Exhibit 1

April 16, 1966.

OFFICIAL
COPY
O. M. E.
RECEIVED
MAY 23 1966
INITIALS CODE

Mr. Thomas B. Shaw,
Bank of California,
2111 Durant Avenue,
Berkeley 4, Calif.

Dear Mr. Shaw:-

As President of Double Rainbow Mines Inc., I am seeking a loan of three hundred thousand dollars ($3000000.00) to develop the potential mineral resources of the above mining property.

The property is located in Galena, Lawrence County, South Dakota approximately seven miles from Deadwood, in a rich mineral bearing area. It is considered by competent geologists very favorable for development.

The only colaatral Double Rainbow Mines Inc. has to offer is the group of patented claims that are free and clear of any liens of indebtedness.

If you will give this request your consideration, we are prepared to supply you wit further details.

Very truly yours,
Rexford W. Barton.

Rexford W. Barton.

THE BANK OF CALIFORNIA *National Association*

BERKELEY OFFICE: 2333 Shattuck Ave., Berkeley 4, California · THornwall 3-6353

April 21, 1966

Mr. Rexford W. Barton
2251 Virginia Street
Berkeley, California 94709

Dear Mr. Barton:

This will acknowledge your letter of April 16 regarding your interest in seeking a loan on behalf of Double Rainbow Mines, Inc. to develop the potential mineral resources.

Unfortunately, our present loan policy precludes our ability to entertain loans of this nature, however, we appreciate your inquiry.

Very truly yours,

Thomas B. Shaw
Manager

TBS:va

April 16, 1966,

Mr. J. B. Chamberlain,
Pacific National Bank,
333 Montgomery Street,
San Francisco, Calif.

Dear Boat:-

As President of Double Rainbow Mines Inc., I am seeking a loan of three hundred thousand dollars ($300,000.00) to develop the potential mineral resources of the above mining property.

The property is located in Galena, Lawrence County South Dakota approximately seven miles from Deadwood, in a rich mineral-bearing area. It is considered by competent geologists very favorable for development.

The only collateral Double Rainbow Mines Inc. has to offer is the group of patented claims that are free and clear of any liens or indebtedness.

If you will give this request your consideration, we are prepared to supply you with further details.

Very truly yours,
Rexford W. Barton.
Rexford W. Barton.

PACIFIC NATIONAL BANK OF SAN FRANCISCO

April 21, 1966

Mr. Rexford W. Barton
2251 Virginia Street
Berkeley 9, California

Dear Rex:

I have referred your proposal regarding the loan to Double Rainbow Mines, Inc. to our commercial loan officers but regret that I must advise you that they do not determine this a proper loan for a bank of our type to enter into. You may be sure that we gave this careful consideration and gave full weight to your valued relationship here; but I believe you will understand that we must, on occasion, limit our lending, both by geography and by the type of proposal presented.

Please keep in touch with us and let us know of any other ways in which we may be of assistance, and I trust that another time we will be able to give you a more positive answer.

Sincerely yours,

Brat

J. Boatner Chamberlain
Vice President and
Senior Trust Officer

333 MONTGOMERY STREET • SAN FRANCISCO 20, CALIFORNIA • CABLE ADDRESS: PANABANK

Exhibit 2

Diamond Drill Hole No. 2
Galena Drilling Project
Drilled May-July, 1954 by Joe T. Monger Drilling Co., Custer, S. Dak.
Location: 2640' FSL, 2450' FEL, sec. 10, T. 4 N., R. 4 E., Lawrence County, S. Dak.
Elevation of collar: 5150' altimeter ← ok topog map.
Corrected location: 1800' S. of N. line, 2780' W. of E. line. ELT

Feet

0 - 14 Overburden

14 - 66 This interval represents surface rubble, as well as some Pahasapa and Englewood, and probably a portion of the upper Whitewood. Individual runs and recoveries are described below:

14 - 18 (rec. 1.75') Dolomite, fine to medium crystalline, light to medium brown, dense, some with much vuggy porosity; dolomite, finely crystalline, very porous, saccaroidal. These make up 90% of the recovery. The remaining 10% is limestone, very finely crystalline to lithographic, light gray-brown.

18 - 24 (rec. 0.9') Upper part rubble of dolomite and lithographic limestone as above. Middle section is plaster (lost circulation); bottom includes two pieces sandstone, fine, silty, glauconitic, badly oxidized (Deadwood).

24 - 40 (rec. 0.3') Mixture limestone, light gray, dolomitic; limestone, lithographic; and sandstone as above.

40 - 48 (rec. 0.6') Limestone, lithographic, light gray; dolomite, finely crystalline, light brown, with vuggy porosity; one piece silicified limestone or chilled contact zone porphyry, buff, with dendrites.

SILL 48 - 50 (rec. 1.3') Clay, white, probably altered porphyry sill. It is. ELT

50 - 66 (rec. 1.8') Dolomite, finely crystalline, consisting of fine, loosely cemented rhombs of dolomite, very porous; limestone, finely crystalline to lithographic, light gray-brown; one piece fairly fresh porphyry.

WHITEWOOD FORMATION

66 - 70.0 dolomite, calcareous, buff to medium brown, finely vuggy porosity; and dolomite, finely to medium crystalline, rhombic, as above, intergrown with limestone, dolomitic, finely crystalline, gray.

- 72.0 limestone, dolomitic (or calcareous dolomite) as above; limestone, dolomitic, mottled buff to gray, some fairly reddish. One piece porphyry at top of this interval appears to be out of place.

- 87.0 dolomite, mottled; buff spots surround vugs.

- 98.6 limestone; dolomitic, mottled; sandstone pebble 0.3' in diameter embedded in limestone at 90.4.

WINNIPEG FORMATION (99.6 - 199.9 feet)

Feet

- 99.0 sandstone, white, with pale greenish-gray cast

- 107.2 quartzite, fine-grained, dense, white. (This should be the "Scolithus" sand, but no borings could be identified with certainty in the core).

- 109.5 sandstone, fine, white, interbedded with shale, sandy, pale greenish gray.

- 115.3 siltstone, very fine, argillaceous, slightly dolomitic, pale greenish gray

- 117.0 siltstone, same, finely mottled, interbedded with silty clay

- 129.3 shale, silty. Actually, this is an intraformational conglomerate on very fine scale. Pebbles, up to 3 x 10 mm. of soft, fine, white sandstone are embedded in a matrix ranging from green shale to green siltstone and fine green sandstone. The sides of the core look like a guinea hen.

- 136.3 same, but softer and less distinct; both pebbles and matrix are siltstone or very fine sandstone.

- 136.8 siltstone, calcareous, red-brown.

- 137.3 shale, dark greenish gray, with a few sand pebbles as above.

- 139.9 shale, dark greenish gray, fissile.

- 193.0 shale, light to dark greenish gray, fissile, with a few black phosphatic pellets

- 199.9 shale, similar but harder, dark greenish gray; a few embedded sand grains.

DEADWOOD FORMATION (199.9 to 535.7 feet) approx. 336'

- 200.0 limestone, very finely crystalline, argillaceous, gray, slightly pyritic, glauconitic

- 208.0 limestone, dolomitic, finely crystalline, gray

- 211.0 dolomite, medium crystalline, rhombic, brown, glauconitic; some of brown rhombs may be siderite.

- 215.0 limestone, argillaceous, finely to medium crystalline, sideritic, very glauconitic, brown.

- 219.5 limestone, medium crystalline, white to buff, sideritic, with some glauconite.

Feet	
219.5- 222.0	siderite, medium crystalline, sandy with coarse, rounded grains; glauconitic
- 224.0	sandstone, coarse, very calcareous, sideritic, glauconitic
- 240.3	sandstone, coarse, sideritic, glauconitic
- 241.3	sandstone, green, argillaceous, glauconitic
- 255.0	sandstone, coarse, cemented by calcite, siderite, glauconite and a trace of hematite — hem
- 280.5	sandstone, coarse, cemented with calcite, siderite and glauconite in varying amounts.
- 291.0	sandstone, same, but divided by paper-thin seams of pale green shale
- 295.0	sandstone, fine to medium, calcareous, sideritic and glauconitic; with streaks of limestone, gray, sandy and shale, gray, sandy
- 300.0	limestone, medium crystalline, gray, glauconitic, sandy; grading to streaks of sandstone, calcareous, glauconitic
- 325.0	sandstone, fine, white, very calcareous, with much glauconite; some hematite cement 303.1 to 303.5 and from 304.5 to 306.85 — hem
- 329.0	dolomite, calcareous, gray to white, with siderite, glauconite, thin streaks of pale green shale
- 337.0	limestone, medium crystalline, light gray to light brown, very glauconitic; some sandy streaks; many paper thin partings of pale green waxy shale
- 341.0	limestone, finely crystalline, medium gray to very dark gray
- 342.8	limestone, like 329-337, except with more shale partings
- 348.9	alternate thin beds limestone as above and sandstone, gray, calcareous, glauconitic.
- 360.0	alternate bands limestone, sandy, gray, glauconitic; and shale, calcareous, gray, glauconitic
- 364.0	interbedded thin streaks limestone, sandstone, and hard dark gray shale
- 401.0	interbedded limestone, finely crystalline, gray, trace sandy; and shale, hard dark gray; streaks of edgewise conglomerate at 381 and between 393 and 400.5
- 402.6	shale, with thin streaks limestone as above

Feet

402.6 - 403.5 limestone, as above, with intraformational conglomerate and thin shale partings

- 404.9 shale, with thin limestone stringers

- 405.7 limestone, intraformational conglomerate; thin shale partings

- 407.9 shale, with few masses of intraformational conglomerate limestone

- 408.4 limestone, intraformational conglomerate

- 410.1 shale, with few limestone stringers

- 411.0 limestone, intraformational conglomerate

- 411.6 shale, traces of limestone stringers

- 412.7 shale, with thin limestone stringers

- 413.8 limestone, intraformational conglomerate

- 414.5 shale, with thin limestone stringers

- 416.2 limestone, intraformational conglomerate, with micaceous shale stringers

- 426.0 shale, with few stringers of intraformational limestone conglomerate

- 430.0 same, about 2/3 shale and 1/3 limestone

- 431.0 limestone, intraformational conglomerate; traces of shale

- 432.5 limestone, same, 2/3; shale, 1/3

STILL 432.5 - 433.9 igneous rock, calcareous, but with phenocrysts of mica and feldspar; pyritic

- 436.0 shale, dark gray, 2/3; limestone, conglomeratic, 1/3

- 441.0 interbedded shale and limestone in equal proportions

- 450.0 shale, as above, 60%; limestone, as above, 40%

- 451.0 limestone, alternate thin streaks medium crystalline, white, and medium crystalline, very glauconitic

- 453.7 shale, with thin streaks of limestone

- 457.8 limestone, some finely crystalline, light gray; mostly medium crystalline, dark green, very glauconitic, with some hematite stain and some pyrite

Galena

FEET

457.8 - 459.2 shale, dark gray

- 459.6 limestone, glauconitic

- 465.0 shale, dark greenish gray, fissile

- 471.0 interbedded limestone, glauconitic; and shale, fissile; pyritic from 469.3 to 469.5

- 486.0 shale, dark gray, fissile (medium greenish gray under microscope)

- 507.0 limestone, intraformational conglomerate; with thin streaks of shale as above. Matrix is glauconitic limestone, pebbles are finely crystalline to lithographic, light gray-brown limestone

- 508.0 shale, dark greenish gray

- 509.0 shale, hard

- 524.5 limestone, as above; trace pyrite near base

- 526.5 limestone and quartzite, with replacing pyrite, galena and sphalerite

- 527.0 quartzite, gray, pyritic

- 528.0 quartzite, coarse-grained, with thin streaks of pyrite

- 535.0 quartzite and quartzitic sandstone, coarse, gray, pyritic

- 535.7 quartzite, steeply dipping banding or bedding, traces of pyrite

PRECAMBRIAN at 535.7

- 536.2 quartz, white, massive

- 539.7 quartzite and quartz

- 544.0 schist, gray to red-brown, micaceous

- 545.0 schist, similar but oxidized red

- 562.0 schist, faintly reddish

- 583.0 schist, gray

- 618.0 schist, as above, to total depth of 618 feet.

Louis Noble

Exhibit 5

REPORT

ON

THE RICHMOND SITTING BULL MINE

BY

LOUIS NOBLE.

R E P O R T

RICHMOND SITTING BULL MINING PROPERTY

IN THE

BLACK HILLS OF SOUTH DAKOTA.

The Company owns sixteen claims and fractions located on Richmond Hill near the town of Galena, which is about ten miles by wagon road from Deadwood. A Narrow Gauge branch of the Burlington Road terminates here (Galena).

Richmond Hill is capped by limestone and shales, underneath which the Cambrian series of quartzite and shales, about three hundred feet thick lies. Below these the schists form the base of the hill. At the top of the Cambrian series a bed of quartzite some 300 feet in thickness occurs and along its upper surface in contact with a shale roof a continuous bed of altered and mineralized quartzite is found, which constitutes the vein of these properties. Numerous vertical cracks or fissures cut this ore horizon and have an important influence in the enrichment of the vein at such lines of intersection.

The dip of the vein is about ten degrees to the east. The ore streak varies from a few inches to several feet and the more valuable ores occur in bunches, pipes and thin sheets usually against the hanging wall, the surrounding material being low grade ore gradually merging into barren quartzite below.

This property was most actively productive from 1880 to 1883 and continued to work to some extent in 1891. The product of the mine during this period was sorted by hand, the lead ores smelted on the ground and shipped to Omaha, the the dru silver and gold ores treated in a pan amalgamation mill on the ground. Material too low for this treatment was put on the dump. Records of production submitted show a net value received for the sale of Bullion and ores of $451,383.00.

An area of the vein 1200 feet north and south by 500 feet east and west has been opened and about half stoped out in making this production and the higher grade and better lead ores were obtained from the first 400 feet of these workings. This seemed to be the bonanza zone and below it the more silicious ores are found which gradually decrease in silver values and increase in gold values as you go south.

The mine workings consist of a series of flat inclines made high enough so that ahorse could be worked to draw out ores.

Where bunches of pipes of ore were encountered, these inclines were widened into stopes and the mine now presents a net work of these openings surrounding pillars of material, which have been left as being less desirable than the portion mined. In addition to this there are large areas of virgin vein on either side.

I have taken ten samples of some of the best exposures now visible, with the idea of demonstrating the fact that rich material does exist throughout the general low grade mass and for the further purpose of verifying some of the statements made to me by Mr. C.B.Harris, who showed me the property.

The description and assay value of these samples is as follows; Gold is figured at $20.00 per ounce. Silver 65 cts. per ounce, Lead at 40¢ per unit.

No.1---- Average streak in most southerly face, 2 ft. thick Gold 11.29 oz., Silver 40.7 oz. Value $32.25 per ton.

No.2.---- Good looking streak at side of drift 100 ft. north of No.1 5½ ft. thick Gold 7.82, Silver 18.4 Value ~~$168.38~~ per ton. 13.0 $21.40

No.3.---- An average of 4 feet of apparently unmineralized quartzite, lying below the ore streak opposite sample No.2 Gold .06, Silver 3.2 oz. Values $3.28 per ton.

No.4----- Grab sample of 20 tons waste, stored in the neighborhood. Gold .06 ozs. Silver 3.6 ozs. Value $3.54 per ton.

No.5 ---- In west heading some 200 feet north of sample #1. average of best streak 1 foot thick. Gold .978 ozs. Silver 14.10 ozs Lead 14.5 per cent. Value $34.36 per ton.

No.6 ---- Sample of bunch 1 x 2 feet, left at side of old stope. Gold 1.24 ozs. Silver 12 ozs. Value $32.60 per ton.

No.7 ---- Middle southerly part of mine two bunches of ore about 1 foot thick. Gold 1.80 ozs. Silver 71.1 ozs. Value $32.21.

No. 8 ---- Lynn drift, central southern portion of mine, average of a triangular pipe of ore 14 inches thick. Gold 2.54 ozs. Silver 259.8 ozs. Lead 10.5 per cent. Value $223.87 per ton.

No.10 ---- In central section of mine a shoot of banded quartzite and carbonite of lead, some Galena bunches, showing a width of 10 feet and an average thickness of 3.5 feet. Gold .16 ozs. Silver 45.6 ozs Lead 15.4 per cent. Value $39.-- per ton.

No.9 ---- In central section of mine, iron sulphide streak 8 inches thick. Gold .06 ozs. Silver 5.10 ozs. Lead 1.5 % Value $5.11 per ton.

The conclusion drawn from these samples is that ore is difficult to judge by the eye and must be continuously assayed in working that the pipes and shoots of richer grades are erratic and not very large and would be difficult to save by themselves, but that they are of sufficient value and frequent enough to materially raise the value of the low grade mass of the vein if mined as a whole, and that Mr. Harris is familiar with ores and his judgment and statements are not misleading.

The method of hand sorting this ore and shipment to smelters of the high grade portions practiced in the past would probably not pay now, and probably in the past paid only in the bonanza parts of the mine.

The only possibility for large returns will be by working the vein as a whole, and milling all material extracted, producing concentrates which will contain the lead and a considerably proportion of the Gold and Silver values, and tailings from which a fair extraction can be made by Cyaniding. Such treatment, I would expect would cost about $1.50 per ton and I think it probable that a commercial extraction of 70% can be realized.

The main dump on the property contains 35000 tons of material and probably small dumps together with the waste left in the mine, will bring the aggregate to 500,000 tons. A portion of this dump has been sorted over in the past and a good grade of shipping ore produced.

The main mass of the material will, however, carry about $5.00 per ton value. About two years ago a trial lot of 183.6 tons of average dump was shipped to the Imperial Gold Mining and Milling Co. plant at Deadwood, S.D. with the following result.

The ore averaged 4.63 ounces Silver, $2.00 Gold per ton, 1.75 per cent Lead, carrying also 1.1 per cent Iron Pyrites. After crushing to 16 mesh, it was treated for several days with 2-10 per cent solution of cyanide and gave an extraction of 61 per cent of the Gold and 40% of the Silver, with cyanide consumption of 1.2 pounds per ton. A small amount of concentrates caught in washing the charge out showed values of about $125.00 per ton.

From this evidence as well as the appearance of the ores, I consider it likely that by concentrating first, and then cyaniding the tailings, extractions of 70% and better can be obtained.

~~From this~~ If this proves true, after proper testing, the dump and fillings represent a profit of about $100,000.00.

As a probable grade of average vein, I have used the following reasonings.

The openings in the mine, I estimate roughly to represent the removal of 100,000 tons of material. 50000 tons are still on the ground and 50000 were milled or shipped. I assume on rather incomplete evidence that the gross value of contensor ore treated and shipped was $750,000 or an average of $15.00 per ton. This combined with the dump at $5.00 per ton, gives an average of $10.00 per ton for all material mined. As a portion of this value came from bonanza ore, whose equivalent is not represented in the ground yet to be mined, I think it probable that $7.50 will more nearly represent the value of the reserves now exposed. Allowing $2.00 per ton for mining and $1.50 for milling and a 70% savings, we would have a profit of $1.75 per ton on mine ore.

While probably most of the Company's territory is underlain by the vein, there is an area of 1500 feet square, which I consider is fairly well proved by workings and outcrops, and which could be most conveniently worked.

At an average of 4 ft. thick, this would represent 860,000 tons, and allowing for pinches and pillars left in the working this would probably yield 500,000 tons of ore. There are, of course, possibilities of finding bonanza areas in the virgin ground, but these are not sufficiently certain to allow them to enter into your calculation. In order to realize the profits indicated above, the mine would have to be re-opened by another system of roads which would be level and allow of cheap handling. A compressor plant would be necessary for the proper breaking of the character of ground and the cost of these improvements would probably be $50,000. A mill would be required of at least 100 tons capacity with the tramway to the mine would be about $125,000.

This briefly shows what I believe may be the commercial possibilities of the enterprise. They are not estimates on which you would be justified in going ahead, but simply express the possibilities as they appear to me, based on the data at hand, and by a proper investigation, they can be proved or disproved with considerable certainty.

The cost of such an investigation consisting of sampling, mining and shipment and testing of trial lots would not exceed $5000.

(Signed) Louis S. Noble

Feb. 1907.

Exhibit 7

PRELIMINARY REPORT ON THE DOUBLE RAINBOW MINE

By Francis Church Lincoln

Introductory

During the summer of 1939, the author of this report made four trips of one day each to the Double Rainbow Mine at Galena. On all of these trips he was accompanied and assisted by Mr. DeWolfe Barton and Mr. Harold B. Ewoldt.

The geology of the Galena District was investigated in the field and a study was made of the published literature on the district. The old maps of the Double Rainbow Mine were examined and the old assays checked in a number of instances by taking new samples and having them assayed. Samples were also taken and assayed from many faces not previously sampled. All assays were made by Mr. Charles Bentley, Analyst at the South Dakota State School of Mines in Rapid City. Large, representative, composite samples of the Double Rainbow ore were prepared and sent to the Denver Equipment Company of Denver and the American Cyanamid Company of New York which made ore tests upon these samples and submitted reports.

The present preliminary report is based upon information obtained from all these various sources. The intention of the report is to present the conditions at the Double Rainbow Mine in a simple manner, avoiding details which might prove confusing at the outset. If the report proves of interest, it can readily be supplemented by copies of old maps, of assay returns, and of ore testing reports.

Location

The Double Rainbow Mine is located at Galena in Lawrence County in the northern Black Hills region of South Dakota. It is 5 miles by air line or 11 miles by road southeast of the city of Deadwood, and 39 miles by road northwest of Rapid City. The town of Galena consists of a few houses stretched out for half a mile along the bottom of the canyon of Bear Butte Creek at an elevation of about 4,800 feet above sea-level. The canyon walls rise abruptly on either side of the creek to elevations more than five hundred feet higher. The general course of Bear Butte Creek is northeasterly, but through the town of Galena it flows in a northerly direction.

The Merrit No. 2 and Merrit No. 1 claims belonging to the Double Rainbow Mine lie on the side of Custer Hill to the east of the town and the creek. As Bear Butte Creek leaves Galena, it turns eastward around the end of the Merrit No. 1 claim and Custer Hill, flowing over the 161 Placer claim which is under option to the Double Rainbow and the Sleeper claim which belongs to it, and between the Double Rainbows' Richmond-Sitting Bull mine on the side of Custer Hill and its Florence mine on the opposite side of the canyon.

Property

The Double Rainbow Mining Company owns 28 patented mining claims and has a lease and bond on the 29th claim. These claims all adjoin one another and consitiute a single compact group. Many of the claims are less than the permissible 1,500 feet in length, and many are less than the permissible 600 feet in width. The total area of the group is roughly 290 acres, or about 10 acres per claim.

The names of the 29 mining claims are:

Merrit No. 1
Merrit No. 2
Rock Hill
Savage
Custer
War Eagle
Margaret
Florence
161 Placer (Under Option)
Chicago
Sitting Bull
Richmond
Mountain
Wabash
Tiger Tail
Center Fraction
Silver Terra
Grand View
Gulch
Gray Eagle
Camilus
Sleeper
Gen. McClelland
Gorman
Oro Flam
Fissure
Bed Rock
Bank of Dakota
Teddy

There is a flotation mill on the General McClelland claim which contains considerable machinery which would be of value in a new mill, and there is also considerable mining machinery on the property which might be used to advantage. The company owns a good office building, a compressor house, and an assay office.

History

The principal mining claims in the Galena District were located in 1877. Only the richest of the silver-lead ore could be shipped in the early days because it had to go 250 miles by wagon and 500 miles by boat to reach the smelter in Omaha. A small smelter and a pan amalgamation mill were erected later, but failed to meet with great success on account of the high cost of fuel for the smelter and salt for the mill. The district made its greatest production from 1881 to 1884, and is credited with a production of about $750,000 in silver and lead up to the end of that period.

In 1883, the famous Sitting Bull-Silver Terra apex dispute was taken to court, and litigation over extralateral rights in the district continued for sixteen years. During this time the production of the principal mines was very low. By the time the apex litigation had been settled, the price of silver had dropped, and while considerable exploration and development has been carried on in the district since 1899, the production has continued small. In 1931, the Double Rainbow Mining Company erected a 150-ton flotation plant, but this mill was only operated for a few months,--its lack of success apparently being due to poor management.

General Geology

Bear Butte Creek has carved out Custer Hill east of the town of Galena by cutting down through the Pahasapaand Englewood Limestones of Mississippian Age, the Whitewood Limestone of Upper Ordovician age, and the Deadwood Formation of Upper Cambrain age, to the Algonkian schist which forms the central core of the Black Hills. The sedimentary formations dip gently eastward away from the exposed metamorphic schist at angles ranging from 8° to 20° from the horizontal; while the Algonkian schist below them strikes about North 60° East and dips about 50° southeasterly. At Galena, the bed of Bear Butte Creek is formed by the Algonkian schist, but as the stream turns eastward to flow between the Richmond-Sitting Bull and Florence mines, the eastward dip of the Deadwood Formation brings it into the stream bed and the Algonkian schist disappears beneath it.

The regularity of this geological structure has been disturbed by intrusions of Tertiary porphyries in the form of sills, dikes and laccoliths. On Custer Hill, the disturbance has been comparatively slight and has consisted in the intrusion of porphyry sills between some of the sedimentary strata; but across the canyon and west of the Florence mine, a great disturbance has occurred. A laccolith of Tertiary porphyry has been intruded between the Algonkian schist and the sedimentary rocks, and the uplifted sediments that formerly capped the laccolith have now been worn away, so that only schist and porphyry remain in this section of the district.

Economic Geology

The ore deposits of the Galena District occur in the Deadwood Formation of Upper Cambrain age. As this formation generally lies nearly flat upon the upturned edges of the steeply dipping Algonkian schist, it is known in the Black Hills as the "Flat Formation". In the Galena District the Flat Formation dips easterly at from 8° to 20° and has a general north-south strike. It consists of a series of thin-bedded strata of alternating shale, dolomite, sandstone, and quartzite with occasional intercalated sills of porphyry--the whole formation having a thickness of about 250 feet.

There are two ore horizons in he Flat Formation at Galena, one within a few feet of the bottom which is known as the "Lower Contact," and one within a few feet of the top which is called the "Upper Contact." The rock composing these "contacts" is a sandy dolomite or dolomitic quartzite composed ~~of layers~~ which frequently differ considerably in composition. The orebodies have been formed by the replacement of parts of these sandy dolomites by solutions rising through fractures locally termed "verticals." These solutions have, in favorable localities, replaced the rock for varying distances upon both sides of the vertical through which they rose. The extent of the replacement depends upon the composition of the rock and the strength of the vertical which introduced the solutions. Variations in the composition of different layers of the contact rocks have led to the replacement of some layers to greater dstances from the verticals than others.

The verticals are small faults which in general do not have great extent either vertically or horizontally. Their displacements are small, frequently no more than a fraction of an inch and never more than a few feet. As the name implies, most of the verticals have a nearly vertical dip. The verticals commonly occur in series and while any individual in a series may not extend for many feet, the series as a whole may extend for a long distance. The verticals at Galena may be divided into three groups according to their strikes--a northeast, and an east-west, and a northwest series. The northeast verticals are the strongest and the east-west of second importance. If the verticals of a series are closely spaced, ore may extend from one vertical to another. When verticals of two series intersect, the intersections are favorable points for the formation of ore bodies.

Since ore deposition depends upon the replacement of beds of varying chemical composition by solutions rising through small fractures which vary in size, strike, and dip, the orebodies formed are in most cases extremely irregular. The thickness of the orebodies ranges from a few inches to 12 or 14 feet, while the width commonly varies from a few inches to 13 or 20 feet. Closely spaced intersecting verticals may increase this width considerably, and there are several stopes in the Richmond-Sitting Bull mine where widths of 50 to 75 feet have been mined.

Character of the Ore and Ore Testing

The ore is partially oxidized and contains values in silver, gold, and lead. A large, composite ore sample taken with care for use in ore testing and containing material from a number of faces in the Richmond-Sitting Bull mine, a few in the Florence, and one in the Merrit, assayed as follows:

Silver	9.55 ozs. per ton, @ 71¢	$6.78
Gold	0.078 " @ $35	2.74
Lead	1.97% @ 5.5¢ per pound	2.17
	Total Value	$11.69

Zinc	0.9 %
Iron	15.5 %
Manganese	3.5 %
Calcium	1.95%
Sulphur	0.85%
Insoluble	56.4%

10 cu ft / ton in place

The specific gravity of this ore was 3.28. Its gross value in silver, gold, and lead was $11.69.

The minerals observed in the ore were quartz, dolomite, limonite, pyrolusite, psilomelane, hematite, cerussite, anglesite, galena, pyrite, arsenopyrite or lollingite, sphalerite, chalcopyrite, covellite, and gold.

By tabling, floating, and cyaniding the flotation tailings for 48 hours, the American Cyanamid Company obtained an extraction of 71.81% of the silver, 82.12% of the gold, and 56.04% of the lead in this ore. This was a gross recovery of $8.33. It is probable that some improvement in extractions would be obtained in practice. The results which the Denver Equipment Company achieved in testing this ore tended to confirm the findings of the American Cyanamid Company.

Development and Mining

Owing to the great irregularity and usual small size of the orebodies, it is impossible to block out ore in Flat Formation mines in the same manner in which it is commonly blocked out in veins. It is possible, however, to determine a development ratio for a Flat Formation mine which will ensure the regular production of sufficient ore to supply the mill. This may be done by conducting experimental mining for a sufficient time to determine with a fair degree of accuracy how many development or prospecting faces must be kept working so that the number or ore-producing faces needed to supply the mill may be kept constent.

The Bald Mountain Mining Company and the Canyon Corporation have both been mining flat Formation for a number of years. While the values in these mines are all in gold, the general characteristics of the ore deposits are similar to those of the Double Rainbow. The Bald Mountain Mining Company has experienced no difficulty in keeping its 325-ton mill supplied with ore; and the Canyon Corporation finds little trouble in keeping its 110-ton mill running.

The general method of development and mining employed is to follow a promising vertical until it "makes ore", and then to enlarge the drift and take out the full width of the ore as the drift or breast stope advances.

Ore Prospects of the Double Rainbow Mine

The Double Rainbow Mine has claims on the outcrops of both the Upper Contact and the Lower Contact. On the outcrop of the Upper Contact, high up on the western slope of Custer Hill, are the Custer, Savage, and War Eagle claims which cover some 2,300 feet of the apex. Below these claims near the bottom of Custer Hill are the Merrit No. 1 and Merrit No. 2 claims which cover about 1,900 feet of the apex of the lower Contact. Around the hill on its northern slope are the Richmond and Sitting Bull claims which are located upon the outcrop of the Upper Contact along the line of its dip. East of the Sitting Bull in the bottom of the canyon where the Upper Contact dips under the bed of Bear Butte Creek, the Sleeper claim covers 300 feet of its apex. North of the Sitting Bull across the canyon is the Florence claim covering 300 feet of the apex of the Upper Contact on that side of the creek.

The workings of the Richmond and Sitting Bull claims are connected and the Richmond-Sitting Bull mine has been the largest producer in the district. Its workings extend for about 1,325 feet into Custer Hill. For the first 800 feet of this distance, the Upper Contact has been rather throughly explored over a

width of about 575 feet. Within this well-explored area, however, shells of ore have been left on the walls of some of the old stopes, and there are a number of promising ore indications which have not been followed. In the deeper portion of the mine beyond the first 800 feet, the possibilities of finding more ore are very good.

The sleeper claim has had no work done upon it and may possibly lie to the eastward of the ore-bearing area.

The Florence mine is opened by a 600-foot tunnel and a few lateral workings. It has produced but little ore and may be considered as still being in the prospecting stage. As no assays from this mine were available, 19 faces were designated for sampling by the writer and were sampled by Mr. H. B. Evolat. The assay returns showed that 8 of the 19 faces sampled were in ore. This ore ranged in value from $6.94 to $15.81 per ton in gold and silver and contained a small undetermined amount of lead.

Two samples each were taken at the Custer, Savage and War Eagle mines. One of the samples from the Custer mine ran $4.95 in gold and silver per ton, one from the Savage mine ran $4.50, and one from the War Eage ran $13.85 in gold and silver per ton. All of these properties are promising.

The Merrit mine was one of the important early producers. Only 3 samples from one working were taken in this large mine. One of these samples ran $3.66 in gold and silver per ton and contained 6.56% lead--a total value of $10.88. The Merrit mine is the only property of the Double Rainbow Mining Company which is located upon the outcrop of the Lower Contact. It deserves thorough investigation.

The Lower Contact underneath the Richmond-Sitting Bull and Florence mines and the 161 placer claim presents a most promising area for prospecting. The past production of the Merrit mine proves that the Lower Contact is well mineralized in the Galena District. It is quite probable that the same series of verticals which make ore in the Richmond-Sitting Bull and Florence mines on the Upper Contact in this area, extend downward to the Lower Contact. In any event, some verticals must be present in the Lower Contact in this neighborhood to have brought mineralizing solutions into the verticals of the Upper Contact. There is, therefore, good reason to believe that ore deposits may exist in this large unexplored area of the Lower Contact.

Recommendations

The workings of the Merrit, Custer, Savage, and War Eagle mines should be examined, mapped and sampled.

A shaft should be sunk in the Lower Contact on the Chicago claim, and exploratory work conducted upon the contact. The depth of this shaft would probably be less than 50 feet.

While the above work is in progress, experimental mining should be started in the Richmond-Sitting Bull and Florence mines; and upon completion of the above work, experimental mining should be extended to such of the Merrit, Custer, Savage, War Eagle and Chicago workings as appeared promising. The ore produced by this experimental mining should be stored in surface bins and convenient underground excavations with a view to minimizing later handling costs. This test would determine the number of faces that would have to be kept working in order to ensure that one face should be in ore.

Upon completion of the exploration work and experimental mining, the mill should be put in the proper shape to treat the ore found, after which regular mining and milling operations should be begun.

Respectfully submitted,

F.C. Lincoln E.M., Ph.D.

Rapid City, South Dakota,
March 1, 1940

Exhibit 8

1 copy

LOCATION AND VALUE OF SAMPLES TAKEN TO FORM
DRA, DRB, DRC, AND DRD . AUS $35.00, AG @ 70¢

	Sample	Width	Value	
	F5	3'	$ 9.24	15
	F6	3'	15.81	15
	F7	3'	1.58	15
	F8	3'	10.55	10
	F9	2'	15.46	10
	F16	4'	6.94	20
	WE1	3'	2.74	15
	WE2	3	13.85	15
R1	D211	2'	14.70	10
R1½	D210	4'	14.91	20
	R14	2'	12.04	10
	R15	3'	13.45	15
	R17	4'	18.23	20
	H66	4'	1.26	20
	R16	3'	25.87	15
	H63	6'	4.20	30
R-10	D78	3'	10.01	15
	D72	3'	5.95	15
	D189	6'	2.25	30
	H187	6'	6.20	30
	R20	38	4.67	15
	R21	3'	3.58	15
	R22	3'	4.54	15
	R24	3'	4.95	15
	D87@H74	6'	5.01	30
	R25	28	4.78	10
	H54	3'	6.93	15
	H55	3'	5.60	15
	H56	3'	7.42	15
	D79	4'	2.31	20
	D63(R30)	6'	6.88	30
	H42	6'	4.55	30
	H173	4'	10.85	20
	H174	4'	3.36	20
	H175	4'	3.08	20
	H176	3'	2.10	15
	H177	4'	5.39	20
	R26	3'	16.16	15
	R27	2'	4.33	10
	R28	2'	2.97	10
				705#

	ag	au	Pb
DRA	9.04	0.08	1.9
DRB	9.34	0.08	2.0
DRC	10.26	.075	1.8
Value av. 3	28.64	23¢	5.9
	9.54	.078	1.9
Value	~~6.79~~ 27.19	~~2.72~~	~~39.4~~
(10-21-65) 21.35	12.30	2.75	6.3

9.50 ave ag
1.57 + 39.4# Pb/ton
$11.07 ave value
$7.75 70% recovery

DRC - 190# to Denver Equip
DRB 150# to Am Cyanamid
340#

DRA 150# Esh
DRD 100#
Total 590

Balance Left at Mine for ore dressing.

SAMPLES MARKED —SHOWED VISIBLE GALENA WHEN TAKEN

Composite sample compiled by adding 5# for each foot. Thus a 3' sample contributed 15# to the composite sample, a 6' sample 30#.

Exhibit 9

Double Rainbow Mining Co.,
Galena, South Dakota.

Rapid City, South Dakota
July 26, 1939

The samples received from you have been assayed and the results obtained are as follows:

Certificate No. 9185. COPY

M--Merrit Mine
R.--Richmond-Sitting Bull Mine

	Sample No.		GOLD Ounces per ton	GOLD *Value per ton	SILVER Ounces per ton	SILVER *Value per ton	LEAD	
1.	M 1	18"	0.01	$ 0.35	0.40	$ 0.28	0.26%	
2.	M 2	12"	0.02	0.70	4.18	2.96	6.56	
3.	M 3	18"	Trace	None	0.32	0.22	0.26	
4.	R 1	30"	0.01	0.35	2.05	1.45	0.15	
5.	R 2	30"	None	None	0.18	0.12	-----	
6.	R 3	14"	0.06	2.10	49.89	35.42	15.21	Au 3.59 Ag 1.29 Pb 16.9
7.	R 4	20"	Trace	None	1.54	1.09	3.62	
8.	R 5	28"	0.38	13.30	1.76	1.25	0.94	$14.96
H78 9.	R 6	16"	0.07	2.45	3.62	2.57	0.47	
10.	R 7	30"	0.02	0.70	1.13	0.80	~~[illegible]~~	
H75 11.	R 8	28"	Trace	None	0.69	0.49	1.36	$4.72
12.	R 9	4.0'	Trace	None	3.44	2.44	———	
Loc.? D78 13.	R 10	18"	0.40	14.00	30.50	21.65	1.99	59.43
14.	R 11	4.0'	0.01	0.35	1.74	1.23	------	
15.	R 12		0.09	3.15	16.80	11.93	------	$24.82
16.	R 13		0.01	0.35	20.50	14.55	------	$26.79

*Values figured on basis of gold @ $35.00 per ounce, silver @ $0.71 per ounce.

Double Rainbow Mines
Deadwood, S. Dak., (Galena)

Rapid City, South Dakota
August 25, 1939

The samples received from you have been assayed and the results obtained are as follows:

Certificate No. 9217 COPY R—Richmond--Sitting Bull Mine

Sample No.	GOLD		SILVER			
	Ounces per ton	*Value per ton	Ounces per ton	*Value Per ton		
1. R 14	0.01	$0.35	16.47	$11.69	$12.04	21.60
2. R 15	0.01	0.35	18.45	13.10	13.45	24.15
3. R 16	0.06	2.10	33.49	23.77	25.87	45.30
4. R 17	0.01	0.35	25.19	17.88	18.23	33.30
5. R 18	0.04	1.40	5.18	3.67	5.07	8.08
6. R 19	0.04	1.40	8.76	6.22	7.62	12.70
7. R 20	0.06	2.10	3.90	2.77	4.87	7.13
8. R 21	0.02	0.70	4.06	2.88		5.74
9. R 22	0.01	0.35	3.31	2.35		4.62
10. R 23	0.04	1.40	4.43	3.14	4.54	7.11

*Values figured on basis of gold @ $35.00 per ounce, silver @ 0.71 per ounce.

Chas. Bentley
Assayer

Double Rainbow Mines
Deadwood, S. Dak. (Galena)

Rapid City, South Dakota
August 25, 1939

The samples received from you have been assayed and the reults obtained are as follows:

Certificate No. 9218 COPY R--Richmond-Sitting Bull Mine

	Sample No.	GOLD		SILVER			
		Ounces per ton	*Value per ton	Ounces per ton	*Value per ton		
1.	R 24	0.07	$2.45	3.52	$2.50	$4.95	6.99
2.	R 25	0.04	1.40	4.77	3.38	4.78	7.55
3.	R 26	0.27	9.45	9.46	6.71	16.16	21.65
4.	R 27	0.02	0.70	5.11	3.63	4.33	7.29
5.	R 28	0.01	0.35	3.69	2.62		5.11
6.	R 29	0.13	4.55	3.28	2.33	6.88	8.78
7.	R 30	0.11	3.85	4.27	3.03	6.88	9.35
8.	R 31	0.02	0.70	2.54	1.80		3.97

*Values figured on basis of gold @ $35.00 per ounce, silver @ $0.71 per ounce.

Chas. Bentley
Assayer

Double Rainbow Mines
Galena, South Dakota

Rapid City, South Dakota
August 23, 1939

The samples received from you have been assayed and the results obtained are as follows:

Certificate No. 9212 COPY F—Forence

	Sample No.	GOLD		SILVER		
		Ounces per ton	*Value per ton	Ounces Per ton	*Value per ton	
1.	F 1	0.01	$0.35	2.58	$1.83	
2.	F 2	0.02	0.70	15.41	10.94	$11.64
3.	F 3	0.01	0.35	1.48	1.05	
4.	F 4	0.01	0.35	0.74	0.52	
5.	F 5	0.17	5.95	4.64	3.29	9.24
6.	F 6	0.28	9.80	8.47	6.01	15.81
7.	F 7	0.02	0.70	1.24	0.88	
8.	F 8	0.21	7.35	4.51	3.20	10.55
9.	F 9	0.22	7.70	10.94	7.76	15.46
10.	F 10	0.01	0.35	15.15	10.75	11.10

*Values figured on basis of gold @ $35.00 per ounce, silver @ $0.71 per ounce.

Chas. Bentley
Assayer

Double Rainbow Mines
Galena, South Dakota

Rapid City, South Dakota
August 23, 1939

The samples received from you have been assayed and the results obtained are as follows:

Certificate 9213 COPY F.--Florence
C.--Custer

	Sample No.	GOLD		SILVER		
		Ounces per ton	*Value per ton	Ounces per ton	*Value per ton	
1.	F 11	0.02	$0.70	13.46	$9.55	$10.25
2.	F 12	0.03	1.05	2.34	2.01	
3.	F 13	0.01	0.35	3.96	2.81	
4.	F 14	Trace	None	0.58	0.41	
5.	F 15	0.01	0.35	2.12	1.50	
6.	F 16	0.01	0.35	9.29	6.59	6.94
7.	F 17	Trace	None	0.70	0.49	
8.	F 18	Trace	None	0.24	0.17	
9.	F 19	0.01	0.35	2.72	1.72	
10.	C 1	0.12	4.20	0.74	0.52	4.72

*Values figured on basis of gold @ $35.00 per ounce, silver @ $0.71 per ounce.

