COMINCO LTD.

EXPLORATION

NTS: 104K/12E

WESTERN CANADA

1 February 1988

BIG BULL PROPERTY

1987 ASSESSMENT REPORT ON

GEOLOGICAL SURVEY

ATLIN MINING DIVISION

LATITUDE: 58° 40'N; LONGITUDE: 133° 33'W

PERIOD OF WORK

JULY 16 TO AUGUST 4, 1987

JANUARY 1988

T.W. MURARO

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REFERENCES

Irvine, W.T., 1957 — Tulsequah Chief and Big Bull Mines Structural Geology of Canadian Ore Deposits Vol. II

Kerr, F.A., 1948 — Taku River map-area British Columbia Geological Survey Canada, Memoir 248

Nelson, J. and Payne J.G. 1984 — Paleozoic Volcanic Assemblages and Volcanogenic Massive Sulfide Deposits near Tulsequah British Columbia Canadian Journal of Earth Sciences, Volume 21 (pp 379 - 381)

Souther, J.G., 1971 — Geology and Mineral Deposits of the Tulsequah map-area, British Columbia Geological Survey of Canada, Memoir 362

LIST OF ATTACHMENTS

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LATITUDE: 58° 40'N; LONGITUDE: 133° 33'W

I. INTRODUCTION

1. Location

This geological survey is centered on the Big Bull mine site at 58°40'N Latitude 133°33'W Longitude in N.T.S. subdivision 104K/12E. (Fig. 1)

Altered dump material highly visible from the air extends down to river level at the base of slope (25m ASL). A channel of the Taku River (Snye Channel or Bull Slough) marks the northwestern extremity of the marshy vegetated river flats at the mine site 4 km due north of the main Taku River junction with Tulsequah River. From the junction it is 8 km southwest down the Taku to the Alaska border and about 30 km to the head of Taku Inlet. Juneau Alaska is about 50 km by water from the head of Taku Inlet.

Access is possible by suitable water craft from Juneau. Alternative access is by fixed wing aircraft 100 km due south from Atlin to a gravel strip on the west bank of Tulsequah River 3.5 km west of the mine site.

The work described here was made possible by working from a tent camp at Tulsequah Chief mine site which is on the east bank of Tulsequah River 8.5 km northwest of Big Bull. Land based aircraft including a DC3 used the strip and a contracted Bell 206 helicopter transferred men, materials and supplies and effected daily deployment of field crews.

Overmature cedar hemlock stands mantel the relatively steep fjord walls to elevations of 300 to 400 meters above the valley bottom. Alder, mock orange, devils club and a few birch and cottonwood prevail as undergrowth in the lower 200 meters of slope thickening with increasing alder and devils club onto the river flats.

The slope above the Big Bull - the south southeasterly flank of Mt. Manville enjoys a less dense ground cover than other aspects in the region.

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2. Property Ownership and History

Big Bull mine is on Big Bull Crown Grant claim Lot number 6303. The property owned 100% by Cominco includes six Crown Grants and six located claims. The names of claims and their corresponding Lot numbers and Record numbers are listed below.

CROWN GRANTS

Name	Lot No.
Big Bull	6303
Bull No. 1	6304
Bull No. 5	6306
Bull No. 6	6305
Hugh	6308
Jean	6307

LOCATED CLAIMS

Name	Record No.
Big Bull Extension	37/21
Bruce (Fr.)	303
Bull Nos. 2 to 4	141/32, 142/32, 143/32
Bull No. 8	142
Bull No. 9	179
Webb 1	2766

Recorded history of the property dates from late May and early June of 1929 when the original claims including Big Bull went on record in Atlin as being owned by a partnership of seven residents of Juneau Alaska. A preliminary report (June 28, 1929) by D.C. McKechnie describes several exposures of massive sulfide in the bed of a small southeasterly flowing creek occupying a sharp gulch or ravine on the southeast flank of what is now called Mt. Manville. Fully exposed widths of massive sulfide were reported to range from 6 feet to 25 feet; the longest continuous strike exposure was 150 feet and greatest strike separation of exposures was 450 feet. McKechnie noted that the ravine occupied by the showings extended up the mountainside in a nearly straight line for 3,000 feet.

