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WALHACHIN EAST QUARRY FEASIBILITY STUDY
WORK ASSESSMENT REPORT

DON 1 TO 6 MINERAL CLAIMS

KAMLOOPS MINING DISTRICT

NTS 92-I/10 and 92-I/15

50°45' Latitude, 120°59' Longitude

OWNER: MR. MARTIN BOBYN
OPERATOR: CP RAIL

FILMED

CONSULTANT: CLIFTON ASSOCIATES LTD.

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FILE R1277B

27 JULY 1993

GEOLOGICAL BRANCH
ASSESSMENT REPORT

22,950



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*Years of Quality
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27 July 1993
File R1277B

Gold Commissioner Office
250 - 455 Columbia Street
KAMLOOPS, British Columbia
V2C 6K4

ATTENTION: Gold Commissioner

SUBJECT: Walhachin East Mineral Assessment Report
WALHACHIN, British Columbia

Please find enclosed two copies of the Walhachin East Quarry Feasibility Study Work Assessment Report. This report, which is being submitted for mineral assessment credit, documents both the physical and geological work conducted on the DON claims during 1992. In addition, assessment report title page, statement of work, notice to group and bill of sale absolute forms are also enclosed.

If you have any questions or comments, please call.

Yours truly,

CLIFTON ASSOCIATES LTD.

GREG M. HERASYMUIK, PROJECT GEOLOGIST
GMH/ic

Distribution: Gold Commissioner Office - 2 copies

pc: Mr. Jan Kubik, CP Rail, Vancouver, British Columbia

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1.0 INTRODUCTION

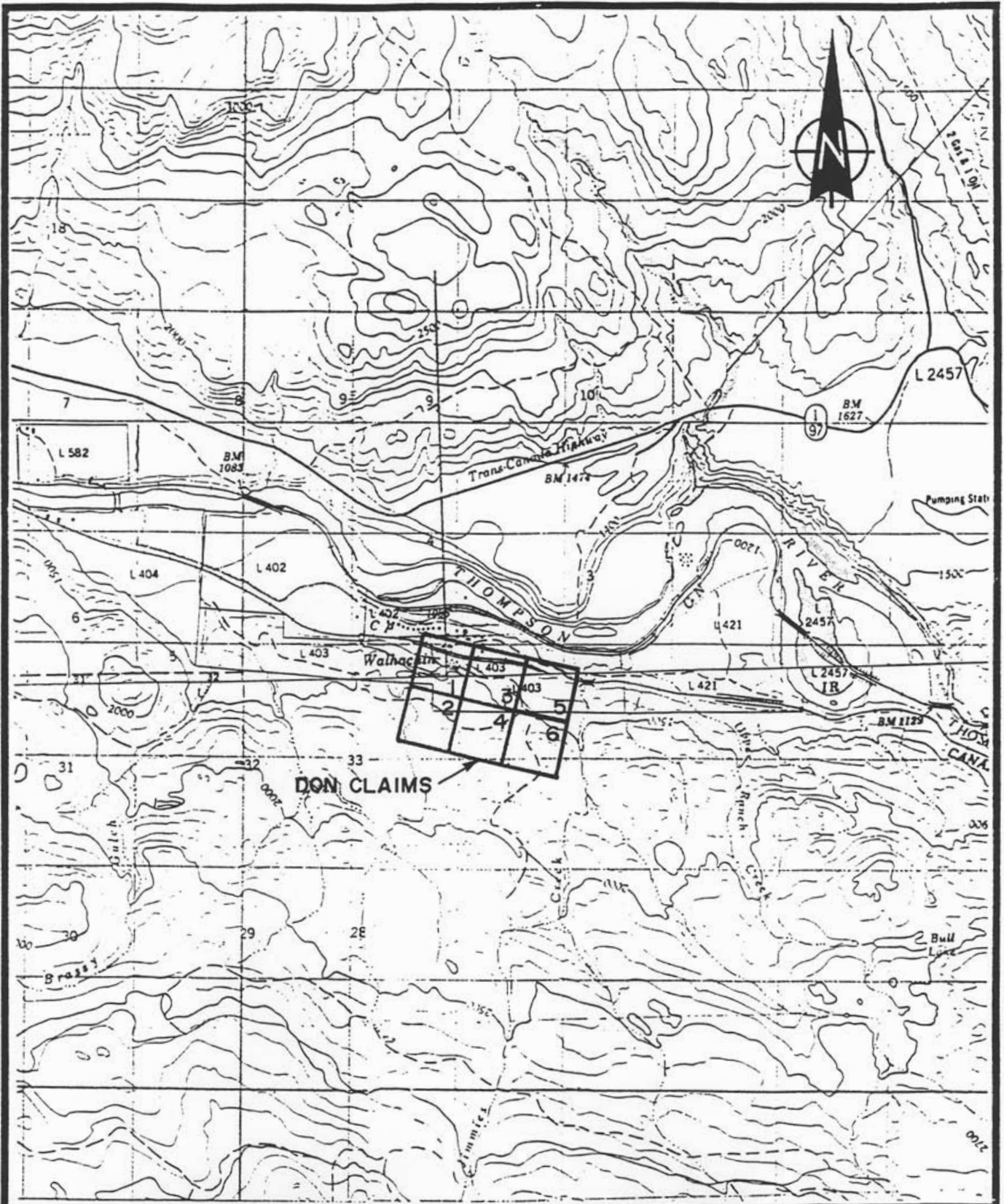
1.1 General

The DON Claims are located approximately 65 km west of Kamloops, British Columbia. The claims are located on the south side of the CP Rail mainline, across from the village of Walhachin. A ballast quarry owned and operated by CP Rail is located on the claims. Access to the claims is via the quarry access road. The claims are located on the 92-I/10 and 92-I/15 NTS sheet. The location is shown on Figure 1.1. The 1992 investigation, which is being submitted for mineral assessment credit, focused on an area east of the existing Walhachin Quarry. This area lies on the DON 3 and DON 5 claims and is referred to as the Walhachin East site.


1.2 Scope

The scope of the investigation is as follows:

- Evaluate the DON 3 and DON 5 claims for their potential as a ballast source.
- Complete a diamond drilling program to further define the geology of the DON 3 and DON 5 claims.
- Conduct a detailed test pit program to determine overburden thickness in this area
- Obtain additional bulk samples from the site and conduct physical testing according to "CP Rail Specifications for Ballast."
- Complete petrographic examination of all bulk samples and diamond drill core.
- Define geological conditions, evaluate the rock quality and examine the feasibility of various preliminary design concepts and reserve estimates.



DATE	93/05/03	DRAWN BY	DMP	APPROVED BY	SCALE	1:50,000	FIGURE	1.1
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Clifton Associates Ltd.
 CONSULTING REGINA GEOTECHNICAL ENGINEERS SASKATOON

CLIENT	CP RAIL
PROJECT	WALHACHIN QUARRY EAST
TITLE	LOCATION PLAN

Topographic maps and detailed geologic mapping were completed prior to the claims being recorded in 1991.

2.0 LAND STATUS

The mineral rights are held by Mr. Martin Bobyn. The operator of the property is CP Rail. The claims are referred to as the DON claims 1 through 6. Table 2.1 summarizes the claim data. Refer to Figure 2.1.

TABLE 2.1
Mineral Claim Summary

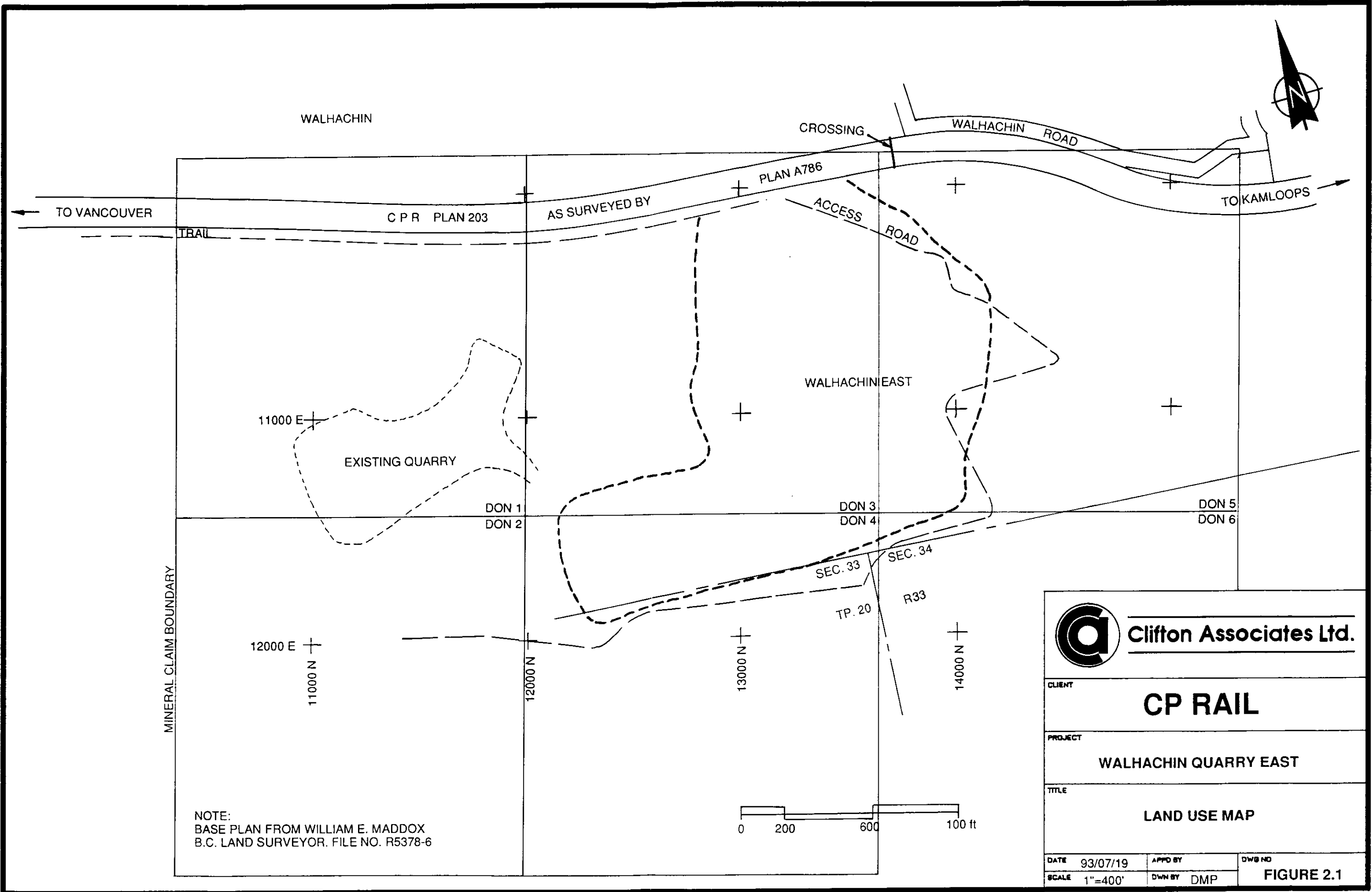
Claim Name	GTD	Tenure #	Tag #	Map #
DON 1	1993/Aug./02	303157	620071M	092I10W-E
DON 2	1993/Aug./02	303158	620070M	092I10W-E
DON 3	1993/Aug./02	303159	620069M	092I10W-E
DON 4	1993/Aug./02	303160	620068M	092I10W-E
DON 5	1993/Aug./02	303161	620067M	092I10W-E
DON 6	1993/Aug./02	303162	620066M	092I10W-E

3.0 WORK SUMMARY

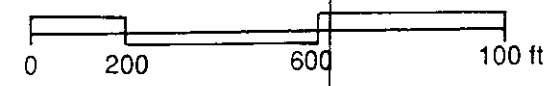
The site investigation consisted of diamond drilling, overburden test pitting and bulk sampling.


3.1 Geological Mapping

Detailed mapping was conducted prior to the field program. This mapping was conducted to confirm the reconnaissance mapping conducted in 1991 and assist in planning the field program. Aerial photographs were used to locate outcrops mapped during the reconnaissance mapping at a scale of 1"=100'.



NOTE:
 BASE PLAN FROM WILLIAM E. MADDOX
 B.C. LAND SURVEYOR. FILE NO. R5378-6



 Clifton Associates Ltd.		
CLIENT	CP RAIL	
PROJECT	WALHACHIN QUARRY EAST	
TITLE	LAND USE MAP	
DATE	93/07/19	APPD BY
SCALE	1"=400'	DWN BY
		DMP
		DWG NO
		FIGURE 2.1

32 Overburden Test Pits

Thirty test pits were dug during the 1992 field investigation. Logs from these test pits are reported in Appendix A. The purpose of the test pits was to determine overburden thicknesses and obtain representative bulk samples. A Komatsu 200 backhoe was used for digging the test pits. In addition to measuring overburden thickness and sampling bedrock (where encountered), the soil profile was described for each of the test pits. The test pits were tied in to the existing grid by total station survey. A summary of the 1992 test pits is outlined in Appendix A and the test pit locations are shown in Drawing No. R1277B-1.

33 Bulk Sampling

Three bulk samples were taken as part of the 1992 detailed site investigation. Representative rock material was collected from each site and shipped to Clifton Associates Ltd. laboratory in Regina, Saskatchewan. The samples were crushed and subject to physical testing and petrographic analysis. The bulk sample location data is summarized in Table 3.1. Bulk sample locations are indicated on Drawing No. R1277B-1. Locations of the 1991 are also shown on this drawing.

TABLE 3.1

Summary of Bulk Samples

Bulk Sample Number	Location		Rock Type
	Northing	Easting	
1992 - 01	13214	11313	Mafic tuff
1992 - 02	13455	11972	Mafic/Int. tuff
1992 - 03	14075	10321	Mafic/Int. breccia

34 Diamond Drilling

Tonto Drilling Ltd. of Kamloops, British Columbia was contracted to drill 5 holes totaling 1,600 feet. Drilling commenced on 30 November 1992 and was

completed on 14 December 1992. BQ and HQ size core was recovered by a skid mounted Longyear 38 diamond drill. The core was geologically and geotechnically logged and stored on site. The diamond drill hole locations and elevations were surveyed using a total station survey. Diamond Drill hole logs are presented in Appendix B.

BQ size core was recovered from DDH Nos. 301 and 302. Highly fractured bedrock resulted in poor hole conditions, slow drilling and poor core recovery. Consequently, Tonto Drilling Ltd. chose to use HQ size equipment. Progress improved significantly upon converting to HQ size core. Diamond drill hole details are summarized in Table 3.2.

TABLE 3.2

Diamond Drill Summary

Diamond Drill Hole No.	Core Size	Azimuth	Incl.	Northing	Easting	Elev.	Length (ft)
DDH 301	BQ	076	-42	13281.83	11635.96	1554.47	415
DDH 302	BQ	040	-42	13635.66	11591.91	1562.56	430
DDH 303	HQ	040	-46	13312.55	11209.38	1513.32	366
DDH 304	HQ	045	-45	14095.31	11159.23	1470.37	296
DDH 305	HQ	040	-42	13245.40	10433.62	1327.87	93

DDH 301 and DDH 302 were drilled immediately south of 2 knobs located near the south boundary of the Walhachin East property. DDH 303 was drilled near an intermittent stream bed on the southwest flank of Reservoir Hill. DDH 304 was drilled adjacent to the road south of Rattler Hill and DDH 305 was drilled near the northern base of Reservoir Hill. Drawing R1277B-1 illustrates the diamond drill hole locations

3.5 Petrographic Analysis and Physical Testing

Representative samples were examined in thin section using a polarizing microscope. Results of the thin section petrographic analysis are presented in Appendix C.

Petrographic analysis and physical tests completed on the three bulk samples taken in 1992 are detailed in Appendix D. The samples were subjected to a full suite of physical tests as prescribed by the CP Rail Specifications for Ballast.

4.0 GEOLOGY

4.1 Surficial Geology

Geomorphology

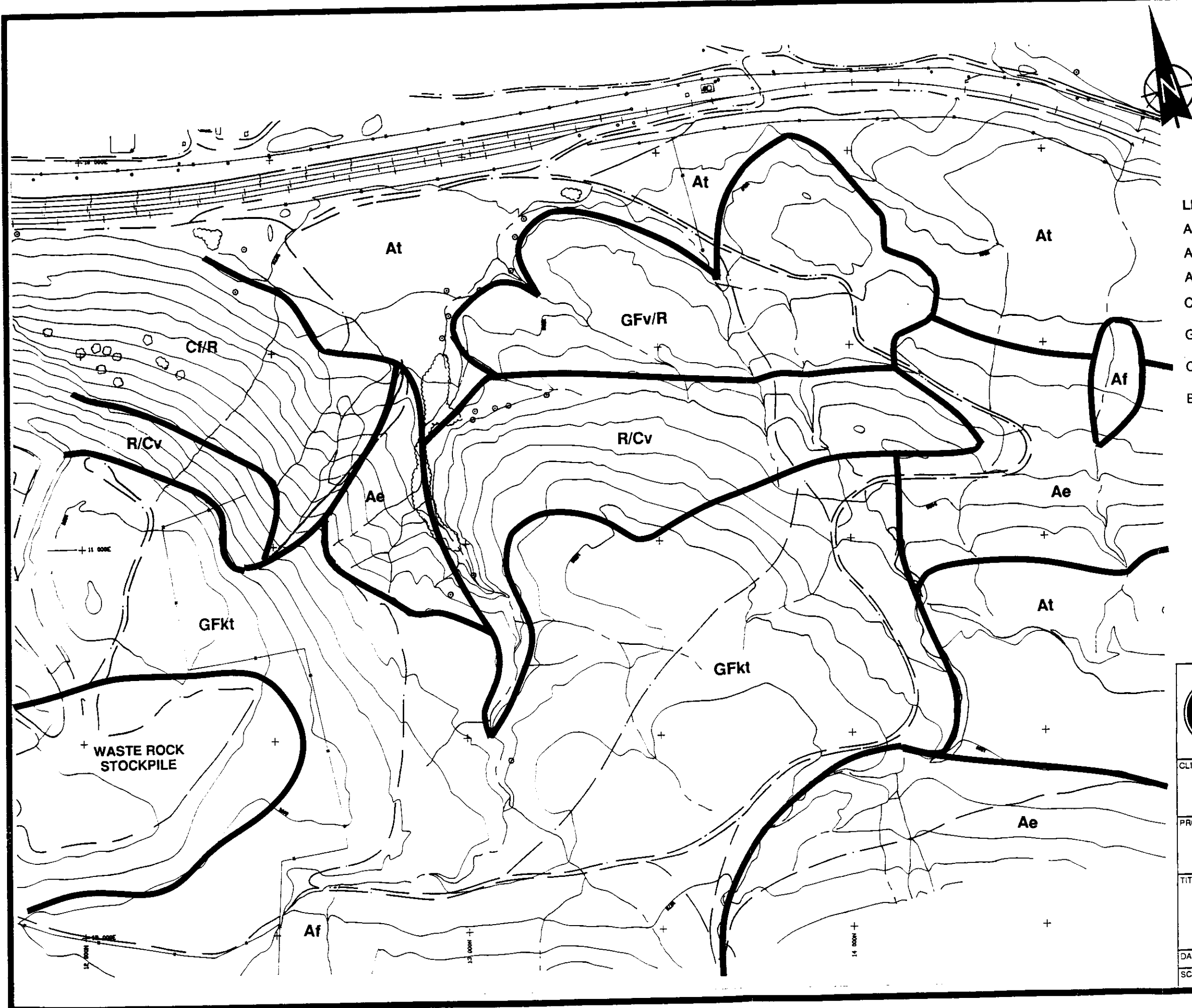
Five separate geomorphological units can be determined on the basis of stratigraphy and landforms. Refer to Figure 4.1.

