" "
Alpha 94	"	"	" "
Alpha 95	"	"	" "
Alpha 96	"	"	" "
Alpha 97	"	"	" "
Alpha 98	"	"	" "
Alpha 99	"	"	" "
Alpha 100	"	"	" "
Alpha 101	"	"	" "
Alpha 102	"	"	" "
Alpha 103	"	"	" "

Total Claims: 108



$$\frac{500 \times 400 \times 1500}{14} = 21,000,000 \text{ tons Ore}$$

<u>Waste Calculations:</u>

2 X 1/2 X 400' X 250' X 1500	=	150,000,000
2 X 1/2 X 180 X 150 X 1500	=	40,000,000
150 X 980 X 1500	=	220,500,000
		410,500,000

$$\frac{410,500,000}{18} = 22,800,000 \text{ tons}$$

Stripping ratio approximately 1:1

<u>PIMA MINING COMPANY</u> <u>" O.P." PRELIMINARY</u>

<u>Estimated Deposit</u>

500' wide

400' deep

1500' long

150' average over burden

Calculated Tonnage: 21,000,000 tons

Calculated overburden and waste: 22,800,000 tons

Stripping Costs

8,500,000 yds. @ 0.15	=	$1,275,000
10,000,000 tons @ 0.30	=	3,000,000
		$4,275,000

Cost of Plant: On basis of Stearns-Rogers costs at Silver Bell.

5000 tons per day @ $1100 per ton of capacity $5,500,000

Surface Plant

1. Shops . . . $150,000
2. Housing . . $140,000
3. Admin.Bldg. $ 15,000
4. Change House$ 20,000
5. Power Install. $150,000
6. Warehouse $ 15,000
7. Miscell. $ 10,000 — $ 500,000

Development Costs, DRILLING, underground development and drilling — $ 450,000

Total Costs: $10,725,000

Milling - 95% recovery

Estimated Grade - 1%

Concentrates - 27%

Concentration ratio $\frac{27}{.95}$ = 28.4:1

<u>Estimated Average Price:</u> 0.24½ per lb.

(27 X 2000) - 20 X (.245 - .03)	=	$111.80 Cu.
2 oz. silver X .95 X 0.883	=	1.68 Ag.
		$113.48
Less freight, hauling, treatment charges		17.30
Net		$ 96.18

Net Value of Ore = $\frac{\$96.18}{28.4}$ = 3.38

Depreciation: $\frac{\$10,725,000}{21,000,000}$ = $0.51

Mining	0.30	
Milling	1.00	
Depletion	0.78	
U. S. income tax(52 X .78).	0.40	
Total Costs		$2.99

Net before State taxes: $3.38
2.99
$0.39

Total Profit($0.78 + .39) = 1.07
State income tax: 0.02
State and County tax: 0.15
Less: .17

Total Net Profit per Ton = $ 0.90

Assume value of property for tax purposes $5,000,000

REPORT ON THE ORE RESERVES,

EXPLORATION PLANS AND COSTS

for the

ALPHA MINING PROPERTY

Pima Mining District
Pima County, Arizona

by

Harry E. Krumlauf
Consulting Mining Engineer
Tucson, Arizona
November 14, 1951

C
O
P
Y

2401 E. 6th St.

November 14, 1951

UNITED GEOPHYSICAL COMPANY, Inc.
595 E. Colorado Street
Pasadena 1, California

Dear Sirs:

This report on the probable ore reserves of Alpha mineral deposit, cost of recommended exploration and possible profits to be derived from mining is a part of the overall report submitted to you by Dr. Bert S. Butler.

Dr. Butler's section of this report is based on many successful years of experience and I recommend that his suggestions and opinions be carefully considered.

As Dr. Butler has stated in his report, the information obtained from the diamond drilling program to date is not conclusive and for this reason the results arrived at in this report may be in error. However, the information gained by the drilling is very favorable and I recommend that additional information be obtained.

Since underground exploration gives the most satisfactory and reliable information, it is my opinion that this phase of the program should now be considered. The encouraging results of the drilling warrants the cost of obtaining this desired information.

I wish to thank the Tucson staff of your organization for their cooperation and assistance in furnishing information for this report.

Sincerely yours,

(s/HEKrumlauf)

Harry E. Krumlauf

Smelter charges

The tentative purchase schedule offered by the American Smelting and Refining Company for the ore and dated August 27, 1951, was for a "limey flux" ore. Since the Alpha ore is siliceous and contains considerable magnetite, a new schedule must be obtained. If the silica content is above 60 per cent and the alumina content is low, the ore can be used as a converter flux and a similar schedule used. If the alumina and magnetite contents are both high, a much less favorable schedule will be obtained.

Samples are being furnished to the A. S. & R. Company for analysis. Mr. Welch, ore buyer for the A. S. & R. Company, will then offer a new schedule.

Grade of ore

Assuming the ore can be used as a converter flux and will be paid for at the same rate given on the purchase schedule submitted by the American Smelting and Refining Company dated August 27, 1951, the minimum or "break even" grade is about 4.5 per cent copper. The current price of copper at 24.5 cents per pound was used in the calculations. The drill logs show a substantial tonnage of material of lower grade that may become ore if the cost of mining can be reduced below the $10 per ton used in this estimate. Also a favorable contract with the Eagle Picher Mining and Smelting Company to concentrate the ore before shipment may permit the profitable mining of some low grade material.

Cost estimates based upon a company-owned concentrator must await the proving of a much larger ore body.

Ore reserves

It is difficult to determine ore reserves from the results of diamond drilling in a newly discovered mineral deposit. Diamond drilling results are frequently unreliable and their accuracy or inaccuracy can be proven only by underground exploration.

The report on the ore reserves submitted by Mr. E. D. Spaulding in October has been checked and the method used is correct. Mr. Spaulding has used only that portion of the indicated ore body of good grade that seemed to be more or less continuous. Some portions of this indicated ore did not extend to adjacent drill holes and were not included in the reserves; this is on the side of conservatism.

The tonnage factor of 9 cubic feet used by Mr. Spaulding in his report seems to be low. Although the ore does contain substantial amounts of magnetite, its principal content is silica. Also, the ore in many places contains fractures and vugs which would increase the volume of voids and voids are not readily detected in diamond drill cores but will reduce the specific gravity of the ore. It seems, therefore, that a tonnage factor of 11 cubic feet would be more satisfactory. This factor, when applied to Mr. Spaulding's computations, would give the following tonnage of probable and possible ore, no positive ore to be considered from drilling only:

$127,442 \times \frac{9}{11} = \underline{104,500}$ tons

Location of Exploration Shaft

For economic reasons it is desirable to locate the exploration shaft south of the east-west section line that crosses the property. Since the drilling to date has not outlined the ore body, there seems to be no particularly favorable place for the shaft.

The area adjacent to the section line is near the outcrop of the ore horizon and in the oxide zone of weak rock formation it, therefore, seems to be an undesirable place to locate the shaft.

Drill hole #10 is barren and hole #6 was not drilled to the ore horizon so the ore must pinch out somewhere between the north-south line of holes and hole #10. This area may be advantageous but little is known about it.

Since holes #7, 8 and 18 all contain ore, it is reasonable to assume a possible extension of the ore body in this direction. If this is true, the center of gravity of the ore would then be in the general location of hole #7. To reduce the underground haulage costs and to increase the amount of exploration that can be done in ore, the shaft should be in the areas adjacent to hole #7.

Cost of Mining

The cost of mining is based primarily on the physical characteristics of the ore and wall rocks. Since these characteristics are not definitely known, the assigning of a cost of mining to the deposit at this early stage of exploration must be based upon diamond drilling results and the experience of the estimator. The drill cores show that parts of the ore and enclosing rocks are hard and firm while other parts are soft or fractured.

The cost must be, at least at this time, based on a small selective mining operation. Mines of this type generally have higher mining costs. The cost of $8.00 per ton used in the report of August 16, 1950, is not too unreasonable but is on the optimistic side. If a cost of mining is to be assigned to the operations at this time, it should be more conservative as it may be necessary to mine the ore by the square-set stoping method.