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By October 1929 Alaska Juneau Gold Mining Company had acquired an option to buy 55% interest in the property. Prior to relinquishing their option sometime before August of 1930 this company had driven 2,000 feet northwesterly along the trend of the shear zone, completed 9 short crosscuts to examine and sample the shear zone, and drilled 8 surface holes and one underground hole.

In 1944 Leta Exploration did some underground drilling and abandoned the property rather than make the option payment.

Resampling in 1946 by C.M. & S. (Leo Telfer) confirmed results of previous sampling.

In 1946 C.M. & S. (Cominco) negotiated to acquire both the Big Bull and Tulsequah Chief properties.

During 1949 C.M. & S. drilled 12 surface holes totalling 5,469 feet and cut 135 underground samples. D.C. Malcom combined these results with earlier Leta and Alaska Juneau drill hole assays to produce an ore reserve figure in November 1947.

Production began in 1951 and by 1956 following sinking of a new shaft underground development and stoping up to surface Cominco had mined about 400,000 tons from Big Bull which averaged 0.15 oz. Au/t, 4.5 oz. Ag/t, 1.2% Cu, 1.95 Pb and 7.3% Zn. This ore was trucked 8 km to a leased concentrator on the west side of the Tulsequah River at the site of the Polaris-Taku gold mine.

In the writer's opinion the probability of the existence of additional ore on the Big Bull property is sufficienty attractive to warrant exploration.

3. Summary of 1987 Work

In the period July 16 to August 4, 1987, the writer and an assistant constructed a plane table map of outcrop geology and topography at a scale of 1:1,000 for about 130,000 square meters surrounding the Big Bull mine site.

Control for the major part of this survey was established with a closed transit loop using a rented theodolite and EDM (Electronic Distance Measuring) device.

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This loop is tied into the concrete collar of the Big Bull shaft and extends up the slope to the northeast of the open pit and counter clockwise beyond the north west extremity of the pit and back down the western side to the cliff edge at the head of the pit.

Transit stations served as plane table stations to collect stadia shots for both outcrop limits and geological observations as well as topography.

The course of the transit loop covered 1,211 horizontal meters, ranged through 200 vertical meters by occupying 24 stations and closed with 6 meters horizontal error and no vertical error.

Plane table mapping occupied all transit stations and an additional 11 stations around the surface workings and extending 200 meters south along the road toward the Tulsequah River.

The transit survey and plane table geological and topographical mapping described here was performed on Crown Grants Big Bull and Bull No. 1 and on the Located Claims Big Bull Extension and Webb 1.

II. GEOLOGY

1. Purpose

Current geological understanding of the ore type represented by Big Bull deposit did not exist in the early fities. Previous mining on the property extracted essentially what was found by the prospectors and its downward extension. Diamond drillling and underground openings beyond known ore did not succeed in identifying additional mineable shapes.

The purpose of the mapping described here is to provide the first bedrock geological map of the surface around the Bull mine at a scale which can be tied in with pre-1956 surface drill hole and underground information. This first step is necessary to objectively access the exploration potential of the Big Bull property and to plan additional exploration.

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2. Regional Geology

Kerr (1948) and Souther (1971) have published GSC Memoirs on the geology in vicinity of Taku and Tulsequah Rivers. Both place the Big Bull and nearby deposits Tulsequah Chief and Polaris Taku in the Upper Treassic Stuhini Group. Both Kerr and Souther recongize two main assemblages of volcanic and associated sedimentary rocks within the Stuhini Group. The southwestern assemblage exposed in Tulsequah and Taku River valleys and of primary concern for this report is predominately andesitic and submarine in character.

Nelson and Payne (1984) mapped the Tulsequah-Taku area in 1982 and 1983 and reassigned some of Souther's Upper Triassic Stuhini Group andesitic rocks to a Pennsylvanian-Permian assemblage they called Mount Eaton Group. Big Bull and Tulsequah Chief occur within these reassigned rocks.