Alluvial Terrace


This unit describes broad flat terraces that are characteristic of the Thompson Valley in this region and are generally composed of well sorted alluvium. A broad flat terrace defines the eastern limit of potential development. Three broad terrace levels exist within the site. The upper terrace is located along the eastern edge of the site and defines the eastern limit of potential development. A second terrace at the 1310 elevation is located below and north of the first terrace. The third terrace is the very well developed and extensive terrace level in which the tracks and the town of Walhachin are built.

Eroded Alluvium

This unit represents features created by the erosion by streams of previously deposited alluvium. This unit is restricted to the northern portion of the broad alluvial terrace located at the eastern edge of the site. Here erosion has defined the northern edge of the upper terrace.



- LEGEND:**
- Ae ALLUVIAL, ERODED
 - At ALLUVIAL, TERRACE
 - Af ALLUVIAL FAN
 - Cv COLLUVIAL VENEER
 - GFv/R GLACIOFLUVIAL, KAME TERRACE
 - GFkt COLUVIAL FAN/TALUS
 - Cf BEDROCK
 - R

 Clifton Associates Ltd.		
CLIENT	CP RAIL	
PROJECT	WALHACHIN QUARRY EAST	
TITLE	GEOMORPHOLOGY	
DATE	93/05/03	APPD BY
SCALE	1" = 250'	DWN BY
		DMP
		DWG NO
		FIGURE 4.1

Alluvial Fan

This geomorphological unit is found in several places throughout the site. It is characterized by an outspreading deposit of alluvium at the base of a steep slope where intermittent streams deposit material.

Glaciofluvial Kame Terrace

This unit comprises much of the south and central portion of the site and is generally composed of clay silt and occasional gravel fluvial deposits. This terrace, in places, is dissected by gullies created by intermittent streams.

Glaciofluvial Veneer

This unit represents an area where a thin veneer of glaciofluvial sediments overly bedrock. The thin veneer is intermittently broken by bedrock outcrops. This unit is common along the northern slopes of the site extending down almost to track level.

Rock Slides and Debris

This unit is characterized by a cover of rock debris created by the downward movement of broken rock debris. This unit is found along the steep north facing slope along the west side of the site.

Stratigraphy

Overburden within the area is comprised of three main soil strata:

Till

The till consists of silt and fine sand with some gravel sized particles throughout. The matrix contains minor amounts of clay. Particles are subrounded to angular and predominantly composed of volcanic tuff. Cobbles and boulders up to 30 inches in diameter are common within the till, especially close to its contact with the underlying bedrock. This unit was encountered in numerous test pits on south Reservoir Hill as well as DDH 301 and DDH 302. It comprises the 2 knobs of south Reservoir Hill from 4 feet to 8 feet to bedrock. A

hard pan encountered on south Reservoir Hill occurs within this unit. This unit is interpreted as a lodgment till.

Alluvium

Alluvial deposits are composed of subangular to rounded gravel, cobbles and boulders with variable amounts of sand and silt to gravely and bouldery silt and sand. These soils are a result of the glaciofluvial deposition of reworked tills. These soils cover much of the study area, particularly at elevations lower than the top of Reservoir Hill. Soils encountered in Test Pit Nos. 39 to 42, 45 to 49 and 51 to 58, in an area between Rattler Hill and Reservoir Hill, are comprised mainly of well rounded cobbles and boulders up to 20 inches. These soils probably result from the reworking of alluvial and soils in a high velocity glaciofluvial channel.

Silt and Clay

These deposits are generally buff coloured, loose to semi-consolidated, blocky and friable, massive to thinly laminated. This unit ranges in thickness from 2 feet to 8 feet. Where present, it overlies the till and alluvium. This unit occurs sporadically along south Reservoir Hill and to a lesser degree on Reservoir Hill proper. This unit represents glaciolacustrine deposition and is typical of the many fine silt deposits seen throughout the Thompson Valley.

Overburden Thickness

Overburden thicknesses across the site are greatest on Reservoir Hill near the southern boundary of the quarry where eroded till and glaciolacustrine soils form 2 topographic highs. Maximum soil depths are 35 to 40 feet, as seen in DDH 301 and DDH 302. Overburden thicknesses on Reservoir Hill reach a maximum of 18 feet and average between 12 and 15 feet. Refer to the isopach and structure maps illustrated in Drawing Nos. R1277B-2 and R1227B-3, respectively.

Overburden ranges between 0 and 5 feet in thickness along the gently dipping north slope of Reservoir Hill, on Rattler Hill and the lower bedrock knobs to the north.

In an area centered between Rattler Hill and the northeast flank of Reservoir Hill (adjacent to Rattler Creek), the overburden reaches depths greater than 20 feet. At this location, soils comprised of well rounded cobbles and boulders up to 30 inches in diameter underlie silt and silty gravels. Bedrock was not reached in many of the test pits due to sloughing.

42 Bedrock Geology

Rock types seen within the Walhachin East area can be classified similarly to those seen within the Walhachin Quarry. Unlike the Walhachin Quarry, limestone or calcareous limestone breccia lithologies are rare. The calcareous tuff exposures are limited to outcrop along Reservoir Creek and another in the creek bed adjacent to DDH 305. In core, calcareous tuff is rare and limited in extent. Where they occur, they are intermediate to felsic in composition and often associated with zones of intense calcite veining.

The vast majority of the rock types in the study area fall within the classification of basaltic to intermediate tuff and breccia. Rocks within this category are subdivided based on mafic or felsic mineral content, grain size and carbonate content. The rock types are:

- 1A) Basaltic Tuff (mafic),
- 1B) Basaltic Tuff (intermediate to mafic),
- 1C) *Intermediate to Mafic Lapilli Tuff, and*
- 1D) Banded Calcareous Intermediate Tuff.

Drawing No. R1277B-4 shows the site geology.

Unit 1A - Basaltic Tuff (Mafic)

Beds of mafic tuff are commonly interbedded within Unit B (Intermediate to Mafic Tuff). Mafic tuff was encountered in DDH Nos. 301, 302, 303, and 304 and in numerous test pits along Reservoir Hill and South Reservoir Hill. Mafic tuff also occurs in beds paralleling Reservoir Creek, adjacent to the contact with

Unit 1D. This unit is similar to that seen adjacent to the limestone in the Walhachin Quarry.

This rock type is generally dark gray to black in colour with a fine grained to aphanitic texture. The mafic tuff is generally massive; however, bedding is occasionally displayed by subtle colour changes which reflect slight compositional variations. It is strongly to rarely moderately magnetic containing 10 to 20% finely disseminated magnetite.

The individual beds range between 2.0 cm and 15.0 cm thick. Epidote commonly occurs as fine bladed crystals along bedding planes and as patchy irregular knots and pods up to 25 cm diameter. Epidote alteration is also common, associated with intrusive felsic veining. Grayish white carbonate and zeolites are present as fracture fillings and discontinuous tension gashes. Hematite is most commonly associated with the mafic tuff, occurring along fracture faces or as halos parallel to fractures staining the rock a dark reddish black.

Fracturing and shearing occur throughout the basaltic tuff but brittle deformation is particularly common within the mafic tuff. Fractures often have chloritic coatings along slickensides with chlorite content high in the pervasively microfractured rock.

A bulk sample of mafic tuff was obtained from Test Pit 99 on Reservoir Hill. It produced an abrasion number of 14.9.

Unit 1B - Basaltic Tuff (Intermediate to Mafic)

This basaltic tuff unit was intersected by DDH Nos. 301 to 305 and forms large ridges and bluffs east of Reservoir Creek. It is less mafic than the mafic tuffs and falls within the intermediate to mafic compositional range. It is commonly interbedded with mafic tuff (1A). This unit generally strikes northwest-southeast and dips moderately southwest. Dips progressively steepen towards the Reservoir Creek syncline.

This rock type is generally light to medium greenish-gray in colour with an aphanitic to fine grained texture. Thin bedding laminations and load cast structures indicate a subaqueous depositional environment, however, these

primary features are usually obscured by weathering. This unit is moderately to rarely strongly magnetic with magnetite making up 5 % to 10% of the rock. Beds of coarse grained tuff, lapilli tuff and breccia ranging from 1 inch to 2 feet are commonly scattered through out this unit and are particularly predominant near the unit's lower contact with the intermediate to mafic lapilli tuff (1C). It is noncalcareous.

Carbonate filled fractures are common throughout. Two to five foot wide carbonate flooded zones often occur where tectonic breccia floats in a carbonate matrix. The tectonic breccia is generally intermediate in composition and rarely calcareous. Fracture filling zeolites associated with the carbonate sometime occur.

Epidote occurs along joint planes and is often associated with the carbonate fracture filling. Pervasive epidote alteration is also common, often associated with coarse grained tuff beds and felsic intrusive veining. Felsic intrusive veining is granitic in composition and ranges in width from 2 inches to 24 inches. The veining rarely contains zenoliths of the host tuff. Chlorite commonly occurs as slickensided fracture coatings and is a variable constituent of the rock.

The hardness of this rock type is high and toughness may vary due to secondary structure. The rock encountered in DDH Nos. 301 and 302 was highly fractured. In areas of strong fracturing, chlorite content is generally higher. Moderate abrasion numbers are expected from this rock type. Absorption and magnesium soundness losses are expected to be low. This rock unit, if not strongly fractured, should produce primary ballast.

Unit 1C - Intermediate to Mafic Lapilli Tuff

This unit crops out on the eastern portion of the study area and was intersected by DDH 209, DDH 304 and DDH 305. It makes up much of Rattler Hill, a prominent bluff with excellent exposure. It forms a northwest-southeast trending belt that underlies and is gradational into the basaltic tuff Unit 1B. It differs from Unit 1B in that it is coarser grained and contains considerably less chlorite. This unit has a consistent northwest-southeast strike with a moderate southwest dip.

This rock type is generally dark greenish-gray in colour and is comprised of interlayered fine, medium and coarse grained tuff horizons. The individual beds range in thickness between 10 cm to 150 cm with the medium grained beds being the most common. The coarser horizons contain unsorted, subrounded to angular fragments of intermediate to mafic composition set in an identical but finer grained matrix. The fragments are usually lapilli size (4 mm to 32 mm), however, frequent breccia size fragments (>32 mm) are also present. Both the fragments and matrix are strongly magnetic with fine grained magnetite disseminated throughout. Epidote occurs as patchy pods and knots up to 30 cm diameter. Preferential epidote alteration of fragments has occurred in some of the coarser tuff horizons. Calcite and carbonate are present only as late fracture fills and discontinuous tension gashes. Chlorite content is negligible.

This rock type will make excellent primary ballast with very high toughness and hardness. The interlocking welded nature of the individual fragments make for a well indurated, hard and tough rock. Abrasion numbers are expected to be in the 15 to 20 range. Absorption and magnesium soundness losses are expected to be low. A representative bulk sample was collected from this unit.

Unit 1D - Banded Calcareous Intermediate Tuff

This rock unit is basically comprised of two interbedded compositionally dissimilar rock types (basaltic tuff, calcareous intermediate tuff), each of which make up separate homogeneous rock units on their own. This banded unit can be considered transitional between them. This unit is uncommon in the Walhachin East area, only seen forming the steeply dipping limbs of the Reservoir Creek syncline.

Within the quarry, this rock unit is comprised of aphanitic to fine grained interbedded basaltic tuff (50 to 80%) and calcareous intermediate tuff (20 % to 50%). Individual beds range in thickness between 5 cm to 30 cm. The basaltic tuff is dark gray to black in colour and moderately to strongly magnetic. The calcareous intermediate tuff is light grayish-green in colour, nonmagnetic and variably calcareous. The color variations result in a distinctive banded appearance.

Epidote occurs as irregular patches in both rock types, but is more common within the basaltic beds. Grayish-white carbonate is occasionally present as tension gashes and fracture fills along and between bedding planes. Calcite is finely disseminated throughout the intermediate tuffs but is not present within the basaltic tuffs. Chlorite occurs within both rock types but is not a major constituent.

The hardness of this unit is expected to be high with moderate to high toughness. The calcareous nature of the intermediate tuffs will reduce the toughness of the rock. Absorption and magnesium soundness losses are expected to be moderate to low. Where the calcareous intermediate tuff is present in proportions of less than 25%, this rock unit is expected to produce primary ballast; however, where it comprises more than 25%, secondary ballast will be produced.

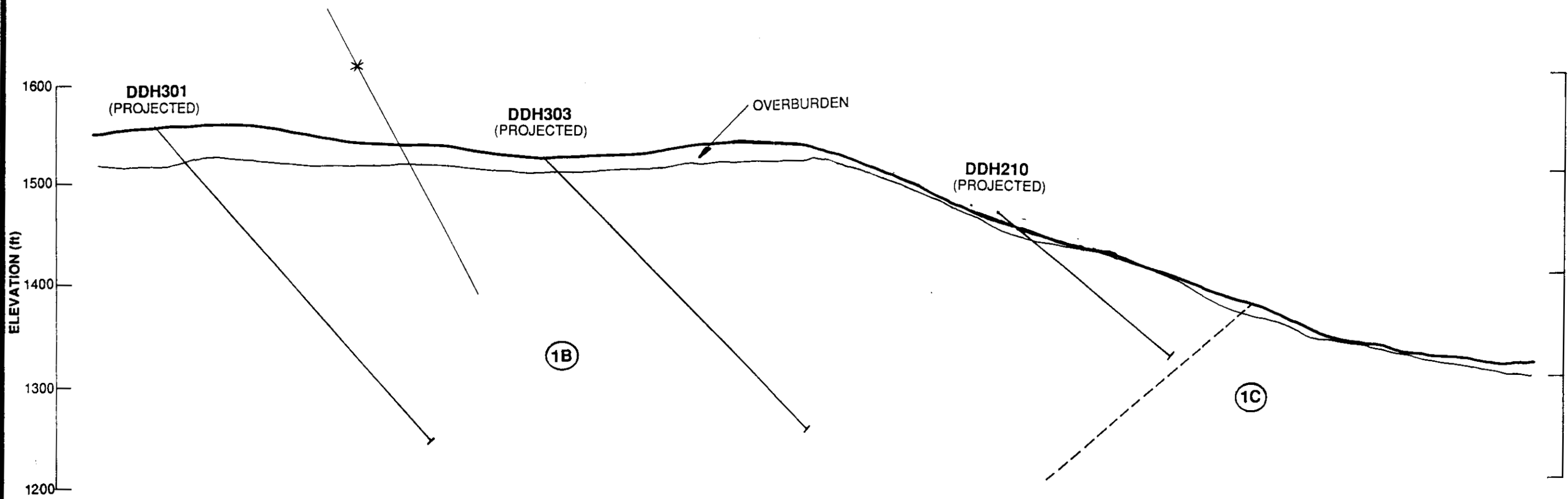
Unit 3 - Intrusive Equivalents

Plugs and dikes of hornblende diorite to gabbro within the Walhachin area are compositionally similar to the mafic flows and are believed to be subvolcanic equivalents. They are medium to coarse grained, feldspar porphyritic and contain up to 20% euhedral hornblende crystals. No mafic intrusives were encountered in diamond drill holes. A large outcrop of gabbro within Reservoir Creek is strongly chlorite altered.

This rock type, where unaltered, has high hardness and moderate to high toughness. Absorption and magnesium soundness losses are expected to be moderate to low. The coarse grained nature of these rocks makes them less resistant to mechanical breakdown than their finer grained extrusive equivalents. As a ballast source, this rock unit will likely produce primary material; however, it is of limited extent within the study area.

43 Structural Geology

The geologic units in the area form a thick volcanic succession. Refer to the geological cross-section illustrated in Figure 4.2 and Drawing No. R1277B-4. At the base of the succession are mafic lapilli tuff (Unit 1C) which underlie



LEGEND:

INTERMEDIATE TO MAFIC TUFF;
 APHANTIC TO FINE GRAINED,
 NONCALCAREOUS

①B

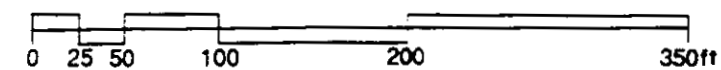
INTERMEDIATE TO MAFIC LAPILLI TUFF;
 NONCALCAREOUS

①C

SYNCLINE

*

GEOLOGICAL CONTACT (APPROXIMATE)



Clifton Associates Ltd.