Since the cost of mining must cover both the direct mining costs of labor and supplies and the indirect mining costs of administration, amortization, taxes, insurance, etc., an estimate should be higher than the one used in the report. It is therefore suggested that a cost of mining at $10 per ton should be used. The above cost of mining includes only a nominal charge for pumping and, if a large flow of water is encountered, the cost will be increased. About 300 gallons of water per minute are pumped from the neighboring San Xavier mine.

Cost of Shaft Sinking

Assuming a 2-compartment exploration type of shaft with a rock section of 6½' x 10' to accommodate a hoisting compartment 4' x 5' in the clear and a manway and pipe compartment 3½' x 5' in the clear. Wall plates, end plates, dividers and posts to be of 8" x 8" timber. Shaft to be lagged with 2" plank. Sets to be spaced 5' center to center.

Best quality Oregon fir in carload lots delivered f.o.b. Sahuarita $80.00 per M board feet. Add $5.00 per M board-feet to deliver to mine.

Timber cost

720 board feet per set @ $85.00/M =	$ 61.00
Hanging rods, wedges, etc. (estimated) =	10.00
Cost per set of 5 feet	$ 71.00

Cost per foot = $ 14.20

Labor

2 shaft miners @ $14.00/shift	28.00
1/2 timber framer @ 13.00/shift	6.50
1 topman @ $10.50/shift	10.50
1 hoistman @ $12.00/shift	12.00
1/2 truck driver, etc. @ $11.00/shift	5.50
1 foreman @ $15.00/shift	15.00
6 Total per shift	$ 77.50

Estimated cost of supplies, etc. per foot

Drilling - air, steel, bits, etc.	$ 7.00
Blasting supplies @ 5 lbs. powder per foot	1.75
Hoist (cost of operation other than labor)	3.00
Administration, insurance, etc.	6.00
Miscellaneous supplies	3.00
Cost per foot	$ 20.75

Miscellaneous per shift

Transportation of men and supplies	8.00
Other	5.00
Total per shift	13.00

Assume an average rate of advance of completed shaft per shift of $1\frac{1}{2}$ feet. In bad or wet ground the advance would be less but in dry firm ground the rate should be more.

Cost per foot of completed shaft @ $1\frac{1}{2}$ feet per shift:

Labor	$ 51.66
Timber	14.20
Supplies, etc.	20.75
Miscellaneous	8.66
	$ 95.27
Add 10% for contingencies	9.53
Estimated cost/foot	$ 104.80

Sinking equipment

Drilling equipment 3 sinkers equipped with pneumatic legs (for later drifting), air and water hoses, line oilers and some spare parts @ $650.00 each complete (new)	$ 1 950.00
*Drill steel - 10 sets (2½', 5' + 7½') at $22 per set . .	220.00
*Bits - either "one-use" or tungsten carbide types . . .	300.00
2 sinking buckets (used) at $100 each	200.00
Air driven pump if quantity of water encountered is small (estimated)	350.00
Air driven "sponge" sump pump (new)	250.00
Small tools (shovels, saws, picks, etc.)	75.00
Cable clips, thimble, rope, etc.	125.00
Total . . .	$ 3 470.00

*Replacements for the initial supply of drill steel and bits is included in the cost of shaft sinking and drifting.

Cost of Surface Construction - estimated

Headframe

40 foot 4-post type to include sheave wheel and foundation	$ 2 000.00

Ore bin

50-ton ore bin attached to head frame	700.00

Waste rock trestle

To rock dump	300.00

Frame structure for hoist & compressor

12' x 12' @ $3.50 per sq. ft.	500.00

Frame structure for shop and storeroom

12 x 24 @ $3.50 per sq. ft.	1 000.00

Office and change room

12 x 24 @ $4.50 per sq. ft.	1 300.00
Toilet and shower	400.00
Furnishings	300.00

Water tank, etc.

For camp water	350.00
Powder house	200.00
TOTAL	$ 7 050.00

Surface Equipment

210 cu. ft. air compressors and receiver gasoline engine driven (new)	$ 5 500.00
Hoist-gasoline engine driven--capacity 5,000 lbs. (new) . .	3 500.00
Truck - used pick-up	1 000.00
General tools for surface	750.00
Ventilation equipment-gasoline engine and fan (new). . . .	500.00
Landing chairs for cage (new)	250.00
Light plant - rebuilt	500.00
Tram car and track for waste	175.00
Add for installation of equipment	500.00
TOTAL	$12,675.00

Cost of Underground Exploration

The drill cores indicate that the ore is in arkose and all exploratory drifting must be done in this type of rock. The cores also indicate that the rock is mostly firm but in all drill holes there are places where very little or no core was obtained and it is assumed that part of the rock in the ore-bearing horizon is weak and some timbering will be necessary. Also the arkosic formation in the nearby San Xavier mine is very weak and even a small drift in this formation must be heavily timbered.

The following computations and estimates on the cost of drifting, cross-cutting and raising are for firm ground where only a small amount of timber is necessary.

Cost of Drifting

Assume an exploration drift 5' x 7' in cross-section, a common size used in small mines. In rock that drills and breaks fairly well an average advance of 3' per shift should be obtained for the following cost:

Labor per shift --

1 miner at $12.50 per shift	$ 12.50
1 mucker @ 11.00 " "	11.00
1 hoistman @ 12.00 " "	12.00
1 laborer @ 10.50 " "	10.50
1 foreman @ 15.00 " "	15.00
	$ 61.00 per shift

Labor per ft. of advance 1/3 x 61 = $20.00 +

Supplies, equipment, etc. per foot

Drilling (steel, bits, air, etc.)	$ 3.50
Explosives (5 lbs/ft., fuse, etc.)	1.75
Hoist	1.25
Labor for pipe, track, etc.	2.00
Administration, ins., etc.	3.00
	$ 11.50

Miscellaneous per shift

Truck	8.00
Other	5.00
	$ 13.00

Cost of drifting at 3' per shift in one heading

Item	cost/foot
Labor	$ 20.00
Supplies, etc.	11.50
Miscellaneous	4.30
Total	$ 35.80

If two exploration drifts are driven simultaneously, the cost will be as follows:

Labor per shift per heading for 2 headings

1 miner @ $12.50/shift	12.50
1 mucker @ $11.00 "	11.00
½ hoistman @ $12.00 "	6.00
½ laborer @ $10.50 "	5.25
½ foreman @ $15.00 "	7.50
Total/shift/heading	$ 42.25/shift

Cost per foot:

Labor cost per foot at 3' per shift	$ 14.08
Supplies, etc. (as above)	11.50
Misc.	4.30
Total cost/foot	$ 29.88/foot

Cost of raising, using a minimum of timber, if carried on as a second heading-estimated cost per foot --	$ 40.00
Cutting and timbering shaft stations -- Estimated cost per foot	50.00

Equipment for underground exploration in addition to sinking equipment

Single-deck cage to handle a one-ton mine car (new)	$ 1 000.00
2 stopers (2-3/4") completely equipped with hoses, etc. @ $550.00 each (new)	1 100.00
4 mine cars -- 18 to 20 cu. ft. capacity to fit cage (used) each $150.00	600.00
Rails, ties, spikes, bolts, air and water pipe @ about $2.00 per foot	4 000.00
1500 feet of metal ventilation pipe @ $1/ft	1 500.00
Signal system	150.00
TOTAL	$ 8,350.00

Summary of Costs

Surface construction	$ 7,050.00	
Surface equipment	12,675.00	
Sinking "	3,470.00	
Underground "	8,350.00	
	$ 31,545.00	$ 31,545.00
Exploration --		
Shaft sinking		
450 feet @ $105.00/foot	47,250.00	
Shaft station - 400 ft. level		
50 feet @ $50.00 per ft.	2,500.00	
Cross-cut		
200 ft. @ $36.00 per ft.	7,200.00	
Drifts		
1000 ft. @ $30.00 per ft.	30,000.00	
Raises		
650 ft. @ $40.00 per ft.	26,000.00	
	$ 112,950.00	$112,950.00
Assaying samples during exploration		2,000.00
		$146,495.00
*Add for contingencies		25,000.00
		$171,495.00

UNITED GEOPHYSICAL COMPANY, Inc.