Chas. Bentley
Assayer

Double Rainbow Mining Co.
Galena, South Dakota

Rapid City, South Dakota
July 26, 1939

The samples received from you have been assayed and the results obtained are as follows:

Certificate No. 9184 COPY B--Barton Tunnel

	Sample No.	GOLD		SILVER		Lead
		Ounces per ton	*Value per ton	Ounces per ton	*Value per ton	
1.	B 1	Trace	None	0.36	$0.25	None
2.	B 2	Trace	None	0.22	0.15	None
3.	B 3	Trace	None	0.48	0.34	None
4.	B 4	0.005	$0.17	0.97	0.69	0.10%
5.	B 5	Trace	None	0.77	0.54	0.26
6.	B 6	0.01	0.35	1.77	1.25	———
7.	B 7	Trace	None	8.76	6.22	———
8.	B 8	0.01	0.35	0.09	0.06	———
9.	B 9	Trace	None	0.52	0.37	———
10.	B 10	None	None	Trace	None	———

* Values figured on basis of gold @ $35.00 per ounce, silver @ $0.71 per ounce.

Chas. Bentley
Assayer

Double Rainbow Mines
Galena, South Dakota

Rapid City, South Dakota
August 23, 1939

The samples received from you have been assayed and the results obtained are as follows:

Certificate 9214 COPY

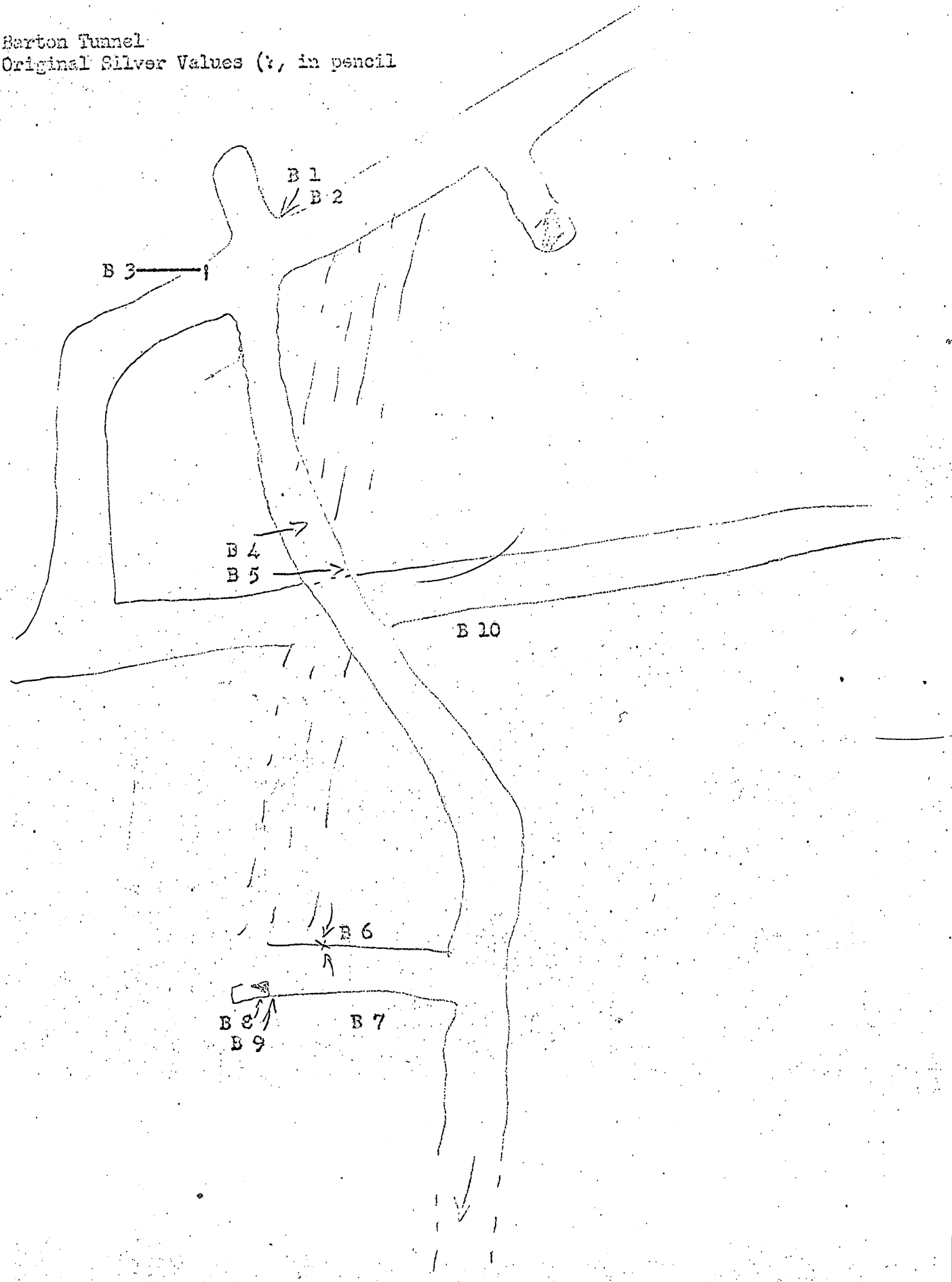
C--Custer
S--Savage
WE--War Eagle

Sample No.	GOLD		SILVER			
	Ounces per ton	*Value per ton	Ounces Per ton	*Value per ton		
1. C 2	0.09	$3.15	2.55	$1.81	$4.96	Prospect
2. C 3	0.01	0.35	1.06	0.75		
3. S 1	0.03	1.05	Trace	None		
4. S 2	0.11	3.85	0.92	0.65	4.50	Prospect
5. WE 1	0.05	1.75	1.40	0.99		
6. We 2	0.33	11.55	3.25	2.30	13.85	

*Values figured on basis of gold @ $35.00 per ounce, silver @ $0.71 per ounce.

Chas. Bentley
Assayer

Barton Tunnel
Original Silver Values (%, in pencil



RICHMOND & KING BULL

R 1 - 30" Qtzte. below ore bed)
R 2 - 30" " above ore bed) 2 OS
R 3 - 14" ore bed)
R 4 - 20" bed immediately above ore)

R 5 - 28" ore bed)
R 6-16" below ore bed) H 78
R 7 - 30" below R 6)

R 8 - 28" top ore bed) H 75
R 9 - 48" below ore bed)

R 10 - 18" ore bed) D 78
R 11 - 48" Qtzte. below R 10)

R 12 - Chip Sample face drift (Qtzte.)) D 210

R 13 - Chip Sample face drift) D 211
Ore above Qzte.
R 12 & R 13 Taken from Wrights figures

M 1 - 18" Qtzte. below ore) Lower Contact
M 2 - 12" Ore bed) Merritt No. 1
M 3 - 18" Qtzte. & Shale above ore) Sulphide

BARTON TUNNEL

B 1 - 36" of limey shale over qtzte. (Sulphur smell)
B 2 - 30" of Qtzte. underlying shale (B 1) (Sulphur smell)
B 3 - 5' Qtzte. and shale
B 4 - 5' " " " shows galena
B 5 - 5' " " " " "
B 6 - 55' " " " one bed about 6" shows considerable galena
B 7 - Sample of limey bed showing galena along Vert. bed 6" thick Prospect X (Small pocket in vertical)
B 8 - Qtzte. at bottom of shallow Winze - 38" along Qtzte. bed
B 9 - 5.5' Sample limey shales above B 8
B 10 - Chip sample qtzte. directly under B 5

Sample No.	Gold Oz. per ton	Gold value per ton	Silver Oz. per ton	Silver value per ton	Lead
DRA	0.08	$ 2.80	9.04	$6.42	1.97%
DRB	0.08	2.80	9.34	6.63	2.09
DRC	0.075	2.62	10.26	7.28	1.86

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Exhibit 10

THE GALENA DISTRICT

Lawrence County, South Dakota

Introduction

Summary of geologic conditions -- The Deadwood formation, 502 feet thick, rests on pre-Cambrian rocks and is overlain by the Whitewood ~~and~~ younger limestones. The Deadwood strikes north and south and dips east at low angles. At two stratigraphic horizons in the Deadwood, beds of dolomite and dolomitic sandstone and dolomitic quartzite have been mineralized. The lower horizon or ore zone, known as the "lower contact," is 20 to 70 feet above the unconformity between the Deadwood and the pre-Cambrian rocks. The upper ore zone, known as the "upper contact," is about 100 feet below the top of the formation. The mineralization occurs where vertical fractures, known as "verticals," intersect the "contacts," forming replacement bodies in the dolomitic rock. The mineralization occurs only in restricted areas and many verticals are unmineralized. The ore shoots are tabular bodies elongated horizontally along the strike of the verticals. The shortest dimension of the ore shoots is vertical, perpendicular to the bedding. The principal primary minerals are pyrite and argentiferous galena. A few hundredths to a few tenths of an ounce of gold per ton usually occur. At many places the ore is oxidized so that little of the primary minerals remain and some mines have only oxidized ore. The Deadwood formation is cut by igneous sills of several types.

Location and property -- The Galena mining district, part of the Bear Butte mining district, is named for the town of Galena. The population of the town formerly was large but now is four. The Galena district is 5 miles southeast of Deadwood.

L. Contact
Silver Queen Group
Merritt No. 2
Horseshoe-Comet

U. Contact
Double-Rainbow
Florence

The claims are owned by various people, but there are two important groups; the Double Rainbow owned by DeWolff Barton of New York City, and the Silver Queen owned by H. H. Stewart and Nels Thompson of Deadwood, South Dakota. The claims are shown in Plate 1.

The most important mine in the district is the Double Rainbow, formerly known as the Richmond-Sitting Bull, on the upper contact. The next most important mine for which reasonably accurate production figures are available is the Silver Queen, on the lower contact. The excavation of the Merritt No. 2 on the lower contact is about as large as that of the Silver Queen (compare mine outlines on Plates 2 and 3). The sizes of the dumps at the Horseshoe-Comet indicate that it may have been larger than the Silver Queen or the Merritt No. 2. The Horseshoe-Comet is on the lower contact and is not in either of the large groups of claims. It is southwest of Merritt No. 2. Next largest is the Florence on the upper contact and in the Double Rainbow group. The Hayes, in the Silver Queen group on the lower contact, is a little smaller. Other smaller mines are shown on Plates 2 and 3 and brief descriptions of mines for which no maps are now available are contained in the literature (Connolly and O'Harra, 1929; and Heins, 1928)*.

Purpose of investigation -- The purpose of this investigation is to determine if the Galena district is promising enough to justify further exploration and to propose details of exploration if it is justified.

Scope of investigation -- The time devoted to field work was 18 days. The party consisted of a geologist and a plane table operator. The party was instructed to spend the time in surface investigations that might lead

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* Names in parentheses refer to papers by authors listed in the bibliography at the end of the report.

to more detailed geologic knowledge and to an understanding of ore control. Since the more important mines previously have been studied and reported in fair detail, little time was spent underground. Most of the time was spent in studying the valley side occupied by the Merritt and Custer claims (see Plate 2), but the traverse was carried down the valley to obtain topographic and structural control at the Double Rainbow and Florence mines.

All available reports, assays, and maps were assembled, and features of mine geology discussed here are largely from those sources. Plate 3 was modified from a map by Ewoldt and Watkins (1940). Detailed maps of all of the mines showing many features not given on Plates 1 and 2 are filed in the District Office of the U. S. Bureau of Mines at Rapid City.

Acknowledgements -- Ideas resulting from discussions with Mr. E. Y. Dougherty, District Engineer, Rapid City were of great value. Mr. Paul E. Pesonen and Mr. Fremont F. Clarke, both of the District Office, offered advice and encouragement. The progress of the work was aided by the enthusiastic cooperation of Mr. Douglas Robinson, operator of the plane table.

General Geology

Topography -- Bear Butte creek occupies a winding valley which is about 700 feet deep. The creek flows in a generally northeasterly direction but consists of stretches which generally are either northerly or easterly.

Stratigraphic geology -- The oldest rocks are pre-Cambrian slate, schist, quartzite, argillite, and amphibolite. In the valley bottom near the south end of the Galena Placer (near Sta. 9, pl. 2) the argillite crops out close to the schist which appears to be more highly metamorphosed.

The Deadwood formation of Cambrian age is unconformable on the metamorphic rocks. A detailed section of the Deadwood at the Merritt and Custer

claims is shown in Plate 4. The total thickness is 502 feet. The lower part of the formation is quartzite, the thickness of which appears to vary from 20 to 70 feet. The mineralized "lower contact" is just above the top of the quartzite. At the Merritt No. 1 only 20 feet of massive quartzite is found between the "lower contact" and the intrusive igneous rock below. It is possible that a greater thickness was cut out by the intrusion. At Merritt No. 2 there appears to be 70 feet of quartzite, both massive and thin-bedded and including conglomerate and glauconitic sandstone, between the "lower contact" and the schist. In all of this area the exposures are poor and the structure is complicated by igneous sills (see plate 5). Exposures at the Comet probably are better. In about the middle of this 70-foot section below Merritt No. 2 there is another mineralized horizon that was not observed to the north.

Above the basal quartzite is thin-bedded dolomite 30 feet thick. Above the dolomite is a flat-pebble dolomite conglomerate interbedded with green shale and totaling 11 feet thick. Next above is green shale at least 29 feet thick and above that through an interval of about 260 feet is a series of interbedded green shale, thin-bedded dolomitic sandstone and sandy dolomite, partly with flat-pebble dolomite conglomerate. Many beds of sandstone and dolomite are glauconitic. Above this series is a massive quartzite about 15 feet thick and the "upper contact" occurs just above the massive quartzite and in the base of a 38-foot series of thin-bedded dolomitic quartzite containing a little interbedded shale. The next 55 feet is covered and at the top of the formation is a massive white quartzite 9 feet thick.

The thick-bedded light buff Whitewood limestone above the Deadwood is 62 feet thick. It is Ordovician in age. Above that is the thin-bedded pink Englewood limestone, 34 feet thick. The Pahasapa limestone is next above. It originally was several hundred feet thick, but it forms the crest of the hill and most of it has been eroded. The Englewood and Pahasapa are Mississippian.

Igneous geology -- Igneous rocks intruded during the early Tertiary form a number of sills in the Deadwood formation, and also make a few dikes and irregular masses cutting all of the formations described above. There are five petrographic types and one of these types has two varieties. The identifications are based on study of hand specimens and brief inspection with the microscope. The principal type was called quartz monzonite porphyry because it was thought to represent that type as shown on the map accompanying U. S. G. S. Folio 219 (Darton and Page, 1925). It is so designated on Plates 2, 3 and 5 of this report. Microscopic examination shows that this type actually contains no quartz and probably is monzonite prophyry. The rock has two varieties. One is exposed in a sill up to 150 feet thick below the mine openings on the Merritt No. 1. It is medium green with abundant small phenocrysts of feldspar and a pyribole. The pyribole is black and fairly vitreous in hand specimen. The other variety of this type of monzonite porphyry is about the same color but has fewer phenocrysts. The feldspar phenocrysts are roundish and the pyribole is dull green. The best exposures are in a dike in the creek bed near the south end of the Galena Placer (coordinates 1, 170 S., 1,550 W., plate 2).

The second most abundant type of igneous rock is designated granite porphyry. It is light gray to cream to pinkish and contains subvitreous

phenocrysts of plagioclase. Orthoclase is abundant in the groundmass. It is found at a number of places on the hillside along the Valley Lode where it forms a sill with thickness up to 110 feet thick.

The third type of rock is designated alkali quartz monzonite porphyry. It has feldspar phenocrysts about 1 1/2 inches in size and also some of about 1/4 inch. There is quartz in the groundmass. It crops out as a 25-foot wall near creek level on the Mogul Mill Site (plate 2) and probably causes the narrowing of the valley. The bottom of it is about 60 feet above the "lower contact" but it apparently does not extend as far south as the Merritt Claims.

The fourth type of rock is called monzonite porphyry (see plates 2 and 5) and diorite porphyry (see Plate 4), but is shown by the same symbol on all plates. Its composition is uncertain. It has dark green groundmass with vitreous black pyribole phenocrysts. This is shown on the map (plate 2) at only one point, about 165 feet above the mine workings of the Merritt No. 1, but a similar rock has been noted at several points as far south as the Hayes Mine.

The fifth type is not shown on the maps and was seen only in the dump of the caved tunnel near the north end of the Custer claim. It is light gray and fine-grained with no phenocrysts. Microscopic inspection indicates that it may be trachyte porphyry.

Structural geology -- The structure of the pre-Cambrian is shown by a few outcrops along Bear Butte Creek below the Merritt claims. The strike is to the northeast, but varies between N. 34° E. and N. 89° E., averaging N. 59° E. The dip is to the southeast at angles between 36 and 71 degrees, averaging 48°. The biggest discordance in attitude is in outcrops

Pre-Cam

36-71

110 feet apart near the dike at the south end of the Galena Placer. South of the dike schist strikes N. 89° E. and dips 71° to the southeast. North of the dike argillite strikes N. 34° E. and dips 36° to the southeast.

Three items are of most importance in considering the structure of the Deadwood formation: (1) the variation in dip and strike, (2) the trends of the "verticals," and (3) the locations of igneous intrusions.

The regional strike of the Deadwood in the northern part of the Galena district is within one or two degrees of north-south and the dip is to the east. Departures from this strike locally may be 35 degrees, but the strike is remarkably constant. No observations were made in the vicinity of the Silver Queen, a mile to the south, but detailed mine maps by Ewoldt and Watkins (1940) show the strike between east-west and north-northwest with dip to north or northeast.

In the northern part of the area the dip to the east varies between 3 and 30 degrees. Very locally it is somewhat more. The variation in dip is systematic in a monoclinal fold. An east-west section along B-B' (plate 2) shows that at the west end of the section the outcrops on the Custer and Merritt claims have dips of 16 to 20 degrees. One thousand one hundred fifty feet east at the Double Rainbow mine the dip has flattened to an average of 5 1/2 to 7 1/2 degrees throughout a distance of 1,000 feet in the mine area. Eight hundred feet east of the McClellan tunnel, in the vicinity of the Barton tunnel (see plate 2) the dip has again steepened to 12 to 30 degrees. In other words, the Double Rainbow mine and the Florence mine to the north across the creek are in an area of flat dip. There are more local variations in dip of similar monoclinal character within the mine. Records of dip and strike show this to be true when the change is not apparent to casual observation. In the Havens drift of the Double Rainbow mine the variation is easily seen. Ewoldt and Watkins (1940) contoured the "lower contact" at the

the Silver Queen and Hayes mines with a contour interval of 5 feet and demonstrated small monoclinal folds. They suggest that a contour interval of 1 foot is necessary to bring out all of the significant features.

Monoclinal folding is typical of the Paleozoic and Mesozoic rocks in the Black Hills. Inspection of structure sections in any of the U. S. Geological Survey folios shows that the beds have relatively steep monoclinal dips at the margins of the Black Hills separating much more gentle dips in the central part of the Black Hills and in the Great Plains. Regionally the structure at the margin of the Black Hills is simple. In detail the marginal structures are quite varied and do not everywhere conform to the regional trend in dip and strike. The structure sections also show that the monoclinal type of marginal structure is repeated on a smaller scale at many places within the Black Hills.

The second item of structure is the "verticals." These are fractures of vertical or steep dip cutting the Deadwood formation. These have been studied only in the mines and only on the upper and lower "contacts" where mineralization of many of the verticals makes them more noticeable. The individual fracture may not extend more than a few feet or a few tens of feet along its strike, but parallel to it and overlapping may be one or more other verticals. Such a group of verticals may be confined to a total width of a few inches or a foot but the group may extend for several hundred feet along the strike. Other groups extend only a few tens of feet. The mine maps (plates 2 and 3) show groups of verticals rather than individual verticals. Many of the verticals are small faults with displacement of a fraction of an inch to a few inches. The largest displacement recorded is 4 feet. The verticals extend from floor to roof of mine excavations and a

few are open several feet into the roof.

Those who have studied the Double Rainbow Mine disagree as to the strike of the strongest verticals. Some have stated that the northeast set contains the strongest verticals and others state that the east-west set contains the strongest ones. The writer did not make enough observations underground to decide, but has plotted all of those recorded on the maps and has found that those with strike between east-west and S. 70° E. include 31 percent of all of the verticals in the Double Rainbow. If the range is extended to include those between N. 70° E. and S. 60° E., the percentage increases to 49. Nineteen percent of the verticals strike between N. 30° E. and N. 50° E. A minor group between north-south and N. 20° W. includes 11 percent of the verticals.

The verticals at other mines in the northern part of the district were tabulated. At the Florence, 36 percent of the verticals lie between N. 60° E. and N. 80° E. Twenty-three percent are between N. 10° E. and N. 10° W. At the Merritt No. 2 all of the verticals are between N. 30° E. and S. 50° E. and those with east-west trend do not form a group distinct from those with northeast trend. At the War Eagle and Savage 72 percent of the verticals strike between N. 10° E. and N. 50° E. while the remainder are between N. 80° E. and S. 60° E.

From the above it may be seen that in the northern part of the district there are two major groups of verticals, those with northeast strike and those with east-west strike. A minor group strikes north-south.

In the southern part of the district the northeast trend is dominant. At the Silver Queen 80 percent of the verticals are between N. 36° E. and N. 71° E. At the Hayes 70 percent are between N. 30° E. and N. 84° E.

The third item of structure concerns the igneous intrusions. These are principally sills, but there are also dikes and irregular intrusions. Within the area of the mines there are several sills. Six different sills were encountered in the hillside of the Merritt and Custer claims. The largest is a quartz monzonite porphyry (actually monzonite porphyry) sill varying between 150 and 70 feet thick. To the north it appears to be intruded along the unconformity at the base of the Deadwood, but to the south it lies between parts of the Deadwood basal quartzite (see plate 5). In this southern part a granite porphyry sill occupies the unconformity but farther south it too is found between parts of the basal quartzite. The other porphyry sills are higher in the section, between the upper and lower "contacts." They are relatively thin as shown in Plate 5.

Cross-cutting sill

Three sills have been reported to lie between the upper and lower "contacts" below the Double Rainbow Mine, but the writer did not study that section in detail. Apparently their total thickness is about the same as those lying between the "contacts" at the Merritt and Custer claims.

The sills increase the interval between the top and bottom of the Deadwood. The stratigraphic thickness is 502 feet, but at the Merritt No. 2 the total thickness is 735 feet because of the sills. At the Merritt No. 1 the total thickness is about 550 feet. The principal variation in the sills thickness occurs below the "lower contact." Therefore, the sills do not cause major variation in the vertical interval between the "contacts."

A dike striking about N. 45° E. crosses Bear Butte Creek near the south end of Galena Placer. A few dikes have been reported in mines not now accessible. An intrusion of granite porphyry, possibly a large dike, passes from the Deadwood up into the Pahasapa in the ground between the Savage and the War Eagle. Large irregular masses of igneous rock are within less than

a mile of the Galena district to the north and west, and a large intrusion is a mile and a half to the east.

Most writers who have tried to explain the verticals and the folds in the Galena district have attempted to assign them a common cause, if they have discussed the folds at all. Some of the early writers believed that the cause was the intrusion of the sills. It has also been suggested that irregularity in thickness of the sills resulted in the folds of the sedimentary rock. Later writers have suggested that the folds and verticals result from the regional forces that made the Black Hills uplift. This probably is nearer the truth, because such folds are found in all parts of the Black Hills, not just where there are sills. However, stated in such general terms, the explanation of cause may be misleading. The writer suggests that the local folding results from the local operation of forces similar to those that caused the regional uplift, as elaborated below.

The marginal monoclinal structure of the Black Hills, simple in regional view but locally quite variable, suggests that the Black Hills resulted from vertical forces. A structural map of the United States, published a few years ago, even shows the Black Hills determined in large part by hidden faults in the pre-Cambrian rocks. It is logical to assume that smaller monoclinal structures within the Black Hills uplift have the same origin as the larger structures at the margin. The folding should occur in all of the beds of the sedimentary series above the pre-Cambrian and should be accompanied by fracturing in those beds that tend to fail by fracture.

Ore Deposits

Distribution, form, and size -- The ore deposits are replacements at two horizons in the Deadwood formation, and occur where vertical fractures,

called "verticals" intersect one or the other of the favorable beds. These two horizons, called the "upper contact" and the "lower contact," are separated by a stratigraphic interval of 328 feet at the Merritt and Custer claims (see Plate 4). The actual interval is 366 feet because sills with total thickness of 38 feet are intruded in the Deadwood between the ore horizons. These intervals are believed to be almost constant into the area of the Double Rainbow Mine. The vertical interval between the "contacts" is slightly more because of dip of the beds. An intermediate "contact" reported to be about 70 feet above the "lower contact" was not observed.

Vertical Interval between ore horizons

The "lower contact" is at the base of a series of thin beds of dolomite, just above the basal quartzite, and 20 to 70 feet above the bottom of the Deadwood. The rock that is replaced is dolomite and sandy dolomite. The "upper contact" is about 100 feet below the top of the formation and is in a dolomitic quartzite at the base of a series of thin-bedded quartzite and dolomitic quartzite and just above massive quartzite. Several writers have reported that at some places a layer of shale about 1/2 inch thick occurs above the "upper contact" and a similar shale has been reported above the "lower contact." These shales are not conspicuous. The whole series of thin-bedded rocks is likely to contain layers of shale.

The ore bodies are tabular with greatest extent along the strike of the vertical that makes the ore. Some shoots are only a few feet long and others are a few hundred feet long. The intermediate dimension is the horizontal one perpendicular to the vertical. This dimension may be only a few inches to a foot but increases out into the ore shoots that commonly are two to four feet wide. Many stopes are 18 to 20 feet wide and in the northern and central part of Double Rainbow several stopes are 30 to 50 feet wide and one is 70 to 80 feet wide for a few hundred feet. The larger ore bodies probably result from mineralization along several verticals. Ewoldt

and Watkins (1940) report that at the Silver Queen the average working face is 8 feet wide. The shortest dimension of the shoots is vertical, at right angles to the bedding.

One report implying that the general maximum thickness of the mineralized zone is only 30 inches has been widely quoted. Where the mineralization is scanty the thickness may be only a few inches, but in the ore shoots the thickness may increase to several feet. Several stopes in the Double Rainbow are more than 10 feet high and mineralization over an interval of 12 to 14 feet has been reported. Sampling of the Double Rainbow Mine by Lincoln (1940) indicates that the ore zone generally is 2 to 4 feet thick. Ewoldt and Watkins (1940) report the average thickness at the Silver Queen is 2 feet.

The primary ore shoots are masses composed principally of argentiferous galena, but at many places the sulphides are completely oxidized. Large sulphide shoots were mined at the Richmond-Sitting Bull (Double Rainbow) but only remnants of these are now found in the mine and most of the ore seen is oxidized. Much sulphide ore is reported to have occurred at the Merritt Mines, the Horseshoe-Comet, and the Cora. Part of the ore at the Washington was sulphide. All of these except the Double Rainbow are on the "lower contact." Mines containing chiefly oxidized ore are the Silver Queen, the Hayes, the Hester A., the Ontario, and the Wanda, all in the southern half of the district and on the "lower contact." The Florence, the Branch Mint, and the Red Cloud on the "upper contant" at the north end of the district have oxidized ore only.

Mineralogy -- The principal primary minerals are pyrite, galena, and quartz. The galena generally is coarse-grained but most of the pyrite is

medium to fine. Much of the quartz is a fine-grained replacement but some coarse-grained milky quartz was seen. Sphalerite is not abundant. Most of that seen is in specimens from the Horseshoe-Comet and the Merritt. Other primary minerals that have been reported and have been found in small amounts by the microscope include arsenopyrite, lollingite, chalcopyrite, and tetrahedrite.

Secondary minerals include limonite, hematite, pyrolusite, psilomelane, cerussite, anglesite, and smithsonite. Small amounts of covellite and native silver have been reported. The oxidized ore is brown to yellow and the higher values seem to be associated with the yellow material. It is called "carbonate ore" by the miners of the district, but actually contains very little carbonate. The mineralogy of much of this material is unknown and difficult to determine. Connolly (Connolly, 1927) has given the most thorough discussion of this problem. The oxidized ore at the Queen contains up to 5 percent vanadium oxide.

Genesis -- The solutions that deposited the ores are commonly believed to have come from the same source as the sills. The mineralogy of the deposits indicates that they were deposited under mesothermal conditions.

Structural control of ore deposits -- The geologic facts that may bear on the control of ore deposition are: (1) The schistosity of the pre-Cambrian strikes between N. 89° E. and N. 34° E., averaging N. 59° E. The dip is to the southeast at an average angle of 48°. (2) Mine workings in both the upper and lower "contacts" expose verticals that fall in several sets. In the northern part of the district one set strikes northeasterly and the other strikes east-west. A minor set strikes north-south. In the southern part of the district the verticals strike northeasterly. The ore is

expand

distributed along these verticals.

(3) The mineralization is in two beds of dolomite and dolomitic quartzite separated by 366 feet or more of rock, principally shale and thin bedded dolomite and dolomitic sandstone, with a few igneous sills. (4) In the northern part of the district the beds dip to the east at angles between 3 and 30 degrees. There is a variation in dip in this monoclinal structure in such a fashion that the Double Rainbow Mine lies in a relatively flat portion of the formation extending down the dip for about 1,000 feet. In addition to this major structure there are minor structures of similar character. Monoclinal structures also occur at the Silver Queen and Hayes, but the strike is east-west to north-northwest. (5) Thin beds of shale are above both lower and upper "contacts" at some places.

Starting with these facts, the rest is speculation. A number of ideas have been advanced to explain the occurrence of the ore and more especially to try to find some pattern of distribution of values that may be a guide to prospecting. It has been proposed that the thin shale layers above the ore horizons have acted as impermiable barriers to rising solutions. Since the fractures continue through the shale and some mineralization has occurred above the shale this idea does not seem valid, nor does the thickness of the shale seem adequate. A more likely explanation for the ore being localized in the same beds (the upper and lower "contacts") at many widely separated places is that of selective replacement of favorable beds. The reason why these particular beds are favorable cannot now be answered. There are many other unmineralized dolomitic beds in the formation.

Whether the reason for mineralization is that of impermiable barriers or selective replacement, it still is not explained why the ore is found only

at certain places in the favorable horizons. It is true that mineralization follows the verticals but it has not been demonstrated that the presence of verticals assures ore. In fact, the ore is not continuous along the strike of the verticals, but rather forms shoots. Wright and Johnson(1930) suggested that the ore-bearing solutions rose along the east-west verticals at the Double Rainbow until the favorable beds were encountered. They supposed that the solutions then followed up the dip of the favorable beds until they encountered the folds, where they were impounded, replacing the beds. Replacement was facilitated by fracturing which had accompanied the folding. It is interesting to note that Heins (1928) believes that where there is an increase in dip there is usually an increase in mineralization, an idea just opposite to Wright's and Johnson's. The writer suggests that relationship between change in dip and mineralization may exist but has not been demonstrated.

How about the mineralizing solutions having coming laterally in only next fractures dissolving above or in line with pre-Cambrian structures along which the solutions were confined.

How about the writer approaching this mineralization idea more in detail. Yours may be the only one and if not, you attacked tried + contributed

Ewoldt and Watkins (1940)agree with Wright and Johnson concerning the importance of flattening of dip, but their assay maps of the Silver Queen are not in sufficient detail to prove this. They add another idea, that there is in the entire district an ore trend N. 50° E. They believe that if ore is found at one place, additional shoots may be expected in a direction N. 50° E. where the trend crosses flat dips in the favorable ore horizon. They cite an example of a supposed trend through the Colletta, Queen and New Years and another through the Ontario, Hester A., Cora, Comet, Emma, General Crook, War Eagle, and part of the Double Rainbow. Distance between trends is believed to be 300 to 600 feet. Additional work is needed to confirm or disprove the existence of the trends.

Wright and Johnson, Ewoldt, and Lincoln (1940) agree that a favorable place to prospect is in the "lower contact" below the Double Rainbow

mineralization of the "upper contact." Lincoln's reason for believing this is that since ore was deposited along verticals at the "upper contact" the ore-bearing solutions must have been carried through the "lower contact" along verticals and should have deposited ore there also. The writer believes that it probably is not necessary to assume that verticals persist from one "contact" to the other. If solutions are passing through permeable rocks, replacement deposits could be formed in rocks of favorable composition where physical conditions also are suitable. If favorable physical conditions result from folding and fracturing of the Deadwood formation, and if such deformation results from differential vertical movements in the pre-Cambrian rocks, then favorable physical conditions developed in a certain area on one bed should be repeated in a similar bed directly above or below.

The question may be raised whether mineralization has actually been found in the same locality on both contacts. The only place where topographic conditions are such that this has been found are at the Custer claim on the "upper contact" and the Merritt claims on the "lower contact" (see Plate 2). The shortest map distance between a stope on the "upper contact" and a stope on the "lower contact" is 180 feet.

Tenor of Ore

Early reports (Irving, 1904) state that ore in the Sitting Bull (Double Rainbow) mine carried as high as 2,000 ounces of silver per ton of ore, but that considerable quantities of ore carried much lower values. Meyer (1919) has calculated that in the early days when the ore was carried by wagon and river boat to Omaha it was not feasible to ship ore with values less than $65 per ton. Noble (1907), divided the estimate of total value produced by

the estimated amount of ore mined and concluded that the average value of the ore mined has been $15 per ton.

Most of the assay records now available are of the material left in the pillars by the early miners. However, the writer has obtained from Mrs. Charles Bentley the assay books of her father, C. B. Harris, who was assayer for the Sitting Bull Mine and who was also an assayer in Galena for many years. The books contain hundreds of assays of the Richmond-Sitting Bull Mine and other mines and prospects in the Galena district, made during operation of the Sitting Bull between August 29, 1889 and July 10, 1890, and during exploration work in 1903 and 1904 and in 1919 and 1920. Most assays are of particular value because the name of the drift from which they came is given. There are also many assays from the Horseshoe-Comet during 1903 and 1904. The assays from the car lot shipments of ore from the Sitting Bull during 1890 indicate the value of the bulk of the ore shipped at that time. In the 5 car lots reported between March 3, 1890 and May 19, 1890, the silver varied between 83 and 109 ounces per ton, the gold varied between 0.2 and 0.4 ounces per ton and the lead varied 25 to 36 per cent. The last figures are of interest because lead assays at the Double Rainbow have seldom been made. During the same period the milling ore carried from 10 to 45 ounces of silver and a trace to 0.1 ounce of gold. This material was concentrated to a product carrying from 35 to 86 ounces of silver, a trace to 0.2 ounce of gold and 31 to 67 percent lead. At about the same time shipping ore at the Merritt carried from 37.5 to 40 ounces of Ag, 0.1 ounce of gold and from 63 to 70 percent lead. During the same period the assays from the Horsehhoe-Comet were much better than those of shipping ore from the Sitting Bull.

shipment Sitting Bull

where is it?

The most thorough assaying of the Double Rainbow mine is shown in an assay map and records, dated 1913, contained in the district files at Rapid City. Four hundred eighteen assays of silver and gold are shown. Samples were systematically spaced at intervals of 10 to 20 feet along the drifts and stopes, apparently without attempting to choose richer places in the ore. Most of the samples show a fraction of an ounce to 4 ounces of silver to the ton and 0.01 to 0.03 ounces of gold. Twenty-four of the assays show between 5 and 10 ounces of silver and 11 assays show more than 10 ounces of silver. The highest silver assay is 40.4 ounces and the highest gold assay is 0.52 ounce.

Other assays taken in connection with Lincoln's investigation shows the variation in values in the face of a stope. The 30 inches of rock above the mineralized zone carried 0.18 ounces of silver, no gold, and was not assayed for lead. The 14-inch ore zone carried 49.89 ounces of silver, 0.06 ounces of gold, and 15.21 percent lead. The 20 inches of rock below the ore carried 1.54 ounces of silver, a trace of gold, and 3.62 percent lead.

In connection with Lincoln's investigation a composite sample was made for metallurgical testing. It was obtained by combining 32 samples from the Double Rainbow, 6 from the Florence, and 2 from the War Eagle. The sample should represent possible mill feed obtainable from present ore exposures. The assays of the ore from the Florence and War Eagle do not differ much from those in the Double Rainbow. The report by the American Cyanamid Company shows 9.20 ounces of silver per ton of ore, 0.073 ounce of gold, 1.98 percent lead and 0.66 percent zinc. This closely checks Lincoln's weighted average.

About 100 of the better assays from various sources were plotted on a map of the Double Rainbow. Most of these are in the area bounded on the

where plotted?

north by the East drift, on the west by the Main drift as far south as the entrance to the West drift and from there southward by the westward limits of the mine, on the south by the most southerly "vertical" shown on the map in the South drift, and on the east by the east edge of the mine. These limits include an area about 950 to 1,000 feet north-south by as much as 400 feet east-west.* The values in the Havens drift are not as high as was expected from descriptions of the mine. Although this drift should not be ruled out in exploratory work, it is not the best part of the mine.

Assays from the report by Ewoldt and Watkins (1940) were plotted on a map of the Silver Queen. No special distribution of values was noted. They state that their samples indicate that the ore in the Silver Queen can be expected to average 18 ounces of silver, 0.04 ounce of gold, and 13 percent lead. They also report that an average of 130 assays from an old record show 8 ounces of silver, 0.235 ounce of gold, 5 percent lead.

Milling Methods

A mill, constructed in 1931, is fully equipped but is reported to be improperly designed to extract the values from the ore. Probably much of the equipment could be used in a redesigned mill. In 1939 the Denver Equipment Company and the American Cyanamid Company tested samples of the ore. By tabling, floating, and cyaniding the flotation tailings for 48 hours, the American Cyanamid Company obtained extraction of 71.81 percent of the silver, 82.12 percent of the gold, and 56.04 percent of the lead. The sample used was the composite sample described in the preceding section.

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* This description is taken from a record sheet found in the office at the Double Rainbow and differs slightly from Lincoln's description, but the assay values check.

Production

It is commonly said that the total production of the Richmond-Sitting Bull (Double Rainbow) mine was $750,000 and that most of that was produced in the early 1880's. Noble (1907) gives that figure and also states that he saw receipts for bullion and ore for $451,383. Meyer (1919) reports net return of $41,049.62 during the period August, 1889 to July, 1891. This was on 486 tons of ore averaging $97.58. Ewoldt and Watkins (1940) state that during the early 1880's the Silver Queen produced $125,000.

Reserves and method of mining

Estimates of reserves have greatly exceeded a million tons for the ground opened by the Double Rainbow. These figures are based on the assumption that the ground can be mined as in a coal mine. The records of the 418 assays made in 1913 show that this is impossible because large volumes of ground do not carry more than a few tenths to 3 ounces of silver and 0.01 to 0.02 ounce of gold. The mining method must be that used in all other Black Hills deposits of this structural type. This is a method of breast stoping following the ore along the verticals and widening and contracting the faces with variations in widths of the shoots. Because of the irregular character of the deposits it is impossible to accurately estimate reserves, but it is the writer's opinion that by proper development it should be possible to keep ore flowing to supply a mill the size of the one on the property. Generally in this type of deposit in the Black Hills a number of faces more than actually needed for the mill are kept open in order to secure working reserves. Thus the proved reserves are not large but nevertheless are adequate.

History of district

The early history of the Galena district is recorded in many reports, so only the recent history is given here. In 1931 a flotation mill was built. The Barton tunnel was driven in the area east of the Richmond-Sitting Bull at the point where the "upper contact" dips beneath the creek level. Assays of the rock exposed in these new workings show only several tenths to a few ounces of silver per ton. So far as the writer has learned, there was little mining in the Richmond-Sitting Bull (Double Rainbow) itself. Two tunnels were driven in the old dumps and a considerable tonnage of this material was run through the mill. The work done at that time did nothing to prove or disprove the existence of adequate supplies of ore in the mine.

In 1939 Lincoln supervised sampling of the mine by Ewoldt, and in 1940 Lincoln reported favorably on the possibilities at the mine. During that year Ewoldt and Watkins also sampled and favorably reported on the Silver Queen. In 1942 Pesonen briefly examined the district for the Bureau of Mines and recommended exploration and development work.

Conclusions and recommendations for exploration

Note

It is the writer's opinion, based on careful study of assay maps and on a brief inspection of the mine, that the Double Rainbow has adequate exposures to insure operation of a mill. The principal values are in silver, but there is also a moderate amount in gold. The lead values in much of the oxidized material are not more than a few percent, but the chances are good that development will expose a few rich sulphide shoots. Production of lead could be a few hundred tons a year.

Development of the district is hindered by the fact that it has been idle for many years. In order to encourage the beginning of operations and

to check the writer's conclusions, it is suggested that a program of exploration be undertaken. There are two alternatives. The first is that further geological studies be made to better determine the ore control and to guide a drilling program to follow. The second is that the drilling program be started on the basis of the present findings without further geological studies. The first should lead to a more effective drilling program.

Geological exploration should include the following: (1) Surface studies should be made to determine details of stratigraphy, igneous geology, and structure in the area from the Merritt No. 1 to the Barton Tunnel. Additional elevations on the "upper contact" should be obtained where possible. Similar detailed studies of geology and the structure of the "lower contact" should be made in the vicinity of the Silver Queen. (2) In the area between the Merritt No. 2 and the Silver Queen elevations should be determined at as many points as possible on both the lower and upper "contacts," with special attention to the area around the Horseshoe-Comet. More detailed studies of stratigraphy and igneous geology are desirable in the area but may not be feasible because of time and expense. Structural studies of both upper and lower "contacts" north of the Florence and of the "lower contact" south of the Silver Queen should also be made. (3) Because of overburden and vegetation, it is likely that ore cannot be found directly by surface studies. The mantle is too thick at most places to allow trenching. The first two points may serve to give knowledge of ore control, but more specific knowledge may be obtained by detailed studies underground at the Double Rainbow, the Silver Queen and the Florence. Ewoldt and Watkins suggest contouring the ore horizons. Correlation of structure with assays will be needed at selected points. Many assays are needed at the Silver Queen since it appears that assays of only the best-looking material have been made. The same applies

to the Florence but the assays indicate lower grade ore there.