CLIENT

CP RAIL

PROJECT

WALHACHIN QUARRY EAST

TITLE

GEOLOGICAL CROSS SECTION A - A'

DATE 93/05/12

APPD BY DWG N.C.

SCALE 1"=100'

DWN BY CMC

FIGURE 4.2

Rattler Hill in the eastern portion of the map area. The rocks young to the west.

The rocks within the DON claims have been intensely folded, faulted and fractured. Axial trends of the folds are generally north-south. Axial planar faults and fractures occur throughout the map area. Deformation of the rocks peripheral to the existing quarry is weak to moderate.

The mafic tuffs (Unit 1B and 1C) underlying Rattler Hill have a consistent northwest-southeast strike and dip gently to moderately southwest. Close to Reservoir Creek, the dips steepen to subvertical. Within Reservoir Creek, the rocks have a steep easterly dip indicating the presence of a syncline. Core angle measurements within DDH 301 support this conclusion.

44 Rock Quality

Three bulk samples were taken during the field program and submitted to Clifton Associates Ltd. Laboratory for testing. The samples were crushed and sieved to a grading 4.5 specification. Table 4.1 summarizes the physical test results. Abrasion numbers of 14.9, 17.4 and 19.8 were derived for the 3 samples. These abrasion numbers will produce over 20 year ballast on the Thompson or Shuswap Subdivisions.

The basaltic rock types are the predominant rock type in the study area. These rocks will have a high hardness. The toughness of this material, however, may be variable and is strongly dependent on secondary structure. The physical breakdown as a result of freeze-thaw processes or wetting and drying will be low. The low porosity, permeability and the lack of voids and clay minerals would make the ballast material that would be produced from this site highly resistant to physical breakdown by these processes. These rock types will have a high resistance to chemical weathering.

TABLE 4.1
Summary of Physical Test Results

Rock Type	Field /Lab Sample No.	L.A. Loss (%)	M.A. Loss (%)	Abrasion No	Specific Gravity	Absorption (%)	MgSO ₄ Loss
Mafic Tuff	BS01 /L5425	8.6	1.3	14.9	2.77	0.64	0.23
Mafic Tuff & Int. Tuff	BS02 /L5426	10.1	1.5	17.4	2.72	0.77	0.19
Mafic & Int. Breccia	BS03 /L4527	9.5	2.1	19.8	2.79	1.01	0.71

5.0 QUARRY FEASIBILITY STUDY

5.1 Development Constraints

The conceptual design is also restricted by several geological constraints. The eastern backwall is restricted by a thick fluvial terrace. To the south, the design is restricted by a geological contact with the Ashcroft Formation conglomerates. Development to the west is restricted by the old Walhachin waste stockpile. Unlike the Walhachin Quarry, the Walhachin East site has no limestone units and therefore no geological constraints exist within the conceptual design area.

5.2 Preliminary Design Criteria

Preliminary design concepts were produced in order to assess the feasibility of the site to provide high quality economic ballast source. Design considerations included optimizing the volume of rock within the area defined by the development constraints while minimizing the amount of overburden stripped.

Minimum criteria established under the Mines Act in the Health, Safety and Reclamation Code for British Columbia are as follows:

- Catchment berm must be designed in order for its final width to be no less than 8 m (26 ft.).
- In safe mining and quarrying practice, the height of the bench or working face shall be no more than 2 m above the maximum reach of the loading equipment.

The basic physical design criteria used in conceptual evaluation of the Walhachin East site are outlined below.

- Maximum bench height of 30 feet.
- Maximum berm width of 30 feet.
- Maximum interbench backwall slope of 65 degrees.
- Overall backwall slope of no steeper than 37 degrees.

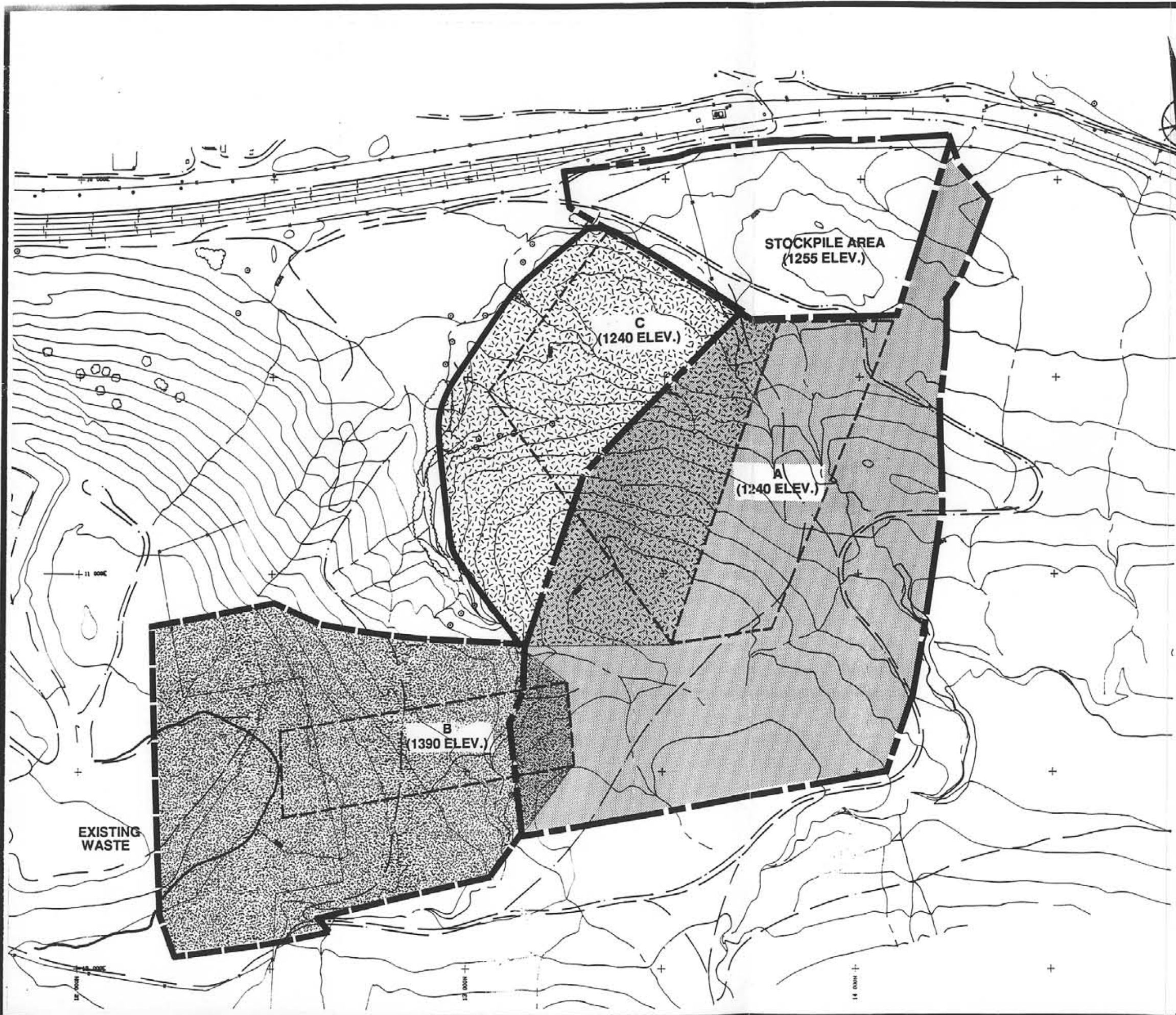
53 Conceptual Quarry Designs

A design was developed to meet the design criteria and to maximize the volume of rock within the development constraints. The design positions the eastern backwall as close to the eastern fluvial terrace as possible. The southern backwall is positioned as far south as possible without encroaching on the higher ground to the south. From these two backwall orientations, three design concepts were developed. Figure 5.1 illustrates these concepts.

In all three schemes, initial development would consist of removing a small bedrock high, along the tracks to produce stockpile space. A total of 385,806 yd³ of rock and 80,203 yd³ of overburden exist in this area to the 1255 elevation. The rock in this area is suitable for ballast. A contract to mine this portion of rock would produce approximately 441,748 tons of ballast.

Design Concept I


The first alternative positioned the western backwall parallel to the eastern backwall (refer to A on Figure 5.1). This alternative, although representing a minimal disturbance and impact alternative contained 2,936,221 yd³ of rock. This would provide approximately 3,361,973 tons of ballast at a 50% yield.



LEGEND:
 AREA A
 AREA B
 AREA C



OPTION 1 = A
 OPTION 2 = B + A
 OPTION 3 = B + A + C

 Clifton Associates Ltd.	
CLIENT	CP RAIL
PROJECT	WALHACHIN QUARRY EAST
TITLE	QUARRY DEVELOPMENT CONCEPTS
DATE 93/05/03	APPD BY
SCALE 1" = 250'	DWN BY DMP
DWG NO	FIGURE 5.1

451,000 yd³ of overburden would have to be stripped and stockpiled. This design did not meet the scope of requirements for a ballast source. This design represents the general conceptual design upon which additional areas of development can be added.

Design Concept II

An extension to the original design was developed to provide additional volume (areas A and B on Figure 5.1). In this alternative, the eastern and western backwalls remain the same. The position of the southern backwall remains the same, however it is extended west to produce a "dog leg" extension to the first design (refer to B on Figure 5.1). This design provides 6,933,033 yd³ of rock or 7,938,323 tons of ballast at a 50% yield. A cumulative volume of 930,364 yd³ of overburden would have to be stripped in this design concept.

Design Concept III

A third design was developed to provide additional volume than the previously mentioned designs. The third design concept is an extension of the first two (refer to A, B and C on Figure 5.1). Here the western backwall is shifted in a northwestern/southeastern orientation. This backwall daylights through the natural slope east of reservoir creek. This extension can occur off of design Concepts I or II and provides 10,459,250 yd³ of rock calculated to the 1240 elevation. This volume of rock would provide 11,975,841 tons of ballast at a 50% yield. Volumes were calculated based on mining to an elevation approximately 15 feet below track level (1240 elevation). Under this design there is adequate area to excavate below the 1240 elevation if needed.

TABLE 5.1
Quantities Summary

Design	Volume Rock (yd ³)	Volume Overburden (yd ³)	Ballast 4.5 (tons)	Cumulative Years (200,000 ton /year)
Stock Pile Area	386,000	80,000	442,000	2
Concept I	2,936,000	451,000	3,362,000	17
Concept II	6,933,000	930,000	7,938,000	40
Concept III	10,459,000	995,000	11,976,000	60

• Mass ballast calculated using 2.29 tons/yd³ and a 50% yield.

6.0 COST SUMMARY

An itemized cost statement is outlined in Table 6.1. This statement details the costs for the field investigation, the feasibility study and report writing which were incurred during the 1992 investigation on the DON claims.

7.0 STATEMENT OF QUALIFICATIONS

The qualifications of each of the authors of this report are presented in Appendix E.

TABLE 6.1
Walhachin East Feasibility Study
COST SUMMARY

ITEM	UNITS	UNIT RATE	LABOUR		EXPENSE UNITS	DISB. UNITS	LABOUR COST	EXPENSE COST	DISB. COST	TOTAL COST	
			ENG.	SUPPORT							
1.0 FIELD PROGRAM November 30/92 to December 15/92											
includes: mob/demob geologic mapping, overburden testing, bulk sampling, diamond drilling											
Senior Geologist	hr	66.00	15.00				990.00				
Project Geologist	hr	49.97	31.50				1,574.06				
Project Geologist	hr	47.95	165.00				7,911.75				
Surveyor	hr	45.95	23.00				1,056.85				
Subtotal Wages For Field Program							11,532.66				
2.0 FEASIBILITY STUDY											
includes: project management, data reduction and analysis, feasibility analysis and final reporting											
Principal Engineer	hr	95.00	8.00				760.00				
Senior Geologist	hr	66.00	36.00				2,376.00				
Project Geologist	hr	49.97	135.00				6,745.95				
Project Geologist	hr	47.95	193.50				9,278.33				
Surveyor	hr	45.77		30.00			1,373.10				
Draftsperson 3	hr	50.23		21.00			1,054.83				
Draftsperson 2	hr	38.00		4.25			161.50				
Draftsperson 1	hr	33.32		6.25			208.25				
Clerical 3	hr	44.30		1.25			55.38				
Clerical 2	hr	35.45		0.50			17.73				
Clerical 1	hr	24.80		1.00			24.80				
Subtotal Wages Feasibility Study							22,055.86				
Total Wages							33,588.51				33,588.51
3.0 CLIFTON ASSOCIATES LTD. LAB TESTING											
Bulk Sample Crushing and Prep.	lump	750.00				1			750.00		
Lab Testing includes:	lump	2135.70				1			2,135.70		
Total Lab									2,885.70	2,885.70	
4.0 DISBURSEMENTS											
Meals and Accommodation	lump	1759.02				1			1,759.02		
Travel (airfare)	lump	2950.32				1			2,950.32		
Vehicle	lump	1510.34				1			1,510.34		
Field Supplies	lump	121.32				1			121.32		
Computer Fees/Supplies	lump	262.50				1			262.50		
Freight - Express and Shipping	lump	320.64				1			320.64		
Telephone	lump	458.29				1			458.29		
Printing and Photography	lump	99.18				1			99.18		
Permit and Fees	lump	525.00				1			525.00		
Total Disbursements									8,006.61	8,006.61	
5.0 EXPENSES											
Freight - shipping, Loomis	lump	17.78				1			17.78		
Company Printing and White Print	lump	76.46				1			76.46		
Total Expenses									94.24	94.24	
6.0 TEST PIT PROGRAM											
PC200 Backhoe	hr	98				36			3,528.00		
Mob/Demob	lump	392				1			392.00		
Total Test Pit Program									3,920.00	3,920.00	

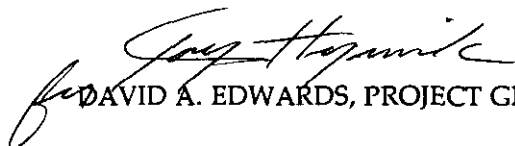
TABLE 6.1
Walhachin East Feasibility Study
COST SUMMARY

ITEM	UNITS	UNIT RATE	LABOUR		EXPENSE UNITS	DISB. UNITS	LABOUR COST	EXPENSE COST	DISB. COST	TOTAL COST
			ENG.	SUPPORT						
DIAMOND DRILLING										
6.1 Diamond Drilling Footage										
DH-301	ft	14.5				395				5,727.50
DH-302	ft	14.5				407				5,901.50
DH-303	ft	14.5				366				5,307.00
DH-304	ft	14.5				291				4,219.50
DH-305	ft	14.5				93				1,348.50
Subtotal										22,504.00
6.2 Hourly Charges										
DH-301										
pull casing, ream rods/casing,	hr	84				13				1,092.00
drill sand/cave, condition hole, survey hole										
move/setup		60				4				240.00
DH-302										
set & pull casing, ream rods/casing	hr	84				11.5				966.00
drill sand/cave, survey hole										
delays	hr	74				1.5				111.00
DH-303										
Ream rod/casing, survey hole	hr	84				2.5				210.00
DH-304										
set casing, survey hole	hr	84				1.5				126.00
water supply	hr	74				3.5				259.00
move & setup	hr	60				2.75				165.00
DH-305										
ream rods/casing, survey hole	hr	84				1.75				147.00
water supply, site prep.	hr	74				5.75				425.50
Tear down, move & setup	hr	60				9.25				555.00
Subtotal										4,296.50
6.3 Materials										
DH-301	lump	1162.65				1				1,162.65
DH-302	lump	982.94				1				982.94
DH-303	lump	159.97				1				159.97
DH-304	lump	479.34				1				479.34
DH-305	lump	764.11				1				764.11
Subtotal										3,549.01
6.4 Other Charges										
Cat Rental	hr	45				5.75				258.75
Mob/Demob	lump	1000				1				1,000.00
Third party charges (water truck)	lump	8085				1				8,085.00
Subtotal										9,343.75
Total Drilling										39,693.26
TOTAL										88,951.22

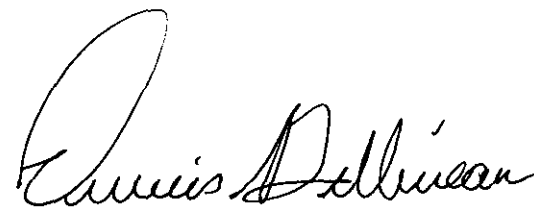
8.0 CLOSURE

The above presents the Walhachin East quarry feasibility study. This report is part of the statement of work being submitted for mineral assessment credit as required under the Mineral Tenure Act. The report documents both the physical and geological work conducted on the DON claims during 1992.

CLIFTON ASSOCIATES LTD.


for DAVID A. EDWARDS, PROJECT GEOLOGIST


GREG M. HERASYMUK, PROJECT GEOLOGIST


for WILLIAM A. JEALOUS, P.ENG.