B. B. Butler

UNITED GEOPHYSICAL COMPANY, Inc.

Location

The ground of the United Geophysical Company, Inc. under discussion is located between Mineral Hill and "Red" Hill as shown on the Twin Buttes quadrangle, U. S. G. S. topographic map (the exact location of the claims has not been examined for this report).

General regional features

Topographic. The outstanding topographic features are the Sierrita Mountains several miles to the west and a piedmont plane sloping gently from the mountains toward the Santa Cruz River valley to the east. Notable irregularities on this plane are mountain ridges rising sharply above the plane.

Geological. The Sierrita Mountains are composed of granitic rocks. The granitic mass is surrounded by a border of sedimentary rocks, parts of which are the conspicuous hills rising above the plane as San Xavier, Helmet Peak and Mineral Hills.

Sedimentary Rocks. The sedimentary rocks of the region include the formations common to southeastern Arizona from the Cambrian Bolsa quartzite to the Permian of the Paleozoic formations. Above the Permian ore the Cretaceous rocks consisting of three main units whose relations are not well shown in the immediate district but which are thought to consist from the base upward of (1) undifferentiated volcanics and sedimentary beds, (2) Recreation red beds mainly shale and sandstone, (3) Arkose with shale and thin limestone beds.

The upper member of this Cretaceous series (3) seems to be the host rock of the deposits under consideration though the relation to the others is not shown in the immediate vicinity.

Structure. The sedimentary rocks have been complexly folded and faulted and there is some evidence that the remnants of the original sedimentary formations represented in the ridges that rise above the plane, are underlain by granitic rocks that are extensions of the Sierrita granite mass. Detail structure in the blocks of sedimentary rocks are complex, in places extremely so. There are, however, certain structures that seem to be significantly related to mineralization. (1) Faults of a general east-west direction and (2) fissures with a general northeasterly strike. Much of the mineralization of the district appears to be associated with one or both of such structures.

Mineralization. The mineralization and the ore deposits that have been mined in the area are well all within a short distance of bodies of granitic rock. In general they are not more than one mile from the boundary of the main Sierrita mountains granitic body and many are close to exposed granitic rocks.

Classification of mineral deposits

It is possible to classify the ores of the area broadly into groups on the basis of mineral characteristics though naturally some deposits fall between the representative types. Three groups are recognized.

1. Copper deposits in which the main commercial metal is copper with little gold or silver.

2. Zinc deposits in which the main metal is zinc but which contains some copper, lead, and silver.

3. Silver-lead in which the main value is silver but contain lead, zinc and copper.

Relation to granitic rocks

There appears to be a space relation or zoning of the types in distance from the granitic rocks. The copper deposits are nearly all close to granitic rocks.

The zinc deposits are farther from known granitic rocks and the silver deposits are still farther from the granitic rocks. Mineralogically there is also a difference not only in the ore minerals but in the associate gangue minerals. Many of the copper deposits have associated magnetite with garnet and other silicates and are typical "contact deposits." The zinc deposits may also contain some magnetite and silicates but usually in less amounts. The silver-lead deposits do not typically contain magnetite and the silicates.

Relation to sedimentary rocks

Practically all of the copper and zinc production from the area has come from deposits in Paleozoic limestone. Several horizons from Cambrian to Permian have been host rocks to copper and zinc deposits. No important copper or zinc production has come from the Cretaceous sedimentary rocks. The deposits that are classed as silver deposits are mostly in what are regarded as Cretaceous rocks.

United Geophysical Company area under exploration

Rocks

The surface material in the area drilled is the valley fill which drilling shows to be approximately 200 feet thick, varying somewhat in the different holes, indicating an old buried surface of slight relief.

The sedimentary rock under the valley fill is arkosic and evidently the Cretaceous arkose of the same type that is exposed at the surface in Red Hill to the southeast. The nearest exposure, to the northwest, in mineral hill, are beds of limestone, gypsum and shale which are the lower part of the Permian group. The section in the drilled area is not distinctive enough to place its position in the arkosic sediments but the arkosic sediments are in the upper group of the Cretaceous. The relation suggests a probable structural break between the rocks exposed in Mineral Hill and those encountered in the drilled area.

Granite, or what is thought to be granite, is cut in drill hole No. 10, fartherest hole to the east. The character of the mineralization suggests that granite is not far distant. Since the drilling is all in arkosic rocks the chance for determining strudture is not good. The drilling shows areas of brecciation and some gouges that indicate structural movement.

Mineralization in the drilled area

The mineralization in the drilled area is simple and varies little in type throughout. The arkose where unmineralized is light gray and of varying coarseness of texture. Where mineralized below the zone of oxidation it is prevailingly dark gray to nearly black due to the abundance of magnetite that has replaced the arkose. Locally there is epidote and probably other silicates. The replaced arkose appears to be of finer texture, a change that is probably due to the replacement process.

Later than the magnetite, sulphides of iron and copper, namely pyrite, pyrrhotite and chalcopyrite were introduced and in part replaced magnetite as well as other minerals.

The introduction of sulphide was apparently not coextensive with introduction of magnetite as some areas of high magnetite mineralization have relatively little sulphide and sulphide is present in places with little magnetite.

Oxidized zone

The oxidized zone extends from the bed rock surface, about 200 feet below the present surface, to a rather uniform depth of about 275 ± feet or a vertical range of about 75 ± feet.

The oxidation of sulphides has produced a yellow to brown limonite stain in the portion that contained sulphide.

From the surface for considerable depth the copper is present as carbonate and silicate with possibly some copper oxide. In the lower part of the oxidized zone native copper is conspicuous and much of the copper content is present as native copper though a black sooty material is probably in part chalcocite. This extends into the sulphide zone but is not conspicuous in the cores. "Black sulphide" in the sludge is reported from some holes in the border zone of oxidized and sulphide ore.

There appears to be some sulphide enrichment that has raised the copper content above and below the boundary between oxidized and sulphide ore. There are, however, portions of the primary sulphide mineralization that contain as much copper as any areas.

Relation of mineralization to structures

The mineralization elsewhere in the district is related to structure and the same is likely true here. This general conclusion is supported by the fact that much of the mineralized rock is brecciated and some zones of fault gouge were cut in drilling.

The similarity of the rock in the drilled area makes it impossible to determine structure with certainty. The drilling was located on the bases of a magnetic survey. The magnetic contour map shows a generally east-west high with gentle southerly slope and a steep northerly slope.

A line of holes drilled across this magnetic "ridge" shows mineralization in holes No. 16 and 15 north of the high point and in No. 4 and 5 south of the high point. The holes were stopped in mineralized ground but where the copper content was low. The holes to the south contained the higher assays of copper deeper than the holes to the north.

Hole No. 7, 300 feet to the west of the north-south line of drill holes, is well mineralized from about 280 to 360 feet. Hole No. 8 is about 100 feet west of No. 7 and No. 9 about 100 feet west of No. 8. No. 8 shows some well mineralized ground but as a whole is rather low and No. 9 is distinctly low.

Hole No. 18, north of the crest of the magnetic "ridge," and about 200 feet north of No. 9 and 400 feet west of the north-south line of holes is mineralized from depth of about 300 to 400 feet.

The results of the drilling together with the magnetic survey have led the geophysicits to postulate a tabular magnetic body with general east-west strike and southerly dip. Where this body approaches the old erosion surface would be the magnetic high. South of the outcrop the increasing cover of rock would blanket the magnetic effect and to the north the magnetic body would be absent.

This explanation could account for many of the observed facts but can hardly be accepted as proven nor is it likely suggested as proven.

I feel that the geological data now available is insufficient to postulate a structural relation that can be regarded as reliable for estimating ore reserves.