Investigation of the variation of throw of slight faulting along verticals might bear on the problem of their origin.

A drilling program should attempt to find the most probable ore first. For that reason drilling of horizontal holes in the Double Rainbow mine is suggested as the first step in extending known ore bodies. The block described in the section on tenor appears the most favorable place and the part that is least developed and also possibly most favorable is at the south end along the South drift. The two verticals that cross the drift near its south end show high values and should be drilled first. Later holes may be drilled along other good-looking verticals. Drilling should be oriented to follow the "upper contact" along the vertical as far as possible. If possible, the drilling program might be planned to investigate the idea of ore trends N. 50° E. from points of high value.

The second step in the drilling program should be in the Silver Queen and the Florence in that order if an exhaustive sampling program verifies the indications of ore.

In any of the mines good indications found by drilling might justify the excavation of exploratory drifts.

The third step in drilling the area should be to explore the "lower contact" below the Double Rainbow mine. The holes should be drilled vertically from within the workings of the Double Rainbow itself and the first one should be placed in the Main drift about 200 feet in from the outcrop, since that is where the largest and richest shoots probably were. The vertical interval between "contacts" is about 390 feet. An inclined hole drilled from the valley bottom could reach the same point beneath the Double Rainbow,

but would be about 460 feet long as may be judged from section C - C'.

Further exploration of the "lower contact" should later be made at points directly below the valley bottom. Since mineralization of the Double Rainbow and Florence occurs on both sides of the valley it is presumed that the portion of the upper "contact" between these mines was mineralized and that mineralization of the "lower contact" below the valley bottom was likely to have occurred. Inspection of sections C-C' and B-B' shows the relationships and the drilling depth to the lower "contact" will vary between 150 and 205 feet.

The drilling program required outlined above might well be undertaken on the basis of the present report if the time and expense of further geologic investigation are impossible.

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Rapid City, South Dakota
July 1, 1944
Edward L. Tullis

Tullis

Ex 61614 11

Extracts from Assay record book of C.B. Harris (Mrs. Charles Bentley's father) who was assayer at Galena for many years. It is impossible to identify the locations of many assays. Only those that can be identified are included. The following extracts made by Edward L. Tullis 6-18-44.

2-24-03
War Eagle Main face $8.00
" " tunnel, left side $8.00
" " " hard rock $3.00
" " Roonay's 1902 assess tr.
" " Near porphyry, hard sh. tr.
" " " " soft sh. tr.

2-27-03
Horseshoe Comet quartzite upraise tr Au, Ag 8 oz.
" " ~~12~~ 12 inches below shale upraise 12 oz Ag, tr Au.
" " Cross cut 500 feet in 14 oz Ag, $1.00 Au. White quartzite.
" " Iron pyrites and quartzite, same place, 10 oz Ag, $2.00 Au
" "

3-10-03
Horseshoe Comet quartzite 10 oz Ag, $1.00 Au.

3-16-03
Horseshoe Comet quartzite 12 oz Ag, $2.00 Au.
" " Iron and galena Pb 30%, 75 oz Ag, $3.00 Au.

3-18-44
Horsehoe Comet quartzite 5oz Ag, tr Au
" " lead and ~~iron~~ pyrites Ag 60 oz, Au $2.00, Pb 40%

4-1-03
Horseshoe comet al of following this day from there
Gen. averagoe of galena today face 130 oz Ag, tr Au, 60% Pb
~~Lastxwaeksxgakenx~~
Upper workings, near surface galena, 60 oz Ag, tr Au, 60% Pb.
Galena cross cut - farther in 190 oz Ag, tr Au, 60% Pb.
Iron from ore house, upper house. 65 oz Ag, $2.00 Au.

4-4-03
Horseshoe Comet gouge matter red stuff. Ag 4 oz, Au tr.

4-17-03
Center Fraction Dump Red and yellow ore (2 assays) $20.00
Grey and black porphyry - dump $6.00

4-24-03
Horseshoe Comet No. 1 Galena and iron Ag 130 oz, Au $3.00, Pb. 50%
" " No. 2 Zinc, galena, and iron Ag 50 oz, Au $2.00, Pb. 10%

4-30-03
Horseshoe Comet fine shale 2 oz Ag, tr Au.

5-7-03
Horseshoe Comet Quartzite 4 oz tr Au
" " Galena R side 10 oz Ag, $1.00 Au, 65%Pb
" " Iron L. side 10 oz Ag, $2.00 Au

5-29-03
Horseshee Comet
1. Henry Gibsons face pyrites 70 oz Ag, $3.00 Au
2. " " " " 80 oz Ag $3.00
3. " " white stuff 1 oz Ag tr Au
4. Gardner's green ore 18 oz Ag, $8.00
5. " brown ore 25 oz Ag, $8.00

6-5-03
Horseshoe Comet

June 5, 1903
Horseshoe Comet ~~xNexxk~~
No. 1 Ag 4 oz, Au $1.00
No. 2 Ag 110 oz, Au $3.00
No. 3 Ag 1 oz, Au $1.00
6-6-03
Horseshoe Comet hard quartzite 2 oz, Au tr. Gibsons face
" " decomposed quartzite Gibsons face 1 oz Ag, tr Au.
6-11-~~44~~ 03
Horseshoe Comet
No. 1 350 oz Ag, Au $2.00, brown stuff
No 2. 350 oz Ag Au $3.00 fine pyrites
No. 3 galena, 350 oz Ag, $2.00 Au, Pb 30%
June 20, 1903
Horsehoe Comet No. 1 pyrite, soft stuff, Ag 1466 (O.K.), Au $60.00
" " No. 2 46 oz Ag, $8.00 Au.
The following assays are from the Horseshoe Comet.
6-22-~~03~~ 03
No. 1 Ball 100 oz, Ag, $2.00 Au
No. 2 " 32 oz Ag, $6.00 Au
No. 3 Brown ore 130 oz Ag, $8.00 Au.
No. 4 Brown quartzite 10 oz Ag, $1.00 Au
No. 5 Gibsons face 3 oz Ag, $1.00 Au.
6-23-03
1466 sample button repeated. 1450 ~~Ag~~ oz Ag, $60.00 Au.
Carbonate and galena 150 oz $3.00
6-24-03
No. 1 ~~Gardmexxxxxxxxxxxxxxxxxx~~ Gardmes Ball - yellow 8 oz Ag, $1.00 Au.
No. 2 Brown stuff 30 oz Ag, $2.00 Au
No. 3 Blue quartzite 2 oz Ag, tr Au
No. 4 Low roof hard stuff 10 oz Ag, $3.00 Au.
No. 5 " " soft " 2 oz Ag, tr Au
No. 6 Fine pyrites 160 oz Ag, $6.00 Au.
End of Horseshoe Comet
~~xxxxxxxxxx~~
6-26-03
Richmond Sitting Bull ~~xxxx~~ Havens drift crossing 14 oz Ag, $8.00 Au.
" " " Left side main drift roof, galena lead ore 320 oz Ag, $10.00 Au.
6-27-03
Horseshoe Comet No. 1 East 10 oz Ag, $1.00 Au.
" " No. 2 West 270 oz Ag, $3.00 Au.
" " No. 3 West 30 oz Ag, $3.00 Au.
" " No. 4 Best 18 oz, $2.00 Au, 10% Pb.
7-1-03
Horseshoe Comet No. 1 surface Ag 40 oz, Au $6.00
7-10-03
Richmond - Smiths red?face (near mouth Havens drift to the right), 80 oz Ag, $20.00 Au
" " white face 120 oz Ag, $20.00 Au
Hoskins screenins Havens drift July 8, 1903 10 oz Ag, $10.00 Au
7-18-03
Richmond Main Drift $10.00 Au, 10 oz Ag.
Same place, a little back 50 oz Ag, $20.00 Au.
12-23-03
War Eagle Smith's face 6 oz Ag., $8.00 Au

to here

12-23-03
War Eagle Roof 3 oz Ag, $8.00 Au
" " South Drift 6 oz Ag, $6.00 Au
" " Waste in mine 8 oz Ag, $4.00
" " Waste wall - south X-cut, 2 oz Ag, $1.00 Au.
Florence dump sorted ore, 14 oz Ag, $20.00 Au.
1-7-04
War Eagle face (apparently about 50 ft. west of the present face, E.L.T.) 10 oz Ag. $18.00 Au.
War Eagle near mouth 6 oz Ag, tr Au.
" " drillings 1 oz Ag, tr Au.
" " between shale and porphyry tr. Au
" " porphyry surfacee tr. Au.
" " surface tr Au.
" " " shale, tr Au.
Bank of Dakota shale tr Au.
Jan. 1904
Crook hard ore 5 oz Ag, $18.00 Au
" soft ore 5 oz Ag, $18.00 Au.
" incline shaft $2.00 Au
" shaft above Hse - $3.00 Au
~~xxxxxxxxxxxxxxxxxxxxxxxxxxxx~~
In February assay reports at two places Harris has written "vanadium" beside a couple of Ag, Au, Pb assays, but gives no vanadium values (E.L.T.)
2-17-04
Horse Shoe Comet galena and iron Ag 105 oz, Au $2.00, Pb. 34%
" " " iron pyrites Au $1.00 Pb 34%.
2-24-04
Horseshoe Comet iron pyrites and quartzite upeer contact (I doubt if this is same upper comet as at Richmond Sitting Bull, E.L.T.) Ag 1 oz, Au tr, S 20%
Same stuff, concentrated 4 into 1 1 oz Ag, tr. Au, 30% S.
3-7-04
Horseshoe Comet No. 4, Ag 50 oz, Au, $2.00, Pb. 15%
" " No. 5, Ag 80 oz, Au $1.00, Pb. 45%
3-9-04
Horseshoe Comet 6 Galena near surface Ag 150 oz, Au $3.00, Pb. 60%
" " 7 Big pile galena and iron ore House Ag 120 oz, Au $2.00, Pb 45%
" " Hole near surface 150 oz Ag.
3-18-04
Horseshoe Comet
No. 8 Ag 1 oz, Au $1.00, Pb none
No. 9 ~~1/8~~ Ag ½ oz, Au $.50, Pb. none.
No. 10 Ag 24 oz, Au $1.00, Pb 11%
No. 11 Ag 1 oz, Au tr.
No. 12 Ag 1 oz, Au $0.50, Pb none.
No. 13 Ag 2 oz, Au $1.00, Pb none.
3-22-04
No. 14 iron pyrites Ag 22 oz, Au $4.00, Cu 1%
3-25-04
No. 15 Ag 38 oz, Au $2.00, Pb 20%
No. 16 Ag 56 oz, Au $2.00, Pb 25%
4-15-04
No. 17 Ag 20 oz, Au $1.00 Pb. 10%
No. 18 Ag 4 oz, Au $7.00 Pb 2 %
No. 19 Ag 11 oz, Au $3.50, Pb 0%

Horseshoe Comet

4-26-04

No. 20 18 oz Ag, $3.00 Au, ~~3x%~~ Pb 3 %

No. 21 10 oz Ag, tr Au,1% Pb

4-28-04

No. 22~~Agx~~ 18 oz Ag, $3.00 Au, 2½% Pb

No. 23 45 oz Ag, Au $1.00, 6% Pb

6-16-04

No. 24 40 oz Ag, tr Au, 10% Pb.

No. 25 12 oz Ag, $3.00 Au, 15 % Pb

6-24-04

No. 24 repeated 38 oz Ag.

No. 25 " 10 oz Ag.

6-27-04

No. 26 102 oz Ag, tr Au, 45 % Pb

No. 27 iron and galena,, ~~k0x~~ 110 oz Ag, $1.00 Au, 15 % Pb.

7-21-04

Richmond Main face South drift Ave of hard ore in face Ag 41 oz, Au ~~$2x0x~~ $20.00

Same drift - Red Chimney Ag 16 oz. Au $98.00 to $100.00.

Same place - 8 feet from main face 22 oz Ag, $20.00 Au.

Havens face Galena and quartzite 128 oz Ag, $4.00 Au.

8-5-04

Although it does not state that the following samples from the main face are in the South drift, I believe this can safely be assumed. E.L.T.

Richmond - Main face. ~~Gen~~ Ave. soft ore Ag 10 oz, Au $40.00

Main face - pipe in face, 10 oz Ag, $30.00 Au.

Main face quartzite pieces - ore 14 oz Ag, $20.00 Au.

Main face black quertzite 6 oz Ag, $3.00 Au.

Lead ore same place 10 oz Ag, $30.00 Au.

Hard ore same place 20 oz Ag, $20.00 Au.

10-28-19

1. Fine stuff Havens vertical back, Ag 40 oz, Au $10.00

2. Hard stuff Havens vertical back (means from vertical in back, E.L.T.) Ag 12 oz, Au $1.00

4. Havens face 10-27-19 (shale in face) Ag 20 oz, Au, $10.00

11-1-19

3. N & South cross fractures - Main Tunnel, old workings - big body Ag 15 oz, Au $10.00, Pb 18%.

4. Main drift west vertical crosses No 3 top, Ag 15 oz, Au $10.00, Pb 70%

5. Small west drift near Bad Ai Ag 18%, Au $4.00 Pb 70%

6. Old workings by Lower Header sandy material like ~~xxxxx~~ 97. Ag 10 oz, Au $6.00

7. Gulch - brown under white ore body Ag 40 oz, Au $6.00

8. Gulch going east red and gray face Ag 32 oz, Au $40.00

~~9. Gulch (old workings) quartzite under 4 oz Ag xxxxxxxxxxx~~

~~10 xxxxxxxxxxxxxxxxxx Hard ore under 6 oz Ag~~

I don't know what the above notes about Gulch mean. The Gulch claim covers the South Drift. But there shouldn't be any outcrops of the "upper contact" on the Gulch claim. E.L.T.

11. Left side Havens face - bluish material Ag 20 oz, Au $30.00, Pb. 2%

12. Left side Havens ~~xxxx~~ face - bluish mud, Ag 200 oz, Au $40.00

13. Upraise Havens Pyrites near curve Ag ~~$2x~~ 40 oz, Au $32.00

14 Havens face pyrites Ag 20 oz, Au $20.00

15.2 Quartzite under Havens face Ag 2 oz, Au $1.00

17. Black shale, Havens vertical - curve, Ag 3 oz, Au $4.00

18. Hard shale Havens vertical - above curve Ag 1 oz, Au tr.

20. Soft ore in vertical Havens at curve, Ag ~~xxxxxxxxxx$10x00~~ 150 oz, Au $30.00

21 Goode's upraise Havens vertical Ag 12, Au $10.00

11-12-19

11. Brownish quartzite R.S. Havens at curve Ag 3 oz, Au $2.00

to here 12. Au quartzite Point of Custer Hill ag 3 oz, Au $6.00

13 Pb-carbonate same point Custer Hill Ag 15 oz, Au $2.00 Pb 8%

14. Iron carbonate - face - point Custer Hill Ag 2 oz, Au $2.00

15. Ab and Fe ore - Brodie Tunnel - Custer Ag 6 oz, Au $6.00, Pb 10%

11-20-19

1. Havens vertical near face Hard black shale Ag 8 oz, Au $1.00,

2. Havens vertical blackish shale Ag 12 oz, Au $3.00

3. Havens vert. Bluish black shale, Ag 12, Au $3.00

4. Havens vert. R.S. of vert, soft Ag ½oz, Au 50¢

5. Havens vert. fine stuff 1 ft. wide Ag 30, Au $2.00 Total value $40.00

6. Havens galena vert near X-cut - vertical, Ag 200 oz, Au $2.00, Pb. 82%

7. Havens L.S. drift Coyles face, Ag 20 oz, Au $10.00

8. Havens quartzite at curve - top Ag 6 oz, Au $1.00

9. Red ore R.S. Main Tunnel Ag 10 oz, Au $2.00,

13. Gulch hard shale by Bob Ag 8 oz, Au $6.00

11-28-19

13 Hard black ore - Havens Raise Ag 3 oz, Au $1.00

14 Drillings black ore R.S. Havens Raise, Ag 3 oz, Au $1.00

15. Gouge L.S. Havens Raise Ag 4 oz, Au tr.

16. Mouth of Bad air- hard ore Ag 10 oz, Au $10.00

12-5-19

9. L.S. Main drift - opposite Bad Air and Bobs 2 going east Ag 16 oz, Au $2.00. Fe oxide and quartzite.

11-28-19

The following are from Bobs No. 2 face the general location of which is given in the entry above. E.L.T.

1. Hard center of face Nov. 24, Ag 10 oz, Au $10.00

2. Hard quartzie face Nov. 24 Ag 12, Au $10.00

3. Hard brown ore R.S. Nov. 24, Ag 22 oz, Au $8.00

4. Left side vein quartzite Nov. 24, Ag 15, Au $20.00

5. Quartzite, some galena Ag 40 oz, Au $10.00. Nove 26.

6. Brown ore Nov. 26, Ag 10 oz, Au $8.00

7. Brown ore like No. 1 Nov. 26 Ag 10, Au $8.00

8. Fine stuff Ag 110 Au $6.00

9. Vertical in back, Ag 4 oz., Au $4.00, Pb. 2%

10. Hard shale in back, Ag 6%, Au $1.00.

12-18-19

L.S. Bobs face 2 Ag 6 oz, Au $8.00

R.S. Bobs face 2, Ag 12 oz, Au $10.00

General ave. vertical near Richmond Drift, Ag 12 oz, Au $4.00, Pb. 10%

Quartzite, specks galena - same place Ag 40 oz, Au $6.00

1-3-20

Bobs face 2 - car sample Ag 10 oz, Au $6.00, Pb. 22%

In the references to Gulch that follows it is probable that Harris refers to what is otherwise known as the South Drift (part of it) or that part of the mine that underlies the Gulch claim.

12-5-19

Gulch soft red in vein Ag 20 oz, Au $10.00 No. 11

" red material under shale, Ag 1 oz, Au $1.00 No. 12

13. Quartzite uner No. 12, Gulch. Ag 2 oz, Au $1.00

14. Gulch red shale in back, Ag 2, Au $4.00

15. Gulch white shale Ag 2 oz, Au $2.00

12-18-19
Gulch R.S. going in - vein 1 x 2, Ag 34 oz, Au $80.00
" same vein - soft stuff in vein Ag 10, Au $40.00
" hard ore under same vein, Ag 30, Au $40.00.
" vertical vein same place Ag 30 oz, Au $40.00
" hard ore on left of same vein, ag 34 oz, Au $40.00
" Ave. when last shots fired. Ag 50 oz, Au $40.00
" shale - in back near vein, Ag 5 oz, Au $4.00
" Gulch - left side going in - Hole. Ag 5 oz, Au $4.00 quartzite.
" Black hard material, same place Ag 5, Au $6.00
1-3-20
Cross cut near Gulch north line, Ag 40 oz, Au $10.00
Gulch L.S. - opposite vertical. Ag 42 oz, Au $36.00
White and black near back Gulch - Ag 4 oz, Au $2.00, near line.
1-13-20
Following are from Gulch.
Pb. pipe Ag 60, Au $40.00, Pb. 5%
Ave mine care - ore house 1-12-20 Ag 30oz, Au $32.00,
Soft red ore in boxes Ag 14, Au $20.00
Pile of waste in mine Ag 9 oz, Au $18.00
Car of waste in ore house - same place Ag 8, Au $8.00
Ave. sample whole mass 1-10-20, Ag 14 oz, Au $10.00
2nd class ore in boxes in mine Ag 10, $10.00,
No. 1 near Main Header Ag 28 oz, Au $8.00
No. 2 near back same place Ag 4 oz, Au $2.00
White quartzite vertical Ag 4, Au $8.00
Cross cut 10 ft. North of Hder - old works, Ag 8 oz, Au $4.00
Here ends the Gulch assays started above.
Fe ore west dft - Large body, some Pb, Ag 5 oz, Au $3.00. Pb. 3%
Carbonate and quartzite west drift, Ag 24, Au $10.00 Pb 5%.
Bobs face No 2, sweeping, Ag 10 oz, Pb 5%, Au, $10.00
Havens Vert - on Plates, Ag 36 oz., Au $6.00
Havens - back near face, Ag 6 oz, Au $4.00
1-22-20
9. Havens face Ag 20 oz, Au $6.00,
10 Havens vertical - car sample Ag 18 oz, Au $2.00
11. Cross cut Gulch Ag 48 oz, Au, $18.00
12. Gulch car sample Ag 16 Au $20.00
13 Gulch car sample fine, Ag 15 oz, Au $22.00
14 Gulch sweepings, car sample Ag 9 oz, Au $8.00
15 Merrit No. 1 porphyry, Ag 1, Au, tr.
1-27-20.
Genl. Av. outside pile, West drift, Ag 10 oz, Au $10.00 No. 4
No. 5 Gulch boxes, face 1-24-20, Ag 24 oz, Au $20.00
6. Gulch, grab of waste fine stuff, Ag 8 oz, Au $8.00
2-9-20
1. Iron ore from west drift - outside pile, course stuff, Ag 7 oz, Au $4.00
2. Same as No. 1 finer material Ag 7 oz, Au $4.00
3. Same ore from pile in mine Ag 6 oz, Au $4.00
10. Gulch waste under ore R.S. face, Ag 5 oz, Au $3.00
11. Gulch waste under ore, L.S. face, Ag 10 oz, Au $6.00
12. Gulch waste in mine, fines on track Ag 8 oz, Au $10.00
13. Gulch ore on plate in mine - track, Ag 16 oz, Au $20.00
14. Gulch center face - by Bob Ag 32, $40.00
15 Gulch - L face on P late, Ag 10 oz, Au $10.00

2-13-20

1. Gulch - car in lower house 2-10-20 Ag 20 oz, Au $20.00
2. " grab - car in mine, Bob 2-12-20 Ag 6 oz, Au $20.00
3. " right face 2-12-20, Ag 8 oz. Au $10.00
4. Gulch some lead special Ag 20 Oz, Au $40.00
5. Waste in cross cut going east Ag 9 oz, Au $3.00
6. Gulch course waste big pieces Ag 5 oz, Au $6.00
7. Gulch, smaller waste ~~chunk~~ chunks Ag 5 oz, Au $6.00
8. " fines from 6 and 7 Ag 6 oz, Au $10.00

2-28-20

Following are from Gulch.

1. Shale in back, Ag 1 oz. Au $1.00
2. " " " , Ag 4 oz, Au $1.00
3. " " ", brown, 11 oz. Ag, $3.00 Au
4. " " " Ag. 12 oz, Au $2.00
5. Waste over ore 2 oz Ag, $1.00 Au.
6. Waste under ore 5 oz Ag, $2.00 Au
7. Wastefines by track 9 oz Ag, $10.00 Au.
9. 1-car sample 2-27-20 13 oz Ag., $10.00 Au
10. ~~Sx~~ 3-car sample 2-27-20 13 oz sample, $20.00
11. 4 car sample ave 2-27-20 13 oz Ag, $15.00 Au
12. Ave. face sample 2-27-20 50 oz Ag., $40.00 Au.
13. Galena spots and quartzite face 2-27, Ag 150 oz, Au $200.00
14. Lead and quartzite face Ag 40 oz, Au $100.00

3-23-20

1. Gulch car ave. 3-20-20. sampled. Ag 30 oz Au $42.00
2. " grab waste, face 3-22-20 Ag 5, Au $4.00
3. Gulch, " " R. face 3-22-20, Ag 5 oz, Au $4.00

~~4~~

5. Havens left vein, shots 3-22-20 Ag 40 oz, Au $8.00

pp. 100-101 in book contains records of ore shipped May 31, 1911 through Oct. 10, 1911. No assay values are given, simply number of sacks and cars.

March 23, 1920

Samples taken by H.N. Johnson U.S.S.

2. No 3 - West drift - Fe? drift Ag 10 oz, Au $10.00
3. No. 4-A West Drift face, back sample Ag 2 oz, Au 50¢
4. No. 4-B West drift, face bottom sample - waste Ag 1 oz, Au tr.
5. Havens left side, back Blackish ore Ag 32, Au $6.00
6. Havens face left side decomposed quartzite Ag 33,oz, Au $6.00
7. Havens face pyrites - I believe (C.B. Harris) Ag 42 oz, Au $10.00
8. Havens - vertical - shale soft Ag 10 oz, Au $1.00
9. Havens hard shale in vertical Ag ~~5x~~ 5 oz, Au, $1.00.
11. Pure waste Ag 1 oz, Au tr.
13. Gulch E face ore and quartzite 4 ft. Ag 16 Au $4.00
15. Gulch - L. side going in 150 ft. from face Ag 35 oz. Au $6.00
24. Face of drift going E. from E. Drift Ag 32 oz, Au $6.00.

No. 27-A Pancake Ag 60 oz, Au $30.00

Done 6-26-44
Tullis

Galena district - Assay values, mainly at Richmond-Sitting Bull Mine Taken from old assay book lent by Mrs. Charles Bentley. On cover of book it reads: "Old Assay Book Aug. 29th, 1889 to July 10th 1890"

First assays are by McBratney, assayer. First page reads: "Richmond Mining Company Assay Record" Following notes by Tullis.

8-29-89. No.1 siliceous sample from East Drift. 39.8 oz Ag., 2% Pb.
Native silver ore, East Drift, 308 oz. Ag, 20.7% Pb, $4.00 Au.
No. 3 Brown ore, porous and burned, East Drift, 192.8 oz Ag, 6.7 %Pb, $2.80 Au.
No. 5 Galena East Drift, 80 oz Ag, no Au.
8-30-89
No. 7 Brown porous ore East Drift, see No. 3, Aug 29. 6.7% Pb.
No. 8 Native silver ore East Drift, see No. 2, Aug. 29, 20.7% Pb.
9-3-89
No. 1 Galena East Drift, Lead 75.9 %, Ag. 128 oz.
9-5-89
No. 2 Siliceous ore East Drift to be labelled. 13% Pb, 39.8 Oz Ag, tr. Au.
9-10-89
No. 5 East Drift Ag 181.6oz, Pb 25.7%
No. 7 Ontario Ag 16.8 oz, $2.50 Au, Pb. 9.5%. (This probably Ontario claim, near Silver Queen, E.L.T.)
9-13-89
No. 1 No. 1 Drift 7% Pb, 47.2 oz Ag, $26.40 Au
No. 2 No. 2 Drift 8.7% Pb, 14.4 oz. Ag, $6.40 Au
No. 3 No. 3 Drift 18% Pb, 6 oz Ag, $4.40 Au
No. 4 South Drift 4% Pb, 16.8 oz. Ag, $3.20 Au
No. 5 East Drift 5.5%Pb, 46.4oz Ag, $2.40 Au
No. 6 West Drift 0%Pb, tr. Ag. Heavy dark ore.
9-18-89
West Drift 54.8 oz Ag, 3.5% Pb, no gold
East Drift 161.6 oz Ag, 50.7 %Pb, $1.00 Au
9-20-89
No. 2 West Drift 2.3 oz Ag, no Au, no Pb.
10-3-89
No. 17 West Drift 2.8 oz Ag, No, Pb.
10-9-89
No. 3 East Drift No. 1 48.6 oz Ag, 10.5% Pb, $10.80 Au
No. 4 East Drift No. 2 95.4 oz Ag, $14.40 Au, 25.2 Pb
No. 5 East Drift No 3 33.4 oz Ag, $15.20 Au, 13.1% Pb
10-9-89
Ludlow Dirft 18.2 oz Ag, $35.20 Au, 12% Pb
Galvin Drift 9.4 oz Ag, 2% Pb, $7.20 Au
10-19-89
No. 1 East Drift No. 1 9.2 oz Au, 15% Pb, $5.00 Au
No. 2 East Drift No. 2 19 oz Ag, 25.2 % Pb, $3.60 Au
No. 3 Ludlow Sample No. 7 191.4 oz Ag, 49.9% Pb, $3.20 Au
10-21-89
No. 3 Ludlow No. 2 19.6oz Ag, 17.2% Pb $20.40 Au
No. 5 South Drift 20.2 oz Ag, 2.1% pb, $4.80 Au
10-26-44
East No. 5 East Drift No 2, 114.8 oz Ag, 36.2 % Pb
No. 11 East Drift No. 1. Galena 72.7% Pb, 257 oz Ag
11-9-89
East Drift, Galena 56.2% Pb
202 oz Ag

11-9-~~11~~89
Galena East Drift 1, 72.1% Pb, 224 oz Ag.
East Drift iron, No lead, 3 oz Ag, no Au.
Florence, 3.4 oz Ag, No Pb, No Au.
11-16-~~11~~89
No.1 East Drift, 63% Pb, 260 oz Ag, no Au.
No 2 East Drift, 38.3%~~xx~~ Pb, 45.4 oz Ag., no Au.
No 3 East Drift, 5.1% Pb, 20.6 oz Ag.
No. 4 East Drift, no Pb, 9.4 oz Ag, $8.80 Au.
11-25-89
No. 1 East Drift galena, 272 oz Ag, no Au.
No. 2 East Drift, 4.8 oz Ag, $4.40 Au, no Pb.
No. 3 East Drift, 4.4 oz Ag, $2.80 Au, 2% Pb.
No. 4 East Drift, 6 oz Ag, $3.60 Au, no Pb.

From here on the assays are by C.B. Harris, Assayer.

~~11-30-89~~
12-16-89
East Drift, Ag 19 oz, Au $2.00, Pb none.
12-28-89
East Drift, Ag 15, Au tr.
Shipping carbonate, Ag 25, Au $2.00, Pb 13.5%
Side of tunnel, 180 ft. in, Ag 5, Au tr.
12-31-89
M Merritt Quartzite, Ag 1, Au none.
1-3-90
M Merritt waste, Ag 1.2
War Eagle, Ag 15, Au tr.
2-1-90
Galvin's drift - carbonate, Ag ~~55~~ 75 oz, Au $6.00, Pb 12%
East drift, Galena, Ag ~~200~~ 300 oz, Au tr, Pb. 80%.
Milling ore Ag 20 oz, Au $2.00
2-3-90
M No 83, Sammy Moll - Merritt galena, Ag 42 oz, Pb 74.5%
M No 84 Merritt Zinc ore, by Sam Moll, Ag 5 oz, Pb 2.5%
No, 13, Galvins No. 1 carbonate, Ag 59 oz, Au $16.00, Pb 14%
No. 14 Galvins No. 2, Ag 24 oz, Au $8.00, Pb 9.5%
No. 15 Galvins No. 3, Ag 12 oz, Au $4.00, Pb 2.5%
Richmond car lot 18, Ag 109, Au $8.00, Pb 36% March 3, 1890 starts with this one.
East Drift galena (R) Ag 215, Au none, Pb 75%
No, 4 East Drift talc (R) Ag 2, Au tr, Pb 2%
No. 5, East drift iron (R), Ag 2, Au tr., Pb none.
No. 7, Milling ore (R) Ag 35, Au $2.00
G.L. Havens No 1, Ag 20, Au tr., Pb 50%
3-8-90
No. 1 Sample of carb. 250 ft. down L.H. sidemain tunnel. Ag 25 oz, Au $2.00, Pb 12%
No. 2 Carbonate R.H. of ~~Main~~ Main drift - ~~26~~ 26 ft. from track, Ag 35, Au $4.00, Pb 15
No. 4 Carb. from mouth of shaft, Ag 40 oz, Au $4.00, Pb 25%
No. 5. 1st 6 ft shaft L.H. side going down, Ag 42 oz, Au $4.00, Pb 30%
No 7 Cross cut 12 feet to left of main shaft Ag 35, Au $6.00 Pb 32%

3-27-90

Car lot 19 Moisture 1.5%, Ag 102 oz, Au $4.00, Pb 30%
Hoskins No. 1, Ag 22, Au $4.00, Pb 5%.
Hoskins No 2, ~~Ag 22 Au $1.00 Pb 5%~~ Ag 12, Au $2.00
Hoskins No. 3, Ag 6, Au tr.
Hoskins drift Ag 85, Au $3.00, Pb. 22%.

4-8-90

Milling No 1, Ag 15, Au tr.
Milling no. 2, Ag 10, Au tr.

4-9-90 Au $2.00

No. 1, 2nd lot of sacked concentrates, moisture 1%, Ag 50 oz, Pb 60%. At this time they were using some type of concentration. ~~Evidently the~~ Presumably the milling ore represents the heads and these are the concentrates from that ore. A number of jig assays are given, so jigs must have been included in the concentrating system. The above assay seems to be typical of the jig assays. Au runs about $1.00 in the jig assays. ~~Ag~~

4-19-90

Car Car lot 20 Richmond, moisture 3%, Ag 93 oz, Au $4.00, Pb. 36%
East Drift Galena, Ag 351, Au none, Pb 78%
East Drift floor sample, Ag 165 oz, Au $3.00, Pb 48%
East Drift Millin ore, Ag 121 oz, Au $2.00.
Hoskins drift - milling ore, Ag 9 oz, Au tr.

5-1-90

Concentrates 19th April, 81 sacks, Ag 35 oz, Au tr. Pb. 56%
Concentrates, 21st April 50 sacks, Ag 35, Au tr, Pb 56%
Concentrates 23 and 24th April - 165 sacks Ag 42, Au $1.00 Pb, 60%
" 25th April 28 sacks, Ag 38, Au $1.00, Pb 57%
" 28, 29, 30 April, 182 sacks, Ag 40, Au $1.00, Pb 60%
" 30th April Night run, Ag 43, Au, $1.00, Pb 61.5%
5-3-90 137 Sacks concent. May 1 and 2, Ag 42, Au $1.00, Pb. 59%

5-5-90

Concentrates May 3 and 4th, 100 sacks Ag. 42 oz, Au $1.00, Pb. 57%.
Car Richmond car lot 21, moisture 21%, Ag, 86 oz, Au ~~$1.00~~ $4.00, Pb. 31%. May 19, 1890.

5-22-90.

Milling ore, Richmond, Ag 15 oz, Au, $2.00.
259 sacks concentrates, Ag 37 oz, Pb. 58% 6-3-90 starts here.
~~62~~ 64 sacks concentrates, Ag 38.5oz, Pb. ~~58%~~ 67%
50 sacks concentrates, Ag 45 oz, Au, Pb 60%.

6-4-90

M Merritt concentrates ~~Ag 39%~~ 39.5 oz, Au tr, Pb. 60%
Car Richmond car lot 22, Ag 83 oz, Au $4.00, Pb. 25%, moisture 1%
Milling ore Silver 45 oz, Au $1.00

6-19-90

Car M Merritt Car 16, Ag 40 oz, Au $2.00, Pb. 68.5%

6-30-90

Car M Merritt car lot 17, Ag 38 oz, Au, $2.00, Pb. 63%
Merritt Zinc and Lead, Ag 15 oz, Pb 18%

7-8-90

Car M Merritt - car lot 18, Ag 37.5 oz, Au, $2.00, Pb 70%
Richmond Hoskins Drift, Ag 40 oz, Au $2.00, Pb. 10%

4-22-1919

1. Richmond West Drift - Galena in seam. vertical break, Ag 115 oz, Au $3.00, Pb. 40%
Richmond vertical break, sandy material, West drift, brown and yellow, Ag 17 oz, Au $2.00
Richmond West Drift - soft sandy yellowish material near vertical, Ag 3 oz, Au $2.00

Mx June 8, 1919

1. McClellan - vertical soft stuff, R.S., Ag tr.
2. " - vert ave. best looking, Ag 6 oz, Au tr.
Havens - vertical - back near face, Ag 6, Au $20.00

Tullis

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LIST OF SAMPLES TAKEN IN RICHMOND-SITTING BULL MINE

October, 1913

Noble

No.	Gold	Silver	No.	Gold	Silver
D 1	.03	.4	D 49	.01	.2
D 2	.03	1.1	D 50	.02	2.5
D 3	.02	.2	D 51	.03	1.7
D 4	.02	.5	D 52	.02	.6
D 5	.01	.3	D 53	.02	1.2
D 6	.02	1.0	D 54	.00	.2
D 7	.01	.7	D 55	.02	.4
D 8	.01	.6	D 56	.01	.2
D 9	.04	1.2	D 57	.01	.2
D 10	.01	1.2	D 58	.01	.2
D 11	.01	.7	D 59	.01	1.0
D 12	.01	.6	D 60	.00	.2
D 13	.02	.9	D 61	.00	.2
D 14	.01	.5	D 62	.03	1.2
D 15	.01	.2	D 63	.12	5.6
D 16	.01	.9	D 64	.01	.4
D 17	.01	.5	D 65	.02	.5
D 18	.00	.5	D 66	.03	3.2
D 19	.01	.6	D 67	.02	2.0
D 20	.01	.8	D 68	.01	1.8
D 21	.01	.7	D 69	.00	2.0
D 22	.01	.6	D 70	.02	2.0
D 23	.01	.6	D 71	.02	4.0
D 24	.01	1.2	D 72	.02	7.3
D 25	.03	.6	D 73	.01	2.7
D 26	.01	.3	D 74	.02	2.2
D 27	.02	1.2	D 75	.01	4.1
D 28	.02	.7	D 76	.02	5.6
D 29	.01	.5	D 77	.02	4.7
D 30	.01	.4	D 78	.15	6.8
D 31	.00	.3	D 79	.02	2.3
D 32	.01	.3	D 80	.05	2.5
D 33	.01	.29	D 81	.03	3.0
D 34	.00	1.2	D 82	.02	1.5
D 35	.01	.3	D 83	.04	2.1
D 36	.00	.6	D 84	.02	4.1
D 37	.02	1.3	D 85	.02	2.2
D 38	.01	.7	D 86	.02	5.3
D 39	.01	.3	D 87	.04	2.4
D 40	.01	.5	D 88	.12	4.2
D 41	.00	.5	D 89	.01	.5
D 42	.01	.3	D 90	.01	.5
D 43	.01	.3	D 91	.04	2.6
D 44	.01	.2	D 92	.02	.2
D 45	.02	.3	D 93	.01	.4
D 46	.01	.2	D 94	.02	.4
D 47	.02	.3	D 95	.01	.5
D 48	.02	1.6	D 96	.02	.6

No.	Gold	Silver
D 97	.02	.5
D 98	.04	6.6
D 99	.01	.4
D 100	.02	2.2
D 101	.00	.4
D 102	.02	.7
D 103	.01	.2
D 104	.00	.3
D 105	.01	1.2
D 106	.02	1.2
D 107	.06	1.1
D 108	.01	.4
D 109	.01	.5
D 110	.07	6.0
D 111	.00	.3
D 112	.00	.2
D 113	.02	.3
D 114	.03	4.5
D 115	.01	.2
D 116	.01	.3
D 117	.01	.5
D 118	.00	.5
D 119	.00	.2
D 120	.00	.3
D 121	.01	1.0
D 122	.01	.5
D 123	.00	.2
D 124	.00	.2
D 125	.00	.2
D 126	.01	.2
D 127	.01	.5
D 128	.00	.4
D 129	.00	.3
D 130	.04	3.2
D 131	.03	2.0
D 132	.00	.4
D 133	.01	1.2
D 134	.01	5.5
D 135	.01	1.0
D 136	.00	.4
D 137	.01	.4
D 138	.02	.5
D 139	.01	.7
D 140	.02	.8
D 141	.01	.4
D 142	.01	1.0
D 145	.03	2.6
D 148	.02	.8
D 151	.02	.6
D 154	.03	.8

No.	Gold	Silver
D 157	.02	2.8
D 160	.03	2.3
D 163	.02	3.6
D 164	.03	1.1
D 165	.02	1.6
D 166	.02	3.2
D 167	.02	2.4
D 168	.02	1.9
D 169	.03	1.4
D 170	.02	2.4
D 171	.03	3.2
D 172	.03	2.2
D 173	.00	.3
D 174	.04	2.3
D 175	.02	.6
D 176	.01	.6
D 177	.00	.6
D 178	.00	.5
D 179	.07	2.8
D 180	.01	3.0
D 181	.01	.4
D 182	.00	.2
D 183	.00	.2
D 184	.00	.2
D 185	.00	.3
D 186	.00	.5
D 187	.00	.6
D 188	.00	.6
D 189	.03	1.7
D 190	.00	.6
D 191	.00	.4
D 192	.00	.4
D 193	.01	.5
D 194	.20	29.0
D 195	.00	2.0
D 196	.52	3.2
D 197	.10	1.8
D 198	.10	3.6
D 199	.05	2.0
D 200	.03	1.6
D 201	.06	5.0
D 202	.04	1.6
D 203	.03	14.0
D 204	.04	2.0
D 205	.03	5.4
D 206	.06	13.5
D 207	.00	1.3
D 208	.00	.7
D 209	.01	.8
D 210	.01	14.4
D 211	.26	18.6

No.	Gold	Silver
H 1	.03	.6
H 2	.05	.6
H 3	.01	.2
H 4	.00	1.1
H 5	.01	.4
H 6	.00	1.5
H 7	.01	.6
H 8	.01	.5
H 9	.01	.4
H 10	.00	.2
H 11	.00	1.2
H 12	.01	3.2
H 13	.02	.3
H 14	.01	1.8
H 15	.01	1.5
H 16	.00	.3
H 17	.01	.6
H 18	.00	.4
H 19	.01	.4
H 20	.01	.4
H 21	.00	.4
H 22	.00	.9
H 23	.00	.7
H 24	.01	.6
H 25	.09	7.0
H 26	.02	4.4
H 27	.00	.6
H 28	.01	.3
H 29	.01	.4
H 30	.01	1.2
H 31	.05	.5
H 32	.00	.4
H 33	.00	.3
H 34	.01	.2
H 35	.09	1.1
H 36	.01	.2
H 37	.02	2.6
H 38	.00	.2
H 39	.01	.1
H 40	.01	.2
H 41	.01	.3
H 42	.03	5.0
H 43	.01	.3
H 44	.01	.4
H 45	.03	2.4
H 46	.01	.2
H 47	.03	1.6
H 48	.05	16.8
H 49	.03	2.0
H 50	.02	1.2
H 51	.05	5.4
H 52	.02	2.8

No.	Gold	Silver
H 53	.02	3.2
H 54	.04	7.9
H 55	.03	6.5
H 56	.04	8.6
H 57	.03	3.5
H 58	.02	4.6
H 59	.03	1.8
H 60	.03	3.1
H 61	.02	2.5
H 62	.03	4.5
H 63	.02	1.2
H 64	.05	5.4
H 65	.05	5.1
H 66	.02	.3
H 67	.02	1.5
H 68	.02	1.5
H 69	.01	.8
H 70	.02	.8
H 71	.04	1.4
H 72	.12	4.3
H 73	.14	3.5
H 74	.06	8.8
H 75	.05	20.0
H 76	.03	.6
H 77	.04	1.6
H 78	.12	3.3
H 80	.01	1.2
H 81	.00	.5
H 82	.00	.4
H 83	.01	.8
H 84	.00	.8
H 85	.00	.8
H 86	.01	.3
H 87	.02	1.8
H 88	.02	1.4
H 89	.01	1.2
H 90	.00	.4
H 91	.00	.5
H 92	.02	1.4
H 93	.02	1.6
H 94	.01	3.1
H 95	.01	.4
H 96	.01	.8
H 97	.03	2.4
H 98	.03	1.5
H 99	.04	2.8
H 100	.01	.3
H 101	.01	.4
H 102	.00	.3
H 103	.00	.3
H 104	.00	.2
H 105	.05	11.0

No.	Gold	Silver
H 106	.01	.6
H 107	.01	.3
H 108	.00	.5
H 109	.01	1.1
H 110	.00	.6
H 111	.00	.5
H 112	.00	.2
H 113	.00	.2
H 114	.00	.1
H 115	.01	1.0
H 116	.02	8.0
H 117	.00	3.7
H 118	.00	.6
H 119	.00	1.0
H 120	.00	.6
H 121	.00	.6
H 122	.00	.7
H 123	.02	.4
H 124	.01	1.0
H 125	.01	.4
H 126	.00	.6
H 127	.03	4.4
H 128	.00	.3
H 129	.01	.5
H 130	.04	3.6
H 131	.00	.2
H 132	.02	4.0
H 133	.01	.4
H 134	.01	.5
H 135	.02	.6
H 136	.00	.2
H 137	.00	.2
H 138	.00	.1
H 139	.00	.0
H 140	.00	.1
H 141	.02	1.4
H 142	.01	.3
H 143	.02	3.6
H 144	.02	1.6
H 145	.01	1.6
H 146	.04	1.8
H 147	.02	2.6
H 148	.03	3.7
H 149	.06	5.8
H 150	.03	3.4
H 151	.03	4.0
H 152	.05	3.6
H 153	.04	6.8
H 154	.02	3.5
H 155	.04	4.0
H 156	.05	2.0
H 157	.04	3.4

No.	Gold	Silver
H 158	.05	10.5
H 159	.04	5.6
H 160	.03	3.5
H 161	.04	4.6
H 162	.04	3.6
H 163	.02	2.4
H 164	.02	2.4
H 165	.01	2.8
H 166	.02	4.0
H 167	.03	3.0
H 168	.02	1.4
H 169	.02	4.3
H 170	.01	3.2
H 171	.01	1.2
H 172	.01	.5
H 173	.03	14.0
H 174	.02	3.8
H 175	.01	3.9
H 176	.02	2.0
H 177	.03	6.2
H 178	.01	.4
H 179	.01	.4
H 180	.00	.3
H 181	.00	.2
H 182	.00	.2
H 183	.00	.2
H 184	.06	3.6
H 185	.02	.4
H 186	.02	1.6
H 187	.08	4.8
H 188	.00	.3
H 189	.00	.1
H 190	.00	.2
H 191	.01	.2
H 192	.02	1.0
H 193	.00	.5
H 194	.05	7.0
H 195	.01	.6
H 196	.04	3.1
H 197	.04	1.4
H 198	.07	4.8
H 199	.03	2.0
H 200	.02	40.4
H 201	.02	2.0
H 202	.01	4.2
H 203	.01	1.7
H 204	.00	.8
H 205	.03	1.5
H 206	.03	5.4
H 207	.04	5.2

HOMESTAKE MINING COMPANY

INTER-DEPARTMENT COMMUNICATION

TO: Mr. A. L. Slaughter

DATE: August 31, 1966

FROM: Donald T. Delicate

SUBJECT: HOMESTAKE MINING COMPANY REVISED BID FOR DOUBLE RAINBOW MINES, INC. PROJECT

MESSAGE:

The following revised bid is submitted for the proposed exploration work at the Double Rainbow Mines property near Galena, South Dakota.