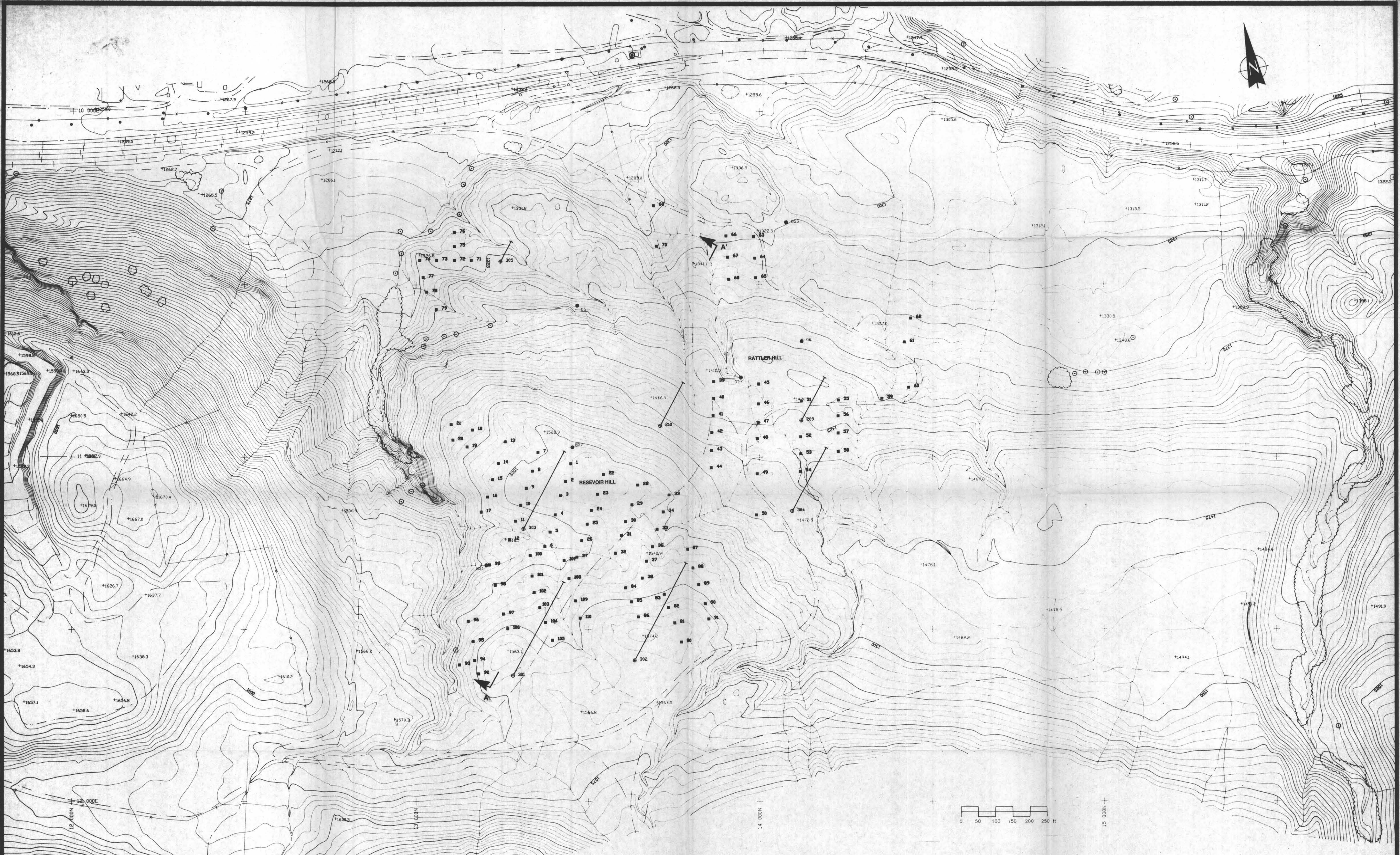
Association of Professional
Engineers of Saskatchewan
Cert. of Authorization No. 238



Clifton Associates Ltd.

CONSULTING ENGINEERS

DRAWINGS



LEGEND:
 TEST PIT LOCATION
 DIAMOND DRILL HOLE LOCATION
 BULK SAMPLE LOCATION (1991)
 BULK SAMPLE LOCATION (1992)

NOTES:
 1. EXISTING GROUND
 2. CONTOUR INTERVAL = 5.0 FT.
 DIAMOND DRILL HOLE PROGRAM
 - 1991 200 SERIES
 - 1992 300 SERIES
 3. TEST PIT PROGRAM
 1991 1-72
 1992 80-110

GEOLOGICAL BRANCH
 ASSESSMENT REPORT

22,950

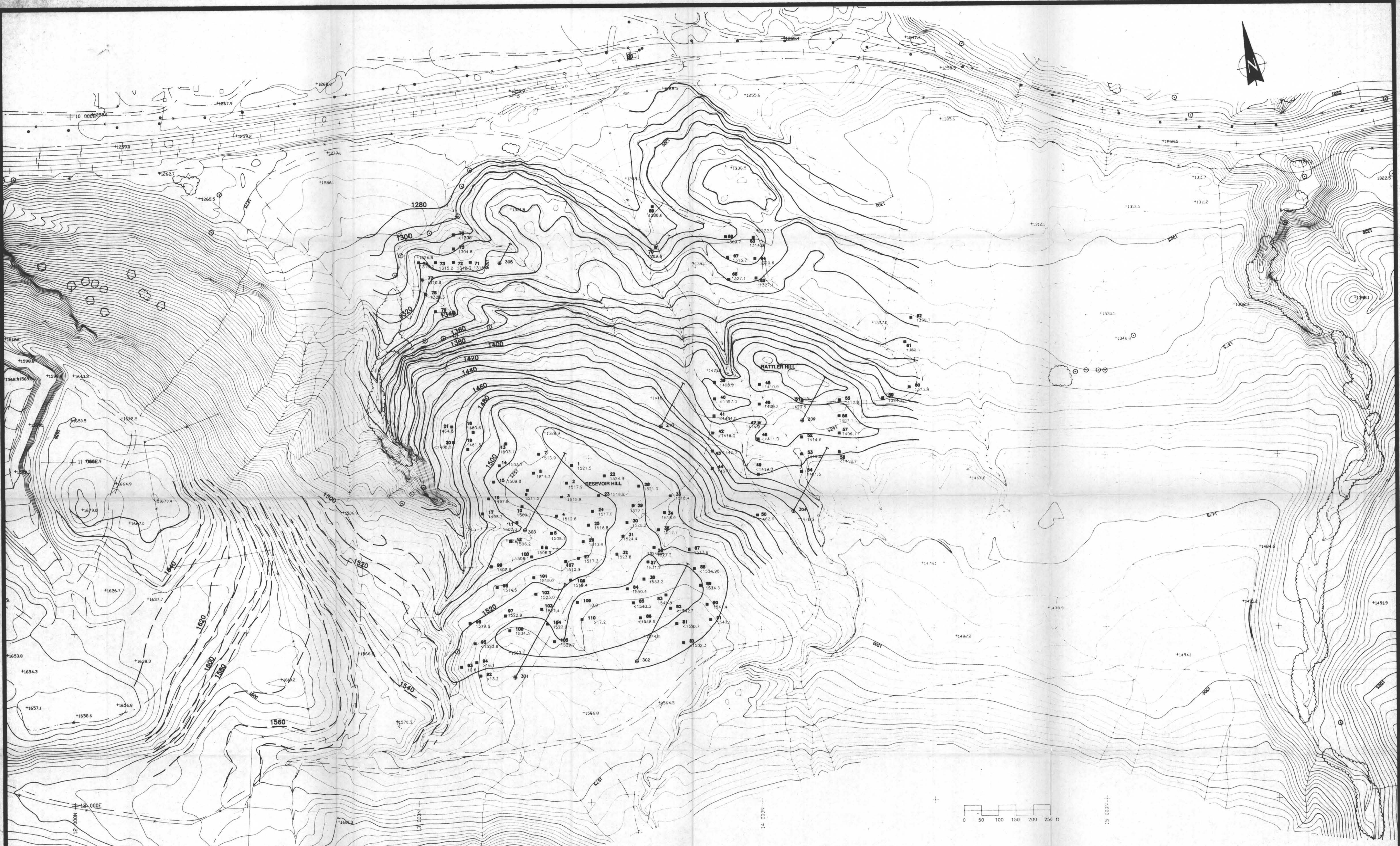
Clifton Associates Ltd.

CLIENT: CP RAIL

PROJECT: WALHACHIN QUARRY EAST

TITLE: SITE PLAN

DATE: 93/04/05 APPR. BY: DRAW. NO.:
 SCALE: 1"=100' DRAW. BY: R1277B-1



LEGEND:
 TEST PIT LOCATION
 DIAMOND DRILL HOLE LOCATION
 TOP OF BEDROCK ELEVATION (ft)
 TOP OF BEDROCK CONTOUR (ft)

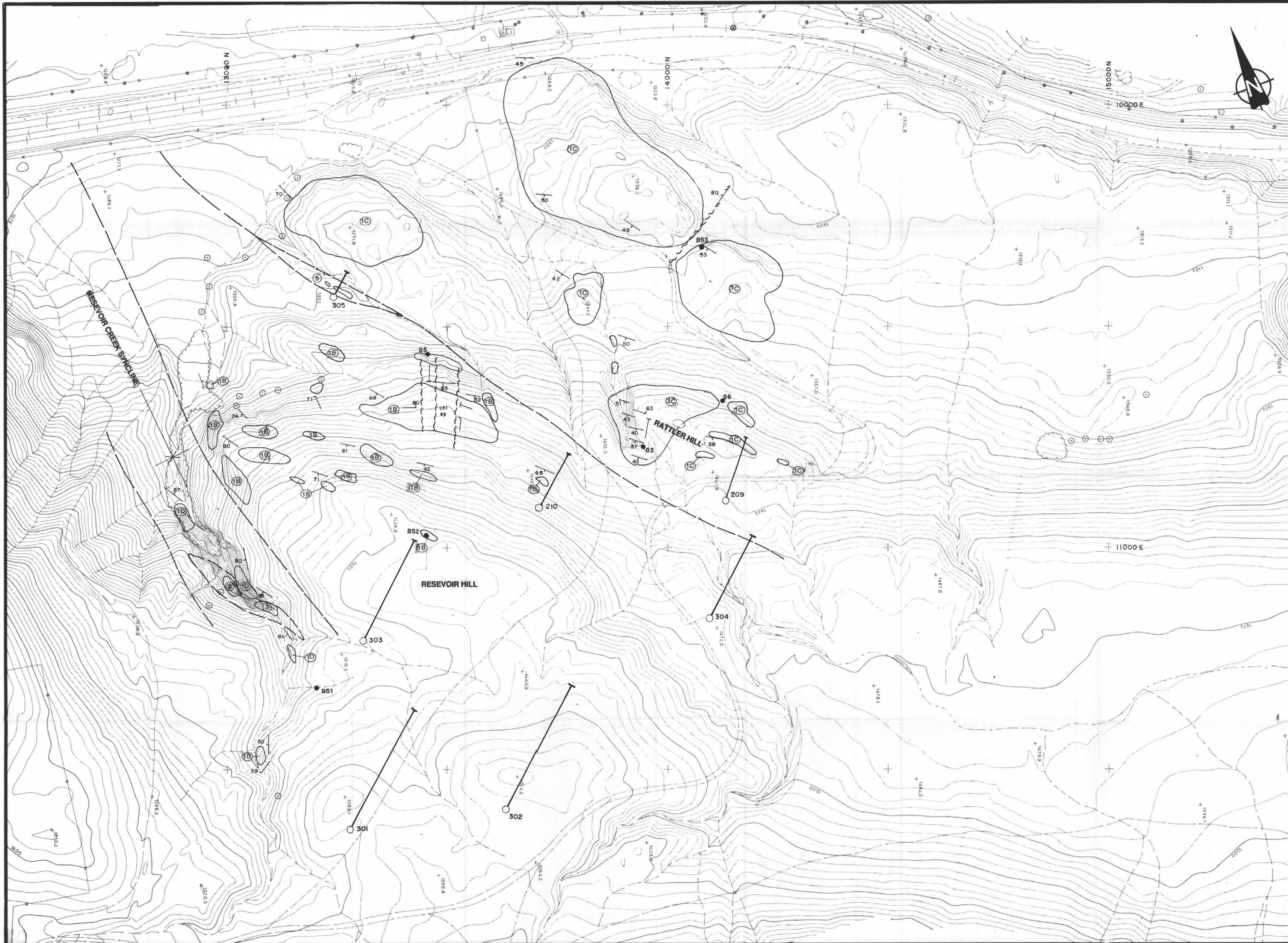
- NOTES:
 1. EXISTING GROUND
 CONTOUR INTERVAL = 5.0 ft.
 2. TOP OF BEDROCK STRUCTURE
 CONTOUR INTERVAL = 10.0 ft.
 3. DIAMOND DRILL HOLE PROGRAM
 - 1991 200 SERIES
 - 1992 300 SERIES
 4. TEST PIT PROGRAM
 - 1991 1-79
 - 1992 80-110

**GEOLOGICAL BRANCH
 ASSESSMENT REPORT**

22,950

CLIENT	CP RAIL
PROJECT	WALHACHIN QUARRY EAST
TITLE	BEDROCK STRUCTURE
DATE 03/04/05	APP'D BY
SCALE 1"=100'	DRAWN BY DMF
	DRAWN NO. R12778-3

R2778-3



- LEGEND:**
- OVERBURDEN 9
 - GABBRO 8
 - ANDESTITIC TUFF (mapped in 1983) 7
 - LIMESTONE/LIMESTONE BRECCIA 6
 - COARSE INTERMEDIATE BRECCIA - VARIABLY CALCAREOUS 5
 - CALCAREOUS INTERMEDIATE TUFF - MINOR BASALTIC TUFF HORIZONS 4
 - INTERLAYERED MAFIC FLOWS, TUFFS AND SUBVOLCANIC INTRUSIONS - VARIABLY FELDSPAR PORPHYRITIC 3
 - BASALTIC BRECCIA 2
 - BASALTIC TUFF; - MINOR CALCAREOUS INTERMEDIATE TUFF HORIZONS 1
 - MAFIC TUFF; APHANTIC TO FINE GRAINED, NONCALCAREOUS 1A
 - INTERMEDIATE TO MAFIC TUFF; APHANTIC TO FINE GRAINED, NONCALCAREOUS 1B
 - INTERMEDIATE TO MAFIC LAPILLI TUFF; NONCALCAREOUS 1C
 - BANDED; <50% CALCAREOUS INTERMEDIATE TUFF 1D
- SYMBOLS:**
- SHEAR / FAULT ORIENTATION 50
 - BEDDING ORIENTATION 40
 - GEOLOGICAL CONTACT ORIENTATION
 - GEOLOGICAL CONTACT (ASSUMED, DEFINED) 70
 - FRACTURE/Jointing ORIENTATION
 - VERTICAL JOINT
 - SYNCLINE
 - OVERTURNED ANTICLINE FOLD AXIS ORIENTATION
 - OUTCROP
 - BULK SAMPLE LOCATION (1991) 02 ●
 - BULK SAMPLE LOCATION (1992) BS2 ●
 - DIAMOND DRILL HOLE LOCATION (1991) 210 ○
 - DIAMOND DRILL HOLE LOCATION (1992) 303 ○

GEOLOGICAL BRANCH - ASSESSMENT REPORT

22,950

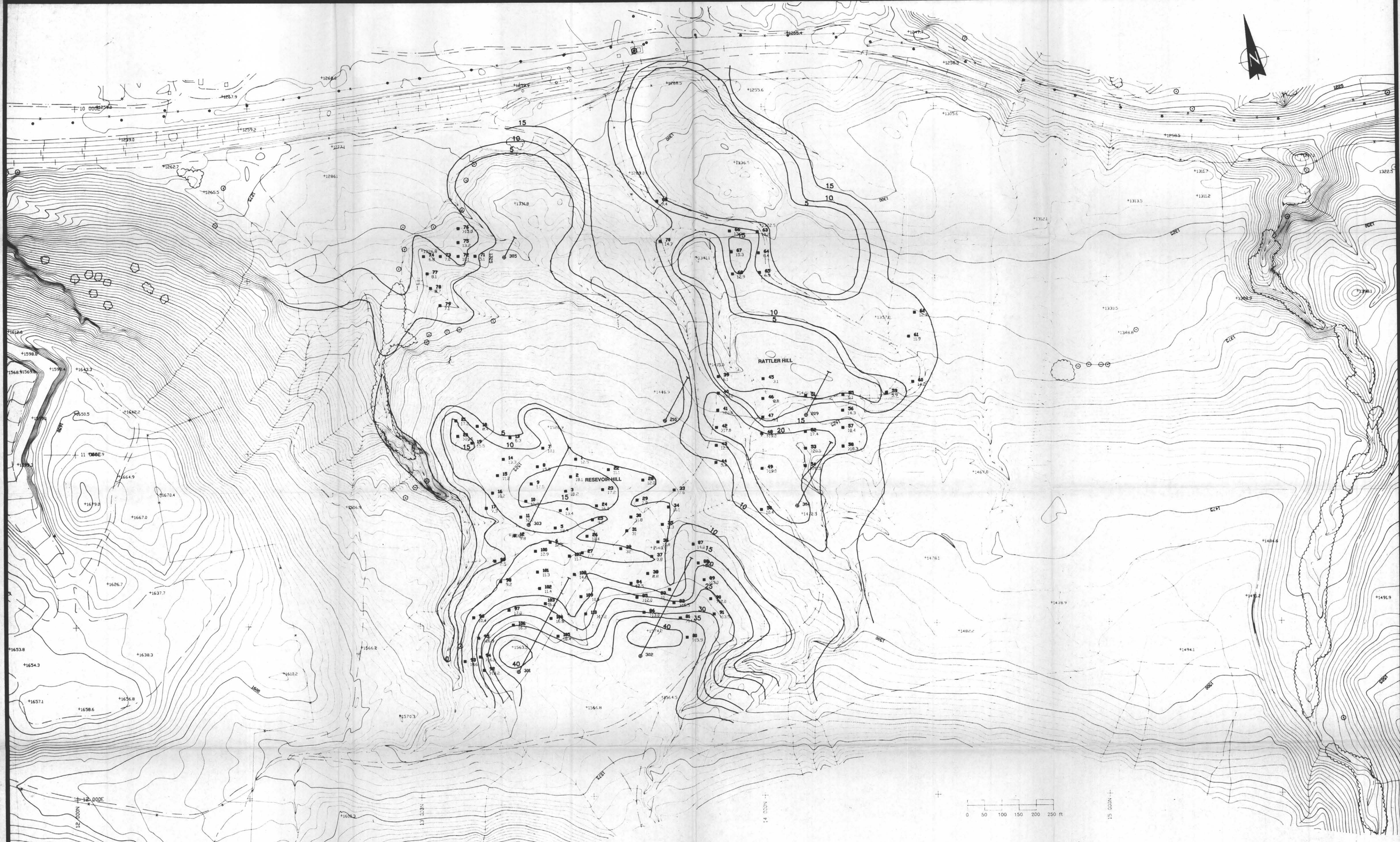
Clifton Associates Ltd.