3. Local Geology

The geology and structure of the Big Bull deposit is described by Irvine (1957) in Volume II Structural Geology of Canadian Ore Deposits. The description is based on information gathered from drilling and mining a more or less continuous lens of ore approximately 400 meters long striking 310° Az and dipping about 70° southwest. Widths varied from 2 meters to 8 meters at the bedrock surface in southerly sloping (25°) bed of the discovery creek. Within the main pit no ore remains in place - near vertical pit walls are slip surfaces which diverge in plan each merging northwestward with faults which form the two corners of the northwestern end of the pit. Irvine describes the deposit as a lens bounded on both sides by westerly dipping structures which converge to form a "V" in cross section about 70 meters below surface. The lens achieved maximum width of 30 m at its northwestern end and split into two narrow tongues extending another 60 meters or so northward from each flank - each tongue following one of the bounding structures.

a) Mineralization

Numerous blocks and fragments of mixed sulfides are scattered on the dumps, in the bottom of the pit and along the flanks of the pit. The ore is classic volcanogenic sulfide rock - an intimate mixture of fine to medium grained crystalline sphalerite, pyrite galena and chalcopyrite in a barite dominated gangue. A moderate to strong planar to gneissic fabric is evident in most pieces. This fabric is evident as segregations of different proportions of sulfides and barite as well as concentrations of talcose, phyllitic, lithic material as streaks and bands or layers of discrete fragments. Experience indicates these various examples of

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b) Dacite

This field term applies to the one felsic lithology mapped at the Bull (Figure 2). Thin (1mm) serecitic folia separate lenticular shapes 5 to 15 mm of white to translucent grey green to translucent apple green, aphanitic siliceous material. Fine grained pyrite is ubiquitous ranging from less than 1 to 10 percent by volume. All weathered exposures display a rusty scale and a bleached rind. Altered feldspar laths, rare quartz eyes and traces of sphalerite and galena can be found. In places a course lumpy lenticular structure suggests a primary fragmental nature with 1 to 5 cm clasts. This dacite forms the northeast flank of the open pit and extends - apparently as a continuous mass eastward and northward up the slope to a maximum elevation of 220 meters forming an area in plan up to 120 m wide and 400 m long. At the pit this rock forms the structural footwall of the ore. The internal structure of this rock is dominated by strong foliation striking 315° Az with vertical to steep southwest dips. Northof the south end of the pit near station 4 the dacite is in apparent stratigraphic contact with andesitic rocks on a vertical surface which strikes 330° Az. This is the only mapped contact on the northeastern edge of the dacite.

A second area of dacite, presumably the same unit, is exposed in a few outcrops near river level in a triangular area south of the dumps at the southeastern end of the pit. This area extends 130 meters south along the bank of Snye channel (Bull Slough) from the boat landing at the site of the lowest portal. As such it lies southwest of the southeastern projection of the ore bounding structures in the pit.

c) Andesitic 1
Rocks NE of Dacite

Mapping was carried far enough northeast of the pit to establish outcrop limits of the prospective dacite, provide some bedrock information about the successive lithologies to the northeast and establish several stations for future mapping northeastward along the hillside.

At the contact described earlier near station 4 dacite lapilli tuff is sharply bounded on the northeast by 1 to 2 meters of fine grained dark green andesite containing calcite amygdules and calcite filled fractures. This thin flow or intrusive is followed to the northeast by at least 30 meters of andesitic crystal and lithic tuff with swirled flow structure. Higher on the slope at, and below station 9B a large outcrop of swirled lumpy andersite pock-marked by carbonate dissolution contains quartz knots and jasper lumps and occupies a similar relative position to the pyritic dacite. Further upslope the rocks exposed northeast of the dacite are massive pyroclastics with andesitic matrix and predominately andesitic clasts plus epidote clots and a few dacite clasts. These exposures do not exhibit any mappable fabric or layering.