This bid is based on the specifications listed by you.

	Type Of Work	Footage	BID PRICE $/Unit	BID PRICE $
1)	Sink vertical shaft and install skips & dump	260 ft.	$ 220.00/ft.	$ 57,200
2)	Excavate station and pocket and install skip loader	9,000 cu. ft.	2.16/cu. ft.	19,500
3)	Lower Contact Drifting			
	Drive exploration drift 8x10	1,500 ft.	56.67/ft.	85,000
	Drive exploration drift 6x6	1,300 ft.	41.73/ft.	54,250
4)	Upper Contact Drifting			
	Drive exploration drift 6x6	1,000 ft.*	35.00/ft.	35,000*
5)	Surface diamond drilling - BX	2,000 ft.	6.00/ft.	12,000
	U.G. diamond drilling - AX	3,200 ft.	3.38/ft.	10,800
				$ 273,750

(*) The shaft sinking bid price will escalate $25.00 per foot for each 50-gallon-per-minute increase in water flow over and above 50 gpm.

Rock Bolting Bid

5-foot bolts	$ 3.00/bolt
8-foot bolts	3.50/bolt

Submitted by:

Donald T. Delicate

Donald T. Delicate
Manager of Mining

DTD:b

* If this footage is increased to 1400 ft. as per suggestion of Mr. Wm. Hasler, this cost is increased to $49,000, the total to $287,750

A.L.S.

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HOMESTAKE MINING COMPANY

INTER-DEPARTMENT COMMUNICATIONS

TO Mr. A. L. Slaughter

FROM Donald T. Delicate

REFERENCE

DATE July 11, 1966

SUBJECT HOMESTAKE MINING CO. BID FOR DOUBLE RAINBOW MINES, INC. PROJECT

The following bid prices are submitted for the proposed exploration work at the Double Rainbow Mines property near Galena, South Dakota.

This bid is based on the specifications listed by you.

	Type Of work	Footage	BID PRICE $/Unit	BID PRICE $
*1)	Sink vertical shaft and install skips & dump	260 ft.	$ 195.19/ft.	$ 50,750
2)	Excavate station and pocket and install skip loader	9,000 cu. ft.	2.16/cu. ft.	19,500
3)	Lower Contact Drifting			
	Drive exploration drift 8x10	1,500 ft.	56.67/ft.	85,000
	Drive exploration drift 6x6	1,300 ft.	41.73/ft.	54,250
4)	Upper Contact Drifting			
	Drive exploration drift 6x6	1,000 ft.	30.00/ft.	30,000
5)	Surface diamond drilling - BX	2,000 ft.	6.00/ft.	12,000
	U.G. diamond drilling - AX	3,200 ft.	3.38/ft.	10,800
				$ 262,300

(*) The shaft sinking bid price will escalate $25.00 per foot for each 50-gallon per minute increase in water flow over and above 50 gpm.

Rock Bolting Bid

5-foot bolts	$ 3.00/bolt
8-foot bolts	$ 3.50/bolt

Submitted by:

Donald T. Delicate

Donald T. Delicate
Manager of Mining

DTD:k

G090

Consideration Schedule
Surface & Underground Drilling
Double Rainbow Property
Galena, South Dakota

To; Hull, Terry and Bret Harte
Phoenix Title Building
Tucson, Arizona

From; MacPherson Drilling Company
601 N. 2nd, Street
P. O. Box 1167
Montrose, Colorado 81401

Attention; Mr. Anthony D. Terry

Gentlemen:

I hereby submit my proposal to core drilling approximately 5000 feet of BX & AX cores from surface and underground drill sites located at Galena, South Dakota on the Double Rainbow property.

MacPherson Drilling Company undertakes to perform such drilling under the terms and for the fees setforth herein. And, Double Rainbow Mines Inc. agrees to accept such terms and fees for the services of MacPhersn Drilling Company which follow for the purpose indicated.

Core drilling rates

Surface drilling
From surface to top of bedrock, Overburden @ $9.00 per ft. cased
From top bedrock to 700 ft. in depth BXWL size core @ 5.85 per ft.

Underground drilling
From 0 to 500 ft. indepth AX-size core @ $ 5.30 per ft.

Mobilization and inculding demobilization of drilling equipment and drill personnel at a lump sum of $1400.00.

Should contractor be requested to furnish a suitable compressor for underground drilling contractor shall receive as payment $8.00 per hour working time plus the cost of mobilization and demobilization

Contractor's labor and equipment funrinshed for both surface and underground drilling to cementing, drilling out cement, reaming for and installing casings, recovery of casings from drill holes on completion of drilling, surveying of drill holes or other work owner may request contractor to perform with his equipment and labor shall be charged to owner at an hourly rate of $12.50 per hr. so used.

Suppiles used to complete holes to the required depth, such as drilling mud, cement or cement substitutes or other additives shall be charged to owner at contractor's cost F.O.B. job site. Core boxes shall be furnished by contractor at cost to owner.

Contractor shall furnish all drilling equipment, pumps,water lines, diamonds, tools, labor, supervision and all auxiliary equipment necessary to complete holes to the required depth. all insurances required by the State of South Dakota shall be furnished by contractor.

Owner agrees to make roads and drill sites for surface drilling, provide suitable drill stations for underground drilling, engineering services in connection with drilling operations when required and make available free of charge it's underground transportation facilities to contractor for the moving of his equipment and supplies to drill locations.

August 20, 1966

Respectfully submitted,

By M. MacPherson
Malcolm MacPherson

P. O. BOX 151 DIAL 468-2663

MATERI

EXPLORATION

DRILLING CONTRACTOR
MOTOR AND MACHINE WORK
UPTON, WYOMING

July 25, 1966

Double Rainbow Mines, Inc.
c/o Anthony D. Terry, Attorney at Law,
509 Phoenix Title Building,
Tucson, Arizona

Re: Double Rainbow Mines , Inc.

Dear Mr. Terry:

In regard to your request for bid to drill in Double Rainbow property, Galena, South Dakota, for surface drilling, consisting of four vertical holes, BX core, we bid $ 8.00 per ft.

For underground drillings of AX core, we submit a bid of $ 6.00 per ft.

Very truly yours,

MATERI EXPLORATION

Lawrence E. Materi

mp

UTAH | COLORADO
ARIZONA | NEW MEXICO

Four Corners Exploration Company

P. O. BOX 116 287-4722 GRANTS, NEW MEXICO

IRVING RAPAPORT
FORREST FINCHER

August 17, 1966

Double Rainbow Mines, Inc.
% Anthony D. Terry
Attorney at Law
509 Phoenix Title Building
Tucson, Arizona

Dear Sirs:

The following bid is submitted in response to your letter of July 22, 1966 in accordance with the specifications presented at that time.

Underground Work at Galena, South Dakota

	Footage	Unit Price	Total Price
Sink Vertical shaft ($11\frac{1}{2}$' X $10\frac{1}{2}$' in the rough) including installation of skip and dump	260 ft.	$275.00/ft.	$71,500.00
Excavate station and pockets including installation of skip loader	9,000 $ft.^3$	$2.50/$ft.^3$	$22,500.00
Lower contact drifting			
Drive exploration drift (8'X10')	1,500 ft.	$60.00/ft	$90,000.00
Drive exploration drift (6'X6')	1,300 ft.	$50.00/ft	$65,000.00
Upper contact drifting			
Drive exploration drift (6'X6')	1,000 ft.	$40.00/ft	$40,000.00
		Total Price	$289,000.00

Water in excess of 50 g.p.m. in the shaft would probably present a serious problem and Four Corners would only be prepared to continue on the basis of cost plus 15%.

Roof bolting of an unspecified quantity in the main exploration heading is bid as follows:

5' bolts	$4.00 per bolt
8' bolts	$4.50 per bolt

I believe all major items have been covered in the bid and specifications. Minor modifications and problems should be negotiable on the job.

I appreciate this opportunity to bid on your work.

Yours truly,

IRVING RAPAPORT

IR/ba

HAROLD B. SPENCER, PRESIDENT
JAMES QUIGLEY, VICE-PRESIDENT
ROBERT E. WATT, SEC'Y-TREASURER

P. O. BOX 290
TELEPHONE 433-6876
AREA CODE 801

CENTENNIAL DEVELOPMENT COMPANY

MINING ENGINEERS AND CONTRACTORS

EUREKA, UTAH

August 1, 1966

Double Rainbow Mines, Inc.
c/o Anthony D. Terry, Attorney at Law
509 Phoenix Title Building
Tucson, Arizona

Gentlemen:

We have examined the work called for under your specifications and request for bid dated July 22, 1966 and are pleased to submit the following proposal.

1.	Sink Vertical Shaft, 260 ft.	$ 225.00 per ft.
2.	Install Skips and Dump.	$1,000.00 Lump Sum
3.	Station and Pocket Excavation.	$ 1.60 per cu. ft.
4.	Install Skip Loader.	$1,500.00 Lump Sum
5.	Lower Contact Drifting.	
	8' x 10' Drift.	$ 60.00 per ft.
	6' x 6' Drift.	$ 42.00 per ft.
6.	Upper Contact Drifting.	
	6' x 6' Drift.	$ 38.00 per ft.
7.	Rock Bolts, installed, 3/4".	$ 1.60 per ft.

We appreciate the opportunity of bidding and hope we may be of service.

Very truly yours,

Centennial Development Company

H B Spencer

H. B. Spencer

HBS/ce

EXHIBIT 3

LEGAL DESCRIPTION OF LAND

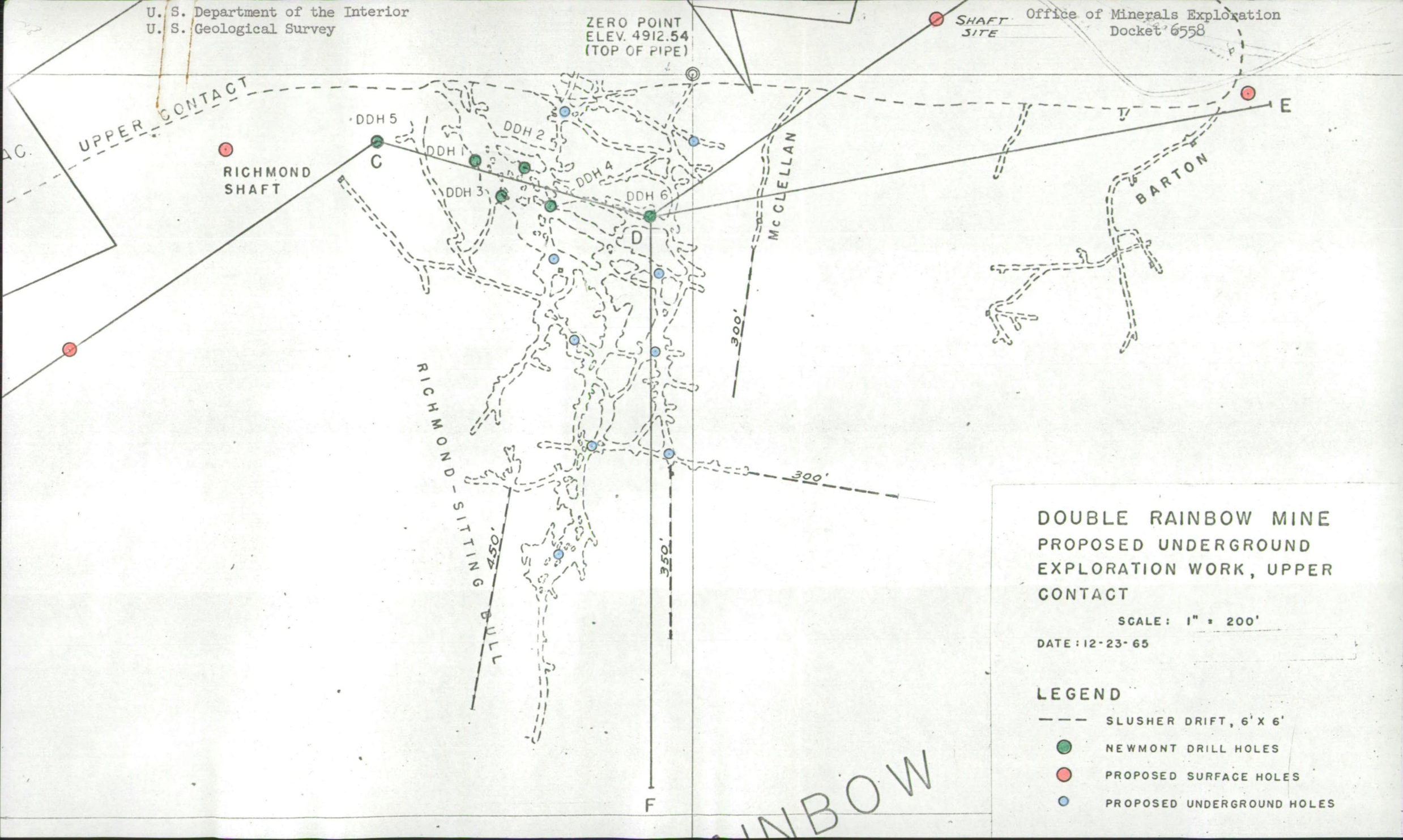
Patented Mining Claims Located in The Black Hills National Forest, Lawrence County, South Dakota, Sections 3, 4, 9 and 10, Township 4 N, Range 4 E, Black Hills Meridian.

Merritt No. 1	- M.S.	73	Grand View	- M.S.	365
Merritt No. 2	- M.S.	133	Ora Flamme	- M.S.	384
Florence	- M.S.	163	Sleeper	- M.S.	1980
Chicago	- M.S.	334	George B. McClellan	- M.S.	2031
Sitting Bull	- M.S.	336	Gorman	- M.S.	2031
Richmond	- M.S.	345	Bank of Dakota	- M.S.	1901
Tiger Tail	- M.S.	333	Teddy	- M.S.	1901
Center Fraction	- M.S.	2030	Fissure	- M.S.	1901
Grand View Fraction			Bed Rock	- M.S.	1901
Lode	- M.S.	366	Gulch	- M.S.	1901
Silver Terra	- M.S.	364	Gray Eagle	- M.S.	1901
Mountain	- M.S.	1640	Camillus	- M.S.	1901
Custer	- M.S.	919	Margaret	- M.S.	1901
Rock Hill	- M.S.	1639	Wabash	- M.S.	1901
Savage	- M.S.	372	War Eagle	- M.S.	1901

(it should be noted that Esther Allen Borsch has surface rights to approximately 1.80 acres on a portion of M.S. 73, which are not considered of any use for purposes of this exploration or development.)

U. S. Department of the Interior
U. S. Geological Survey

Office of Minerals Exploration
Docket 6558

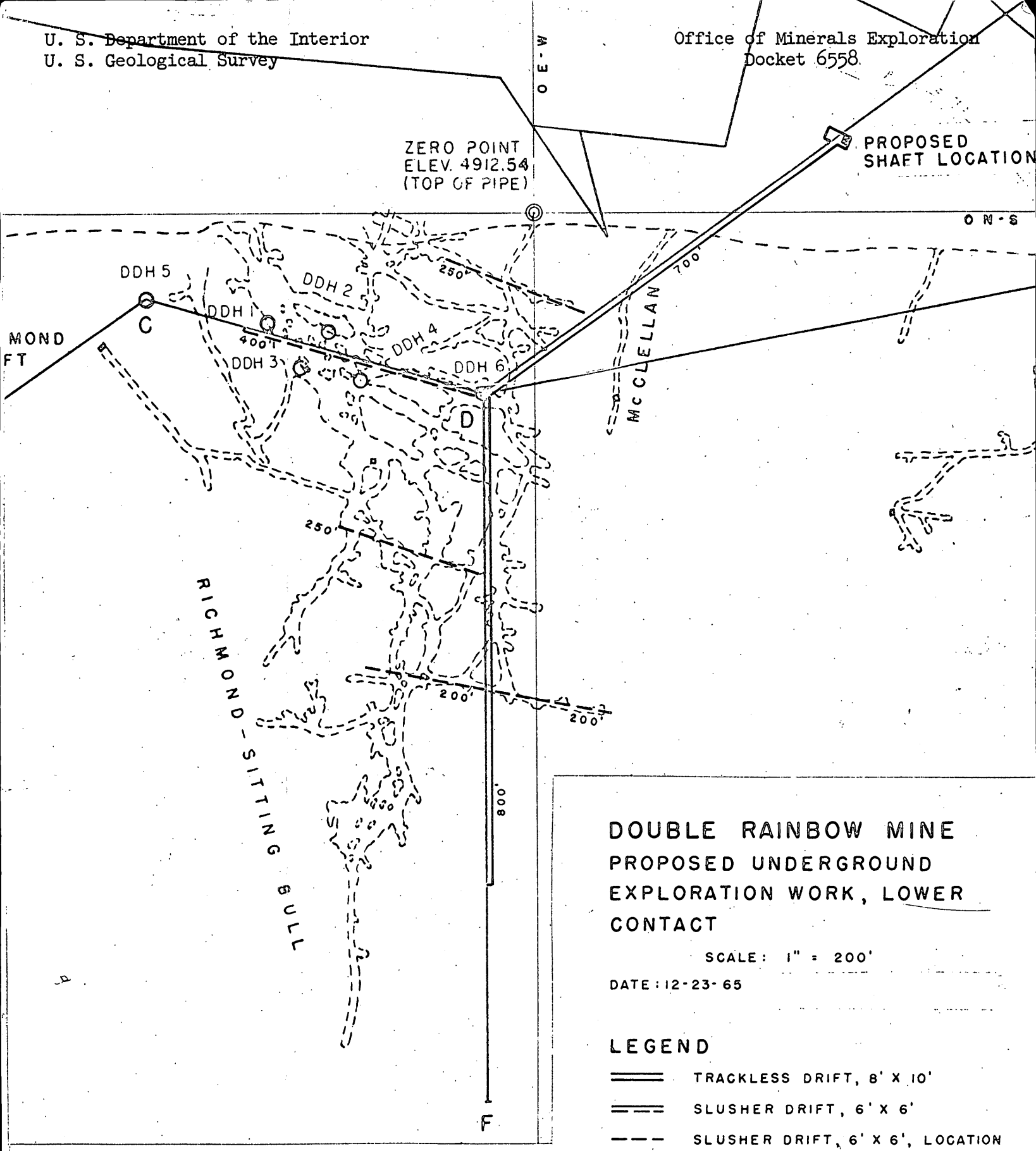


OFFICIAL
COPY
O. M. E.
RECEIVED
OCT 3 1966

INITIALS	CODE

U. S. Department of the Interior
U. S. Geological Survey

Office of Minerals Exploration
Docket 6558



DOUBLE RAINBOW MINE

PROPOSED UNDERGROUND EXPLORATION WORK, LOWER CONTACT

SCALE: 1" = 200'

DATE: 12-23-65

LEGEND

- TRACKLESS DRIFT, 8' X 10'
- SLUSHER DRIFT, 6' X 6'
- SLUSHER DRIFT, 6' X 6', LOCATION DEPENDS UPON POSITION OF ORE INTERCEPTS ALONG TRACKLESS DRIFT

HOMESTAKE MINING COMPANY

INTER-DEPARTMENT COMMUNICATIONS

TO Mr. A. L. Slaughter

FROM Donald T. Delicate

REFERENCE

DATE July 11, 1966

SUBJECT HOMESTAKE MINING CO. BID FOR DOUBLE RAINBOW MINES, INC. PROJECT

The following bid prices are submitted for the proposed exploration work at the Double Rainbow Mines property near Galena, South Dakota.

This bid is based on the specifications listed by you.

	Type Of work	Footage	BID PRICE $/Unit	BID PRICE $
*1)	Sink vertical shaft and install skips & dump	260 ft.	$ 195.19/ft.	$ 50,750
2)	Excavate station and pocket and install skip loader	9,000 cu. ft.	2.16/cu. ft.	19,500
3)	Lower Contact Drifting			
	Drive exploration drift 8x10	1,500 ft.	56.67/ft.	85,000
	Drive exploration drift 6x6	1,300 ft.	41.73/ft.	54,250
4)	Upper Contact Drifting			
	Drive exploration drift 6x6	1,000 ft.	30.00/ft.	30,000
5)	Surface diamond drilling - BX	2,000 ft.	6.00/ft.	12,000
	U.G. diamond drilling - AX	3,200 ft.	3.38/ft.	10,800
				$ 262,300

(*) The shaft sinking bid price will escalate $25.00 per foot for each 50-gallon per minute increase in water flow over and above 50 gpm.

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5-foot bolts	$ 3.00/bolt
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Submitted by:

Donald T. Delicate

Donald T. Delicate
Manager of Mining

DTD:k

G090

Consideration Schedule
Surface & Underground Drilling
Double Rainbow Property
Galena, South Dakota

To; Hull, Terry and Bret Harte
Phoenix Title Building
Tucson, Arizona

From; MacPherson Drilling Company
601 N. 2nd, Street
P. O. Box 1167
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Attention; Mr. Anthony D. Terry

Gentlemen:

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Core drilling rates

Surface drilling
From surface to top of bedrock, Overburden @ $9.00 per ft. cased
From top bedrock to 700 ft. in depth BXWL size core @ 5.85 per ft.

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August 20, 1966

Respectfully submitted,

By M. MacPherson
Malcolm MacPherson

P. O. BOX 151 DIAL 468-2663

MATERI

EXPLORATION

DRILLING CONTRACTOR
MOTOR AND MACHINE WORK
UPTON, WYOMING

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c/o Anthony D. Terry, Attorney at Law,
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Tucson, Arizona

Re: Double Rainbow Mines , Inc.

Dear Mr. Terry:

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Very truly yours,

MATERI EXPLORATION

Lawrence E. Materi

mp

UTAH | COLORADO
ARIZONA | NEW MEXICO

IRVING RAPAPORT
FORREST FINCHER

Four Corners Exploration Company

P. O. BOX 116 287-4722 GRANTS, NEW MEXICO

August 17, 1966

Double Rainbow Mines, Inc.
% Anthony D. Terry
Attorney at Law
509 Phoenix Title Building
Tucson, Arizona

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Underground Work at Galena, South Dakota

	Footage	Unit Price	Total Price
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I appreciate this opportunity to bid on your work.

Yours truly,

IRVING RAPAPORT

IR/ba

HAROLD B. SPENCER, PRESIDENT
JAMES QUIGLEY, VICE-PRESIDENT
ROBERT E. WATT, SEC'Y-TREASURER

P. O. BOX 290
TELEPHONE 433-6876
AREA CODE 801

CENTENNIAL DEVELOPMENT COMPANY

MINING ENGINEERS AND CONTRACTORS

EUREKA, UTAH

August 1, 1966

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c/o Anthony D. Terry, Attorney at Law
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Gentlemen:

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2.	Install Skips and Dump.	$1,000.00 Lump Sum
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4.	Install Skip Loader.	$1,500.00 Lump Sum
5.	Lower Contact Drifting.	
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Centennial Development Company

H B Spencer

H. B. Spencer

HBS/ce

EXHIBIT 3

LEGAL DESCRIPTION OF LAND

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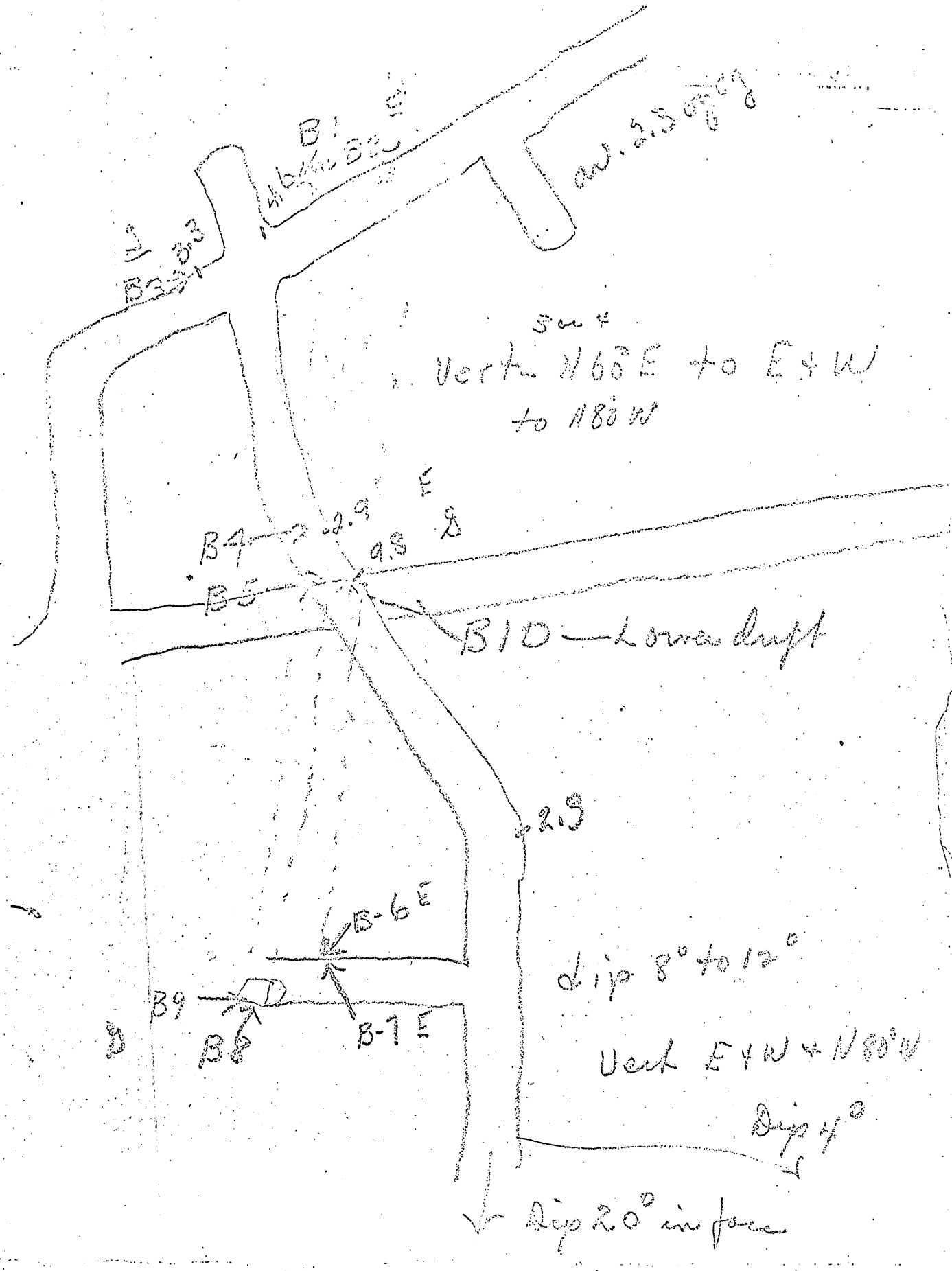
Custer	- M.S.	919	Margaret	- M.S.	1901
Rock Hill	- M.S.	1639	Wabash	- M.S.	1901
Savage	- M.S.	372	War Eagle	- M.S.	1901

(it should be noted that Esther Allen Borsch has surface rights to approximately 1.80 acres on a portion of M.S. 73, which are not considered of any use for purposes of this exploration or development.)

Exhibit 16

Trullies

Sample No	Au	Ag	Pb	Sample No	Au	Ag	Pb
B1	tr	0.36	None	R5	0.38	1.26	.94%
B2	tr	0.22	"	R6	.07	3.62	.47%
B3	tr	0.48	"	R7	.02	1.13	—
B4	.005	0.97	0.10%	R8	tr	.89	1.34
B5	tr	.77	0.26%	R9	tr	3.44	—
B6	.01	1.77	—	R10	.40	30.50	1.99
B7	tr	8.76		R11	.01	1.74	
B8	.01	.09	—	R12	.09	16.80	
B9	tr	.52	—	R13	.01	20.50	
B10	None	tr	None				
M1	.01	0.40	.26%				
M2	.02	4.18	6.56				
M3	tr	.32	.26%				
R1	01	2.05	.15%				
R2	None	.18					
R3	.06	49.89	15.31				
R4	tr	1.54	3.62				


B1
B2
B3
3.3
B4
2.9
9.5
E
B5
B10 — Lower drift
2.9
B-6 E
B9
B8
B-7 E
dip 8° to 12°
Vert E+W + N80°W
Dip 4°
Dip 20° in face

R-1 3" graphite below ore bed } 205
R-2 30" " above ore bed

R-3 14" ore bed (see sample above) 49.8 Tonnes

R-4 20" bed immediately above ore 1.54

R-5 28" ore bed top
R-6 16" below ore bed
R-7 30" below R-6
} HK 0.12 ore below 3.3 g/t drift

R-8 28" top ore bed
R-9 4' below ore bed
} HK 5 bed air drift .05 ore 20.0 g/t

R10 18" ore bed
R11 4' graphite below
} D 48 5 [illegible] .15 ore 6.8 g/t

R-12 - Chip sample graphite drift - D 210 .10 ore 14.4 g/t

R-13 Chip sample from drift on line of [illegible] D 211 .26 ore 18.6 g/t

M1 15' graphite below ore
M2 12" bed from Seam & vein
M3 18" graphite shale above ore

[illegible] ore
graphite below

B1 - 36" of limey shale over pyrite (Sulphur bu

B2 - 30" " pyrite underlying shale " "

B3 - 5' of pyrite & shale.

B4 - 5' " " " Shows galena

B5 - 5' " " " " "

B6 - 5.5' " " " one bed about 6" shows considerable galena

B7 - Sample of limey bed showing galena along vert. bed 6" Thick

B8 - pyrite at Bottom Shallow mange - 38" thick along bed

B9 - Vert Sample overlying B8 - 5.5'

B10 - Chip Sample pyrite directly under B5

Sample #10 ra: —

F1. Shot sample - 3' down from fault - 6-8' long Face of [illegible]

F2. " " - 3' " " " " " "

F3 " " 3' " " " " "

F4 " " 2' " " " " "

F5 " " vertical

" " 7.5 tons

F6 " " " 5 tons

F7 " " Face in stope 3'X6'

F8 " " " " " 3X8'

F9. " " Rim 2'X10'

F10 " " Wall - 3X12 ~~[illegible]~~

F11 " " " 3X10'

F12 " " " 3X10

F13 " " " 4X12

F14 " " face 3'X7

F15 " " " 3X5'

F16 " " " 3X5'

F17 " " " 3X5'

F18 " " Right wall face 3X6'

F19 One time smoked Right 3X3

R-29 [illegible] band 2' - one [illegible] - [illegible]
dark brown to black

R-28 [illegible] 2' - one [illegible] - Sheet Sample
dark brown to black

R30 - Channel Sample to Check D63

R-23 - face left - [illegible]
Sheet sample - 4½' wide - reddish brown
Silicon Some PbS

R-22 face left on [illegible] face
Sheet sample
reddish brown
Silicon

R-21 face left Sheet sample
3' wide - some PbS near face
reddish brn, Silicon

R-20 Sheet Sample - face - reddish brown, Silicon
one about 18" wide - some PbS
left wall

R-14 Small Sample Near Back - 3' x 1'
Mn

R-15 - Small Sample - ore in back 6"-8"
thick

R 17 - top of sample by 5' - D85 South
about 3' on bed

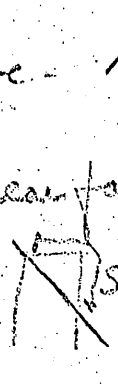
R-16 - Sample pocket in face

Sample Sheet

R-25 - lower half face drift - Sheet sample
3X5
(ore goes into floor)

R-26 - upper half drift face 3X5 - Sheet sample
Reddish brn. ore.

R-28 - upper half face - 3X8 - Sheet Sample
reddish brn ore - some gray - gray sulphide(?)

R-27 - lower half wall near face drift - Sheet Sample
3X10  Sample - Some PbS. drift here
vein

R-29 - Sheet Sample 3X12 - hard siliceous ore?
(ore apparent all along walls)

R-31 - Sheet sample face 4X4 - (doesn't have appearance ore)

R-2[illegible] Sheet sample face ore hard 4' - Some PbS in face and along walls.

aw 9.35.00 @ 70¢

Sample	width	Value (Note this is assay value of face sampled)
F5	3'	9.24
F6	3'	15.81
F7	3'	1.58
F8	3'	10.55
F9	2'	6.94
F16	4'	18.46
aw. value 7lb.		9.93

954
21
9.54

3.54
70
6678
6.773 4

19.7
59.4 lb per ton

6678 0

.0278
35
390
234 0
9.73

3.4
394
4
1576 11.07
70
7.7490

8/11/27

Cust.

C1 - Sample face (Shot) about 3 x 12
Heavy iron stained, some hard Silicious

C2 - Shot Sample face about 3' x 12'
darkened to brn iron oxide
Some Nodules of Manganese, Lead (?)
appearance of a gossan

C3 - Heavy iron oxide along wall or footwall,
9-10' above contact? See plan on Sample
map. Maybe similar mineralization to lower
on Boston Tunnel.

Savage

S-1 Sample packed yellow material on seams & have been
yellow oxidized material - pockets 18" and 3-4'
areas

S-2 Similar to S-1 - Vein trend N 25-30° E
not very plainly marked.

War Eagle

WE1 - 3 x 10' Shot Sample on iron,
some "pipes" noticeable on hard Silicious
Similar to Elsemere.

WE2 - Sample of X vein, reddish iron material

Trenches

F5 5 - 3' thick
F6 [redacted] 3' "
(F7) 3'
F8 3'
E1 2'
E1 [illegible] 8'

Wo[illegible]

- WE1 3'
- WE2 3

15# Samples
make list of thickness of one
who sampled

Send D.E.Co	200#
Send S.W.	200
Keep	200

Raymond - [illegible]

D 21 2'
D 21 4'
- R 14 - 2'
R 15 3'
- R 17 4'
- H 66 4'

Inhem (D 79) 5
- R 16 3'
- H 62 6'
- D 78 3'
- D 72 3'

H 54 3'
H [illegible] 3'
H [illegible] 3'
(D 77) 4'
D [illegible] 6'
[illegible] 6'
R 30 Sumac 0-63

H 17 4'
H 1[illegible] 4'
[illegible] 4' Some PDS
[illegible] 3 Some PDS
H 17 4'
R 2[illegible] 3'
- R 3[illegible] 2' Some galena

Ruth -
- D 167 1.5 6'
- H 167 3' Better than 187 - ore goes to NE
- R 20 3' Some galena (one pocketty)
- R 21 - 3'
- R 22 3'
[redacted]
- R 24 3' Some galena (pocketty)
R 25 2'
- H 75 3' - (R8) discarded
- Hedgerow between D 78 & H 74 6'
- H 73 mined out -

H62 on vein -
Ore seems to be more
silicious farther south.
Compare with Galena found at
Logan in Decorah.

R28 - 2' Some galena

Read 6-28-44
Trellis

Exhibit 18

AMERICAN CYANAMID COMPANY

COPY

Ore Dressing Laboratory

Metallurgical Tests on a sample of Lead-Silver Ore Submitted by Double Rainbow Mines, Inc., Deadwood, South Dakota.

Table I

Partial Analysis of Head Sample

Gold	0.073	Oz/ Ton
Silver	9.20	Oz/ Ton
Lead(Total)	1.98	%
Lead(Non-sulfide)	0.70	%
Zinc	0.66	%
Iron	15.79	%
Nickel	None	
Manganese	4.13	%
Calcium	1,95	%
S ulfur	0.41	%
Insoluble	56.74	%
Spec. Gravity.	3.16	

Microscopical Examination:

A portion of the ground head sample was carefully panned and the pan concentrate was observed under a binocular microscope. The following minerals were identified: limonite, pyrolusite, psilomelane, hematite, cerussite, anglesite, galena pyrite, arsenopyrite, chalcopyrite, covellite and gold.

Microscopical Examination of Test Products:

Due to the fact thatan assayed screen analysis of the flotation tailing did not NNN indicate the case of the low recoveries obtained it was d eeme d advisable to conduct a microscopical examination on a like sample.

The flotation t ailing from Test 6 was anned on a Super panner, the pan concentrate and the pan tailing were then submitted to our Microscopical De Department forexamination. Their report on this examination is as follows:

A panner concentrate and a panner tailing from the flotation tailing were submitted for microscopical examination. The object ofthe investigation wasto determine the nature and mode of occurrence of the gold and silver values in the panner products.

Read 6-28-44

Preparation of the Material

Small protions of the panner concentrate and panner tailing were briquetted separately in thermo-reactive resin, ground to a plane cross-section and pliched on the Gration-Vanderwilt pòlicing machine. The briquets were then examined by vertical, reflected light. The transparent mine4als were identified by transmitted light in the samples, as received. Several mineral constituents of the sample were subjected to microchemical tests to determine whether they carried any of the gold or silver values in the sample.

M ineralogy.

Panner Concentrate

The following minerals were identified in the panner concentrate:

limonite	hematite	galena	chalcopyrite
pyrolusite	cerussite	pyrite	covellite
psilomelane	anglesite	arsenopyrite	gold

Limonite was the most abundant single mineral in the sample. Pyrolusite and psilomelane were also major mineral constituents and these two manganese oxides together were more abundant than the limonite. Hematite, anglesite, cerussite and galena occurred in minor amounts. The galena was frequently observed as small inclusions in the anglesite and cerussite. Pyrite, arsenopyrite, chalcopyrite, and covellite were observed only as occasional grains.

The few grains of gold observed in the panner concentrate were all apparently free, and ranged from2 to 10 microns in minimun diameter. As no silver minerals had been identified in the sample, it seemed probable that either the galena of the manganese oxides, pyrolusite and psilomelane, might carry the silver values. Accordiggly, small amounts of galena and of the manganese oxides were removed from the sam le under a binocular microscope, and were separately tested for silver by microchemical methods. The galena gave a negative test for silver. The manganese oxi es, however, carried an appreciable amount of silver, and were probably largely responsible for the silver content of the ppanner concentrate.