CLIENT
CP RAIL HeavyHaul Systems

PROJECT
WALHACHIN QUARRY EXPANSION FEASIBILITY STUDY

TITLE
SITE GEOLOGY EAST HALF

DATE 93/07/20 APP'D BY
SCALE 1" = 100' DWN BY DMP DWG NO R1277B-4



LEGEND:
 TEST PIT LOCATION
 DIAMOND DRILL HOLE LOCATION
 OVERBURDEN THICKNESS (ft)
 OVERBURDEN THICKNESS
 CONTOUR (ft)

- NOTES:**
1. EXISTING GROUND
CONTOUR INTERVAL = 5.0 ft.
 2. OVERBURDEN THICKNESS
CONTOUR INTERVAL = 5.0 ft.
 3. DIAMOND DRILL HOLE PROGRAM
- 1991 200 SERIES
- 1992 300 SERIES
 4. TEST PIT PROGRAM
- 1991 1-79
- 1992 80-110

**GEOLOGICAL BRANCH
ASSESSMENT REPORT**

22,950

CLIENT	CP RAIL
PROJECT	WALHACHIN QUARRY EAST
TITLE	OVERBURDEN ISOPACH
DATE 03/04/05	APP. BY []
SCALE 1"=100'	DRAWN BY []
	DWG. NO. R1277B-2



Clifton Associates Ltd.

CONSULTING ENGINEERS

APPENDIX A

TEST PIT SUMMARY

Test Pit Number	Location (Test Pit Line)	Depth to Bedrock (Feet)	Bedrock Type
1992 Test Pits			
80	20	>15.5	Not encountered
81	20	>14.0	Not encountered
82	20	>15.5	Not encountered
83	20	10.0	Mafic Tuff
84	21	12.5	Mafic to intermediate tuff
85	21	>12.0	Not encountered
86	21	>13.0	Not encountered
87	22	14.0	Intermediate/Mafic tuff
88	22	>8.0(?)	Not encountered
89	22	>13.0	Not encountered
90	22	>12.0	Not encountered
91	22	>13.5	Not encountered
92	23	>13.2	Not encountered
93	23	10.6	Intermediate lapilli tuff
94	23	>16.7	Not encountered
95	23	>16.9	Not encountered
96	23	10.4	Mafic tuff
97	24	>17.0	Calcareous intermediate tuff
98	24	9.2	Intermediate/Mafic tuff
99	24	2.5	Mafic tuff
100	25	12.9	Mafic tuff
101	25	11.3	Mafic tuff
102	25	11.4	Mafic tuff
103	25	16.2	Mafic tuff
104	25	>16.8	Not encountered
105	25	>18.4	Not encountered
106	24	>16.3	Not encountered
107	26	11.7	Intermediate/Mafic tuff
108	26	14.2	Calcareous intermediate tuff
109	26	10.0	Mafic tuff
110	26	>17.2	Not encountered

WALHACHIN EAST

TEST PIT LOGS

TP80

Location: 13772.20N/11537.51E

Elevation: 1567.75 ft.

- 0.0 ft. - 7.0 ft. Clay - buff
 - massive to laminated
 - dry, firm, blocky, friable
- 7.0 ft. - 15.5 ft. Silt - some angular gravel and cobbles
 - some sand, some clay
 - hardpan of gravel in clay at 11.0 ft.
- 15.5 ft. EOH

TP81

Location: 13752.36N/11481.82E

Elevation: 1564.70 ft.

- 0.0 ft. - 4.0 ft. Clay - buff
 - massive to laminated
 - dry, firm, blocky, friable
- 4.0 ft. - 14.0 ft. Silt - some angular gravel and cobbles
 - some sand, some clay
 - hardpan at 10.0 ft.
- 14.0 ft. EOH

TP82

Location: 13734.32N/11437.17E

Elevation: 1557.22 ft.

- 0.0 ft. - 1.5 ft. Clay - buff
 - massive to laminated
 - dry, firm, blocky, friable
- 1.5 ft. - 15.5 ft. Silt - some angular gravel and cobbles
 - some sand, some clay
 - hardpan at 11.0 ft.
- 15.5 ft. EOH

TP83

Location: 13721.64N/11398.55E

Elevation: 1551.35 ft.

- 0.0 ft. - 3.0 ft. Clay - buff
 - massive to laminated
 - dry, firm, blocky, friable
- 3.0 ft. - 10.0 ft. Silt - some angular gravel and cobbles
 - some sand, some clay
- 10.0 ft. Bedrock - mafic tuff
 - highly fractured with hematite coating
- 10.0 ft. EOH

TP84

Location: 13609.72N/11380.10E

Elevation: 1542.93 ft.

- 0.0 ft. - 6.0 ft. Clay - some silt
- 6.0 ft. - 12.5 ft. Silt - some angular gravel and cobbles
 - some sand, some clay
- 12.5 ft. - 14.0 ft. Bedrock - intermediate/mafic tuff
 - black, massive, fine grained
 - hematite coating along fractures
- 14.0 ft. EOH

TP85

Location: 13626.69N/11420.73E

Elevation: 1552.32 ft.

- 0.0 ft. - 5.0 ft. Clay - buff
 - massive to laminated
 - dry, firm, blocky, friable
- 5.0 ft. - 12.0 ft. Silt - some angular gravel and cobbles
 - some sand, some clay
- 12.0 ft. EOH

TP86

Location: 13647.05N/11464.35E

Elevation: 1561.69 ft.

0.0 ft. - 13.0 ft. Silt - some angular gravel and cobbles
- some sand, some clay

13.0 ft. EOH

TP87

Location: 13790.95N/11268.32E

Elevation: 1531.63 ft.

0.0 ft. - 8.5 ft. Clay - buff
- massive to laminated
- dry, firm, blocky, friable

8.5 ft. - 14.0 ft. Silt - some angular gravel and cobbles
- some sand, some clay

14.0 ft. Bedrock - intermediate/mafic tuff
- dark green, massive, fine grained

14.0 ft. EOH

TP88

Location: 13806.97N/11322.65E

Elevation: 1542.98 ft.

- 0.0 ft. - 2.0 ft. Clay - buff
 - massive to laminated
 - dry, firm, blocky, friable
- 2.0 ft. - 8.0 ft. Silt - some angular gravel and cobbles
 - some sand, some clay
 - large fractured boulder at 8.0 ft.
 - initially thought to be bedrock
- 8.0 ft. EOH

TP89

Location: 13824.27N/11371.17E

Elevation: 1547.27 ft.

- 0.0 ft. - 13.0 ft. Silt - some angular gravel and cobbles
 - some sand, some clay
- 13.0 ft. EOH

TP90

Location: 13843.02N/11426.55E

Elevation: 1553.44 ft.

- 0.0 ft. - 12.0 ft. Silt - some angular gravel and cobbles
 - some sand, some clay
 - hardpan at 8.0 ft.
- 12.0 ft. EOH

TP91

Location: 13853.05N/11470.65E

Elevation: 1553.62 ft.

- 0.0 ft. - 13.5 ft. Silt - some angular gravel and cobbles
 - some sand, some clay
 - hardpan at 11.0 ft.
- 13.5 ft. EOH

TP92

Location: 13182.17N/11629.69E

Elevation: 1551.19 ft.

0.0 ft. - 13.2 ft. Silt - some angular gravel and cobbles
 - some sand, some clay
 - highly fractured boulder of lapilli tuff at 7.0 ft.
 - competent boulder of lapilli tuff at 11.0 ft.

13.2 ft. EOH

TP93

Location: 13126.60N/11603.57E

Elevation: 1537.06 ft.

0.0 ft. - 2.0 ft. Clay - buff to gray, loose
 - some silt

2.0 ft.- 10.6 ft. Silt - some angular gravel and cobbles
 - some sand, some clay
 - few boulders up to 2.5 ft. near bedrock

10.6 ft. - 11.0 ft. Bedrock - intermediate coarse grained lapilli tuff
 - slightly calcareous with calcite knots

11.0 ft. EOH

TP94

Location: 13170.96N/11590.81E

Elevation: 1548.45 ft.

0.0 ft. - 16.7 ft. Silt - some angular gravel and cobbles
 - some sand, some clay
 - hardpan of gravel in clay at 11.0 ft..

16.7 ft. EOH

TP95

Location: 13166.52N/11535.67E

Elevation: 1540.71 ft.

- 0.0 ft. - 2.0 ft. Clay - buff to gray, loose
- some silt
- 2.0 ft. - 10.4 ft. Silt - some angular gravel and cobbles
- some sand, some clay
- hardpan at 10.0 ft.
- 10.4 ft. - 11.0 ft. Bedrock - mafic tuff, black
- aphanitic, massive
- strongly magnetic
- 11.0 ft. EOH

TP96

Location: 13152.35N/11476.56E

Elevation: 1530.02 ft.

- 0.0 ft. - 1.5 ft. Clay - buff to gray, loose
- some silt
- 1.5 ft. - 16.9 ft. Silt - some angular gravel and cobbles
- some sand, some clay
- 16.9 ft. EOH

TP97

Location: 13255.08N/11455.59E

Elevation: 1539.91 ft.

- 0.0 ft. - 16.4 ft. Silt - some angular gravel and cobbles
- some sand, some clay
- boulders at 16.4 ft.
- 16.4 ft. EOH

TP98

Location: 13231.05N/11372.72E

Elevation: 1523.74 ft.

- 0.0 ft. - 2.3 ft. Clay - buff to gray, loose
- some silt
- 2.3 ft. - 9.2 ft. Silt - some angular gravel and cobbles
- some sand, some clay
- 9.2 ft. - 11.8 ft. Bedrock - intermediate/mafic tuff
- black, massive, highly fractured
- moderately magnetic
- 11.8 ft. EOH

TP99

Location: 13214.42N/11313.48E

Elevation: 1505.10 ft.

- 0.0 ft. - 2.5 ft. Silt - some angular gravel and cobbles
- some sand, some clay
- 2.5 ft. - 4.5 ft. Bedrock - mafic tuff, black
- strongly magnetic
- aphanitic to fine grained
- 4.5 ft. EOH

TP100

Location: 13332.51N/11285.93E

Elevation: 1521.82 ft.

- 0.0 ft. - 1.0 ft. Clay - buff to gray, loose
- some silt
- 1.0 ft. - 12.9 ft. Silt - some angular gravel and cobbles
- some sand, some clay
- 12.9 - 13.2 ft. Bedrock - mafic tuff, black
- aphanitic, massive
- strongly magnetic
- 13.2 ft. EOH

TP101

Location: 13337.96N/11345.55E

Elevation: 1530.28 ft.

- 0.0 ft. - 2.0 ft. Clay - buff to gray, loose, some silt
- 2.0 ft. - 11.3 ft. Silt - some angular gravel and cobbles
- some sand, some clay
- 11.3 ft. Bedrock - mafic tuff, black
- aphanitic, massive
- strongly magnetic
- 11.3 ft. EOH

TP102

Location: 13360.31N/11437.08E

Elevation: 1543.55 ft.

- 0.0 ft. - 7.6 ft. Clay - buff
- massive to laminated
- dry, firm, blocky, friable
- 7.6 ft. - 11.4 ft. Silt - some angular gravel and cobbles
- some sand, some clay
- 11.4 ft. - 11.6 ft. Bedrock - mafic tuff, black
- aphanitic, massive
- strongly magnetic
- trace malachite
- 11.6 ft. EOH

TP103

Location: 13343.80N/11393.13E

Elevation: 1534.72 ft.

- 0.0 ft. - 6.0 ft. Clay - buff
- massive to laminated
- dry, firm, blocky, friable
- 6.0 ft. - 16.2 ft. Silt - some angular gravel and cobbles
- some sand, some clay
- 16.2 ft. - 16.5 ft. Bedrock - mafic tuff, black
- aphanitic, massive
- moderately to strongly magnetic
- trace hematite, trace calcite
- 16.5 ft. EOH

TP104

Location: 13376.62N/11480.17E

Elevation: 1546.545 ft.

- 0.0 ft. - 5.0 ft. Clay - buff
- massive to laminated
- dry, firm, blocky, friable
- 5.0 ft. - 16.8 ft. Silt - some angular gravel and cobbles
- some sand, some clay
- 16.8 ft. EOH

TP105

Location: 13396.84N/11531.91E

Elevation: 1548.08 ft.

- 0.0 ft. - 7.8 ft. Clay - buff
- massive to laminated
- dry, firm, blocky, friable
- 7.8 ft. - 18.4 ft. Silt - some angular gravel and cobbles
- some sand, some clay
- 18.4 ft. EOH

TP106

Location: 13267.33N/11498.63E

Elevation: 1550.64 ft.

- 0.0 ft. - 16.3 ft. Silt - some angular gravel and cobbles
- some sand, some clay
- 16.3 ft. EOH

TP107

Location: 13430.77N/11300.41E

Elevation: 1524.03 ft.

- 0.0 ft. - 6.0 ft. Clay - buff
 - massive to laminated
 - dry, firm, blocky, friable
- 6.0 ft.- 11.7 ft. Silt - some angular gravel and cobbles
 - some sand, some clay
- 11.7 ft. - 12.8 ft. Bedrock - intermediate/mafic tuff
 - aphanitic, massive
 - local hematite staining
- 12.8 ft. EOH

TP108

Location: 13444.87N/11353.25E

Elevation: 1532.64 ft.

- 0.0 ft. - 10.0 ft. Clay - buff
 - massive to laminated
 - dry, firm, blocky, friable
- 10.0 ft. - 14.2 ft. Silt - some angular gravel and cobbles
 - some sand, some clay
- 14.2 ft. - 14.4 ft. Bedrock - intermediate coarse grained tuff
 - medium to dark green
- 14.2 ft. - 14.4 ft. EOH

TP109

Location: 13463.97N/11417.77E

Elevation: 1542.42 ft.

- 0.0 ft. - 2.0 ft. Clay - buff
 - massive to laminated
 - dry, firm, blocky, friable
- 2.0 ft. - 10.0 ft. Silt - some angular gravel and cobbles
 - some sand, some clay
- 10.0 ft. - 10.2 ft. Bedrock - mafic tuff, black
 - aphanitic, massive
 - moderately magnetic
- 10.2 ft. EOH

TP110

Location: 13477.22N/11467.72E

Elevation: 1550.16 ft.

0.0 ft. - 6.0 ft.	Clay	- buff - massive to laminated - dry, firm, blocky, friable
6.0 ft. - 17.2 ft.	Silt	- some angular gravel and cobbles - some sand, some clay
17.2 ft.	EOH	



Clifton Associates Ltd.

CONSULTING ENGINEERS

APPENDIX B



Client: C P RAIL	Northing: 13281.83	Drill Contractor: Tonto Drilling Ltd
Project: Detailed Site Investigation	Easting: 11635.96	Drill: Longyear 38
Location: Walhachin, British Columbia	Inclination: 42 Deg	Drilling Method: BQ Diamond Drill
Project No: R1277	Azimuth: 076 Deg	Logged by: D. Edwards
Date Drilled: December 1, 1992	Ground Elev.: 1554.47	Top Casing Elev.: N/A

Depth (ft)	Symbol	Rock Description	Total Core Recovery	RQD %	Fracture Density	Core Angle	Type	Fracture Coatings	Competence	Piezometer Construction Details
0 - 48		CASING								
48 - 55		OVERBURDEN								
55 - 60		MAFIC-INTERMEDIATE TUFF						hem	rubi-blky	
60 - 65		- fine grained to coarse grained, commonly aphanitic						hem		
65 - 70		- dark greenish grey to light green where intermediate in composition						hem,carb		
70 - 75		- massive and homogenous to well bedded			8		40 frac	hem,mcarb,mep	comp	
75 - 80		- strongly magnetic to moderately magnetic where intermediate in composition						hem,carb	rubi	
80 - 85		- non calcareous						50 cont hem,mcarb		
85 - 90		- common hematite coating along fractures with halos parallel to fractures						65 hem,mcarb		



Client: .	C P RAIL	Northing:	13281.83	Drill Contractor:	Tonto Drilling Ltd
Project:	Detailed Site Investigation	Easting:	11635.96	Drill:	Longyear 38
Location:	Walhachin, British Columbia	Inclination:	42 Deg	Drilling Method:	BQ Diamond Drill
Project No:	R1277	Azimuth:	076 Deg	Logged by:	D. Edwards
Date Drilled:	December 1, 1992	Ground Elev.:	1554.47	Top Casing Elev.:	N/A

Depth (ft)	Symbol	Rock Description	Total Core Recovery	RQD %	Fracture Density	Core Angle	Core Angle Type	Fracture Coatings	Competence	Piezometer Construction Details
410	*****	MAFIC-INTERMEDIATE TUFF - 423.3 ft - 413.8 ft carbonate/clay gouge; C.A. 12 ° - 413.8 ft brownish pink granitic intrusive; medium grained, equigranular, composed of plagioclase, orthoclase, quartz and biotite				15	bdg	chl,carb,ep chl,carb	rubi- blky	
						12	flt	chl,carb	blky	
									comp	

415 ft EOH

ACID TEST 42° @ 415 ft



Client: C P RAIL	Northing: 13635.656	Drill Contractor: Tonto Drilling Ltd
Project: Detailed Site Investigation	Easting: 11591.913	Drill: Longyear 38
Location: Walhachin, British Columbia	Inclination: -42 Deg	Drilling Method: BQ Diamond Drill
Project No: R1277	Azimuth: 040 Deg	Logged by: D. Edwards
Date Drilled: December 3, 1992	Ground Elev.: 1562.559	Top Casing Elev.: N/A