Geological difficulty in ore tonnage calculation

On the assumption that mineralization is a tabular body along a south dipping fault, the vertical drill holes cutting this body would show a greater apparent thickness of ore than the actual thickness, which would be normal to the dip of the inclined body. If the dip is steep the difference would be large. The ores in the fracture zones commonly do not occur uniformly along the fracture but are confined to shoots that may have varied positions in the fracture zone and occupy varying proportions of the zone. These are some of structural problems in the calculation of ore tonnage that are insuperable in attempting estimate that are even approximate or probable with the information available.

Geological problems in the grade estimates

The problems in the estimate of grade of ore are perhaps less difficult than those of amount of ore. The assay of cores where recovery was large can very well be assumed to represent the copper content of the ground passed through. Where the core recovery was poor the core assay is less reliable and may be too low or too high.

Sludge assays are less representative as there may be loss of heavy minerals escaping into fractures or a concentration of heavy minerals in the sludge. Caution suggests that high assays in sludge should be regarded with doubt.

In mining such an ore body, the entire body will be taken as a unit. In calculating grade, therefore, low grade and even barren portions must be included in the calculation, if they must be mined with the better grade. The matter of tonnage and grade estimates have been considered by Prof. H. E. Krumlauf as well as estimates of cost of development and mining. His report is submitted herewith. Independent assays were not made but there seems no reason to doubt the correctness of the assays.

A report by Professor Krumlauf on tonnage and grade of ore and on cost of development and mining is submitted herewith.

I have already indicated the difficulty, because of lack of information on geological conditions, of making a definite prediction of the amount and position of mineralized ground and of ore. I believe that Professor Krumlauf has done as well as can be done at the present stage of development in estimates. I am not a miner and am not qualified to pass on costs of development and mining, but I believe that Professor Krumlauf is qualified and I therefore have no reason to question his estimates.

Further development

The first step in this project was geophysical surveys. The location of a deposit high in magnetic minerals, magnetite, and pyrrhotite, together with non-magnetic sulphides as pyrite and chalcopyrite, under 200 feet of cover, is a contribution to the search for that type of deposit, burried beneath valley fill.

The second step drilling has obviously not yet completely outlined the ore body and the question arises, how can the further outlining best be advanced.

I have already indicated the difficulty of interpreting the structure from drill data in this rather uniform rock. Underground openings are obviously more revealing. Underground opening is relatively costly and is perhaps not justified till it is felt that there is assurance that the known quantity and grade of material well warrant mining operations.

If more drilling is considered the area between the north-south section and holes 8, 9 and 18 to the west would add to the information and likely to the indicated ore. Also, a hole to the south of those drilled since hole No. 14 was not successful would be desirable.

I may say that had I been told in advance that the drilling that has been carried on would be in the Cretaceous arkosic rocks, I would have been pessimistic because of the supposed unfavorable character of the host rock. The presence of abundant magnetite would not have been reassuring either because of the indication of temperature at time of formation that was too high to be favorable for deposition of copper sulphide.

I have not completely divested myself of these feelings. There is, however, abundant evidence of mineralization in the Arkosic rocks and assays must take precedence over feelings in the matter of copper content.

I wish to express my warm appreciation of the courtesy and cooperation of the Tucson staff of the company in this examination.

Sincerely,

B. S. Butler

MILL RUN — 5/8/53

FEED: 129 Tons (Presumed General Run 3, 4, 5 & 6 Levels (Mill Ore?)

		% Tot.	ASSAYS Ag.	Pb.	Cu.	Zn.	METAL CONTENT Ag.	Pb.	Cu.	Zn.	RECOVERIES Ag./100	Pb./100	Cu./100	Zn./100
FEED: 129 Tons			0.84	0.20	5.10	1.62	0.84	0.20	5.10	1.62				
S. Cu. Conct.	7.21	5.59	2.48	0.33	24.90	6.40	0.14	0.02	1.39	0.36	16.67	9.30	27.26	22.22
Ox. Cu. Conct.	20.34	15.77	3.16	0.33	20.00	7.00	0.50	0.05	3.15	1.10	59.26	25.58	61.77	67.90
			3.0	0.33	21.25	6.84	0.64	0.07	5.54	1.46	75.93	34.88	89.03	90.12
Tails		78.64	0.25	0.17	0.70	0.20	0.20	0.13	0.56	0.16	24.07	65.12	10.97	9.88

GRINDING

Plus Mesh
Plus 65 2.6%
Minus 200 63.0% 16.6 Tons/hr.

NOTE: There is some question about this run. Previous run, or information ffom other tests much more favorable

REAGENTS	Consumption - : #/ton Cu. Conct. #1		Cu. Conct. #2	
NA CN.	0.10			
Zn SO4	0.29	(0.12?)		
Z9	0.16		0.07	Tails
Methyl Isobuytl Carbinol	0.24			
Sodium Sulfide		1.79		
#250			0.13	

PIMA MINING COMPANY

History

The Pima orebody was discovered in 1950; extensive underground development was begun in 1952. In August 1954 the parent company, Union Oil Company of California, granted Cyprus Mines Corporation an option to examine the property, and Utah Construction Company was engaged to study the economic possibilities of mining by open pit.

After sampling and drilling to check the work completed under the original Pima management, Cyprus purchased a three-quarter interest in the property, Union Oil retaining one quarter. Cyprus later sold a one-quarter interest to Utah Construction Company, retaining half interest and management responsibility.

The first ore was reached by stripping October 1956, and the first concentrate was produced in December.

The mine lies about 20 miles southwest of Tucson, Arizona. Some 250 people are now employed, all of whom live in Tucson and commute daily.

The Pit

The Pima pit is a 1700 x 1400-foot oval, the long axis parallel to the strike of the orebody. The north side of the pit is carried as a final pit slope that coincides with the footwall of the orebody. The south side and east and west ends of the pit are working slopes continually being stripped back toward the final slopes.

An inclined roadway extending from the natural ground surface on a 5 percent grade down to the northeast corner provides access to the pit. This road enters the pit 130 feet below the natural surface and continues as a pit ramp on a 5 percent grade to the 3150-foot bench (roughly the base of the alluvial cover). At this point the ramp system is steepened to a 12 percent grade and continues to the pit bottom. The 5 percent grade is maintained in the alluvial section to facilitate scraper haulage out of the pit. In addition to this main access ramp, temporary working ramps in the alluvial areas allow shorter routes to dumps. These are left on top of working benches and do not change the overall working slopes.

Below the base of the alluvium, haulage is by truck down to the skip loading point or up from the bottom to the skip loading point.

The final pit slopes in the alluvium are laid out at 1.2:1 overall with 50-foot bank heights, 0.6:1 bank slopes, and 30-foot benches except at the base of the alluvium, where a 50-foot bench was left as protection against excessive sloughing. Final slopes in the rock are laid out at 1:1 with 40-foot bank heights, 0.375:1 bank slopes, and alternate 10 and 40-foot bench widths.

Working slopes in the alluvium are maintained at 1.35:1 with alternate 25 and 50-foot benches. Bank slopes and heights are the same as final slopes. Working slopes in the rock are usually held at 2:1 overall with 50 to 60-foot benches, 40-foot bank heights, and approximately 0.5:1 bank slopes.

An incline for the skip hoist trackage was left on the center of the north (final) slope. Slotting into the pit slope on the upper benches and allowing a slight protrusion on the lower benches permitted a 38° skipway incline -- somewhat flatter than the over-all final slope.

Utah Construction Company, which had been awarded the pre-stripping contract on the basis of low bid, started actual stripping in November 1955. MRS tractor units and Wooldridge 34-cubic yard scrapers were used in conjunction with one Marion 151-M shovel and four LLD Euclid trucks. Utah stripped approximately 6 million cubic yards during its contract (November 1 to October 1, 1956). Pima commenced stripping operations alongside the contractor in April 1956 and by the end of that year had moved about 3 million cubic yards. During stripping, Pima trained a competent group of employees to operate the pit after Utah completed its contract.

Total pre-mine stripping amounted to a little more than 9 million cubic yards. About 1 million cubic yards of this was rock and the remainder alluvium.

At the present time stripping rate is about 3.0 cubic yards of waste per ton of ore. Rate for the remaining life of the mine will be about 2.6 cubic yards of waste per ton of ore.