Panner Tailing

The following mineral constituents were identified in this panner product:

limonite	anglesite	chalcopyrite	gold
pyrolusite	cerussite	quartz	
psilomelane	galena	car onate (calcite or dolomite.)	

The chief metallic constituent was limonit. Pyrolusite and psilomelane were also majormetallics. Anglesite, cerussite, galèna and chalcopyrite were present in small amounts.

The gold observed in this sample occurred principally as small particles locked with transparent gangue and with limonite. An illustration of a particl

of gold locked with limonite and enclosed in transparent gangue is given in Figure. 1.

The transparent gangue minerels, which constituted the major portion of the sample, were frequently observed locked with the metallic minerals. The principal transparent gangue mineralwas quartz. A minor amount of calcite or dolomite was also present.

Summary of Microscopical Ex amination.

Panner Concentrate

1. The following minerals were identified in this sample; limonite, pyrolusite, psilomelan , hematite, cerussite, anglesite, galena, pyrite, arsenopyrite, chalcopyrite, covellite and gold.

2. The gold observed in the panner concentrate consisted ofa few apparently free grains, ranging from2 to 10 microns in minimum diameter. Microchemical test on the manganese oxides showed that they carried silver values, and wereproba ly largely responsible for the silve4 content of the sample.

Panner Tailing.

1. The following m neral constituents were identified in this product; limonite, pyrolusite, psilomelane, anglesite, cerussite, galena, chalcopyrite, quartz and calcite of dolomite.

Summary

The results obtained in this investigation may be summarized as follows:

1. Cyanidation of the ore for a period of 72 hours resulted in extractions of 83 % of the gold and 64 % of the silver, (Test 1).

2. Cyanidation in the prisence of mercuric chloride did notimprove the results obtained.

3. Fine grinding prior to cyanidation did not effedt increased recoveries.

4. Flotation of the ore resulted in a recovery of approximately 50 % of the gold and 50 % of the silver. The flotation concentrate assayed approximately 0.9 Oz./ ton Au and 100.0 Oz./ tonAg.

5. In test 9 the minus 20 mesh material was tabled. The table tailing was ground and floated. The flotation tailing, after filtering, was cyanided for a period of 48 hours. The results obtained in this test show that 18.41 % of the gold, 27.04 % of the silver and 52.30 % of the lead were recovered in the table concentrate. The flotation concentrate contained 24.85 % of the gold, 23,46 % of the silver and 3.74 % of the lead. Cyanidation recovered 38.86 % of the gold and 21.31 % of the silver. The overall recoveries were 82.12 % of the gold, 71.81 % of the silver and 56.04 % of the lead.

6. An assayed screen analysis of the flotation tailing showed an even distribution of the gold and silver values throughout the various sizes.

7. Microchemical tests on panner products showed that the manganese oxide minerals carried considerable silver values.

8. Very fine metallic gold was observed locked with the gangue minerals.

9. No true silver mineral was observed.

Conslusions:

The foregoing data show that fair recoveries of the gold and silver values sere affectdd by a combination method consisting of tabling , flotation and cyanidation. The lost silver was possibly assaciated with the manganese oxide minerals which were not recovered. The lost lead was present as cerussite, anglesite and tarnished galena.

AMERICAN CYANAMID COMPANY

C. Marsh
Ore dressinglaboratory

D. W. Davis
Microscopical Department

BR

December 13,.1939

Unsigned

DOUBLE RAINBOW MINES INC.

C O P Y

Written after 1931

Exhibit 20

Location:

The property of the Double Rainbow Mines, Inc., is located in the Bear Butte Mining District, Lawrence county, So. Dak. The claims are in sections 3, 4, 9 and 10, Twp. 4 North, Range 4 East, Black Hills Meridian. It is about 10 miles from Deadwood, the county seat of Lawrence County and 10 miles from Sturgis, the county seat of Meade County, So. Dak. The buildings on the property are located on Bear Butte Creek which flows the year round.

There is a power line and telephone line to the property. The roads are excellent.

Property:

The property consists of the following patented claims: Merrit No. 1, M. S. 73, Merrit No. 2, M. S. 133, Florence, M. S. 163, Chicago, M. S. 334, Sitting Bull, M. S. 336, Richmond, M. S. 345, Tiger Tail, M. S. 333, Fraction Lode, M. S. 366, Silver Terra, M. S. 364, Mountain, M. S. 1640, Custer, M. S. 919, Rock Hill, M. S. 1649, Savage, M. S. 372, Grand View, M. S. 365, Oro Flam, M. S. 364, Sleeper, M. S. 1980, McClellan and Gorman, M. S. 3021, Bank of Dakota, Teddy, Fissure, Bad Rock, Gulch, Gray Eagle, Camillus, Margaret, Wabash, and War Eagle, all M. S. 1901. These form one continuous block of ground about 275 acres in extent. The claims cover the apex to both the upper and lower ore horizons in the Deadwood formation.

History:

Ore was first discovered in the Bear Butte Mining District in 1875, before the Black Hills was opened for settlement. Soldiers moved the prospectors out but they returned in 1876, locating the Sitting Bull and Florence claims.

In 1881 these claims were sold to a Mr. Davey who built a small smelter. In two years these claims produced $750,000 in gold, silver and lead. In 1883 the Sitting Bull - Silver Terra apex suit was taken to court and litigation lasted for 16 years. In the early 1900's the various properties were consolidated and operated for several years as the Richmond Sitting Bull Mine. The owner died in 1913.

In 1930 some development work and additional property was acquired and the present mill built. Due to the low price of metals and incompetent management the property was shut down early in 1932. Since 1932 a watchman has been maintained and considerable and considerable surveying and sampling has been done. The present company, Double Rainbow Mines, Inc. is owned by the estate of the man that operated the property in the early 1900's. The property has been in the family for nearly 40 years.

To date the property has produced about $1,750,000 in gold, silver and lead.

Geology:

The geology of district is comparatively simple. Bear Butte Creek has

eroded through the sedimentary formation into the underlying schist on the west end of the property and on the east it flows over the sediments. Of the sedimentary formations, the Deadwood, of Cambrian age is of economic importance. In the Deadwood formation there are three ore horizons of commercial importance, the lower horizon lying about 30 feet above the schist, the intermediate lying about 100 feet above the schist and the upper horizon lying about 300 feet above the schist. These ore horizons are of dolomitic quartzite overlain by shale and the ore is a replacement of the dolomite directly under the shale roof. The horizons are found at the contact of the dolomitic quartzite and shale, rarely porphyry, and are known locally as "contacts."

The character of the ore varies on the different contacts. The ore as exposed in the Merrit mine, lower contact, is a heavy sulphide of pyrite and galena. In some places this has oxidized to a heavy grayish material.

The intermediate contact is not developed on the Double Rainbow property, but it is exposed on the Washington claim lying just east of the Merritt No. 1. This ore is very similiar to the ore of the lower contact, a heavy sulphide of pyrite and galena.

The upper contact ores are silicious, a reddish brown in color and are exposed on the War Eagle, Florence and Richmond Sitting Bull claims. In appearance the oxidized ore of the upper contact is very similiar to the oxidized ore of the Bald Mountain area. It should be noted that in the primary ore, the gold is associated with the pyrite and the lead and silver with the galena. However, in some localities, part of the silver has been found with minor amounts of manganese minerals.

On all three contacts the ore lies in troughs or pockets in the quartzite, directly under a shale or other impervious roof and along mineralized fractures or "verticals" as they are known locally. The verticals that have the ore values are a series of overlapping, discontinuous, mineralized fractures varying in trend from East and West to North and South, most of them trending N. 50 E. The same verticals were probably caused by warping of the Deadwood formation due to igneous intrusions in the formation or the underlying schist, previous to mineralization. That there are barren fractures indicates some warping after mineralization.

The control of the ore is a different matter. There seems to be a definite ore trend of N. 50 E. extending throughout Bear Butte Mining District. The fractures that cross this ore trent were mineralized and ore bodies formed on favorable horizons. There are certain areas along the ore trend presenting the best places for ore deposition. The biggest and richest stopes are found on the flatter dips.

The size of the ore bodies varies but in the main workings of the Richmond Sitting Bull mine the stopes are about 50 feet wide, 8 feet high and up to 600 feet long.

Tramway:

There is a 400 foot tramway from the rough ore bin to a transfer raise to the mine. The tram equipment consists of a Ruth gasoline motor powered with a model Ford motor and 5 one ton side dumpcars. The track is 18" gauge laid with 20# rail. The tramway is in fair shape and could be easily repaired. A wagon

road could be very easily constructed to the head of the mill. Bins for custom ore could be easily constructed along this tramway.

Water and Tailings Disposal:

The mill is situated along Bear Butte Creek and water can be pumped from shallow wells for mill supply. Formerly water was pumped direct from the creek to the mill but at present the Gilt-Edge Mine is dumping their tailings in the creek thus prohibiting the use of creek water. For the time being it would be possible to dump tailings in the creek but if the state should discontinue the practice there is ample room on the Bank of Dakota claim for a tailings dam.

Metallurgy:

The samples submitted to the American Cyanamid Co. and The Denver Equipment Co. suggested the following treatment. Grinding of the ore to a minus 65 mesh, flotation making a very high-grade concentrate, vanidation of the flotation tailings to get additional gold, silver values and finally tabling of the cyanide tailings to pick up any oxidized lead. The recovery is about 82% of the gold, 72% of the silver, and 65% of the lead.

Office:

A four room frame building about 16' x 24' is used as an office, one room is used as a warehouse, one room as a filing room, one as a drafting room and the other as a private office.

The equipment consists of two steel filing cabinets, two flat topped tables, drafting boards, map cases and chairs. In the warehouse room there are small tools, electrical equipment, machine repairs and odds and ends.

Change House:

A frame building about 16' x 20' is fitted with shower and sink for washing, with locker space for about 20 men.

Oil House:

A small building located between the mill and the office building is used as an oil house. At present it contains picks, shovels, bars and blacksmith shop equipment.

Company House:

200 feet North of the office building is a company house, four room about 24' x 24'. It has been used as a watchman's residence and is rather dirty at present but can be easily cleaned.

Other buildings:

There are several other buildings on the property that have been used as blacksmith shops, storage, etc., which are slightly in need of repair.

Mine Plant:

Built in 1930 the mine plant consists of an Ingersoll Rand Imperial type KB compressor about 400 cu. ft. capacity with a 75 H.P. motor, air receiver and cooling system. The air is piped to the mine in a three inch pipe, there is another air receiver at the mine and distributed throughout the mine by a two inch air line. There are four drifters in the compressor house, one Chicago pneumatic No. 3 drifter, 3 Ingersoll Rand L74 drifters, two Ingersoll Rand S49 jackhammers, one S49 Stoper (Ingersoll Rand); about one ton of 1" hexagon drill steel and the necessary columns bars, etc. one class E Sullivan Drill sharpener; one 25 H.P. Sullivan double drum slusher hoist; one Mancha Little Trammer Storage battery motor complete and about 10 tons of 20 pound rails; 1 Ingersoll Rand air hoist.

The compressor is located in a building 20' x 44', one-half of which is used for the assay office.

Assay Office:

A brick QQ muffle coal fired furnace, pulp balances and Ainsworth button balance, hot plates, sink, etc. comprise the equipment. This equipment is rather dirty but can be easily cleaned. A small gyratory crusher and a Braun pulverizer comprise the sample crushing equipment. These are located in the mill.

Mill:

Built in 1931, completely new, the mill has the following equipment, 3" grizzly and 250 ton coarse ore bin, 18" x 24" Universal jaw crusher with 25 H.P. motor V-belt drive; 2' Symmons cone crusher with 25 H.P. motor V-belt drive; 250 ton fine ore bin; apron feed to a 4' x 11' Ruth rod mill with 75 H.P. motor V-belt drive; four Diester plat-o tables each with 1 H.P. individual motors and V-belt drive; a 4' x 11' Ruth Rod mill with 75 H.P. motor V-belt drive used as a regrind unit; a Dorr Model C Classifier with a 3 H.P. motor V-belt drive; a 2" Wilfley pump complete with 7½ H.P. motor direct connected to pump; 10, 22" Ruth Gradient flotation cells with individual 3 H.P. V-belt drive; a wet and dry Ruth reagent feeder and concentrate bins. There is an extra 2" Wilfley pump complete with motor and base, a 2000 gram Denver Equipment laboratory flotation cell and a 2000 gram Denver Equipment laboratory ball mill for test work.

The mill has been operated about six weeks. The size of the building housing the equipment is 40' x 80'. The ore bins are each 24' x 24'. There is a water tank at the head of the mill and a pump with 3 H.P. motor to pump water for the mill.

There is ample water and tailings disposal.

Mine:

The following claims have been the heavy producers, Florence, Merritt No. 2 and the Sitting Bull Tiger Tail group. The workings on the Sitting Bull extend through the Tiger Tail, Richmond Silver Tower, Grand View and Gulch claims. The distance from the portal to the back of the mine is about 1500 feet. There is a main haulage into the mine for a distance of 1000 feet and there is sufficient track and ties to complete the track to the back end of the mine. Most of the ore as exposed at present lies on the Grand View and Gulch claims and the trend of the ore is toward the Wabash and War Eagle claims. This ore is on the upper contact.

The Merritt No. 2 mine is on the lower contact and extends through the Rock Hill claim to the Custer Claim. The portal to the Merritt mine has been caved in but there is track and pipe line into the face.

The Florence mine extends for about 700 feet into the claim, track and pipe has been salvaged from the property but there is considerable ore left in the mine. This is upper contact.

The ore from the Sitting Bull and adjoining claims can be brought directly to the mill by tramway. The ore from the Merritt and Florence would have to be trucked to the mill, a distance of about a mile.

The ground is good and stands well without timbering.

Air line and water line are in the mine. An electric line was run in to the mine but there is no demand for it.

Ore:

The ore on the upper contact is a reddish brown silicious ore with some galena. It occurs in stopes ranging in thickness from 2' to 14', in width from 8' to 50', and in length it varies up to 800'. The average thickness of the ore is 6', the average stopes 25' wide and the length about 500'. The specific gravity of the ore is 3.4 (after the American Cyanamid Co.) and it takes about 10 cu. ft. in place to make a ton. The tenor of the ore is 0.08 ounces of gold, $2.80; 9.0 ounces of silver, $6.30; and two percent lead, $2.00. The weighted average of the samples taken is 0.78 ounces Au, 9.54 ounces Ag and 1.97% Pb. Total value $11.07. .078

The ore in the mine is in several blocks, totaling about 30,894 tons of ore divided as follows:

				Mostly Pay
Block 1	10,500 tons ore	Value	$ 10.10 per ton	Au .35 oz
Block 2	4,611 tons ore	Value	9.62 per ton	Ag 71¢ oz
Block 3	11,281 tons ore	Value	7.40 per ton	Pb 5¢ lb
Block 4	2,455 tons ore	Value	9.50 per ton	
Rims 1	107 tons ore	Value	9.50 per ton	
Rims 2	960 tons ore	Value	11.73 per ton	

Term rims means edge or rim of ore left after mining. In this case the remains of stopes where better ore was shipped to the smelter. Rims 1 is in Richmond Sitting Bull mine, Rims 2 in the Florence mine.

Assuming a gross recoverable value of 75% this ore has a value of $282,015.00.

Not enough work has been done in the Merritt Mine to warrant blocking out ore but the mine has been surveyed and a few samples taken which check the ore values on the upper contact.

Sampling:

In the summer of 1939 the mine was resampled with two definite view points. First to ascertain the amount of commercial ore in the mine, second to obtain as representative sample as possible for metallurgical test work. Dr. F. C. Lincoln, professor of mining at the South Dakota State School of Mines laid out the sampling method, Harold S. Ewoldt of Galena, So. Dak. had charge of the actual work.

After the preliminary sampling and the value of the ore was ascertained, a composite sample was taken from 40 different working faces for the metallurgical test work. The composite sample was cut at the rate of 5 pounds per foot, i.e. if the ore was 3 feet thick, 15 pounds of ore from that face went to the composite sample. This composite sample was crushed and mixed, then three separate samples weighing about 200 pounds each were cut out of this, one sample was sent to the Denver Equipment Co. Denver, Colorado, and the other sent to the American Cyanamid Co., Stamford, Conn. for test work. The third is stored in the offices of the Double Rainbow Mines, Inc. in a sealed can.

These three samples were known as DRA, DRB and DRC. On a separate page is the widths or thickness of the ore, the value and the weight.

Sample No.	Width	Value	Weight	
F 5	3'	$ 9.24	15#	27.72
F 6	3'	15.81	15	47.43
F 7	3'	1.58	15	4.74
F 8	3'	10.55	15	31.65
F 9	2'	15.46	10	30.92
F16	4'	6.94	20	27.76
WM1	3'	2.74	15	8.22
WM2	3'	13.85	15	41.55
R12	2'	14.70	10	29.40
R13	4'	14.91	20	59.64
R14	2'	12.04	10	24.08
R15	3'	13.45	15	40.35
R17	4'	18.23	20	72.92
H66	4'	1.26	20	5.04
R16	3'	25.87	15	77.61
H32	6'	4.20	30	25.20
R10	3'	10.01	15	30.03
D72	3'	5.95	15	17.85
D189	3'	2.25	30	13.50
H187	6'	6.20	30	37.20

Sample No.	Width	Value	Weight	
R20	3'	4.67	15	14.01
R21	3'	3.58	15	10.74
R22	3'	4.54	15	13.62
R24	3'	4.95	15	14.85
D07 & H74	6'	5.01	30	30.06
R25	2'	4.78	10	9.56
H54	3'	6.93	15	20.79
H55	3'	5.60	15	16.80
H56	3'	7.42	15	22.26
D79	4'	2.31	20	9.24
D80	6'	6.88	30	41.28
H42	6'	4.55	30	27.30
H173	4'	10.85	20	43.40
H174	4'	3.36	20	13.44
H175	4'	3.08	20	12.32
H176	3'	2.10	15	6.30
H177	4'	5.39	20	21.56
R26	3'	16.16	15	48.48
R27	2'	4.33	10	8.66
R28	2'	2.97	10	5.94
	141			1043.42

These samples were combined in the amounts given in the weights and the samples split into three separate samples with an average value of $6.77 in silver, $2.78 in gold and $1.57 in lead, total value $11.07. These are several samples that are not commercial ore but they were added to get as representative sample as possible.

Ag = 71¢
Au 35
Pb = 4¢

Cost of putting Plant in operation:

	Mine	Labor	Material
1.	Repaid and Clean Tramway	$ 150.00	
2.	Repaid and clean pipeline	150.00	$ 100.00
3.	Construct new ore raise	400.00	250.00
4.	Relay track where needed	250.00	50.00
5.	Relay air & water lines	150.00	100.00
6.	Repaid and overhaul mine cars	50.00	50.00
7.	General checking equipment	150.00	15.00
	Totals	$ 1300.00	$ 565.00
	Mill		
1.	Repaid upper rod mill	500.00	500.00
2.	Re-arrange and tear out unless machinery	500.00	
3.	Installation, freight, etc. on new machinery	2000.00	3000.00
4.	Down payment on new machinery less old machinery turned in		1500.00
		$ 3000.00	$ 5000.00

Total mine and mill	$ 9865.00
add 10% for unexpected	986.50
	$ 10851.50

Estimated working capital	4000.00
Grand total	$ 14351.50

Operating cost: 50 ton daily

Mining, development and tramming	$ 2.25
Milling	2.00
Overhead, incl. royalties	2.75
Total cost per ton	7.00

100 ton daily

Mining, development & tramming	$ 2.00
Milling	1.75
Overhead, including royalties	$ 2.25
	$ 6.00

Ore Reserves: 50 ton daily

Block 1	10,500 tons @	$ 19.19	$ 201,495.00
Block 2	4,811 tons @	9.62	46,281.82
Block 4	2,455 tons @	9.50	23,322.50
Rims 1	907 tons @	9.50	8,616.50
			$ 279,715.82

100 tons daily add

Block 3	11,261 tons @	7.49	84,344.89
Rims 2	960 tons @	11.73	11,960.80
			$ 376,021.51

Estimated Profit:

Treating	18,673 tons @	7.00 ton	$ 130,711.00
"	30,894 tons @	6.00	185,364.00
Cost of 50 ton plant			14,851.00
Cost of 100 ton plant (estimated)			30,000.00
75% of $ 279,715.82 is			209,786.86
Less cost of treating and installation of 50 ton plant			145,562.00
Profit on 50tons daily			64,224.86
75% of $ 376.021.51 is			282,015.00
Less cost of treatment and installation of 100 ton plant			215,364.00
Profit on 100 tons daily			64,651.00

75% is the amount of the assay value that can be recovered in the mill according to test runs.

From these figures it would seem that the 50 ton plant was the best investment.

Exhibit 6

Tullis

Copies		Assays			Basis of Settlement			American Smelting & Refining Co.				
Date	Net Lbs.	ozs Gold	ozs Silver	% Lead	per ozs Gold	% Silver	per Unit Lead	Treatment per ton	Net Value	Total Value	Frt.	Net Value
11/17/08	28499	0.25	7.60		19	95		4.	4.37	62.7	52.30	9.77
9/22/08	42675	.42	10.75		19	95		4.	9.29	195.44	74.38	121.06
1/22/09	31324	0.25	6.55		19	95		4.	3.91	61.86	57.40	4.64
10/15/10	27146	0.90	– 91.9	10.1	19	95	36	5.	62.88	853.47	67.58	785.97
11/21/10	44774	.05	7,4		19	95		3.	1.49	33.35	81.62	48.27*
11/29/10	23975		5.0		L.s	1 oz		3.	.81*	9.71*	52.50	62.21*
2/21/11	29119	.67	59.2	11/15	19	95	38	5.	40.54	590.24	67.55	522.69
2/27/11	27817	1.19	62.30	5.00	19	95	35	6.	49.65	690.56	67.50	623.06
2/21/11	31639	.475	65.65	14.1	19	95	38	5.	42.38	668.85	73.62	595.25
7/25/11	33469	.82	76.5	8.6	19	95	35	6.	50.93	852.29	93.92	758.37
7/26/11	11075	.62	– 190.15	29.5	19	95	43	2.	117.75	652.04	31.48	620.56
9/27/11	29478	.58	47.20		19	95		6.	28.56	420.95	52.64	368.31
10/7/11	22539	.48	132.1	21.15	19	95	38	6.25	80.79	110.46	52.47	857.72
10/7/11	28773	.42	19.05		19	95		5.74	11.74	168.90	69.00	99.90
11/14/11	43207	.37	32.8	6.45	19	95	30	6.	20.41	440.93	78.19	362.74

NOTE; Average N.Y. Quotations for Silver 55.63
" " " " Lead 4.40

****

10/22/12	34305	.08	6.57		20	63.58		4.	5.52	95.56	61.95	35.00
8/17/12	29829	.23	110.71		20	62.38		4.	10.81	165.25	53.38	50.21
7/6/12	34453	.21	22.09	1.00	20	61.18	2.50	5.74	[illegible]	301.08	61.78	148.42
5/18/12	19144	.35	35.77	3.3	20	61.38	2.50	6.		277.03		219.60
4/26/12	27672	.29	26.96	4.9	20	60.50	2.50	6.		325.13	53.02	187.02
4/26/12	1737	.83	117.88	14.1	20	60.5	2.50	4.		78.76		75.29
4/18/12	10167	.47	81.12	18.1	20	61.38	2.50	4.		330.99	83.38	257.28
12/14/11	28703	.75	19.97	1.9	20	.55	2.50	4.		183.54	53.55	72.58
2/17/12	52725	.65	17.78	3.1	20	.60	2.50			338.25	97.13	135.65
/17/12	51325	.105	20.44	3.4	20	58.50	2.50			384.68	94.15	175.18
/14/12	58680	.145	12.80		20	58.78		4.		264.95	100.98	58.61
/14/12	16948	.105	7.14	0.7	20	58.78	2.50	4.		54.31		20.41
/14/12	38276	.125	15.52	1.0	20	58.78	2.50	4.		222.57	102.57	42.50
/16/12	38448	.13	11.47	0.9	20	58.38	2.50	4.		180.03	71.05	32.08

Note: Average N.Y. Quotation for silver 59.98
" " " " lead .50

441 1,395
453 33.01
280 6.54

Exhibit 3

EXHIBIT 3

Legal Description of Land

Patented Mining Claims located in Sections 3, 4, 9 and 10, Township 4 N, Range 4 E, Black Hills Meridan, Lawrence County, South Dakota.

Merritt No. 1	- M.S.	73	Grand View	-M.S.	365
Merritt No. 2	- M.S.	133	Ora Flamme	- M.S.	384
Florence	- M.S.	163	Sleeper	- M.S.	1980
Chicago	- M.S.	334	George B. McClellan	- M.S.	2031
Sitting Bull	- M.S.	336	Gorman	- M.S.	2031
Richmond	- M.S.	345	Bank of Dakota	- M.S.	1901
Tiger Tail	- M.S.	333	Teddy	- M.S.	1901
Center Fraction	- M.S.	2030	Fissure	- M.S.	1901
Grand View Fraction			Bed Rock	- M.S.	1901
Lode	- M.S.	366	Gulch	- M.S.	1901
Silver Terra	- M.S.	364	Gray Eagle	- M.S.	1901
Mountain	- M.S.	1640	Camillus	- M.S.	1901
Custer	- M.S.	919	Margaret	- M.S.	1901
Rock Hill	- M.S.	1639	Wabash	- M.S.	1901
Savage	- M.S.	372	War Eagle	- M.S.	1901

Unpatented Mining Claim located in Section 3, Township 4 N, Range 4 E, Black Hills Meridan, Lawrence County, South Dakota.

Rattle Fraction - Book 240, Page 286, beginning at Cor. No. 1 of the Rattle Fraction Lode Mining Claim from which USLM 6 bears N 56° 49' W a distance of 1495 feet; thence East 850 feet to Cor. No. 2; thence South 400 feet to Cor. No. 3; thence West 850 feet to Cor. No. 4; thence North 400 feet to Cor. No. 1, the place of beginning.

Exhibit 4.

REPORT

ON

THE RICHMOND SITTING BULL MINE

LOCATION

The Richmond Sitting Bull Mine is situated in the Galena district of the Black Hills, South Dakota, about twelve miles south-east from Deadwood.

Deadwood is reached by the Burlington Railroad. A good road connects Deadwood to Galena, and then to the Custer Hill, where the mine is located.

A Narrow Gauge railroad is branched on the Burlington railroad at Englewood, and runs along the dumps of the Richmond Sitting Bull Mine, crossing the McLellen Claim and so giving all facilities for the supplies of the mine and economical transportation of the ore.

HOLDINGS

The Company owns sixteen claims and fractions located on Richmond Hill, near the town of Galena, which is about ten miles by wagon road from Deadwood. A Narrow Gauge branch of the Burlington railroad terminates here (Galena).

Patented Claims.		Name and Area.		
Chicago	Patent	334	4.64	
Sitting Bull	"	336	9.16	
Richmond	"	345	7.00	
Tiger Tail	"	353	4.00	
Gen. Fraction	"	2030	1.36	
Grand View	"	365	9.63	
" " Fet.	"	366	9.65	
Silver Terra	"	364	9.91	
Savage	"	372	10.04	
Custer	"	919	5.21	
McLellen	"	2031	8.96	
Corman	"	2031	9.61	Joint
Florence	"	163	10.19	
			99.80	

PRODUCTION

The mine has produced according to the books of the First National Bank of Deadwood, $410,336.00.

The Richmond Silver Mining Company operating with a small force has extracted 485 tons of silver ore, averaging $87.48 per ton producing $41,049.65.

Lately a few shipments of ore extracted in the developing work made by the present Richmond operating Company have been sent to the Omaha smelter.

GEOLOGY

The Custer Hill on which the Richmond Sitting Bull Mines are located is of Cambrian formation.

Beginning with the water edge there is a flat slate shale bed over which is a twenty-five foot duke of porphyry, protruding horizontally. One second dyke of porphyry about ten feet thick and a third one about five feel thick may be also seen overhanging the creek.

Over them the shale formation again. The whole mass of shales being about 250 feet high.

Over this mass of shales and on top of the Cambrian series is the quartzite vein carrying the precious metals, the thickness of the mineralized vein having an average of ten (10) to eleven (11) feet.

Over the vein and separating the quartzite from the limestone roof, there is a seam of soft talcy or clayey material of ½" to 1" in thickness. The thickness of the overlying Dolomitic limestone. up to the crest of the mountain, is about 400'. This limestone is stratified with seams of sand rock.

The dip of the general stratification in the country is southeast. This dip is not uniform, sometimes it dips west. The dip varies from ten degrees to a maximum incline of twenty-five degrees.

The Sitting Bull vein is a very well defined contact vein or one separating two formations.

The whole vein is mineralized, but the best ore lies in shoots of long lenticular bodies of varying thickness or width, the most and richest mineralized portion of the quartzite vein being always in the uppermost layers immediately beneath the limestone roof. There are many vertical fractures, most of them in an east-west direction which traverse the Cambrian Strata.

These fissures have considerable influence in the enrichment of the deposit. For example, where the Blind Lode crosses the main vein, the quartzite has undergone a change and the Galena becomes richer.

DESCRIPTION OF THE MINE

The mine workings consist of a series of four main tunnels. The main drift-- Lover Header -- Blacksmith Tunnel-- and McLellan Tunnel-- all going in the north-south direction and connected by numerous secondary drifts or cross-cuts running in a east-west direction.

With the exception of the entrance of the main tunnels and for only about fifty feet, the workings are not timbered, the roofing rock being found firm and massive everywhere. At the entrance of the tunnels, like in all other ledges situated on the side hill there are a few breaks over the first few feet near the surface, this settling or breaking of the ledges having been caused by the surface weight of the side hill.

There a pocket of rich ore has been encountered the inclines have been widened into stopes and pillars of ore have been left capable of holding up the roof.

All the main galleries are flat or only slightly inclined in a direction south. Their height varies from six to twelve feet, so that a horse may draw out the ore.

A compressor and a net of pipe lines deliver the fresh air to any point of the mine. The workings are also ventilated by the air draught of the Richmond Shaft, which is connected with nearly all the workings by the tunnels and crosscuts.

There is no trace of water in all the mine except at the entrance, where there are some infiltrations from the surface water which filters through the breaks of the ledge.

The length of all the tunnels and cross-cuts may be estimated to over two miles.

The Richmond Shaft, which is 50' west of End Line of the Tiger Tail Claim, has been sunk 100' through limestone rocks stratified with seams of sand rock and Dolomite before the vein was reached.

The tunnels and all the workings in general are mineralized from the Limestone roof to the shale foot wall, and the mineralization commences at the front of the workings extending into the mountain from the surface and continues the entire distance covered by the tunnels. The inclination of the vein is slightly downwards with the exception of the mouth of the main tunnel which is flat. The best values being in the three or four feet of the upper layers.

The Dolmitic Limestone cap rock is smooth and the contact very distinct, the cap rock is separated from the quartzite by a seam of soft material.

In the workings of the Sitting Bull Claim following the main drift, the vein is composed of quartzite mineralized with Galena, carbonate of Lead and Chlorites and Sulphuretts of Silver, the distance between the hangings in the foot wall varying from 11 to 12 feet, sometimes 16 feet. This part of the mine is mostly a Silver Lead mine. About $240,000.00 have been spent on the development work. (Main drift, Fort drift, Dankake and Bline Lode). By looking at the map enclosed in the present report one can see that the Richmond Tunnel has been drifted so that it would intercept the operations in the Sitting Bull Claim, in fact the distance between the extremity of Fort Drift and the Richmond Tunnel in Center Fraction is only a few feet (about 10 ft.)

A systematic sampling of that part of the mine on 37 bags of 50 lbs. each gave an average of thirty-five ounces of silver per ton. Assays averaging 800, 1300 and even 5000 ounces of silver per ton have been frequent. Values in gold from $2.00 per ton and up.

Following further on the main drift, we find a body of ore in which the Fort Drift is run, the ore has changed and contains less, sometimes no lead and more iron. This body of ore extends from foof to foot of vein.

Following the main drift to the south end in the Grand View Claim, where the Bad-Air drifts, Hastings and Morrison drift are opened, we find many good veins with little lead, the ore having a value of about $35.00 per ton (gold $12.00 to $15.00 per ton, silver 30 to 40 ounces per ton).

~~The Bad-Air Drift will be later on comment~~

The Bad-Air drift will be later on connected to the West drift, (distance at the present time about fifty feet) and then a good ventilation will be established. This drift is also in a massive vein of ore. Starting from the entrance north of the Blacksmith tunnel, one is again in the Silver mine, the Galena showing everywhere and increasing in quantity and value until one reaches the B Blind Lode fissure where a shaft has been sunk and abandoned. The roof as we come to it suddenly rises and what has the appearance of a vein, crosses the main working tunnel at nearly a right angle. Here the roof is thrown up about three feet.

In descending in the shaft is found;

A gauge of a few inches
10" of Chloritic shale
Quartzone shale with fossils
35" below a dyke of porphyry 4½" thick
Calcareous shale.

Going down in this cross vein the ore became poorer and poorer until nothing was found in it.

In the region of the vein east of the Blacksmith shop drift, the ore changes gradually, lead becoming scarce, it may be defined as a low grade gold and silver mine (average gold $3.00, Silver 6 to 20 ounces). Many rich pockets or benches of pipes of rich ore are found in the vicinity of what is known as the Chloride workings with values of Gold $15.00 and Silver 60 ounces.

Going further southeast, the Galena and Carbonates of Lead re-appear and the proportion of gold increases, some rich values having been found near the East end of the Richmond drift. ~~This drift entirely located~~ Finally some very good ore has been found in the Havens drift. This drift entirely located in the Silver Terra claim dips to the east with an inclination increasing as you proceed further east (inclination at the end 27 degrees). It runs in a mass of ore where values of gold $20.00 and Silver 80 ounces, Lead 10 to 15 per cent are found near the roof and a good low grade ore with a total value of about $15.00 in gold and silver in the lower layers.

In this region the mine develops into a real gold mine with very alluring prospects. There is an enormous body of ore so developed by the Havens drift in a virgin part of the mine.

To summarize the general condition of the Mine--- It is a mine well developed and which can easily be worked. All the tunnels and crosscuts are in good condition and no difficulties of any kind, water, faults, ventilation etc. are encountered. The vein is continuous, very well defined and is easily followed.

It seems the mine can be divided in three zones;

ZONE No1. Silver Lead mine in the north western portion of the mine, including the Richmond drift, the Pankake, Main drift, Chlorides working and limited to the south by the Blind Lode.

ZONE No.2 Low grade Gold Silver mine including a large diagonal running from north west to south west of the mine from the lower header to the south west extremity of the main drift.

ZONE No3 The Gold mine developed in all the regions south-east of

the mine with values increasing as you proceed east.

ORE IN SIGHT

The body of ore in sight developed by the workings extends over a surface of about 1200' x 1200' and may conservatively estimated to over 1,500,000 tons.

This valuation includes only the ore developed in claims Sitting Bull, Tiger Tail, Grand View and Fractions, Silver Terraand Eastern part of Richmond. There is no doubt in my mind that the vein extends under the whole Richmond claim, Custer, Savage, Gorman and part of the McLellan.

Also this valuation does not include the Florence mine nor part of the dumps.

It is nearly impossible to assign an average value to such a mass of different ores. Only a very careful and exhaustive sampling could give an approximate idea. It is also a fact that it is impossible to judge accurately by the eye the value of the ore in this vein. Two pieces of ore having exactly the same appearance will given when assayed values of considerable difference.

In order to give an approximate idea of the values of ore, I have copied the records of ten shipments of ore extracted at different points in the mine and shipped lately to the American Smelting & Refining Co. at Omaha or Denver.

I have reported on the map the locations from where shipments were extracted, the numbers encircled correspond to the number of the shipments. These locations were indicated to me by Mr. C.B.Harris, Manager of the Mine and by Mr. Alfred Dany, Foreman. They were verified by myself in the examination of the mine.

As these shipments represent the proceeding from drifting or from connecting some of the cross-cuts, and as they englobe some large quantities of ore, they will give a far better idea of the value of the ore than any hasty or fancy sampling. They will give also an approximate idea of the proportion between first and second grade ore.

SHIPMENT No.1 Location; Chloride drift, First Grade ore.

Gold	$18.00	
Silver	91.4	ounces
Lead	10.	per cent

Net value per ton $67.88 $ 142.00

Total weight of shipment 27420 lbs.

SHIPMENT No.2 Location; Same as above, Second grade ore.

Gold	$ 1.60	
Silver	24.75	ounces
Lead	Nothing	

Net value per ton $14.50

Total weight of shipment 55,000 lbs. 27.07

8-65. 31.20

SHIPMENT No.3 Location; Mouth of Main drift.

Gold 2.20
Silver 16.85 ounces
Lead Nothing
Net value per ton $10.94 20.57
Total weight of shipment 58,506 lbs. 8-65 24.00

NOTE The gangue was pure quartzite with 55% Silica and 21% iron.

SHIPMENT No.6 Location Water Drift, High grade ore.

Gold $12.40
Silver 190.15 ounces
Lead 29.5 per cent
Net value per ton ------- $118.75 270.23
Total weight of shipment 11,075 lbs.

SHIPMENT No.7 Location; Same as precedent, Second grade ore.

Gold $16.40
Silver 76.5 ounces
Lead 8. per cent
Value per ton --------- $56.93 120.30
Total weight of shipment 33,469 lbs.

SHIPMENT No.8 Location; South end of East drift.

Gold $ 9.60
Silver 33.37 ounces(value 0.54 per oz)
Lead 11. % (at $2.50)
Value per ton ---------- $35.10 71.60
Total weight of shipment 11,423 lbs.

SHIPMENT No.9 Location; End of Havens drift, First grade ore.

Gold $16.60
Silver 117.88 oz. (value 0.60½)
Lead 14. % (2.50¾)
Value per ton ---------- $78.76 174.0
Total weight of shipment 17,037 lbs.

SHIPMENT No.10 Location; Same as precedent, Second grade ore.

Gold $1.35
Silver 21.93 oz (value 0.60½)
Lead 2 %
Value per ton ---------- $16.00
Total weight of shipment 28,051 lbs. 28.20

SHIPMENT No.11 Location; South end Main drift.

Gold	$13.20		
Silver	36.54 oz at (.64)		
Lead	3.9 %		
Value per ton ----------		$36.18	66.70
Total weight of shipment	17,450 lbs.		

SHIPMENT No.12 Location; Lower Header in Tiger Tail Claim.

Gold	$18.80		
Silver	54.2 oz.		
Lead	8.36 %		
Value per ton ----------		$42.50	103.80
Total weight of shipment	84,182 lbs.		

We must also put on record here the general sampling of the zone defined as Silver Mine. 37 bags of 50 lbs. each taken in all the points of the mine exposed at the time, and which gave an average of 35 ounces of Silver.

35 x .60 $21. per ton for the whole mass.

Values in gold were of nearly no consideration and note recorded in this sampling although they amount to about $2.00 per ton.

From a careful examination it may been seen that about one-third of the ore is high grade and two-thirds second grade. In my estimation the value of the ore body in sight must run between $10,000,000 and $20,000,000.

THE ORE AND THE DUMPS

The ore, as previously stated, is very difficult to sort by hand, and it was in this way that from the beginning the shipments were made. At that time the Burlington railroad did not exist and the ore had to be carted to the Smelter at Omaha, and only ore of a value of $65.00 per ton was considered as paying ore of sufficient value to pay t the expenses of transportation and treatment.

I have also mentioned the fact that there are in the mine numerous shoots and pipes of richer grade ore which are erratic and not very large. When the vein is mined as whole they are of sufficient value and in sufficient quantities to enrich the whole mass, but not in sifficient quantities to be practically sorted by hand.

These conditions made the dumps of the Richmond very valuable. There are four dumps on the side hill of the Richmond mine, the total amount of tonnage may run anywhere from 150,000 to 200,000 tons with a value of $5.00 to $8.00 per ton as a conservative estimation.

Two cars of the ore of the dumps were sent to Denver and here is a copy of the returns of the Smelter.

SHIPMENT No. Location From Big Dumps.

Gold	$5.00
Silver	7.6 oz
Lead	Nothing
Value per ton ---------	$8.37

Total weight of shipment 28,500 lbs.

SHIPMENT No.5 Location; From Big Dumps.

Gold	$5.00
Silver	6.55 oz
Lead	Nothing
Value per ton ---------	$ 7.95

Total weight of shipment 31,352 lbs.

These two shipments made at different dates and from different spots in the dump show a nearly constant value which permit safely the average value of the ore from the dumps at $5.00 per ton.

TREATMENT

Gold is distributed in the ore in a very fine state. Some samples, which when assayed, gave values as high as $16.00 did not show practically any colors when panned. The dry ore will have to be ground very fine for treatment by the cyanide process and even then the consumption of KCN per ton will probably be a little higher than usual.

From experiments made by Mr. Howell Clevenger, Palo Alto, Cal. The consumption of KCN amounts to about 3 lbs. per ton of ore treated with an extraction of 82%. The ore was ground to only 100 mesh. Better results would be obtained by grinding finer.

CLAIMS

The claims belonging to the Richmond Operating Co. are the following;

Ore Flam Claim. I call here special attention to a very important point. As reported above, the region of the mine developed by the Havens drift is the one which at the present time attracts the greatest interest. As such a rich gold mine has been shown to be there and as the values seem to increase as we proceed further east into this drift.

Florence Mine The Florence Claim is separated from the Richmond Mine and is entirely surrounded by the properties of the Branch Mint Co. The Florence mine is a small silver mine by itself, the vein having a thickness from four to five feet.

The ore is a refractory Siliceous ore mostly Chloride of Silver, Horn Silver with Sulfuretts, Galena and even Native Silver. The gangue contains more iron than the Sitting Bull ore, also Manganese and Pyrites. Some parts of the mine gave values in gold averaging $10.00 to $15.00 and even $20.00 per ton.