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d) Andesite 2
Rocks NW of Pit

Northwest beyond the highest mapped exposures of dacite, upslope from the junction of the two creeks flowing into the open pit draw (above stations 16 and 17) green and mixed purple and green andesitic rocks predominate. These appear to be mainly massive flows with calcite amygdules and exhibiting good flow fabric shown by purple and green color streaking - mixed with minor amounts of purple lithic tuff. These rocks form the southwest side of the steep creek gully which leads southeast into the head of the pit.

e) Andesite 3
Rocks SW and S of Pit:

Within the area mapped this portion has the fewest exposures notwithstanding a strip of outcrop bordering the west side of the haulage road which probably represents the limit of a former river terrace.

Within the pit several en echelon large slip surfaces at 310° Az and near vertical expose vertically foliated altered sericitic and chloritic volcanic rock with abundant pyrite. This is the sub ore grade southwest margin of extracted massive sulfide ore. However, the top few meters of bedrock on the southwest edge of the pit and extending for a few meters steeply back from the pit wall are green andesitic rocks. These are slightly foliated but relatively massive and slighty recrystallized andesite flows lapilli tuffs and breccias. They contain no pyrite and do not appear to be hydrothermally altered. The contact between these rocks and the underlying ore-bounding wall of the pit is a tight plane which can be traced as a line which climbs uphill along the southwest pit wall for 100 meters more or less parallel to the bedrock surface and 2 to 4 meters below it. On close examination the plane appears to be a fault striking 090° Az and dipping south at 30°. The trace of this plane on the steep pit wall is so sharp as to suggest it has been truncated by near vertical structures in the pit.

The slightly recrystallized or hornfelsed nature of these andesitic rocks at pit edge is seen again in mixed andesite and minor dacite exposed near the haulage road south of the mine. Between these exposures and the river channel a few outcrops of rusty pyrite bearing serecitic dacite occur in the triangular area of ore-related dacite referred to under the previous section on dacite.

f) Structure

Measured attitudes of stratigraphic layering are scarce - 4 or 5 at most. All strike 310 - 330° Az with vertical to steep dips. Only two of these can be taken as contact between depositional units and one of these

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is disturbed and therefore somewhat doubtful. This latter being the structural and possible stratigraphic footwall of the main ore lens against the highly foliated, altered, pyritic dacite along the northeast wall of the pit.

A few limited exposures of contorted millimeter scale fine laminations in green and white and some coarser streaking in green and purple is taken as flow banding best seen NW of the pit.

Foliation, predominately tectonic foliation, is pervasive through most of the mapped outcrops. It is best developed around the pit and within the pyritized dacite away from the pit. It is less strong at the upslope extremities of the mapping where massive andesitic rocks prevail.

The strongest faults observed are exposed at the limits of the pit projecting more or less along strike from the former ore lens. In the extreme northwest corner of the pit about 15 meters below station 23 drawdown of the pit exposes the 5,000 foot level drift.

A 2 meter wide talcose sericitic gouge filled fault strikes 310° Az and dips 70 to 80° SW in the back of the drift.

The map (Figure 2) shows this fault projected northwestward toward the prominent fork in the discovery creek and southeastward through the pit to the river level. Relative motion preliminary interpretation treats this as a normal fault with an unknown amount of relative motion west side down and unknown sense or amount of strike slip movement.

A second direction of faulting at 010° Az is represented by prominent surfaces on the footwall side of the pit that dip 70° west indicating apparent right lateral relative motion.

This east side south relative motion is tentatively regarded as responsible for positioning the ore-related dacite along the river bank southwest of the line of the pit.

The surface described earlier which forms the trace of a contact on the SW wall of the pit is interpreted as a fault and as such represents the only example of a third direction of faulting at 090° and dipping 30° S.

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Rocks grouped in unit Andesite 3 which seem to display a higher grade of thermal metamorphism relative to other two andesite subdivisions lie above or in the hanging wall of this south dipping fault.

Moreover, the northeast side of the pit which stands at least several meters higher than corresponding positions on the opposite wall shows no sign of this fault. This could be explained by normal motions on the 310° Az fault following creation of the third (090° Az) direction of faulting.