Production

Daily mine production is set at approximately 4000 tons of ore on the basis of a 6-day week. Ore is mined on one shift and rock stripped on the other two shifts. Alluvium is stripped on all three. Normal payroll for the pit is 114, including supervision. Daily production averages 12,000 cubic yards -- 1700 cubic yards of ore (4000 tons), 4500 cubic yards of waste rock, and 6000 cubic yards of alluvium. Output is therefore approximately 107 cubic yards per manshift.

Between November 1, 1955 and January 1, 1958, 12.8 million cubic yards of alluvium, rock, and ore were moved from the pit. Of this total excavation, 5.9 million cubic yards were moved by a contractor as pre-mine stripping. A total of 1.1 million tons of sulfide ore averaging 1.74 percent copper has been handled by the concentrator. In addition, 659,668 tons of mixed sulfide and oxide ore have been stockpiled.

Geology

Bedrock is overlain by 200 feet of alluvial wash, which has a regular eastward slope, and there are no outcroppings within a 1500-foot radius of the mine. Lying immediately above bedrock is an irregular conglomerate zone (0 to 25 feet thick) of medium to coarse texture, composed of igneous and sedimentary rocks cemented by siliceous and calcareous material.

The Pima orebody is a pyrometasomatic (contact metamorphic) deposit. The main ore zone has an average dip of 45° to the south and trends east-west, curving from a northwesterly bearing on the west to a slightly northeasterly direction on the east. The ore zone is variable in thickness, probably averaging 200 feet, and this zone has been developed over a lateral span of 1600 feet in the main part of the mine. It extends into a neighboring property on the west, but to the east geology and mineralization are obscure. The lower limits of the zone have not been determined, but it has been intersected by drillholes at about 800 feet vertical depth. Paralleling the main ore zone on its footwall side is a persistent breccia zone, which extends to the northeast beyond the present known main orebody.

Determination of age and identification of rock types has been complicated, since most of the rocks are moderately to highly altered or metamorphosed. Many of the less altered rocks are fine-grained; consequently field determinations have often been uncertain, and even petrographic studies have not been definite. The rocks fall into three broad classes: 1) carbonate, 2) clastic, and 3) igneous.

The carbonate rocks, grouped under the term "hornfels", constitute the main high grade ore zone. These rocks are garnet (Grossularite) hornfels, diopside hornfels, and tremolite hornfels. Dolomite and limestone are present in varying amounts. The main ore sulfide is chalcopyrite, with minor amounts of chalcocite, native copper, chrysocolla, tenorite, bornite, and cuprite.

The zone of oxidation extends erratically 40 to 50 feet below top of bedrock. The chalcopyrite forms local and highly irregular concentrations, and shows a tendency to favor one type of hornfels more than another.

The clastic rocks, occurring in both hanging and footwalls of the carbonate formation, are extremely fine-grained with a quartzitic appearance. They are composed of quartz, feldspar, and sericite, and texture is definitely clastic. In some places it is almost sedimentary; in other it has an igneous appearance. On the basis of petrographic work and visual examination of drill core, those at Pima believe that some of the clastic rocks formerly called "arkosite" may be better classified as pyroclastics. Even though they cannot be decisively proven petrographically, these pyroclastics may contain local accumulations of sediments, clastic and otherwise. In the hanging wall clastic rocks, pyrite is widely disseminated and there are zones of low grade disseminated chalcopyrite mineralizations, which makes an open pit operation feasible.

The igneous rocks found at the mine are of intrusive nature and consist of rhyolite, syenite, and quartz monzonite porphyry. The rhyolites and syenites are unmineralized and occur in and above the hanging wall of the carbonate series. The bulk of the quartz monzonite porphyry is found in the footwall clastics and is slightly mineralized by pyrite and chalcopyrite.

Engineering

The engineering department works in close cooperation with the production departments and is responsible for operating layouts, estimates, pit schedules, and uniformity of mill feed. Present personnel consists of a chief mining engineer, pit engineer, ore control engineer, and draftsman and a field survey crew of three -- an instrument man and two rodmen.

Mine operating layouts are prepared on the basis of a series of pit expansions. Each expansion is scheduled for completion of alluvium and waste rock stripping before the ore is exhausted in the previous expansion. Layouts are made on current pit maps on a scale of 1 inch to 50 feet. Volume estimates of ore and stripping are made on horizontal level maps on which the ore blocks are outlined. Cross sections on a scale of 1 inch to 50 feet are used in planning the layouts, although currently these are not used for estimating. Owing to the size and shape of the present pit, a more accurate estimate can be obtained from horizontal level maps.

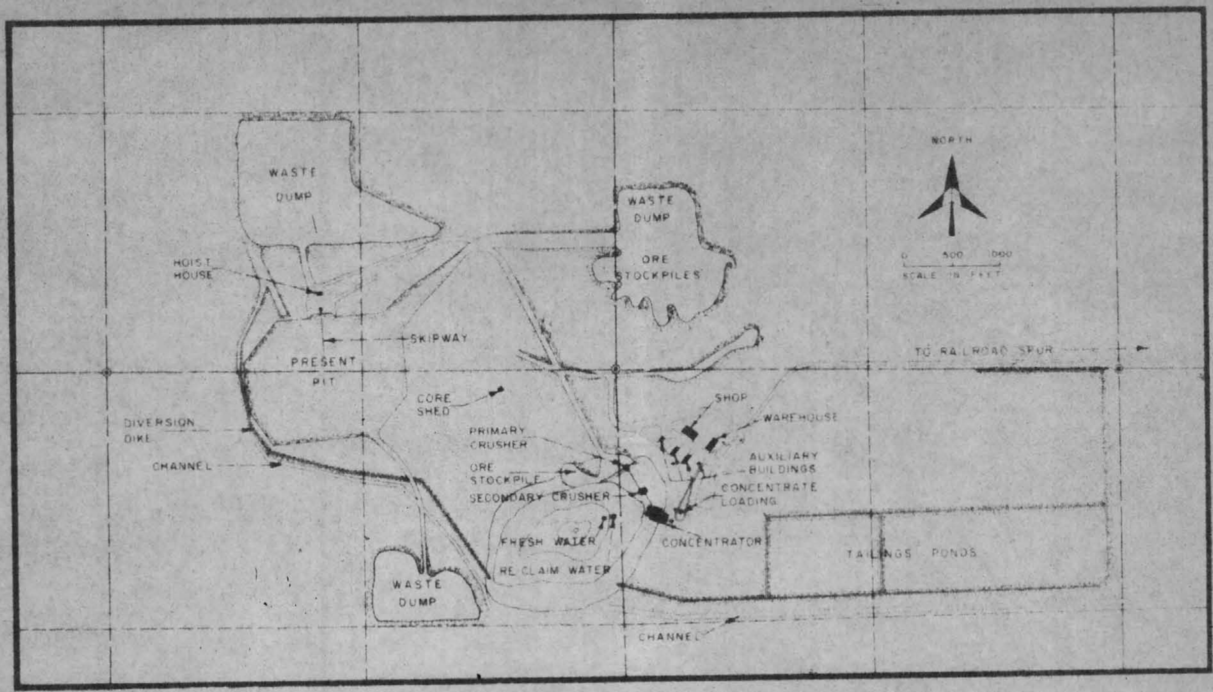
Volume estimates of material removed from the pit are made quarterly on specially prepared section. To keep the pit map and ore control maps up to date the pit is surveyed each month, with a more accurate survey when a volume estimate is made.

For ore control, each blasthole drilled is sampled and assayed. From the established grade cutoffs, the material in each pit blast is classified and where necessary is segregated. Where two or more types of material are encountered in one blast, the cutoffs are flagged in the bank for the operators' guidance. From the assays of the ore material, a blend is established between various working faces for a constant grade of mill feed. Close cooperation is maintained between the ore control engineer and the mine operating staff.