The ore from this mine is a milling ore and as it could not be treated at the time that the mine was operated, a big dump resulted which at a low estimate can be valued to $75,000. Here is a copy of a shipment made from this dump.

SHIPMENT FROM FLORENCE MINE DUMP

Gold	$8.40		
Silver	10.75 oz	(at 0.52)	
Lead	Nothing		
Value per ton		----------	$13.29
Total weight of shipment	62,075 lbs.		

NOTE: This ore contained 75% silica and 10% iron. 24.90

MILL SITE

There is a very fine mill site on the property in the Geo. McLellan Claim near the railroad.

SUPPLY OF WATER

Plenty of water can be obtained from the Bear Butte Creek and also from the Artesian wells which are numerous in the vicinity.

POWER

Any amount of electric power can be supplied by the Consolidated Light & Power Co. of Deadwood. Current is 11,000 volts with transformers at 450 volts.

The price of the current is two cents per kilowatt hour. This price can be reduced if large power be required.

LABOR

There is plenty of good and skilled labor available in the district at from $3.00 to $3.50 per day of eight hours. One must not forget many mines are operated in the region, among then the Homestake Mine. Gilt Edge Maid, Branch Mint, Wash #2, Golden Crest, Horseshoe, Golden Reward, etc. and the Richmond Mine has always been a favorite among workman on account of its safety.

SMELTER

A smelter of 150 tons daily capacity and possibilities for increase for 300 tons, has been recently built near the east end of the McLellan claim by the Black Hills Smelting Co.

I consider this fact as greatly beneficient to the Richmond itself, the milling ore in the cyanide plant which will have to be erected.

LOWER VEIN

My attention has been called to the possibility of the existance of a lower vein three hundred feet under the Sitting Bull. This vein is exploited in other mines in the vicinity.

CONCLUSION

In concluding, I beg to submit that this property is an absolutely safe and profitable proposition, which under proper managment must give some very high returns.

I trust that this report and the adjoining map covers all the main features of the Richmond. The originals of all the documents referred to may be obtained from Mr. C.B.Harris, owner of the mine and if needed, I will be glad to give further explanation.

(Signed) Jos. Boreo.

Dated Feb. 13th, 1913.

Figure 10

DIAMOND DRILLING

HOLE NO. 6 COMPLETED _____ LOG BY APG, WRH 10-65

LOCATION Double Rainbow (Newpoint) COLLAR ELEVATION 5029.9

SCALE DIRECTION 1" = 50' VERTICAL ANGLE 90°

DEPTH	FORM	LITHOLOGY	INTERVAL	MINERALIZATION	SURVEY
		No Core			
73					
105		32' QTe Dol, Shale partings			
132		27' Sandy Dol - SS			
142		10' Brn porous Sandstone			
175		33' Brn Dol QTe, Shale partings			
224		49' Brn-Gry Sandy Dol, Shaly zones, Cong zones			
231		7' Gry-Pink Feld Porp			
279		48' Brn-Gry Sandy Dol, Shaly beds, Cong zones			
289		10' Gry shale - few Ls Pebbles			
291		2' Gry Feld Porp			
341		50' Gry Shale W/ Ls Cong			
345'6"		4'6" GRY-Pink Sdy Dol Cong			
352'6"		7' Gry Shale			
356		3'6" Gry Shale W/ Feld fragments			
359'6"		3'6" Gry Shale			
419		59'6" Gry Feld porp, mod Alt			
434		15' Med Gry shale			
462		28' Gry Shale W/ Ls Cong			
466		4' Gry Sdy Dol py Noted		SAMPLED	
477		11' Gry QTe, Py, Galena Noted		SAMPLED SAMPLED	
479		2' Gry Feld Porp			
489		10' Gry QTe, Py, Sphalerite Noted			
564		75' Gry Feld, Ampb Porp			
578		14' Gry QTe W/ Shale Partings			
619'		41' Gry Feld Porp, Scattered Py		SAMPLED	
				SAMPLED	
				SAMPLED	
667		48' Gry Sandy QTe, Shale partings		SAMPLED	
670		3' Gry-Pink Sandy Dol Cong			
676		6' Med Gry MICA, Gar Schist			
BOTTOM					

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COPY
O. M. E.
RECEIVED
MAY 23 1966
INITIALS/CODE

Figure 8

DIAMOND DRILLING

HOLE NO. 2 COMPLETED _____ LOG BY APG - JTW 10-65

LOCATION Double Rainbow (Newmont) COLLAR ELEVATION 5040.6

SCALE ~~DIRECTION~~ 1" = 50' VERTICAL ANGLE 90°

DEPTH	FORM	LITHOLOGY	INTERVAL	MINERALIZATION	SURVEY	
		NO CORE				
51						
		19' Brn-Pink Sandy Dolomite				
70				SAMPLED		
72		2' Gry QTe				
78		6' Brn-Pink Sandy Dolomite		SAMPLED		
				SAMPLED		
				SAMPLED		
125		47' Buff QTe & SS				
137		12' Brn-Gry Dol & Dol QTe				
141		4' Feld Por - Altered				
145		4' Brn-Gry Sandy Dol				
150		5' Gry QTe				
				SAMPLED		
		54' Brn-Gry Sandy Dol With Ls Cong				
204						
225		21' Gry Feld Por				
255		GRY Interbedded dol & 30' Shale, Cong in Part				
		No Core				
350						
352		2' Gry Shale				
412		60' Feld Por, Gry				
423		11' Gry Shale				
442		19' Gry Dol, Shale Cong				
444		2' Gry Shale				
449		5' Gry Shaly dol				
462		13' Gry Dolomite				
				SAMPLED		
472		10' Gry QTe, Py		SAMPLED		
				SAMPLED		
565		93' Gry Feld Por, Py 500'-503'				
				SAMPLED		
590		25' Gry QTe, Minor Py		SAMPLED	3.0' - 0.08 oz Au, 9.34 oz Ag	
599		9' Gry Feld Porp, Py noted 599-609 Py				
609		10' Gry Dol QTe		SAMPLED		
610		1' Rhyolite Porp?		SAMPLED		
616		6' Mic Phyllite & QTe				
BOTTOM						

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Figure 9

DIAMOND DRILLING

HOLE NO. 5 COMPLETED _____ LOG BY APG, JTW 10-65

LOCATION Double Rainbow (Newmont) COLLAR ELEVATION 5064.4

SCALE ~~DIRECTION~~ 1" = 50' VERTICAL ANGLE 90°

DEPTH	FORM	LITHOLOGY	INTERVAL	MINERALIZATION	SURVEY	
		No Core				
68						
72		4' Brn-Pink Sandy Dolomite				
77		5' Brn-Gry QTE		SAMPLED		
92		15' Brn-Pink Sandy Dolomite		SAMPLED		
117		25' Gry-Pink QTE				
122		5' Brn-Gry Sandy Dolomite				
128		6' Gry Feld Porp, highly Altered				
211		Brn-Gry QTE Dol, Shaly 83' Beds, Cong zones				
222		11' Gry Feld Porp, Ampth? phenO				
255		Brn-Gry QTE Dol, shaly 33' beds, Cong zones				
285		Gry Shale with interbedded 30' Cong & sdy dol				
290		5 Gry Shale, Trace Py				
318		28' Gry shale w/ Ls Cong				
326		8' No Core				
338		12' DK Gry Shale				
400		62' Gry Feld Porph, mod altered				
408		8' GRY Shale, Py Noted				
438		30' GRY Shale w/ Ls Cong				
447		9' Gry dol w/ shale Partings				
464'6"		17'6" Gry QTE, Py & Sphalerite		SAMPLED SAMPLED SAMPLED		
568		103'6" GRN/GRY Porp - Amph, Feldspars				
591		23' Gry QTE, shale partings, Py				
598		7' Gry QTE, Py throughout		SAMPLED		
658		60' Gry Feld Porp, mod Alt				
661		3' Grn/Red Mic, Chl Schist				
BOTTOM						

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MAY 23 1966

INITIALS	CODE

Figure 7

DIAMOND DRILLING

HOLE NO. 1 COMPLETED _____ LOG BY ALS - WH - APG 10-65

LOCATION Double Rainbow (Newmont) COLLAR ELEVATION 5052.7

SCALE ~~DIRECTION~~ 1" = 50' VERTICLE ANGLE 90°

DEPTH	FORM	LITHOLOGY	INTERVAL	MINERALIZATION	SURVEY
		No Core			
84					
85		1' Light gray shale			
89		4' Brown quartzitic ss.		Sampled	
100		11' Brown dolomitic ss.			
107		7' Brown quartzitic ss.		Sampled	
109		2' Brown sandy dolomite			
135		26' Brown quartzitic ss.			
140		5' White altered Por.			
168		28' Yel-brn sandy dolomite			
169½		1½' Fine-gr silicious rock		Sampled	
174		4½' Brown sandy dolomite			
194		Sandy dolomite, flat 20' pebble cong. in part			
221		27' Interbedded gray sh & dol, flat ls. pebbles			
231		10' Gray Por.			
266		35' Gray dolomite, shaly bds, few flat pebbles			
325		59' Dark gray shale, few flat pebbles			
329		4' Gray to pink ls.			
332		3' Dark gray shale			
346		14' Massive gray sh.			
414		68' Coarse feld Por.			
419		5' Gray shale			
441		22' Gray shaly ls. cong.			
460½		19½ Gray dolomitic ls.			
462½		2' Gray silcious rock		Sampled	
465		2½' Msv py, some galena		Sampled Ore	2.5'-0.16 oz Au, 10.41 oz Ag
467½		2½' Msv py, abund galena		Sampled Ore	2.5'-0.22 oz Au, 401.11 oz Ag
472½		5' Gray fine qte, some py		Sampled	
476		3½ Gray fine qte, some py			
485		9' No Core			
534		49' Feld Por, part altered & soft			
537		3' No Core			
573		36' Por. part altered			
579		6' Gray fine qte			
586		7' Coare feld por. py			
				Sampled	
601		15' Gray mottled qte			
607		6' White coarse qte.		Sampled	
610		3' Gray qz cong. abund py			
		Pre-Є schist, qte		Sampled	
650		40' & vn qz			
				Sampled	
694		44' Por			
720		26' Mic sch & qte			
Bottom					

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INITIALS	CODE

EDWARD L. TULLIS

Figure 14

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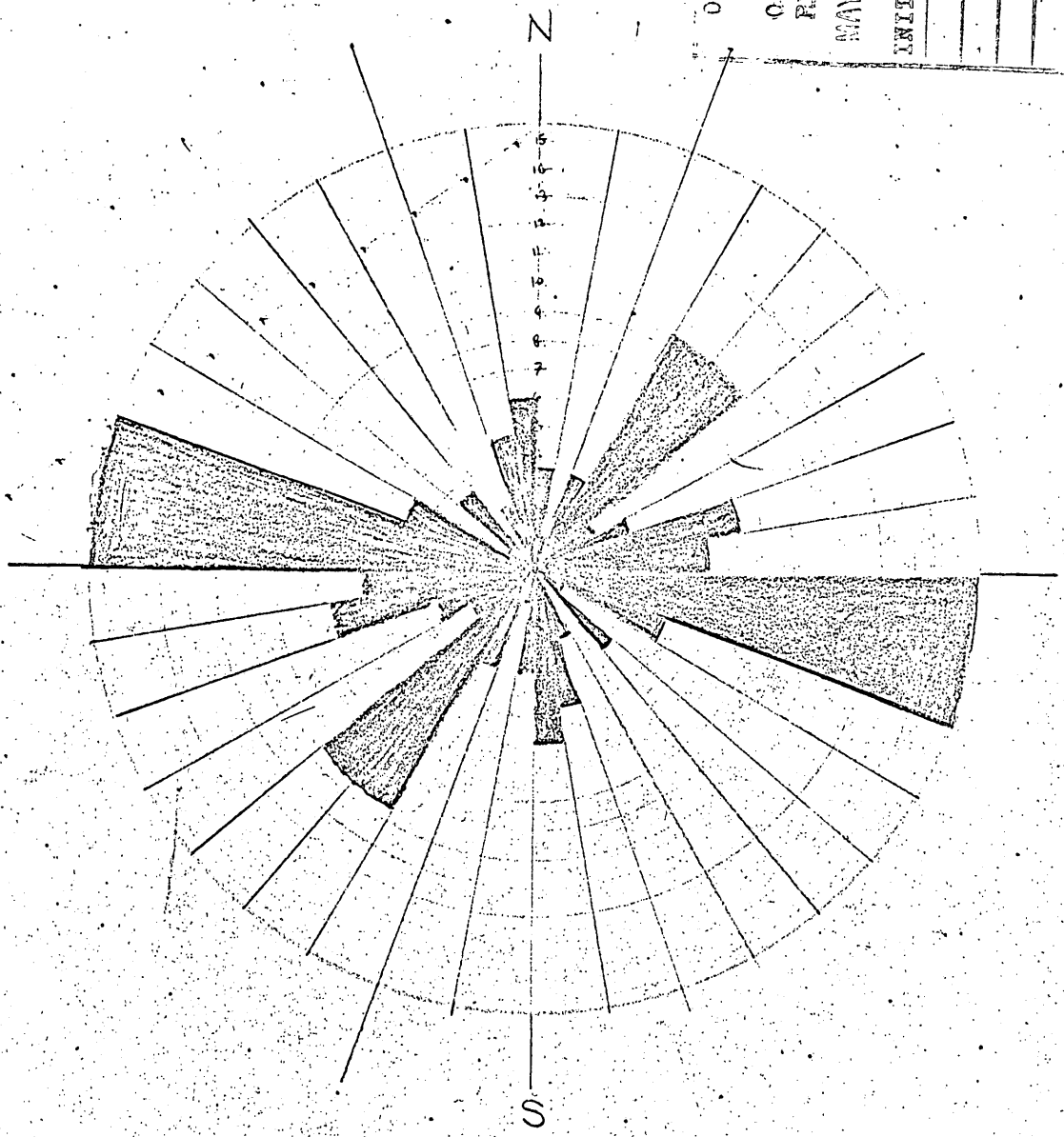
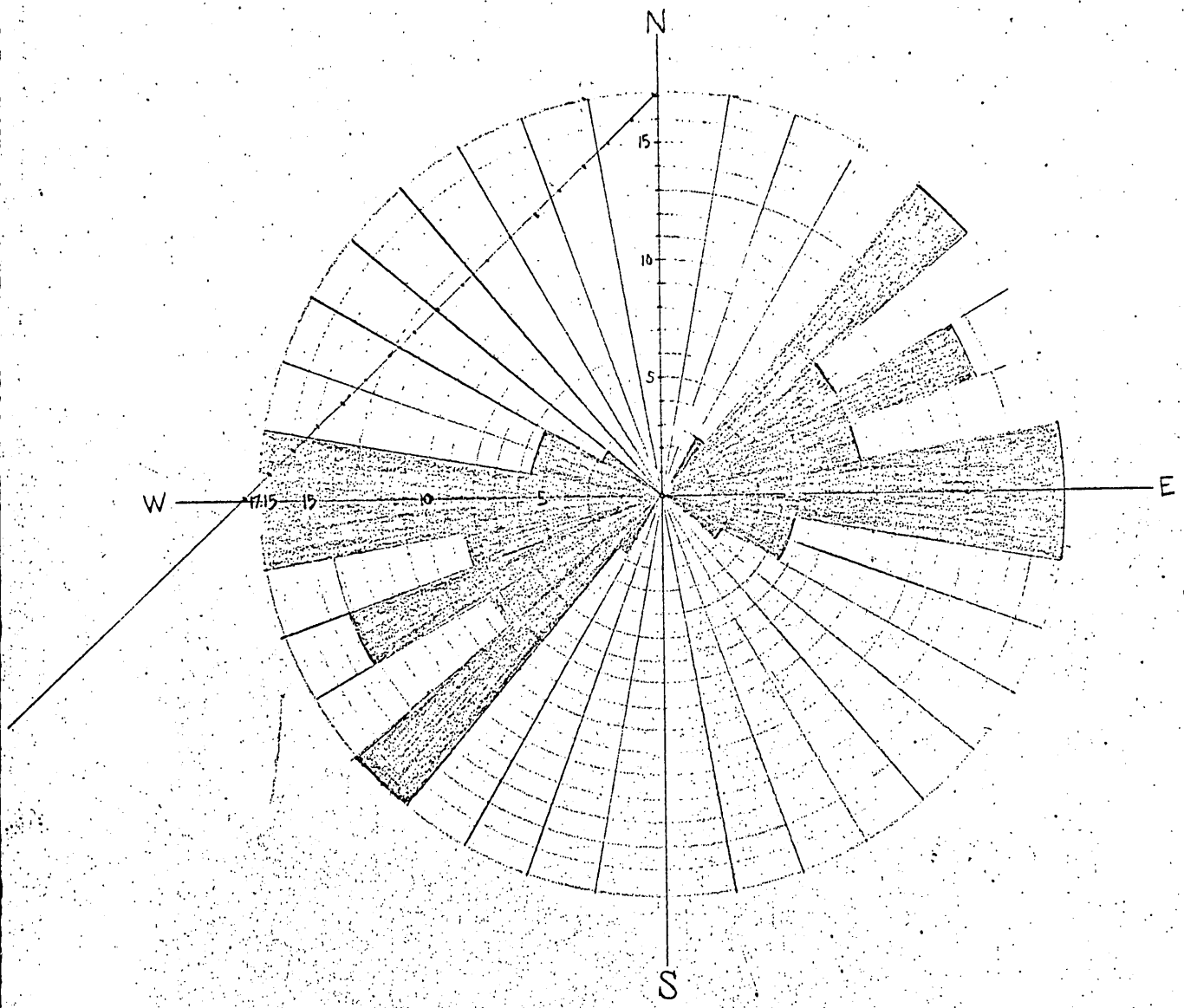
INITIALS/CODE



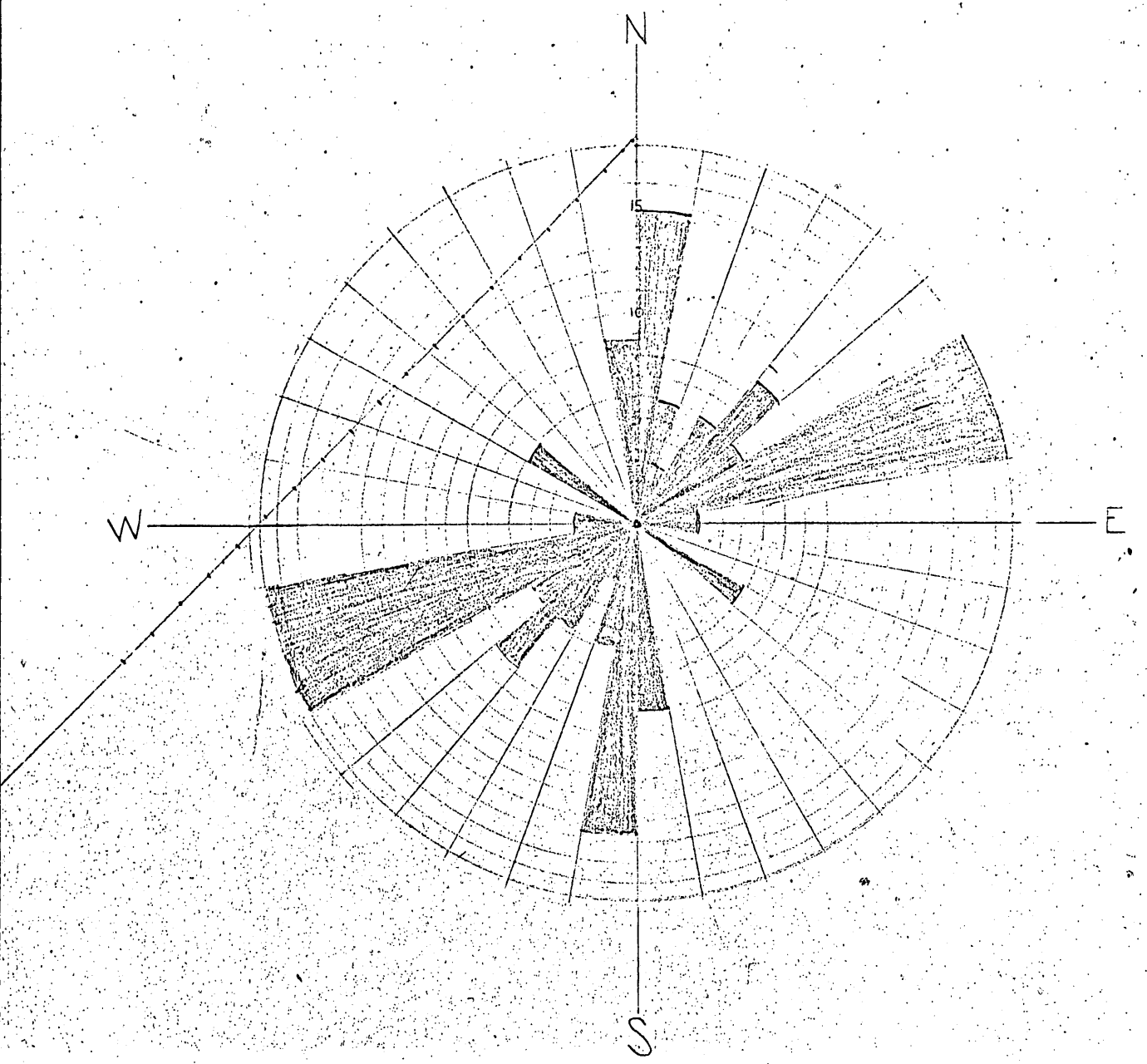
RICHMOND

EDWARD L. TULLIS



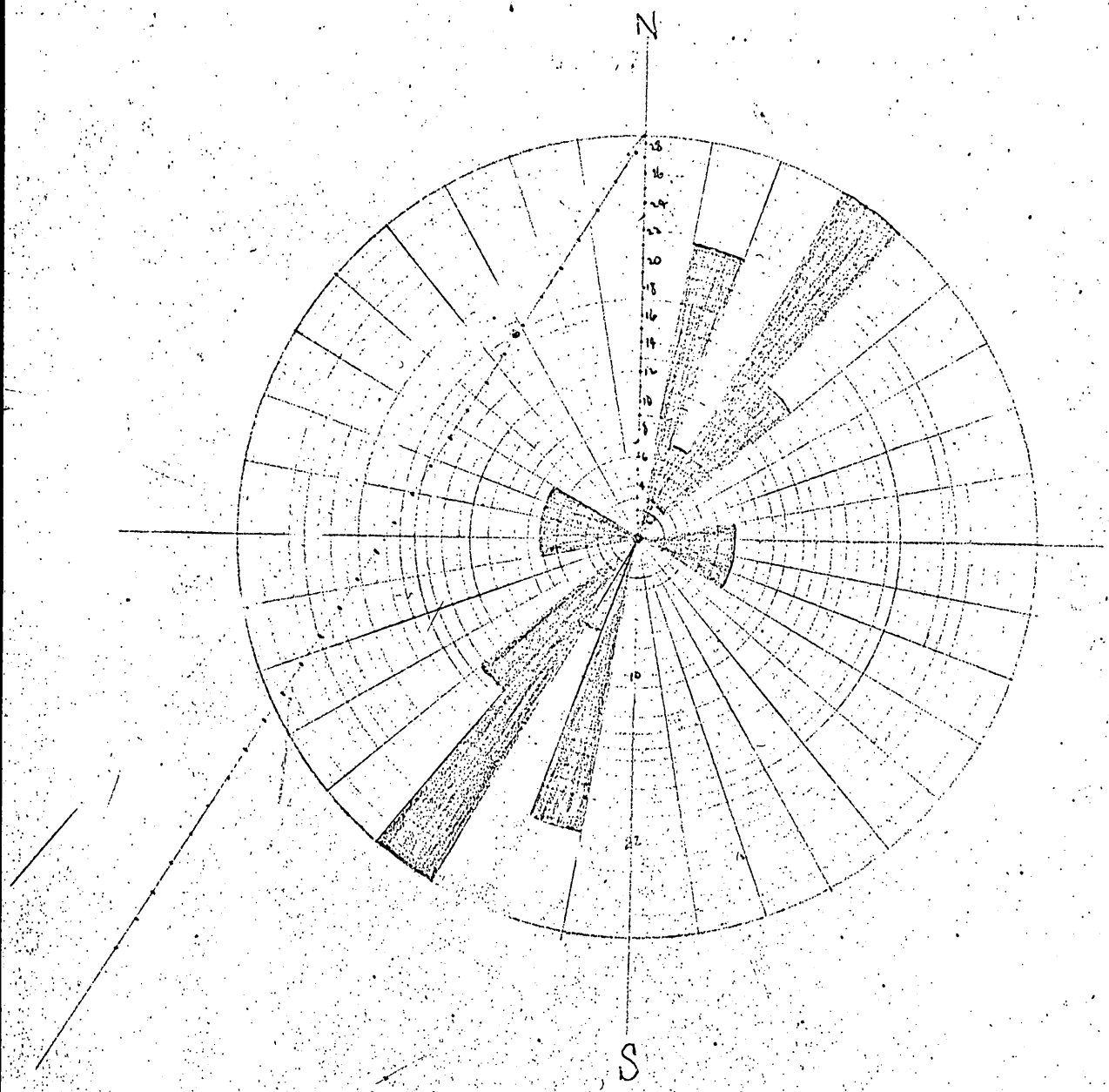
Marritt No. 2

EDWARD L. TULLIS



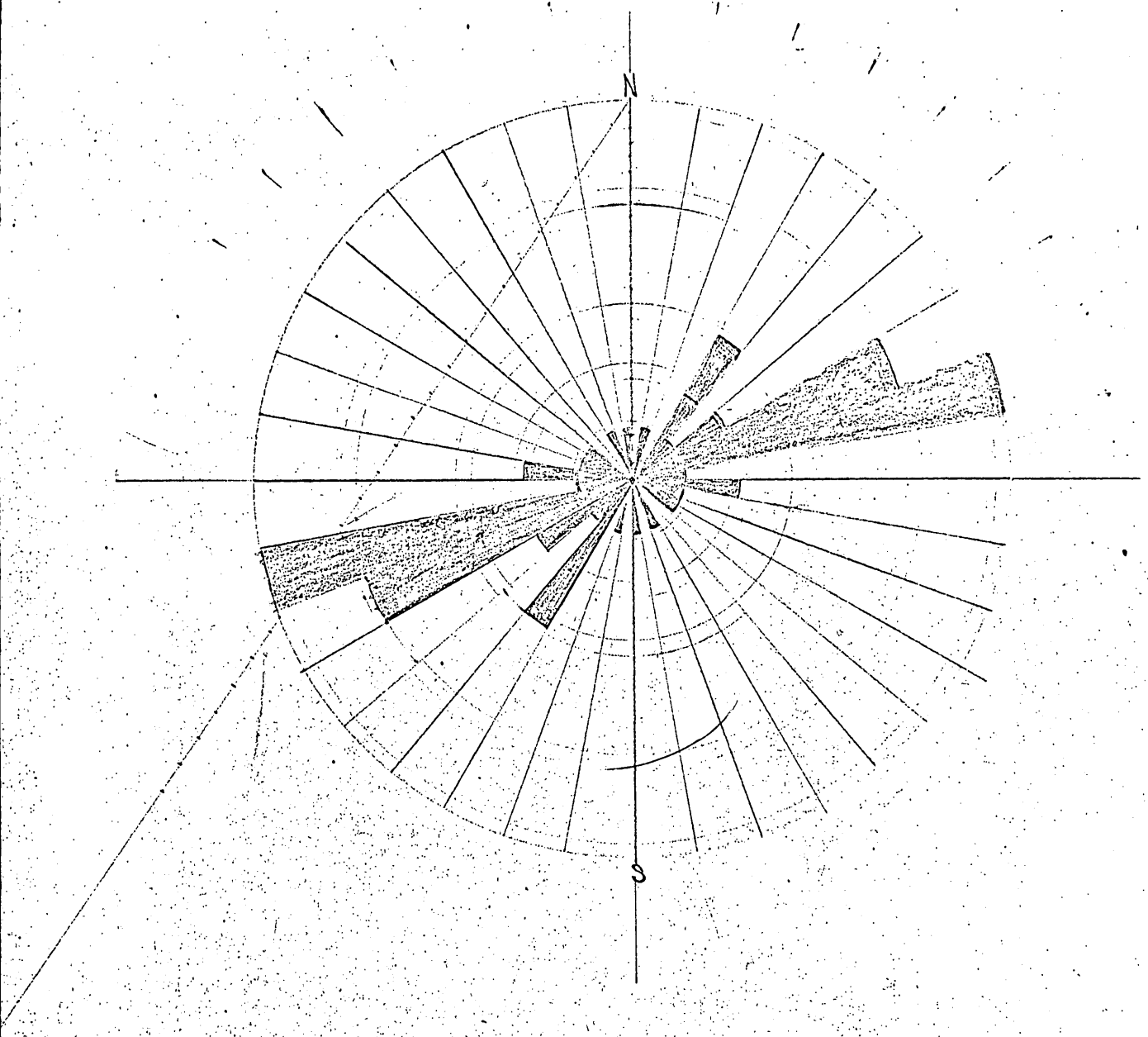
Florence District

EDWARD L. TULLIS



War Eagle & Savage

EDWARD L. TULLIS



Hayes District

Exhibit 19

December 14, 1965

Little Beaver Mining Company
Lead, South Dakota

METALLURGICAL TESTING GALENA ORE

PURPOSE OF TESTS:-

To determine the extraction of silver and gold from a series of the higher value samples taken at the Galena project.

PROCEDURE:-

200 gram were taken from the following samples. 4 - 5 - 8 - 10 18 - 20 - 25 - 27 - 28 - 32 - 34 - 37 - 40 - 48 - 52 - 53 and 55. These were composited into one sample for subsequent cyanidation tests. The composite sample assayed .124 oz/T of Au and 11.30 oz/T Ag. Tests were run at various grinds and at several times of contacts. The solution strength used was .12% NaCN and .24% CaO. chemicals were added when needed during the tests.

CONCLUSION:-

1. A short time of contact seems to give as good an extraction of the gold and silver as the longer time.

2. Finer sizes gives good recovery expecially in regard to the silver. The best grind seems to be around 70% -200 mesh.

3. The chemical consumption is rather high, but a .12% NaCN solution was used, and it may be that a lower strength could be used, but usually for silver recovery it does take a higher cyanide strength.

4. The ore seems hard to grind, especially when trying to grind finer then the Quartzite size.

Work done by:-
Harold Hinds
Renaldo D. Gallo

Renaldo D. Gallo
Plant Metallurgist

RDG/e

TABULATED DATA OF TESTS MADE

Test No.	Chem NaCN Lbs/T	Cons CaO Lbs/T	Ph End Of Test	Assays Au Sol Oz/T	Tails Oz/T	Calc Hds	% Rec	Assays Ag Sol Oz/T	Tails Oz/T	Calc. Hds	% Rec	Sizings - Mesh + 80	+ 100	+ 150	+ 200	- 200
24 Hour Contact - Cyanide Test																
1.	7.6	10.35	9.8	.115	.012	.127	90.6	10.310	5.064	15.374	67.1	0.0	0.4	4.4	16.7	78.5
2.	7.9	10.35	10.2	.142	.012	.154	92.2	10.429	4.186	14.615	71.4	0.0	0.0	0.0	2.1	97.9
48 Hour Contact - Cyanide Test																
1.	7.4	17.8	9.7	.115	.024	.139	82.0	9.838	7.158	16.996	57.9	27.8	17.2	14.7	9.0	31.3
2.	7.0	17.4	10.1	.093	.018	.111	83.8	9.121	5.586	14.707	62.0	27.8	17.2	14.7	9.0	31.3
1.	7.0	17.4	9.7	.115	.015	.130	86.0	10.479	5.814	16.293	64.3	23.8	11.4	16.3	8.5	40.0
2.	7.3	17.4	10.3	.093	.015	.108	86.1	9.433	5.688	15.121	62.4	23.8	11.4	16.3	8.5	40.0
1.	8.5	15.5	10.4	.126	.022	.148	85.1	10.562	4.224	14.786	71.4	0.0	0.0	10.7	21.3	68.0
2.	9.9	17.5	10.8	.097	.024	.121	80.2	11.034	4.347	15.381	71.7	0.0	0.0	0.0	3.3	96.7
96 Hour Contact - Cyanide Test																
1.	9.2	23.1	11.2	.115	.027	.142	81.0	10.213	5.592	15.805	64.6	10.1	14.0	20.1	14.0	41.8
2.	8.4	23.1	11.6	.098	.024	.122	80.3	9.982	5.742	15.724	63.5	10.1	14.0	20.1	14.0	41.8
1.	5.5	23.1	11.8	.101	.021	.122	82.8	9.226	5.763	14.989	62.6	5.4	12.3	20.5	16.2	45.6
2.	7.7	23.1	11.6	.122	.018	.140	87.1	10.587	5.126	16.723	63.3	5.4	12.3	20.5	16.2	45.6
1.	8.6	16.1	10.4	.083	.024	.107	77.6	10.047	4.473	14.520	69.2	0.0	0.4	8.7	5.2	85.7
2.	9.8	17.0	10.8	.119	.010	.129	92.3	10.310	3.329	13.639	75.6	0.0	0.0	0.0	1.0	99.0

Tullis

Exhibit 17

WAR MINERALS REPORT

UNITED STATES DEPARTMENT OF THE INTERIOR * BUREAU OF MINES

Report of the Bureau of Mines to Hon. Harol L. Ickes,
Secretary of the Interior

- Initial Report -

THE GALENA MINING DISTRICT
Lawrence County, South Dakota

- Lead, Silver, and Zinc -

Respectfully submitted,

September 16, 1942.

Paul E. Pesonen,
Mining Engineer.

WAR MINERALS REPORT

UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

Report of the Bureau of Mines to Hon. Harold L. Ickes
Secretary of the Interior

- Initial Report -

THE GALENA MINING DISTRICT
Lawrence County, South Dakota

- Lead, Silver, and Zinc -

List of References

1. Irving, J.B., "Economic Resources of the Northern Black Hills," U.S.G.S. Prof. Paper#26, pp. 169-171.

2. Connolly, J.F. and O'Harra, C.C., "The Mineral Wealth of the Black Hills", South Dakota School of Mines Bulletin #16, pp. 188-198.

3. Lincoln, F.C. "Preliminary Report on the Double Rainbow Mine", to Mr. De Wolf Barton, Owner.

4. Ewoldt, H.B. and Watkings, V.L., "Report on the Silver Queen Mine", to Messr's. Stewart and Thompson, owners.

5. Ewoldt, H.B. "Some Notes on the Flat Formation in the Bear Butte Mining District, Lawrence County, South Dakota", to Mr. J.H. Hodges, 5/25/42.

6. Barton, D.Wolf, owner of Double Rainbow Mine. Private communication to U.S.Bureau of Mines engineer.

7. Reports of Analyses of 218 samples from the Richmond-Sitting Bull Mine. Bureau of Mines ditrict files, October, 1913.

8. Reports of Analyses, 70 samples, from Richmond-Sitting Bull and other properties, Bureau of Mines district files. July, 1939.

W.M.R.
August, 1942

WAR MINERALS REPORT [1]

UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

Report of the Bureau of Mines to Hon. Harold L. Ikes
Secretary of the Interior

- Initial Report -

THE GALENA MINING DISTRICT
Lawrence, County, South Dakota

- Lead, Silver, and Zinc -

Summary

The Galena Mining District of Lawrence County, South Dakota contains two ore horizons, which are stratigraphically about 200 feet apart. The two horizons represent the upper and lower contacts of the Cambrian-Deadwood formation which dips gently eastward in this area. Silver, lead, gold, and some zinc mineralization occurs in a network of vertical fractures in the two contacts, and in seams varying in thickness from 18 to 30 inches of sandy dolomite and dolomitic quartzite. The seams are separated by hard quartzite.

The upper horizon ore possibilities cover an area of about 500,000 square feet; the lower contact about one square mile. The area has produced more than two million dollars in gold, silver, and lead, and the old workings show promise of possible extensions. The great area of the little-explore lower horizon indicates the possibility of new ore areas being developed by proper exploration procedures.

1. The reports of the War Minerals Series are based upon field work of engineers of the Bureau of Mines together with data available to the Bureau from other sources. The purpose of these reports is to supply information that may be helpful to owners and operators of properties examined, and to others who are especially interested in them. For this reason distribution is limited to those who request the reports individually.

A new flotation mill was constructed in 1931 but has seen little service since it failed to yield a satisfactory recovery of the metallic values in the ore. An exhausting metallurgical study of the ore and proper revamping of this mill would result in satisfactory recoveries and economical operation.

If the results of exploration and metallurgical investigations indicate that sufficient ore exists to warrant further expenditure, the cost of putting the area into production would be about $45,000 and the time required, about 6 months.

INTRODUCTION

The Galena Mining District of South Dakota is situated along Bear Butte Creek about five and one-half air miles southeast of Deadwood.

In order to make a study of the ore in both horizons two representatives mines were visited; the Double Rainbow Mine, formerly known as the Richmond-Sitting Bull Workings, in the upper contact; and the Silver Queen Mine in the lower contact. Details of ore analysis and mine workings of the two mines are given under supplements A and B. to this report.

HISTORY

Gold, silver and lead ores were discovered in the Galena district in 1876 and the principal claims were located in 1877 before railroads had been built into the country. Wagons, bringing supplies from Missouri River point, carried back the high-grade silver ores on their return trip. The ore cargo was transferred to river boats and shipped to the Omaha and Grant Smelting Plant at Omaha, Nebraska. This smelter is now a part of the American Smelting and Refining Co. Considering 250 miles of wagon haul, 500 miles of boat shipment, and smelter charges, costs were so high that only the highest grade ores could be handled economically. Lower grade material was left in the mine ore stored in dumps. Later a small smelter and old-style pan-amalgamation silver were built in the district, but because of the excessive costs of operation the

results were unpromising. During the years 1881.1882, and 1883 more than $750,000 worth of lead and silver were procuced. In 1883 the principal companies engaged in a legal controversy over the apex question, and during the following 16 yeats of litigation, production in the area practically ceased. By the end of this period the price of silver had reached low levels and production was not resumed. Since that time considerable development work has been carried on, but production has been negligible.

PHYSICAL FEATURES

The predominant physical feature of the Galena District is Custer Hill, which is a ridge with its north and west walls cut fairly steep by the action of Bear Butte Creek. The creek enters the district from the south, then turns east and has cut down through sedimentary material for 700feet to form the steep north side of Custer Hill. From this northern height, the hill slopes rater abruptly westward, but more gently southward. Two hundred feet above Bear Butte Creek on the north side of the hill the upper horizon of the Deadwood formation outcrops and follows the walls of the canyon westward for 3,000 feet, where it turns southward with the creek canyon, runs along the side of the hill for another 2,000 feet, then circles eastward across the south slope. The lower contact of the Deadwood formation outcrops low on the north wall of the canyon near the southward bend of the creek, and can be traced thence southward along the creek banks for more than 7,000 feet.

The Double Rainbow Mine is located in the upper contact region near the summit of the hill. The Silver Queen Mine is about 2 miles down the southern slope of Custer Hill, where the upper contact has been eroded away and only the lower contact is exposed.

DESCRIPTION OF THE DEPOSITS.

The canyons of Bear Butte Creek and tributaries have cut sharply through the Pahasapa, Englewood, and Whitewood limestones; through the Cambrian-Deadwood

formation, which catains three intrusive sheets of Tertiary ryolite porphyry; and into the Algonkian schists. The strike of the sedimentary formationsis north-south and the beds dip gently, from 8 to 20 degrees, to the east. The Algonkian schists strike N 60° E and dip about 50° to the southeast.

Ore deposits in the area all occur in the Deadwood formation and are found in two principle horizons or contacts. The lower contact ores are in a quartzite bed, lying a few feet above the Algonkian schists; the upper contact ores ore in a stratum some 200 to 300 feet higher, within a few feet of the contact with Whitewood limestones. A few small prospects opened in between these strata were never of any importance. The ore bodies are replacements in dolomitic quartzite on the lower contact, and in sandy dolomite on the upper contact, and in both instances are closely associated with intrusive porphyry. Ores in both contacts have been so extensively oxidized that in most places it is difficult to determine the nature of the primary mineralization.

The upper contact occurs at the top of the Cambrian-Deadwood formation just below the Whitewood limestone. The sedimentary layers have been broken by vertical, discontinuous, overlapping fractures, the major fractures striking east and we t, parallel to Bear Butte Creek and probably parallel to an anticline, the present canyon of the creek having evidently been cut along a major fault zone which may have been the main course of hypogene mineralizatinn of the silver, lead and gold ores. Minor fractures are present, striking in all directions, as is evidenced by the maxe of old workings which followed the high-grade mineralized fractures, forming large network of drifts, cross-cuts, and stopes. The ore occurs as a replacement in dolomitic quartzite layer , 18 to 30 inches thick, adjacent to the vertical fractures. The extent of mineralization away from the structures depends on the magnitude of the fr actures and the permeability of the bed. Often where the fractures intersect or are close together, the mineralization extends from one to the other.

The lower contact ore horizon is exposed on the west side of Custer Hill, where the creek has cut through it to the Pre-Cambrian schists below.

The ore in this horizon, as seen in the Silver Queen Mine, occurs as a replacement in dolomitic quartzite in lenticular bodies conformable with the bedding and adjacent to vertical fractures. The major verical fracture zones strike N 50° E and minor fractures striking in every direction are also noticeable. The thickness of the ore varies from a few inches to two feet and a mining height may contain several ore layers separated by hard, dense quartzite. This horizon extends throughout the district for many square miles and is mineralized where structural features are favorable.

It is geologically probable that the lower horizon extends northward from the Silver Queen Mine under and parallel to the upper horizon mined by the Double Rainbow Mine. Because of the extensive fracture system in the upper contact and the extensive mineralization shown in that portion of the lower horizon where it is exposed and worked to the west and south. it is highly possible that the lower contact is mineralized some 200 or more feet below the present workings of the Double Rainbow Mine. A similar possibility exists in that part of the lower contact extending under the bed of Bear Butte Creek and perhaps even beyong to the north side of the creek. This portion of the lower horizon has not been explored.