Widespread tectonic fabric of consistent attitude suggests folding at some intermediate or major scale has a significant effect on the bedrock geology of the south slope of Mt. Manville. One tectonic fold was observed, it is only partially exposed (a minimum 3 meters of half amplitude) in dacite 10 meters north of the old shaft on northeast side of the pit. The crest of an upright anticline is defined by a core of green andesite wrapped over and down the east side into the creek draw by dacite. Course fluting provides a "b" lineation plunging 5 degrees at 330° Az. Prominent planner vertical joint surfaces strike 050° Az.

A larger anticlinal crest of the same attitude can be called on to explain the outcrop pattern of dacite on the hillside north of the pit. The southwestern half of this larger fold may be faulted down by the main 310° fault in the pit.

III. SUMMARY AND CONCLUSIONS

Given that this is a typical volcanogenic syngenetic sulfide-sulfate deposit then:

a) The structures which limit the extracted ore and the ore-related dacite are post ore.

b) The covered northeastern contact of the dacite could be the prospective horizon.

c) The dacite exposed south of the dumps along the river could be stepped south along 010° faults. Moreover the southwestern limit of this dacite (corresponding to the ore position in the pit) may not appear at bedrock surface because of the 090° south dipping fault overriding the key stratigraphy with meta andesite (Andesite 3). If this is the case, the dashed contact limiting Andesite 3 would be a fault.

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IV. RECOMMENDATIONS

1. Mapping: 1:1,000

   a) Along main creek and tributaries northeast of pit.

   b) 3 or 4 strips reaching away from both sides of present mapping along contours.

   c) West of haulage road to Tulsequah River.

2. Geochemistry:

   i) Contour soils 20 m intervals

      a) Along 50, 100 and 150 m contours for 2 km either side of pit.

   ii) Rock

      a) Two traverses across maximum width of dacite north of pit.

      b) Exposures of dacite south of dumps near river.

Reported by: T.W. MURARO
Consulting Geologist

Approved for Release by: W.J. WOLFE
Manager, Exploration - Western Canada

TWM/eml

APPENDIX "A"

STATEMENT OF EXPENDITURES
JUNE 16 - AUG. 4, 1987

Salaries		
T.W. Muraro	20 days @ $295/day	$ 5,900.00
R. McGillivary	20 days @ $130/day	2,600.00
Transportation		
Fixed Wing		1,005.00
Helicopter		7,098.00
Surveys and Ground Control		
Equipment Rental Theodolite and EDM		1,060.00
Supplies and Equipment Purchase		783.00
Repairs		171.00
Communications		1,028.00
Domocile - food, shelter	40 man days @ $60/day	2,400.00
		$22,045.00

APPENDIX "B"

EXPLORATION WESTERN CANADA

IN THE MATTER OF THE B.C. MINERAL ACT AND

IN THE MATTER OF A GEOLOGICAL MAPPING PROGRAM

CARRIED OUT ON THE BIG BULL PROPERTY

LOCATED IN THE ATLIN MINING DIVISION OF THE PROVINCE OF

BRITISH COLUMBIA - MORE PARTICULARY N.T.S. 104K/12E

A F F I D A V I T

I, THEODORE W. MURARO OF THE MUNICIPALITY OF WEST VANCOUVER, IN THE PROVINCE OF BRITISH COLUMBIA, MAKE OATH AND SAY:

1. THAT I AM EMPLOYED AS AN IN-HOUSE CONSULTING GEOLOGIST BY COMINCO LTD. AND AS SUCH HAVE A PERSONAL KNOWLEDGE OF THE FACTS TO WHICH I HEREINAFTER DEPOSE:

2. THAT ANNEXED HERETO AND MARKED AS "APPENDIX A" TO THIS MY REPORT IS A TRUE COPY OF EXPENDITURES OF A GELOGICAL MAPPING PROGRAM CARRIED OUT ON THE BIG BULL PROPERTY.

3. THAT SAID EXPENDITURES WERE INCURRED FROM THE 16TH DAY OF JULY TO 4TH DAY OF AUGUST 1987 FOR THE PURPOSE OF MINERAL EXPLORATION ON THE BIG BULL PROPERTY.