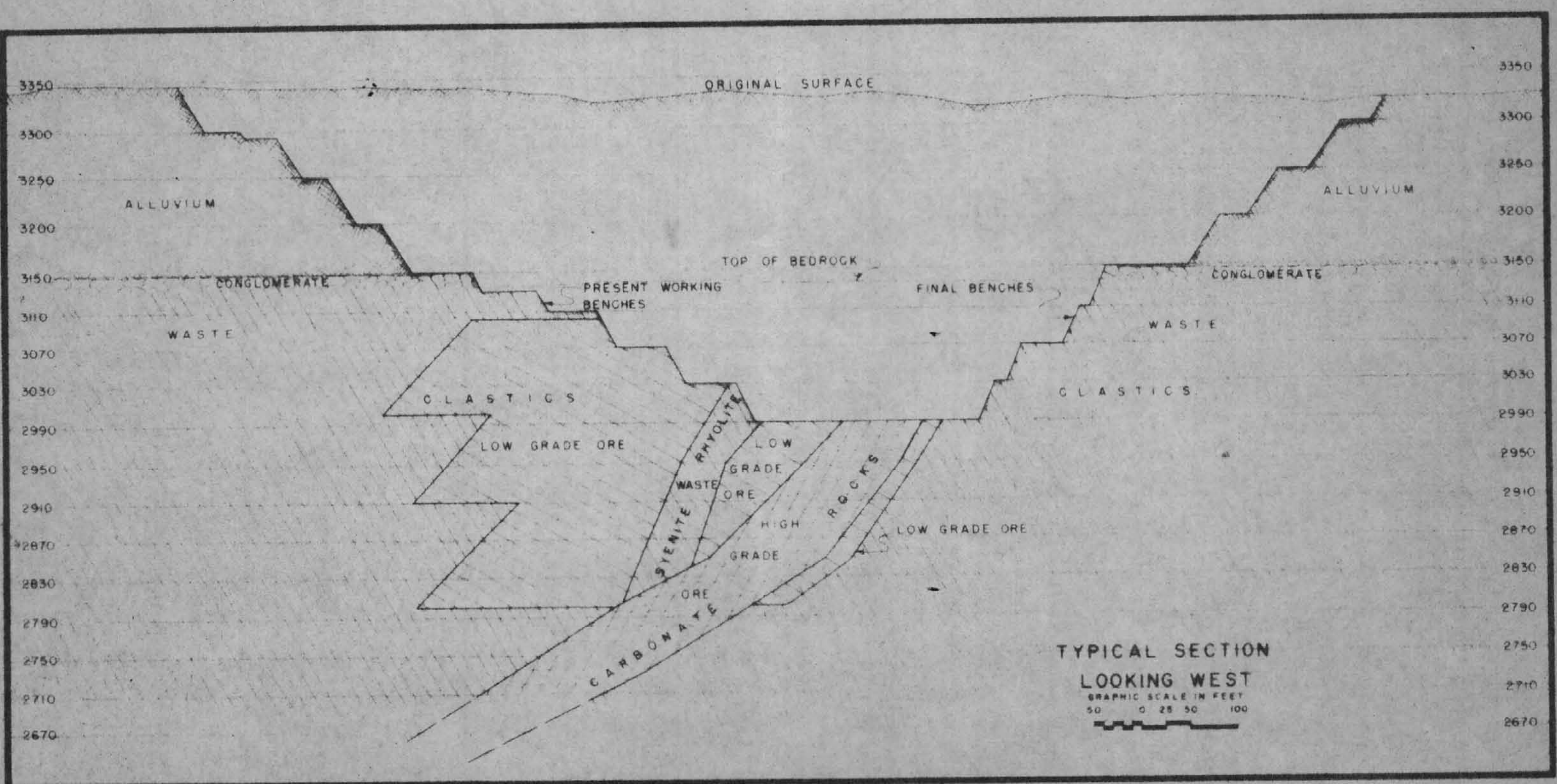
A certain amount of mechanical drafting, construction design, and detailing is done by this department for all other departments in connection with repair and alterations of facilities and small construction work. Cost estimates are also prepared and specifications set up.

The engineering department makes claim surveys, conducts time studies on equipment, maintains records on material stockpiled from the pit, provides line and grade control for pit operations, and does sampling. Because the orebody now being worked is split between a state mineral lease and federal patented claims, careful estimates are made of ore volumes of the other material removed from each section of the property, and records are kept up regularly on these volumes.

PIMA MINING COMPANY
PIMA MINE
TUCSON, ARIZONA



GENERAL AREA MAP



TYPICAL SECTION

LOOKING WEST

GRAPHIC SCALE IN FEET

50 0 25 50 100

Hole #2 - H_2O at 196'
23 April 51
(Measured with respect to Surface)

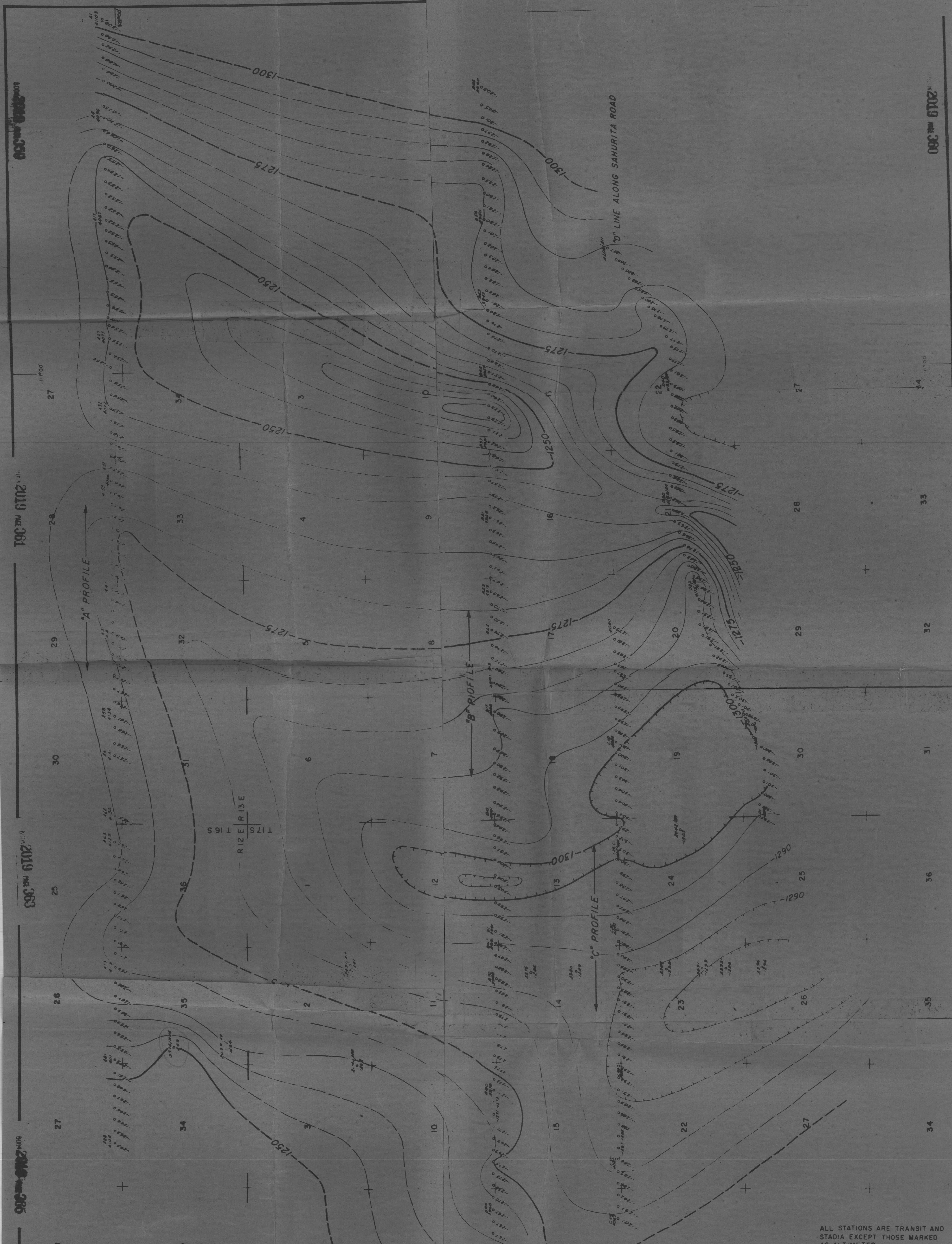
PIMA MINE DRILL HOLE MODEL

Tables of Section and Color Code used:

Yellow - Alluvium
Green - Bed rock, oxidized
Blue - Bed rock, not oxidized
Brown - 3 to 5% ore
Silver - over 5% oxide ore
Red - over 5% sulfide ore
White - 3 to 5% sulfide ore
Black - Near granite

Hole No.	Green	Brown	Silver	Red	White	Blue	Black
1.	209-231	231-249			249-255		
				255-265	265-290	290-305	
2.	209-276	276-286			286-334	334-345	
3.	211-235						
4.	210-277			307-333	333-355	277-307	
				355-362		362-400	
					400-404	334-387	
5.	250-334			387-421	421-426	426-455	
6.	185-248					248-267	
7.	205-272	272-278				278-289	
				289-296		296-318	
					318-330	330-338	
				338-347		347-366	
8.	185-292					292-302	
					302-310		
				310-315	315-322	322-347	
				347-357		357-402	
9.	170-292					292-337	
10.	196-315					[illegible]	315-320
12.	195-222	222-243		248-271	271-297		
			243-248				
				297-310		310-373	
14.	180-300					300-307	
16.	215-229		229-236				
	236-318					318-331	
17.	195-215			215-250			
		250-260				275-282	
	260-275			282-286		286-295	
				295-301		301-315	
18.	205-239	239-249		249-267	267-279	279-310	

Hole	Ore 3 to 5%	Ore 5%-	Ore 3 to 5%	Bedrock	Carbonate	Sulfide	Depth of Hole
1.	231-255	255-265	265-290	209	209-249	249-305	305
2.	276-334			209	276-286	287-334	345
3.				211-227	227-235		235
4.	333-355	307-333 355-362	See 13	210 -	240--277	277-356	356
5.		387-421	421-426	250	260-334	334-455	455
6.				185	225-248		267
7.	272-278 318-330	289-296 338-347		205	270-278	278-360	366
8.	302-310 315-322	310-315 347-357		185	288-292	292-402	402
9.				170		292-320	337
10.				196			315-320 (granite)
12.	222-243	243-271 297-310		195	212-248	248-340	373
13.	Sec. 4		400-404			355-379 399-404	404
14.				180	200-300 minor		307
15.	244-253	253-287 234-244	287-315 Salted?	213	213-270	270-297	315
16.		229-236		215	229-318	318-331	331
17.	250-260	215-250 282-286 295-301		195	215-275	275-315	315
18.	239-249	249-267	267-279	205	211-249	249-310	310



ALL STATIONS ARE TRANSIT AND STADIA EXCEPT THOSE MARKED AS ALTIMETER

GEOPHYSICS DIVISION	BEAR CREEK MINING COMPANY	
DETAIL GRAVITY SURVEY MAP TWIN BUTTES AREA, ARIZONA		
SCALE: 1" = 2000'	CONTOUR INTERVAL: 5 g.u.	REVISIONS
	DATA BY: T.L.L.	
DATE: APRIL, 1962	SHEET 1 OF 1	
DRAWN BY: R.J.R.	DRAWING NO.: S9-2025	FILE: 5A

GEOPHYSICS DIVISION		BEAR CREEK MINING COMPANY
"B" GRAVITY PROFILE & INTERPRETED SECTION TWIN BUTTES AREA, ARIZONA		
SCALE: H, 1" = 2000' V, 1" = 400' or 1" = 10 g.u.	CONTOUR INTERVAL:	REVISIONS
	DATA BY: T.L.L.	
DATE: APRIL, 1962	SHEET 1 OF 1	
DRAWN BY: R. J. R.	DRAWING NO.: S9-2045	FILE: 5-A

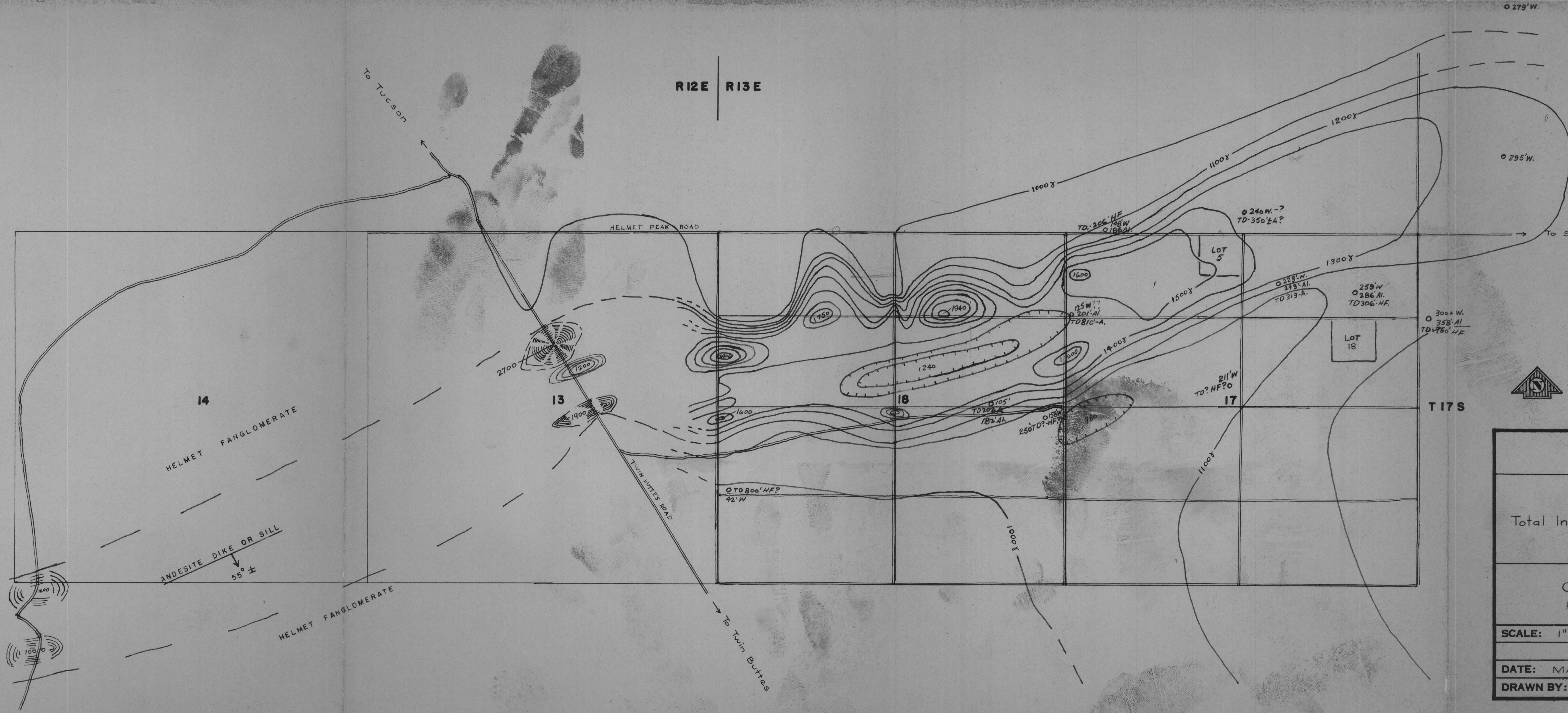
GEOPHYSICS DIVISION		BEAR CREEK MINING COMPANY
"A" & "C" GRAVITY PROFILES TWIN BUTTES AREA, ARIZONA		
SCALE: H, 1" = 2000'	CONTOUR INTERVAL:	REVISIONS
V, 1" = 10g.u.	DATA BY: T.L.L.	
DATE: APRIL, 1962	SHEET 1 OF 1	
DRAWN BY: R.J.R.	DRAWING NO.: S9-205S	FILE: 5-A