Suggestions for Exploration

It is proposed to core drill the lower contact horison in the vicinity of the Double Rainbow Mine to determine whether the same system of vertical fractures, which are believed to be the sources of the mineraliation in the upper contact, also caused mineralization of the lower contact. It is beliefed that drilling should begin at or near the outcrop of the lower contact which is found on the east-west portion of Bear Butte Creek near where the creek channel turns sharply to the south. The planned drilling would continue along the creek bed eastward to the point where the creek intersects the outcrop of the upper

horizon. The drill holes will vary from 25 to 140 feet in depth and extend over a distance of 2,500 feet. The drilling area would be projected in either direction, depending on the results of the first holes drilled.

While this drilling is in progress, geological mapping and correlation of the fracture system and structure of the old workings should be carried out with the view of extending the old workings in the most favorable areas of the upper horizon.

Bulk samples should be taken of both horizons to conduct laboratory tests to determine the most suitable method of concentrating the ores to obtain the maximum of a good grade of concentrates.

If the drilling on the lower horizon proves that ore of a suitable grade exists in the lower horizon, an inclined shaft should be sunk to intersect and develop the body. The incline will be from 150 to 200 feet in depth, depending on its location and inclination.

Proposed Disposal of Product

A new flotation mill, built in 1931 at the Double Rainbow, is said to be incapable of treating the ore with the present flow sheet. A thorough metallurgical study of the ore from the two horizons may indicate that the existing plant can be easily revamped to effect efficient operation and recovery. The plant and machinery are new and the cost of labor and additional equipment to place the mill in operation should not be great.

Approximate Capital Expenditures (To get into production if exploration and and laboratory tests show promise.)

$20,000	for mapping, sampling testing and drilling
3,000	for mine development, through old workings.
15,000	for alterations to present mill.
8,000	for incline and lower contact development.
$45,000	

Time Required to Start Production

One month from present workings(after mill is revamped.)

Six months drilling, laboraboyy tests and mill alterations.

Three months sink incline and lower development. Might be be started before drilling and exploration completed.

Estimated Rate of Production.

~~100~~ 200 tons of ore per day.

Conclusions

It is believed by the Bureau of Mines engineer that this area bears further investigation and it is suggested that the following program be followed:

1. Drilling along Bear Butte Creek to explore lower contact.
2. Mapping and sampling old mine workings in district. (concurrent with 1.)
3. Bulk sampling and ore testing. (Concurrent with 1.)
4. Alteration of present plant.
5. Sinking incline and lower contact development.

Geo. Special

Date October 30, 1965

ASSAY REPORT

SAMPLE		Silver Oz. Per Ton	GOLD Dollars per Ton at $20.67
Galena ~~Paul Melancon~~ # 9	ALS	4.6	* N.F.
#10		64.9	4.00
#11		1.28	N.F.
#12		N.F.	N.F.
~~Zun Granite Paul Melancon~~		~~N.F.~~	.60

Exhibit 12

Assay Form No. 9

Geological Special

Date November 3, 1965

ASSAY REPORT

11- SAMPLE		Silver Oz. Per Ton	GOLD Dollars per Ton at $20.67
Galena # 13	ALS	.54	N. F. .58
14		N. F.	.60
15		1.64	N. F. 3.14
16		N. F.	.80 .36
17		.12	.20 .56
	N. F. = None Found		

Assay Form No. 9

Geological Special

Date November 6, 1965

ASSAY REPORT

11-5 SAMPLE	Silver Oz. Per Ton	GOLD Dollars per Ton at $20.67
Geo. Galena # 18	9.8	.40 2.00

Assay Form No. 9

Galena Special

Date November 10, 1965

ASSAY REPORT

11- SAMPLE				Silver Oz. Per Ton	GOLD Dollars per Ton at $20.67
Galena #19	Ht 2½'	Wt 6'	ALS	4.4	N.F.
#20	4'	6'		11.4	.20
#21	3½'	7'		2.0	N.F.
#22	3'	7'		.9	N.F.
#23	4'	5'		.84	N.F.

Assay Form No. 9

Galena Special

Date November 11, 1965

ASSAY REPORT

SAMPLE				Silver Oz. PerTon	GOLD Dollars per Ton at $20.67
Spec. Galena #24	Ht 2'	Wt 5'	ALS	4.69	.20
#25	2'	7'		13.55	8.05
#26	4'	7½'		3.18	.80
#27	2'	7½'		7.46	1.20
#28	4'	6'		10.32	3.70
#29	2'	4'		None Found	N.F.
#30	2'	4'		3.24	N.F.

Special Galena

Date November 12, 1965

ASSAY REPORT

SAMPLE				Silver Oz. Per Ton	GOLD Dollars per Ton at $20.67
Spec. Galena #31	Ht 5½'	Wt 6'	ALS	1.11	1.00
#32	10"	6'		24.1	3.10
#33	3'	6½'		4.23	.20
#34	3½'	6½'		12.72	.80
#35	Vert Fr Filling			5.12	.80
#36	Cavity Filling			5.9	.40
#37	Galena Vein			62.16	.80
#38	3'	7'		1.52	.40
#39	2½'	7'		1.9	2.90
#40	3½'	5'		5.07	2.25

Galena Special

Date November 13, 1965

ASSAY REPORT

SAMPLE				Silver Oz. Per Ton	GOLD Dollars per Ton at $20.67
Spec. Galena #41	Ht 1½'	Wt 5'	ALS	3.95	1.00
#42	2½'	6½'		.84	.40
#43	1½'	6½'		1.46	1.00
#44	2½'	6½'		1.42	6.09 3.60
#45	3'	5½'		3.46	.60
#46	1½'	5½'		5.46	.60
#47	3'	6½'		.64	.40
#48	2'	6'		13.24	.60

Assay Form No. 9

Geological Special

Date November 15, 1965

ASSAY REPORT

11-13 SAMPLE				Silver Oz. Per Ton	GOLD Dollars per Ton at $20.67
Galena # 49	Ht-3'	Wt-6'	ALS	4.2	1.00
# 50	Ht-3'	Wt-6'		1.06	.40
# 51	Ht-2½'	Wt-4½'		2.36	N.F.
# 52	Ht-1½'	Wt-4½'		9.2	.40
# 53	Ht-1½'	Wt-4½'		3.53	5.75 3.40
# 54	Ht-4'	Wt-4½'		.75	.60
# 55	Ht-3½	Wt-3'		3.38	9.20

N.F. = None Found

REPORT OF ANALYSIS

SAMPLE OF

LEAD-SILVER ORES

RECEIVED FROM A.L. Slaughter ON

	% Pb
Galena No. 9	None Found
Galena No. 10	1.26
Galena No. 11	N. F.
Galena No. 12	N. F.
12-18-64 Taylor reports re-run on #10 using larger sample 1.42% Pb	

	% Pb
Galena No. 13	0.58
14	None Found
15	3.14
16	0.36
17	0.56
18	2.00

	% Pb
Galena No. 19	0.52 1.66
20	0.59 1.89
22	0.20 .64
23	0.16 .51
24	0.32 1.02

REPORT OF ANALYSIS

SAMPLE OF

LEAD - SILVER ORES

RECEIVED FROM A.L. Slaughter ON

	% Pb
Galena No. 25	0.75
26	0.20
27	0.20
28	0.60
29	0.19
30	0.36

	% Pb
Galena No. 21	0.37
31	0.51
35	12.02
36	2.10
37	57.26
38	0.40
39	0.69
42	0.77
43	0.93
47	0.37
50	0.38
~~53~~ 52	7.26
54	0.43

DATE 11/29/65 ANALYST W.H. Taylor

REPORT OF ANALYSIS

SAMPLE OF

LEAD - SILVER ORES

RECEIVED FROM A. L. Slaughter ON

	% Pb
Galena No. 32	0.86
33	0.39
34	0.58
40	2.32
41	2.34
45	0.67
46	3.04
48	1.37
49	2.66
51	0.93
52	6.99
53	1.65
55	0.80

DATE 11/22/65 ANALYST W.H. Taylor

THE BROWN LABORATORY

2263 Broadway
GRAND JUNCTION, COLORADO 81501

ANALYTICAL DEPARTMENT

Phone 242-4589

Exhibit 15

CERTIFICATE OF ANALYSIS

TO

Little Beaver Mining Company
Lead, South Dakota 57754

Date 12-24-65

Order No. 17717-S 2

SUPERSEDES PREVIOUS REPORT
Correcting Error in Pb Assays

Material: Ore Samples
Received: 11-19-65
For: Analysis

Lab. No.	Your No.	Description	Ounces Per Ton Gold	Ounces Per Ton Silver	%Cu	%Pb	%Zn
17741-1	9	Galena			0.005		0.55
17741-2	10	Galena			0.03	1.04	1.34
17741-3	19	Galena			0.005		0.66
17741-4	20	Galena			0.005		0.72
17741-5	25	Galena			0.03	0.41	0.86
17741-6	26	Galena			Nil		0.43
17741-7	27	Galena			0.036		0.53
17741-8	28	Galena			0.038		0.93

Analyst

THE BROWN LABORATORY
2263 Broadway
GRAND JUNCTION, COLORADO 81501

ANALYTICAL DEPARTMENT

Phone 242-4589

CERTIFICATE OF ANALYSIS

TO

Little Beaver Mining Company
Lead, South Dakota 57754

Date 12-13-65
Order No. 17741-S

Material: Ore Samples
Received: 12-10-63
For: Analysis

Lab. No.	Your No.	Description	Ounces Per Ton Gold	Ounces Per Ton Silver	%Cu	%Pb	%Zn
17741-1	32	Galena					1.00
17741-2	33	Galena					0.78
17741-3	34	Galena					0.72
17741-4	40	Galena					1.15
17741-5	41	Galena					2.17
17741-6	45	Galena					0.75
17741-7	46	Galena					1.07
17741-8	48	Galena					0.90
17741-9	49	Galena					1.11
17741-10	51	Galena					0.66
17741-11	52	Galena			0.14	6.90	0.82
17741-12	53	Galena					0.79
17741-13	55	Galena					0.75

H. D. Brown
Analyst

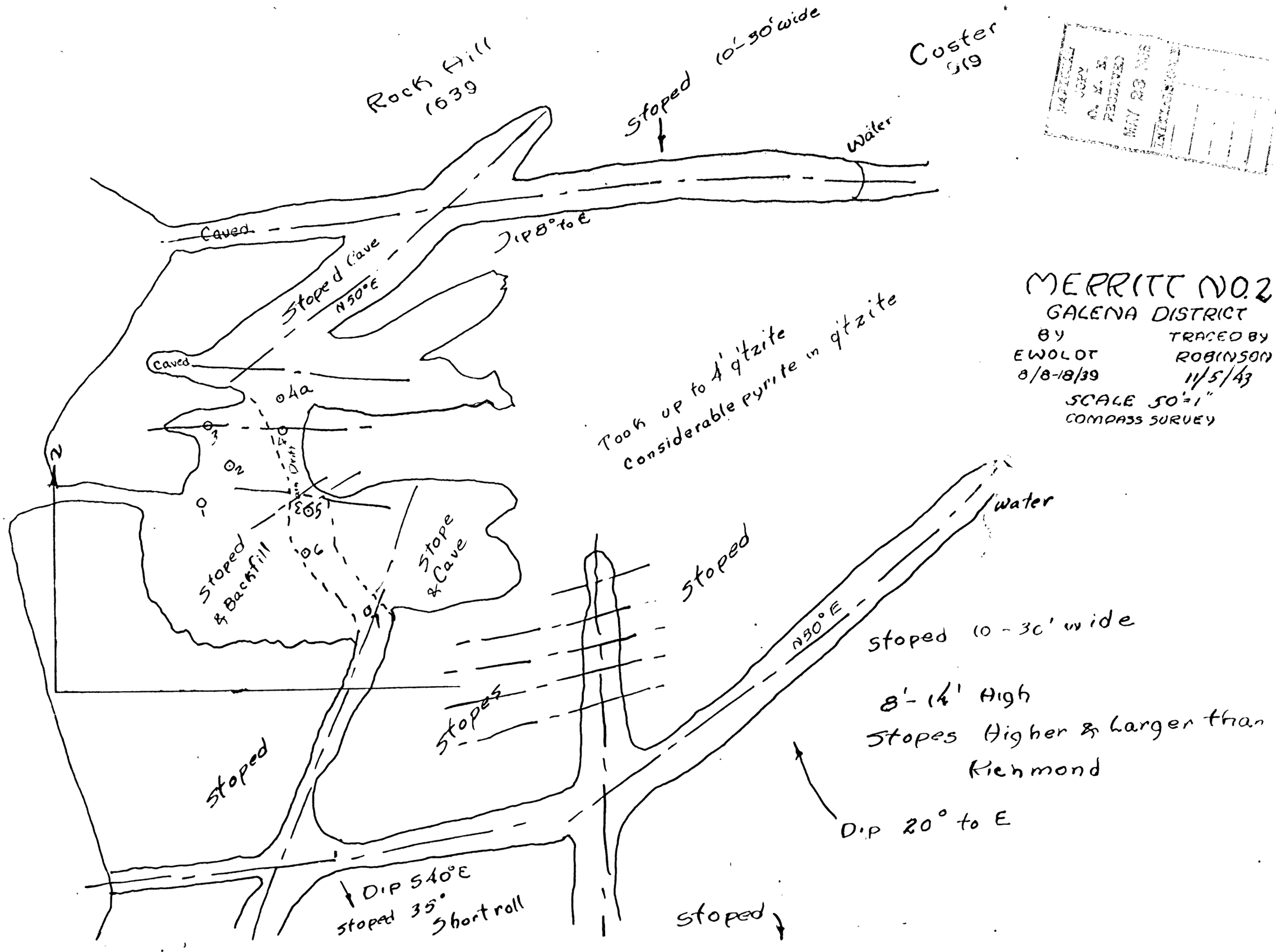
Double Rainbow Samples - Nov. 1965
Richmond - Sitting Bull - RSB

No.	Location & Description	Thick Ft.	Width Ft.	Gold @ $35.00	Gold, Avg. of combined Samples	Silver ozs	Silver $ @ 1.29	Silver, Avg. of combined Samples ozs	$	Lead %	Lead $ @ 166	Lead, Avg. of combined Samples %	$	Zinc %	Zinc $	Zinc, Avg. of combined Samples	$	Copper %	Copper $		Total Contained $ value excluding Copper	
G 9	RSB, Face Haven's Dft	3.0	7.0	nil		4.60	5.93			nil				.55	1.65			.005	.03			
10	" " " " 5.5	1.5	7.0	6.80	1.85	64.70	83.72	20.44	26.36	1.26	4.03	.34	1.10	1.34	4.02	.67	2.00	.030	.21		31.31	
11	" " " "	1.0	7.0	nil		1.28	1.65			nil												
12	" Grab, 150 ton pile			nil		nil				nil												
14	Merritt No 2	2.0		1.02		nil				nil											1.02	
15	Merritt No 1 4.5	1.25		nil	.93	1.64	2.12	0.45	.58	3.14	10.05	1.14	3.30								5.16	
16	" "	3.3		1.36		nil				0.36	1.15											
17	" " grab, 25 Tons across vert.			.34		.12	.15			.56	1.79										2.26	
18	RSB, S. Dft in back		3.0	.68		9.80	12.64			2.00	6.40										19.72	
19	" XC N. from S. Dft 6.5	2.5	6.0	nil	.21	4.40	5.68	8.71	11.23	.52	1.66	.60	1.80	.66	1.98	.70	2.09	.005	.03		15.33	
20	" " " "	4.0	6.0	.34		11.40	14.70			.59	1.89			.72	2.16			.005	.03			
21	" S. Dft West side 6.5	2.5	7.0	nil	nil	2.00	2.58	1.49	1.92	.37		.29	.93								2.85	
22	" " " "	3.0	7.0	nil		.90	1.16			.20	.64											
23	" XC N. from S. Dft 6.0	4.0	5.0	nil	.27	.84	1.08	2.12	2.74	.16	.51	.21	.68								3.69	
24	" " " "	2.0	5.0	.34		4.69	6.05			.32	1.02											
25	" S. Dft West side	2.0	7.0	13.60		13.55	17.48			.75	2.40			.86	2.58			.03	.21		36.06	
26	" " " " " 6.0	4.0	7.5	1.36	1.58	3.18	4.10	4.61	5.94	.20	.64	.20	.64	.43	1.29	.46	1.39	Nil			9.55	
27	" " " " "	2.0	7.5	2.03		7.46	9.62			.20	.64			.53	1.59			.036	.25			
28	" " " " "	4.0	6.0	6.26		10.32	13.31			.60	1.92			.93	2.79			.038	.27		24.28	
29	" XC N from S. Dft. 4.9	2.1	4.0	nil	nil	nil		1.48	1.88	.19	.61	.30	.85								2.73	
30	" " " "	2.2	4.0	nil		3.24	4.18			.36	1.15											
31	" 6.4	5.5	6.0	1.69	2.19	1.11	1.43	4.34	5.60	.51	1.63	.56	1.79			.14	.42				10.00	
32	"	.9	6.0	5.25		24.10	31.09			.86	2.75			1.00	3.00							
33	" 6.5	3.0	6.5	.34	.89	4.23	5.46	8.80	11.35	.39	1.25	.50	1.58	.78	2.34	.74	2.22				16.04	
34	"	3.5	6.5	1.36		12.72	16.41			.58	1.86			.72	2.15							
35	" Vert. Fa Filling (JKW)			1.36		5.12	6.60			12.02												
36	" Cavity Filling (JKW)	.05	4.0	.68		5.90	7.61			2.10												
37	" Galena vein (JKW)			1.36		62.16	80.18			57.26												
38	" 5.5	3.0	7.0	.68	2.59	1.52	1.96	1.69	2.18	.40		.53	1.70								6.47	
39	"	2.5	7.0	4.90		1.90	2.45			.69												
40	" 5.0	3.5	5.0	3.81	3.17	5.07	6.54	4.73	6.10	2.32	7.42	2.33	7.44	1.15	3.45	1.41	4.38				21.09	
41	"	1.5	5.0	1.69		3.95	5.09			2.34	7.49			2.17	6.51							
42	"	2.5	6.5	.68		.84	1.08			.77	2.46											
43	" 6.5	1.5	6.5	1.69	2.99	1.46	1.88	1.21	1.55	.93	2.98	.83	2.71								7.25	
44	"	2.5	6.5	6.09		1.42	1.83															
45	" 4.5	3.0	5.5	1.00	1.00	3.46	4.63	4.12	5.43	.67	2.14	1.50	4.67	.75	2.25	.86	2.58				13.68	
46	"	1.5	5.5	1.00		5.46	7.04			3.04	9.72			1.07	3.21							
47	" 5.0	3.0	6.0	.68	.81	.64	.82	5.68	7.32	.37	1.18	.77	2.46			.36	1.08				11.67	
48	"	2.0	6.0	1.00		13.24	17.07			1.37	4.38			.90	2.70							
49	" 6.0	3.0	6.0	1.69	1.18	4.20	5.42	2.63	3.39	2.66	8.51	1.52	4.86	1.11		.55	1.65				11.08	
50	"	3.0	6.0	.68		1.06	1.37			.38												

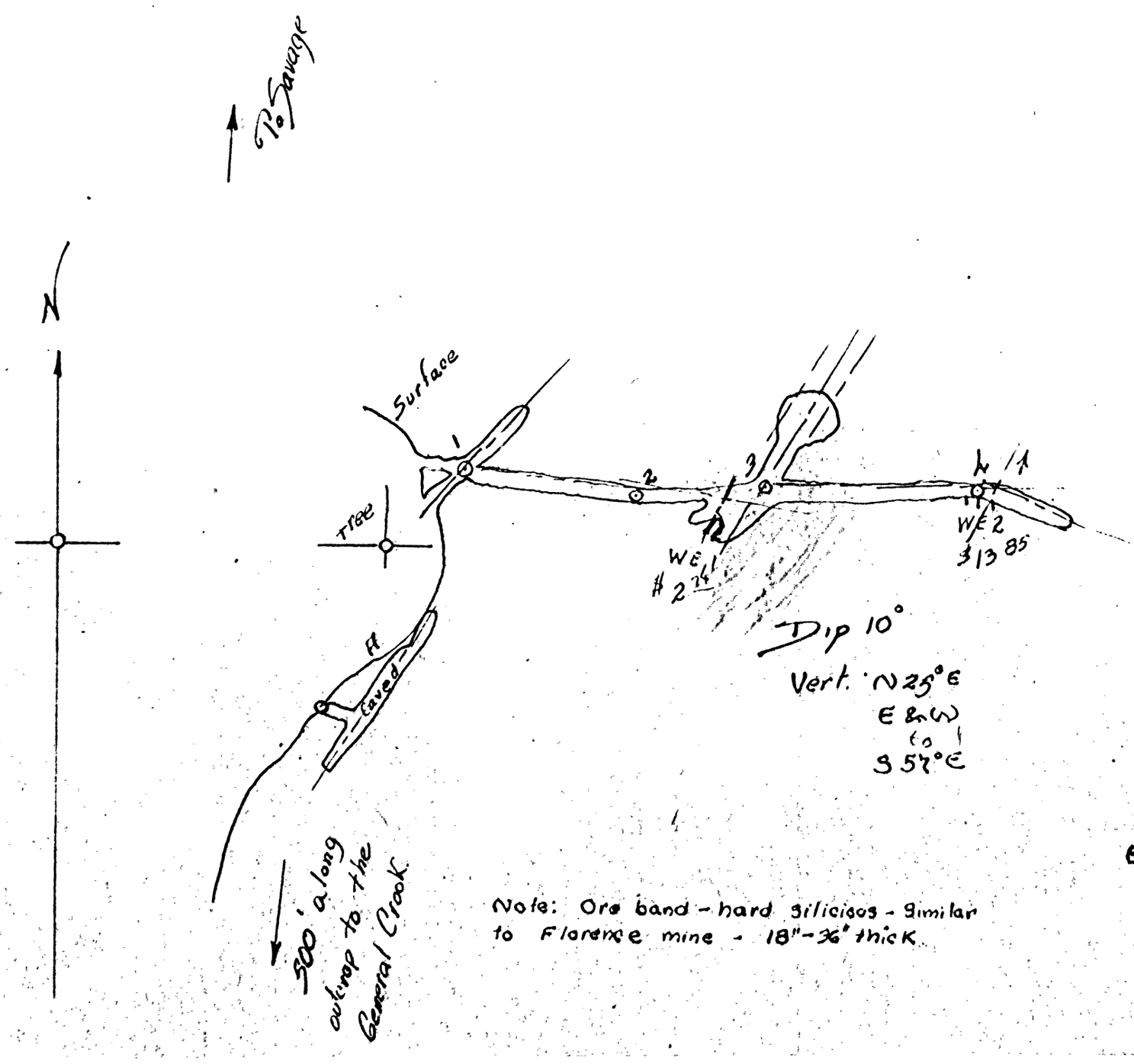
No.	Location & Description	Thick Ft	Width Ft	Gold @ 35.00	Gold, Avg of combined Samples	Silver ozs.	Silver $ @ 1.29	Silver, Avg of combined Samples	Lead %	Lead $ @ 16¢	Lead, Avg of combined Samples	Zinc %	Zinc $ @ 15¢	Zinc, Avg. of combined samples %	Zinc $	Copper %	Copper $ @ 35¢		Total Contained $ value excluding Copper	
G 51	RSB	2.5	4.5	nil		2.36	3.04		.93	2.98		.66								
52	" 5.5	1.5	4.5	.68	1.75	9.20	11.87	4.54	6.99	22.37	2.80	.82		.74	2.22	.14			18.75	
53	"	1.5	4.5	5.75		3.53	4.55		1.65	5.28		.79								
54	"	4.0	4.5	1.00		.75	.97		.43	1.50									3.47	
55	"	3.5	3.0	15.58		3.38	4.36		.80	2.56		.75	2.25						24.75	

Exhibit 13

Figure 13

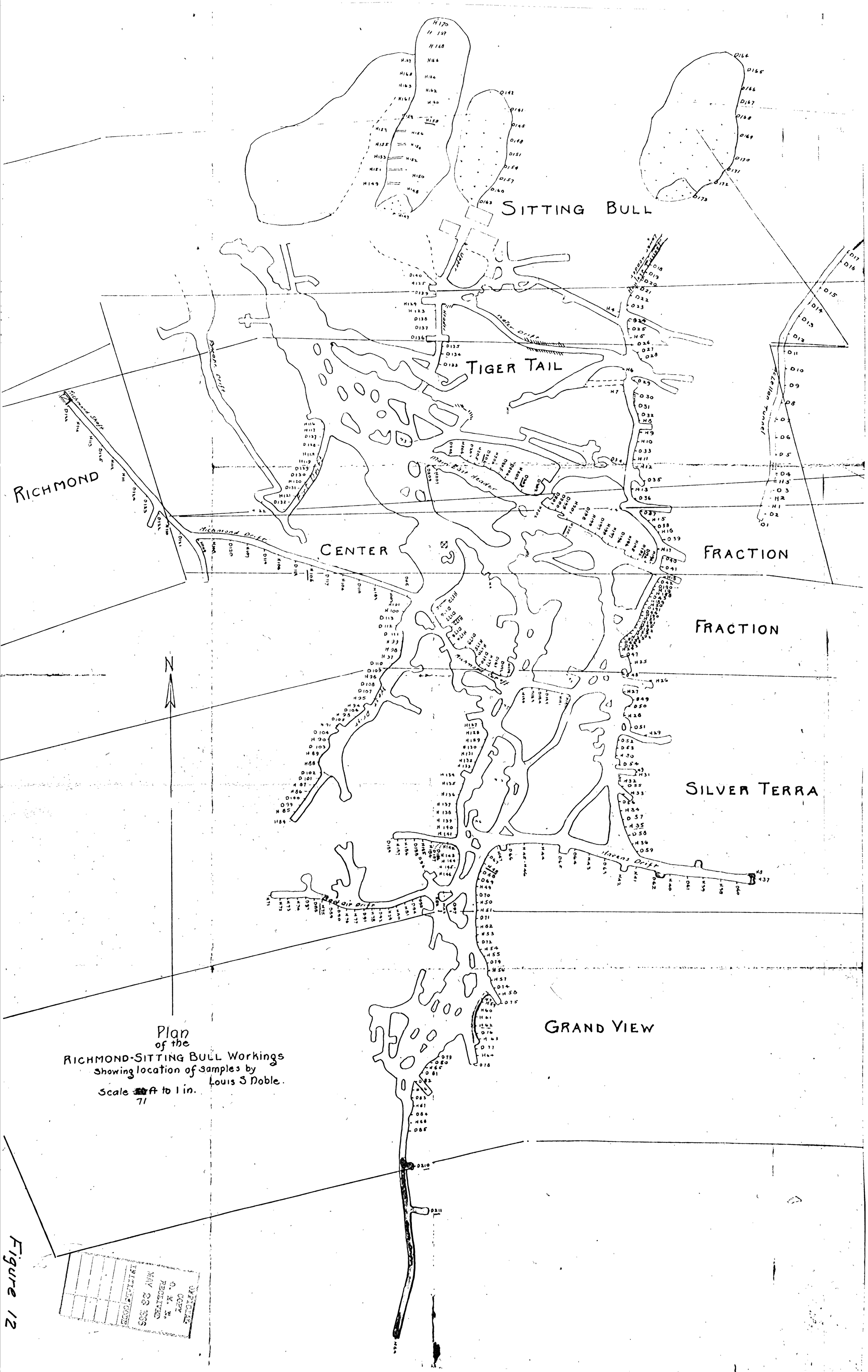


MERRITT NO.2
GALENA DISTRICT
BY EWOLDT 8/8-18/39
TRACED BY ROBINSON 11/5/43
SCALE 50'=1"
COMPASS SURVEY



Note: Ore band - hard siliciosos - similar to Florence mine - 18"-36" thick.

WAR EAGLE
GALENA DISTRICT
By EWOLDT 8-9-39
TRACED By ROBINSON 11-4-43
COMPASS SURVEY
SCALE 1" = 50'



Plan
of the
RICHMOND-SITTING BULL Workings
Showing location of samples by
Louis S Doble.
Scale 71 ft to 1 in.

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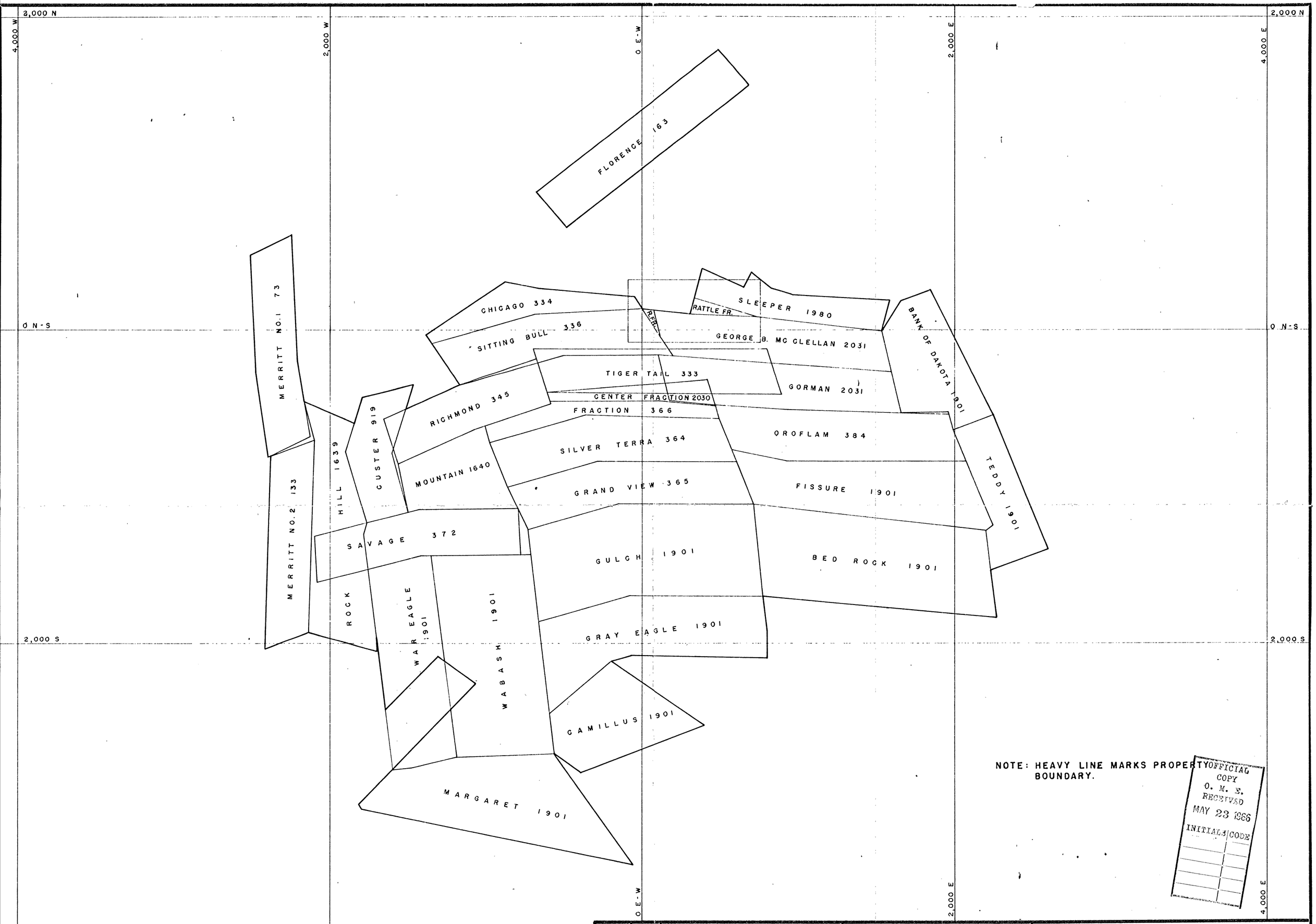
Figure 12



NOTE: HEAVY LINE MARKS PROPERTY BOUNDARY.

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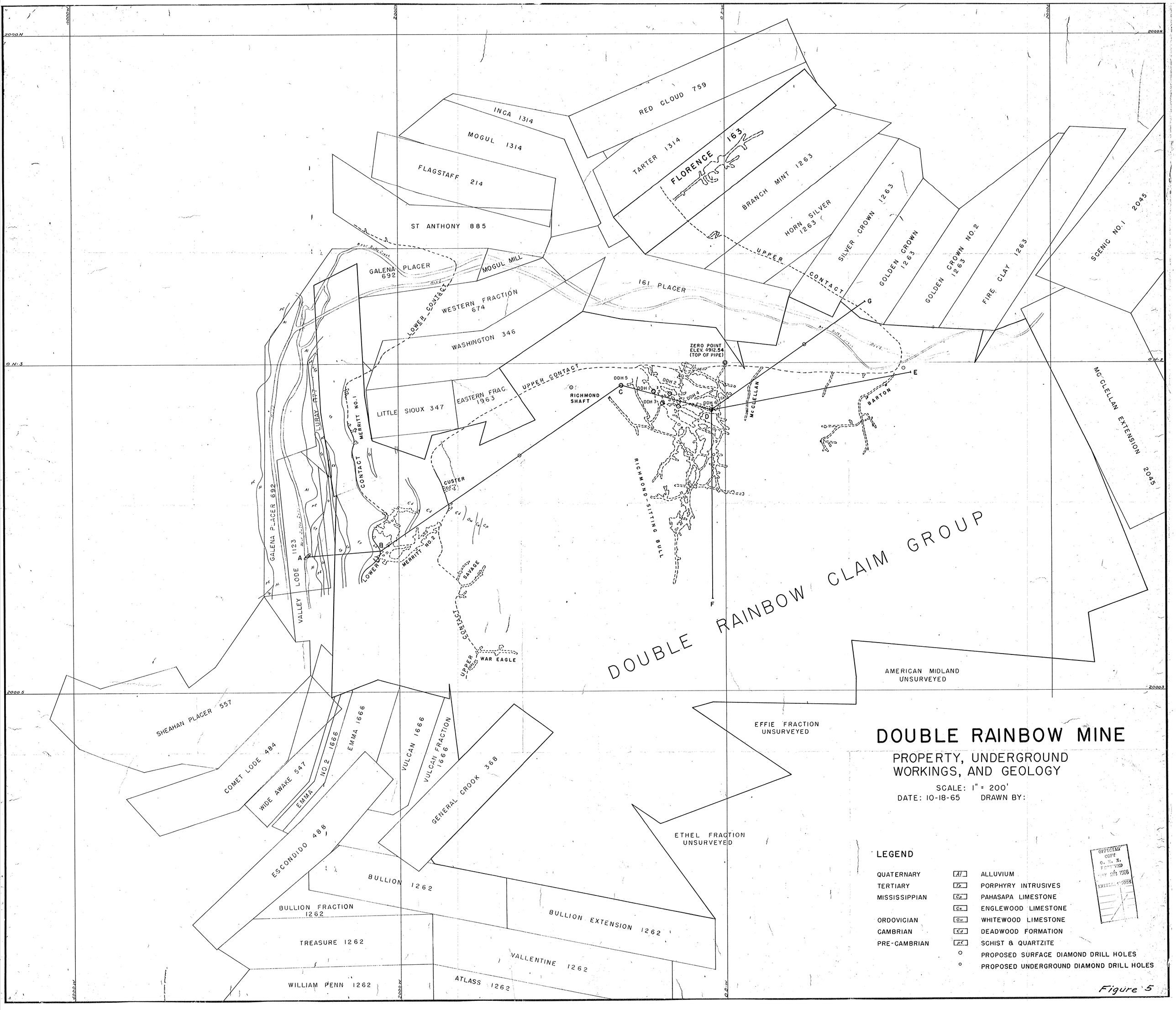
DATE	BY	REVISIONS

DRAWN BY ____ APPROVED ____
TRACED ____ SCALE 1" = 400'
CHECKED ____ DATE 12-29-65

DOUBLE RAINBOW MINE
CLAIM MAP

DWG. NO. FIGURE 1


DOUBLE RAINBOW MINE
PROPERTY, UNDERGROUND WORKINGS, AND GEOLOGY
SCALE: 1" = 200'
DATE: 10-18-65 DRAWN BY:
LEGEND
QUATERNARY Al ALLUVIUM
TERTIARY Tp PORPHYRY INTRUSIVES
MISSISSIPPIAN Cp PAHASAPA LIMESTONE
Ce ENGLEWOOD LIMESTONE
ORDOVICIAN Ow WHITEWOOD LIMESTONE
CAMBRIAN Ꞓd DEADWOOD FORMATION
PRE-CAMBRIAN p€ SCHIST & QUARTZITE
PROPOSED SURFACE DIAMOND DRILL HOLES
PROPOSED UNDERGROUND DIAMOND DRILL HOLES
DOUBLE RAINBOW CLAIM GROUP
INCA 1314
MOGUL 1314
FLAGSTAFF 214
ST ANTHONY 885
RED CLOUD 759
TARTER 1314
FLORENCE 163
BRANCH MINT 1263
HORN SILVER 1263
SILVER CROWN 1263
GOLDEN CROWN 1263
GOLDEN CROWN NO. 2 1263
FIRE CLAY 1263
SCENIC NO. 1 2045
MC CLELLAN EXTENSION 2045
GALENA PLACER 692
MOGUL MILL
161 PLACER
WESTERN FRACTION 674
WASHINGTON 346
LITTLE SIOUX 347
EASTERN FRAC. 1963
UPPER CONTACT
LOWER CONTACT
ZERO POINT ELEV. 4912.54 (TOP OF PIPE)
RICHMOND SHAFT
DDH 1
DDH 2
DDH 3
DDH 4
DDH 5
DDH 6
MC CLELLAN
BARTON
RICHMOND-SITTING BULL
CUSTER
MERRITT NO. 1
MERRITT NO. 2
LURAY RAT
GALENA PLACER 692
VALLEY LODE 1123
SAVAGE
WAR EAGLE
AMERICAN MIDLAND UNSURVEYED
EFFIE FRACTION UNSURVEYED
ETHEL FRACTION UNSURVEYED
SHEAHAN PLACER 557
COMET LODE 484
WIDE AWAKE 547
EMMA NO. 2 1666
EMMA 1666
VULCAN 1666
VULCAN FRACTION 1666
GENERAL CROOK 368
ESCONDIDO 488
BULLION 1262
BULLION FRACTION 1262
BULLION EXTENSION 1262
TREASURE 1262
VALLENTINE 1262
WILLIAM PENN 1262
ATLASS 1262
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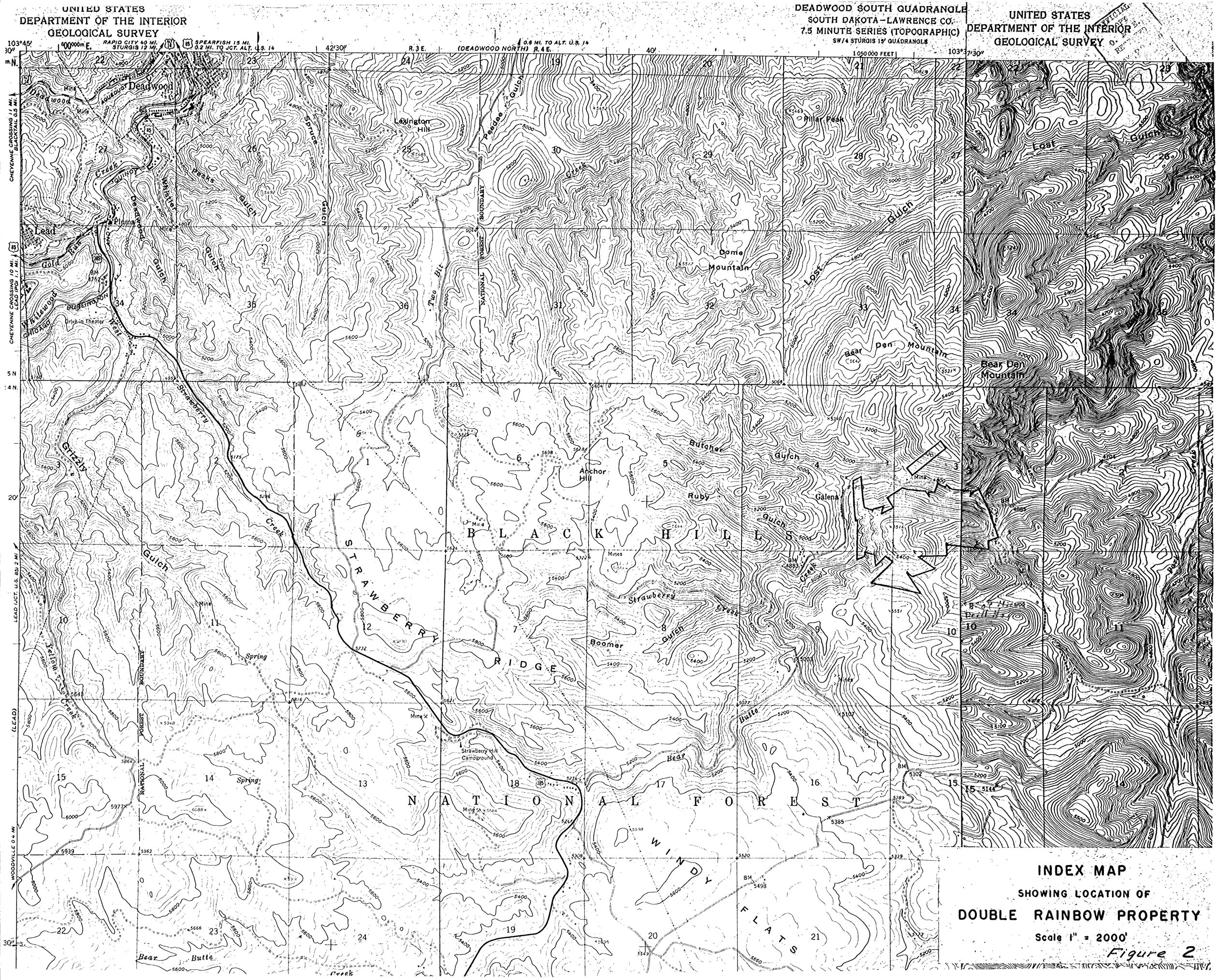
ENGINEERING GEOLOGY
Figure 5