Muraro

T.W. MURARO

APPENDIX "C"

EXPLORATION WESTERN CANADA

STATEMENT OF QUALIFICATION

I, THEODORE W. MURARO, OF THE MUNICIPALITY OF WEST VANCOUVER, HEREBY CERTIFY:

- THAT I AM A GEOLOGICAL ENGINEER RESIDING AT 4438 STONE COURT, WEST VANCOUVER, BRITISH COLUMBIA WITH A BUSINESS ADDRESS AT 2400 - 200 GRANVILLE STREET, VANCOUVER, BRITISH COLUMBIA.

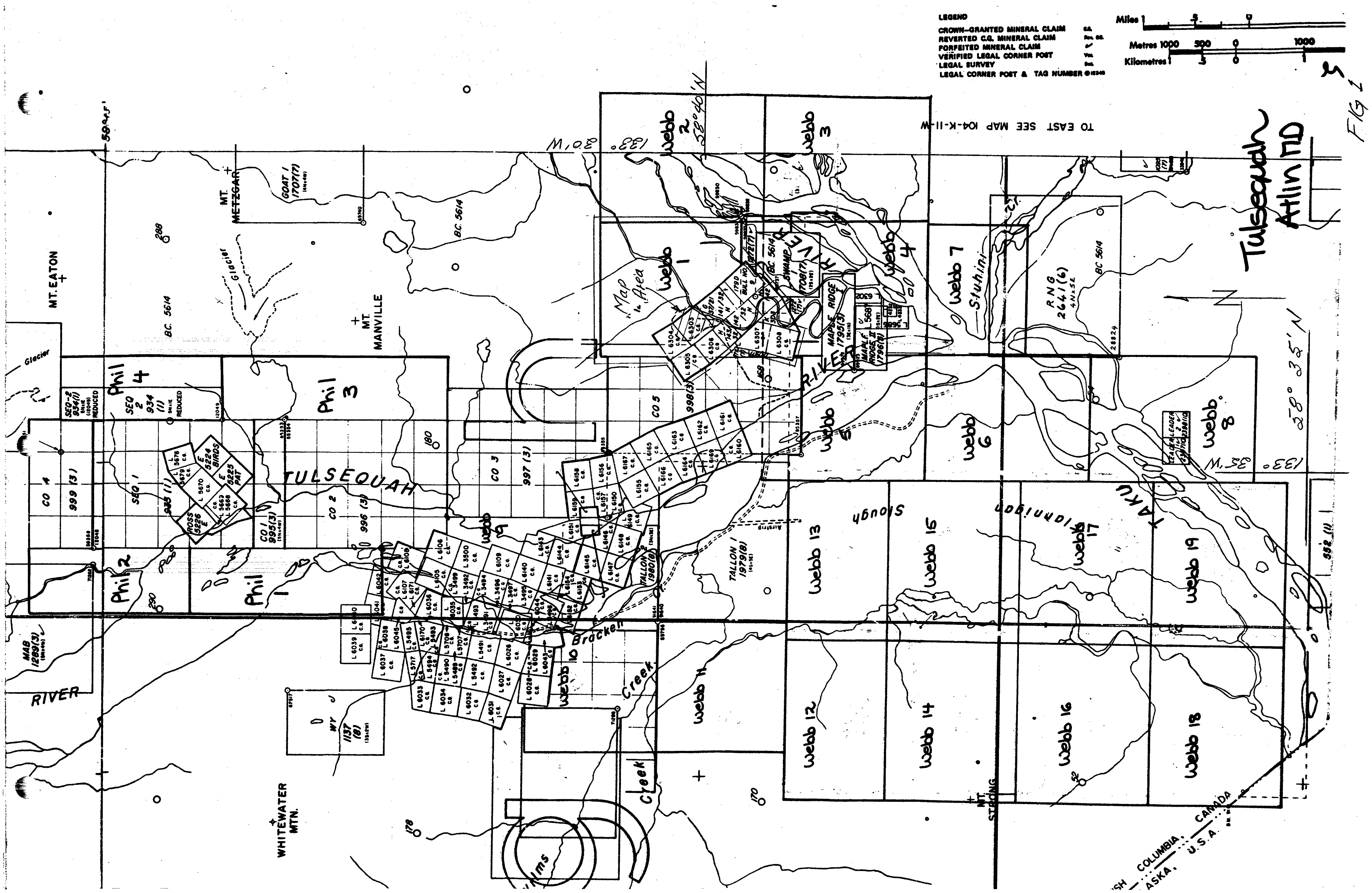
- THAT I GRADUATED WITH BASC DEGREE IN GEOLOGICAL ENGINEERING FROM THE UNIVERSITY OF BRITISH COLUMBIA IN 1956 AND A MSC IN GEOLOGY FROM QUEEN'S UNIVERSITY, KINGSTON, ONTARIO IN 1962.