GEOPHYSICS DIVISION — BEAR CREEK MINING COMPANY

DETAIL GRAVITY SURVEY MAP
TWIN BUTTES AREA, ARIZONA

SCALE: 1" = 2000'	CONTOUR INTERVAL: 5 g.u.	REVISIONS
	DATA BY: T.L.L.	
DATE: APRIL, 1962	SHEET 1 OF 1	
DRAWN BY: R.J.R.	DRAWING NO.: S9-2025	FILE: 5A


"A" PROFILE
BOUGUER ANOMALY (GRAVITY UNITS)
-1240
-1250
-1260
-1270
-1280
-1290
-1300
-1310
ASARCO MINE BRIDGE
(TWIN BUTTES ROAD)
(SW COR OF SEC 30) (T16S, R13E)
(SW COR OF SEC. 27) (T16S, R13E)
A88 4104
A8 4111
A73 4119
A63 4129
A62 4130
A61 4131
A58 4134
A51 4141
4144
4153 A37 4066
A32 4072
A27 4077



HEINRICHS GEOEXPLORATION COMPANY

P.O. Box 5671 **Tucson, Arizona**

MAGNETIC MAP

Total Intensity from continuous Profiles by Mobile Magnetometer

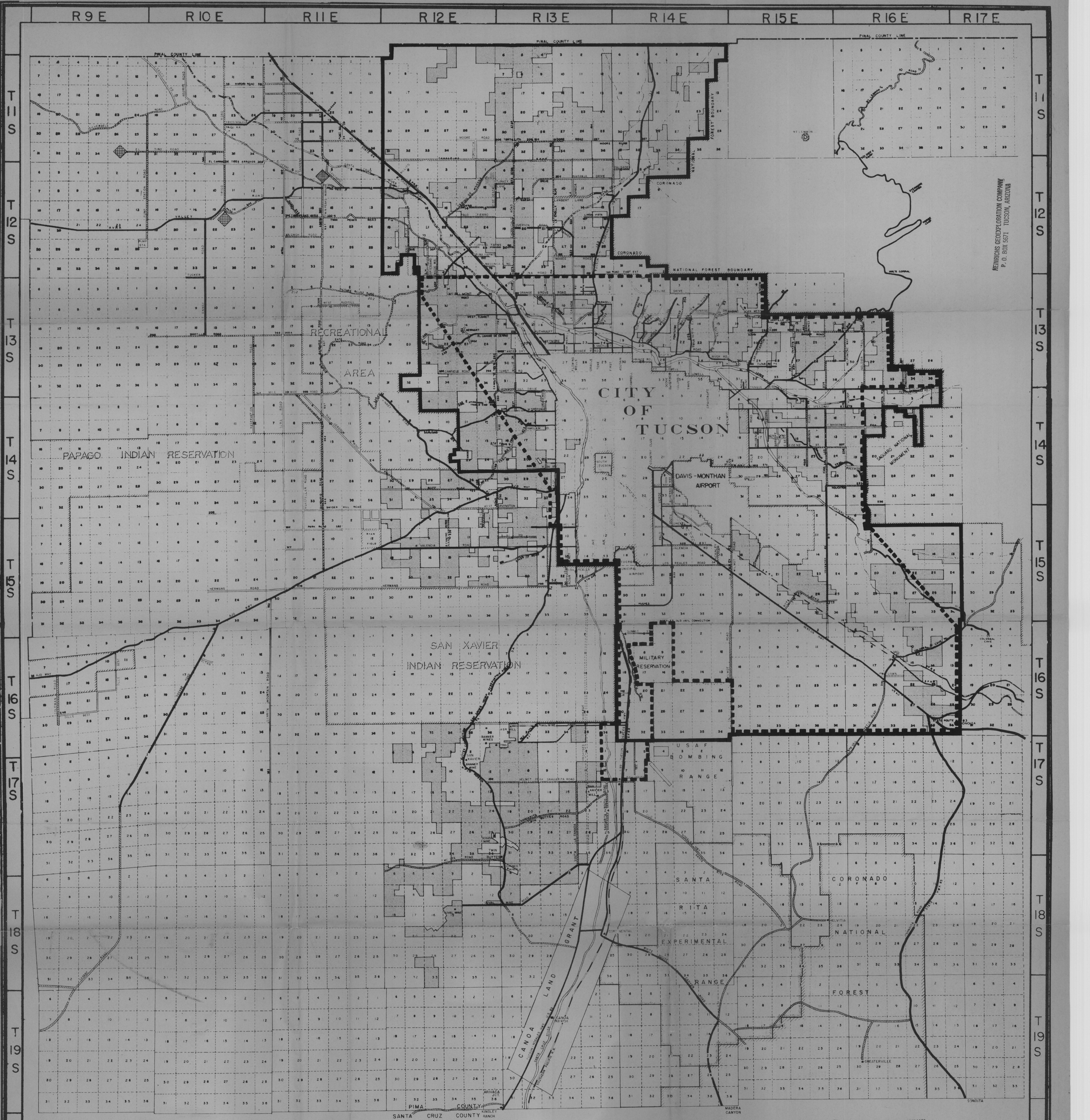
FOR

CURLY HORN RANCHES & VICINITY

PIMA DISTRICT PIMA COUNTY, ARIZONA

SCALE: 1" = 1000'	**CONTOUR INTERVAL:** 100 γ	**REVISIONS**
	DATA BY: J. W. M.	
DATE: MARCH 1960	**SHEET** **OF**	
DRAWN BY: F. S. jr	**DRAWING NO.:**	**FILE:**


EXPLANATION
SEDIMENTARY ROCKS
Krsh SHALES SCHIST
CRETACIOUS?
PERMIAN
Csh SNYDER HILL FORMATION
PENN.
Cn NACO LIMESTONE
CARBONIFEROUS
MISS.
Ce ESCABROSA LIMESTONE
Dm MARTIN? LIMESTONE
DEVONIAN
Ɛa ABRIGO FORMATION
Ɛc COCHISE? FORMATION
CAMBRIAN
Ɛb BOLSA QUARTZITE
IGNEOUS ROCKS
Tap APLITE
Tqmp QUARTZ MONZONITE
TERTIARY?
APLITE
GRANITE
PRE-CAMBRIAN?
Round Top
Deer Hill
Escabrosa Cliff
Aplite Hill
GEOLOGIC MAP
SECTION ON AA'
AREAL GEOLOGY
BLUE JAY AREA
HELVETIA, ARIZONA
Scale
CONTOUR INTERVAL - 50 FEET
DATUM IS MEAN SEA LEVEL
TOPOGRAPHY and GEOLOGY by M.S. DUNHAM
1937



LEGEND

- DEDICATED
- GRADED
- PAVED
- LAND PATENTED SURFACE RIGHTS FEDERAL GOVERNMENT MINERAL RIGHTS
- AREA OUTLINE IN WHICH FEDERAL MINERAL RIGHTS TO BE GIVEN TO SURFACE OWNERS
- OUTLINE AREA TO BE WITHDRAWN FROM MINERAL ENTRY AS SUGGESTED TO THE BUREAU OF LAND MANAGEMENT BY DR. WILLARD C. LACY, PROFESSOR OF GEOLOGY, UNIVERSITY OF ARIZONA

TUCSON AND VICINITY SECTION MAP

HEINRICHS GEOEXPLORATION COMPANY
P. O. BOX 5671 TUCSON, ARIZONA

NORTH

SCALE: 1/2" = 1 Mile

For Sale By TUCSON BLUEPRINT CO. - 39 S. 5th Ave. - Tucson, Arizona - Ma 4-8881

R9E R10E R11E R12E R13E R14E R15E R16E R17E

BOUGUER GRAVITY ANOMALY MAP OF THE TWIN BUTTES AREA, PIMA AND SANTA CRUZ COUNTIES, ARIZONA

BY

DONALD PLOUFF—1962

This map is preliminary and has not been edited or reviewed for conformity to Geological Survey standards.

U. S. GEOLOGICAL SURVEY

Released to open files

August 8, 1962

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