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

DEADWOOD SOUTH QUADRANGLE
SOUTH DAKOTA–LAWRENCE CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
SW/4 STURGIS 15' QUADRANGLE

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

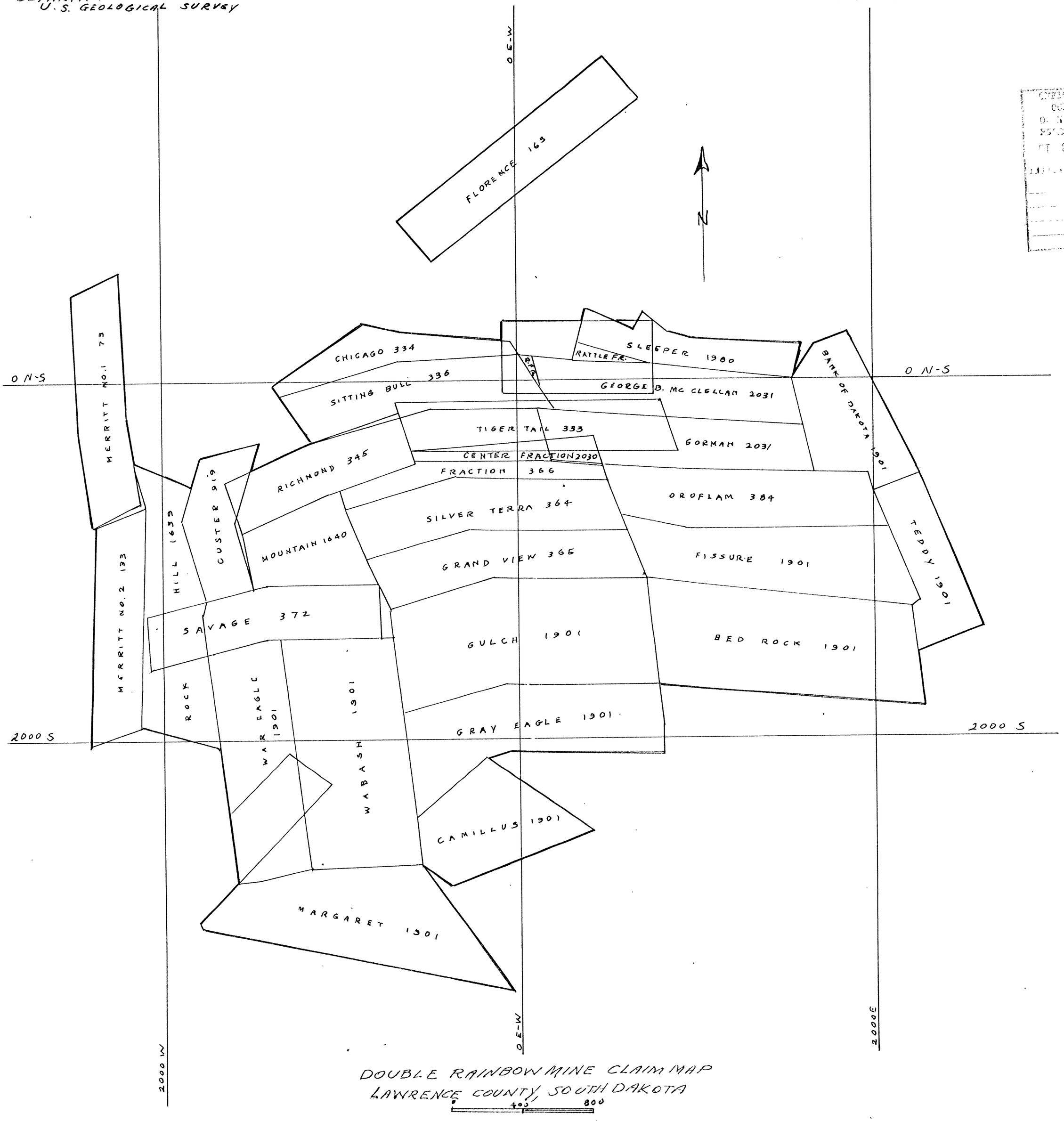


INDEX MAP
SHOWING LOCATION OF
DOUBLE RAINBOW PROPERTY
Scale 1" = 2000'

Figure 2

DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

OFFICE OF MINERALS EXPLORATION
DOCKET 6558



DOUBLE RAINBOW MINE CLAIM MAP
LAWRENCE COUNTY, SOUTH DAKOTA

0 400 800

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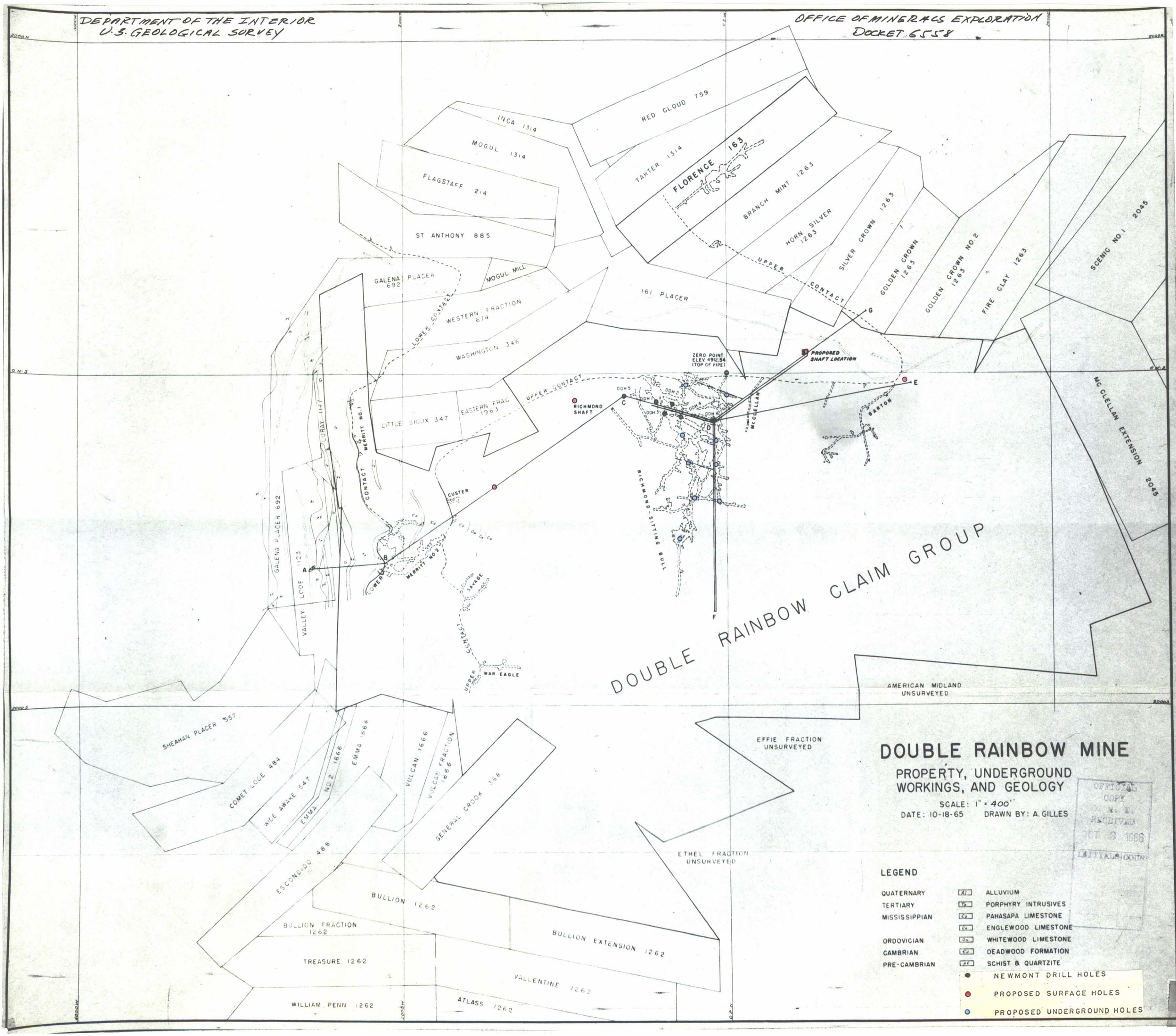
U.S. GEOLOGICAL SURVEY

OFFICE OF MINERALS EXPLORATION
DOCKET 6558



DOUBLE RAINBOW MINE

PROPERTY, UNDERGROUND WORKINGS, AND GEOLOGY

SCALE: 1" = 400'

DATE: 10-18-65 DRAWN BY: A. GILLES

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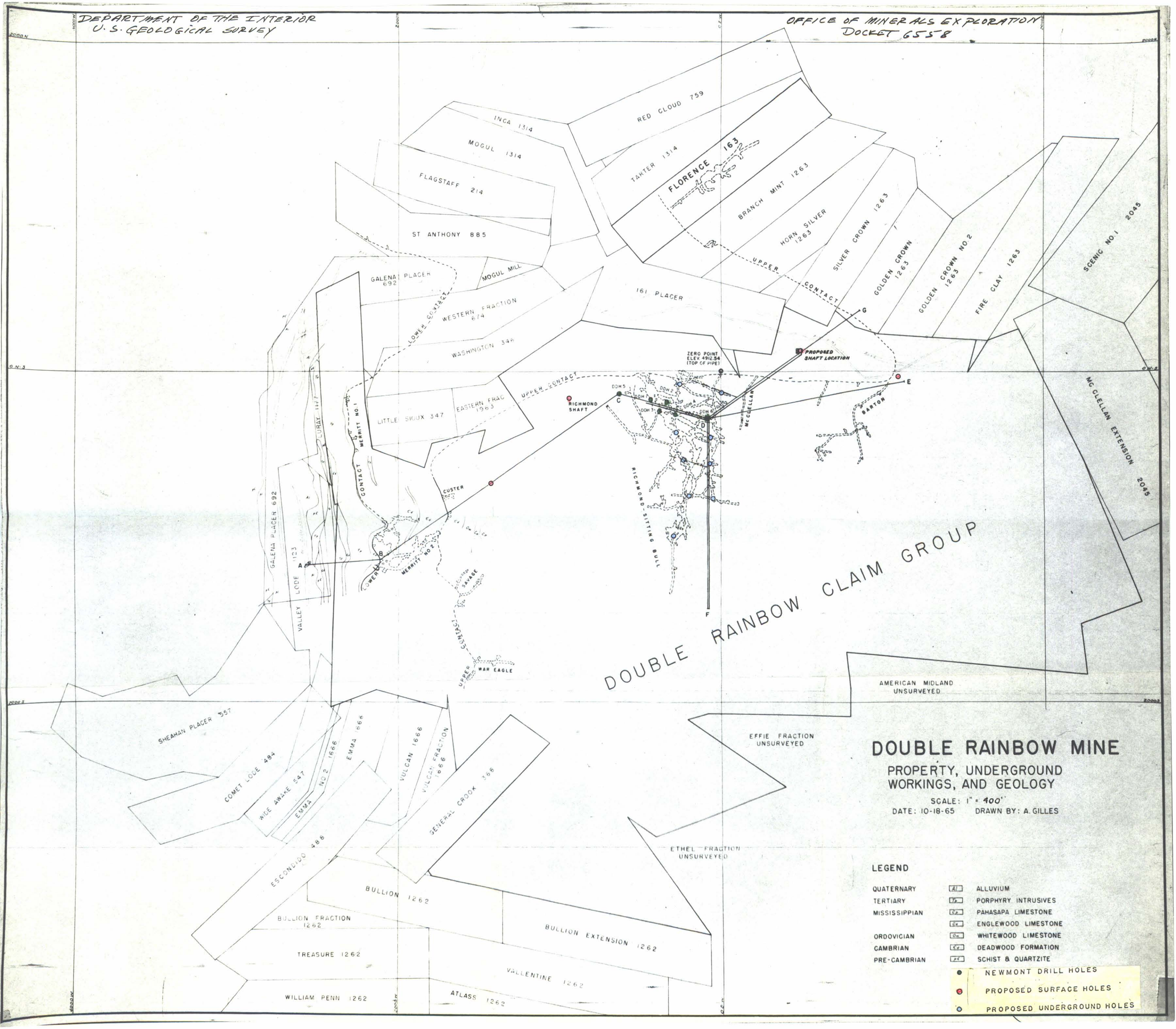
LEGEND

QUATERNARY	Al	ALLUVIUM
TERTIARY	Tp	PORPHYRY INTRUSIVES
MISSISSIPPIAN	Cp	PAHASAPA LIMESTONE
	Ce	ENGLEWOOD LIMESTONE
ORDOVICIAN	Ow	WHITEWOOD LIMESTONE
CAMBRIAN	Cd	DEADWOOD FORMATION
PRE-CAMBRIAN	p€	SCHIST & QUARTZITE

- NEWMONT DRILL HOLES
- PROPOSED SURFACE HOLES
- PROPOSED UNDERGROUND HOLES

DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

OFFICE OF MINERALS EXPLORATION
DOCKET 6558



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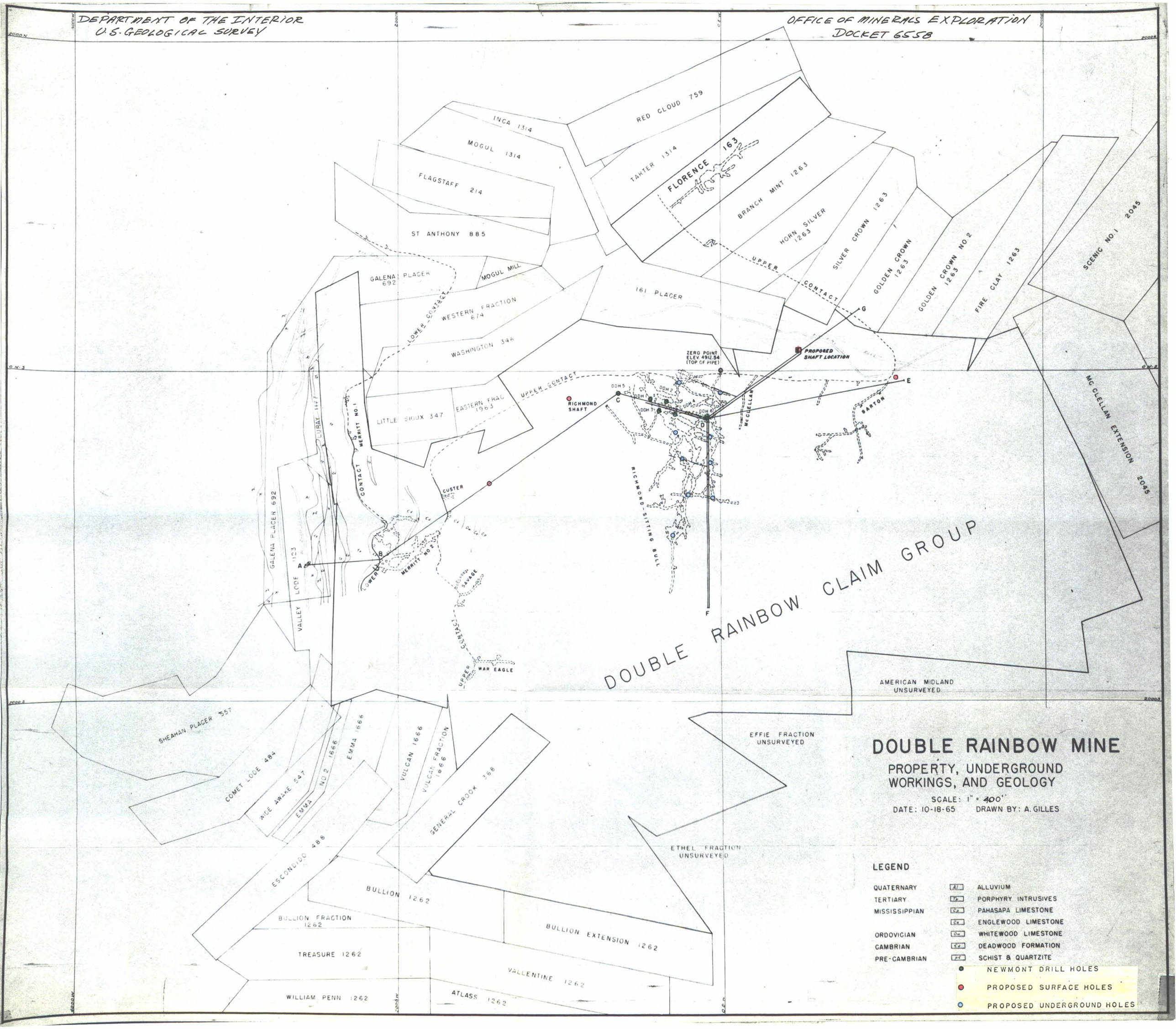

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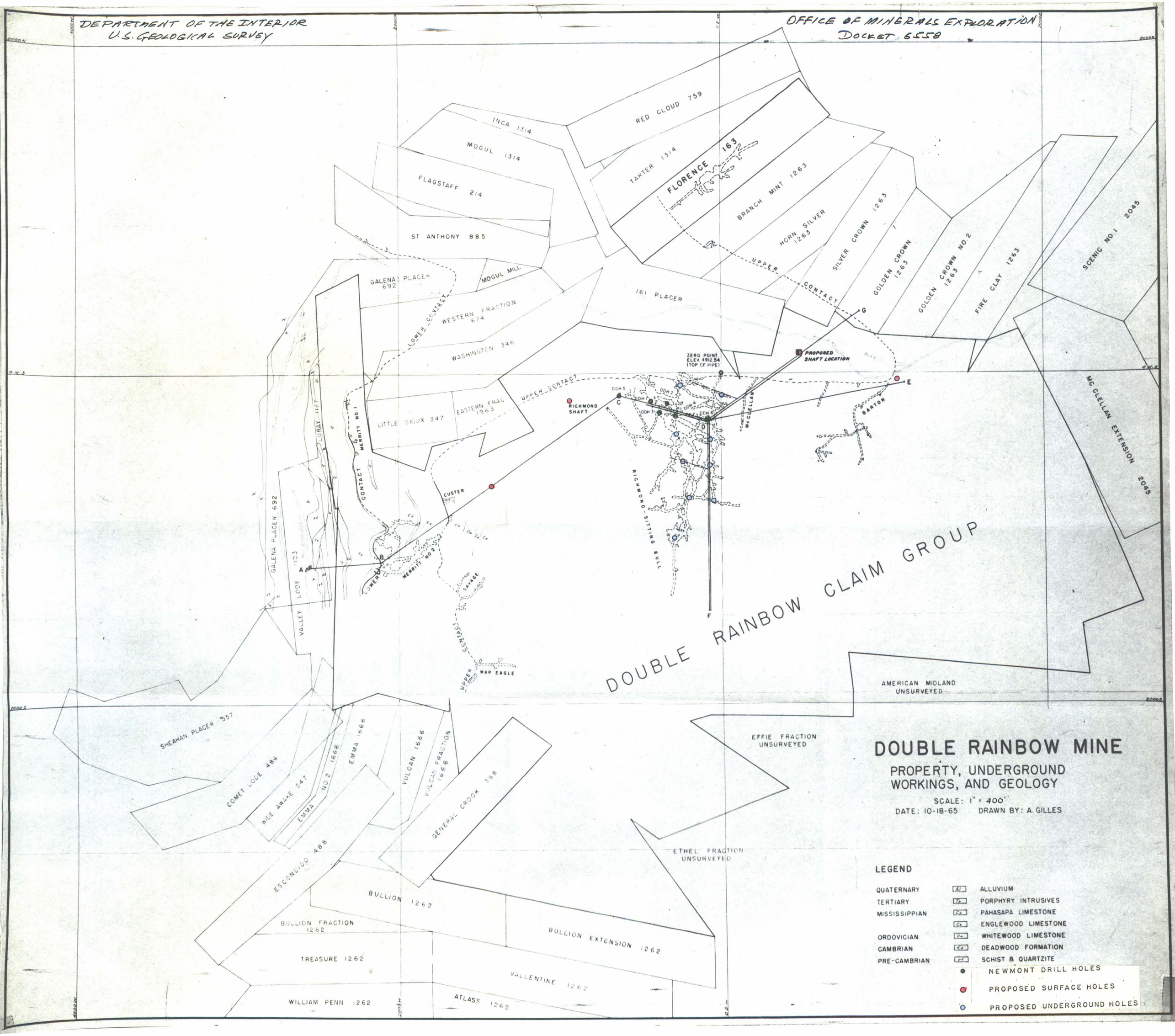
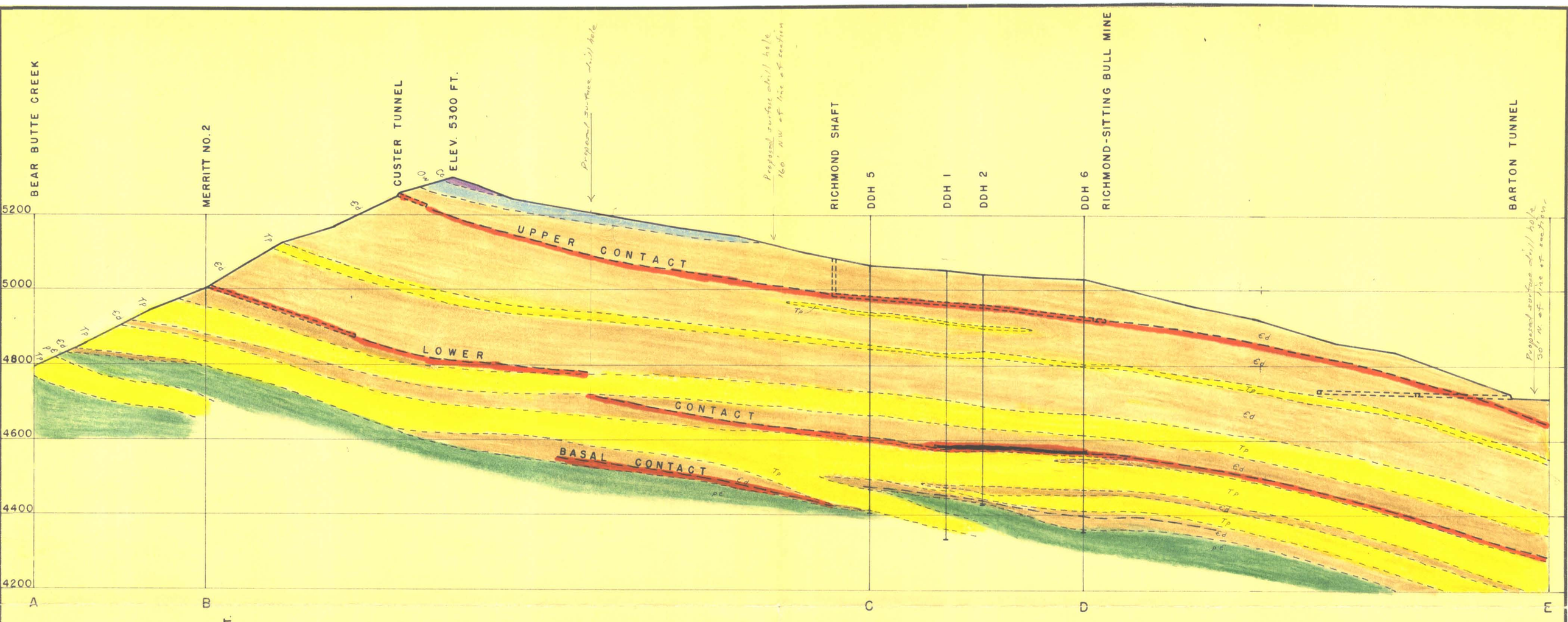
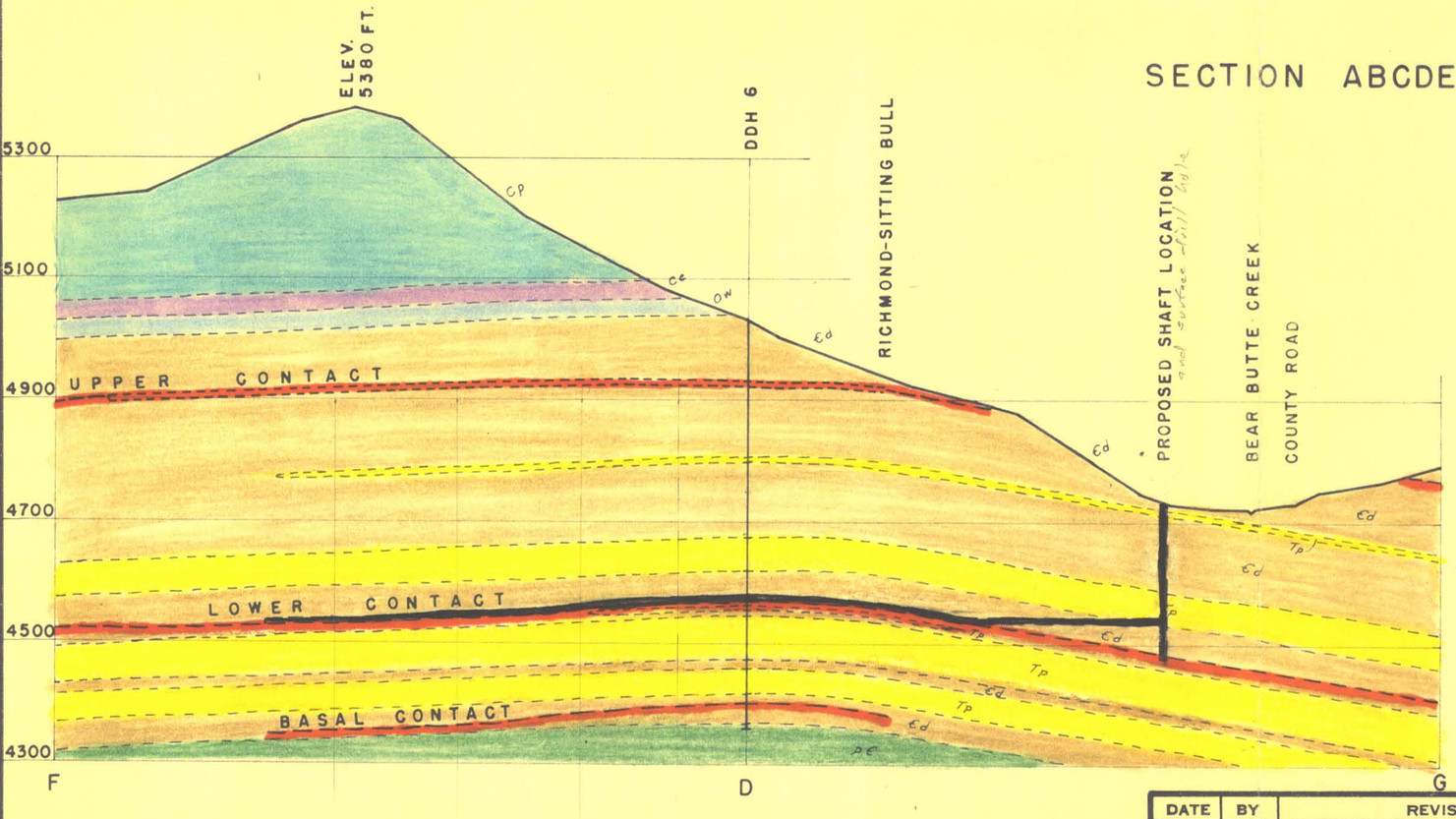
U.S. GEOLOGICAL SURVEY

OFFICE OF MINERALS EXPLORATION
DOCKET 6558





SECTION ABCDE



SECTION FDG

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INITIALS	CODE

EXPLANATION

EXISTING MINE WORKINGS

PROPOSED UNDERGROUND EXPLORATION WORK

TERTIARY	Tp	PORPHYRY INTRUSIVES
MISSISSIPPIAN	Cp	PAHASAPA LIMESTONE
	Ce	ENGLEWOOD LIMESTONE
ORDOVICIAN	Ow	WHITEWOOD LIMESTONE
CAMBRIAN	Ꞓd	DEADWOOD FORMATION
PRE-CAMBRIAN	pꞒ	SCHIST AND QUARTZITE

DATE	BY	REVISIONS

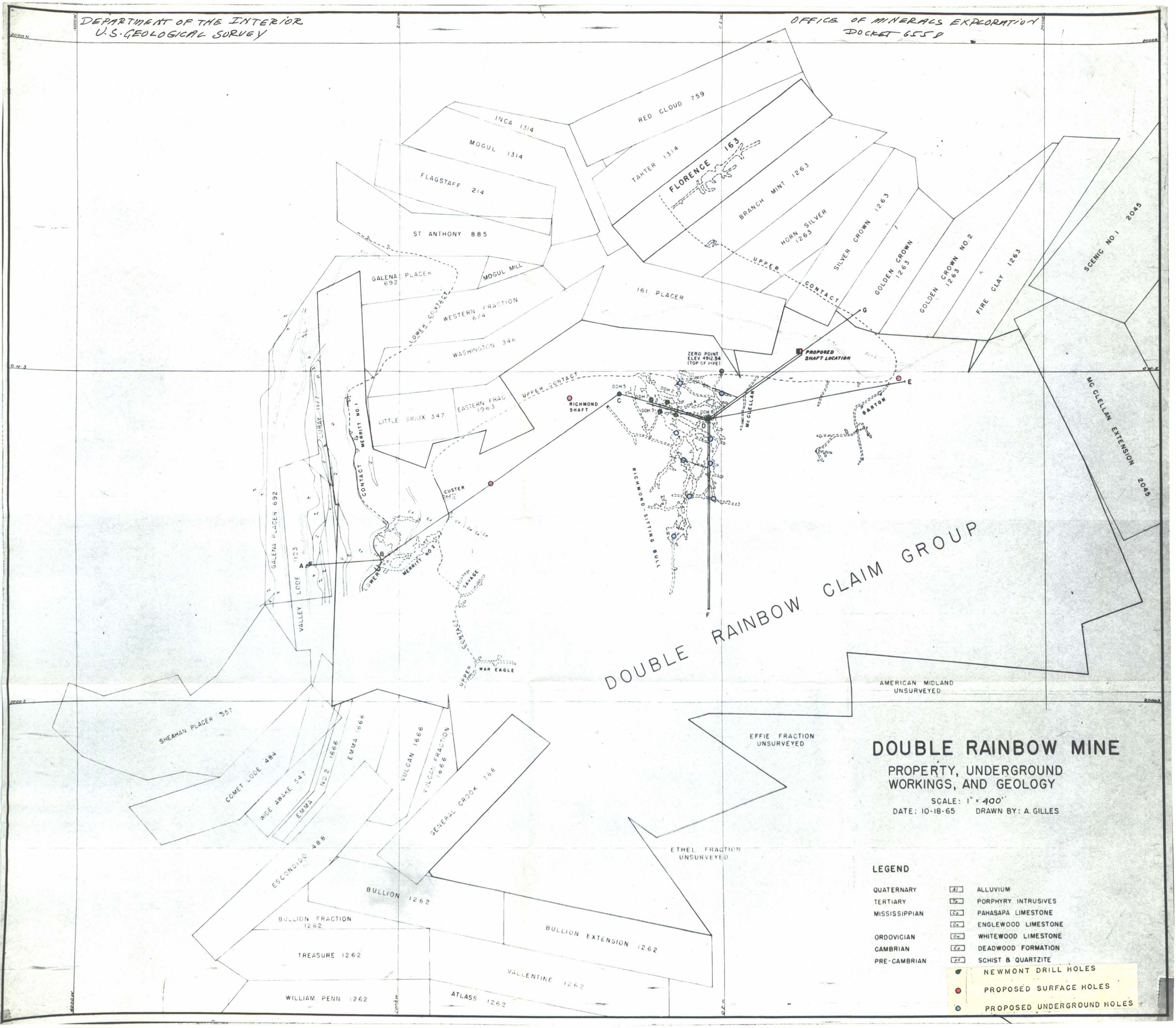
DRAWN BY _____ APPROVED _____
TRACED _____ SCALE 1" = 200'
CHECKED _____ DATE 10-27-65

DOUBLE RAINBOW MINE
SECTION ABCDE AND FDG
THROUGH CUSTER HILL

DWG. NO. Figure 6

DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

OFFICE OF MINERALS EXPLORATION
DOCKET 6558



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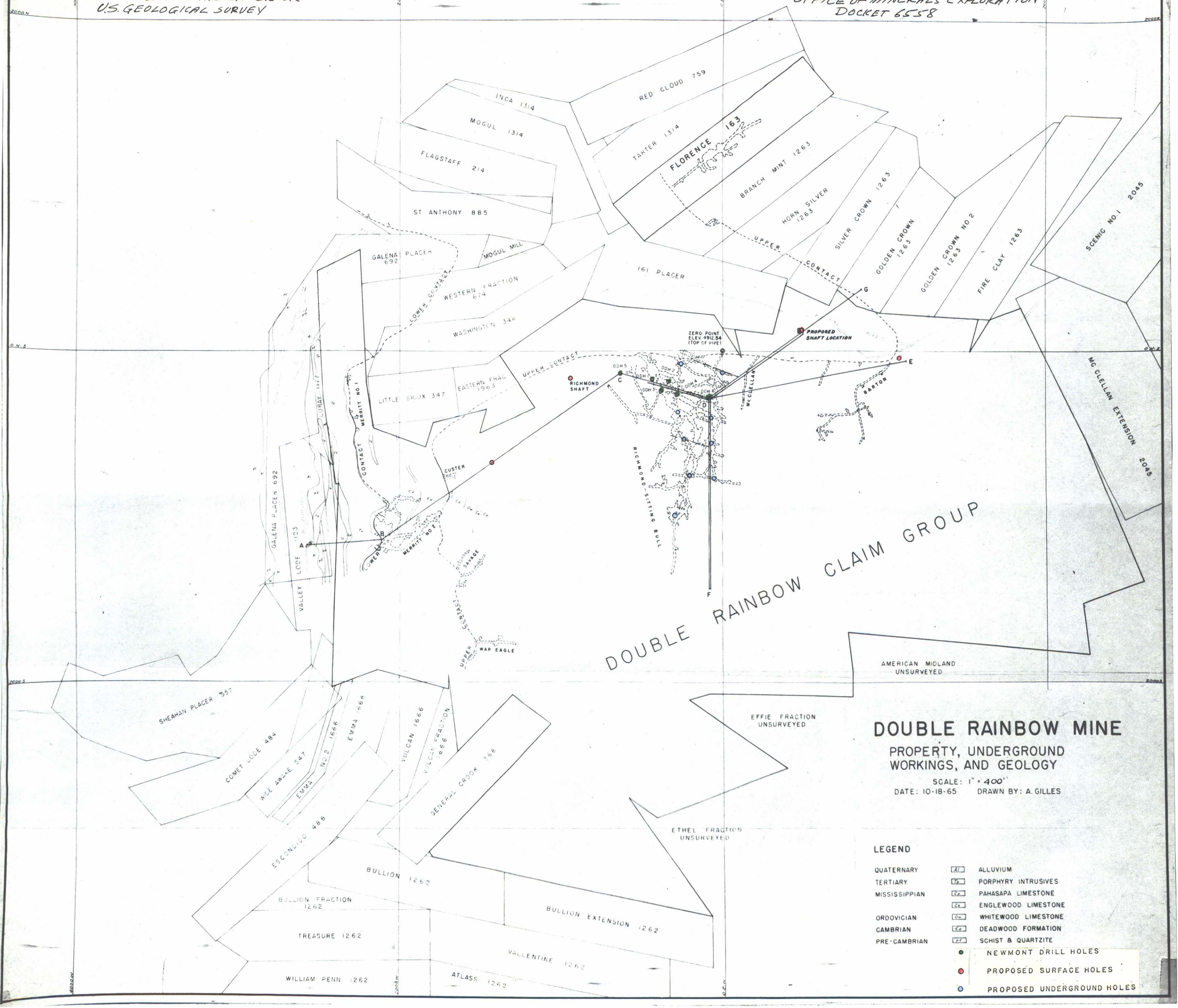
U.S. GEOLOGICAL SURVEY

OFFICE OF MINERALS EXPLORATION
DOCKET 6558



DOUBLE RAINBOW MINE

PROPERTY, UNDERGROUND WORKINGS, AND GEOLOGY

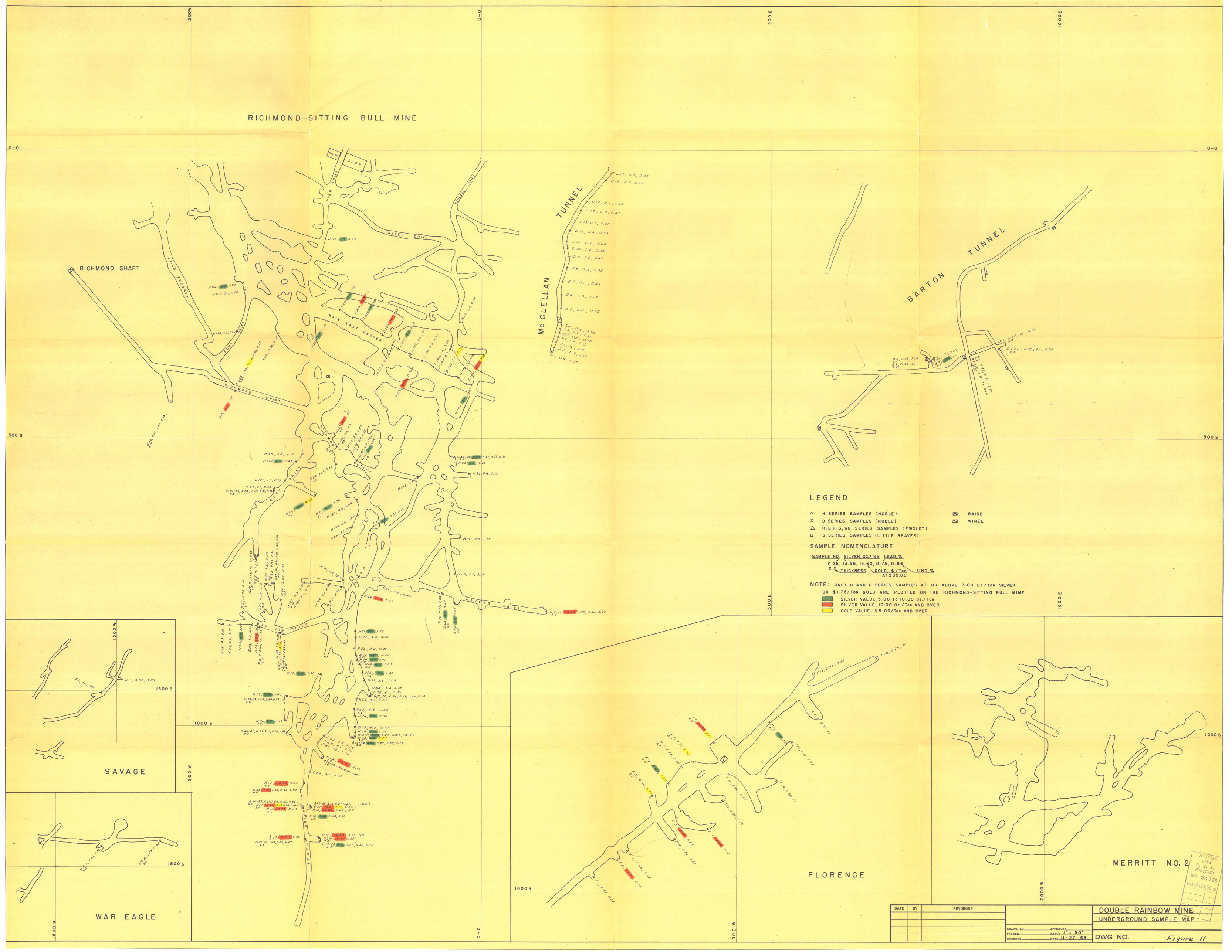
SCALE: 1" = 400'

DATE: 10-18-65 DRAWN BY: A. GILLES

LEGEND

QUATERNARY	Al	ALLUVIUM
TERTIARY	Tp	PORPHYRY INTRUSIVES
MISSISSIPPIAN	Ma	PAHASAPA LIMESTONE
	Me	ENGLEWOOD LIMESTONE
ORDOVICIAN	Ow	WHITEWOOD LIMESTONE
CAMBRIAN	Cd	DEADWOOD FORMATION
PRE-CAMBRIAN	p€	SCHIST & QUARTZITE

- NEWMONT DRILL HOLES
- PROPOSED SURFACE HOLES
- PROPOSED UNDERGROUND HOLES


RICHMOND-SITTING BULL MINE
RICHMOND SHAFT
SHOP
UPPER DRIFT
WATER DRIFT
MAIN EAST HEADER
RICHMOND DRIFT
HAVENS DRIFT
AIR DRIFT
Mc CLELLAN TUNNEL
BARTON TUNNEL
LEGEND
H SERIES SAMPLES (NOBLE)
D SERIES SAMPLES (NOBLE)
R, B, F, S, WE SERIES SAMPLES (EWOLDT)
G SERIES SAMPLES (LITTLE BEAVER)
RAISE
WINZE
SAMPLE NOMENCLATURE
SAMPLE NO.
SILVER, Oz./Ton
LEAD, %
THICKNESS
GOLD, $/Ton At $35.00
ZINC, %
NOTE: ONLY H AND D SERIES SAMPLES AT OR ABOVE 3.00 Oz./Ton SILVER OR $1.75/Ton GOLD ARE PLOTTED ON THE RICHMOND-SITTING BULL MINE.
SILVER VALUE, 5.00 To 10.00 Oz./Ton
SILVER VALUE, 10.00 Oz./Ton AND OVER
GOLD VALUE, $5.00/Ton AND OVER
SAVAGE
WAR EAGLE
FLORENCE
MERRITT NO. 2
OFFICIAL COPY U. S. RECEIVED MAY 23 1966 INITIALS CODE
DATE
BY
REVISIONS
DRAWN BY
TRACED
CHECKED
APPROVED
SCALE 1" = 50'
DATE 11-27-65
DOUBLE RAINBOW MINE
UNDERGROUND SAMPLE MAP
DWG. NO.
Figure 11