Depth (ft)	Symbol	Rock Description	Total Core Recovery	RQD %	Fracture Density	Core Angle	Core Angle Type	Fracture Coatings	Competence	Piezometer Construction Details
0		CASING								
10										
20										
30										
40										
50		OVERBURDEN								
60		MAFIC-INTERMEDIATE TUFF				39	frac	chl,hem,m carb	blky	
65		- black to dark green to light green where intermediate in composition						chl,hem		
70		- aphanitic to coarse grained with occasional lapilli tuff and breccia beds						chl,hem,m mal	rubi-blky	
75		- strongly to moderately magnetic; zones of intermediate composition less magnetic				62	frac		rubi	
80		- noncalcareous				70	frac	chl,hem,carb	comp	
85						45	bdd	chl,carb,m hem	rubi	



Client:	C P RAIL	Northing:	13635.656	Drill Contractor:	Tonto Drilling Ltd
Project:	Detailed Site Investigation	Easting:	11591.913	Drill:	Longyear 38
Location:	Walhachin, British Columbia	Inclination:	42 Deg	Drilling Method:	BQ Diamond Drill
Project No:	R1277	Azimuth:	040 Deg	Logged by:	D. Edwards
Date Drilled:	December 3, 1992	Ground Elev.:	1562.559	Top Casing Elev.:	N/A

Depth (ft)	Symbol	Rock Description	Total Core Recovery	RQD %	Fracture Density	Core Angle	Core Angle Type	Fracture Coatings	Competence	Piezometer Construction Details
90		<p>MAFIC-INTERMEDIATE TUFF</p> <ul style="list-style-type: none"> -variable chlorite content ranging to very high where associated with carbonate veining and fractures - abundant slickensides associated with chlorotic surfaces on highly fractured rock - abundant hematite and chlorite fracture coatings - rare granitic intrusive veining up to 2 ft occasional epidote alteration associated with granitic intrusive - core generally highly fractured and broken up - @89.2 ft -89.8 ft mafic breccia in mafic matrix -@97.0 ft -101.5 ft highly fractured with a network of carbonate veining up to 0.3 inches, locally chloritic, C.A. 20 ° 						chl,carb,hem chl,carb,hem	blky-comp	
								chl,carb,hem	rubl	
100								carb,hem,m chl	rubl-blky	
110								chl,carb,hem mep		
120								chl,hem		
130								chl,hem,carb		
140								chl,hem,m carb,mep		
150								chl,hem	blky	
								chl,hem,m carb		
160								hem,chl,m carb		
								chl,hem,m carb		



Client:	C P RAIL	Northing:	13635.656	Drill Contractor:	Tonto Drilling Ltd
Project:	Detailed Site Investigation	Easting:	11591.913	Drill:	Longyear 38
Location:	Walhachin, British Columbia	Inclination:	42 Deg	Drilling Method:	BQ Diamond Drill
Project No:	R1277	Azimuth:	040 Deg	Logged by:	D. Edwards
Date Drilled:	December 9, 1992	Ground Elev.:	1562.559	Top Casing Elev.:	N/A

Depth (ft)	Symbol	Rock Description	Total Core Recovery	RQD %	Fracture Density	Core Angle	Type	Fracture Coatings	Competence	Piezometer Construction Details
250		MAFIC-INTERMEDIATE TUFF - @241.8 ft - 242.8 ft tectonic breccia floating in carbonate/ quartz matrix					52	frac carb,chl	rubl	
								carb,chl	blky	
		-@ 246.8 ft -247.5 ft 256.0 ft - 256.4 ft 259.8 ft -260.0 ft epidote alteration associated with lapilli tuff to breccia					55	bdg ep,carb,m chl	comp	
									blky	
							67	frac ep,carb,mchl	blky-comp	
							37	bdg mchl,mep,m carb	comp	
								mchl,mep,m carb	blky-comp	
		-@ 279.3 ft - 281.1 ft granitic intrusive with associated epidote alteration; C.A. 28 °					28	bdg mchl,mcarb		
								mchl,mcarb		
							27	bdg chl,carb mchl,mcarb		
		-@ 289.0 ft -306.5 ft core badly coated with oil and diesel					57	frac chl,carb,m hem		
								carb,chl,mep		
							40	frac mchl,mcarb	comp-blky	
							20	bdg mchl,carb mep		
		-@319.0 ft - 320.0 ft carbonate veining and epidote alteration					46	frac ep,mcarb,m chl		
							47	frac carb,mchl,ep	rubl	



Client:	C P RAIL	Northing:	13635.656	Drill Contractor:	Tonto Drilling Ltd
Project:	Detailed Site Investigation	Easting:	11591.913	Drill:	Longyear 38
Location:	Walhachin, British Columbia	Inclination:	-42 Deg	Drilling Method:	BQ Diamond Drill
Project No:	R1277	Azimuth:	040 Deg	Logged by:	D. Edwards
Date Drilled:	December 3, 1992	Ground Elev.:	1562.559	Top Casing Elev.:	N/A

Depth (ft)	Symbol	Rock Description	Total Core Recovery	RQD %	Fracture Density	Core Angle	Core Angle Type	Fracture Coatings	Competence	Piezometer Construction Details
330		MAFIC-INTERMEDIATE TUFF				47	frac	carb,ep,mchl	blky	
									rubl	
						15	bdg	mcarb,mchl	blky	
									comp	
						15	frac	mcarb,mchl	rubl-blky	
						18	bdg	mcarb,mchl		
								mcarb,mchl		
								mcarb,mchl		
						32	frac	mcarb,mchl		
		- @ 353.5 ft -354.8 ft carbonate and chlorite associated with intense microfracturing						carb,chl		
						29	frac			
								carb,chl		
								chl,mcarb		
						70	frac			
						28	bdg	mchl,mcarb	blky	
								chl,carb		
						20	bdg	chl,carb	rubl-blky	
						67	frac	chl,carb		
								chl,carb	comp-blky	
								mcarb		
		- @ 388.2 ft - 389.4 ft coarse grained tuff bed				22	frac	chl,carb		
						41	frac	carb,chl chl,carb	rubl-blky	



Client:	C P RAIL	Northing:	13635.656	Drill Contractor:	Tonto Drilling Ltd
Project:	Detailed Site Investigation	Easting:	11591.913	Drill:	Longyear 38
Location:	Walhachin, British Columbia	Inclination:	42 Deg	Drilling Method:	BQ Diamond Drill
Project No:	R1277	Azimuth:	040 Deg	Logged by:	D. Edwards
Date Drilled:	December 3, 1992	Ground Elev.:	1562.559	Top Casing Elev.:	N/A

Depth (ft)	Symbol	Rock Description	Total Core Recovery	RQD %	Fracture Density	Core Angle	Core Angle Type	Fracture Coatings	Competence	Piezometer Construction Details
410		MAFIC-INTERMEDIATE TUFF				48	frac	chl,carb chl,carb chl,carb	rubi- biky	
420						25	bdg	chl,carb,hem		
430		- @ 428.0 ft - 428.2 ft epidote alteration 430.0 FOH				70	frac	chl,carb mchl chl,carb		
						55	frac	chl,carb,ep, hem		

ACID TEST 42 °



Client:	C P RAIL	Northing:	13312.549	Drill Contractor:	Tonto Drilling Ltd
Project:	Detailed Site Investigation	Easting:	11209.380	Drill:	Longyear 38
Location:	Walhachin, British Columbia	Inclination:	-46 Deg	Drilling Method:	NQ Diamond Drill
Project No:	R1277	Azimuth:	040 Deg	Logged by:	D. Edwards
Date Drilled:	December 7, 1992	Ground Elev.:	1513.323	Top Casing Elev.:	N/A

Depth (ft)	Symbol	Rock Description	Total Core Recovery	RQD %	Fracture Density	Core Angle	Core Angle Type	Fracture Coatings	Competence	Piezometer Construction Details
0		CASING								
10										
20										
25		MAFIC-INTERMEDIATE TUFF			5.0	10	bdg	hem,carb,lim lim	comp- biky	
30		- dark to light green where intermediate in composition - medium to coarse grained to rarely aphanitic, local bedding laminations - common beds of lapilli tuff to breccia sized clasts - nonmagnetic to moderately magnetic - hematite associated with mafic tuff - calcite flooding often associated with intermediate tuff - @ 32.9 ft - 33.7 ft calcite vein - @ 36.3 ft - 38.8 ft intermediate, medium to coarse grained tuff; variably calcareous			1.9	72	frac	hem,carb,lim		
40		- @ 40.3 ft, 43.3 ft, 43.4 ft, 43.8 ft, 44.1 ft and 45.4 ft 5 mm thick clay/carbonate gouge			3.7	9	bdg	mhem,carb		
50		- @ 42.1 ft - 54.0 ft intense microfracturing			4.5	38	flt	carb,mchl		
60		- @ 42.1 ft - 42.8 ft tectonic breccia floating in carbonate flooded zone			4.0			chl,carb,hem		
70		- @ 45.0 ft - 46.0 ft 1 to 2 inch carbonate veining			55		bdg	carb,hem	blky- rubl	
75		- @ 46.4 ft - 47.5 ft tuff fragments floating in carbonate adjacent to 6.0 inch gouge						carb,mhem	comp	
80					40		bdg	mcarb		
					7.5	25	bdg	carb		comp- biky
					4.3	8	bdg	carb		
					3.3	14	bdg	carb,chl		
					3.7	21	bdg	carb		



Client:	C P RAIL	Northing:	13312.549	Drill Contractor:	Tonto Drilling Ltd
Project:	Detailed Site Investigation	Easting:	11209.380	Drill:	Longyear 38
Location:	Walhachin, British Columbia	Inclination:	-46 Deg	Drilling Method:	NQ Diamond Drill
Project No:	R1277	Azimuth:	040 Deg	Logged by:	D. Edwards
Date Drilled:	December 7, 1992	Ground Elev.:	1513.323	Top Casing Elev.:	N/A

Depth (ft)	Symbol	Rock Description	Total Core Recovery	RQD %	Fracture Density	Core Angle	Core Angle Type	Fracture Coatings	Competence	Piezometer Construction Details
		MAFIC-INTERMEDIATE TUFF			3.7	21	bdg	carb	comp-blky	
		- @ 67.8 ft - 69.0 ft 2 inch carbonate vein associated with medium to coarse grained intermediate tuff				15	bdg	carb,mhem carb,hem carb,mhem		
90					4.7	20	bdg	carb,mhem, mep	comp	
		- @ 77.6 ft gouge								
		- @ 93.5 ft chlorite and carbonate alteration adjacent to 0.5 inch clay gouge			4.7	17	bdg	mcarb,mhem, mchl,mep		
100										
		- @ 102.0 ft - 103.2 ft breccia clast in coarse grained tuff			6.0	19	bdg	mcarb,mchl carb,chl		
110					9.4	40	cont	carb,mchl		
					8.1	21	bdg	mcarb		
120						17	bdg	carb,mchl,mhem		
									blky	
						13	bdg	carb,mhem	comp-blky	
130						17	bdg	carb carb		
		- @ 133.7 ft - 128.0 ft well developed bedding in aphanitic tuff to coarse grained tuff with brecciated clasts				15	frac	mhem,carb, chl		
140								carb,chl	blky	
						50	frac	carb,chl carb,chl		
150						42	frac			
		- @ 159.8 ft 0.5 inch zone of epidote alteration						carb,chl,mhem		
160					2.1	13	bdg	m	comp	



Client:	C P RAIL	Northing:	13312.549	Drill Contractor:	Tonto Drilling Ltd
Project:	Detailed Site Investigation	Easting:	11209.380	Drill:	Longyear 38
Location:	Walhachin, British Columbia	Inclination:	-46 Deg	Drilling Method:	NQ Diamond Drill
Project No:	R1277	Azimuth:	040 Deg	Logged by:	D. Edwards
Date Drilled:	December 7, 1992	Ground Elev.:	1513.323	Top Casing Elev.:	N/A

Depth (ft)	Symbol	Rock Description	Total Core Recovery	RQD %	Fracture Density	Core Angle	Core Angle Type	Fracture Coatings	Competence	Piezometer Construction Details
170		MAFIC-INTERMEDIATE TUFF			2.1	13	bdg	carb,mep,mchl	comp	
		- @ 166.0 ft - 176.0 ft common coarse grained tuff beds			3.0	79	frac	carb,chl		
		- @ 168.0 ft - 169.0 ft 0.5 inch wide calcite vein			1.6	34	bdg	mcarb		
180					1.7	76	frac	carb,mchl,mhem		
		- @ 184.0 ft breccia sized clasts in mafic matrix; chloritically altered			4.0	14	bdg	mcarb,mhem		
190		- @ 187.3 ft lapilli sized clasts			5.2	65	frac	carb,mhem		
		- @ 191.5 0.5 inch calcite vein; C.A. 65°			3.8	30	frac	carb,mhem		
200					>10	85	frac	carb,mhemchl		
					3.4	12	bdg	carb,mhem		
210					3.0	29	bdg	mcarb,mhem		
220		- @ 218.8 ft - 219.9 ft lapilli tuff bed underlain by amygdaloidal basalt			6.8	21	frac	mcarb,mhem		
230		- @ 228.8 ft - 232.4 ft scattered lapilli sized clasts			4.4	31	cont	carb,mhem,mchl,mep		
240					7.1	14	bdg	carb,mhem,mchl		



Client: C P RAIL	Northing: 13312.549	Drill Contractor: Tonto Drilling Ltd
Project: Detailed Site Investigation	Easting: 11209.380	Drill: Longyear 38
Location: Walhachin, British Columbia	Inclination: -46 Deg	Drilling Method: NQ Diamond Drill
Project No: R1277	Azimuth: 040 Deg	Logged by: D. Edwards
Date Drilled: December 7, 1992	Ground Elev.: 1513.323	Top Casing Elev.: N/A

Depth (ft)	Symbol	Rock Description	Total Core Recovery	RQD %	Fracture Density	Core Angle	Core Angle Type	Fracture Coatings	Competence	Piezometer Construction Details
250		MAFIC-INTERMEDIATE TUFF - @ 243.0 ft - 257.0 ft very poor core recovery				14	bdg	carb,mhem,mchl	comp-blky	
260						44	frac	carb,chl,ep		
270						34	frac	carb,chl	comp	
280		- @ 273.9 ft 1 inch thick hematite stained clay gouge - @ 274.0 ft - 274.5 ft network of calcite filled fractures				21	frac	carb,hem		
290		- @ 284.5 ft - 285.5 ft highly fractured zone - @ 285.5 ft brecciated fragments floating in calcite matrix - @ 287.0 ft - 287.5 ft epidote alteration associated with intermediate tuff zone				11	bdg	carb,mhem	blky	
300						40	frac	carb,mhem		
310						18	bdg	carb,mhem	comp	
320		- @ 317.0 ft - 318.0 ft @ 330.0 ft - 335.0 ft epidote alteration associated with fractures; C.A. 8 °				30	frac	carb	comp-blky	
						40	frac	carb,hem		
						12	bdg	carb,mhem,ep	comp	
						19	bdg	carb,hem,mep	comp-blky	
						81	frac	carb,mep	comp	



Client: C P RAIL	Northing: 13312.549	Drill Contractor: Tonto Drilling Ltd
Project: Detailed Site Investigation	Easting: 11209.380	Drill: Longyear 38
Location: Walhachin, British Columbia	Inclination: -46 Deg	Drilling Method: NQ Diamond Drill
Project No: R1277	Azimuth: 040 Deg	Logged by: D. Edwards
Date Drilled: December 7, 1992	Ground Elev.: 1513.323	Top Casing Elev.: N/A

Depth (ft)	Symbol	Rock Description	Total Core Recovery	RQD %	Fracture Density	Core Angle	Fracture Coatings	Competence	Piezometer Construction Details
330		MAFIC-INTERMEDIATE TUFF			4.5	81	frac carb,mep	blky	
					4.9	80	frac carb,ep,m hem	comp-blky	
340					6.7	15	bdg carb,mhem		
						42	frac carb,hem,m ep	blky	
350		- @ 349.8 ft - 350.2 ft epidote alteration associated with fractured zone			7.5	13	bdg	comp-blky	
					7.2		carb carb,mchl		
					55		frac carb,hem carb,hem		
360		- @ 353.6 ft - 359.8 ft scattered 2 to 3 inch wide beds of coarse grained lapilli tuff			15		bdg carb,mhem		
								blky-comp	
		EOH 366.0 ft			32		frac		

ACID TEST 46° @ 366.0 ft



Client: C P RAIL	Northing: 14095.308	Drill Contractor: Tonto Drilling Ltd
Project: Detailed Site Investigation	Easting: 11159.232	Drill: Longyear 38
Location: Walhachin, British Columbia	Inclination: -45 Deg	Drilling Method: NQ Diamond Drill
Project No: R1277	Azimuth: 040 Deg	Logged by: D. Edwards
Date Drilled: December 10, 1992	Ground Elev.: 1470.367	Top Casing Elev.: N/A