- THAT I HAVE PRACTISED GEOLOGY WITH COMINCO LTD. FROM 1956 TO PRESENT.

- THAT I AM A REGISTERED MEMBER OF THE ASSOCIATION OF PROFESSIONAL ENGINEERS OF THE PROVINCE OF BRITISH COLUMBIA.

DATED THIS " 11 " DAY OF FEBRUARY 1988
AT VANCOUVER, BRITISH COLUMBIA

T.W. MURARO
BASC, MSC, P. ENG.



LEGEND
CROWN-GRANTED MINERAL CLAIM
REVERTED C.G. MINERAL CLAIM
FORFEITED MINERAL CLAIM
VERIFIED LEGAL CORNER POST
LEGAL SURVEY
LEGAL CORNER POST & TAG NUMBER
Miles
Metres 1000 500 0 1000
Kilometres 1 .5 0 1
FIG 1
Tulsequah
Atlin MD
TO EAST SEE MAP 104-K-11-W
MT. EATON
MT. METZGAR
MT. MANVILLE
WHITEWATER MTN.
MT. STRONG
TULSEQUAH
RIVER
TAKU
Bracken
Creek
Slough
BRITISH COLUMBIA, CANADA
ALASKA, U.S.A.
Webb 1
Webb 2
Webb 3
Webb 4
Webb 5
Webb 6
Webb 7
Webb 8
Webb 9
Webb 10
Webb 11
Webb 12
Webb 13
Webb 14
Webb 15
Webb 16
Webb 17
Webb 18
Webb 19
Phil 1
Phil 2
Phil 3
Phil 4
Map Area
58°40'N
58°35'N
133°30'W
133°35'W

9600E 9700E 9800E 9900E 10000E

10400N 10300N 10200N 10100N 10000N 9900N

PIT OR GLORY HOLE

BIG BULL L 6303
BIG BULL EXTENSION R.M. 3712

BULL (SHIE) CHANNEL

Scaled from Ministry Claim Map

Not located on ground

Bearing Tree Large Cottonwood 6 milk marker on Bull - Chief road

Dac DACITE — Aphanitic, translucent apple green to white, fragmental in places, foliated sericite, 1-10 percent pyrite

And 1 ANDESITE 1 — Mixed flows breccias tuffs Swirled scoriaceous appearance in places. Apparent stratigraphic footwall to Dacite

And 2 ANDESITE 2 — Massive green and mixed green and purple flows and fine lithic tuffs. Flow banding fault contact with Dacite

And 3 ANDESITE 3 — Flows, breccias lapilli tuffs some flow structures. Recrystallized. Fault contact with Dacite and Andesite II

Foliation

Lineation cumulations, minor fold axis

Lineation in plane of foliation

Outcrop

Geologic contact; mapped, interpreted

Fault; mapped, interpreted

Spring, sink

Stream

Road, rail bed

Contour 10m interval

Survey station 30-50 cm stake, faced, numbered, plus numbered aluminum disk fixed to top with nail. Subscript number is elevation meters. Elevation Δ1 at South corner of concrete shaft collar is arbitrary choice 40.27m ASL.

Orientation of grid transferred from plan of mine workings.

0 50 100 meters

GEOLOGICAL BRANCH ASSESSMENT REPORT

16,983

Drawn by: TWM	Traced by:	BIG BULL GEOLOGY
Revised by / Date	Revised by / Date	Scale: 1:1000 Date: JAN 88 Plate: Fig 2

NCI - 119 - C.L.

Form 210 - 0660