Depth (ft)	Symbol	Rock Description	Total Core Recovery	RQD %	Fracture Density	Core Angle	Core Angle Type	Fracture Coatings	Competence	Piezometer Construction Details
0 - 30		CASING								
30 - 32		MAFIC-INTERMEDIATE TUFF - black to dark grey to grey green with common beds of light grey intermediate tuff - strongly to moderately magnetic to nonmagnetic where intermediate in composition - massive, aphanitic to coarse grained with scattered lapilli sized fragments - carbonate veining common in light grey intermediate tuff - @ 46.8 ft - 50.5 ft and @ 53.0 ft - 55.5 ft beds of medium to light grey intermediate to felsic tuff; abundant coarse grained fragments, amygdaloidal in part - @ 72.5 ft - 78.3 ft partly calcareous, medium grey intermediate tuff; amygdaloidal in part, grading upwards to dark grey mafic tuff with coarse grained to lapilli sized fragments - @ 77.0 ft - 78.0 ft highly fractured with carbonate alteration and carbonate/clay gouge								
32 - 34			44	frac	lim,carb	blky-comp				
34 - 36			39	frac	lim,carb,m hem					
36 - 38			63	frac	lim,carb					
38 - 40					lim,carb					
40 - 42			51	frac	lim,carb,mchl	comp				
42 - 44			6.0		lim,mcarb					
44 - 46			2.1	47	cont	lim,carb				
46 - 48					lim	blky-comp				
48 - 50			5.3		lim,carb	comp				
50 - 52				mcarb,mchl						
52 - 54		4.8	70	frac	carb,chl,hem					
54 - 56				lim						
56 - 58		5.3		lim,carb						
58 - 60				mcarb,mchl	comp					
60 - 62		4.8	70	frac	carb,chl,hem					
62 - 64				lim						
64 - 66		5.3		lim,carb						
66 - 68				mcarb,mchl	comp					
68 - 70		4.8	70	frac	carb,chl,hem					
70 - 72				lim						
72 - 74		5.3		lim,carb						
74 - 76				mcarb,mchl	comp					
76 - 78		4.8	70	frac	carb,chl,hem					
78 - 80				lim						
80 - 82		5.3		lim,carb						
82 - 84				mcarb,mchl	comp					
84 - 86		4.8	70	frac	carb,chl,hem					
86 - 88				lim						
88 - 90		5.3		lim,carb						
90 - 92				mcarb,mchl	comp					
92 - 94		4.8	70	frac	carb,chl,hem					
94 - 96				lim						
96 - 98		5.3		lim,carb						
98 - 100				mcarb,mchl	comp					



Client:	C P RAIL	Northing:	14095.308	Drill Contractor:	Tonto Drilling Ltd
Project:	Detailed Site Investigation	Easting:	11159.232	Drill:	Longyear 38
Location:	Walhachin, British Columbia	Inclination:	-45 Deg	Drilling Method:	NQ Diamond Drill
Project No:	R1277	Azimuth:	040 Deg	Logged by:	D. Edwards
Date Drilled:	December 10, 1992	Ground Elev.:	1470.367	Top Casing Elev.:	N/A

Depth (ft)	Symbol	Rock Description	Total Core Recovery	RQD %	Fracture Density	Core Angle	Core Angle Type	Fracture Coatings	Competence	Piezometer Construction Details
88.0		MAFIC-INTERMEDIATE TUFF						carb,chl	blky-comp	
83.0 - 89.0		@ 83.0 ft - 89.0 ft carbonate veining in highly fractured mainly intermediate variably calcareous tuff with scattered breccia sized clasts						carb,chl	comp	
88.2 - 89.2		@ 88.2 ft - 89.2 ft chloritic carbonate gouge						carb,chl,hem		
98.0 - 99.5		@ 98.0 ft - 99.5 ft abundant calcite filled fractures			1.7			carb,chl	blky	
100.8 - 102.2		@ 100.8 ft - 102.2 ft fault gouge						carb,mchl	comp	
102.5 - 103.2		@ 102.5 ft - 103.2 ft calcite amygdals						mcarb,mchl, mhem mcarb,mchl	blky-comp	
114.5 - 115.3		@ 114.5 ft - 115.3 ft light green grey intermediate tuff						carb,chl		
115.0 - 115.5		@ 115.0 ft - 0.5 inch gouge						carb,mpyr chl,hem		
124.2 - 124.6		@ 124.2 ft - 124.6 ft lapilli tuff bed with altered porphyritic clasts						carb,chl,hem ,mep		
124.2 - 124.6		@ 124.2 ft - 124.6 ft lapilli tuff bed with altered porphyritic clasts						carb,chl,hem ,mep	comp-biky	
135.0 - 135.5		@ 135.0 ft - 135.5 ft clay gouge and fragments; calcareous, hematitic and chloritic; abundant calcite healed fractures above gouge						carb,chl,hem ,mep	blky	
135.0 - 135.5		@ 135.0 ft - 135.5 ft clay gouge and fragments; calcareous, hematitic and chloritic; abundant calcite healed fractures above gouge						carb,mchl hem	comp	
145.0 - 149.0		@ 145.0 ft - 149.0 ft clay gouge and fragments; calcareous, hematitic and chloritic; abundant calcite healed fractures above gouge						carb,chl,hem	blky-comp	
145.0 - 149.0		@ 145.0 ft - 149.0 ft clay gouge and fragments; calcareous, hematitic and chloritic; abundant calcite healed fractures above gouge						carb,chl,hem	comp	
145.0 - 149.0		@ 145.0 ft - 149.0 ft clay gouge and fragments; calcareous, hematitic and chloritic; abundant calcite healed fractures above gouge						carb,hem,ep	rubl	
145.0 - 149.0		@ 145.0 ft - 149.0 ft clay gouge and fragments; calcareous, hematitic and chloritic; abundant calcite healed fractures above gouge						carb,hem,ep	blky	
145.0 - 149.0		@ 145.0 ft - 149.0 ft clay gouge and fragments; calcareous, hematitic and chloritic; abundant calcite healed fractures above gouge						carb,hem,ep	comp-biky	



Client: C P RAIL	Northing: 14095.308	Drill Contractor: Tonto Drilling Ltd
Project: Detailed Site Investigation	Easting: 11159.232	Drill: Longyear 38
Location: Walhachin, British Columbia	Inclination: -45 Deg	Drilling Method: NQ Diamond Drill
Project No: R1277	Azimuth: 040 Deg	Logged by: D. Edwards
Date Drilled: December 10, 1992	Ground Elev.: 1470.367	Top Casing Elev.: N/A

Depth (ft)	Symbol	Rock Description	Total Core Recovery	RQD %	Fracture Density	Core Angle	Core Angle Type	Fracture Coatings	Competence	Piezometer Construction Details
250		MAFIC-INTERMEDIATE TUFF - @ 243.5 ft - 250.0 ft alternating 6 -8 inch beds of lapilli tuff in medium grained tuff				45	bdg	ep, kfld, m carb	comp	
						10	frac	mcarb, chl	blky-comp	
260		- @ 257.5 ft minor gouge; core highly fractured and broken up - @ 264.0 ft - 266.0 ft medium green tuff (?); C.A. 50 °				53	frac	mcarb, chl	blky comp	
		- @ 265.0 ft - 268.0 ft - 0.1 inch clay gouge along fracture surfaces				14	bdg	carb, chl, m pyr	comp-biky	
270		- @ 267.0 - 273.8 ft light to medium green partly bedded tuff(?); bedding C.A. 76 °, contact with surrounding rock 45°(dyke?)						mcarb, mchl mcarb	blky	
280		- @ 279.5 ft -296.0 ft lapilli tuff with minor mafic/intermediate tuff beds and common light green coarse grained tuff beds				15	bdg	mcarb	comp	
290		- @ 292.0 ft - 293.0 ft apparent bedding orientations C.A. 0 ° and 42°				0	bdg	mcarb	blky	
		296.0 ft EOH				5	bdg	mcarb	comp	

ACID TEST 45 o @ 296.0 ft



Client:	C P RAIL	Northing:	13245.40	Drill Contractor:	Tonto Drilling Ltd
Project:	Detailed Site Investigation	Easting:	10433.62	Drill:	Longyear 38
Location:	Walhachin, British Columbia	Inclination:	-42 Deg	Drilling Method:	NQ Diamond Drill
Project No:	R1277	Azimuth:	040 Deg	Logged by:	D. Edwards
Date Drilled:	December 13, 1992	Ground Elev.:	1327.87	Top Casing Elev.:	N/A

Depth (ft)	Symbol	Rock Description	Total Core Recovery	RQD %	Fracture Density	Core Angle	Core Angle Type	Fracture Coatings	Competence	Piezometer Construction Details
90	*****	MAFIC-INTERMEDIATE TUFF				8	bdg	carb,mhem	comp-blky	
		- 92.0 ft -92.5 ft lapilli tuff				15	bdg	carb,mhem	blky-comp	
		EOH 93.0 ft							comp-blky	

ACID TEST 42° @ 93 ft



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APPENDIX C

WALHACHIN EAST
DETAILED INVESTIGATION

THIN SECTION ANALYSIS

SAMPLE TS 92-01

DDH301 - 207.0 ft.

ROCK TYPE

Bedded Mafic Crystal Tuff

MINERALOGY

Groundmass	75%
Plagioclase Phenocrysts	10%
Magnetite	10%
Epidote	4%
Calcite	1%
Zeolite	trace

TEXTURE

This originally hypohyaline rock is comprised of 10% recognizable subhedral plagioclase phenocryst fragments in a devitrified volcanic glass groundmass. Disseminated magnetite occurs throughout and demarks bedding planes. Fine grained epidote occurs throughout the sample. Accessory calcite and zeolite fill rare microfractures.

ALTERATION

The microcrystalline volcanic glass groundmass has been devitrified. Individual plagioclase phenocrysts display saussuritization.

COMMENTS

Hardness and toughness of this rock will be high due to its high feldspar content within the devitrified groundmass and the low degree of carbonate and chlorite. Its well indurated fine grained nature also will enhance toughness.

WALHACHIN EAST
DETAILED INVESTIGATION

THIN SECTION ANALYSIS

SAMPLE TS 92-02

DDH301 - 139.5 ft

ROCK TYPE

Bedded Fine Grained Crystal Tuff

MINERALOGY

Groundmass	55%
Plagioclase Phenocrysts	20%
Magnetite	10%
Amphibole	5%
Calcite	5%
Epidote	3%
Quartz	2%

TEXTURE

This rock is comprised of 20% recognizable subhedral plagioclase and 5% amphibole phenocrysts fragments in a devitrified volcanic glass groundmass. Disseminated magnetite occurs throughout and demarks bedding planes. Anhedral epidote occurs throughout the sample as individual grains. Calcite occurs as veining. Fine grained and coarse grained beds displayed in this sample are similar in texture and composition and differ only in grain size.

ALTERATION

The microcrystalline groundmass, originally comprised of fine grained volcanic glass fragments, has been devitrified. The plagioclase phenocrysts have been saussuritized.

COMMENTS

Hardness and toughness of this rock will be high due to its high feldspar content within the devitrified groundmass and the low degree of carbonate and chlorite. Its well indurated fine grained nature also will enhance toughness. Fracturing within the rock is minimal.

WALHACHIN EAST
DETAILED INVESTIGATION

THIN SECTION ANALYSIS

SAMPLE TS 92-03

DDH301 - 193.5 ft

ROCK TYPE

Banded Mafic Tuff

MINERALOGY

Groundmass	40%
Magnetite	37%
Quartz	10%
Calcite	5%
Epidote	5%
Chlorite	3%

TEXTURE

Bedding laminations and subaqueous deformational structures within this sample are demarked by concentrations of magnetite within the quartz rich devitrified volcanic glass groundmass. Very fine grained chlorite and medium grained epidote occur scattered throughout the sample.

ALTERATION

The microcrystalline groundmass, originally comprised of fine grained volcanic glass fragments, has been devitrified.

COMMENTS

This rock displays syndepositional deformation common within the fine grained tuff seen throughout Walhachin east. A greater than average magnetite content contributes to the toughness and hardness of this rock. The minor amount of chlorite within this rock will not detract from its overall hardness and toughness.

WALHACHIN EAST
DETAILED INVESTIGATION

THIN SECTION ANALYSIS

SAMPLE TS 92-04

DDH301 - 414.0 ft

ROCK TYPE

Granitic Vein

MINERALOGY

Feldspar	70%
Quartz	20%
Chlorite	5%
Calcite	2%
Magnetite	3%
Epidote	trace

TEXTURE

This holocrystalline phaneritic rock displays a partially mosaic texture with interstitial quartz occurring among subhedral altered feldspars. Numerous feldspar crystals display Carlsbad twinning suggesting a high alkali feldspar content relative to plagioclase within the rock.

ALTERATION

Plagioclase has been saussuritized to some degree within the rock and chlorite and magnetite likely occur from a breakdown of biotite.

COMMENTS

Hardness of this rock will be high due to its high feldspar and quartz content. The interlocking nature of the rock will result in high toughness. The chlorite is fine grained and does not detract from the overall toughness of the rock.

WALHACHIN EAST
DETAILED INVESTIGATION

THIN SECTION ANALYSIS

SAMPLE TS.92-05

DDH304 - 55.5 ft

ROCK TYPE

Calcareous Intermediate Tuff

MINERALOGY

Groundmass	50%
Plagioclase	20%
Calcite	20%
Magnetite	5%
Quartz	5%
Zeolite	trace

TEXTURE

This rock was originally porphyritic with altered plagioclase in a ground mass of devitrified volcanic glass. This rock is slightly amygdaloidal.

ALTERATION

Most plagioclase phenocrysts within the sample have been saussuritized. The ground mass, consists of devitrified volcanic glass fragments, It is also calcareous. Calcite also occurs as veining associated with minor quartz and in rare amygdals.

COMMENTS

The high degree of calcite within the rock will lower its hardness. This rock would produce secondary ballast material.

WALHACHIN EAST
DETAILED INVESTIGATION
THIN SECTION ANALYSIS

SAMPLE TS 92-06

DDH304 - 87.0 ft

ROCK TYPE

Calcareous Intermediate Tuff

MINERALOGY

Groundmass	49%
Calcite	40%
Quartz	10%
Magnetite	1%

TEXTURE

The original texture of this rock is unrecognizable due to alteration. The strongly calcareous groundmass consists of devitrified volcanic glass with common relic plagioclase phenocrysts.

ALTERATION

The devitrified volcanic glass matrix of this rock is strongly calcareously altered. Numerous saussuritized plagioclase outlines are seen within the sample. Calcareous veining with variable amounts of quartz occurs throughout the rock.

COMMENTS

This rock would make poor ballast material due to its high degree of calcite. It would be soft and moderately hard.

WALHACHIN EAST
DETAILED INVESTIGATION
THIN SECTION ANALYSIS

SAMPLE TS 92-07

DDH304 - 102.8 ft

ROCK TYPE

Vesicular Basalt Flow

MINERALOGY

Plagioclase	45%
Void Space	20
Groundmass	15%
Calcite	15%
Magnetite	3%
Epidote	2%
Zeolite	trace

TEXTURE

This hypocrystalline rock consists of fine grained accicular feldspar crystals in an aphanitic devitrified volcanic glass groundmass. Common fine grained fragments of devitrified to partially devitrified volcanic glass also occur. The rock displays a flow texture with randomly oriented plagioclase phenocrysts. Void space comprised of vesicles make up 20% of the thin section. The rock is amygdaloidal in part with calcite occurring within the vesicles.

ALTERATION

This rock shows the least alteration of all basalts sampled. The groundmass is comprised of microcrystalline devitrified volcanic glass fragments. Vesicles are rarely filled with calcite and minor zeolite.

COMMENTS

This rock would make poor ballast material due to its high degree of calcite and void space. It would be moderately hard and have high absorption values.

WALHACHIN EAST
DETAILED INVESTIGATION
THIN SECTION ANALYSIS

SAMPLE TS 92-08

DDH304 - 215.5 ft

ROCK TYPE

Altered Vesicular Basalt Flow

MINERALOGY

Plagioclase	45%
Groundmass	35%
Magnetite	10%
Calcite	5%
Epidote	<5%
Quartz	<1%
Zeolite	<1%

TEXTURE

The rock probably originally consisted of fine grained accicular feldspar crystals in an devitrified volcanic glass groundmass similar to sample TS92-07. Plagioclase phenocrysts are now partially saussuritized and difficult to recognize and the groundmass and larger volcanic glass fragments are completely devitrified.

ALTERATION

Fine grained plagioclase phenocrysts have been partially saussuritized and the groundmass is comprised of aphanitic to microcrystalline devitrified volcanic glass fragments. Calcite and epidote occurs in common microfractures as does epidote.

COMMENTS

The overall hardness and toughness of this rock is high due to the high feldspar content. It would make good ballast material. The calcite content is minor and would not detract from overall rock quality.

WALHACHIN EAST
DETAILED INVESTIGATION

THIN SECTION ANALYSIS

SAMPLE TS 92-09

DDH304 - 270.0 ft

ROCK TYPE

Coarse Grained/Lapilli Tuff

MINERALOGY

Tuff Fragments

Groundmass	40%
Plagioclase	5%
Magnetite	4%

Matrix

Groundmass	25%
Plagioclase	5%
Calcite	5%
Quartz	10%
Magnetite	2%
Epidote	2%
Chlorite	2%

TEXTURE

The rock is comprised of fine to coarse grained fragments of crystal tuff, volcanic glass, feldspar porphyry, vesicular basalt and basaltic flows in a groundmass of aphanitic devitrified volcanic glass, quartz, plagioclase and calcite. Disseminated magnetite occurs throughout the sample.

ALTERATION

The groundmass within the tuff fragments, and interstitial to them, is comprised of devitrified volcanic glass. The thin section straddles a contact between tuff displaying primary textures with common intergranular quartz and tuff that displays a higher degree of devitrification associated with minor calcareous alteration.

COMMENTS

The better preserved quartz rich tuff is harder than the more devitrified rock within the sample. The interlocking nature of grains within both rock types will enhance its toughness.

WALHACHIN EAST
DETAILED INVESTIGATION

THIN SECTION ANALYSIS

SAMPLE TS 92-10

Bulk Sample No. 1

ROCK TYPE

Coarse Grained Mafic Tuff

MINERALOGY

Groundmass	50%
Plagioclase	35%
Magnetite	10%
Amphibole	5%
Epidote	trace

TEXTURE

The thin section straddles a contact between two rock textures. The first rock is comprised of common fractured subhedral plagioclase and amphibole phenocrysts in a groundmass of aphanitic devitrified volcanic glass. The second rock is composed of coarse grained fragments of feldspar porphyry and basaltic flows in a groundmass of aphanitic devitrified volcanic glass with rare plagioclase fragments. Intergranular fine grained quartz is common and occurs between volcanic rock fragments. Disseminated magnetite occurs throughout the sample.

ALTERATION

The volcanic glass groundmass has become devitrified. Plagioclase phenocrysts are partially saussuritized. Secondary intergranular quartz occurs within coarser fractions. Epidote occurs filling rare microfractures.

COMMENTS

This rock will have high hardness and toughness values. The interlocking coarse grains will contribute to the strength of the rock.



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APPENDIX D

PETROGRAPHIC ANALYSIS
WALHACHIN EAST
Sample L5425 (Bulk Sample BS01)

Location: 13214N/11313E

Rock Type	-1 1/2 + 1	-1 + 3/4	-3/4 + 1/2	-1/2 + 3/8	-3/8 + 4	Total
1 Mafic Tuff - coarse grained to rare lapilli tuff	44.1	45.3	45.2	40.3	51.0	44.8
2. Mafic Tuff - medium to fine grained	55.9	54.7	54.8	59.7	49.0	55.2
Percent of Total	35.1	40.5	14.7	5.3	4.4	100.0

Mafic Tuff - coarse grained to rare lapilli tuff

The coarse grained lapilli tuff is dark gray, green to black and coarse grained with rare fine grained angular to subrounded lapilli tuff sized clasts of mafic composition. It displays a welded texture. The matrix is mafic in composition with 1% - 5% euhedral to subhedral feldspar crystals up to 2 mm. It is strongly magnetic and partially fractured with minor fracture filling epidote, calcite and hematite. It contains no sulphides.

Mafic Tuff - medium to fine grained

This tuff is dark gray, green to black, medium to fine grained and rarely aphanitic. It is mafic in composition, massive and strongly magnetic. The rock occasionally displays bedding but does not fracture along bedding planes. It often displays subconchoidal fracture faces. The tuff is very rarely calcareous. It is partially fractured with minor fracture filling epidote, calcite and hematite. It contains no sulphides.

Both rocks are hard (approx. >5.5) and tough. The coarse grained tuff is expected to be moderately tougher than the finer grained tuff. Larger particle shapes are roughly equidimensional. Particles <3/4 inch are elongated or bladed.

PETROGRAPHIC ANALYSIS
WALHACHIN EAST
Sample L5426 (Bulk Sample BS02)

Location: 13455N/11972E

Rock Type	-1 1/2 + 1	-1 + 3/4	-3/4 + 1/2	-1/2 + 3/8	-3/8 + 4	Total
1 Mafic Tuff	64.6	47.2	65.0	45.1	66.7	59.0
2. Mafic/Intermediate Tuff	35.4	52.8	35.0	54.1	33.3	41.0
Percent of Total	46.1	25.0	16.1	7.3	5.5	100.0

Mafic Tuff

The mafic tuff is black in colour, aphanitic and rarely displays bedding. It is massive and strongly magnetic. The tuff is rarely fractured with minor fracture filling calcite. Fractures are often subconchoidal and rarely occur along bedding planes. The rock contains no sulphides.

Mafic/Intermediate Tuff

This tuff is dark gray, green to dark gray and fine to medium grained. It is mafic to intermediate in composition, equigranular and moderately magnetic. The tuff is rarely calcareous. It is partially fractured with common fracture filling epidote, calcite and hematite. It contains no sulphides.

Both rocks are hard (approx. >5.5) and tough. The mafic/intermediate tuff is expected to be moderately softer than the aphanitic mafic tuff. Larger particle shapes are roughly equidimensional. A greater than average proportion of mafic/intermediate tuff particles occur within the -1 + 3/4 fraction. Particles <3/4 inch are often elongate or bladed.

PETROGRAPHIC ANALYSIS
WALHACHIN EAST
Sample L5427 (Bulk Sample BS03)

Location: 14075N/10321E

Rock Type	-1 1/2 + 1	-1 + 3/4	-3/4 + 1/2	-1/2 + 3/8	-3/8 + 4	Total
1 Lapilli Tuff	46.2	24.9	97.4	92.7	92.7	98.7
2. Epidote Vein Material			2.6	7.3	7.3	1.3
Percent of Total	46.2	24.9	16.1	7.2	5.6	100.0

Lapilli Tuff

The lapilli tuff is pistachio green to dark gray, green. The rock consists of coarse grained tuff to lapilli tuff sized, often mafic, clasts up to 2 cm in a finer grained mafic/intermediate matrix. It commonly contains plagioclase porphyroclasts (ie: crystal/lapilli tuff) up to 2 mm. The tuff is weakly to moderately magnetic. Abundant epidote alteration occurs as saussuritization of feldspars, pervasive matrix alteration and frequent epidote veining. Epidote makes up between 20% and 30% of the rock.

Rare particles consist partially to wholly of feldspar porphyry in a mafic ground mass with saussuritized orthoclase phenocrysts up to 5 mm. These particles may represent an adjacent igneous intrusive phase. The rock is commonly fractured but fractures have been healed by epidote veining. The matrix of the tuff is commonly calcareous, especially in areas of intense epidote alteration. The rock contains no sulphides.

Epidote Vein Material

Particle shapes <3/4 inch contain minor amounts of epidote vein material. The vein material is pistachio green to white with minor amounts of calcite and silica present.

SUMMARY OF BALLAST TEST RESULTS

CLIENT:	CP RAIL	SAMPLE RECEIVED:	92/12/23
PROJECT NO.:	R1277B	LOCATION:	WALHACHIN, BC
CAL SAMPLE NO.:	L5425	TRACK CLASSIFICATION:	Main Line CWR
CLIENT SAMPLE NO:	Bulk#1	BALLAST GRADING:	4.5

<u>TEST</u>	<u>TEST RESULTS</u>	<u>SPECIFICATIONS</u>
Los Angeles Abrasion Loss (%)	8.6	45 max.
Mill Abrasion Loss (%)	1.3	9 max.
Abrasion No.	14.9	65 max.
Specific Gravity	2.77	2.60 min.
Absorbtion (%)	0.64	0.5 max.
Magnesium Sulphate Soundness Loss (%)	0.23	1.0 max.
Fractured Faces (%)		90
Minus 2" plus 1 1/2"		90
Minus 1 1/2" plus 1"	98.7	90
Minus 1" plus 3/4"	97.9	90
Minus 3/4" plus 1/2"		90
Minus 1/2" plus 3/8"		90
Shape Factor		
Minus 2" plus 1 1/2"		
Minus 1 1/2" plus 1"	1.81	
Minus 1" plus 3/4"	2.08	
Sieve Analysis, Finer Than Sieve (%)		
2 1/2"	100.0	100
2"	100.0	90-100
1 1/2"	100.0	60-80
1"	57.6	15-35
3/4"	15.8	0-5
1/2"	4.2	
3/8"	2.7	
#4	1.4	0-3
#200	0.4	0-2

SUMMARY OF BALLAST TEST RESULTS

CLIENT:	CP RAIL	SAMPLE RECEIVED:	92/12/23
PROJECT NO.:	R1277B	LOCATION:	WALHACHIN, BC
CAL SAMPLE NO.:	L5426	TRACK CLASSIFICATION:	Main Line CWR
CLIENT SAMPLE NO.:	Bulk#2	BALLAST GRADING:	4.5

<u>TEST</u>	<u>TEST RESULTS</u>	<u>SPECIFICATIONS</u>
Los Angeles Abrasion Loss (%)	10.1	45 max.
Mill Abrasion Loss (%)	1.5	9 max.
Abrasion No.	17.4	65 max.
Specific Gravity	2.72	2.60 min.
Absorbtion (%)	0.77	0.5 max.
Magnesium Sulphate Soundness Loss (%)	0.19	1.0 max.
Fractured Faces (%)		
Minus 2" plus 1 1/2"		90
Minus 1 1/2" plus 1"	98.3	90
Minus 1" plus 3/4"	92.5	90
Minus 3/4" plus 1/2"		90
Minus 1/2" plus 3/8"		90
Shape Factor		
Minus 2" plus 1 1/2"		
Minus 1 1/2" plus 1"	2.28	
Minus 1" plus 3/4"	2.19	
Sieve Analysis, Finer Than Sieve (%)		
2 1/2"	100.0	100
2"	100.0	90-100
1 1/2"	100.0	60-80
1"	48.9	15-35
3/4"	21.2	0-5
1/2"	8.8	
3/8"	5.9	
#4	2.7	0-3
#200	0.4	0-2

SUMMARY OF BALLAST TEST RESULTS

CLIENT:	CP RAIL	SAMPLE RECEIVED:	92/12/23
PROJECT NO.:	R1277B	LOCATION:	WALHACHIN, BC
CAL SAMPLE NO.:	L5427	TRACK CLASSIFICATION:	Main Line CWR
CLIENT SAMPLE NO:	Bulk#3	BALLAST GRADING:	4.5

<u>TEST</u>	<u>TEST RESULTS</u>	<u>SPECIFICATIONS</u>
Los Angeles Abrasion Loss (%)	9.5	45 max.
Mill Abrasion Loss (%)	2.1	9 max.
Abrasion No.	19.8	65 max.
Specific Gravity	2.79	2.60 min.
Absorbtion (%)	1.01	0.5 max.
Magnesium Sulphate Soundness Loss (%)	0.71	1.0 max.
Fractured Faces (%)		90
Minus 2" plus 1 1/2"		90
Minus 1 1/2" plus 1"	98.7	90
Minus 1" plus 3/4"	97.6	90
Minus 3/4" plus 1/2"		90
Minus 1/2" plus 3/8"		90
Shape Factor		
Minus 2" plus 1 1/2"		
Minus 1 1/2" plus 1"	2.03	
Minus 1" plus 3/4"	2.14	
Sieve Analysis, Finer Than Sieve (%)		
2 1/2"	100.0	100
2"	100.0	90-100
1 1/2"	100.0	60-80
1"	56.7	15-35
3/4"	26.9	0-5
1/2"	12.7	
3/8"	8.7	
#4	3.9	0-3
#200	0.3	0-2



Clifton Associates Ltd.

CONSULTING ENGINEERS

APPENDIX E



**WILLIAM A. JEALOUS, B.Sc., P.ENG.
MANAGER, GEOLOGY**

SPECIALTY

- hydrogeological and glacial geological investigations
- photogrammetry and terrain analysis
- geologic mapping and quarry evaluations
- groundwater resource evaluation
- petrographic analyses of concrete aggregate and ballast
- thin section petrographic analysis
- geochemical investigations
- computer applications in geographic information systems and image analysis systems
- geological evaluation of base and precious metals deposits

EDUCATION

- B.Sc. Geology, University of Regina, 1980
- Diploma in Remote Sensing Technology, Nova Scotia College of Geographic Sciences, 1987

PROFESSIONAL REGISTRATIONS AND AFFILIATIONS

- Canadian Geotechnical Society
- International Association of Engineering Geology
- Regina Geotechnical Group

PROFESSIONAL RECORD

Clifton Associates Ltd. 1987 - present	Senior Geologist
Geological Consulting 1985 - 1987	Geologist
Saskatchewan Mining and Development Corporation 1982 - 1985	Research Geologist
Sherritt - Gordon Mines Ltd. 1980 - 1982	Exploration Geologist



KEY PROJECT EXPERIENCE

- Hydrogeologic Investigation, Shand Coal Handling and Storage Area, Estevan, Saskatchewan.
- Hydrogeologic Investigation, Proposed Shand Ash Disposal Site, Estevan, Saskatchewan.
- Ash Lagoon Contaminant Migration Investigation, Estevan, Saskatchewan.
- Geochemical Investigations on Waste Rock from Mines to Assess Trace Element Content, Acid Generating Potential and Potential Leachate Concentrations.
- Preparation of Project Proposal and Environmental Impact Statement for Shand Ash Disposal Scheme, Estevan, Saskatchewan.
- Contact Lake Gold Mine, Waste Management Siting Study.
- Rafferty Reservoir Monitoring Network Design, Estevan, Saskatchewan.
- Cyclohexanone Spill Investigation, Regina, Saskatchewan.
- Baseline Hydrogeologic Investigation, Middle Cretaceous Calcareous Shales, Dauphin, Manitoba.
- Baseline Hydrogeologic Investigation for Cu-Zn Deposit, Hanson Lake, Saskatchewan.
- Gas Station Decommissioning Investigations, Davidson, Humboldt, Regina, Saskatchewan.
- Geotechnical Investigation, Pressure Packer Testing of Bedrock for Island Falls "A" Dam Replacement Project.
- Water Supply Investigation and Well Construction, Kenosee Lake, Saskatchewan.
- Water Supply Investigation and Well Construction, Neudorf, Saskatchewan.
- Decommissioned five industrial water supply wells on an old petroleum refinery site, Regina, Saskatchewan.
- Settlement Capability Study, Swift Current. Groundwater and land use study.
- Petrographic Analyses of concrete aggregates in Southern Saskatchewan.
- Patience Lake Groundwater Investigation. Drilling, assessing hydrodynamic containment and potential salt contamination of Forestry Farm Aquifer.
- PCB Site Contamination Assessment, Regina.
- Hydrogeologic Investigations at Little Fishing Lake and Lac Des Isles. Assessed suitability as lagoon sites.
- South Saskatchewan River Basin Groundwater Study. Predicted basin yield and characterized water quality.
- Southeast British Columbia Ballast Search. Conducted reconnaissance mapping, field and laboratory studies of potential ballast sources.
- Amisk Lake Hydrogeological and Geotechnical investigation. Geotechnical core logging, permeability testing, water sampling and reporting.
- Soil Salinity Investigations, Wolseley area. Co-op research project with Saskatchewan Research Council and Nova Scotia College of Geographic Sciences.
- Stoney Rapids Glacial Geology Compilation. Consulting contract.
- Petrographic Analysis of Coal Liquefaction feedstocks and residues. Consulting contract.

TECHNICAL PUBLICATIONS

- Jealous, W.A., 1987. Soil Salinity Investigations Utilizing Digital Image Analysis and Geographic Information Systems in the Wolseley Area, Saskatchewan, unpublished research project, Nova Scotia College of Geographic Sciences.
- Olsen, P.E., Jealous, W.A., Plecash, J. and Sawyer, R., 1982. Geology and Geochemistry of the Fox Mine, Lynn Lake, Manitoba, Geological Association of Canada Proceedings, Winnipeg, Manitoba.



**DAVE A. EDWARDS, P.Geol.
PROJECT GEOLOGIST**

SPECIALTY

- environmental site investigations for hydrocarbon contamination
- geologic field mapping
- geologic stratigraphic and structural analysis
- petrographic analysis of concrete aggregate and ballast
- geologic well site supervision

EDUCATION

- Transport of Dangerous Goods, Short Course, Petroleum Institute Training Service, April 1993
- Industrial Site Decommissioning, Workshop, Chemical Institute of Canada, October 1992
- Bachelor of Science (Honours in Geology), University of Alberta, 1989
- Business Administration Diploma - Management Major, 1984

PROFESSIONAL REGISTRATIONS AND AFFILIATIONS

- Association of Professional Engineers, Geologists and Geophysicists of Alberta (APEGGA)
- Canadian Society of Petroleum Geologists

PROFESSIONAL RECORD

Clifton Associates Ltd. 1992 - Present	Project Geologist
Belloy Petroleum Consulting Ltd. 1989 - 1992	Wellsite Geologist
Equity Engineering Ltd. 1990 Summer	Prospecting Geologist
Cordilleran Engineering Ltd. 1989 Summer	Junior Geologist
Amoco Canada Petroleum Co. Ltd. 1988 Summer	Student Geologist



KEY PROJECT EXPERIENCE

- Environmental site assessment of petroleum distribution facilities with hydrocarbon contaminated soils and groundwater in southern Alberta.
- Environmental site investigation of a rail yard in Calgary, Alberta including; supervision of bore hole drilling and monitoring well installation, water and product sampling, implementation of product recovery systems.
- Geologic investigation of potential ballast sources including; geological surface mapping and structural and stratigraphic analysis on quarry sites in southern British Columbia and diamond drill program supervision and core logging.
- Geological supervision of ballast quarry during completion of crushing contract.
- Petrographic and geochemical analysis of ballast samples.
- Geologic well site supervision including: describing drill cuttings and core, coordinating coring and geophysical well logging operations, providing accurate geological evaluations and interpretations on site and preparing technical reports and strip logs.
- Geologic mapping and diamond drilling of copper-gold porphyry deposit in northwestern British Columbia.
- Geologic mapping and prospecting of proterozoic rock in north central British Columbia.



**GREG M. HERASYMUIK, B.Sc.
PROJECT GEOLOGIST**

SPECIALTY

- geologic investigations
- hydrogeologic investigations
- petrographic analysis

EDUCATION

- B.Sc. in Geology, University of Regina, 1989
- Introduction to Seismic Methods, 1991
- Petroleum Economics and Strategy Planning, 1991
- Formation Damage Assessment, 1991
- Open Hole Log Analysis, 1991
- Blasting and Construction Methods, 1992

PROFESSIONAL REGISTRATIONS AND AFFILIATIONS

- Saskatchewan Geological Society
- Regina Geotechnical Group

PROFESSIONAL RECORD

Clifton Associates Ltd.

February 1992 - present

Project Geologist

Saskoil

April 1991 - August 1991

Contract Geologist

Clifton Associates Ltd.

February 1990 - April 1991

Geologist

KEY PROJECT EXPERIENCE

- Geological services and contract administration, Walhachin Quarry, British Columbia.
- Evaluation of ballast production potential, Nemiskam East, Alberta.
- Geology and step out potential, Coothills Pool, Saskatchewan.
- Geology and step out potential, Midale South Pool, Saskatchewan.
- Water well inventory and preliminary design of groundwater monitoring system for Rafferty Dam Reservoir, Saskatchewan.
- Lead, zinc contamination investigation and site remediation.
- Supervision of hydrocarbon contaminated site remediation.
- Petrographic analysis of concrete and concrete aggregate.
- Petrographic and geochemical evaluation of ballast samples.
- Field mapping for potential frac sand source, Hanson Lake, Saskatchewan.